ABSTRACT

SCHULTZ, COURTNEY LYNNE. Examining the Feasibility of Nature-based Physical Activity Prescriptions as a Viable Integrated Healthcare Approach (Under the direction of Dr. Jason Bocarro and Dr. Myron Floyd).

Over a lifetime, personal behaviors have greater influence on health than other health determinants. The United States healthcare system continues to struggle with the growing impacts of non-communicable diseases, spurring the need for innovative prevention and treatment approaches. Preliminary evidence shows that parks and green spaces hold promise for encouraging healthy behaviors (e.g., increasing physical activity and nature exposure) that may improve overall health. Park Prescriptions (Park Rx) are one intervention program that could be used to strategically invest in appropriate clinical approaches to achieve desired health impacts for non-communicable diseases linked to inactivity, such as diabetes and hypertension. While there is increased interest in using Park Rx to help patients manage their chronic disease and improve health outcomes, there is little evidence measuring the impact of nature-based physical activity prescriptions to improve patients’ health outcomes, and almost no research on integrating Park Rx programs into a standardized clinical practice.

This dissertation strove to address these research gaps by examining Park Rx programs (nature-based physical activity prescriptions) as a clinical-community approach to healthcare through three papers that independently and collectively contribute to the scientific literature on nature-based prescriptions. The first paper, a systematic literature review, assessed if patients of all ages experience positive health outcomes as a result of receiving a clinically-based Park Rx program from their healthcare provider. The second paper utilized a discrete-choice experiment with healthcare providers across the United States, to identify the preferences of healthcare providers to understand which patient attributes are most impactful for providers’ likelihood to write nature-based physical activity prescriptions. The final paper presents the development of a
controlled clinical protocol for a tailored park prescription program that sought to integrate that Park Rx program within the clinical workflow of Federally Qualified Health Centers in rural North Carolina. The pilot clinical protocol informed by focus groups conducted with providers and patients assessed how the use of eHealth technologies such as physical activity monitors, SMS text messaging, and a web-based app could streamline the integration of the health behavior intervention into the clinical workflow. In contrast to much work that has emphasized generalized physical activity interventions, this dissertation demonstrates the viability of designing and implementing a clinically-friendly tailored Park Rx intervention.
Examining the Feasibility of Nature-Based Physical Activity Prescriptions as a Viable Integrated Healthcare Approach

by
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BIOGRAPHY

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# TABLE OF CONTENTS

LIST OF TABLES .................................................................................................................. vii
LIST OF FIGURES ............................................................................................................... viii

Chapter 1: Introduction ........................................................................................................ 1
Emerging Science Linking Nature and Health ................................................................. 3
Theoretical Pathways Connecting Nature and Well-being ............................................ 9
Theoretical Pathways Between Leisure and Health ......................................................... 11
  Theory of Planned Behavior ......................................................................................... 13
  Needs and Motivations ............................................................................................... 14
  Constraints and Negotiation ...................................................................................... 16
  Leisure Settings and Health ....................................................................................... 17
Nature-based Leisure as Health Intervention ..................................................................... 19
Dissertation Organization and Objectives ........................................................................ 21
References ......................................................................................................................... 24

Chapter 2: A Scoping Literature Review of Park Prescription Referrals in Primary-Care Settings ............................................................................................................... 40
Introduction ....................................................................................................................... 42
  Physical Activity Prescriptions in Healthcare ............................................................ 42
  Health Benefits of Green Exercise ............................................................................. 44
  Park Prescriptions as an Emerging Program ............................................................... 46
  Study Purpose ............................................................................................................. 48
Methods ............................................................................................................................. 48
  Article Selection .......................................................................................................... 49
    Eligibility Criteria ..................................................................................................... 50
  Search Strategy Methods ............................................................................................ 51
    Data Extraction and Analysis .................................................................................... 52
Results ................................................................................................................................. 53
  Study Designs ............................................................................................................. 57
  Target Populations ...................................................................................................... 57
  Intervention Designs .................................................................................................... 58
  Outcome Findings ....................................................................................................... 60
Discussion .......................................................................................................................... 62
  What is the Nature of the Evidence? ........................................................................... 62
  What Methodologies and Intervention Designs Are Used? ...................................... 65
  What are the Priority Future Park Rx Research Needs? ............................................. 67
    Strengths and Limitations of Review ...................................................................... 70
      Risk of Bias ............................................................................................................ 72
Conclusion .......................................................................................................................... 72
References .......................................................................................................................... 74

Chapter 3: What Underlies Healthcare Provider Decision-making and Engagement with Nature-based Physical Activity Prescriptions ................................................................. 87
Introduction ....................................................................................................................... 89
  Healthcare and Nature-based Prescriptions ............................................................... 90
  Study Aims .................................................................................................................. 93
Materials and Methods ..................................................................................................... 93
Data Collection and Analysis
Assignment of Interventions
Participant Timeline
Recruitment
Sample Size Calculation

Results
Participants’ Perceptions Regarding the DCE Vignettes
Familiarity with Nature-based Physical Activity Prescriptions
Level Balance of the DCE Choice Sets
Regression Models
  Cox Regression Model Full Results
  Cox Regression Model Prior Experience
  Cox Regression Model Adequacy of Education

Discussion
Limitations
Future Studies

Conclusion
References

Chapter 4: Design of a Park Prescription Program Informed by the Perspective of Patients and Healthcare Providers: A Study Protocol
Introduction
  Clinical Intervention Models
  Use of eHealth Tools
  Study Purpose
Materials and Methods
  Study Design
  Study Setting
  Eligibility Criteria
  Intervention
    Group 1—Park-Based Physical Activity
    Group 2—Home/Indoor Physical Activity Control Group
    Group 3—Health Eating Control Group
  Fitbit Use Across All Three Groups
  SMS Text Message Use Across All Three Groups
Outcomes
  Primary Outcome
  Secondary Outcomes
Sample Size Calculation
Recruitment
Participant Timeline
Assignment of Interventions
Data Collection and Analysis
  Data Collection
  Fitbit Data Collection
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMS Data Collection</td>
<td>174</td>
</tr>
<tr>
<td>Data Management</td>
<td>175</td>
</tr>
<tr>
<td>Participant Biometric Data</td>
<td>175</td>
</tr>
<tr>
<td>Fitbit Data</td>
<td>175</td>
</tr>
<tr>
<td>SMS Data</td>
<td>176</td>
</tr>
<tr>
<td>Statistical Analysis</td>
<td>176</td>
</tr>
<tr>
<td>Fitbit Data Analysis</td>
<td>177</td>
</tr>
<tr>
<td>SMS Data Analysis</td>
<td>177</td>
</tr>
<tr>
<td>Ethics and Dissemination</td>
<td>178</td>
</tr>
<tr>
<td>Research Ethics Approval</td>
<td>178</td>
</tr>
<tr>
<td>Declaration of Interests</td>
<td>178</td>
</tr>
<tr>
<td>Dissemination Policy</td>
<td>178</td>
</tr>
<tr>
<td>Discussion</td>
<td>179</td>
</tr>
<tr>
<td>Lessons Learned</td>
<td>180</td>
</tr>
<tr>
<td>Future Plans</td>
<td>182</td>
</tr>
<tr>
<td>Conclusion</td>
<td>183</td>
</tr>
<tr>
<td>References</td>
<td>185</td>
</tr>
<tr>
<td>Chapter 5: Conclusion</td>
<td>195</td>
</tr>
<tr>
<td>Summary of Findings</td>
<td>196</td>
</tr>
<tr>
<td>Limitations and Future Research</td>
<td>199</td>
</tr>
<tr>
<td>Implications and Outlooks for Potential Research</td>
<td>202</td>
</tr>
<tr>
<td>References</td>
<td>210</td>
</tr>
<tr>
<td>APPENDICES</td>
<td>214</td>
</tr>
<tr>
<td>Appendix A: Discrete-choice Experiment Survey</td>
<td>215</td>
</tr>
<tr>
<td>Appendix B: Park Rx Audit Tool</td>
<td>229</td>
</tr>
<tr>
<td>Appendix C: SMS Protocol Workflow by Intervention Group</td>
<td>243</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 2.1  Summary of research studies included in the scoping review .......................... 55

Table 3.1  Final attributes and levels chosen for the discrete-choice experiment .................. 96

Table 3.2  Demographic and professional characteristics of respondents (n=75) .................. 106

Table 3.3  Participants’ ease of use and comprehension of the DCE Vignettes .................. 107

Table 3.4  DCE attribute level balance and frequency of appearance in the patient vignettes .......................................................................................................................... 113

Table 3.5  Relative preferences—full Cox regression main effects model from DCE (n=1500) ................................................................. 115

Table 3.6  Relative preferences—segmented Cox regression full effects model: providers experienced with nature-based physical activity prescriptions vs providers without experience ............................................................................................................. 117

Table 3.7  Relative preferences—segmented Cox regression full effects model: providers with adequate education vs providers with inadequate education to provide nature-based physical activity counseling ................................................................................. 119
LIST OF FIGURES

Figure 1.1  Antonovsky’s 1979 ease/dis-ease continuum of health ............................................. 10

Figure 1.2  A theoretical model of the relationship between leisure and individual health (Coleman & Iso-Ahola, 1993) .................................................................................................................. 12

Figure 2.1  PRISMA flow diagram of study selection ........................................................................ 52

Figure 3.1  Example patient vignette and choice set from the DCE ..................................................... 97

Figure 3.2  Frequency of respondents’ self-reported knowledge and familiarity around nature-based physical activity prescriptions (n=65) ...................................................................................... 108

Figure 3.3  Frequency of respondents’ preference for additional education resources to address their feeling of inadequate knowledge (n=34). .......................................................... 110

Figure 3.4  Frequency of respondents’ stated likeliness of additional resources increasing their willingness to increase the use of nature-based physical activity prescriptions in their daily practice (n=75) .................................................................................. 111

Figure 4.1  Five A’s of physical activity counseling adapted from AuYoung et al. (2016) based on the original model conceptualized by Fiore et al. (2011) .................................................. 149

Figure 4.2  Example of the SMS feedback response system for park-based physical activity prescriptions ................................................................................................................................. 167

Figure 4.3  Flow of participants throughout the GPT pilot study ......................................................... 172

Figure 5.1  The SH/FT Rx challenge pyramid ....................................................................................... 203
CHAPTER 1: INTRODUCTION

“While the Romantics were emoting over their connection to Nature, the working class was suffering from their separation from nature. Physically suffering, that is, because health and nature are deeply entwined…nature makes people healthier.”

-Alice Outwater (2019, p. 51)

According to the World Health Organization, health is “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO, 2000). It was not until the early 1990s that leisure researchers began specifying the role of leisure for maintaining health (Carbonneau & Duquette, 2018). However, the idea of health and the influence of recreation, parks, and leisure research upon public health have been associated with both professional and scientific fields since their earliest conception. As far back as the fourth century, Hippocrates was noting the impact of nature upon health and citing nature as a treatment for disease (Arvay, 2018). During the last half of the nineteenth century, the industrial revolution changed the social composition of America, spurring the development of expanded urban areas, public education, and unionized workforces. Along with these social changes came dense urban populations that facilitated the spread of old and new diseases such as measles, diphtheria, whooping cough, tuberculosis, cholera, and typhoid (Outwater, 2019). Parks originated to address the negative impacts of the quickly industrialized cities on the health of those cities, to give the masses an opportunity to engage in sunshine, fresh air, and nature. These green spaces and public gardens were a common ground that allowed the continuous immigrant influx at the time to be quickly assimilated into the turbulent social spheres that American cities had become. Cranz (1982) emphasized that the evolution of the urban American park was conceptualized as a miniaturization of the country to provide fresh air and sunshine within the city for citizens to engage in relief from urban ills. Indeed, John H. Griscom wrote a seminal report for New York
City in 1845 that drew upon testimony from physicians to position parks as a critical solution to sanitation and health problems (Griscom, 1845). By the 1850s, several reports connecting fresh air and parks had led to the American embrace of urban parks as a solution to sanitation-related health problems (Crompton, 2013). The public recreation movement, a period spanning the mid-nineteenth to early twentieth century, was in response to the social concerns over health and morality as both the environmental and social landscape of America were quickly changing (McLean & Hurd, 2011). This early emergence of the leisure profession saw the development of national, state, and municipal parks; growth of adult education movements; creation of voluntary organizations; and perhaps most related, the early constructs of health in nature, such as the playground movement.

Connection and access to nature were important parts of this early movement. Less focus was given to the psychological and emotional benefits; instead more emphasis was given to physical health and the prevention of disease (Ward Thompson, 2011). The waves of urbanization had more than doubled the population in cities between 1880 and 1900 (McLean & Hurd, 2011). Across the eastern United States, places of green were carved from the landscape. The Boston Sand Garden and New York City’s first playgrounds were established to provide access to parkland for children of poor, working class neighborhoods. Perhaps the most notable green spaces figure of the nineteenth century, Frederick Law Olmsted, was an ardent believer that experiences with nature were vital to the health and well-being of individuals and, as a result, to the whole of society (Rybczynski, 1999). This belief was imbued in his careful design of notable landscapes such as New York City’s Central Park and Boston’s Back Bay Ferns, perhaps sculpted due to his belief that viewing nature:

- employs the mind without fatigue and yet exercises it; tranquilizes it and yet enlivens it;
- and thus, through the influence of the mind over the body, gives the effect of refreshing
rest and reinvigoration to the whole system (Olmsted, 1865 as cited by Ulrich et al., 1991).

Physical activity, including sports, exercise, outdoor recreation, and supervised play, was central to the promotion of the recreation and park movement during this time. Early recreation pioneers such as Joseph Lee, Luther Halsey Gulick, and Jane Addams further addressed quality of life by advocating for, and working through major societal institutions to position parks, recreation, and leisure as being an important and rightful part of life for all Americans. As Godbey, Caldwell, Floyd, and Payne (2005) noted, the focus of this period was to use selected forms of recreation to promote physical activity, social skills, education, and exposure to nature – quite similar to the inextricably linked scholarship of health and leisure that has continued to grow since the early 1990s. In 1996, a report by the U.S. Surgeon General found that individuals engaged in physical activity benefited from reduced risk of premature death; lowered risk of coronary heart disease, hypertension, colon cancer, and non-insulin-dependent diabetes; improved maintenance of muscle strength, joint structure, and joint function; weight loss and favorable redistribution of body fat; improved physical functioning in persons suffering from poor health; and healthier cardiovascular, respiratory, and endocrine systems (CDC, 1996). This strong pathway between parks and physical activity leading to improved health helped to spur a new generation of leisure and health research in the United States.

