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Examining Psychosocial Factors of Chronic Disease Control to Improve Outcomes for Patients with Multiple Chronic Conditions

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EXAMINING PSYCHOSOCIAL FACTORS OF CHRONIC DISEASE CONTROL TO IMPROVE OUTCOMES FOR PATIENTS WITH MULTIPLE CHRONIC CONDITIONS

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Dedication

This dissertation is dedicated to my parents for their endless love, support, and encouragement of my academic pursuits.

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Psychosocial needs are associated with worse health outcomes for patients with multiple chronic conditions (MCC). The Biopsychosocial Model provides a framework for conceptualizing the influence that psychosocial factors have on the management of disease. To date, research has primarily focused on examining the relation between psychosocial factors and chronic disease onset. Therefore, the temporal relation between psychosocial factors and disease management remains poorly understood. The current study aimed to 1) describe patients’ psychosocial needs and their prioritization, 2) examine reciprocal relations between anxious symptoms, depressive symptoms, social needs, and MCC management, and 3) qualitatively explore patient definitions of health in the context of MCC. Data came from the Enhanced Care Planning (ECP) study, a randomized controlled trial of primary care patients with MCC; all participants were included (*n* = 175). Patients had an average of 1.01 psychosocial needs (*SD* = 1.44), 27.0% of patients endorsed a mental health need and 33.3% endorsed having a social need, though very few patients prioritized either type of need. Four cross-lagged regression models were run with three waves of data. When anxious symptoms and MCC management were examined alone, better MCC management predicted greater future anxious symptoms. When all psychosocial variables were examined together, anxious symptoms predicted better future MCC management. No support was found for a relation between depressive symptoms or total social needs with chronic disease management. Finally, when defining health, patients identified four states which were of particular interest to them: health condition management, pain management, mental wellness, and social connectedness. They described health as an active and complex interaction between several stable factors (i.e., healthcare, social context, and physical environment) and a range of dynamic psychosocial factors. Collectively, these findings highlight the relevance of psychosocial factors to patients' everyday lives and perceived ability to be healthy. Further research is necessary to examine a broader scope of health-related needs among patients with MCC, assess the nuanced relation between anxiety levels and chronic disease management, and to elucidate how psychosocial factors differentially relate to various metrics of health.

Examining Psychosocial Factors of Chronic Disease Control To Improve Outcomes for Patients with Multiple Chronic Conditions

The overarching goal of this project is to better understand psychosocial factors that are important to patients to address and lead to meaningful improvements in the management of their MCCs and overall sense of health. The introduction first discusses chronic disease in the United States and the role that the Biopsychosocial Model can play for identifying and exploring factors that influence chronic disease control. Then, the introduction provides a literature overview of 1) psychosocial needs and patient prioritization of them, 2) reciprocal relations between depression, anxiety, and chronic disease, and 3) defining health in the context of MCCs. Finally, limitations of the current literature are discussed and how the current study will seek to address them.

Chronic Disease

Chronic diseases are of great public health concern in the United States. Chronic disease is defined by a persistent nature which lasts beyond one year and typically requires ongoing medical attention (*About Chronic Diseases*, 2022). They are increasingly common among the adult population. A large national sampling of primary care practices reported that 20% of adults had one chronic disease (Ornstein et al., 2013). Though, it was most typical for patients to have two or more chronic conditions. Recent estimates indicate that 27% of American adults live with MCCs (Boersma, 2020).

Common chronic diseases in the United States include diabetes, hypertension, heart disease and obesity (Ornstein et al., 2013). Prevalence rates for these conditions have continued to increase over the last few decades, making them increasingly common (Kuehn, 2018; J. Lin et al., 2018; Marelli et al., 2014; Zhang et al., 2017). For patients with MCCs, managing more than one chronic condition is complex due to conflicting medical recommendations, drug interactions, and experiencing an overall poor functional status (Parekh et al., 2011). Subsequently, poor control of these conditions leads to worsening health, poor quality of life, and increased healthcare utilization (Carvalho et al., 2013; Kim, 2007; Kolotkin et al., 2001; Lotfy et al., 2017; Singh & Yu, 2016; Vanstone et al., 2015; Willems et al., 2019).Therefore, the presence of MCC creates a significant burden for patients, healthcare teams and the healthcare system (Buttorff et al., 2017; Lehnert et al., 2011). Given its growing prevalence and consequences of poor control, understanding factors that influence chronic disease control and related health outcomes is critical.

Theoretical Framework

The Biopsychosocial (BPS) Model provides a framework for conceptualizing and examining the influence that psychosocial factors have on MCC management (Engel, 1977; Kusnanto et al., 2018). According to this model, chronic disease management influences and is influenced by an individual's psychosocial wellbeing. Specifically, this model posits that an individual's illness and health is the result of three broad and interrelated domains: biological, psychological, and social (Engel, 1977, 1981). As such, each domain influences and is influenced by the other two. Engel, a psychiatrist by training, created this model to emphasize the psychosocial elements of illness. He aimed to move beyond the biomedical model as it emphasizes that health and disease are best understood through all three domains rather than biology alone.

Each of the three BPS domains were defined broadly so as to be adapted to specific diseases and contexts. The biological domain includes factors such as physical health, disease, disability, and genetic vulnerability. Secondly, the psychological domain refers to psychological wellbeing, including emotions, coping, behavior, personality, and learning. The third domain, social, refers to the social environment including socioeconomic status, work, social support, family, community and culture.

Research supports a connection between psychosocial factors and both chronic disease onset and management, however many important gaps remain in the literature. More research is needed to investigate how psychological and social domains relate to MCC management over time and the patient perspectives on how important they are.

Psychosocial Needs and Patient Prioritization of Psychosocial Needs

Psychosocial needs often co-occur with chronic disease and are considered to be some of the root causes for poor health. Psychosocial factors are defined by their influence on an individual's psychological status or social environment and functioning (Upton, 2013). Organizations including the National Academy of Science, Engineering, and Medicine (NASEM) have called for health care systems and workers to incorporate psychosocial factors into patient care (National Academies of Sciences, Engineering, and Medicine, 2019). As a result, healthcare systems have created their own processes to screen for needs and refer to community based-services (Gold et al., 2018; O'Toole et al., 2017).

Broad screening tools implemented by healthcare systems reveal high levels of need in their general patient populations and a high number of needs per patient. Three community health centers in the Pacific Northwest piloting a screening and referral program for 12 psychosocial needs found that nearly every patient (97%) screened endorsed a need (Gold et al., 2018). Commonly endorsed needs were finances, stress, and loneliness. Among a sample of North Virginia primary care patients, 71% of patients screened positive for a psychosocial need (Tong et al., 2018). Further examination of individual patients' burden of psychosocial needs is expansive. Patients in general outpatient clinics report an average of 3 to 6 psychosocial needs

(Byhoff et al., 2022; McClintock & Bogner, 2017; Phillips et al., 2014). Other screening efforts focused on narrower scopes of psychosocial needs, though consistently revealed high need for housing (O'Toole et al., 2017), food security (Karnik et al., 2011), and anxiety/depression (Katon, 2011; Wittchen et al., 2002). While these samples have had high levels of chronic disease, there is very limited research into the unique psychosocial needs of patients with MCCs.

High rates of anxiety, depression, and unmet social needs (e.g., housing, food, finances) have been reported among patients with MCCs. Most adults with MCCs appear to have anxiety (Farooq et al., 2019; Gould et al., 2016). They are also about twice as likely to have depression than those without MCCs (Read et al., 2017). Several studies have linked social factors such as low socioeconomic status, educational attainment, and loneliness to MCC occurrence (Pathirana & Jackson, 2018; Schiøtz et al., 2017; Souza et al., 2021). However, the prevalence of these needs has not been clearly reported for this population. More research is needed to better understand the unique psychosocial needs of patients with MCCs.

When it comes to screening for psychosocial needs, patients express willingness to answer questions about their psychosocial needs, though describe certain topics as more sensitive than others for discussing with their healthcare team (Byhoff et al., 2019; O'Loughlin et al., 2022; Palakshappa et al., 2017). Patients recognize regular screening of these needs as important to their clinical care and understand the connection to their overall health (Byhoff et al., 2019). Yet, once a need is identified, patients often decline offers of assistance. Patient acceptance rates for psychosocial assistance have been reported as low as 3 to 19% (Gold et al., 2018; Tong et al., 2018). Rates of acceptance of assistance differ across topics (Hasan et al., 2013; Phillips et al., 2014; Tong et al., 2018). Previous research suggests that a patient's perceived need for assistance and acceptability of the assistance offered may influence their acceptance (Van Voorhees et al., 2008). Only two studies have investigated acceptance of assistance for both psychological and social needs (McClintock & Bogner, 2017; Tong et al., 2018). One study observed the same acceptance rates for mental health, housing, and transportation (Tong et al., 2018). The second study found that twice as many patients prioritized financial needs as did mental health; other social needs (e.g., transportation, housing) were much less likely to be prioritized (McClintock & Bogner, 2017). Low acceptance rates remain poorly understood due to the nascent state of the literature. It is possible that patients are declining assistance for needs because they perceive other needs to be more urgent (Ronis et al., 2022). Screening methods used to identify psychosocial needs are inconsistent and typically lack assessment of multiple domains (Byhoff et al., 2017). To date, no study has examined how patients prioritize their psychological and social needs when both types are present. Learning how patients prioritize their competing needs may help us to inform policy and funding for programs to address these roots of poorly controlled MCCs.

Reciprocal Relations Between Depression, Anxiety, and Chronic Disease

Chronic Disease as a Risk Factor for Depression and Anxiety. Depression and anxiety often co-occur with chronic disease and a reciprocal relation between them has been well established (Chang-Quan et al., 2010; Read et al., 2017). Not only is the presence of chronic disease a risk factor for developing depression or anxiety, there appears to be a dose-dependent relationship. As the number of medical conditions increase that an individual has, the more their risk for developing depression and anxiety increases (Barnett et al., 2012; Jaisoorya et al., 2022; H. Lin et al., 2021). This relation is often conceptualized as a result of difficulty adjusting to the chronic illness and associated treatments. Individuals with chronic illness frequently face restrictions to their daily activities and ability to work (Maresova et al., 2019), strain on personal relationships (Baanders & Heijmans, 2007), side effects of medications (Gordon et al., 2007), and changes to how they view themselves (Sand et al., 2021).

Depression and Anxiety as Risk Factors for Chronic Disease. Conversely, anxiety and depression serve as risk factors for the onset of new chronic conditions. Investigations into anxiety and depression separately have revealed associated risk for developing one or more chronic conditions (Bhattacharya et al., 2014; Birk et al., 2019; Hasan et al., 2013; Kawachi et al., 1994; Melis et al., 2014; Mezuk et al., 2008; Shen et al., 2008). Though recently, anxiety and depression together were found to be associated with the accumulation of chronic conditions over time (Bobo et al., 2022). In this study, depression and anxiety were both independently associated with developing new chronic conditions, but the highest rate of accumulation was observed when both depression and anxiety were present. Support has been found for several biological mechanisms that may underlie both chronic disease and depression or anxiety, including chronic inflammation (Liu et al., 2017; Voinov et al., 2013), HPA dysregulation (Agorastos & Chrousos, 2022; Brown et al., 2004), and immune dysregulation (Blume et al., 2011).

Depression, Anxiety, and Chronic Disease Management. In addition to contributing to chronic disease onset, depression and anxiety are also contributors to their poor control. Research examining the impact of depression and anxiety on objective measures of disease management are limited to disease specific samples. Two reviews of predominantly cross-sectional studies found that depression and anxiety were separately associated with poor glycemic control among type I and II diabetics (Anderson et al., 2002; Lustman et al., 2000). A similar review of heart failure indicates that individuals who were depressed or anxious had greater risk for hospitalizations, recurrent cardiac events, and mortality (Celano et al., 2018).

Among women, depression is associated with poor control of obesity as measured by self-reported BMI and a similar trend was observed for men (de Wit et al., 2010). Cross-sectionally, anxiety appears to have a weak positive relationship with obesity control (Gariepy et al., 2010). For patients with hypertension, clinical levels of depressive and anxious symptoms were found to be associated with uncontrolled hypertension (Elperin et al., 2014; Lim et al., 2021). Despite growing support for links between depression and anxiety with chronic disease management, only one study has explicitly included a sample of patients with MCCs (Harrison et al., 2012). This study found that depressed patients reported the worst self-management behaviors including diet and exercise, however, no impact on objective measures of disease control were collected.

Psychological interventions have resulted in improvements in the management of specific conditions and general measures of health. Depression medication management led to improvements in self-reported quality of life, disability, and social functioning in patients with diabetes and arthritis (E. H. Lin et al., 2000; E. H. B. Lin et al., 2003; Unützer et al., 2002). Improvements have also been observed in objective measures for the control of diabetes and coronary heart disease following medication management and cognitive behavioral therapy treatments (Katon et al., 2010; E. Lin et al., 2004; E. H. B. Lin et al., 2003; Uchendu & Blake, 2017). Less research has evaluated the impact of anxiety treatments on chronic disease, though a health education intervention had positive impact for both anxious symptoms and blood glucose levels among diabetics (Wayne et al., 2015).

The Influence of Social Wellbeing. According to the BPS model, it is important to also consider the impact of social factors on chronic disease incidence and management. The social determinants of health are fundamental to health and are considered to have a greater impact on morbidity than medical care itself (Berkman, 2009; Marmot et al., 2008; National Research

Council (US) & Institute of Medicine (US), 2013; Woolf et al., 2007). Social determinants are defined as "the conditions in the environments where people are born, live, learn, work, play, worship, and age" (*Social Determinants of Health*, n.d.). A prospective study of nearly 42,000 adults found that there was a dose-response association between the number of social needs and risk of developing a new chronic illness (Pantell et al., 2019). Social factors have also been linked to earlier onset of disease and greater overall disease burden. Individuals living in deprived areas experience MCCs approximately 10 to 15 years earlier than their peers living outside of social depravation (Barnett et al., 2012). Lower educational attainment and income also appear to be associated with risk for developing MCCs (Hill-Briggs, 2003; Pathirana & Jackson, 2018). Importantly, some social factors may be more closely linked to certain chronic conditions, such as food insecurity with obesity (Byhoff et al., 2022), infrequent exercise, smoking and food security with hypertension (Pantell et al., 2019; Venci & Lee, 2018), financial worry and food security with diabetes (Pantell et al., 2019; Venci & Lee, 2018) and food insecurity with heart disease (Venci & Lee, 2018). A meta-analysis reviewing the relation between food insecurity and blood pressure found a significant relation between food insecurity and self-reported hypertension but not a hypertension diagnosis (Beltrán et al., 2020). This review highlights the importance of utilizing the health record and objective data when examining chronic disease and related factors; findings can be easily influenced by patient literacy and other confounding factors.

Social determinants have also been linked to poor outcomes in disease specific samples and general chronically ill samples. Among diabetic patients, low socioeconomic status and low educational achievement has been strongly linked to poor blood glucose control (Bijlsma-Rutte et al., 2018; R. J. Walker et al., 2014). This is supported by interviews with a sample of young diabetics who identified their social needs as barriers to effectively managing their diabetes and contributing to its progression to kidney disease (Hill et al., 2015). They identified factors including poor education, low socio-economic status, and childhood environment. Among hypertensive patients, social support influenced blood pressure control (Cornwell & Waite, 2012); worse control was seen in patients who had less support, particularly if they didn't discuss health issues with their social network. Additionally, being uninsured or not having a routine place for medical care are associated with uncontrolled hypertension (Commodore-Mensah et al., 2021). Greater social and financial stress have also been linked to worse lipid levels in a sample of patients with hyperlipidemia and related diseases (Huebner Torres, 2018). Beyond objective measures of control, social needs are also linked to worse patient-reported outcomes. Regular experience of financial, housing, and employment-related stressors appear to be related to worse symptom management generally (van Houtum et al., 2015). Transportation alone has demonstrated a strong association with overall chronic disease severity, which may highlight the foundational role that access to transportation has with important health-related behaviors such as attending medical appointments (Byhoff et al., 2022). Though each social need type may have unique impacts, overall burden of social needs is positively associated with risk for hospitalization (Wray et al., 2022).

The literature also provides preliminary support for the positive effects that interventions for social needs have on health outcomes. Reviews of social needs interventions reported positive outcomes including decreases in social needs, improvements in self-reports of general health, and reductions in primary care contact and overall healthcare utilization (Bickerdike et al., 2017; Mossabir et al., 2015). A third review of social needs interventions found that only 30% of studies included *any* measurement of health and that while the results for the impact of interventions on health were mixed, they were generally positive (Gottlieb et al., 2017). While programs are being increasingly developed to address social needs in medical settings, surprisingly few studies have examined their effects on *objective* health outcomes. One large-scale study offered housing vouchers to families living in poverty allowing them to move to a new neighborhood with less poverty (Sanbonmatsu et al., 2012). At the 10-year follow-up period, families who received the housing voucher had lower rates of extreme obesity and diabetes. A study across three academic medical centers in Boston developed and tested a program which screened their patients for social needs and provided rapid resource referrals for any unmet needs (Berkowitz et al., 2017). They observed modest improvements in both blood pressure and cholesterol, but not blood glucose levels. Similarly, an enhanced care intervention with social needs support led to significant improvements in both depressive symptoms and blood pressure (McClintock & Bogner, 2017). In 2017, a social needs intervention including community health worker support was provided to patients with MCCs and improvements were observed in blood glucose levels, body mass index, and blood pressure (Kangovi et al., 2017). Patients also reported improvements in their mental health, quality of life, and hospitalization rates. While these studies provide promising findings, it remains unclear the extent to which improvements in social needs lead to improvements in chronic conditions.