**Emerging Science Linking Nature and Health**

A surge of research over the last 40 years has built upon the intuitive rationale of these leisure health pioneers, further grounding the interwoven concepts of nature, physical activity, and human health through scientific findings. Since the early 1980s, *shinrin yoku* (forest bathing), first developed in Japan as a preventive healthcare approach, has been recognized in medicine for its healing properties (Tsunetsugu, Park, & Miyazaki, 2010). This practice is based
on Shinto and Buddhist traditions that predate the program’s implementation by the Japanese government. Exposure to nature in these woodland settings has been shown to have several physiological impacts. For instance, after spending time in the woods, the human body demonstrates a higher number of killer cells in the immune system; those killer cells are more active and the levels of anti-cancer proteins are elevated (Song, Ikei, & Miyazaki, 2016). These biological changes are in response to terpenes (the main components of forest aerosols) which are released by plants into the air; studies have discovered that forest air terpenes prevent the formation of cancer, remove viruses from the body, and fight against existing tumors, all evidence of a direct impact of natural elements upon the body to improve health and wellbeing (Cho et al., 2017; Li et al., 2007; Li et al., 2012).

But it is not just trees that positively impact human health; water also has significant impacts upon well-being. Positive restoration effects of green space locations were found to be comparable to coastal locations (White, Pahl, Ashbullby, Herbert, & Depledge, 2013). Built environments with blue spaces are as positively rated as natural green space in terms of attractiveness and perceived restorativeness (Nutsford, Pearson, Kingham, & Reitsma, 2016; White et al., 2010). In another study, researchers found that restorativeness experienced from visiting coastal areas was heightened when the ambient temperatures were cooler than the monthly average, during low tides, and when the water and air water were better quality than normal (Hipp & Ogunseitan, 2011). In much the same way that the aerosols of the forest positively impact health, so too can oceanside conditions positively affect perceived restorativeness. Urban blue (defined as visible surface waters in urban areas; Kistemann, Völker, & Lengen, 2010) have been positively associated with health enhancing aspects such as facilitating relaxation, supporting active recreation, increased social relationships, and improved sense of belonging (Völker & Kistemann, 2011, 2013). One study found that restorative
experiences in waterside environments were actually stronger than in urban park settings (Korpela, Ylén, Tyrväinen, & Silvennoinen, 2010). In psychosocial terms, an internal state of calm is facilitated by certain landscapes of both green and blue spaces, which leads to the restorativeness and clarity of thought associated with the positive mental and psychological impacts of nature. It is not the color of the natural scape that matters; rather it is the importance of the opportunity to act in a way that improves well-being, and in turn, life satisfaction (Capaldi, Dopko, & Zelenski, 2014; White et al., 2016).

Stress reduction is another benefit from being immersed in natural surroundings. Ulrich’s (1983) Aesthetic Affective Theory specifically details the way in which sensory perceptions of nature affect affections that dictate the mind’s response to fight or relax. Studies have repeatedly found that exposure to nature acts as a buffer for life stresses (Olafsdottir, Cloke, & Vogele, 2017; Roe et al., 2013; Triguero-Mas et al., 2017), and as such, it is not surprising that the leisure field began associating nature-based recreation with stress reduction in the mid-1990s (Hull & Michael, 1995). This concept of attention was further explored by Kaplan (1995), who noticed that the mind needs a break from directed attention. This became known as attention restoration theory (ART) which focuses on the concept of directed attention, an attentional mechanism that functions in mental information processing and focus. As such, the fatigue of directed attention results in mental exhaustion leading to diminished capacity to problem solve and control inhibition and thought, and increased experiences of irritability and isolation (Kaplan, 1995). The restoration of effectiveness is facilitated through fascination; ART postulates that if a mind becomes softly fascinated with nature, the directed attention is reset, and in turn, replaced by a sense of fascination that manifests as the subject moves through a landscape. According to ART, nature is the best environment for restoring attention and reducing the effects of fatigue because natural elements provide the mechanism necessary to block distractions leading to an opportunity
to mentally rest and restore (Kaplan, 1995; Kaplan, Kaplan, & Ryan, 1998; Sullivan & Kaplan, 2016). Specifically, restoration is conceptualized in terms of four properties of a restorative environment that includes: 1) “being away,” a sense of being distinct from the everyday environment whether physically or conceptually; 2) “soft fascination” in which patterns that hold one’s attention effortlessly, such as sunsets and the motion of leaves, are present; 3) “extent” in which the experience of spaces having scope and coherence keep a person engaged, such as a trail or miniaturized garden; and 4) “compatibility” of supporting an individual’s intrinsic motivations or wants through the many predetermined patterns of relating to the natural setting through prescribed roles (i.e., locomotion, domestication of nature; Kaplan, 2001).

Even if there is some dispute as to which aspects of attention are truly affected by nature, there is evidence of the positive impact of nature on reducing mental fatigue and science to support the intuition of Olmsted (Hartig & Staats, 2006; Kuo, 2001; Ohly et al., 2016). An accumulation of empirical evidence in support of ART shows that exposure to green or natural settings consistently improves an individual’s capacity to pay attention. Taylor, Kuo, and Sullivan (2002) examined whether apartment-dwelling children with greater surrounding green space had higher levels of self-discipline and found a positive impact upon girls. In another study, Taylor and Kuo (2009) found that a 20-minute exposure to a natural park setting led to improved concentration among attention deficit hyperactivity disorder youth better than a walk downtown or in a neighborhood. A recent study found that 40 second views of green roof views sustained attention providing experimental evidence that the restorative nature of green is reflected in boosts to sub-cortical arousal and cortical attention control (Lee, Williams, Sargent, Williams, & Johnson, 2015). Another study further explored the impact of environment type by comparing the effects of an urban street to three nature settings, including parkland, tended woodland, and wild woods, in which there was no significant difference among the natural
settings, suggesting that natural stimuli and settings have a common trigger of restoration in line with the four properties of settings that ART defines (Van den Berg, Jorgensen, & Wilson, 2014). Thus, the viewing of nature scenes as compared to urban settings has been shown to significantly reduce the stress people feel (e.g., Brown, Barton, & Gladwell, 2013; Jiang, Chang, & Sullivan, 2014).

Further, nature exposure has been shown to have significant positive impacts on all types of mental health. Characteristics of nature such as vegetation cover and bird abundances have been associated with lower prevalence of depression, anxiety, and stress (Cox et al., 2017). In other studies, nature experience has shown a decrease in anxiety and rumination, balanced by improved complex working memory span tasks (Bratman, Daily, Levy, & Gross, 2015a), suggesting that even brief nature experiences can have a significant impact on affect and cognition. Furthermore, participants who experience a 90-minute nature walk reported lowered levels of rumination (Bratman, Hamilton, Hahn, Daily, & Gross, 2015b). An Australian study found that time spent in green spaces can increase an individual’s capacity to self-manage their mental illness (Henderson-Wilson & Weerasuriya, 2017). A recent environmental intervention study found that greening vacant urban lots led to a decrease in feelings of depression and self-reported poor mental health (South, Hohl, Kondo, MacDonald, & Branas, 2018). As Jerrett and van den Bosch (2018) note, “nature exposure may also have direct structural and functional effects on the brain, resulting in reduced symptoms of depression” (p. 1).

While the exact direct structural and functional effects of nature exposure on the brain are still emerging in the research, the evidence to date is compelling (Bratman et al., 2015b). The deliberate use of natural environments for therapeutic approaches has shown short and long-term positive effects on groups with mental stress (Adevi & Mårtensson, 2013; Barton & Pretty, 2010; Pretty, Wood, Hine, & Barton, 2013). In short, nature exposure, along with access to green space
For recreation activities, can lead to greater mental wellbeing (Townsend, 2006; Wood, Hooper, Foster, & Bull, 2017).

There is also evidence that contact with nature is associated with multiple whole-body health benefits. Nature has been shown to have positive impacts even upon specific diseases. While it is well established that regular exercise is important for diabetic patients, Ohtsuka (2013) found that both walks in a forest and simply being in the forest significantly reduced blood glucose levels in the diabetic participants. These findings point to the ability of nature exposure to heal via biological and physical access as well as psychological. Among children, increased time spent outdoors was associated with lower levels of myopia (Rose et al., 2008). Both viewing and walking in a forest environment has been shown to significantly lower systolic and diastolic blood pressure compared to the same activity in an urban landscape (Li et al., 2011; Miyazaki, Lee, Park, Tsunetsugu, & Matsunaga, 2011; Park et al., 2007). While nature exposure can encourage healthy behaviors such as increased physical activity, it may be that the biological mechanisms acting on the autonomous nervous system are causing a reduction of stress that is preventing systemic inflammation, therefore positively reducing a common cause of many noncommunicable diseases (Egorov et al., 2017; van den Bosch & Ode Sang, 2017).

The power of nature upon health has been documented even when an individual is not directly accessing the natural elements. Ulrich (1984) conducted a study of surgery patients in which a hospital room with a view of outdoor green space sped up the healing process. The concept of simply viewing images of nature to improve health has been explored by other researchers (Brown et al., 2013; Gladwell et al., 2012; Olafsdottir et al., 2018; Ulrich et al., 1991). Similar with water, patients with symptoms of fatigue and problems organizing daily life who submitted to a flotation tank treatment saw significant decrease in depression and anxiety.
and an increase in a positive outlook as a result of the treatment (Kjellgren, Buhrkall, & Norlander, 2011).

**Theoretical Pathways Connecting Nature and Well-being**

Building upon Erich Fromm’s biophilia, E.O. Wilson popularized the biophilia hypothesis that states a belief that humans are healthier when connected to nature. This has been appropriated by environmental psychologists into stress reduction theory, also referred to as psycho-evolutionary restoration theory (Kellert & Wilson, 1995; Williams, 2017). The stress reduction theory posits that natural environments facilitate recovery from stress, whereas urban built environments tend to hinder that same process (Konijnendijk 2008; Velarde, Fry, & Tveit, 2007). The base argument is that since humans developed and evolved within natural environments (compared to contemporary built urban environments), these original environments are possibility adaptive for modern humans to help the body respond to threats of negative emotions, physiological indicators, and increased autonomic arousal, fear, anger, sadness, and increased blood pressure and heart rate – some of the many emotions and indicators of the stress response (Ulrich, 1983; Ulrich et al., 1991). At the core, this argument is that human health is dependent upon nature to recover from the stresses of modern life.

A more recent approach, green mind theory (Pretty, Rogerson, & Barton, 2017), emphasizes the linkages between the mind, brain, and body, connecting the body into natural and social environments. The theory outlines the reciprocal links between human (behavior, mind, brain, and body) and environment (nature and social), where beliefs are likely to influence outcomes of spending time in nature. The key is the importance of the nature setting in inducing health related expectations that play a role in the psychological benefits of green exercise, suggesting that modification of expectations can further enhance those outcomes. Being outdoors
in nature can afford a sense of escapism from the daily stressors of life, which can contribute to restorative experiences.

This concept of linkages harkens back to Antonovsky’s (1996) salutogenic model that, at its base, argues that throughout a lifetime, all the different systems in the actual environment (natural and social) create a unique human being and health outcome. Within this model, health is a movement on a continuum of ease and dis-ease that prompts the question of how to move any person along the continuum towards the healthy pole (Figure 1.1).

![Antonovsky's Health Continuum](image)

Figure 1.1. Antonovsky’s (1979) ease/dis-ease continuum of health.

This model incorporates the concept of salutogenesis which means the origin of health. Therefore, the salutogenic model is a health promotion theory that advocates the holistic person at the center of treatment, not only the disease. Salutogenesis perspectives in health research focus on determining how people stay healthy despite stressful circumstances, to better understand what causes health. The restorative environment (von Lindern, Lymeus, & Hartig, 2017) became a complementary concept for salutogenesis approaches. The restoration perspective complements the stress and coping found in salutogenesis and introduces the concept of resource depletion and renewal needed to maintain and promote health. Through this
additional linkage, socio-physical environments play a critical positive role in health and wellbeing. Such theoretical models have underpinned the examination of psychosocially supportive designs for the physical environment specifically within the healthcare environment, to imbue clinical design with salutogenesis (Dilani, 2008) and in the development of personalized and preventive healthcare (Alivia, Guadagni, & Di Sarsina, 2011). These theoretical models provide a useful framework for understanding why nature exposure is valuable for improving human health and for exploring how to increase the utility of nature exposure within healthcare clinical practice and spaces.

**Theoretical Pathways Between Leisure and Health**

By the late 1980s, early leisure scholars such as Coleman and Iso-Ahola had been examining the ways in which leisure contributed to well-being through maintaining physical and mental health. Life stress and health outcomes were examined to assess the moderating effects of leisure, specifically through leisure-based social support and self-determination dispositions (Coleman, 1993; Coleman & Iso-Ahola, 1993). Early empirical evidence suggested that perceived leisure freedom interacted with life stress, buffering against the negative influence of life stress on general health. These early studies lead to a theoretical model of the relationship between leisure and health (Figure 1.2).
Parks, recreation, and leisure scholars in the late 1980s published several studies suggesting that leisure is beneficial for psychological well-being and health (e.g., Caldwell & Smith, 1988; Iso-Ahola, 1980). Indeed, Wheeler and Frank (1988) examined 22 factors, and discovered that four buffers – a sense of competence, nature and extent of exercise, sense of purpose, and leisure activity – significantly acted as buffers between stress and well-being. Meanwhile, other leisure theorists were positing several connections between leisure and health. For example, Hull advocated improved health from leisure through promotion of positive moods. Caldwell and Smith (1988) focused on the reduction of loneliness leading to well-being. Other scholars promoted a conceptualization of health “as a state of well-being which encompasses emotional, physical, social, and spiritual health” (Coleman & Iso-Ahola, 1993, p. 112), mirroring the early stance of the World Health Organization’s definition of health. Caldwell (2005) noted
that existing literature on leisure and health had, up to that point, centered on the prevention of, coping with, and transcending of negative life events, a framework reminiscent of the salutogenic model.