While there is strong support for the relations between various psychological and social factors and chronic disease management, important gaps remain in the literature. Researchers have largely focused on disease specific samples and utilized patient self-report of chronic disease outcomes rather than objective measures of disease management. Additionally, little research has examined the potential interplay between psychological needs, social needs, and MCC management. Screening efforts for social needs in primary care have centered around housing stability, food insecurity, transportation access and financial stress (Fraze et al., 2019). Therefore, the current study will focus on these four social needs for their known influence on chronic disease management and overall health.

Defining Health in the Context of MCC

The way that health is defined drives health goals and medical care. As the landscape of health needs change in the United States and in-line with the rise in patient-centered care, it's important that we continue to evolve our definition of what health and wellbeing is with a focus on the patient perspective. Historically definitions of health have heavily focused on physical status, including the absence of disease or physical limitations. Previously, the Oxford Dictionary defined health as "the absence of disease or infirmity" (Brüssow, 2013). However, in 1948 the World Health Organization (WHO) expanded this narrow scope to include psychological and social domains, "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (*Constitution*, 1948). The WHO's definition has remained an international standard over the last seventy years, though amendments have been suggested to include other factors such as spirituality (Stokes et al., 1982).

The rise in chronic disease throughout the United States has also shifted our conceptualization of health. According to previous definitions, all individuals with chronic conditions were inherently unhealthy as "*complete"* physical wellbeing could not be achieved with chronic diseases. Therefore, a recently proposed definition frames health as the processes of successful adaptation, "health is the dynamic balance of physical, mental, social, and existential well-being in adapting to conditions of life and the environment" (Krahn et al., 2021). This newer framing creates opportunity for anyone to pursue and achieve "health" regardless of chronic disease status.

Frameworks have been created to conceptualize health and health related factors in the context of chronic illness (Devins, 1994; J. Walker et al., 2004; Weinert, 2008a). Consistent with recent definitions of health, these frameworks have proposed that health is the result of an individual successfully managing and adapting to their chronic illness which are directly influenced by environment and psychosocial wellbeing. While these frameworks were created for specific chronic diseases, they may be valuable for understanding health in the context of MCCs too. Several key concepts from these frameworks have shown to be pertinent to quality of life and functioning in multimorbidity, including self-efficacy (Warner et al., 2012), optimism (Warner et al., 2012), social support (Warner et al., 2011; Wicke et al., 2014), and mental health (Forjaz et al., 2015; Wicke et al., 2014). Further, a qualitative study describing patient experiences living with MCCs revealed that good health literacy and social support were key factors patients identified as promoting their ability to handle their MCCs (Sand et al., 2021). Overall, the research surrounding adaptation to MCCs and patient perspectives is sparse.

The practice of patient-centered care focuses on the patient's perspective, tailoring care to a patient's goals and how they conceptualize wellness (Epstein & Street, 2011). However, the patient perspective is not well documented in the literature. For patients with more complex medical presentations including MCC, it is unclear how they define their health and therefore, whether their health care team's goals and resources align with it.

Statement of the Problem

Approximately 27% of American adults live with multiple chronic conditions (MCC) (Boersma, 2020). The presence of MCC creates a significant burden for patients, healthcare teams and the healthcare system through greater service utilization and spending. Consistent with the Biopsychosocial Model, psychosocial needs are thought to be the root of poorly controlled chronic disease. Despite multimorbidity being the standard among individuals with chronic disease, research focuses primarily on single diseases; patients with MCCs are underrepresented in the literature. Little is known about the unique psychosocial needs of this population. Healthcare systems have worked to develop programs to help patients address these important health-related needs. Yet, patients often decline assistance when offered. To date, few studies have examined acceptance of assistance for both psychological and social needs, and none have assessed the relative importance of needs when both are present.

Psychosocial needs have been linked to the onset of chronic disease and poor disease-related outcomes. However, most research examining the relation between psychosocial factors and chronic disease outcomes are limited to disease specific samples and do not assess or explicitly report comorbidities within the sample. Additionally, most of this literature has examined either psychological factors or social needs and few studies have examined how psychosocial factors relate to objective measures of chronic disease *management* over time. This has left the impact of psychosocial factors on chronic disease management poorly understood. Finally, the way that we conceptualize health has dramatically changed over time. Current definitions of health are inclusive towards individuals living with chronic disease and describe health as one's adaptation to conditions of their life and environment. Limited research has sought to understand the unique experiences and perspectives of patients living with MCCs, particularly related to their definitions of health. In response, the proposed study seeks to address these important gaps in the literature regarding patient prioritization of needs, how patient psychosocial factors relate to MCC control over time, and how patients define health in the context of MCCs.

Current Study

First, this study will assess for and describe the psychosocial needs of patients with MCCs. A diverse range of psychological and social needs will be included (depression, anxiety, housing security, transportation access, financial needs, and food security). The study will also examine patient characteristics that predict their prioritization of needs when multiple needs are present. Next, structural equation modeling will be used to provide a more sophisticated understanding of chronic disease management over time. Specifically, it will be used to examine the relations between psychosocial factors and chronic disease management over time. Finally, the study aimed to involve patients with MCCs in the process of describing their views on the meaning of health and which factors are most influential to it.

The specific aims outlined below were addressed through secondary data analysis from an ongoing clinician level randomized controlled trial with a primary care population with MCCs (N=390; Enhanced Care Planning [ECP]; AHRQ 1R01HS026223-01A1, PI Alex Krist). The ECP study is testing a care planning process using the My Own Health Report (MOHR) platform to address patients' mental health needs, unhealthy behaviors, or unmet social needs. Data sources include extractions from the medical chart, MOHR data, patient surveys, and semi-structured patient interviews. Timepoints include: baseline, 6- and 12-months.

Specific Aims

Aim 1: To describe the psychosocial needs of patients with MCCs and their prioritization of needs they would like to address.

Sub-Aim 1a: Describe the prevalence of reported anxious/depressive symptoms and social needs for all patients.

Sub-Aim 1b: Describe the number of and characteristics of patients with both psychological and social needs and how they prioritize them.

Hypotheses: Based on existing literature, high rates of psychosocial needs are expected to be present among patients (Byhoff et al., 2022; McClintock & Bogner, 2017; Phillips et al., 2014). A similar number of patients are expected to prioritize their psychological needs as do social needs (McClintock & Bogner, 2017; Tong et al., 2018).

Aim 2: Assess the factor structure of the biopsychosocial model among patients with MCC and examine relations between anxious and depressive symptoms, MCC management, and social needs over time.

Sub-aim 2a: Assess the factor structure of the biopsychosocial model using confirmatory factor analysis and establish measurement invariance over the three timepoints.

Sub-aim 2b: Examine the longitudinal relations between the biopsychosocial domains (anxious/depressive symptoms, MCC management, and social needs) at baseline, 6- and 12-months using a cross-lagged panel model.

Hypotheses: The relations between anxious/depressive symptoms and MCC management will be bidirectional (Anderson et al., 2002; Celano et al., 2018; de Wit et al., 2010; Elperin et al., 2014; Gariepy et al., 2010; Lim et al., 2021; Lustman et al., 2000). Social needs will be negatively related to MCC management (Berkowitz et al., 2017).

Aim 3: To describe patient definitions of health in the context of MCC and factors they perceive to promote or hinder their health.

Hypothesis: Patients will describe health in terms of adaptation to their chronic conditions and maintaining other valued activities (Devins, 1994; Krahn et al., 2021). Promoting and hindering factors will include their overall psychosocial wellbeing, perceived self-efficacy with managing their conditions, and the extent to which their MCCs interfere with their daily and social functioning (Devins, 1994; Sand et al., 2021).

Methods

Overview of the Enhanced Care Planning Study

Data for this study came from the Enhanced Care Planning (ECP) Study (PI Alex Krist, *N* = 390; Enhanced Care Planning [ECP]; AHRQ 1R01HS026223-01A1)(Krist et al., 2020). This is an ongoing 5-year clinical trial currently in Year 4. The goal of ECP is to examine the effectiveness of an enhanced care planning intervention to better manage MCC. The trial aimed to match sixty primary care clinicians in the Virginia Ambulatory Care Outcomes Research Network (ACORN) by age and sex and randomized to usual care (control condition) or enhanced care planning with clinical-community linkage support (intervention). The intervention included two components. First, an enhanced care planning tool called My Own Health Report (MOHR) screened patients with a health risk assessment for unhealthy behaviors, mental health needs, and social needs. A patient navigator then helped patients prioritize needs, create care plans based on their preferences, and write a personal narrative for their care plan to guide the care team. Patients then received ongoing support from their patient navigator through weekly phone call check-ins. Community health worker support was also available; if patients express interest in community resource referrals to support their care plan, patient navigators alerted a community health worker. Patients continued to receive support until they completed or chose to stop their care plan(s). All patients completed follow-up surveys at 6- and 12-months and a subset of patients completed semi-structured exit interviews.

Participants

ECP study sampling procedure. The ECP study's population of interest is adult primary care patients with poorly controlled MCC. To identify the patient study sample, providers shared a list of patients with an office visit in the previous 12 months who were aged

18 and older and with at least two MCCs. Patients were randomly selected from each clinician list to receive a baseline postal survey. Of respondents, up to 14 patients per clinician with uncontrolled MCC were randomly selected, with oversampling of minorities.

A subset of 48 patients who created care plans for diverse topics, were recruited for exit interviews.

Eligibility. Participants were eligible to participate in the ECP study if they: 1) responded to the baseline survey, 2) were 18 years or older, 3) had two or more MCC (cardiovascular disease, hypertension, diabetes, obesity, major depressive disorder). Exclusion criteria included 1) clinician excluded patient, 2) patient did not complete the baseline survey.

Present sample. Three samples were included in the present study. For Aim 1, all participants were included from the intervention arm that completed a health risk assessment and prioritized their needs (n = 135). For Aim 2, all control and intervention participants were included that had completed the full 12-month participation period and had data for at least one follow-up timepoint (n = 175). For Aim 3, interviews were conducted with participants until saturation was met (n = 19). Characteristics of the sample for the primary analysis (Aim 2) are summarized in Table 1. A majority of the participants were female (60.6%), either White (49.7%) or Black (43.4%), and Non-Hispanic (84.6%). The age range was 33 to 76 years (*M* = 60.88, *SD* = 9.63). Of the sample, 77.7% patients had hyperlipidemia, 81.7% had hypertension, 34.9% had diabetes, and 66.9% were obese. Of this group, 41.1% had private insurance, 37.7% had Medicare insurance, 14.3% had Medicaid insurance, 0.6% were dually insured, 5.1% were uninsured, and 1.1% did not report insurance status.

Table 1

Characteristics of Aim 2 Sample at Baseline

Variable		*n* (%)
Total patients		175
M baseline age (*SD*)		60.87 (9.63)
Gender		
	Female	106 (60.6%)
	Male	67 (38.3%)
	Not reported	2 (1.1%)
Race		
	White	87 (49.7%)
	Black	76 (43.4%)
	Asian	2 (1.1%)
	Other	5 (2.9%)
	Not Reported	5 (2.9%)
Ethnicity		
	Not Hispanic	148 (84.6%)
	Hispanic	3 (1.7%)
	Not Reported	24 (13.7%)
Frequency of Chronic Conditions		
	Hyperlipidemia	136 (77.7%)
	Hypertension	143 (81.7%)
	Diabetes	61 (34.9%)
	Obesity	117 (66.9%)
M Chronic Conditions (*SD*)		2.61 (0.98)

Sample Size and Power.

Aim 1. Based on the assumptions of normal distribution of variables, homogeneous variances, and homogeneity of variances differences, there is ≥ 80% power in Aim 1 to detect an effect size of .66, which would be classified as large based on Cohen's conventions (C. J. Ferguson, 2009). Prior work on patient characteristics predicting patient needs reported odds ratios that range from 1.51 to 5.5 (Craig et al., 2016; Naessens et al., 2005). A minimum sample size of 53 intervention patients was deemed necessary to detect an odds ratio of 3.

Aim 2. General rules of thumb suggest that sample sizes around 200 will ensure adequate power for SEM analyses and provides initial justification for moving forward with conducting these analyses (Boomsma, 1982, 1985; Nunally, 1967). Moreover, as a part of this aim's analyses, adequacy of the sample will be determined through examining precision of the parameter estimates. Specifically, the margins of error will be considered using a 95% confidence interval (i.e., 1.96 x standard error) for the regression coefficients to calculate the smallest sample coefficients that would be identified as significant at $p < .05$.

Aim 3. Sample size recommendations for qualitative research range between 20 and 50 participants (Green & Thorogood, 2018; Ritchie & Lewis, 2003). However, sample size is best determined once thematic saturation is reached. Saturation cannot be pre-determined, though previous research reported that saturation was met between 12-20 interviews (Francis et al., 2010; Guest et al., 2006; Hagaman & Wutich, 2017). As such, a minimum sample size of 15-20 was expected to be a sufficient number to reach saturation.

Procedures

All procedures were approved by the University's Institutional Review Board. The ECP study team mailed all patients a paper survey at baseline. All eligible participants then completed the MOHR health risk assessment (HRA) and received automated feedback on their areas of risk (e.g., unhealthy behaviors, mental health need, social needs) based on their responses. Intervention participants then prioritized one or two needs identified from the HRA to create care plans for. Intervention participants also received regular check-ins from a patient navigator and were connected to a community health worker for community referrals if appropriate. Most intervention participants completed care plans within 3-6 months (Gilbert Hinesley et al., 2022). At 6- and 12-months post-enrollment, all participants received the baseline survey again and completed the MOHR HRA.

Measures

Demographic Variables

Participant demographic information was collected from review of their medical chart. Characteristics of interest included: age, sex, race/ethnicity, education level, and insurance type.

Patient Preference Variable

The MOHR data includes the health-related risks patients endorsed having and which specific needs they prioritized wanting to address. Patients selected one or two needs to create care plans for. Possible care plan topics included examined for the current study include: mental health, housing, transportation, finances, food security.

Anxious and Depressive Symptom Variables

Mental health data were collected from participant self-report in the online MOHR HRA and survey administered at baseline, 6- and 12-months (See Appendices A and B) (Krist et al., 2013). Both depressive and anxious symptoms were assessed across three measures. A total anxious and depressive needs score was calculated for each participant by totaling their responses to the PHQ-2 and GAD-2, with possible scores ranging from 0-12.

Depression Measure. The Patient Health Questionnaire-2 (PHQ-2; (Arroll et al., 2010; Spitzer et al., 1999) is a self-report measure with the purpose of identifying depressive symptom severity. Each participant rated 2-items of depressive symptoms on the degree to which they were bothered by them over the previous 2 weeks. Individual responses range in value from "0" (*Not at all*) to "3" (*Nearly every day*). The measure is scored by taking the sum of scores for both questions, with possible scores ranging from 0-6. Scores are interpreted as higher scores indicating greater severity of symptoms. The clinical cut-off is 3. A study among medical outpatients evaluating the performance of the PHQ-2 at identifying depressive disorders reported specificity of 79% and sensitivity of 86% (Löwe et al., 2005).

Anxiety Measure. The Generalized Anxiety Disorder-2 (GAD-2; (Spitzer et al., 1999) is a self-report measure with the purpose of identifying anxiety symptom severity. Each participant rated 2-items of symptoms on the degree to which they were bothered by them over the previous 2 weeks. Individual responses range in value from "0" (*Not at all*) to "3" (*Nearly every day*). The measure is scored by taking the sum of scores for all questions, with possible scores ranging from 0-6. Scores are interpreted as higher scores indicating greater severity of symptoms. The clinical cut-off is 3. A systematic review evaluating the performance of the GAD-2 at identifying anxiety disorders reported pooled specificity of 76% and sensitivity of 81% (Plummer et al., 2016).

Anxiety and Depression Measure. The EQ-5D-5L (Rabin & de Charro, 2001) is a self-report measure with the purpose of assessing five dimensions of health: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Participants rated each domain on a 5-point scale of severity from "0" (*No problems*) to "5" (*Extreme problems*). The present study will focus on the anxiety/depression domain. Possible scores range from 0-5 and are interpreted as higher scores indicating greater severity of symptoms. A systematic review of the EQ-5D-5L's psychometric properties reported good construct validity for the Anxiety/Depression domain and moderate correlation with other measures of mental and emotional health items (Feng et al., 2021).

Social Needs Variables

Social data were collected from participant self-report in the online MOHR HRA and survey administered at baseline, 6- and 12-months (See Appendix A) (Krist et al., 2013). Social variables of interest were housing stability, transportation, finances, and food security. A total social needs score was calculated for each participant, with possible scores ranging from 0-4.

Housing. Housing stability was assessed by two-items prompting participants to indicate where they were living and if they were at risk of losing their housing. The presence of housing stability was determined by participants endorsing homelessness or risk of losing their housing.

Transportation. Access to transportation was assessed by one-item. Participants reported the frequency that they had access to transportation on a 4-point scale from *Never* to *All the time.* Participants endorsing *Never, Rarely,* or *Some of the time* indicated the presence of transportation inaccessibility.

Finances. Financial security was assessed by one-item. Participants were asked to report whether or not they had difficulty *making ends meet*. Participants responding affirmatively indicated the presence of financial insecurity. A pilot study among Canadian primary care patients reported that this item identified poverty with a sensitivity of 98% and specificity of 60% (Brcic et al., 2011).

Food Security. Food security was assessed by one-item. Participants endorsed the frequency that they ran out of food and were unable to buy more over the previous six months on a 3-point scale from *Never* to *Often*. Participants responding *Sometimes* or *Often* indicated the presence of food insecurity. This item was evaluated among adult community members and it was found to identify food insecurity with 96% sensitivity and 74% specificity (Gundersen et al., 2017).

Chronic Disease Variables

Patient medical charts were reviewed for active chronic disease diagnoses (hypertension, diabetes, obesity, and hyperlipidemia) and data relevant to their control. Consistent with medical guidelines, control of these chronic conditions will be defined by blood pressure (James et al., 2014), A1c level (American Diabetes Association, 2018), body mass index (BMI)(Moyer & U.S. Preventive Services Task Force, 2012), and total cholesterol level. Each condition was characterized as controlled (1) or uncontrolled (0; See Table 2 for details). Then an average control score was calculated for each patient, with possible scores ranging from 0-1.

Table 2

Definitions of MCC Control

MCC	Eligible population	Definition of Control
Diabetes	Diabetic patients	A1c <8
Hypertension	18-59 years or any age diabetes/kidney disease	Blood pressure ≤ 140/90
	60 years and older no diabetes/kidney disease	Blood pressure ≤ 150/90
Hyperlipidemia	All patients with hyperlipidemia	Total cholesterol ≤ 200
Obesity	Obese patients	BMI < 30

Analyses

Data Preparation

Prior to conducting analyses, all variables were examined. For continuous variables, means, standard deviations, and 95% confidence intervals were estimated. For categorical variables, frequencies, proportions, and 95% confidence intervals were determined. All data were checked for univariate and multivariate outliers. Additionally, skewness and kurtosis were evaluated. Data was considered to be within normal ranges if skewness was within the range of 2 to −2 and kurtosis was within the range 7 to -7. Matrices of scatterplots between variables were used to assess linearity. Finally, bivariate correlations between all study variables were examined to assess multicollinearity, and a cutoff of 0.80 was used (Tabachnick & Fidell, 2007).

Missing Data. Missingness was assessed to determine whether it was random or biased, using Little Missing Completely At Random's (MCAR) test in SPSS (Garson, 2015). Baseline data were complete, therefore missing data was only relevant to Aim 2 (Little et al., 2014). Evaluating all variables resulted in a significant Little MCAR's test, suggesting that data were not missing randomly. Missing data were addressed using MLR, a robust estimator and preferred method for small sample sizes (Maydeu-Olivares, 2017).

Inclusion/Exclusion for Proposed Analyses. For Aim 1, the analysis was limited to patients in the intervention arm who reviewed and prioritized their needs. For Aim 2, the full sample of patients included those who had completed 1-year in the study and had data for at least one follow-up timepoint. For Aim 3, all patients who completed exit interviews were included in the analysis until saturation was met.

Statistical Software. Aim 1 analyses were conducted in IBM SPSS Statistics (Nie et al., 2020). Aim 2 analyses were conducted using Mplus Version 8 (Muthén & Muthén, 2017). Aim 3 analyses were coded and organized using Microsoft Excel.

Aim 1: To describe the psychosocial needs of patients with MCC and their prioritization of needs they would like to address.

First, I calculated the prevalence for anxious symptoms, depressive symptoms and each social need. Then I calculated the prevalence of having both types of needs (mental health and social). The planned analysis included a binary logistic regression to determine whether and to what extent patient characteristics (e.g. patient age, sex, race, insurance type) predicted the type of need prioritized (anxious/depressive symptoms, social need), while controlling for the severity of baseline anxious/depressive symptoms. Given the lower-than-expected prevalence of having both types of needs, the current study was not powered for that analysis. Instead, I conducted two binary logistic regressions to determine whether and to what extent patient characteristics (e.g. patient age, sex, race, insurance type) predict whether a patient prioritizes mental health or social needs, while controlling for the severity of baseline anxious/depressive symptoms. A Wald test was used to evaluate the effects of each patient characteristic on predicting type of prioritized need, which was summarized with odds ratios.

Aim 2: Assess the factor structure of the biopsychosocial model among patients with MCC and examine relations between anxious and depressive symptoms, MCC management, and social needs over time.

Sub-aim 2a: The planned analysis included assessing the factor structure of the biopsychosocial model using confirmatory factor analysis and establishing measurement invariance over the three timepoints. The available sample (*n* = 175) was lower than expected and did not meet general recommendations for structural equation modeling (Boomsma, 1982, 1985; Nunally, 1967). As a result, the

Table 3

Variables in Models

Domains	Constructs	Observed Variables
Biological	Chronic Disease Management	Total Cholesterol BMI Blood Pressure A1C level
Psychological	Anxious/ Depressive Symptoms	PHQ-2 GAD-2 EQ5D
Social	Social Needs	Housing Finances Transportation Food security

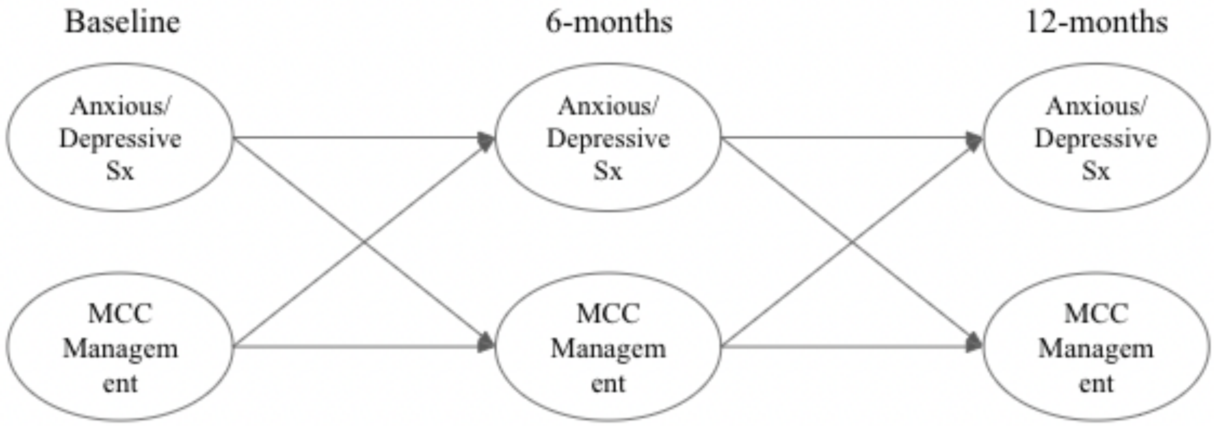
models were simplified by replacing latent variables with manifest variables. The latent variable for mental health was replaced with two separate manifest variables representing anxious symptoms (GAD-2) and depressive symptoms (PHQ-2). The EQ5D was excluded due to its conflation of anxious and depressive symptoms together and overlap with the two other mental health variables. The social needs latent variable was replaced with a composite score of total social needs. Finally, an average chronic disease management score was computed for use in the cross-lagged panel models.

Sub-aim 2b: Examine the longitudinal relations between anxious symptoms, depressive symptoms, social needs, and MCC management across three timepoints (baseline, 6- and 12-months) using a cross-lagged panel model.

Four cross-lagged panel models were conducted. First, a two-variable cross-lagged model was used to examine the temporal relation between anxious symptoms and MCC management. Then a two-variable cross-lagged model was used to examine the temporal relation between depressive symptoms and MCC management. A third two-variable cross-lagged model was used to examine the temporal relation between total social needs and MCC management over time. Finally, the full four-variable model examined the temporal relations between anxious symptoms, depressive symptoms, social needs, and MCC management (Allison, 2017; Kenny, 1975; Selig & Little, 2012). Treatment group (intervention vs control) was included as a covariate. Data from baseline, 6- and 12-months post-enrollment were used, as displayed in Figures 1 and 2. Model fit was evaluated based on the RMSEA, Comparative Fit Index (CFI), and Tucker-Lewis index (TLI) (Hu & Bentler, 1999). Standardized cross-lagged paths were used to estimate the effect of one variable on the other, after controlling for the stability of the variables over time (Kearney, 2017).

Figure 1

Path Diagram Representing the First Two-Variable Cross-Lagged Panel Model



Note: This is the latent model and indicators are not shown.

Figure 2

Path Diagram Representing the Second Two-Variable Cross-Lagged Panel Model

Note: This is the latent model and indicators are not shown.

Aim 3: To explore patient definitions of health and factors that promote and hinder their health in the context of MCC.

Transcribed data from each patient's semi-structured interview was first cleaned and de-identified. Using a thematic analytic approach, a codebook was created in an iterative process (Braun & Clarke, 2006). First, all transcribed interviews were reviewed for familiarity and initial code brainstorming. An initial list of codes were created, informed by the transcript review and interviewer discussion, the biopsychosocial model (Engel, 1981), and relevant literature (Forjaz et al., 2015; Sand et al., 2021; Warner et al., 2011, 2012; Wicke et al., 2014). Then all transcripts were coded. Once complete, codes were organized into preliminary themes and sub-themes. A thematic map was constructed to aid analysis. To establish rigor of findings, two types methods of investigator triangulation were used (Amankwaa, 2016; Krefting, 1991). First, both interviewers with different training backgrounds (i.e., psychology, anthropology) reviewed coded data extracts for each theme and themes were refined as needed. Second, the thematic map was reviewed with the multidisciplinary ECP study team for feedback. Themes were refined until consensus was reached. Finally, themes were named and representative quotes were identified.

Results

Aim 1: To describe the psychosocial needs of patients with MCC and their prioritization of needs they would like to address.

Preliminary Analyses

Examination for missing data indicated that most demographic variables had complete data. One demographic variable, ethnicity, was missing 21.4% of data. Examination of the anxious symptom and depressive symptom variables indicated that complete data were available. Social needs variables were missing between 0-4.4% of data. Data were checked for univariate and multivariate outliers. Skewness and kurtosis were also evaluated for the relevant variables. Finally, means, standard deviations, and correlations were run for all variables.

Sample Characteristics

In total, 135 patients reported and prioritized their needs. Patients were on average 60.64 years old (*SD* = 10.24), most were female (61.5%), White (63.0%), and Non-Hispanic (76.3%). Of this group, 45.2% had private insurance, 37.8% had Medicare insurance, 13.3% had Medicaid insurance, and 3.7% were uninsured. See Table 4 for more detailed information pertaining to this group.

Based on responses to the health risk assessment, some patients were characterized as having a mental health or social need. Relative to the overall group, both needs groups were somewhat younger and a higher proportion of patients who were Black, Asian, and that identified as female.

Table 4

Aim 1 Sample Characteristics

	Full Group *n* (%)	MH Need *n* (%)	Social Need *n* (%)
Total patients	135	37	45
Age, M (*SD*)	60.64 (10.24)	57.32 (10.15)	56.60 (12.44)
Gender, *n* (%)			
Female	83 (61.5%)	25 (67.6%)	33 (73.3%)
Male	52 (38.5%)	12 (32.4%)	12 (26.7%)
Race, *n* (%)			
White	85 (63.0%)	19 (51.4%)	21 (46.7%)
Black or African American	40 (29.6%)	13 (35.1%)	20 (44.4%)
Asian	3 (2.2%)	2 (5.4%)	2 (4.4%)
Other race	4 (3.0%)	3 (8.1%)	1 (2.2%)
Not reported	3 (2.2%)	0 (0.0%)	1 (2.2%)
Ethnicity			
Non-Hispanic	103 (76.3%)	33 (89.2%)	34 (75.6%)
Hispanic	3 (2.2%)	0 (0.0%)	0 (0.0%)
Not reported	29 (21.5%)	4 (10.8%)	11 (24.4%)
Insurance			
Private	61 (45.2%)	17 (45.9%)	20 (44.4%)
Medicare	51 (37.8%)	10 (27.0%)	15 (33.3%)
Medicaid	18 (13.3%)	8 (21.6%)	9 (20.0%)
Uninsured	5 (3.7%)	2 (5.4%)	1 (2.2%)

Prevalence of Needs

Half of the sample endorsed having at least one mental or social need. Patients had an average of 1.01 needs (*SD* = 1.44). Thirty-seven (27.4%) patients endorsed a mental health need. Specifically, twenty-eight patients (20.7%) endorsed elevated levels of depressive symptoms and twenty-nine (21.4%) endorsed elevated levels of anxious symptoms above the clinical cut-off.

One third of patients reported having at least one social need. Financial need was most common with a 26.7% endorsing the need. Lack of transportation access and food insecurity were each observed in twenty-one patients. Only five patients endorsed a housing need.

Table 5

Prevalence of Psychosocial Needs and Priorities

	Need *n* (%)	Priority *n* (%)
Total patients	135	
Any need	67 (49.6%)	
Mental health		
Depression	28 (20.7%)	
Anxiety	29 (21.4%)	
Total with a MH need	37 (27.4%)	12 (8.9%)
Social		
Transportation need	21 (15.6%)	
Housing instability	5 (3.7%)	
Food insecurity	21 (15.6%)	
Financial need	36 (26.7%)	
Total with a social need	45 (33.3%)	8 (5.9%)
Both need types	19 (14.1%)	

Of the full sample, nineteen patients (14.1%) reported having at least one mental health and one social need.

Need Prioritization

Of the patients with a mental health need, only seven prioritized their mental health. Five additional patients without a mental health need also prioritized mental health. Of the patients with a social need, only seven (13.5%) prioritized a social need. One additional patient without an identified need also prioritized a social topic. Among patients with both types of needs, five prioritized mental health and five prioritized a social need.

Given the low number of patients reporting having both types of needs, the present study is not powered to conduct a binary logistic regression to determine whether and to what extent patient characteristics (e.g. patient age, sex, race, insurance type) predict the type of need prioritized (i.e., mental health versus social need).

Exploratory Analyses

Two exploratory analyses were pursued to examine if patient characteristics predicted whether or not a patient chose to prioritize each type of need (i.e., mental health or social need).

A binary logistic regression analysis was used to examine whether patient characteristics and anxious/depressive symptoms predicted if a patients chose to prioritize mental health. Due to patients prioritizing mental health without an elevated PHQ-2 or GAD-2 score, the following analysis included the full sample ($N = 135$). Independent variables included in the model were: patient age, sex, race, insurance type, anxious symptoms, and depressive symptoms. When all predictor variables were considered together, they did significantly predict whether or not a patient prioritized a mental health need, χ^2 (11) = 21.06, $p = .03$. The Nagelkerke pseudo R^2 suggested that the model accounted for approximately 32% of the total variance in mental health prioritization. With the model 94.1% of cases were correctly predicted; 100% of the cases which didn't prioritize a mental health need were accurately predicted whereas only 33% of cases that did prioritize a mental health need were accurately predicted. According to the Wald criterion, patient insurance type was a significant predictor, $\chi^2(1) = 4.19$, $p < .001$, $OR = 0.03$. Patients with Medicaid health insurance were 97% less likely than patients with private insurance to prioritize mental health. Anxious symptoms were also a significant predictor of prioritizing mental health, $\chi^2(1) = 11.34$, $p < .001$, $OR = 3.17$. As patients' anxious symptoms increased, their likelihood of prioritizing mental health increased by 317%. The remaining predictors did not exert a unique effect on prioritizing mental health (all *p*s >.05).

A binary logistic regression analysis was used to examine whether patient characteristics and anxious/depressive symptoms predicted if a patient chose to prioritize a social need. Due to patients prioritizing social topics without a known need (i.e., housing instability, transportation need, financial need, food insecurity), the following analysis included the full sample ($N = 135$). Independent variables included in the model were: patient age, sex, race, insurance type, anxious symptoms, and depressive symptoms. When all predictor variables were considered together, they did significantly predict whether or not a patient prioritized a social need, χ^2 (11) = 37.17, $p < .001$. The Nagelkerke pseudo R^2 suggested that the model accounted for approximately 66.4% of the total variance in social need prioritization. With all predictors included in the model, 97.0% of cases were correctly predicted; 99.2% of the cases which didn't prioritize a social need were accurately predicted whereas 62.5% of cases that did prioritize a social need were accurately predicted. According to the Wald criterion, anxious symptoms were the only significant predictor of prioritizing a social need, $\chi^2 (1) = 5.21$, $p = .02$, $OR = 3.16$. As patients' anxious symptoms increased, their likelihood of prioritizing a social need increased by 316%. The remaining predictors did not exert a unique effect on prioritizing mental health (all *p*s >.05).

Aim 2: Assess the factor structure of the biopsychosocial model among patients with MCC and examine relations between anxious and depressive symptoms, MCC management, and social needs over time.