**Theory of Planned Behavior.** Ajzen (1991) proposed a theoretical framework that built upon the theory of reasoned action (Ajzen & Fishbein, 1975). This framework was used by scholars to study leisure activities and their benefits, by allowing for an examination of the links between activities, benefits, and an individual’s goals. The theory of planned behavior (TPB) focuses on three conceptually independent determinants of intentions: attitude toward the behavior, subjective norm to perform the behavior, and perceived behavioral control. TPB includes antecedents of actual behavior such as intention, availability of requisite opportunities, and resources. TPB also includes antecedents to the determinants of intention as well. One study examined the impacts of communications in promoting physical activity through an intervention based on TPB and found that persuasive messaging positively impacts attitudes and stronger intentions (Chatzisarantis & Hagger, 2005). Another study utilized the TPB as a model for understanding sedentary behavior and found that subjective norms and intentions were the strongest and most consistent predictor of behavior (Prapavessis, Gaston, & DeJesus, 2015). Such studies suggest that the TPB is a useful framework for understanding both active and sedentary health behavior and leisure activity (Pierro, Mannetti, & Livi, 2003). Ajzen’s theory can help to explain why a person may choose to pursue a specific behavioral goal and is useful in examining the psychological-based motivations and social factors that can impact motivation to participate in leisure time physical activity. For instance, application of the TPB can be used to explain an individual’s connection with a nature-based physical activity and utilize the motivations towards a tailored health intervention.
**Needs and Motivations.** Leisure needs and motivation concepts provide a framework for examining what type of leisure time health activities can benefit an individual’s health needs, while also addressing the underlying mechanisms that guide a person’s willingness to engage in specific activities and for what reasons they will commit to leisure-based active living. This essentially builds upon the TPB. Payne, Ainsworth, and Godbey (2010) raised the question of whether good health is one thing or many things. Health has evolved from a disease treatment model to being conceptualized as a function of the multidimensional components of physical, psychological, social, and spiritual well-being (salutogenic). People tend to view their health as having multiple dimensions, and they often have equally complex needs and motivations for addressing the array of health concerns they experience across the life span. Mannell and Kleiber (1997) note that there are two distinct types of need: physiological needs (biochemical imbalances such as thirst, hunger, or sleep) and psychological needs (autonomy, competence, and belongingness).

Optimal arousal theory has been used in conjunction with affect research to understand how the most relevant physiological need involves the drive to attain an individual’s desired level of stimulation (Walker, Scott, & Stodolska, 2016). Tsai and Coleman (2007) introduced the component of ideal affect and the state of when, how, and why it differed from actual affect to identify four types of ideal affective states. This theory argues that when people’s actual affect is significantly different than their ideal affect, they will engage in leisure activities that affect mood or modify life behaviors to minimize the discrepancy; this concept is similar to the linkages of the green mind theory. As such, optimal arousal theory can help inform tailored health interventions that focus on providing leisure outlets to realign an individual’s actual and ideal affect as it relates to specific psychophysiological health outcomes related to natural settings.
Psychological needs within leisure research has spurred a more robust line of inquiry that led to the creation of specific needs inventories that are satisfied by various leisure activities (e.g., Driver, Tinsley, & Manfredo, 1991; Tinsley, Barrett, & Kass, 1977). Leisure theory research on psychological needs has focused on identifying basic psychological needs, but also has addressed the question of when and how these basic needs are satisfied in a leisure setting. For example, leisure activities that lead to flow experiences (Csikszentmihalyi, 1990) can satisfy basic needs and provide an escape from the demands of trying to satisfy them. In addition to needs theory, leisure researchers as early as the 1970s began to identify frameworks that would define and explain what drives leisure behavior. Motivation theorists such as Neulinger (1974) and Deci and Ryan (1991) proposed that there are two types of motivation: intrinsic (doing a task for the sake of doing it) and extrinsic (doing a task for some form of reward). Later theories posited that there are several types of extrinsic motivation. Within health-focused research, empirical research in cognate areas such as physical activity successfully used Kleiber, Walker, and Mannell’s (2011) framework between basic needs and motivations.

The Self-Determination Theory (SDT; Deci & Ryan, 1987) offers a broad framework for studying motivation and personality. For instance, it has been used to examine how a school-based intervention impacted students’ leisure-time physical activity (Chatzisarantis & Hagger, 2009). In another leisure health context, SDT was used as a framework to understand how women’s participation in leisure-time physical activity influences their psychological well-being (Lloyd & Little, 2010). SDT explains how intrinsic and extrinsic forces produce behavior and explains how leisure behaviors are maintained over time, despite shifting constraints (Coleman & Iso-Ahola, 1993). Settings in which an individual’s autonomy, competence, and relatedness are unsupported within a social context can be detrimental to wellness. However, leisure-generated motivation within the SDT framework was connected to lower illness and stress. This
particular theory posits that while external environments influence decisions, people tend to participate in healthy leisure activities based on psychologically-based intrinsic motivations.

**Constraints and Negotiation.** Constraints have also been a foundational contribution to understanding the linkages between leisure and health. Defined as factors that are assumed, perceived, or experienced by individuals to limit the formation of leisure preferences, and/or inhibit or prohibit participation and enjoyment of leisure, constraints have been conceptualized in many ways. Intrapersonal constraints are psychological conditions, such as personality, attitudes, and self-efficacy, that are internal to an individual. Interpersonal constraints focus on the social ties and relationships with others. Structural constraints arise from external conditions of the environment, such as lack of opportunities or costs that can include policies as well. Constraints can manifest in various ways. For instance, an individuals’ socio-demographic characteristics are likely to create a higher probability of facing constraints to outdoor recreation when intersectionality of identity aspects (i.e., females of lower socioeconomic status) are present (Shores, Scott, & Floyd, 2007). Indeed, setting-dependent constraints impact the mental restoration of people during their visits to a wilderness park (von Lindern, 2015), suggesting that such constraints can limit direct attention restoration. Despite constraints, individuals continue to participate in leisure activities. Leisure negotiation strategies help individuals overcome constraints and are seen in higher numbers among individuals at a maintenance stage compared to an inactive stage (Wilhelm Stanis, Schneider, & Pereira, 2010). Higher motivation to participate in outdoor leisure activities is associated with the use of negotiation strategies to overcome constraints (White, 2008). As partnerships between leisure studies and public health have grown, comparative analyses have examined how personal, social, and environmental factors that influence physical activity have emerged in both fields. Findings suggest that many of the conclusions in leisure constraints and negotiation research mirror public health studies.
Mannell and Loucks-Atkinson (2005) noted that leisure constraints theory has evolved into a social cognitive theory; its unique contribution is a focus on identifying and classifying constraint categories, while health research has focused more on the operation of specific obstacles to narrowly defined behaviors.

**Leisure Settings and Health.** Frameworks have continued to be proposed and refined that help to explain the influence of parks, recreation, and leisure upon public health in an attempt to go beyond the leisure activity to better understand the influence of the leisure setting upon health. In 2005, Bedimo-Rung, Mowen, and Cohen proposed a conceptual model to connect parks and physical activity to public health. The proposed framework describes the antecedents and correlates of park use, examining the relationships between park benefits, park use, and physical activity. The environmental framework builds upon a classification scheme that highlights park environmental characteristics that could influence park-based physical activity. A growing body of knowledge has demonstrated that significant health benefits are derived from outdoor recreation (Breitenstein & Ewert, 1990; Godbey, 2009; Rosenberger, Bergerson, & Kline, 2009; Takeshima et al., 2002). Kaczynski and Henderson (2008) conducted a review of the evidence on the environmental correlates of physical activity to examine the role of park and recreation services in promoting health. They identified 50 primary articles in which a relationship between parks or recreation and physical activity was directly analyzed; all or most of the associations examined between parks/recreation and physical activity variables were positive. Studies comparing the impact of indoor versus outdoor exercise setting found that participants rated the outdoor setting as more restorative (Hug, Hartig, Hansmann, Seeland, & Hornung, 2009; Thompson Coon et al., 2011) and perceived exercise to be less demanding in the natural environment (Ceci & Hassmén, 1991; Gladwell, Brown, Wood, Sandercock, & Barton,
Additionally, participants who visit a favorite outdoor or natural space have increased positive psychological feelings and reduced stress (Korpela & Ylén, 2007).

Evidence of health benefits of physical activity has been a central theme of U.S. leisure research since the early 1990s. While health promotion and disease prevention traditionally were approached using epidemiologic approaches, investigations of physical activity require the consideration of personal and environmental influences. Paffenbarger, Hyde, and Dow (1991) argued that leisure research concerned with leisure-time activities requiring energy expenditure needed to recognize that physical activity is essential to health, and as such, should be addressed in the context of leisure settings. Epidemiological evidence as early as the 1970s showed that sedentary lifestyles were directly and causally related to the incidence of hypertensive-atherosclerotic diseases such as coronary heart disease and stroke (Paffenbarger et al., 1991). Research on the health of urban bus drivers since the 1950s found that sedentary lifestyle of the drivers lead to ill health affects in physical, psychological, and behavioral outcomes compared to active occupations, with greater mortality rates among the bus drivers (Tse, Flin, & Mearns, 2006). Epidemiological studies in the late 1970s and early 1980s concluded that exercise reduces blood glucose levels, increases the effectiveness of endogenous insulin, and was promising for decreasing the incidence or delayed development of noninsulin-dependent diabetes mellitus (Helmrich and Paffenbarger as cited by Paffenbarger et al., 1991). Reiner, Niermann, Jekauc, and Woll (2013), in a systematic review of longitudinal studies, found that among fifteen longitudinal studies with at least a five-year follow-up showed that physical activity had a positive long-term influence on the treatment of noncommunicable diseases, including coronary heart disease, Alzheimer’s disease, dementia, and type 2 diabetes mellitus.

Within leisure research, more studies have begun to examine how leisure-time physical activity and physical activity within leisure settings influence measurable health outcomes. Kuo
(2010), in a monograph published by the National Recreation and Park Association, discussed the relationship between nature and human health. It focused on the positive physical, psychological, and social effects derived from living among parks and green habitats, summarizing the evidence that leisure physical activity within a natural environment has positive health benefits. Godbey and Mowen (2010), in a monograph in the same series, examined the benefits of physical activity provided by park and recreation services, highlighting the value of public park and recreation departments in addressing poor health outcomes. Barton, Griffin, and Pretty (2012) examined health promotions in a clinical population and found that self-esteem and mood improved as a result of participating in a green exercise health initiative.

**Nature-based Leisure as a Clinical Health Intervention**

As nature exposure and green exercise has been shown to be beneficial for individual and community health (Niedermeier, Grafetstätter, Hartl, & Kopp, 2017), several ecotherapy and nature-based health interventions have evolved. For instance, surfing therapy has emerged as a successful intervention for U.S. Service members with combat-related trauma (Fleishmann et al., 2011), as it is shown to improve balance and decrease depression levels. Another similar program found that surfing lead to significant improvement in posttraumatic stress disorder symptoms and depression (Rogers, Mallinson, & Peppers, 2014). Green exercise programs in the United Kingdom have utilized activities such as walking, cycling, horse-riding, fishing, canal-boating, and conservation activities to promote good health through improved self-esteem and mood (Pretty et al., 2007). The use of green prescriptions (clinical prescriptions for engaging in recreation activities) in New Zealand has been found to effectively improve health for participants long term (2-3 years) by engaging in changes in physical activity levels (Hamlin, Yule, Elliot, Stoner, & Kathiravel, 2016).
One nature-based health behavior program is of particular interest to this dissertation: Park Prescriptions (Park Rx) programs. These programs “strived to increase the prescription of outdoor physical activity to prevent (or treat) health problems resulting from inactivity and poor diet” (ParkRx.org, 2016). Since 2013, a collaboration among the Institute at the Golden Gate and the National Recreation and Park Association (NRPA) with support from the National Park Service (NPS) has advocated the concept of Park Rx that has developed into a nationwide initiative (Park Rx 2018 Census, 2018). The Park Rx 2018 Census released by the Institute shows that at the end of 2018, more than 71 Park Rx programs were represented in 32 states, up from a recorded eight programs in 2010 (ParkRx 2018 Census, 2018). These programs are designed to intentionally link public lands and park programs to the medical community to increase nature exposure, and in turn, improve patient health outcomes. Although communities are generally positive about public investment in outdoor spaces and things like outdoor exercise equipment, the individuals who need it most are not using it (Sibson, Scherrer, & Ryan, 2018). This disconnect is one opportunity for Park Rx programs to facilitate increased use, and a clinical referral is one way to alleviate this disengagement.

The clinical rigor associated with these programs can be conceptualized as falling along a continuum from generalized advice for a patient to participate in outdoor activities (TRACK Rx, n.d.) to highly specialized patient-tailored clinical prescription programs (Razani et al., 2018). For example, there are several programs that offer “prescriptions,” such as the Montana Trails Rx which provides informational maps that outline “prescription” walking routes that can be distributed by healthcare providers to patients to encourage more nature-based physical activity through self-guided walks, neighborhood walking groups, or a buddy system to encourage healthy lifestyle choices (ParkRx.org, 2016). The Kids in Parks TRACK Rx focused on youth provides a brochure to providers that can be used to encourage kids to participate in activities
such as playing in their backyard or exploring a trail near home (TRACK Rx, n.d.). At the other end of the spectrum are nature-based physical activity prescriptions tailored by healthcare providers for their patients to match their interests, such as the Park Rx America initiatives that work with providers to prescribe parks to patients during routine care to address the burden of chronic disease and increase health (Park Rx America, 2018). Along that continuum, there is a growing list of cities across the United States that offer programs that vary from traditional recreation outdoor programs that are filled by participants referred by their healthcare provider, to more clinically-based programs focused on “dosage” that integrate the health behavior prescription into the patients’ routine care.

Despite increased interest in using Park Rx to help patients manage their chronic disease, physical inactivity, and poor mental health, Park Rx is a trend that the NPS, NRPA, and other national organizations promote based largely on little to no empirical evidence on the viability of these programs. Furthermore, there is almost no research that assesses the integration of Park Rx programs into a standardized clinical practice (despite more than 71 programs nationwide), and there is little evidence that directly measures the impact of the Park Rx prescriptions on patients’ health outcomes.

**Dissertation Organization and Objectives**

With growing evidence of the individual health benefits derived from both passive and active use of natural environments, Park Rx programs have gained popularity in the U.S. within the last several years as a health behavior intervention program that utilizes public parks to engage targeted patient populations in increased physical activity to improve health outcomes. Despite the promotion and adoption of Park Rx programs, there is no systematic evaluation and little evidence documenting their uptake, sustainability, or effectiveness for improving health outcomes. Fewer studies have examined the design, dissemination, and implementation of Park
Rx programs as a salutogenic, clinical approach. As a result, leisure and public health professionals lack essential information needed to strategically invest resources in the appropriate programs and facilities to achieve desired health behaviors and impacts expected from nature-based health intervention programs. This dissertation attempted to address these research gaps by examining Park Rx programs (nature-based physical activity prescriptions) as a clinical-community approach to healthcare through three papers that independently and collectively contribute to the Park Rx literature.