Simplified Model

The sample (*n* = 175) available for the current analysis was lower than expected and did not meet general recommendations for structural equation modeling (Boomsma, 1982, 1985; Nunally, 1967). As a result, the proposed models were simplified replacing latent variables with manifest variables (See Methods).

Preliminary Analyses

Examination for missing data indicated that four demographic variables were missing 1% of data: age, sex, race, and insurance type. The fifth demographic variable, ethnicity, was missing 13.7% of data. Little's MCAR test was used to assess for missingness of data. Results indicated that all missing data were missing completely at random, X^2 (4) = 4.99, $p = .289$. Complete data were available at baseline for anxious symptoms, depressive symptoms, social needs, and chronic disease management. Examination of anxious symptoms, depressive symptoms, social needs, and chronic disease management at follow-up timepoints revealed that they were missing between 1-37% at 6-months and 1-33% of data at 12-months. Results of the Little MCAR tests indicated that not all data were MCAR, X^2 (56) = 135.38, $p < .001$. Missing data were addressed using MLR, a robust estimator and preferred method for small sample sizes, which uses all available observed responses to infer missing responses (Maydeu-Olivares, 2017; Muthen & Muthen, 2017). Patterns of missing data were further examined in the Analysis of Attrition section below. Data were checked for outliers; patients were removed if identified as a multivariate outlier. Skewness and kurtosis were also evaluated for the relevant variables. Finally, means, standard deviations, and correlations were run for all variables.

Each variable was positively correlated with itself across all waves: anxious symptoms (rs = .61 to .82, ps < .001), depressive symptoms (rs = .53 to .68, ps < .001), total social needs (rs = .72 to .80, ps < .001), and average chronic disease management (rs = .38 to .41, ps < .001). At baseline, chronic disease management was not correlated with anxious symptoms (r = -.08, p = .28), depressive symptoms (r = -.08, p = .27), or total social needs (r = -.06, p = .41). At 6-months, chronic disease management was not correlated with total anxious symptoms (r = -.09, p = .34) or depressive symptoms (r = -.04, p = .65), but was significantly negatively correlated with total social needs (r = -.21, p = .03). Finally, at 12-months, chronic disease management was not associated with total anxious symptoms (r = .00, p = .90), depressive symptoms (r = .01, p = .89), or total social needs (r = -.13, p = .16).

Table 6

Descriptive Statistics and Correlations for Anxious/Depressive Symptoms, Social Needs, and Chronic Disease Management

Variable	1	2	3	4	5	6	7	8	9	10	11	12	*M*	*SD*
Baseline														
1. Anxious symptoms	--	.60***	.40***	-.08	.62***	.47***	.30**	-.10	.61***	.56***	.30**	.04	1.57	1.71
2. Depressive symptoms		--	.33***	-.08	.48***	.53***	.30**	-.16*	.50***	.61***	.31**	-.12	1.43	1.62
3. Total social needs			--	-.06	.30***	.29**	.74***	-.15*	.33***	.36***	.72***	-.14	0.69	1.02
4. Chronic disease management				--	.05	-.12	-.01	.39***	.03	-.00	-.06	.41***	0.69	0.23
6-Months														
5. Anxious symptoms					--	.70***	.33***	-.09	.82***	.64***	.34**	.08	1.10	1.36
6. Depressive symptoms						--	.24*	-.04	.63***	.68***	.35**	-.11	1.05	1.40
7. Total social needs							--	-.21*	.37**	.36**	.80***	-.12	0.56	0.93
8. Chronic disease management								--	-.03	-.07	-.11	.38***	0.74	0.31
12-Months														
9. Anxious symptoms									--	.65***	.24**	.00	1.32	1.47
10. Depressive symptoms										--	.31**	.01	1.21	1.44
11. Total social needs											--	-.13	0.74	1.03
12. Chronic disease management												--	0.77	0.26

Sample Characteristics

Sample characteristics of the present sample are summarized in Table 1 and 7. A majority of the patients were female (60.6%), either White (49.7%) or Black (43.4%), and Non-Hispanic (84.6%). The age range was 33 to 76 years (*M* = 60.87, *SD* = 9.63). Of the sample, 77.7% had hyperlipidemia, 81.7% had hypertension, 34.9% had diabetes, and 66.9% were obese. Of this group, 41.1% had private insurance, 37.7% had Medicare insurance, 14.3% had Medicaid insurance, 0.6% were dually insured, 5.1% were uninsured, and 1.1% did not report insurance status. Patients had an average of 2.61 (*SD* = 0.98) chronic conditions.

Analysis of Attrition

A series of *t*-tests were conducted to compare scores at all three timepoints for patients with complete data and patients missing data for one or both follow-up timepoints. Results indicated that patients with missing data reported greater social needs (*t* (173) = -1.84, *p* = .03) and greater anxiety

Table 7

Aim 2 Sample Characteristics

	Baseline *n* (%)
Total patients	175
Age, M (*SD*)	60.87 (9.63)
Gender, n (%)	
Female	106 (60.6%)
Male	67 (38.3%)
Not reported	2 (1.1%)
Race, n (%)	
White	87 (49.7%)
Black or African American	76 (43.4%)
Asian	2 (1.1%)
Other race	5 (2.9%)
Not reported	5 (2.9%)
Ethnicity	
Non-Hispanic	148 (84.6%)
Hispanic	3 (1.7%)
Not reported	24 (13.7%)
Insurance	
Private	72 (41.1%)
Medicare	66 (37.7%)
Medicaid	25 (14.3%)
Dual insured	1 (0.6%)
Uninsured	9 (5.1%)
Not insured	2 (1.1%)
Frequency of Chronic Conditions	
Hyperlipidemia	136 (77.7%)
Hypertension	143 (81.7%)
Diabetes	61 (34.9%)
Obesity	117 (66.9%
M Chronic Conditions (*SD*)	2.61 (0.98)

(*t*(173) = -2.23, *p* = .02) at baseline. No significant differences between groups were observed for average chronic disease management at baseline (*t*(173) = 0.54, *p* = .64). At 6-months, no significant differences were observed between groups for total social needs (*t*(108) = 0.91, *p* = .09), anxious symptoms (*t*(109) = 0.22, *p* = .46), depressive symptoms (*t*(109) = -0.31, *p* = .70), or average chronic disease management (*t*(172) = -1.24, *p* = .06). Finally, at 12-months, there were no significant differences between groups in reported total social needs (*t*(115) = -1.71, *p* = .16) or average chronic disease management (*t*(168) = -1.21, *p* = .11). However, patients with missing data reported greater anxious symptoms (*t*(115) = -2.94, *p* = .01) and depressive symptoms (*t*(115) = -1.87, *p* = .02).

Longitudinal Relations between Anxious Symptoms and Chronic Disease Management

A series of analyses was conducted to assess relations between anxious symptoms and chronic disease management across a 1-year period. An initial unconstrained model (i.e., Model 1) allowed all path coefficients to vary across baseline to 12-months. This model was a perfect fit for the data x^2 (2) = 1.49, *p* > .05, RMSEA = .000 (90% Confidence Interval: .000-.137), CFI = 1.000, and TLI = 1.000. The unconstrained model was then compared to models in which the autoregressive path coefficients were each constrained to be equal across baseline, 6-months, and 12-months for: anxious symptoms and chronic disease management. Once the autoregressive path constraints had been tested, then cross-lagged path coefficients were constrained to be equal across baseline, 6-months, and 12-months for: chronic disease management to anxious symptoms and anxious symptoms to chronic disease management. Final constraints were imposed on within time covariances. Models with new constraints were evaluated using the Satorra-Bentler Chi-Square difference test (S-BΔX^2) and model fit indices: RMSEA, CFI, and TLI.

Imposing constraints for all autoregressive path coefficients did not significantly reduce the model fit, suggesting that the autoregressive path coefficients (e.g., anxious symptoms, average chronic disease management) were stable over time (See Table 8). Imposing constraints for both cross-lagged paths regressing anxiety on chronic disease management and chronic disease management on anxiety did not significantly reduce the model fit. Finally, constraints were imposed to hold all within-timepoint covariances stable, which significantly decreased the fit of the model (S-BΔX^2 (1) = 5.86, p = .02); constraints were rejected. There was support for a final (i.e., Model 5) in which autoregressive coefficients for each variable were held constant across timepoints, all cross-variable coefficients were held constant, and covariances among the residuals for each timepoint were allowed to vary. Overall, the model was an excellent fit for the data, X^2 (6) = 6.93, p > .05, RMSEA = .030 (90% Confidence Interval: .000-.106), CFI = .994, TLI = .978.

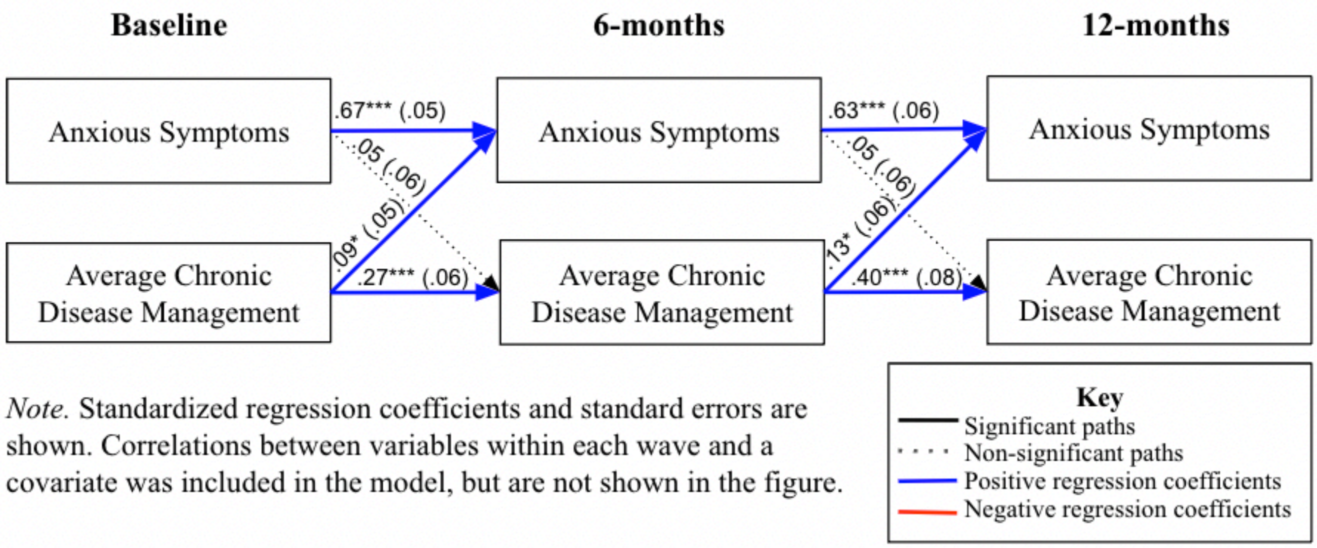
Covariate effects and covariances among variables within each wave were included in the model, but are not shown in the figure. Anxious symptoms were not significantly correlated with chronic disease management (r = -.13, p = .08) at baseline after controlling for intervention status. Anxious symptoms showed moderate stability across timepoints with standardized coefficients ranging from .63 to .67. Chronic disease management showed lower stability with coefficients ranging from .27 to .40. The model accounted for 44.7% to 55.0% of the total variance in anxious symptoms and 7.7% to 30.3% of the variance in chronic disease management across waves.

There was support suggesting that average chronic disease management influences anxious symptoms. Better average chronic disease management predicted greater anxious symptoms from baseline to 6-months, (β = .09, p = .04) and 6-months to 12-months (β = .13, p =

.04). Conversely, anxious symptoms did not predict chronic disease management from baseline to 6-months (β = .05, *p* = .36) or 6-months to 12-months (β = .05, *p* = .37). This model controlled for intervention status, which did not significantly predict changes in anxious symptoms (βs = -.14 to .09, *ps* > .05) or chronic disease management (βs = -.07 to .04, *ps* > .05). Standardized regression coefficients for the final model are reported in Figure 3.

Figure 3

Anxiety Two-variable Cross-lagged Panel Model



Note. Standardized regression coefficients and standard errors are shown. Correlations between variables within each wave and a covariate was included in the model, but are not shown in the figure.

Table 8

Fit indices and Comparison Models for the Anxiety Two-Variable Cross-lagged Regression Models

	Model	x^2	*df*	RMSEA	CFI	TLI	Δx^{2a}	Δdf
	1. No constraints	1.49	2	.000	1.000	1.000	-	-
Auto-regressive paths	2. GAD AR(1) constraints added to Model 1	1.81	3	.000	1.000	1.000	0.49	1
	3. MCC AR(1) constraints added to Model 2	4.08	4	.011	.999	.997	2.53	1
Cross-lagged paths	4. Constraints on MCC → GAD added to Model 3	4.08	5	.000	1.000	1.000	0.12	1
	5. Constraints on GAD → MCC added to Model 4	6.93	6	.030	.994	.978	3.79	1
	6. Within time covariance constraints added to Model 5	10.90	7	.059	.973	.919	5.86*	1

N = 175

**p* <.05; ***p* <.01; ****p* <.001

^{a}Satorra-Bentler scaled chi-square difference test

Longitudinal Relations between Depressive Symptoms and Chronic Disease Management

A series of analyses was conducted to assess relations between depressive symptoms and chronic disease management across a 1-year period. An initial unconstrained model (i.e., Model 1) allowed all path coefficients to vary across baseline to 12-months. This model was an adequate fit for the data x^2 (2) = 3.70, $p > .05$, RMSEA = .070 (90% Confidence Interval: .000-.180), CFI = .989, and TLI = .884. The unconstrained model was then compared to models in which the autoregressive path coefficients were each constrained to be equal across baseline, 6-months, and 12-months for: depressive symptoms and chronic disease management. Once the autoregressive path constraints had been tested, then cross-lagged path coefficients were constrained to be equal across baseline, 6-months, and 12-months for: chronic disease management to depressive symptoms and depressive symptoms to chronic disease management. Final constraints were imposed on within time covariances. Models with new constraints were evaluated using the Satorra-Bentler Chi-Square difference test (S-BΔX^2) and model fit indices: RMSEA, CFI, and TLI.

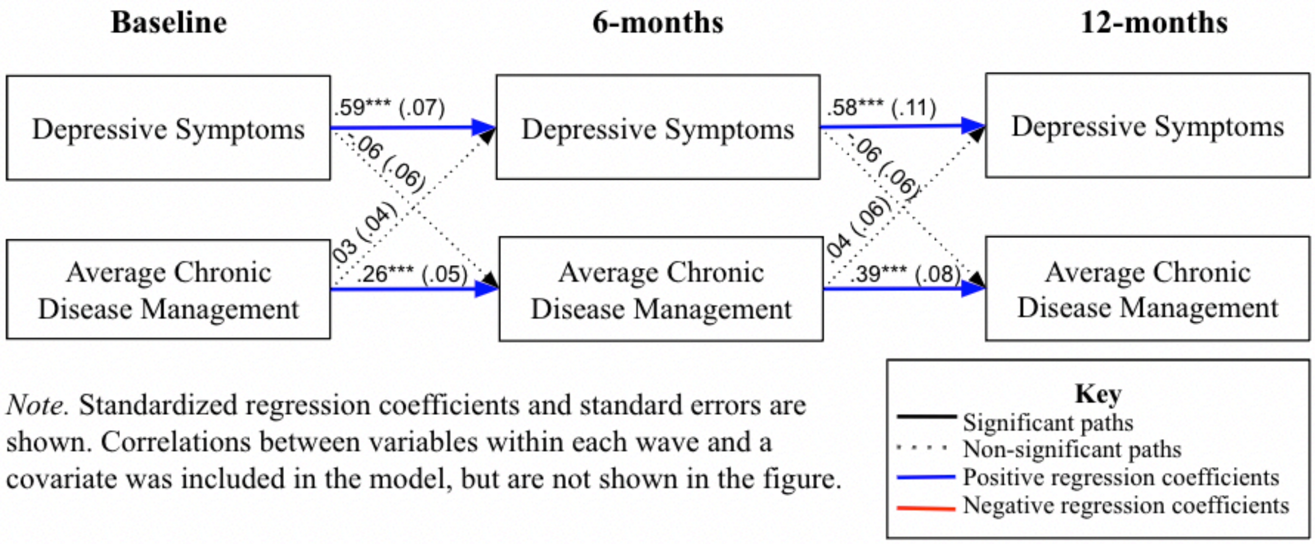
Imposing constraints for all autoregressive path coefficients did not result in significantly reducing the model fit, suggesting that the autoregressive path coefficients (e.g., depressive symptoms, average chronic disease management) were stable over time (See Table 9). Imposing constraints for both cross-lagged paths regressing depressive symptoms on average chronic disease management and chronic disease management on depressive symptoms did not result in significantly reducing the model fit. Finally, constraints were imposed to hold all within-timepoint covariances stable, which also did not significantly decrease the fit of the model. There was support for a final model (i.e., Model 6) in which autoregressive coefficients for each variable were held constant across timepoints, all cross-variable coefficients were held constant, and covariances among the residuals for each timepoint were held constant. Overall, the model was a good fit for the data, X^2 (7) = 10.71, $p > .05$, RMSEA = .055 (90% Confidence Interval: .000-.117), CFI = .976, TLI = .928.