The first paper reports on a scoping literature review conducted to assess if patients of all ages experience positive health outcomes as a result of receiving a clinically-based Park Rx program from their healthcare provider. This was driven by three research questions:

**RQ 1.1:** What is the nature of the evidence that clinically-based Park Rx programs are improving patient health?

**RQ 1.2:** What methodological approaches are being used to assess Park Rx programs?

**RQ 1.3:** What future Park Rx research needs are of highest priority?

The second paper utilized a discrete-choice experiment that was used to identify the preferences of healthcare providers to understand which patient attributes are most impactful for providers’ likelihood to write nature-based physical activity prescriptions. This was driven by two research questions:

**RQ 2.1:** When do healthcare providers assign treatment of nature-based physical activity prescriptions?

**RQ 2.2:** What educational, clinical, and recreation resources are necessary to increase the willingness of providers to write a nature-based physical activity prescription?

The third paper used the insights provided by focus groups to guide the development of a controlled clinical protocol for a tailored park prescription program and to successfully integrate
that Park Rx program within the clinical workflow of Federally Qualified Health Centers in rural North Carolina. This was driven by two research objectives:

**RO 3.1:** Investigate the effectiveness of a park-based physical activity prescription intervention that utilizes eHealth tools (e.g., fitness trackers, SMS text messaging, and an electronic medical record integration provider web-based application) to increase time spent in moderate-to-vigorous physical activity as assessed by accelerometry.

**RO 3.2:** Investigate the interventions’ effectiveness for improving the participants’ objectively measured physical health; improving the participants’ self-reported mental wellbeing as measured by the PHQ-9; encouraging the participants’ adherence to their tailored prescription by engaging them in self-reporting texts and receipt of motivational SMS messages; and streamlining the participants’ enrollment into physical activity counseling through the use of a preferences survey in the web-based application that generates customizable prescriptions automatically for the providers.

This dissertation is organized into five chapters; the current chapter provides an overview introduction addressing the topic of nature and health through leisure experiences. Chapters two through four report on separate but related studies that examine the concept of Park Rx from a scientific perspective, from the healthcare provider’s viewpoint, and finally from a specific pilot study that looks at both patients and providers. The final fifth chapter provides a discussion of the overall findings of the research studies and its implications. This research contributes to three areas of understanding: 1) the state of Park Rx research, 2) the utility of patient attributes influencing providers’ likelihood of prescribing nature-based physical activity, and 3) a clinical protocol that streamlines the incorporation of Park Rx programs into the clinical workflow by utilizing several eHealth technologies.
REFERENCES


CHAPTER 2: A SCOPING LITERATURE REVIEW OF PARK PRESCRIPTION REFERRALS IN PRIMARY-CARE SETTINGS

Abstract

For more than 30 years, health care professionals have been called upon to encourage physical activity, and most recently to integrate physical activity counseling into a standardized clinical practice. This is in great part a response to the continued struggles of the United States healthcare system to address the growing impacts of non-communicable diseases such as diabetes mellitus, hypertension, and cardiovascular disease.

Innovative programs, such as the Exercise is Medicine movement launched in 2007, have integrated physical activity assessments into standard clinical care, with studies showing physical activity enhances psychological wellbeing and improves physical functioning. Yet increasingly studies are also finding that physical activity experiences in outdoor settings, or natural spaces, have mental and physical health benefits that go beyond that of just exercise, to include reduced stress, improved mood and cognitive functioning, and enhanced social capital.

Green exercise prescriptions were touted in a policy statement by the American Public Health Association in 2013, coinciding with the formation of intervention programs such as the National Park Rx Initiative in that same year. Park Prescriptions (Park Rx) engage health providers, public land agencies, and community partners in utilizing public land to improve health in individuals and communities. This study systematically reviews the evidence to determine if adults and children are having positive health outcomes when clinically-based Park Rx programs are used by healthcare providers.

To date, there has been no review of the structure of Park Rx programs or their impact when integrated into clinical care. A scoping literature review was conducted which yielded a total of 314 articles. After examining their relevance per the review parameters, a total of 10
articles were included. These 10 articles consisted of seven completed studies and three study protocol papers, and while it is clear that patients do receive mental and physical wellbeing benefits through nature-based physical activity prescriptions, it is unclear, however, exactly what key factors determine the success of clinically-based Park Rx programs. Future studies are needed to explore what key factors comprise a successful Park Rx program and define what is considered success at the individual and community level. This is needed prior to taking nature-based physical activity prescriptions and integrating them fully as a national roll-out of Park Rx community-clinical interventions.
Introduction

Annually in the U.S., an estimated $117 billion is spent on healthcare costs directly associated with inadequate physical activity (CDC, 2018). The U.S. healthcare system continues to struggle with the growing impacts of non-communicable diseases, spurring the need for innovative and sustainable approaches to healthcare. Physical activity has been shown to improve health by enhancing psychological wellbeing and by improving physical functioning. According to the Centers for Disease Control and Prevention, not only does physical activity protect an individual’s health, but regularly engaging in recommended amounts of physical activity can help prevent cases of type 2 diabetes, heart disease, and some forms of cancer. Highlighted in the 2018 Physical Activity Guidelines for Americans, physical activity produces brain health benefits, including improved cognitive function, reduced anxiety and depression risk, and improved sleep and quality of life (Piercy et al., 2018). Despite the health benefits of physical activity, approximately 80% of U.S. adults and adolescents are insufficiently active and there remains a need to understand what works to increase physical activity at both the individual and community level (Piercy et al., 2018).

Physical Activity Prescriptions in Healthcare

The concept of health through exercise has been persistent in the literature, with calls advocating for health care professionals to encourage physical activity occurring for more than 30 years (Morris & Collins, 1992). More recently, researchers have called for further integration of physical activity counseling into a standardized clinical practice (Berra, Rippe, & Manson, 2015; Harrabi & Al Ghamdi, 2014; James et al., 2017; Thornton et al., 2016), while a recent review found that physical activity is underutilized in primary care despite the accumulating evidence (Crump, Sundquist, Sundquist, & Winkleby, 2019). Healthcare providers have previously shown a willingness to incorporate physical activity counseling programs into clinical
care. One such program based in the United States is the Exercise is Medicine movement, co-launched in 2007 by the American College of Sports Medicine and the American Medical Association (Sallis, 2009). The focus of the Exercise is Medicine program was to integrate physical activity assessments into standard clinical care, where healthcare providers assess a patient’s physical activity level and provide brief counseling advice to encourage the patient to meet the National Physical Activity Guidelines, as well as refer the patient to healthcare or community resources for further physical activity counseling and support. Indeed, the prescription guidelines from Exercise is Medicine have been shown to increase exercise prescription frequency and quality among healthcare providers (Leavitt, 2017).

While there are promising findings related to the effectiveness of Exercise is Medicine interventions aimed at promoting physical activity within a primary health care setting, one review found that the translation of these interventions into healthcare practice is not always successful (Huijg et al., 2015), noting the lack of evidence regarding physical activity promotion determinants. Another review found a lack of high-quality studies to evaluate sustainability of exercise on prescription schemes for general practice (Sørensen, Skovgaard, & Puggaard, 2006). However, further examination of physical activity intervention programs within a medical setting, such as exercise on prescription (e.g., initiating physical activity among sedentary primary care patients), shows evidence that the programs can lead to increased physical activity. A more recent review of the effectiveness of physical activity promotion in primary care found that self-reported measures show increases in physical activity at 12 months when the participant is recruited through primary care (Orrow, Kinmonth, Sanderson, & Sutton, 2012). An assessment of eight randomized controlled trials (RCTs) comparing exercise referral schemes found that the programs did increase physical activity (Pavey et al., 2011). A systematic review of RCTs physical activity behavior promotion interventions with a mean sample age of 55 to 70 years.
found that interventions in adults led to long-term improvements in physical activity at 12 months (Hobbs et al., 2013). This finding mirrored an earlier review that found both weekly energy expenditure and physical fitness were improved through physical activity interventions (Müller-Riemenschneider, Reinhold, Nocon, & Willich, 2008). Therefore, not only can interventions to increase physical activity in primary care settings successfully increase patient physical activity levels, they are inexpensive compared to traditional care approaches (Vijay, Wilson, Suhrcke, Hardeman, & Sutton, 2016). Although these studies showed that interventions could promote increased adult physical activity, they were assessed in either an indoor or general setting. No literature review, to date, has assessed the outcomes of RCTs physical activity through a formal physician prescription in an outdoor or natural setting.

**Health Benefits of Green Exercise**

Increasingly, studies are finding that experiencing outdoor settings, or natural spaces, has positive impacts on physiological and psychological outcomes (Haluza, Schönbauer, & Cervinka, 2014). Recent studies have identified the diverse health benefits derived from active and passive use of parks and green spaces. Contact with natural outdoor environments has been linked to better mental health (Triguero-Mas et al. 2015) and lower levels of negative emotions and anxiety (Song, Ikei, Igarashi, Takagaki, & Miyazaki, 2015). Higher amounts of green space in a neighborhood have been connected to lower levels of perceived stress (Ward Thompson, Aspinall, Roe, Robertson, & Miller, 2016) while public green spaces, such as national parks, have been shown to encourage and motivate people to exercise regularly (Wolf & Wohlfart, 2014). Pretty, Peacock, Sellens, and Griffin (2005) found that green exercise was more effective than exercise in a non-natural environment for improving cardiovascular and mental health. Active walks through a park setting have also been tied to health benefits such as lower heart rates (Song et al., 2015). The biophilic influence of natural outdoor environments has been found
to positively affect physical mobility in Parkinson’s Disease patients (Ottosen, Lavesson, Pinzke, & Grahn, 2015).

The mental and physical health benefits of green exercise go beyond that of just exercise. Living in highly green spaces can have positive impacts on health and wellbeing outcomes (de Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003) and may be important for reducing health inequalities (Mitchell & Popham, 2008). Rapidly accumulating evidence suggests public parks and recreation facilities hold promise for increasing physical activity and preventing and treating various health conditions such as type 2 diabetes, hypertension, and cardiovascular disease (Costigan, Veitch, Crawford, Carver, & Timperio, 2017; Flowers, Freeman, & Gladwell, 2016; van den Bosch & Ode Sang, 2017). Use of parks have also been associated with reduced stress, improved mood and cognitive functioning, and enhanced social capital (Roe et al., 2013; Van den Berg, Maas, Verheij, & Groenewegen, 2010).

Growing awareness among public health and park agencies of these benefits have contributed to greater use of parks as settings for interventions targeting inactivity, obesity, and associated conditions. Abraham, Sommerhalder, and Abel (2010) advocated the use of a heuristic framework on the health-promoting impact of landscape to illustrate the ways in which landscape promotes mental, physical, and social wellbeing. Landscape, they argued, can “be imagined as a continuum between ‘wild nature and the designed environment such as urban and rural forests, green spaces, parks, gardens, water, and neighborhood areas’” (pg. 59). There is growing evidence that contact with nature and physical activity in nature can have a positive impact on human health.

Although the health benefits exist in terms of physiological and psychological as described above, access to nature spaces is disproportionate; certain groups have less access to these spaces and the benefits they afford (e.g., Gaither, 2011; Wolch, Wilson, & Fehrenbach,
However, research has shown that green spaces and parks have the potential to address health inequities within local communities (Gladwell, Brown, Wood, Sandercock, & Barton, 2013; Jennings & Gaither, 2015; Jennings, Larson, & Larson, 2016; Shanahan et al., 2015). Urban nature parks have been shown to contribute to neighborhood social health (Baur, Gómez, & Tynon, 2013). A Montreal-based study of immigrant youth and families in the context of green exercise suggests that active use of urban green spaces can act as a buffer to the stress of housing insecurities while reducing emotional stress (Hordyk, Hanley, & Richard, 2015). The presence of greenery in an urban setting has also been shown to result in lower levels of fear, fewer incivilities, and less aggressive and violent behaviors (Kuo & Sullivan, 2001). Green exercise can also positively impact rural communities as well, acting as a practical health platform (Garrin, 2015). While not all communities are positioned to offer wilderness experiences or introduce large comprehensive park systems, research shows that even small, low-cost approaches such as greening vacant lots (South, Hohl, Kondo, MacDonald, & Branas, 2018) can lower feelings of depression in a community, and outdoor walking groups in nature have been shown to significantly improve health (Marselle, Irvine, & Warber, 2014).

**Park Prescriptions as an Emerging Program**

With the continued growth of evidence to support the value of green exercise, it appears that such interventions will become more routinely integrated into daily healthcare encounters (Van den Berg, 2017). In 2013, the American Public Health Association released a policy statement advocating

public health officials, physicians, nurse practitioners, and other health professionals should advise patients and the public at large about the benefits of green exercise, personal and community gardening, and nature-based play and recreation and form alliances with parks departments, departments of planning and design, area aging
agencies, greening and garden organizations, cooperative extension services, school
districts, and nature centers to increase access to green spaces where people live, work,
and play and to raise awareness about their value (pg. 4).

This policy statement, as Van den Berg suggested, calls for the development and growth of
healthcare provider green exercise prescriptions. Park Prescriptions (Park Rx) are one
intervention approach that could be used to strategically invest human and financial resources
into appropriate clinical approaches to achieve desired health impacts for non-communicable
diseases through green exercise. The National Physical Activity Plan (2016) under strategy one
calls for communities to work with public health and medical communities to promote evidence-
based or evidence-informed Park Rx programs.

Park Rx programs have gained popularity in the U.S. within the last several years as a
health program that utilizes public parks to engage health providers, public land agencies, and
various community partners to improve health at the individual and community level through
increased physical activity. The Park Rx movement gained popular traction in 2013 when the
Institute at the Golden Gate, the National Recreation and Park Association, and the National Park
Service collectively created the National Park Rx Initiative (Park Rx, 2016). Park Rx programs
continue to be featured in popular media outlets (e.g., Washington Post, National Geographic
Magazine), and professional health care related publications (American Academy of Pediatrics,
2017; Humana, 2016; National Physical Activity Plan Alliance, 2016; Root, 2017; Sellers,
2015). Healthcare providers across the U.S. have begun prescribing parks to improve health
(Melamed, 2017; Seltenrich, 2015). Non-profit organizations, such as Park Rx America, offer
how-to guides and resources for healthcare providers to begin prescribing nature to their patients.
Park Rx America’s leaderboard shows that since April 2018 more than 150 health professionals
have joined the Park Rx America network to prescribe nature to patients (Park Rx America,
2018). However, despite the growth in popularity and integration of Park Rx into clinical care, to date, there has been no review of the structure of these programs, the impact of the programs, or calls for further examination.