Covariate effects and covariances among variables within each wave were included in the model, but are not shown in the figure. Depressive symptoms were not significantly correlated with chronic disease management ($r = -.12$, $p = .15$) at baseline after controlling for intervention status. Depressive symptoms showed moderate stability across timepoints with standardized coefficients ranging from .58 to .59. Chronic disease management showed lower stability with coefficients ranging from .26 to .39. The model accounted for 34.2% to 60.9% of the total variance in depressive symptoms and 8.1% to 60.9% of the variance in chronic disease management across waves.

There was no support for an influence of depressive symptoms on chronic disease management or chronic disease management on depressive symptoms. Depressive symptoms did not predict chronic disease management from baseline to 6-months ($\beta = -.06$, $p = .32$) or 6-months to 12-months ($\beta = -.06$, $p = .32$). Conversely, chronic disease management did not predict depressive symptoms from baseline to 6-months ($\beta = .03$, $p = .55$) or 6-months to 12-months ($\beta = .04$, $p = .55$). This model controlled for intervention status, which did not significantly predict changes in depressive symptoms (βs = -.13 to .11, *ps* > .05) or chronic disease management (βs = -.06 to .05, *ps* > .05). Standardized regression coefficients for the final model are reported in Figure 4 .

Figure 4

Depression Two-variable Cross-lagged Panel Model



Note. Standardized regression coefficients and standard errors are shown. Correlations between variables within each wave and a covariate was included in the model, but are not shown in the figure.

Table 9

Fit indices and Comparison Models for the Depression Two-Variable Cross-lagged Regression Models

	Model	x^2	*df*	RMSEA	CFI	TLI	Δx^{2a}	Δdf
	1. No constraints	3.70	2	.070	.989	.884	-	-
Auto-regressive paths	2. PHQ AR(1) constraints added to Model 1	3.62	3	.034	.996	.972	0.22	1
	3. MCC AR(1) constraints added to Model 2	6.40	4	.059	.984	.918	2.71	1
Cross-lagged paths	4. Constraints on MCC → PHQ added to Model 3	8.24	5	.061	.979	.912	1.83	1
	5. Constraints on PHQ → MCC added to Model 4	10.01	6	.062	.974	.909	1.82	1
	6. Within time covariance constraints added to Model 5	10.71	7	.055	.976	.928	0.45	1

N = 175

**p* < .05; ***p* < .01; ****p* < .001

[a]Satorra-Bentler scaled chi-square difference test

Longitudinal Relations between Social Needs and Chronic Disease Management

A series of analyses was conducted to assess relations between social needs and chronic disease management across a 1-year period. An initial unconstrained model (i.e., Model 1) allowed all path coefficients to vary across baseline to 12-months. This model provides a perfect fit for the data x^2 (2) = 0.23, $p > .05$, RMSEA = .000 (90% Confidence Interval: .000-.068), CFI = 1.000, and TLI = 1.000. The unconstrained model was then compared to models in which the autoregressive path coefficients were each constrained to be equal across baseline, 6-months, and 12-months for: social needs and chronic disease management. Once the autoregressive path constraints had been tested, then cross-lagged path coefficients were constrained to be equal across baseline, 6-months, and 12-months for: chronic disease management to total social needs and total social needs to chronic disease management. Final constraints were imposed on within time covariances. Models with new constraints were evaluated using the Satorra-Bentler Chi-Square difference test (S-BΔX^2) and model fit indices: RMSEA, CFI, and TLI.

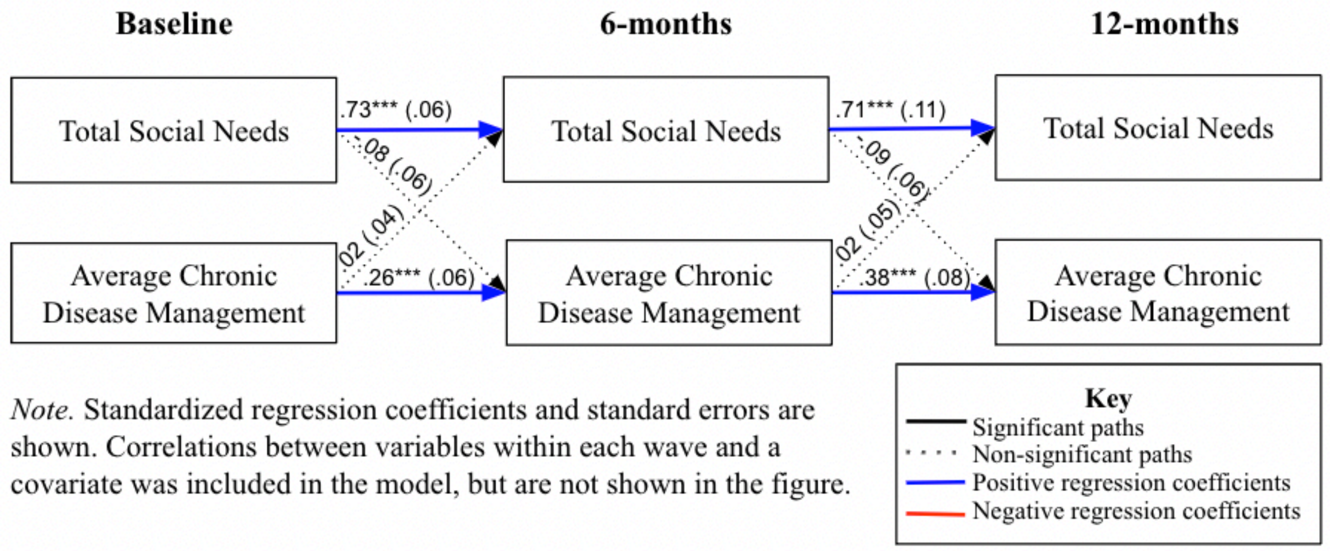
Imposing constraints for all autoregressive path coefficients did not result in significantly reducing the model fit, suggesting that the autoregressive path coefficients (e.g., total social needs, average chronic disease management) were stable over time (See Table 10). Imposing constraints for both cross-lagged paths regressing total social needs on average chronic disease management and average chronic disease management on total social needs did not result in significantly reducing the model fit. Finally, constraints were imposed to hold all within-timepoint covariances stable, which also did not significantly decrease the fit of the model. There was support for a final model (i.e., Model 6) in which autoregressive coefficients for each variable were held constant across timepoints, all cross-variable coefficients were held constant, and covariances among the residuals for each timepoint were held constant. Overall, the model was a perfect fit for the data, X^2 (7) = 5.32, $p > .05$, RMSEA = .000 (90% Confidence Interval: .000-.078), CFI = 1.000, TLI = 1.000. Of note, a perfect fit may indicate that the model is overfitting the data.

Covariate effects and covariances among variables within each wave were included in the model, but are not shown in the figure. Total social needs were not significantly correlated with chronic disease management ($r = -.11$, $p = .13$) at baseline after controlling for intervention status. Total social needs showed moderate stability across timepoints with standardized coefficients of .71 to .73. Chronic disease management showed lower stability with coefficients of .26 to .38. The model accounted for 57.6% to 64.4% of the total variance in social needs and 8.3% to 29.7% of the variance in chronic disease management across waves.

There was no support for an influence of total social needs on chronic disease management or chronic disease management on total social needs. Total social needs did not predict chronic disease management from baseline to 6-months ($\beta = -.08$, $p = .13$) or 6-months to 12-months ($\beta = -.09$, $p = .13$). Conversely, chronic disease management did not predict total social needs from baseline to 6-months ($\beta = .02$, $p = .64$) or 6-months to 12-months ($\beta = .02$, $p = .64$). This model controlled for intervention status, which did not significantly predict changes in total social needs (βs = -.17 to -.04, *ps* > .05) or chronic disease management (βs = -.08 to .02, *ps* > .05). Standardized regression coefficients for the final model are reported in Figure 5.

Figure 5

Social Needs Two-variable Cross-lagged Panel Model



Note. Standardized regression coefficients and standard errors are shown. Correlations between variables within each wave and a covariate was included in the model, but are not shown in the figure.

Table 10

Fit indices and Comparison Models for the Social Needs Two-Variable Cross-lagged Regression Models

	Model	x^2	*df*	RMSEA	CFI	TLI	Δx^{2a}	Δdf
	1. No constraints	0.23	2	.000	1.000	1.000	-	-
Auto-regressive paths	2. SocTot AR(1) constraints added to Model 1	0.57	3	.000	1.000	1.000	0.30	1
	3. MCC AR(1) constraints added to Model 2	3.02	4	.000	1.000	1.000	2.75	1
Cross-lagged paths	4. Constraints on MCC → SocTot added to Model 3	3.26	5	.000	1.000	1.000	0.01	1
	5. Constraints on SocTot → MCC added to Model 4	3.86	6	.000	1.000	1.000	0.60	1
	6. Within time covariance constraints added to Model 5	5.32	7	.000	1.000	1.000	1.74	1

N = 175

**p* < .05; ***p* < .01; ****p* < .001

[a]Satorra-Bentler scaled chi-square difference test

Longitudinal Relations between Anxious Symptoms, Depressive Symptoms, Social Needs, and Chronic Disease Management

A series of analyses was conducted to assess relations between anxious symptoms, depressive symptoms, and social needs with chronic disease management across a 1-year period. An initial unconstrained model (i.e., Model 1) allowed all path coefficients to vary across baseline to 12-months. This model was a fair fit for the data x^2 (24) = 48.89, p <.01, RMSEA = .077 (90% Confidence Interval: .045-.108), CFI = .953, and TLI = .848. The unconstrained model was then compared to models in which the autoregressive path coefficients were each constrained to be equal across baseline, 6-months, and 12-months for: anxious symptoms, depressive symptoms, total social needs, and chronic disease management. Once the autoregressive path constraints had been tested, then cross-lagged path coefficients were constrained to be equal across baseline, 6-months, and 12-months. Final constraints were imposed on within time covariances. Models with new constraints were evaluated using the Satorra-Bentler Chi-Square difference test (S-BΔX^2) and model fit indices: RMSEA, CFI, and TLI.

Imposing constraints for all autoregressive path coefficients did not result in significantly reducing the model fit, suggesting that the autoregressive path coefficients (e.g., anxious symptoms, total social needs) were stable over time (See Table 11). Imposing constraints for cross-lagged paths regressing most psychosocial variables on chronic disease management did not result in significantly reducing the model fit. Though, constraining the cross-lagged paths regressing depressive symptoms on chronic disease management did result in a significant decrease in fit, (S-BΔX^2 (1) = 5.40, p = .02). The relation between these variables changed over time; though not significant, chronic disease management was negatively related to depressive symptoms from baseline to 6-months ($\beta = -.10$, $p = .23$) and positively from 6-months to 12-months ($\beta = .08$, $p = .23$). Similarly, constraining the cross-lagged paths regressing chronic disease management on anxiety resulted in a significant decrease in fit, (S-BΔX^2 (1) = 6.21, $p = .01$). Anxious symptoms were not significantly related to chronic disease management from baseline to 6-months ($\beta = .06$, $p = .46$) but were from 6-months to 12-months ($\beta = .28$, $p = .002$). The remaining cross-lagged path constraints did not result in significantly reducing the model fit and were retained. The final constraints imposed held all within-timepoint covariances stable, which significantly decreased the fit of the model (S-BΔX^2 (6) = 28.80, $p < .001$); constraints were rejected. There was support for a final (i.e., Model 11) in which autoregressive coefficients for each variable were held constant across timepoints, eight out of ten cross-variable coefficients were held constant, and covariances among the residuals for each timepoint were allowed to vary. Overall, the model was a good fit for the data, X^2 (32) = 51.79 $p < .05$, RMSEA = .059 (90% Confidence Interval: .027-.088), CFI = .963, TLI = .909.

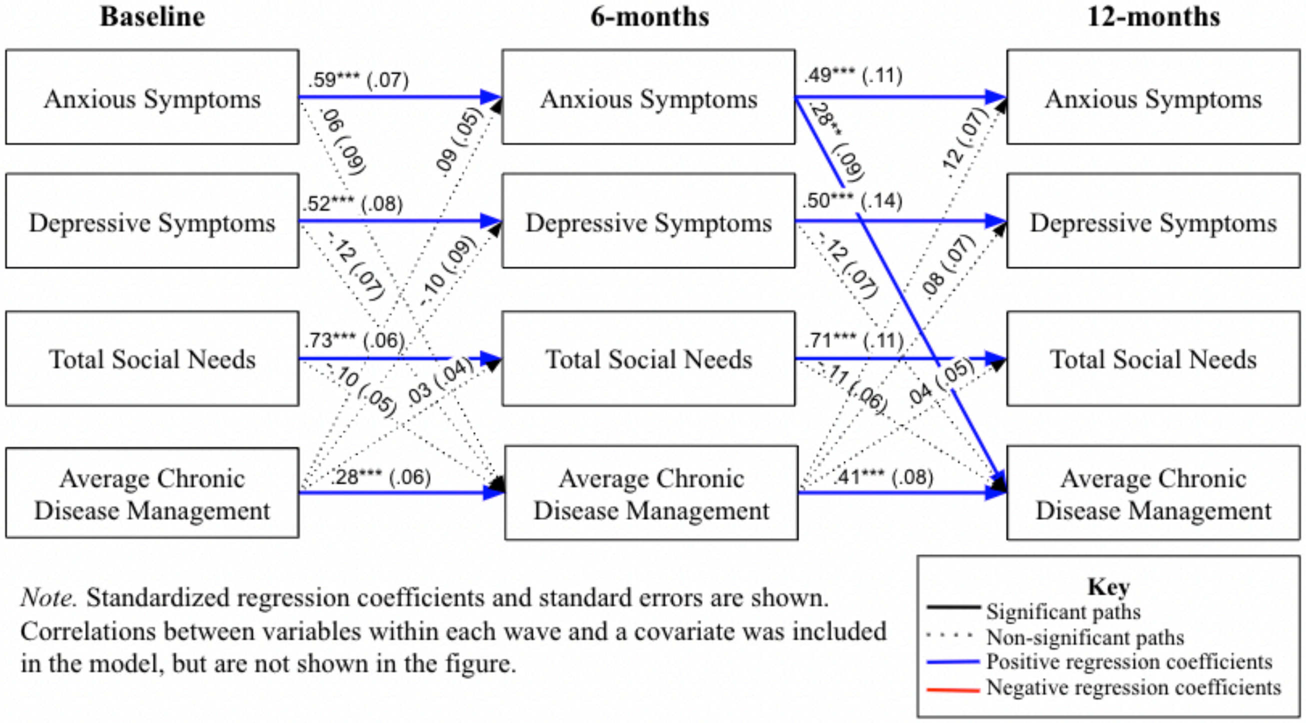
Covariate effects and covariances among variables within each wave were included in the model, but are not shown in the figure. Chronic disease management was not significantly correlated with anxious symptoms ($r = -.13$, $p = .08$), depressive symptoms ($r = -.12$, $p = .12$), or total social needs ($r = -.11$, $p = .13$) at baseline after controlling for intervention status. However, anxious and depressive symptoms were moderately correlated at baseline after controlling for intervention status ($r = .60$, $p < .001$). Total social needs were also moderately correlated to anxious symptoms ($r = .40$, $p < .001$) and depressive symptoms ($r = .35$, $p < .001$). Three of four variables showed moderate stability across timepoints. Standardized coefficients ranged from .49 to .59 for anxious symptoms, .50 to .52 for depressive symptoms, and .71 to .73 for total social needs. Chronic disease management showed lower stability with coefficients ranging from .28 to

.41. The model accounted for 34.7% to 44.4% of the total variance in anxious symptoms, 29.7% to 54.4% of the variance in depressive symptoms, 57.5% to 64.2% of the variance in total social needs, and 11.2% to 35.2% of the variance in chronic disease management across waves.

There was support suggesting that anxious symptoms influence chronic disease management. Greater anxious symptoms predicted better chronic disease management from 6- to 12-months (β = .28, *p* = .002). Results did not provide support for depressive symptoms (βs = -.12, *ps* > .05) or total social needs (βs = -.10, *ps* > .05) predicting future chronic disease management. Conversely, chronic disease management did not appear to predict subsequent anxious symptoms (βs = .09 to .12, *p* > .05), depressive symptoms (βs = -.10 to .08, *ps* > .05), or total social needs (βs = .03 to .04, *ps* > .05). This model controlled for intervention status, which did not significantly predict changes in anxious symptoms (βs = -.13 to .10, *ps* > .05), depressive symptoms (βs = -.13 to .11, *ps* > .05), or chronic disease management (βs = -.06 to .00, *ps* > .05). Intervention status also did not significantly predict total social needs at baseline (β = -.05, *p* = .53) or 12-months (β = -.04, *p* = .53), but did at 6-months (βs = -.17, *p* = .003). Standardized regression coefficients for the final model are reported in Figure 6.

Figure 6

Full Model Four-variable Cross-lagged Panel Model



Note. Standardized regression coefficients and standard errors are shown. Correlations between variables within each wave and a covariate was included in the model, but are not shown in the figure.