**Study Purpose**

The principal objective of this study is to conduct a scoping review of peer-reviewed scientific evidence in order to assess the effectiveness of healthcare provider use of Park Rx or referrals to Park Rx programs to improve health outcomes in adults and children. This review seeks to answer three research questions. First, what is the nature of the evidence that clinically-based Park Rx programs are improving patient health? Second, what methodological approaches are being used to assess Park Rx programs? And third, what future Park Rx research needs are of highest priority?

There is no standardized use of the phrase “Park Rx” across the literature. Therefore, for the purpose of this review, Park Prescriptions (Park Rx) were defined as the use of natural outdoor environments such as parks, green spaces, or blue spaces to improve health and wellness among individuals through a formal prescription or referral by a health care provider. Furthermore, to date, there is no consensus in the literature as to what type of intervention constitutes a Park Rx. Thus, study interventions in which a healthcare provider prescribes nature-based spaces to patients to improve health outcomes will be classified as a Park Rx in this review and may include intervention programs such as Ecotherapy, Nature Therapy, Nature Prescriptions, Green Prescriptions, Walking in Nature, or Outdoor Exercise referral programs.

**Methods**

A scoping literature review was undertaken to identify studies of healthcare provider prescribed Park Rx (nature-based physical activity) patient health behavior interventions for mental and/or physical health.
Article Selection

A comprehensive search strategy was designed in collaboration with a research librarian. The search strategy included a search of four electronic databases: Web of Science, CAB Abstracts, PubMed, and PsychINFO. The search conducted in these four databases was for articles published between January 1998 and November 2018. These databases were chosen due to an affiliation with the topical subject of physical activity and clinical referral programs. The search was delimited to this 10-year period based on an initial search. Few articles around Park Rx programs were published prior to 1998. Those early publications were often focused on Exercise is Medicines studies, which promote physical activity prescriptions, but do not specify nature-based activity. As such, the 10-year period was selected a priori to exclude the early EIM studies from the search pool. A search for Subject Terms (SU) and the matching following keywords and Boolean operators consisted of:

(park AND prescription*)
(green AND prescription*)
(nature AND prescription*)
(exercise referral scheme* AND nature)
(exercise referral scheme* AND outdoor)
(physical activity prescription* AND nature)
(physical activity prescription* AND outdoor)
(green exercise AND healthcare OR health care)
(nature therapy)

The use of the asterisks (*) helped to pull variations of the affiliated root word. In instances where SU was not supported, such as with the Web of Science database, keywords were searched under TOPIC.
Eligibility Criteria. Studies were included if they met the following criteria:

i) Type of study— All descriptive and intervention studies including randomized controlled trials (RCTs), pre-post design, quasi-experimental, and case studies based in a healthcare setting were included. Eligible studies had to contain a patient referral or prescription for physical activity in an outdoor, nature-based setting from a healthcare provider. The definition of a healthcare provider was inclusive of varying healthcare professionals including Pediatricians, General Practitioners, and Therapists. The key criteria around defining a healthcare provider was conceptualized as a healthcare provider who directly addresses patient health and provides prescriptions for treatment and/or prevention.

ii) Type of intervention— The purpose of the prescription intervention must be focused on improving mental and/or physical wellbeing through increased nature-based physical activity. Interventions aimed at improving physical activity levels, fitness levels, or health outcomes (or a combination of the three) at the individual level were included in the review. Therefore, interventions structured to positively influence health outcomes through prescribed physical activity within nature were included. Studies were included if the prescription intervention was the primary focus of the study; if the study examined multifactorial interventions (e.g., promoting dietary modifications in addition to physical activity) they were excluded from review.

iii) Intervention setting— The referral or prescription for physical activity had to be specified as nature-based to be included in the review. A Park Prescription was defined as one in which the patient was engaged outdoors where elements of fauna and flora were present, in varying degrees of naturalness from urban parks to countryside natural landscapes. For example, Green Prescription studies from New Zealand were excluded from this review due to the fact that “Green Prescription” refers to a healthcare provider referral to
physical activity in either outdoor or indoor settings. There is no differentiation in these studies between the impact of outdoor versus indoor participation; these studies are more closely aligned with the EIM literature.

iv) Study populations—Children (0-18 years), Adults (19-59) and Seniors (60+) were included study populations. Study populations that were targeted or selected on the basis of pre-existing disease conditions (e.g., diabetes, severe mental health, depression) were also included.

v) Type of Outcome—Measure of prescription impact on the patients’ health was required. This included specific physiological, psychological, or behavioral changes correlated with the engagement in the nature-based physical activity. It also includes qualitative assessment of changes in perception or willingness to engage with the prescription, and perceived health improvements.

vi) Language Restrictions—Only articles available in English were included.

vii) Text Availability—Full-text articles had to be available through the academic institution’s library system.

**Search Strategy Methods**

The search in fall 2018 returned 314 articles (Web of Science n=217; CAB Abstracts n=26; PubMed n=57; and PsycINFO n=14) focused on park-based or green prescriptions between January 1998 and November 2018. The titles and abstracts of the identified articles were screened against the eligibility criteria (Figure 2.1). Duplicate publications were removed. Further screening eliminated articles with no relevance to the topic, that were conducted outside of a defined healthcare setting (e.g., primary care, mental health centers, community care centers), and that focused on interventions that did not qualify as outdoor-based. A Google search engine query was used to identify studies published in non-indexed journals. A total of 17
articles underwent a full-text assessment. References of retrieved articles and recent reviews on the promotion of physical activity were examined manually after reviewing the title and abstracts to identify any other pertinent studies. The screening process resulted in a final database of seven study articles and three study protocols for a total of 10 reviewed articles.

Figure 2.1. PRISMA flow diagram of study selection.

**Data Extraction and Analysis.** The articles were read by the lead author and coded for basic publication information, sample characteristics, and the intervention study design. Studies were categorized according to the main approach of the intervention: 1) a generic unstructured physical activity prescription; 2) a generic structured physical activity program referral; 3)
tailored physical activity prescription. A generic prescription is conceptualized as a referral for
the patient to engage in more physical activity outside, without determining the specifics of the
frequency, duration, activity intensity, and activity based on the patient’s preferences. For
example, the patient might be told to go run at the park more often or join structured weekend
outings with fellow patients. Conversely, a personalized physical activity prescription, also
known as tailored prescriptions, build upon the patient’s preferences to identify the activity,
location, frequency, intensity, and duration of the prescription unique to each patient.
Unstructured prescriptions refer to a referral to a self-guided activity that is not contingent upon
a formal group program. Structured prescriptions therefore, are referrals to a pre-structured
formal program that is offered at a specific time and place with a program leader and/or
predefined group structure (e.g., guided nature walks, park-based tai chi class). Key
characteristics and outcomes of the studies were extracted and organized by study location, study
design, study methodology, sampling strategies, target intervention population, specific
demographic information on target intervention population, intervention setting, mode of
physician prescription, control group present, length of intervention/prescription, key measured
outcomes, measurement instruments, primary health outcome, stated success of the program, and
ranking of the strength of the evidence.

Results

This scoping review yielded a total of 10 articles: seven completed studies and three
study protocol papers. Research in the area of healthcare provider-initiated Park Rx programs
that meet our inclusion criteria has emerged from 2012 onwards. The majority of research has
come from the United States (n=7) with additional research originating in Austria (n=1),
Singapore (n=1), and the United Kingdom (n=1). Seven of the studies were classified as quasi-
experimental. Two of the studies were experimental and one article utilized a descriptive
nonrandomized study design. A further investigation into the study methodology of these articles revealed that five articles utilized a pilot study design, two were randomized control trials, two used a pre-post survey design, and one used a case study field report approach (Table 2.1).
Table 2.1. Summary of research studies included in the scoping review.

<table>
<thead>
<tr>
<th>Article Title</th>
<th>Author(s) &amp; Year</th>
<th>Journal Title</th>
<th>Study Location</th>
<th>Study Design</th>
<th>Study Methodology</th>
<th>Sampling Strategies</th>
<th>Target Intervention Population</th>
<th>Specific Demographic Information on Target Intervention Population</th>
<th>Intervention Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise, nature and socially interactive-based initiatives improve mood and self-esteem in the clinical population.</td>
<td>Burton, Griffin &amp; Petty 2012</td>
<td>Perspectives in Public Health, UK</td>
<td>Quasi-experimental</td>
<td>Pre-post Survey</td>
<td>Random Selection</td>
<td>Clinical Population (n=55) with mental health problems</td>
<td>Gender: Adults (21-63 yrs)</td>
<td>Mental Health Center</td>
<td></td>
</tr>
<tr>
<td>When pediatric primary care providers prescribe nature engagement at a state park, do children &quot;VIP&quot; for prescriptions?</td>
<td>Cope &amp; Ganderer 2014</td>
<td>European Journal of Paediatrics</td>
<td>Quasi-experimental</td>
<td>Pilot Study</td>
<td>Non-randomized Convenience Sampling and Non-randomized for PCPs; Purposive for Parents</td>
<td>Children ages 9-14 (n=1,93) written Rx</td>
<td>Rural State in the NW</td>
<td>Pediatric Offices</td>
<td></td>
</tr>
<tr>
<td>Acute effects of outdoor physical activity on affect and psychological well-being in depressed patients—A preliminary study.</td>
<td>Freidland, Nienaar, Elliott, Lededowski, Morkstein, &amp; Kopp 2016</td>
<td>Anxiety Care</td>
<td>Quasi-experimental</td>
<td>Pilot Study, Within-subjects experiment during two periods</td>
<td>Purposive Sampling</td>
<td>Adult Patients (n=10) with clinical depression</td>
<td>Depression</td>
<td>Mental Health Center</td>
<td></td>
</tr>
<tr>
<td>Prescribing Physical Activity in Parks to Improve Health and Wellness: Protocol of the Park Prescription Randomized Controlled Trial</td>
<td>Miller, Sitz, Bennett, Fiallo, &amp; Johnson 2018</td>
<td>International Journal of Environmental Research and Public Health, Singapore</td>
<td>Experimental</td>
<td>Randomized Controlled Trial</td>
<td>Randomized</td>
<td>Singapore Adults ages 40-65</td>
<td>N/A reported</td>
<td>Community Health Screenings (Hospital and DUSC Cohort Study)</td>
<td></td>
</tr>
<tr>
<td>Healing through nature: a park-based intervention for young people in Oakland, CA.</td>
<td>Rambach, Mandel, &amp; Long 2015</td>
<td>Children, Youth and Environments, Oakland California</td>
<td>Descriptive Non-randomized</td>
<td>Field Report</td>
<td>Purposive Sampling</td>
<td>Children ages 0-18 eligible</td>
<td>Low-income, Urban, Spanish speaking, Recent Immigrant Families, Housing insecure, Families of Color</td>
<td>Primary Care Clinic</td>
<td></td>
</tr>
<tr>
<td>Effect of park prescriptions with and without group visits to parks on stress reduction in low-income parents: SHINE randomized trial</td>
<td>Rambach, Mandel, Kohn, Wills, Thompson, Alescani, &amp; Rutherford 2018</td>
<td>Oakland California</td>
<td>Experimental</td>
<td>Randomized Trial</td>
<td>Blanket Randomized Sampling</td>
<td>Parents of children ages 4-18 (n=78)</td>
<td>Low-income Urban Families, Parents: gender, SES, race/ethnicity, education level, primary language, county of birth</td>
<td>Primary Care Clinic that is a Federally Qualified Health Center</td>
<td></td>
</tr>
<tr>
<td>Park Prescription (DC Park Rx): A new strategy to combat chronic disease in children</td>
<td>Zin, Cottrell &amp; Merrill 2017</td>
<td>Journal of Physical Activity and Health, Washington DC</td>
<td>Quasi-experimental</td>
<td>Pre-post survey</td>
<td>Convenience Sampling</td>
<td>Parents of children (n=225 families)</td>
<td>Demographics for children within City Health Care: 72% African American; 17% Hispanic; Low-income (91% below poverty line)</td>
<td>Pediatric Office in Community Health Center</td>
<td></td>
</tr>
<tr>
<td>Mode of Physician Prescription</td>
<td>Type of Prescription: Generic vs Personalized, Structured vs Unstructured</td>
<td>Control Group Present? Yes/No</td>
<td>Length of Intervention/Presentation</td>
<td>Key Measured Outcomes</td>
<td>Measurement Instruments</td>
<td>Primary Health Outcome: Mental vs Physical Wellbeing</td>
<td>Stated Success of the Program</td>
<td>Reviewer Ranking of Evidence (Strong, Emerging, Inconclusive)</td>
<td></td>
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<tr>
<td>Self-selection into one of three health promotion initiative groups (not specified)</td>
<td>Generic; Structured</td>
<td>Yes: Social Club (social component) &amp; Swimming Group (exercise and social components)</td>
<td>6 weeks</td>
<td>Activity levels; Self-Esteem; Mood</td>
<td>Questionnaire; Rosenberg-Self-Esteem Scale; 10-item short POMS; Total Mood Disturbance Score</td>
<td>Mental</td>
<td>Green Exercise change in self-esteem significantly greater than in social activity. Total mood significant improvement</td>
<td>Emerging</td>
<td></td>
</tr>
<tr>
<td>Verbal &amp; Written Rx along with support materials</td>
<td>Generic; Unstructured</td>
<td>Yes: No intervention</td>
<td>3 months</td>
<td>Children’s PA and Outdoor PA: Sedentary Behaviors; Child Time Spent Outdoors</td>
<td>YRBSS, LTPQ; Modified Questions for Outdoor Time &amp; Sedentary Behavior</td>
<td>Physical</td>
<td>No increased PA and time spent outdoors compared to control</td>
<td>Inconclusive</td>
<td></td>
</tr>
<tr>
<td>Written Rx along with brochure with map of park locations</td>
<td>Generic; Unstructured</td>
<td>No</td>
<td>1 state park visit over a 15-week study period</td>
<td>Redeemed Entrance Pass; Time in Nature</td>
<td>PCP completed NR scale and short survey</td>
<td>Not specified</td>
<td>Little evidence on how it impacted child PA or health; Only 13% of Park Rx were redeemed</td>
<td>Inconclusive</td>
<td></td>
</tr>
<tr>
<td>Prescribed (not specified) as part of in-patient treatment</td>
<td>Generic; Structured</td>
<td>Yes: Sedentary Control Condition; Indoor PA Condition</td>
<td>60 min session in each of the 3 conditions</td>
<td>Self-reported excitement; Perceived Activity; Affective Valence; Mood; Exercise Intensity</td>
<td>Mood Survey Scale; Feeding Scale; Felt Arousal Scale; RPE Scale</td>
<td>Mental</td>
<td>Outdoor PA needed in higher perceived activity and lower excitement. Greater effective benefits</td>
<td>Emerging</td>
<td></td>
</tr>
<tr>
<td>Written Rx along with support materials</td>
<td>Generic; Structured &amp; Unstructured</td>
<td>No</td>
<td>Not specified</td>
<td>PCP completed survey</td>
<td>Study Survey</td>
<td>Physical</td>
<td>Feasible to implement outdoor Rx programs</td>
<td>DESIGN &amp; IMPLEMENTATION PAPER</td>
<td></td>
</tr>
<tr>
<td>Written &amp; Online registration along with support materials</td>
<td>Generic; Structured &amp; Semi-Structured</td>
<td>No</td>
<td>6 months</td>
<td>BMI; Blood Pressure; Fitness; Nutrition; Knowledge</td>
<td>MDPROS Parks Rx 4Health Software; Rosenberg Self Esteem Scale; Social Anxiety for Adolescents</td>
<td>Mental/Physical</td>
<td>IN TRIAL</td>
<td>PROTOCOL PAPER</td>
<td></td>
</tr>
<tr>
<td>Verbal &amp; Written Rx along with support materials</td>
<td>Personalized; Structured</td>
<td>Yes: Standard PA promotion materials to Park Rx or programming</td>
<td>6 months</td>
<td>Time Spent in MVPA; Time in parks; PA time in parks; LTPA; Mental Wellbeing; Physical Health</td>
<td>Accelerometer; GPAQ; IPAQ; SF-12; K10; WHIS; WHODL; BREF; BMI; Blood Pressure; Blood Pressure; Self-Administered Questionnaire</td>
<td>Mental/Physical</td>
<td>IN TRIAL</td>
<td>PROTOCOL PAPER</td>
<td></td>
</tr>
<tr>
<td>Referral (not specified) to outdoor program</td>
<td>Generic; Structured</td>
<td>No</td>
<td>Ongoing Monthly Program</td>
<td>Stress Allocation; Nature Deficiency</td>
<td>Observational Data</td>
<td>Mental/Physical</td>
<td>Anecdotal</td>
<td>Inconclusive</td>
<td></td>
</tr>
<tr>
<td>Prescriptions (not specified) given physician counseling and support materials</td>
<td>Generic; Structured &amp; Unstructured</td>
<td>Yes: Supported Park Rx Group compared to Independent Park Rx Group</td>
<td>3 months</td>
<td>Stress; Park visits per week; Loneliness; PA; Physiologic stress (systolic cardiac); Nature affinity</td>
<td>40-pt Perceived Stress Scale; Modified UCLA-Loneliness Scale; Self reported PA; Polometer; Salivary Cortisol</td>
<td>Mental/Physical</td>
<td>Significant decrease in stress. Improvement in park visits, loneliness, PA, physiologic stress, nature affinity.</td>
<td>Emerging</td>
<td></td>
</tr>
<tr>
<td>Written Rx along with support materials</td>
<td>Personalized; Unstructured</td>
<td>No</td>
<td>3 months</td>
<td>Park Visitation; Physical Activity Levels</td>
<td>Study Survey</td>
<td>Physical</td>
<td>Increase in reported park visits. Increase in parents belief PA affected child health. Average weekly PA increased and number of days/month spent in a park for &gt;30 mins increased.</td>
<td>Inconclusive</td>
<td></td>
</tr>
</tbody>
</table>
Study Designs

Since nine of the 10 articles were empirical studies, it is interesting to assess what sampling strategies were employed. The majority of samples were collected through purposive sampling strategies (n=4), followed by random selection strategies (n=3), and convenience sampling (n=3). Perhaps due to the nature of engaging patients in a clinical setting, the majority of studies relied upon convenience and purposive sampling for the implementation of these Park Rx intervention studies. Sample sizes across the studies ranged from 14 to 1,935; the included case study did not report a total sample size. There are some unique anomalies within the reported sample sizes. One study clearly reported the sample of physician participants (n=24) and reported that 1,935 Park Rx were written for children, but it was not clear if each prescription was to a unique patient. Furthermore, one study reported that 225 families participated in the study but did not clarify how many unique child participants were represented within those families.

Target Populations

An assessment of who these Park Rx interventions targeted shows that overwhelmingly populations were either only children (n=6) or combination child/parent dyads (n=1) while few studies (n=3) focused on adult populations. Further examination of the child focused studies reveals a range of ages termed “child” to indicate participants anywhere from birth to 18 years of age. Two studies included the majority of both child and teen years, while three studies included only the pre-teenage years, and one study included youth 6-14 years old. None of the included studies specifically focused on senior populations, although one study did include adult participants ranging from 21 to 83 years.

Population demographics were not consistently reported across the articles. Studies focused on adult populations as the targeted intervention group gave the least specific
demographic information. Of the three studies, only one study reported gender and age demographics. The other two studies gave no specific participant demographic information. Among the seven articles focused on youth and/or youth and their families, four studies gave broad demographics for either the surrounding community or the typical demographics of the broader clinical population but did not disclose actual demographics for the study population. One study listed gender, race/ethnicity, socioeconomic status, primary language, country of birth, and education level for the parents of participants, but did not specifically list the demographics of the children included in the intervention. Another study used a similar approach, breaking down the demographics between parents (race/ethnicity, body mass index, education level, socioeconomic status, and marital status) and children (gender, race/ethnicity, and body mass index). One study did not give any demographics for the targeted youth population, although the study design employed in this study did not specifically track individual patients. Rather, it tracked the number of prescriptions given.

**Intervention Designs**

A range of clinical settings were used in patient recruitment. Four studies recruited out of pediatrician offices, two studies were conducted within mental health clinics, two articles recruited out of primary care clinics, and two studies were focused on patients of community health centers. Within these clinical settings, intervention patients received their Park Rx using both a verbal and written approach to prescribing the physical activity. In four studies, patients received a written Park Rx. A verbal and written prescription was used in two of the studies. Four of the studies did not specify if the prescription was verbal or written. However, seven of the ten studies went beyond just giving the Park Rx and included support materials such as brochures, maps, handouts, and support messages.

Patients enrolled in the Park Rx interventions were provided with one of four main types
of prescriptions: generic unstructured prescriptions (n=4), generic structured prescriptions (n=6), personalized unstructured prescriptions (n=1), and personalized structured prescriptions (n=1). One study compared between generic unstructured and generic structured prescriptions (Razani et al., 2018). In half of the studies (n=5), a control group was used to compare findings with the intervention group. Two studies used an indoor exercise group and a sedentary group as controls for the Park Rx participants. One study used a standard physical activity promotion approach but did not give a formal Park Rx as the control. Another study used a generic unstructured prescription group (independent use of a park) to compare the findings to the supported generic structured prescription (supported Park Rx group). One study used a non-intervention control group (regular treatment, no Park Rx) to see if there were any significant health benefits from receiving the Park Rx.

The interventions across the studies were also characterized by the length of the prescription or intervention. The length of the prescription interventions varied from three 60-minute sessions up to a six-month timeframe and seemed to be influenced as to whether the primary outcome of the study was mental, physical, or both. Studies with a primary focus on mental wellbeing consisted of the shortest intervention durations. Frühauf, Niedermeier, Elliott, Ledochowski, Marksteiner, and Kopp (2016) utilized a within-subjects experimental study design in which participants experienced three 60-minute sessions. Each session was one hour in each intervention group (sedentary control group, indoor physical activity control group, and outdoor physical activity intervention group). Similarly, Barton, Griffin, and Pretty (2012) used randomized selection to assign participants into the green exercise group that consisted of either six 45-minute walks in nature, the indoor swimming club, or the social club.

The Park Rx interventions with a primary focus on physical wellbeing (n=3) were typically structured as either a three-month intervention (Christiana, Battista, James, & Bergman,
or did not specify how long the youth participants were enrolled into weekly generic structured Park Rx programs (James, Hess, Perkins, Taveras, & Scirica, 2017).

Four studies were classified as having a primary focus on both mental and physical wellbeing. Two studies utilized a six-month timeframe (Messiah et al., 2016; Müller-Riemenschneider et al., 2018). One study conducted the intervention on a three-month timeframe (Razani, et al., 2018). The case study field report by Razani, Meade, Schudel, Johnson, and Long (2015) did not specify the average program engagement by families or articulate if there was a minimum session requirement; rather it simply reported the intervention as an ongoing monthly program. One study (Coffey & Gauderer, 2016) did not specify a primary outcome other than measuring time in nature. This study used a 15-week intervention period in which one outing to a park was measured per patient.

**Outcome Findings**

All nine of the empirical studies used a number of validated survey instruments (e.g., Rosenberg Self-Esteem Scale and Mood Survey Scale) and self-reported data to collect information regarding: physical activity levels, self-esteem, mood, time spent outdoors, stress, park visits per week, loneliness, nature affinity, and attitudes towards physical activity. Only three articles used non-survey related measurements to capture biometric related data activity levels. Razani et al. (2018) used a pedometer to capture physical activity levels and salivary cortisol measures to assess physiologic stress. Messiah et al., 2016 incorporated body mass index and blood pressure measures from the clinic into their assessment of the intervention. Müller-Riemenschneider et al. (2018) also include measures from accelerometers, body mass index, blood samples, and blood pressure to validate the impact of the intervention. One empirical study calculated the compliance rate of Park Rx and did not report specific health outcomes (Coffey &
Gauderer, 2016). The descriptive study provided observational data looking at stress alleviation and nature deficiency.

Mental health behaviors were a primary outcome in two of the studies. The mental health studies showed positive effects for adults with depression and mental health problem. Sessions where adult patients engaged in green exercise led to improved mood, valence, and activation (Frühauf et al., 2016), and showed greater improvement compared to sedentary and indoor physical activity sessions. Another study showed green exercise led to positive changes in self-esteem (Barton et al., 2012) that was significantly greater than in existing social activity sessions. The authors concluded that green exercise is equally effective as the existing social and indoor physical activity options.

Changes in physical activity behaviors were a primary outcome in three of the studies (Christiana et al., 2017a; James, Hess, Perkins, Tavera, & Scirica, 2017; Zarr et al., 2017). There is no consensus among these studies to conclusively show Park Rx significantly increases physical activity among children. Youth given a generic unstructured Park Rx showed no significant difference in physical activity levels compared to a control group (Christiana et al., 2017a), while in a similar study, youth referrals to generic unstructured Park Rx showed an increase of physical activity levels, resulting in an increase of reported park visits, an increase of weekly PA, and an increase in the number of days per month spent in a park for 30 or more minutes (Zarr et al., 2017). The third article was a protocol paper and does not provide evidence to the outcome success of Park Rx on physical activity levels but does provide evidence that such intervention programs can successfully be integrated into primary care settings. A fourth study by Coffey and Gauderer (2016) focused on time in nature as the primary outcome. The study provided little evidence on whether or not individual health outcomes were impacted by the intervention. The study did provide evidence that compliance rates among youth were quite low.
(13% of Park Rx were redeemed within the 15-week study period).

Four studies focused primarily on mental and physical wellbeing. However, two of those articles are study protocols and the third is the case study field report. The one clinical study found that family dyads given either an unstructured Park Rx or structured Park Rx showed an increase in park visits and time spent in moderate physical activity per week (Razani et al., 2018). Both groups also showed that engagement in a Park Rx lead to a significant decrease in stress and an improvement in nature affinity. While the findings indicate that Park Rx can lead to an increase in overall physical activity, average duration of physical activity, and intensity, that study did not have a non-Park Rx control group. A lack of control group limits the significance of the actual impact of the Park Rx, as there is no comparison to the results of either no physical activity prescription or an indoor physical activity prescription.

**Discussion**

This scoping review finds evidence that Park Rx programs can positively influence both mental and physical wellbeing. To date, a greater research focus (n=8) has been on either physical or mental and physical outcomes of Park Rx compared to just mental wellbeing (n=2). The importance and implications of these findings are further explored as it relates to the research questions this study set out to address.

**What is the Nature of the Evidence?**

The two studies focused solely on mental health found emerging evidence that Park Rx can significantly improve a patient’s mental wellbeing. However, the sample sizes of these studies (n=53 and n=14) limit the generalization of the results. The initial findings of these mental health studies do support the utility of Park Rx and can further inform larger studies. In this systematic review, evidence suggests that participants engaged in a Park Rx will likely experience mental health benefits. Evidence for the secondary health outcomes such as mood
improvement or stress reduction was strongest (Barton et al., 2012; Frühauf et al., 2016). These findings reflect those by Ewert and Chang (2018) who found that visits to natural environments can be beneficial in reducing both physical and psychological stress levels. Proponents for ecotherapy (treatment programs aiming to improve mental and physical wellbeing through outdoor activities in nature) have pointed to the established relationship between nature and mental health to reduce stress (Kaplan, 1995) and improve mood (Hull & Michael, 1995) that is corroborated in the emerging evidence of Park Rx programs. The concept of nature therapy, such as the Japanese concept of shinrin yoku (forest bathing), has long been posited as a health-promotion model based on its successfulness to address stress (Hansen, Jones, & Tocchini, 2017). The calls to integrate nature-based counseling into therapy practices (Greenleaf, Bryant, & Pollock, 2013) are predicated upon similar theoretical constructs (e.g., biophilia) as Park Rx and provide similar health outcomes (e.g., stress reduction) in support of the utility of using nature as part of a responsive and impactful healthcare clinical practice. Parallels between the positive mental health impact of nature therapy and Park Rx suggest there is utility in further exploring the range of applications of Park Rx as a validated and successful model for addressing a range of mental health disorders such as stress and depression.