Table 11

Fit indices and Comparison Models for the Full Seven-Variable Cross-lagged Regression Models

	Model	x^2	*df*	RMSEA	CFI	TLI	Δx^{2a}	Δdf
	1. No constraints	48.89	24	.077	.953	.848	-	-
Auto-regressive paths	2. GAD AR(1) constraints added to Model 1	49.79	25	.075	.953	.854	1.48	1
	3. PHQ AR(1) constraints added to Model 2	49.58	26	.072	.956	.867	0.01	1
	4. SocTot AR(1) constraints added to Model 3	49.02	27	.068	.959	.880	0.40	1
	5. MCC AR(1) constraints added to Model 4	50.83	28	.068	.957	.880	1.81	1
Cross-lagged paths	6. Constraints on MCC → GAD added to Model 5	50.40	29	.065	.960	.892	0.12	1
	7. Constraints on MCC → PHQ added to Model 6	54.49	30	.068	.954	.880	5.40*	1
	8. Constraints on MCC → SocTot added to Model 6	50.80	30	.063	.961	.898	0.03	1
	9. Constraints on GAD → MCC added to Model 8	55.67	31	.067	.954	.883	6.21*	1
	10. Constraints on PHQ → MCC added to Model 8	52.35	31	.063	.960	.899	1.48	1
	11. Constraints on SocTot → MCC added to Model 10	51.79	32	.059	.963	.909	0.00	1
	12. Within time covariance constraints added to Model 11	81.50	42	.081	.918	.832	28.80***	6

$N = 175$

*$p < .05$; **$p < .01$; ***$p < .001$

[a] Satorra-Bentler scaled chi-square difference test

Aim 3: To explore patient definitions of health and factors that promote and hinder their health in the context of MCC.

Sample Characteristics

Interviews were conducted with 19 participants. Participants were on average 59.58 years old (*SD* = 11.99), the majority were female (57.89%), White (68.4%), and had Medicare insurance (52.6%).

Table 12

Aim 3 Sample Characteristics

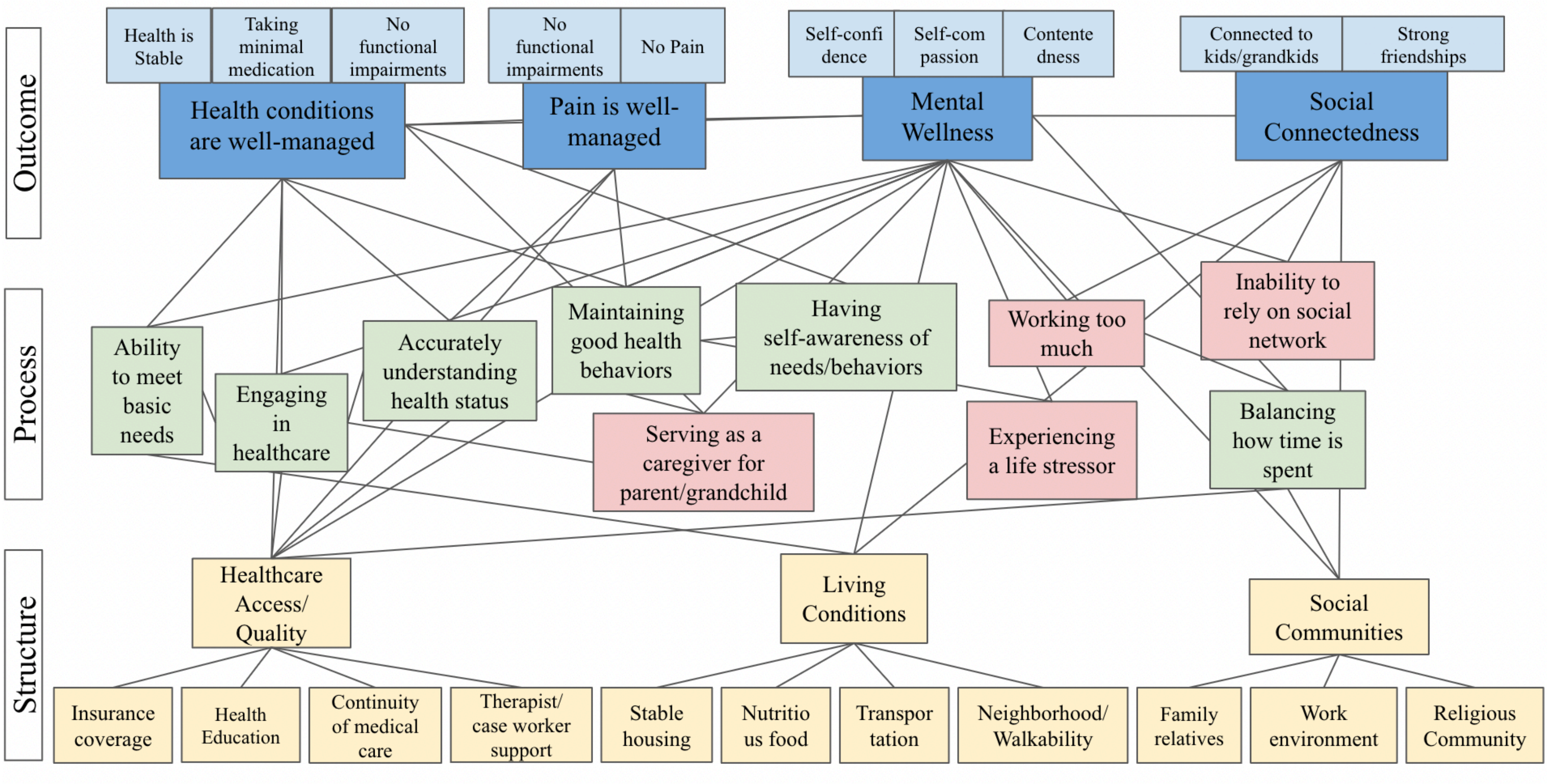
	Full Group *n* (%)
Total patients	19
Age, *M* (*SD*)	59.58 (11.99)
Gender	
Female	11 (57.9%)
Male	8 (42.1%)
Race	
White	13 (68.4%)
Black or African American	5 (26.3%)
Not Reported	1 (5.2%)
Ethnicity	
Non-Hispanic	16 (84.2%)
Hispanic	0 (0%)
Not reported	3 (15.8%)
Insurance	
Private	5 (26.3%)
Medicare	10 (52.6%)
Medicaid	4 (21.1%)
Uninsured	0 (0.0%)

Defining Health

Interviews revealed that patients' definition of health is complex. Their view is that health is not static, but an active and complex interaction between patients' healthcare, social context, and physical environment along with diverse promoting and hindering factors. The presentation of findings is inspired by Donabedian's Structure-Process-Outcomes Framework in order to illustrate how stable structural factors interact with numerous dynamic processes on an ongoing basis to influence a patient's state of health (Donabedian, 1988). See concept map below for details.

Figure 7

Concept Map of Patient Health



Structures

Three structural themes related to patient definitions of health were identified, including 1) healthcare access and quality, 2) living conditions, and 3) social communities.

Healthcare Quality and Access. Healthcare access and quality played a critical role in facilitating or hindering patients' health. Insurance coverage enhanced patients' reported access to necessary medical care. They also highlighted the importance of obtaining health education related to their health conditions and a healthy lifestyle, so that they knew how to take care of themselves in between medical appointments. Patients valued continuity of care and being able to establish a strong relationship with their providers over time. One patient described her experience as:

> *"The whole, lower back pain and not being able to stand or walk long distances is a big concern of mine. I had a phone conversation with my pain specialist, but she's new. Well, she's a nurse practitioner and they're new for me, so trying to adjust medications and stuff is a little harder because they really don't know me like my old doctor did."*

Finally, patients viewed access to therapy and case worker support as important resources for their overall health.

Living conditions. Patients also acknowledged the importance of their physical living environment and resources for daily living. Patients who had experienced a lack of stable housing discussed the challenges that imposed on their ability to focus on their health or engage in healthy behaviors. Similarly, patients described access to transportation and nutritious foods as critical resources for their health. Patients also preferred neighborhood characteristics such as walkability and close proximity to safe walkable areas. One patient described their living conditions as:

> *"We live out in a suburban area and the roads that [are] around here are not very heavy traffic wise, so we have easy walking areas on the roads all around and exercising is easy to do."*

Social Communities. Three social communities repeatedly arose throughout patient interviews for their influence on patient health: family relatives, work environment, and religious community. Family relatives were the most commonly discussed social community; patients characterized family support as a highly valuable resource for health, while family dysfunction had a detrimental impact. Patients reported that the quality of social relationships in their work environments could also positively or negatively influence their health. One patient described the role of their partner in influencing their health:

> *"And I think, as far as health and wellbeing, my wife is very health conscious; she bakes all of our bread, all whole wheat. She reads labels and I've often said 'Boy, if I wasn't married to you, I'd probably be one of those guys with some kind of a thing in my arm and be taking all kinds of pills to try and keep me alive at this point in my life.' And she makes sure I get my exercise."*

Finally, several patients with religious beliefs characterized their religious communities as highly consequential to their health.

Processes

While describing health, patients identified numerous processes which promote or hinder their health status on an active basis.

Promoting Processes. Many patients underscored the importance of being able to meet their basic needs (e.g. housing, nutritious food), and the pervasive impact that unmet need(s) had on their overall health. Patients shared that the ability to accurately understand their health status, engaging in their healthcare, and maintaining good health behaviors were all influenced by their healthcare access and quality, and in turn, are vital to facilitating the health outcomes most important to them. Patients described balancing how their time was spent promoted health through protecting energy to focus on their health and time for engaging in healthy behaviors. Patients also shared the value of having self-awareness around their health behaviors, including understanding what they were doing well and where they may benefit from working to improve. One patient described how his social support enhanced his self-awareness:

> *"I think, you know, that it's really important to know where you're at. Know what triggers you… like with alcohol, am I drinking just for recreation? Am I drinking just because of the habit or am I drinking to reduce conflict within myself, kind of thing you know, and knowing exactly what level that you're functioning at. And then if it's an unhealthy level, either stopping it, figuring it out, or finding somebody I trust like my wife or kids and listen to what they have to say… then making a decision that maybe is a little better in that sense."*

Hindering Processes. The most commonly reported hindering process was experiencing a life stressor. Patients reported stressors including a spouse's medical emergency, a housing move, the death of a parent, and their adult child becoming incarcerated. Some patients shared the impact that caregiving for a parent or grandchildren had on their capacity for taking care of their health. One patient described her experience:

> *"I care for my mother, she was diagnosed with early stages of Alzheimer's in 2000. And … she kind of always looked to me more than to other siblings, but anyway, you know, I've just been the primary caregiver and control overseeing her finances and her assets and her care. And I've really not had a lot of time to think about me."*

Despite caregiving largely being described by patients as a hindering process, one patient described a positive impact once he started to incorporate his grandchildren into his exercise routine:

> *“That [caregiving] helped manage the stress actually. When I would go walking with them, I would feel a lot better, I would calm down, I would relax. I would have moments where my thoughts were good thoughts, you know, 'the old things are gonna get better', 'it's getting better', 'it's looking up', stuff like that.”*

Patients also reported that working too much had detrimental impacts on their sense of mental wellness and their ability to engage in good health behaviors for managing their health conditions. Throughout interviews, several patients discussed an inability to rely on their social network along with the negative impact that had on both their mental wellness and sense of social connectedness.

Domains of Health

Interviews revealed that patients defined health by four primary states of being: 1) health condition management, 2) pain management, 3) mental wellness, and 4) social connectedness.

Health Condition Management. Patients shared that management of their chronic conditions ensured a sense of stability with their health over time without worsening of conditions or new conditions developing. They also indicated that their conditions were well-managed if they “didn’t have to think about it”; health meant the absence of functional impairment or new medications being prescribed. Some patients described being able to discontinue medication as an indicator that their health had improved. One patient described:

> *“I have chronic issues, so I think, managing them... If I remember to take my medicine, and I'm managing my health issues, then that is my barometer.”*

Pain management. Patients frequently discussed the importance of pain management for achieving overall health, specifically to eliminate pain or find ways to mitigate functional impairment caused by pain. One patient's report was:

> *"If my body is aching or sore or hurting, then it's just not well. Or if I have difficulty doing things like stooping, bending and sitting or standing, I look at that my body as not well."*

Mental Wellness. Patients described mental wellness as integral to overall health. They described mental wellness as being comprised of contentedness, self-confidence, self-compassion, and simply not having to think or worry about ones' health. Patients often described mental wellness as closely related to social connectedness, specifically having regular contact with their kids and grandkids and strong peer friendships. For example, one patient shared:

> *"How do I define health and wellness for me? Physical and mental wellbeing with emotional wellbeing. I think that if you don't have the overall picture, then you're not really at the peak of health. I think that I have had a distorted expectation of perfection when I compare myself to other people who are physically fit… I think 'that's healthy', but I also think they might not have the right mental health. So I think it's about balance and life balance."*

Social Connectedness. When describing health, most patients emphasized their need for social connectedness. They described need for regular social interactions. Many also discussed desire for being connected to their children and grandkids as well as maintaining strong peer relationships across life domains (e.g., workplace, religious community). One patient stated:

> *"I was a whole manager and now I'm part time cashiering at a department store, something totally different from what I was accustomed to but it's working out. I only*

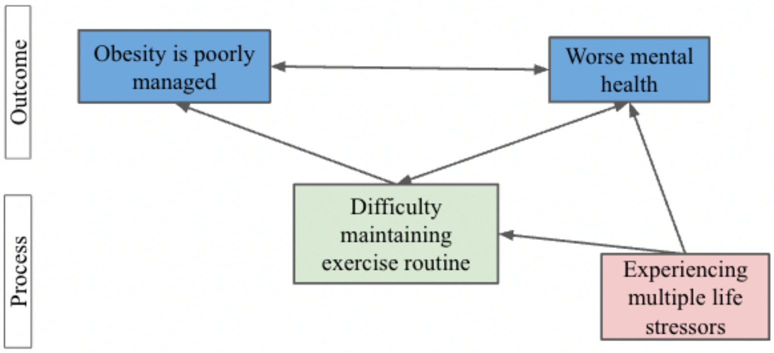
> *work two or three days a week and I'm fine with that. You know, it just gets me out to be sociable with other people. That's basically what I got a part time job for."*

Case Example

To illustrate the complex interactions between themes within this model, a case example is presented. Ms. Smith is a 67-year-old White female who largely defined health by how well her chronic conditions were managed and the extent to which she felt mentally well. She reported recently experiencing several life stressors. Ms. Smith attributed both a decline in her mental health and disruption to her exercise routine to several life stressors. She acknowledged that the lack of regular exercise had detrimental impacts on her MCC management and also further worsened her mental health.

Figure 8

Case Example of Ms. Smith



> *"I am the world's worst worrier…I used to belong to the gym for like three years before COVID hit and really felt much better. And then you know, they closed the gym. But [now] I can't make the steps to go back and I don't know why. It's some crazy things going on in my life right now and I should be able to get over it, but it makes me feel sometimes like my feet are in concrete. And so I'm just kind of stuck in that rut of worrying and all that stuff."*

Discussion

The present study examined the psychosocial needs of patients with MCCs, how they are prioritized, and how they relate to the management of their chronic conditions. Patient definitions of health were also explored.

Patient Psychosocial Needs and Their Prioritization

Half of patients endorsed at least one psychosocial need. A prevalence of 21% was observed for depression and 21% for anxiety, which are consistent with rates observed among condition-specific groups including diabetes, hypertension, and obesity (Ali et al., 2006; Lester et al., 2011; Li et al., 2015; Pan et al., 2015; Sharafi et al., 2020). Similarly, one third of patients endorsed having at least one social need. The rates for most social needs were consistent with previous surveys among medical populations (Byhoff et al., 2022; Kranz et al., 2020; McClintock & Bogner, 2017). The prevalence of housing instability was particularly low in the present sample. Lower than expected housing needs may rates may be a result of federal and state eviction protections that had been implemented during the COVID-19 pandemic, which coincided with the recruitment period (Benfer et al., 2022). Notably, the observed social needs were not higher than those reported in disease specific populations. This may indicate that, though not explicitly described, high rates of multimorbidity were present in the disease specific samples.

Despite moderate rates of mental health and social needs, the majority of patients chose not to prioritize either type of need. Similarly low rates of need prioritization and acceptance of help have been observed in larger scale primary care screening efforts (Gold et al., 2018; McClintock & Bogner, 2017). Possible explanations include a patient not feeling ready to make a change, the presence of other important competing needs, and the influence of the setting that priorities are assessed. According to the Stages of Change Model, patients must move through stages towards readiness to change, and therefore, may only prioritize or address needs when in the action stage (Prochaska & Velicer, 1997). Entering the action stage requires that a patient has recognized the need exists, decided they want a change, and developed a certain level of confidence in their ability to make that change. Unsurprisingly, most patients state they are not ready to address any of their health-related needs following screening (Phillips et al., 2014). For patients who do express some readiness to make a change, they typically indicate readiness to address one at a time. Therefore, many patients will have needs which go unprioritized. Given that most patients in the sample were not experiencing clinical levels of anxiety or depression, it is possible that their mental health was less important than or exacerbated by their other needs. In fact, broad screening of health-related needs among primary care patients revealed that when prompted to identify and prioritize their health-related needs, most patients requested help with unhealthy behaviors (i.e. weight loss, exercise) over mental health or social needs (McClintock & Bogner, 2017). Patients have rated their overall health status as being the most important to them (Phillips et al., 2014). This may be in part a reflection of the setting. Interviews among primary care patients confirm that patients tend to feel most comfortable discussing health behaviors with their medical providers (O'Loughlin et al., 2022). They also expressed less confidence in their provider's ability to help with social needs.

The COVID-19 pandemic is an important contextual factor which may have influenced patients' lower prioritization of mental health and social needs in the present study. Participant recruitment began shortly after the start of the COVID-19 pandemic. The COVID-19 pandemic and government restrictions had a profound impact on the public's mental health, social wellbeing, and health behaviors. Commonly observed health behavior changes were a reduction in physical activity, increase in sedentary behavior, decrease in the nutritional content of food, and increase in overall food consumption (Ammar et al., 2020; Arora & Grey, 2020; Flanagan et al., 2021). Unsurprisingly, approximately half of adults reported weight gain during the COVID-19 pandemic (Khubchandani et al., 2022). Weight gain is a common health priority of patients and often associated with distress (Levenkron & Greenland, 1988). A survey conducted prior to the COVID-19 pandemic indicated that patients were more likely to prioritize weight loss than anxiety or depression (Phillips et al., 2014). Patient emphasis on health behaviors may have been further exacerbated by the COVID-19 pandemic's impact on them, and in turn, led to the low prioritization of mental health and social needs.

Most patient characteristics did not predict prioritization of mental or social needs, though greater anxiety levels were associated with increased odds of prioritizing both mental health and social needs. These findings mirror previous research that identified anxiety severity as a predictor of seeking mental health treatment (Mojtabai et al., 2011). Investigations into the trajectories of mental health symptoms over the course of the COVID-19 pandemic also found that individuals whose anxious symptoms persisted beyond the end of government restrictions were more likely to have a history of mental health need and likely would benefit from mental health treatment (Saunders et al., 2022). While the overall sample reported sub-clinical symptoms of anxiety, the individuals with the greatest mental health need appear most ready to request and accept help. Unmet social needs are known contributors to the development and worsening of anxious symptoms (Alegría et al., 2022; Batterham et al., 2021). There is some support to suggest that greater social needs can result in greater mental health symptoms (Allen et al., 2014). Patients reporting greater anxiety in this study may be more likely to prioritize their social needs as they may represent some of the individuals with a greater severity of social need.

Finally, insurance type significantly predicted the prioritization of mental health. Patients with Medicaid insurance were less likely to prioritize mental health than their peers with private health insurance. Medicaid insurance eligibility requires that an individual or family's annual income does not exceed a limited threshold. As such, individuals with Medicaid insurance have low-income and are often burdened by a number of basic needs not being met (Kulie et al., 2021; Thompson et al., 2019). Maslow's hierarchy of needs suggests that some needs are more important than others in order to achieve wellbeing (Maslow, 1943). Mental health would be considered less important than access to food and shelter, health, and safety. Therefore, patients insured by Medicaid may be less likely to prioritize mental health due to the presence of other greater needs which have not yet been met.

Psychosocial Factors and Chronic Disease Management Over Time

Anxious Symptoms. When anxious symptoms and chronic disease management were examined alone, better chronic disease management was associated with greater future anxious symptoms. When all psychosocial variables were included in the model, chronic disease management no longer predicted future anxious symptoms. However, greater anxiety did predict better chronic disease management from 6-months to 12-months. To our knowledge, there is only one other study which has found a positive relation between anxiety and an objective measure of disease control (e.g., blood pressure) (Hildrum et al., 2008). It is well accepted that anxiety has a bidirectional relation with poor health. Anxious individuals engage in unhealthy behaviors, including increased alcohol consumption, more sedentary behavior, and poor medication adherence (Bautista et al., 2012; Dyer et al., 2019; Hiles et al., 2017; Sundbom & Bingefors, 2013). As a result, anxiety contributes to the onset of chronic disease (Bhattacharya et al., 2014). Inversely, risk for developing anxiety increases with the number of chronic conditions present (Felez-Nobrega et al., 2022; Smith et al., 2022). Yet, limited research has focused on how anxiety relates to disease management once chronic conditions are present. One meta-analysis reported that anxiety was associated with worse glycemic control among diabetics (Anderson et al., 2002), though, this relationship held only when considering clinical levels of anxiety. Similarly, another meta-analysis reported that anxiety disorders are weakly related to increased body mass index among obese adults (Gariepy et al., 2010).

However, the current study found that anxious symptoms were protective for chronic disease management. The current study differs from those included in the meta-analyses in several critical ways, including its longitudinal design, inclusion of multiple chronic conditions, and the sample's sub-clinical levels of anxious symptoms. Given the long-term nature of chronic disease and the sustained effort required to manage them, it is imperative that we study the relation between chronic disease control and influencing factors in longitudinal designs. Examining anxiety and chronic disease control at one timepoint could misrepresent the relation between constructs. Another consideration is that the link between chronic disease and anxiety may differ based on the condition(s) studied. Previous research with disease specific samples revealed differing strengths of relations that anxiety had with each condition (Bhattacharya et al., 2014; Gould et al., 2016). The current study's use of an average management score across conditions represents a new chronic disease management outcome that has not previously been evaluated; it is possible that low levels of anxiety may be uniquely beneficial for patients with multiple chronic conditions. Finally, a key characteristic of the current sample is their sub-clinical levels of anxious symptoms. Sub-clinical levels of anxious symptoms are generally considered advantageous in preparing for threats and enhancing performance (Kupriyanov & Zhdanov, 2014; Robinson et al., 2013). Anxiety has been hypothesized to have health-promoting benefits (Tully et al., 2013). It is possible that low levels of anxiety may enhance patients' engagement in self-management and health-promoting behaviors, including utilizing healthcare at higher rates (Horenstein & Heimberg, 2020). A study of adults with uncontrolled hypertension found that the presence of anxious symptoms and higher healthcare utilization were both predictors of achieving hypertension control (Ho et al., 2015). Unsurprisingly, patients with anxious symptoms utilized health care at a higher frequency than their non-anxious peers. Frequency of healthcare visits may represent one mechanism through which anxiety helps to promote chronic disease control.

Better chronic disease management was also found to predict future anxious symptoms. If sub-clinical levels of anxiety lead to better chronic disease management, it is plausible that the benefits patients experience from well-managed chronic conditions serve to reinforce and maintain their anxiety. Managing chronic disease and engaging in self-management behaviors can lead to many noticeable benefits for patients including better mood, decreased disease-related distress, less fatigue, and greater quality of life (Didarloo et al., 2016; Messier et al., 2013; Milani & Lavie, 2007; Millan-Ferro et al., 2020; Rea et al., 2004). Furthermore, patients commonly receive positive reinforcement from their medical teams when their objective measures of disease control fall within the target range. Positive feedback and reinforcing behaviors by the medical provider promote positive outcomes for patients (Beck et al., 2002). Reinforcing of patient health-related worry and hypervigilance may be another mechanism through which better management leads to increased anxiety.

Of note, the relations observed between anxious symptoms and chronic disease management was contingent on other variables included in the model. The presence of one or both new variables included in the model (i.e., depressive symptoms and social needs) appear to have had a suppressor effect. Anxious symptoms had a moderate positive correlation with depressive symptoms and small positive correlation with social needs across time points. Therefore, these variables likely diminished the relation between chronic disease management predicting future anxious symptoms and enhanced the relation between anxious symptoms predicting chronic disease management.

Depressive Symptoms. No evidence was found for a relation between depressive symptoms and chronic disease management over time. While there is a clear evidence-base for the reciprocal relation between depression and chronic disease over time (Alzahrani et al., 2019; Luppino et al., 2010; Lustman et al., 2000), the current findings may align with the literature given unique aspects of the present study. First, the current sample reported low sub-clinical levels of depressive symptoms. A meta-analysis examining the relation between depression and glycemic control among diabetics reported higher effect sizes among studies which assessed for depression using clinical diagnostic interviews compared to those using brief symptom screeners (Lustman et al., 2000). Similar patterns were observed in reviews examining the relations depression has with obesity and hypertension (Luppino et al., 2010; Meng et al., 2012). It is possible that the depressive symptoms in the current sample were too low to be able to detect a relation with chronic disease management. The current study also differed from past literature by examining average disease control of multiple chronic conditions. Chronic disease control is directly influenced by patients' adherence to self-management. However, adherence rates tend to vary by complexity of the behaviors (Mogre et al., 2019). While depression has a detrimental impact on adherence broadly, it is possible that depressive symptoms have a weaker relation with chronic conditions that require less complex self-management routines, such as hypertension.

More research is needed to elucidate the potential relation between sub-clinical depressive symptoms and objective measures of chronic disease control.

Social Needs. No relations were observed between total social needs and average chronic disease management over time. These findings are generally inconsistent with the literature which has linked numerous social determinants of health to poor health outcomes in both disease specific samples and general chronically ill samples (Beltrán et al., 2020; Byhoff et al., 2022; Pantell et al., 2019; Venci & Lee, 2018). There are several possible explanations for this. One possibility is that the quality of measurement used to detect social needs. All four social needs were assessed using one or two items on the health risk assessment. While the questions for financial need and food insecurity have previously demonstrated excellent sensitivity to detecting need in medical populations, sensitivity and specificity of the items for housing stability and transportation access are unknown. Therefore, it is possible that these items were not sensitive enough to detect the social needs of this sample. Another possible explanation is that using composite scores for social needs and chronic disease management may have obfuscated any possible effect that one social need might have uniquely exerted on the control of any of the chronic conditions. Previous research has indicated that some social needs may be more relevant to certain chronic conditions than others. For example, transportation has demonstrated a particular relevance to diabetes and food insecurity with obesity (Byhoff et al., 2022). A third potential explanation is that these social needs may be more closely related to other important metrics of health. Recent work examining unmet social needs among chronically ill populations have shown an association with patient-reported health and functional impairment (Beltrán et al., 2020; Byhoff et al., 2022). Finally, it is important to note that the model examining total social needs and chronic disease management alone had fit indices which indicated a perfect fit. This suggests that the model may have been overfitting the data and the results may not be reliable. When a model overfits data, it shows good fit through capturing the error within the data and therefore is likely not generalizable beyond the sample used (Preacher, 2006).

Patient Definitions of Health

This study is the first to highlight patients' perspectives on how they conceptualize health in the context of chronic illness. Patients defined health as an active process with four states of being which were of particular interest to them, including health condition management, pain management, mental wellness, and social connectedness. The holistic way that patients defined their health is reflective of recent shifts in the medical field's definition of patient health. Medical providers and researchers have broadened their frameworks of health to include two key parts. First, to frame health as an individual's ability to manage and adapt to their chronic illness (Devins, 1994; Weinert, 2008b). The second key part is acknowledging the important roles of environment and psychosocial factors in facilitating health. As such, the Veterans Health Administration has coined the term *whole health* which defines health as "physical, behavioral, spiritual, and socioeconomic wellbeing as defined by individuals, families, and communities" (Kligler, 2022). Patients with medically complex presentations appear to view good mental health and quality social relationships as of similar importance to more traditional health targets such as a low pain ratings or normal blood pressures. Both mental health and social connection have been well-recognized for their influence on health (Forjaz et al., 2015; Warner et al., 2011; Wicke et al., 2014), though they have not been weighted as equally important metrics of health. These findings underscore the need for patient-centered care, which has influenced the culture of medical visits to view patients more holistically and encouraged collaboration to tailor care to patient values and broader needs (Constand et al., 2014).

Participants described a wide range of factors which enhance their sense of health on an ongoing basis. These ranged from individual to community factors. For instance, some viewed being able to understand their health status and maintain good health behaviors as critical to their health. Others discussed their strong relationships and support from their social communities. Previous research exploring the experiences of patients with multimorbidity have also highlighted the benefits of good health literacy, an ability to take ownership of one's health, and social support particularly related to following treatment recommendations (Duguay et al., 2014). Patients also described aspects of daily living and their social environment. They felt most healthy when they had access to stable housing, healthy food, and a good neighborhood environment. Access to good quality healthcare was also commonly raised by patients. Addressing basic social needs and access to health insurance are related to better subjective well-being and objective health outcomes (Bickerdike et al., 2017; Gottlieb et al., 2017; Mossabir et al., 2015).

Treatment burden provides a number of challenges for patients with multimorbidity (Eton et al., 2012), yet none of the participants discussed these factors as influencing their sense of health. Instead, participants identified experiencing a major life stressor, serving as a caregiver, and working long hours. These hindering life factors represent a clash between patients' daily life demands and wellbeing. A qualitative study among patients with multimorbidity found that patients reported experiencing tension within and between major domains of their life (i.e., family and social life, work life) which interfered with their ability to manage their health

(Ørtenblad et al., 2018). The present study suggests that, unsurprisingly, difficulties in these domains also contribute to an overall worse sense of health.

Implications

The findings from the present study have important implications for patient care. Based on this narrow screening, psychosocial needs are common among patients with MCC. However, it is critical that providers implement comprehensive screening measures to understand the full scope of needs a patient may have. Initiatives for screening patients' needs continue to broaden their scope as more is learned about which needs are relevant to improving population health (Andermann, 2018). Low rates of prioritization for mental health and social needs in the present study may be an indication that patients' highest priorities were not captured in the psychosocial screening used. Elevated anxiety may be an indicator of greater need or patient readiness to address their psychosocial needs.

Although support was not found for a relation between most psychosocial factors and average chronic disease management, patients with well-managed chronic conditions may still have important psychosocial needs that require addressing. This study had several novel factors including explicit inclusion of a sample with MCC and objective measurement of chronic disease management. Therefore, additional research is needed to further explore how these factors may relate to objective measures of disease control. The presence of sub-clinical symptoms appeared to be promotive for chronic disease management, which was an unexpected finding. It highlights the need to better understand when anxious symptoms may become maladaptive for objective measures of chronic disease management and how anxiety may differentially relate to other metrics of health.

Patient interviews revealed that patients' definitions of health are broad and complex; health is the result of an interplay between social activities and demands, job responsibilities, self-care, and access to resources. Patients' views on their own health appear to support the cultural shift being made in medical care, moving from disease specific care towards holistic person-centered care. A prominent example of patient-centered care being implemented is the Whole Health System developed by the Veterans Affairs Administration. This approach to care includes "an interprofessional, team-based approach anchored in trusted longitudinal relationships to promote resilience, prevent disease, and restore health. It aligns with a person's life mission, aspiration, and purpose" (National Academies of Sciences, Engineering, and Medicine, 2023). Whole Health encourages each veteran to consider what matters most to them and create a working definition of wellness. This is then documented into their medical chart and available to all health providers. The aim is for traditional medical care to be provided from a broader perspective incorporating the patient's values around what health looks like to them. Finally, veterans are connected to relevant health education programs, complementary therapies, and resources as appropriate. Whole health provides an excellent guiding framework for other healthcare systems wanting to implement patient-centered care in a way that appears to align well with patients' views on health.

Supporting patients in achieving their definitions of health and providing holistic care can be a difficult resource-heavy task. However, healthcare providers or systems may implement changes to enhance their own patient-centered care. For example, patients report benefiting from increased self-awareness and health education. The healthcare team is well positioned to explore with patients what factors are influencing their health status and to offer health education explaining how those factors may directly or indirectly relate to their efforts to promote their health (L. A. Ferguson & Pawlak, 2011). Mental health and social connectedness are valued domains of patient health, which may be beneficial to incorporate into routine screening. Given the expansive topics and need that may arise when exploring patient health, practices may benefit from creating a centralized database of community or specialist resources to support common patient needs. Referring patients to resources that are available both on-site and off-site have led to improvements in community health centers' healthcare quality scores (Kranz et al., 2020). However, the current study underscores the importance of assessing for patient readiness and motivation to address needs given the low rates of prioritization. It is important to also note and recognize that the medical team is often limited in time and resources (De Marchis et al., 2020; Tong et al., 2018), and thus efforts should be made towards finding an efficient way to integrate these considerations into already-existing workflows.

Strengths and Limitations

The present study has a number of strengths and limitations for consideration. One primary strength was the explicit inclusion of a sample with MCC. This extends previous research assessing psychosocial needs among general chronically ill samples and disease specific samples. Using a sample with these medical characteristics enhances generalizability of findings given that multimorbidity is the standard among individuals with chronic disease. Another important strength was the use of objective measures for chronic disease management. Much of this literature has focused on the onset of chronic disease and poor disease-related outcomes, though very little attention has been paid to objective health outcomes after a disease has developed.

A third strength of the present study was the use of qualitative methods to center the patients' perspective and understand their definitions of health in the context of MCC.

Incorporating qualitative analyses provides a richer understanding of the intersection between psychosocial factors and disease management. Qualitative methods also help to contextualize the quantitative findings and uncover new areas for future exploration.

One limitation was the lower-than-expected percentage of patients who reported experiencing both mental health and social needs. Consequently, the study was not powered to examine patient characteristics as predictors of the prioritization of mental health versus social needs. Instead, the analyses examined patient characteristics that predict prioritization of each need separately. Additionally, while patients prioritized their psychosocial needs, it remains unclear the extent to which they followed through on or would accept help with addressing them.