A majority of the studies (n=8) included in this review focused on assessing either physical or mental and physical outcomes. Interestingly, there is a division between the study protocols and the published studies. The study protocols focus on measuring physical wellbeing utilizing biometric measures such as body mass index, blood pressure, accelerometry data, and blood assays (e.g., Müller-Riemenschneider et al., 2018), in addition to behavioral measures such as time spent in parks or physical activity time in parks. Research indicates that increased physical activity can have a direct impact on physiological measures such as blood pressure (Farpour-Lambert et al., 2009; Li, Harmer, Cardinal, & Vongjaturapat, 2009); however, most of
the studies included in this review did not examine most of the commonly used physiological measures such as blood pressure, cortisol levels, or waist circumference/body mass index. The published studies singularly utilized behavioral measures (e.g., time in nature, park visits per week); only one of the published studies included pedometer data to measure physical activity. Furthermore, while studies examined Park Rx from the medical providers’ perspective (Coffey & Gauderer, 2016; James et al., 2017a), few studies have evaluated the effectiveness of Park Rx programs using patients’ physiological measures. The one study that examined the impact of Park Rx upon physiological measures (salivary cortisol) in children and adults is limited by its lack of a non-Park Rx control group (Razani et al., 2018). While increased physical activity has been linked to improved health outcomes in other settings (e.g., Arsenijevic & Groot, 2017; Hemmingsson, Uddén, Neovius, Ekelund, & Rössner, 2009), additional research is needed to definitively show that Park Rx improves physical wellbeing beyond modifying engagement in physical activity. This can be done by continuing to evaluate what impact Park Rx can have upon biometrics in order to examine if Park Rx can be used in either the treatment or prevention of chronic diseases. The emerging Park Rx literature suggests that these programs hold the potential to positively affect health outcomes through the mediating effect of both physical activity and exposure to nature/natural elements. The extent of these outcomes needs to be more thoroughly tested and documented in the Park Rx study research, rather than relying on the associated literature around green exercise and exercise more broadly. Furthermore, the majority of the reviewed Park Rx interventions lasted for either three or six months. Moving forward, longitudinal studies longer than six months will be needed to detect changes in select biometric measures (e.g., glucose or HbA1c levels in diabetic patients) and to determine the long-term impact and maintenance of the physical activity behavior change.
What Methodologies and Intervention Designs Are Used?

Both within the park and recreation field and in related disciplines such as public health, psychology, and medicine, only two Park Rx randomized control trials were identified by this scoping literature review: one provided an evaluation of the effectiveness of Park Rx interventions, while the second was a protocol paper. The emerging research shows that Park Rx programs have promise as a tool for improving health outcomes. However, as Razani et al. (2018, p. 8) note, “[f]uture research should include a controlled trial comparing a park prescription as we have described to no intervention.” Considering half of the included studies lacked a control group, it is fair to say that future studies need to examine the degree of impact that Park Rx interventions have and compare those impacts to better balanced control groups, such as an indoor exercise and no treatment control groups. Additional study controls around the level of intervention (Park Rx with social support, Park Rx with transportation provided, Park Rx with customized text message reminders) could also serve to identify what elements of a Park Rx intervention design are critical for patient success. While many of the studies included in this scoping review were pilot studies, the limitations of the findings suggest a need for future clinical trials that allow for extended data collection periods and follow-up measures that extend beyond six months. Initial findings suggest that Park Rx can trigger changes in health outcomes, however, whether those changes are significantly different from simply being in nature regularly or from exercising indoors needs to be established. Furthermore, the lasting effect of the Park Rx needs to be established; with only short-term interventions to-date, it is impossible to know whether Park Rx are a valid health intervention for long-term behavior modification.

There is inconclusive data to suggest if there is a more effective Park Rx model when comparing between standard Park Rx utilizing a healthcare provider physical activity counseling approach (Zarr et al., 2017) or the emerging Park Rx “plus” that incorporates partnerships with
external entities to provide structured activity outings at local nature areas in addition to a prescription for nature-based physical activity (e.g., James et al., 2017a; Razani et al., 2018).

Most of the included studies reported using several educational resources (e.g., brochures, maps, and handouts) with the dissemination of the Park Rx to the patient, but to date, no studies have assessed which supplemental communication channels are most effective for encouraging compliance and lasting health behavior changes. It remains to be seen whether a generic Park Rx (e.g. time-based for a specific frequency) is sufficient for an intervention or if tailored Park Rx approaches are needed. It also remains to be seen if a Park Rx combined with additional services, such as skills trainings, are necessary for the Park Rx to be effective beyond increasing physical activity. Future studies are needed to determine what the key factors are for a successful Park Rx intervention. Deepening the understanding of what makes these programs successful (and defining what is considered success, whether that is just an increase in physical activity or specific biometric benchmarks) will be critical in order to scale Park Rx interventions up from the individual to community-level.

Future research is needed to determine not only what information is included, but also how that information is communicated. With the ubiquitous nature of electronic medical health records and wi-fi capable mobile phones, the notion of a written Park Rx as referred to in these studies is quickly becoming outdated. There is a need to assess whether mobile applications, websites, SMS messaging, emails, social media platforms, or eHealth devices (e.g., Fitbits) are better suited to engaging and communicating with Park Rx patients, and furthermore, to explore how this technology can facilitate and support the implementation of Park Rx programs within the clinical setting.
What are the Priority Future Park Rx Research Needs?

Physical activity is recognized and strongly endorsed for its usefulness in managing chronic conditions (Golightly et al., 2017). Among adults and older adults, physical activity lowers the risk of cardiovascular disease, hypertension, type 2 diabetes, and some cancers (Piercy et al., 2018). Numerous studies have shown that physical activity reduces the incidence of several chronic health conditions, such as type 2 diabetes mellitus, cardiovascular disease, and some types of cancer (Penedo & Dahn, 2005; Reiner, Niermann, Jekauc, & Woll, 2013; Warburton, Nicol, & Bredin, 2006). As Chakravarthy, Joyner, and Booth (2002) point out, counseling patients to be physically active for the prevention of chronic health conditions becomes a primary prevention modality. Given the evidence that green exercise, and Park Rx specifically, can be more beneficial than just exercise, further developing the evidence-base to examine the potential effectiveness of Park Rx in the United States could be useful in combating the rise in morbidities related to non-communicable and chronic diseases.

Additionally, further examination of patients’ adherence to the Park Rx written by healthcare providers is needed. Across the studies included in this scoping review there is no clear indication as to the overall adherence by patients to the prescription. For instance, Zarr et al. (2017) surveyed parents to assess changes in attitudes and physical activity behaviors, but there is no mention of the overall adherence rate of patients in following the received prescription that outlined intensity, frequency, and duration of the outdoor physical activity. The ambiguity around specific prescription adherence raises questions of appropriate dosage that are yet to be answered by the current literature included in this scoping review. Where benefits are being recorded, there remains questions of how much weekly nature exposure, what activities, how frequently, and at what intensity is required to see the health benefits? Moving forward,
research can begin to assess how adherence and prescription dosage affect the health outcomes recorded within these health behavior interventions.

There is also an opportunity to compare the effectiveness of nature-based Park Rx programs with the effectiveness of Exercise is Medicine programs. In the United States, research studies have built a more comprehensive body of research surrounding the Exercise is Medicine prescription programs (Lobelo, Stoutenberg, & Hutber, 2014; Sallis, 2015). Future research could begin to assess how the nature component of Park Rx affects health outcomes compared to the indoor-focused Exercise is Medicine physical activity prescription programs. Maier and Jette (2016) called for integrating nature-based programming as a treatment for mental illness through the growing Exercise is Medicine initiative. Contrasts between the Park Rx and Exercise is Medicine programs could provide needed insight into the specific pathways between nature/natural elements being specific to aspects of health and wellbeing, as opposed to physical activity itself.

A few studies have begun to identify built environments in terms of a rural to urban continuum (Christiana et al., 2017a, 2017b; Coffey & Gauderer, 2016; Messiah et al., 2016; Razani et al, 2015, 2017; Zarr et al., 2017), but there are too few studies for comparative analysis between these settings. Future research is needed to better examine how built environments in rural settings affect the availability and accessibility of natural outdoor environments comparative to suburban and urban communities with more numerous and accessible natural environments such as parks. Shores and West (2010) found that active use patterns differ between rural and urban residence, and as such, study findings from urban areas regarding park use and physical activity should not be considered representative of rural spaces. It remains to be seen as to whether or not the health benefits derived from a Park Rx are uniform across the built environment continuum.
The studies included in this scoping review did not specify the natural elements or degree of naturalness of the natural outdoor environments. The question still remains unanswered as to the effect of the quality of the natural space upon health outcomes. Studies have shown that the exposure of the human body to forest aerosols released by plants trigger physiological responses that prevent the formation of cancer, remove viruses from the body, and fight against existing tumors (Cho et al., 2017; Li et al., 2007; Li et al., 2012). Sensory pathways—sound, smell, taste, touch—and non-sensory pathways all play a role in the human nature experience and the resultant impacts of nature on human physiology and psychology (Franco, Shanahan, & Fuller, 2017). It remains however unclear as to precisely which elements in a view of nature or exposure to nature are beneficial, which limits the design of Park Rx interventions. Studies have identified eight perceived sensory dimensions that urban green space visitors prefer and that are also associated with stress reduction (Grahn & Berggren-Bärring, 2005; Grahn & Stigsdotter, 2010). These properties suggest that physical elements such as canopy cover, variety of flora and fauna, and soundscapes are all factors that impact the nature experience and exert an influence on health outcomes from the natural outdoor environment. Moving forward, clearer identification of the natural outdoor environments and the natural elements present in the Park Rx studies may prove beneficial.

No study to date has examined how the informational content that accompanies a Park Rx may be influencing health outcomes, specifically around cultural sensitivity and appropriateness. For instance, while there have been examinations on how culturally tailored interventions impact the success of diabetes prevention in U.S. Hispanic adults (McCurley, Gutierrez, & Gallo, 2017), the Park Rx literature has not matured to the point of evaluating how various communities based on race/ethnicity, geographic location, age, gender, or other background characteristics need Park Rx programs structured. Future studies may be needed to explore this in greater depth. As
greater evidence regarding the specific Park Rx and dosage are refined, there needs to be consideration for how different communities connect and interact with natural spaces. No research to date has explicitly examined either young or middle adulthood populations (ages 18-40) or have examined the impact on seniors (ages 65+). To date, no studies have stated whether low-income patients are more or less benefited by Park Rx than other socioeconomic cohorts, despite low-income populations being specifically targeted in four of the reviewed studies. No U.S. based research has considered the influence of race/ethnicity or even accessibility of natural environments within the examination of Park Rx.

Strengths and Limitations of Review

First, one of the eligibility criteria for this review was that the intervention setting must explicitly state that the physical activity was occurring in a natural outdoor environment. This parameter excluded the growing literature of studies conducted in New Zealand often referred to as Green Prescriptions (e.g., Anderson, Taylor, Grant, Fulton, & Hofman, 2015; Croteau, Schofield, & McLean, 2006; Elley, Kerse, Arroll, & Robinson, 2003; Hamlin, Yule, Elliot, Stoner, & Kathiravel, 2016). While the Green Prescription is a nationally supported and funded intervention delivered through primary care to increase physical activity in New Zealand, the program includes both indoor and outdoor settings without delineating the effect of setting in the results (Kolt et al., 2012; Swineburn, Walter, Arroll, Tilyard, & Russell, 1998). Similar research lines of physician-based physical activity prescriptions have been emerging in the UK, Spain and other European countries (e.g., Norway), and Australia (James et al., 2017b), but fail to adequately describe the setting as outdoor and natural, and therefore are excluded from this review by means of not being included at all and screened out as necessary.

Second, the eligibility criteria required that the Park Rx be given to the study participant from a healthcare provider. This also excludes a growing number of studies that have compared
the effectiveness of physical activity in nature or green spaces compared to indoor programs or other health behavior approaches (e.g., Calogiuri, Nordtug, & Weydahl, 2015; Elliot & Hamlin, 2018). For instance, in the United Kingdom, nature group walks have been studied (Marselle et al., 2014), but participation in the Walk for Health program does not require a healthcare provider referral and as such was excluded from this review. However, the findings of such studies do provide additional evidence that Park Rx are associated with significantly lower depression, less perceived stress, and less negative effects (Marselle et al., 2014).

Third, future research could examine the various terms used in Park Rx programs and attempt to provide a grounded definition for several key terms, including nature, park, and Park Rx. Brymer, Davids, and Mallabon (2014) point out “since individuals bring personal characteristics to the relationship with the environment, it is important to determine which characteristics are most relevant for the development of positive psychological health when undertaking physical activity in nature” (p. 194). The concept of a park is likely to vary depending on who is viewing the landscape; a micropark in a dense urban neighborhood in Washington D.C. that has trees and grass can be a valuable nature retreat to some, while for others, “park” conjures images of the Grand Tetons. A review of 30 studies found 41 distinct exposures in nature related to mental health benefits (Barnes et al., 2019) that could be present in varying combinations in microparks and national parks. As such, it might be of more importance to understand how elements of nature such as the presence of fauna and flora or even exposure to UV light create the value of the “outdoors” over indoor exercise. For instance, recent studies suggest that the concentration of phytoncides (wood essential oils) may be an important mediator between forest bathing and the reduction of stress (Li et al., 2007). Barnes et al. (2019) also found that many articles did not describe the “nature of the nature” making it difficult to replicate studies based on the natural setting impacts—an important consideration for the growing Park

Rx literature. While this review adopted a definition for Park Rx, there is no widely accepted consensus of the term. Across the ten studies included in this scoping review, several terms were used, including Green Exercise (Barton et al., 2012), Outdoor Physical Activity Prescription (Christiana et al., 2017a; Frühauf, et al., 2016), Park Rx (Coffey & Gauderer, 2016; Messiah et al., 2016; Müller-Riemenschneider et al., 2018; Razani et al., 2015, 2018; Zarr et al., 2017), and Outdoor Rx (James et al, 2017a).

**Risk of Bias.** The nature of these interventions limits the ability to blind the data collectors to the treatment condition of the participant; future studies’ continued use of randomized control trials would help to address this potential bias. The reporting and handling of missing data was not provided in detail for most studies. Additionally, five of the seven U.S. studies were focused on urban populations, making it difficult to generalize the findings of these studies across rural and suburban communities. The lack of specific demographic information reported for the actual intervention participants limited the generalizability of the results. It also makes it difficult to do a meta-analysis, which is particularly important for assessing studies with small sample populations.

**Conclusion**

Interestingly, while the leisure field has contributed theoretical constructs for leisure and wellbeing, all ten of the articles included in this scoping review were published in either a public health or medical journal. Even articles with co-authors from a leisure or parks and recreation background (e.g. Christiana et al., 2017a, 2017b; Messiah et al., 2016) were still published in medically-focused journals rather than leisure journals. This suggests that there is a need for translational studies that help to bridge the disciplines of medicine, public health, leisure studies, and leisure practice. Leisure theories and constructs can be a useful lens for understanding individuals’ connection to the natural outdoor space and to better explore potential leisure
constraints and negotiations required for long-term adherence to a Park Rx. For instance, Coffey and Gauderer (2016) examined if children would fill a nature prescription from their healthcare provider and found that only 13% of the state park passes were redeemed. Such a study could benefit by drawing upon the leisure field to consider leisure behavior motivations as well as common constraints and possible negotiations for overcoming those constraints to design a program that better meets the needs of the target population.