The cross-lagged panel model analyses had several important limitations. First, due to the sample size being smaller than general recommendations, the cross-lagged panel models were simplified to include manifest variables instead of latent variables. The manifest variables cover a limited scope of psychological and social factors which are hypothesized to be related to chronic disease management. Many of the regression coefficients observed in the models were small and had corresponding standard errors which were large relative to them. This suggests that the model lacked precision and a larger sample may be needed to better examine relations between variables. Several psychosocial variables had high rates of missingness, which upon inspection, were not missing at random. It is possible that patterns in the missing data may have influenced the present study's results, particularly given that the patients missing data appeared to have higher rates of psychosocial needs at baseline and 12-months. Length of time between waves may serve as another limitation of the cross-lagged panel models. Objective measures of disease control reflect management from a period of weeks (e.g. cholesterol) to several months (e.g., hemoglobin A1C levels) which suggests that a shorter timeframe between waves may be more appropriate to assess the relation between these psychosocial factors and MCC management.

Patients who participated in the qualitative interviews were recruited as a part of a larger randomized controlled trial testing a care planning intervention which supported patients with MCCs in addressing health-related needs. It is possible that completing the enhanced care planning intervention may influence their responses. However, completing the intervention may have enhanced patients' reflection on their health and ultimately benefitted the interviews.

Future Directions

This study provides important insights into patients' definitions of health, burden of psychosocial needs and how they are prioritized, as well as how they relate to chronic disease management. These analyses also highlight a need for several important future research directions. First, additional research is needed to examine a broader scope of potential patient needs (e.g., mental health, social needs, and health behaviors) along with how patients prioritize multiple needs when present and potential factors which influence their decision making (e.g., readiness to change). It is important to understand how patients weigh the importance of competing needs in order to inform the creation of assistance programs and appropriately allocate resources. High rates of decline for psychosocial assistance suggest that the assistance being offered does not match with or encapsulate the needs and priorities of patients (Gold et al., 2018; Tong et al., 2018).

Second, further research is needed to explore the nuanced relation between different levels of anxiety and chronic disease management. The present study found that sub-clinical levels of anxiety were promotive for chronic disease management, though, this is largely inconsistent with the literature. Therefore, efforts are needed to determine the replicability of these findings and explore factors which may be driving this promotive effect (e.g. severity of symptoms, specific symptoms).

Finally, future research should operationalize health in multiple ways to reflect the complex nature of defining health. This may also enhance our understanding of the present study's unexpected findings. It is recommended that psychosocial variables be examined first with each chronic condition individually to allow for direct comparison between new findings and the literature. Along with objective measures of chronic disease management, it would be beneficial to also include other metrics of health. It is possible that these psychosocial variables are more strongly related to specific chronic diseases or patient-reported outcomes.

Conclusion

The present study extends the literature in several meaningful ways. This study highlights the patient perspective on defining health in the context of MCC. This is also the first study to explore both psychological and social needs among patients with MCC and examine how they relate to objective measures of disease management over time. Patient interviews revealed the complex and active nature in which they view their health with a wide range of influencing factors. Moderate rates of mental health and social needs were observed within the sample, yet the majority of patients with either type of need chose not to prioritize them. Cross-lagged panel model analyses revealed that only anxious symptoms were related to objective measures of chronic disease management. Collectively, these findings highlight the relevance of psychosocial factors to patients' everyday lives and important role they play in influencing their health and wellbeing. Clinicians should continue to orient patient care more towards the broader perspective of viewing the patient holistically, rather than just focusing on objective measures of disease control. Further research is necessary to examine a broader scope of health-related needs among patients with MCC, assess the nuanced relation between anxiety levels and chronic disease management, and to elucidate how psychosocial factors differentially relate to various metrics of health.

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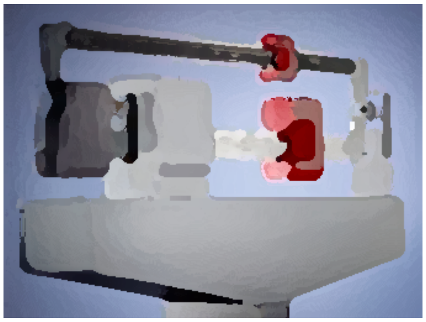
Appendices

Appendix A. Health Risk Assessment

What is your height? _____ ft _____ inches

What is your weight? ______ lb



What is your sex?

☐ Male
☐ Female

Over the past 7 days:

How many times did you eat unhealthy fast food meals/snacks *each day*?

☐ Not at all
☐ One Time
☐ Two Times
☐ Three Times
☐ Four Times
☐ Five Times
☐ Six Times
☐ Seven Or More Times

How many servings of fruits/vegetables did you eat *each day*?

☐ no servings
☐ 1 serving
☐ 2 servings
☐ 3 servings
☐ 4 servings
☐ 5 or more servings

How many soda and sugar sweetened drinks (regular, not diet) did you drink *each day*?

☐ 0 drinks
☐ 1 drink
☐ 2 drinks
☐ 3 drinks
☐ 4 drinks
☐ 5 drinks
☐ 6 drinks
☐ 7 or more drinks

How many days did you get moderate to strenuous exercise, like a brisk walk?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7

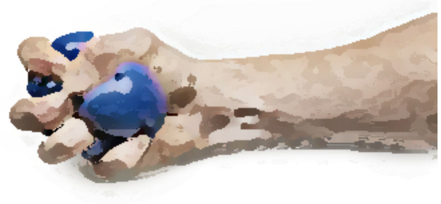
On those days that you engage in moderate to strenuous exercise, how many minutes, on average, do you exercise at this level?

________ minutes

Please choose the number that best describes how much stress you have been experiencing in the past 7 days (0 is no stress and 10 is the most stress you can imagine)

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5

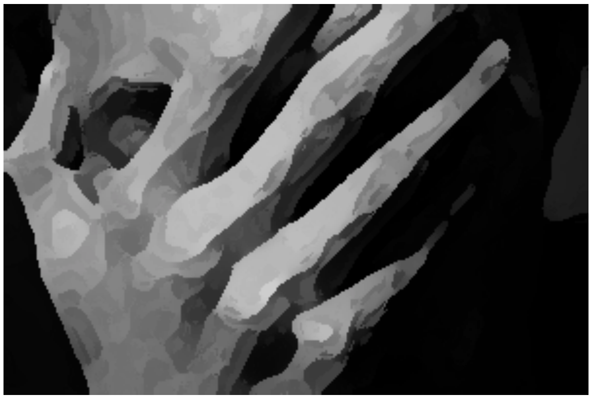
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10



Over the past 2 weeks, how often have you been bothered by these problems below?

Feeling nervous, anxious, or on edge:

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day



Not being able to stop or control worrying:

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Worrying too much about different things

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Trouble relaxing
- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Being restless that it's hard to sit still
- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Becoming easily annoyed or irritable
- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Feeling afraid as if something awful might happen
- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Over the past 2 weeks, how often have you been bothered by these problems below?

Feeling down, depressed, or hopeless:
- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Little interest or pleasure in doing things:
- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Trouble falling or staying asleep, or sleeping too much
- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Feeling tired or having little energy

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Poor appetite or overeating

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Feeling bad about yourself – or that you are a failure or have let yourself or your family down

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Trouble concentrating on things, such as reading the newspaper or watching television

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Moving or speaking so slowly that other people could have noticed. Or the opposite – being so fidgety or restless that you have been moving around a lot more than usual

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

Thoughts that you would be better off dead, or of hurting yourself in some way

- ☐ Not at all
- ☐ Several days
- ☐ More days than not
- ☐ Nearly every day

In the past 7 days, how often were you sleepy during the daytime:

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Always

Have you used tobacco in the last 30 days?

Smoked:
- ☐ Yes
- ☐ No

Used a Smokeless Tobacco Product:
- ☐ Yes
- ☐ No

How many times in the past year have you used an illegal drug or prescription medication for non-medical reasons?
- ☐ Never
- ☐ 1-3 times
- ☐ 4 or more times

How often do you have a drink containing alcohol?

- ☐ Never
- ☐ Monthly or less
- ☐ 2-4 times a month
- ☐ 2-3 times a week
- ☐ 4 or more times a week

How many standard drinks containing alcohol do you have on a typical day?

- ☐ 0 to 2
- ☐ 3 or 4
- ☐ 5 or 6
- ☐ 7 to 9
- ☐ 10 or more

How often do you have six or more drinks on one occasion?
- ☐ Never
- ☐ Less than monthly
- ☐ Monthly
- ☐ Weekly
- ☐ Daily or almost daily

In general, would you say your health is:
- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor

How concerned are you that you will not have a place to live sometime in the next 6 months?

- ☐ Not concerned
- ☐ Somewhat
- ☐ Very

How often do you have access to transportation?

- ☐ Never
- ☐ Rarely
- ☐ Some of the time
- ☐ All the time

In the past 6 months, how often did the food you bought not last, and you didn't have money to buy more?

- ☐ Never
- ☐ Sometimes
- ☐ Often

Do you every have difficulties making ends meet at the end of the month?

- ☐ Yes
- ☐ No

When was your last dental appointment?

- ☐ Less than a year ago
- ☐ 1-2 years ago
- ☐ Greater than 2 years ago

Do you feel safe in your neighborhood?

- ☐ Yes
- ☐ No

Are you ever afraid that your spouse/partner or another person you live with might hurt you?

- ☐ Yes
- ☐ No

Where are you living today?

- ☐ Homeless
- ☐ Shelter
- ☐ With a friend or family member
- ☐ Home/Apartment
- ☐ Other

Are you at risk of losing your housing?

- ☐ Yes
- ☐ No

The next questions are about how you feel about different aspects of your life. For each one, mark how often you feel that way:

How often do you feel that you lack companionship?

- ☐ Hardly Ever
- ☐ Some of the time
- ☐ Often

How often do you feel left out?

- ☐ Hardly Ever
- ☐ Some of the time
- ☐ Often

How often do you feel isolated from others?

- ☐ Hardly Ever
- ☐ Some of the time
- ☐ Often

Appendix B. Baseline Survey

TELL US ABOUT SOME OF YOUR HEALTH BEHAVIORS

We want to better understand our patients' daily health behaviors to know how it might impact their health. Your answers will be kept confidential and will not be shared with anyone else.

Over the past 7 days…

1. How many times did you eat unhealthy fast food meals or snacks?	☐ Not at all ☐ 1 time ☐ 2 times ☐ 3 times ☐ 4 times ☐ 5 or more times	
2. How many servings of fruits and vegetables did you eat each day?	☐ No servings ☐ 1 serving ☐ 2 servings ☐ 3 servings ☐ 4 servings ☐ 5 or more servings	
3. How many times did you drink soda and sugar sweetened drinks (regular, not diet) each day?	☐ Not at all ☐ 1 time ☐ 2 times ☐ 3 times ☐ 4 times ☐ 5 or more times	
4. How many days did you get moderate to strenuous exercise, like a brisk walk?	☐ Not at all ☐ 1 day ☐ 2 days	☐ 4 days ☐ 5 days ☐ 6 days

	☐ 3 days	☐ 7 days
5. On those moderate to strenuous exercise days, how many minutes, on average, do you exercise at this level?	________(usually 10-60 minutes per day)	

HOW DOES OUR OFFICE DO WITH HELPING YOU MANAGE YOUR HEALTH?

Staying healthy can be difficult when you have a chronic illness. We would like to learn about the type of help with your condition you get from your health care team. This might include your regular doctor, his or her nurse, or physician's assistant who treats you.

Think about the health care you've received for your chronic conditions over the past 6 months. (If it's been more than 6 months since you've seen your doctor or nurse, think about your most recent visit.)

Over the past 6 months, when receiving medical care, I was:

	Almost never	Generally not	Sometimes	Most of the time	Almost always
6. Asked for my ideas	☐	☐	☐	☐	☐
7. Given choices about treatment to think about	☐	☐	☐	☐	☐
8. Asked to talk about any problems with my medicines or their effects	☐	☐	☐	☐	☐
9. Given a written list of things I should do to improve my health	☐	☐	☐	☐	☐
10. Satisfied that my care was well organized	☐	☐	☐	☐	☐
11. Shown how what I did to take care of my illness influenced my condition	☐	☐	☐	☐	☐
12. Asked to talk about my goals in caring for my illness	☐	☐	☐	☐	☐
13. Helped to set specific goals to improve my eating or exercise	☐	☐	☐	☐	☐

14. Given a copy of my treatment plan	☐	☐	☐	☐	☐
15. Encouraged to go to a specific group or class to help me cope with my chronic illness	☐	☐	☐	☐	☐
16. Asked questions, either directly or on a survey, about my health habits	☐	☐	☐	☐	☐
17. Sure that my doctor or nurse thought about my values and traditions when they recommended treatments to me	☐	☐	☐	☐	☐

Over the past 6 months, when receiving medical care, I was:	Almost never	Generally not	Sometimes	Most of the time	Almost always
18. Helped to make a treatment plan that I could do in my daily life	☐	☐	☐	☐	☐
19. Helped to plan ahead so I could take care of my illness even in hard times	☐	☐	☐	☐	☐
20. Asked how my chronic illness affects my life	☐	☐	☐	☐	☐
21. Contacted after a visit to see how things were going	☐	☐	☐	☐	☐
22. Encouraged to attend programs in the community that could help me	☐	☐	☐	☐	☐
23. Referred to a dietitian, health educator, or counselor	☐	☐	☐	☐	☐
24. Told how my visits with other types of doctors, like the eye doctor or surgeon, helped my treatment	☐	☐	☐	☐	☐
25. Asked how my visits with other doctors were going	☐	☐	☐	☐	☐
26. Asked what I would like to discuss about my illness at that visit	☐	☐	☐	☐	☐
27. Asked how my work, family, or social situation related to taking care of my illness	☐	☐	☐	☐	☐

28. Helped to make plans for how to get support from my friends, family or community	☐	☐	☐	☐	☐
29. Told how important the things I do to take care of my illness (e.g., exercise) were for my health	☐	☐	☐	☐	☐
30. Set a goal together with my team for what I could do to manage my condition	☐	☐	☐	☐	☐
31. Given a book or monitoring log in which to record the progress I am making	☐	☐	☐	☐	☐
32. Able to work with a community program to help take care of my illness	☐	☐	☐	☐	☐

HOW IS YOUR HEALTH TODAY?

Under each heading, please select the ONE box that best describes your health TODAY.

33. MOBILITY

I have no problems walking about	☐
I have slight problems walking about	☐
I have moderate problems walking about	☐
I have severe problems walking about	☐
I am unable to walk about	☐

34. SELF-CARE

I have no problems washing or dressing myself	☐
I have slight problems washing or dressing myself	☐
I have moderate problems washing or dressing myself	☐
I have severe problems washing or dressing myself	☐
I am unable to wash or dress myself	☐

35. USUAL ACTIVITIES *(e.g. work, study, housework, family or leisure activities)*

I have no problems doing my usual activities	☐
I have slight problems doing my usual activities	☐

I have moderate problems doing my usual activities	☐
I have severe problems doing my usual activities	☐
I am unable to do my usual activities	☐
36. PAIN / DISCOMFORT	
I have no pain or discomfort	☐
I have slight pain or discomfort	☐
I have moderate pain or discomfort	☐
I have severe pain or discomfort	☐
I have extreme pain or discomfort	☐

HOW IS YOUR HEALTH TODAY? (Continued)

Under each heading, please select the ONE box that best describes your health TODAY.

37. ANXIETY / DEPRESSION	
I am not anxious or depressed	☐
I am slightly anxious or depressed	☐
I am moderately anxious or depressed	☐
I am severely anxious or depressed	☐
I am extremely anxious or depressed	☐

38. This scale to the right is numbered from 0 to 100.

100 means the best health you can imagine.

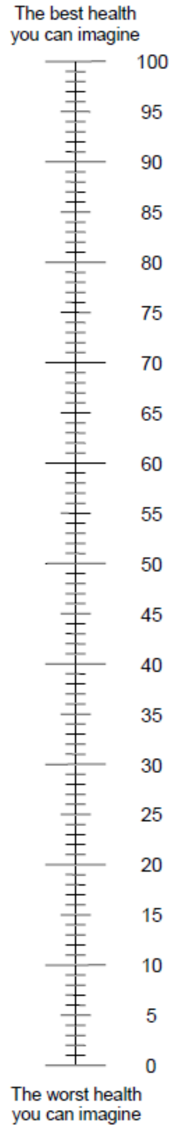
0 means the worst health you can imagine.

Mark an X on the scale to indicate how your health is TODAY.

Now, please write the number you marked on the scale in the box below.

YOUR HEALTH TODAY = ☐

(from 0 to 100)



39. Would you be interested in learning more about our office's care planning study?

☐ Yes

☐ No

40. If yes, what is the best way to contact you?

__________________ email _________________ cell phone

Thank you for taking the time to complete this survey.

Appendix C. Vita

Kristen M. O’Loughlin was born on September 15, 1992. She obtained her Bachelor of Science in Psychology at the University of Washington in 2015. She subsequently earned a Master of Arts in Clinical Psychology at Northwestern University in 2018 and a Master of Science in Clinical Psychology at Virginia Commonwealth University in 2020. Kristen is currently a fifth-year student in the Clinical Psychology doctoral program at Virginia Commonwealth University.