While there is limited theoretical and empirical research regarding Park Rx or, more generically, healthcare provider prescribed nature-based physical activity, the initial studies forming the basis of the Park Rx literature do suggest that Park Rx programs can be a feasible clinical approach to affective positive change in mental and physical wellbeing for patients through nature-based physical activity prescriptions. The studies included in this scoping review focused on utilizing green exercise, or nature exposure, for improved health and wellbeing. What emerges from the literature is an indication that experiences and exposure to natural environments can lead to specific health benefits. What is less clear from these studies is what degree the health benefit was derived from the exposure to the natural outdoor environment compared to the physical activity itself. Future studies are needed to determine what the key factors are for a successful Park Rx program. Deepening the understanding of what makes these programs successful (and defining what is considered success) will be critical in order to scale Park Rx programs up from the local level and truly implement Park Rx as clinical interventions.
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CHAPTER 3: WHAT UNDERLIES HEALTHCARE PROVIDER DECISION-MAKING AND ENGAGEMENT WITH NATURE-BASED PHYSICAL ACTIVITY PRESCRIPTIONS?

Abstract

With chronic health conditions such as hypertension, type 2 diabetes, and mental health disorders on the rise, exposure to nature through physical activity can lead to physiological relaxation, improved physical fitness, and immune function recovery, while also doing so in a cost-effective manner. Innovative health behavior intervention programs, such as nature-based physical activity prescriptions programs that utilize public parks and public recreation programs, can be used to achieve desired health impacts within a given community. In addition, by engaging the interest and ability of medical practitioners to incorporate these types of nature-based physical activity prescriptions helps refocus patient healthcare on personalized care around health behaviors.

To our knowledge, this discrete-choice experiment (DCE) study, conducted from September 2018 through January 2019 in conjunction with Park Rx America, is the first of its kind to examine and catalogue the preferences of healthcare providers in identifying which patient attributes are most impactful for providers’ likelihood to write nature-based physical activity prescriptions. Healthcare providers across the United States were invited to participate in the DCE through direct contact and a snowball recruitment approach. A total of 75 healthcare providers completed the DCE, which included 10 patient vignettes. A Cox regression was used to assess the significance of patient attributes, the relative utility of levels, and determine which attributes were most likely to receive a nature-based park prescription. The respondents in this DCE were significantly less likely to write a prescription for patients with no or little physical mobility limitations compared to patients with major limitations. Patients with hypertension or
severe mental health were significantly more likely to receive a nature-based physical activity prescription compared to obese/overweight patients. Patients with a dislike of the outdoors were significantly more likely to receive a prescription compared to those who liked the outdoors. The ‘dislike of the outdoors’ was shown to have the highest utility to providers in making their decision to prescribe nature-based physical activity to patients. This study also found three themes emerge regarding what healthcare providers want and need to systematically implement nature-based physical activity prescriptions: 1) usefulness of facilitators and external partnerships, 2) improved access to recreation resources, and 3) codified structured referral and/or integration of the prescription workflow into the electronic medical record.

As providers have been shown to have personal biases and perceptions that can influence their approach to patient healthcare, identifying which patients’ healthcare providers are most likely to engage in these nature-based physical activity programs can inform a clinical trial that has a higher likelihood of success, given its implicit buy-in from the providers. In determining preferred patient groups, a nature-based physical activity prescription program focused on these patients can make use of targeted messaging, language, and community resources for an increased chance of success of clinical integration on behalf of the providers and patient adherence and implementation of lifestyle changes toward better health outcomes. Despite the increase in nature-based physical activity prescription programs in the United States, few studies worldwide have conducted an in-depth examination into medical providers’ views and experiences with engaging patients in these types of prescriptions.
Introduction

Physical activity is beneficial in the prevention and management of chronic health conditions (e.g., Chrimes, Kitos, Kushniruk, & Mann, 2014; Marshall, Booth, & Bauman, 2005; Turner, Lira, & Brum, 2017). Indeed, it is well-established that exercise and physical activity have a direct, positive impact on health (WHO, 2018). However, the setting within which physical activity occurs impacts the magnitude of the health benefits. The biophilia hypothesis states a belief that humans are healthier when connected to nature, and the resulting biophilic research program has shown the potential role of the natural environment to improve human well-being (Heerwagen, 2009). Thus, nature-based physical activity not only leads to improved physical fitness and health (Hemmingsson, Uddén, Neovius, Ekelund, & Rössner, 2009), but does so in a cost-effective manner (Ewald et al., 2018).

Increasing interest in the connection between human health and nature has led to a growing literature documenting the direct and positive impacts nature has on well-being (Bowler, Buyung-Ali, Knight, & Pullin, 2010). For example, shinrin yoku (forest bathing) and nature therapy have shown positive physiological and psychological effects (Hansen, Jones, & Tocchini, 2017). Green exercise, or activity in the presence of natural elements, has been shown to lead to positive short and long-term health outcomes (Brymer, Davids, & Mallabon, 2014; Marselle, Irvine, & Warber, 2013) such as positive effects on emotions and attention (Han, 2017). Green space has been shown to be important for population health and individual mental health, social health, psychological restoration, and numerous physical health outcomes including reduced cortisol levels, improved glucose levels, and weight management (Niedermeier, Grafetstäffer, Hartl, & Kopp, 2017; Razani et al., 2018).

The phrase “dose of nature” was used by Barton and Pretty (2010) to articulate that exposure to green exercise is analogous to a pharmaceutical medical dosage to the body. Song,
Ikei, and Miyazaki’s (2016) Concept of Nature Therapy model posits that when an individual in a stressed state is exposed to the restorative effects of nature, physiological relaxation and immune function recovery occur. These responses to nature, as shown in research, are increasingly incorporated into the Evidence-based Medicine model that supports findings of preventive medical effects triggered by nature exposure. Exposure to the scents of a natural environment (such as water, dirt, trees, and grass) has been shown to have positive effects on the body’s limbic system (the brain’s key emotional center) that regulates the fight-or-flight response (Dayawansa et al., 2003). Natural light has been correlated with improved cognitive function and mood (Beute & de Kort, 2017), and a midday walk in nature has been shown to restore the autonomic control leading to better sleep (Gladwell, Kuoppa, Tarvainen, & Rogerson, 2016).

The positive health outcomes associated with nature exposure is not limited to green spaces. Blue spaces, such as lakes, rivers, and oceans, are also associated with positive effects, such as more prosocial behavior and fewer issues with peer relationships (Amoly et al., 2014).

**Healthcare and Nature-based Prescriptions**

While the U.S. healthcare system continues to struggle with the burden of chronic diseases, increasingly medical providers and community advocates are turning to physician prescribed nature-based physical activity referrals as an innovative solution. Known as Park Prescriptions, Green Exercise, Nature Prescriptions, Outdoors Prescriptions, Trail Prescriptions, Walking Prescriptions, and Blue Prescriptions, among other titles, these intervention programs focus on healthcare providers giving a prescription to a patient to go to a nature location (or a space with prominent natural features) and engage in an activity for their mental and/or physical wellbeing. Nature-based physical activity prescription programs, specifically, could be used to inform strategic investments of human and financial resources into appropriate clinical approaches to achieve desired health impacts for non-communicable chronic diseases such as
diabetes and hypertension. Nature-based physical activity prescription programs continue gaining popularity in the U.S. as a health behavior intervention program that utilizes public parks to increase physical activity. Since 2015, the U.S. has celebrated National ParkRx Day to promote the growing movement of prescribing parks and nature to improve health (ParkRx, 2016).

Engaging the interest, ability, and openness of medical practitioners to incorporate nature-based physical activity prescriptions requires a basic understanding of the complexities and constraints of the medical industrial complex. Medical care in the U.S. is shaped largely by the intertwinement of physician practices and larger organizational structures. Clinic and hospital administrators often focus on physicians as their true customers—not the actual patients (Hoegerl, Want, McKenzie, & Cybulski, 2016). Increased volume is often prioritized even above cost-savings and innovation. Therefore, a new concept of physician engagement is necessary to earn doctors’ buy-in and to spur systemic change that is urgently needed to refocus healthcare in a patient-centric approach. As Chakravarthy, Joyner, and Booth (2002) noted, increased physical activity greatly reduces the incidence of developing several chronic health diseases, including type 2 diabetes and cardiovascular disease. As such, they argue that physicians are obligated to prescribe physical activity; emerging research into the effects of nature would argue that should be nature-based physical activity. Nature-based physical activity prescription is a health intervention program that can help restructure patient health care by reintegrating personalized care around health behaviors within the existing priorities of health care systems.

Despite the rising prominence of nature-based physical activity prescription programs in the United States, only a few studies have examined medical providers’ views and experience in engaging in physical activity prescriptions. The results of one New Zealand study found that medical providers were providing Green Prescriptions for both primary prevention (e.g., weight
management) and secondary management (e.g., diabetes management) for patients with pre-existing conditions (Patel, Schofield, Kolt, & Keogh, 2011). A more recent study conducted in the U.S. found that while pediatricians were aware of the health benefits of children spending time outdoors, few of them prescribed time outdoors because of perceived barriers (Christiana, James, & Battista, 2017). Barriers cited included lack of patient readiness, baseline patient health, limited consultation time, lack of community resource knowledge, and lack of reimbursement from insurance companies for providing physical activity prescriptions. Indeed, focus groups conducted by the lead author found similar stated perceived barriers among physicians, most commonly in that study providers mentioned a lack of knowledge, lack of time, and patient care fatigue driven by trying to fit multiple health approaches into short patient encounters (Schultz, Bocarro, Hipp, & Floyd, 2018).

There is a need to go beyond these commonly cited barriers and explore the deeper psychological factors behind how providers view patient readiness for nature-based physical activity prescriptions. Providers tend to hold personal biases and perceptions that influence their approach to patient healthcare (Bélanger et al., 2015). Despite the influence of provider biases, within the medical community, exercise has been validated as an effective evidence-based medicine (Green, Engstrom, & Frijs, 2018). What needs further examination is what happens when the exercise prescription is targeted within a nature setting. As such, in attempting to build further clinical evidence for the effectiveness of nature-based physical activity prescriptions, it stands to reason that by identifying which patients healthcare providers are most likely to engage in these programs, then such a clinical trial has a higher likelihood of successful implementation and completion due to the implicit buy-in from providers. Once that default patient group has been identified, a community-centered nature-based physical activity prescription program can be created and implemented to the strength of both provider preference and patient resonance
through refined and targeted messaging and language, both in-clinic and throughout the prescription process (e.g., Armit et al., 2009).

**Study Aims**

This study aims to determine what patient characteristics physicians view as compatible with a nature-based physical activity prescription, as well as examine if personal background and experience of the healthcare provider primes adoption or refusal to participate in nature-based physical activity programs. Through a discrete-choice experiment (DCE), this study will identify healthcare providers’ stated preference for nature-based physical activity prescription in patient care, to better understand for whom and what this approach is viewed as being appropriate complementary care. The goals are to 1) understand when healthcare providers assign treatment of a nature-based physical activity prescription, and to 2) identify when providers are likely to write a nature-based physical activity prescription. By focusing on the experience and perceptions of medical practitioners, this study will evaluate their knowledge and general attitude towards nature-based physical activity prescriptions, including willingness to prescribe, formal physical activity counselling education, and overall need for specific resources to support the use of nature-based physical activity prescriptions in-clinic.

**Materials and Methods**

This study was conducted from September 2018 through January 2019. The discrete-choice experiment (DCE) was open nationwide to healthcare providers (e.g., medical, health behavioral, nutrition, etc.) who were actively practicing healthcare in the United States and directly providing healthcare to patients. A sample of 80 survey patients completed the DCE and were recruited in partnership with Park Rx America, a non-profit organization dedicated to the integration of nature during the routine delivery of healthcare. The study was approved by the Institutional Review Board at North Carolina State University.
Rationale for Using Discrete-choice Experiment

This study uses a discrete-choice experiment (DCE) to assess healthcare providers’ stated preferences for patient treatment as a function of the patient’s characteristics via an online survey. The DCE study design is a quantitative method for evaluating different factors that influence providers’ treatment decisions for patients. DCEs are a commonly used method in patient-preference analysis and for addressing policy questions (e.g., Torbica, Fattore, & Ayala, 2014; Veldwijk et al., 2013). DCEs have long been utilized in health economics, but more recently have been used to value health outcomes in the provision of care (de Bekker-Grob, Donkers, Jonker, & Stolk, 2015; Ryan, 2004). Studies have found that the methodology of a DCE leads to internal validity and consistency across respondents (Ryan & Gerard, 2003; Viney, Lancsar, & Louviere, 2002). The hypothetical nature of DCEs allows for an a priori identification of independent variables, which allows identification of all effects of interest. As noted by Ryan and Gerard (2003), the observed pattern of choice reveals how different respondent groups implicitly weigh, value, and access different characteristics of treatment. Furthermore, since DCEs are survey-based, it allows the participants to self-administer the online survey at their own pace. The underlying principle of DCEs is that the value of an option is determined by the value of its attributes (Lancaster, 1966). Participants choose their preferred patient type based on varying attribute-level combinations. This study then quantifies how patient characteristic attributes affect a healthcare provider’s choice to prescribe a nature-based physical activity prescription.

Attribute Levels

Attributes were derived from similar interventions using behavior-change strategies (Ramirez, Wu, & Beale, 2016). DCE guidelines suggest using six or fewer attributes (Ryan, Gerard, & Amaya-Amaya, 2007), therefore we narrowed our initial list of 11 attributes down to
six attributes: health condition diagnosis, gender, age, degree of physical mobility, degree of treatment adherence, and stated attitude toward nature. The design of attribute levels is derived from Lancaster’s characteristics theory of value that argues the importance of characteristics in choice decision making. The theory suggests that individuals face a level of demand that influences their choices; this demand is not dependent on the available goods (alternatives) but rather on the characteristics (attributes) of these goods (Lancaster, 1966). This DCE utilizes the responses within choice sets to determine if the selected attributes significantly influence preference and reveal the relative attribute’s importance.

DCE guidelines suggest using two to five levels per attribute to minimize the cognitive burden on survey respondents (Tinelli, 2016). The guidelines also suggest that levels cover the full range of product and services possibilities. We reviewed published studies and consulted with our seven-person pilot study panel (consisting of a Pediatrician, General Practitioner, Behavioral Health Therapist, Behavioral Health Consultant, Nurse, and researchers) to reach consensus on common operationalization of the six attributes and selected the most typical conceptualizations as the final levels. Attribute and level descriptions were finalized after adjusting for clarity according to feedback from the pilot test involving experts who are familiar with nature-based physical activity prescription programs (Table 3.1). For instance, experts discussed the inclusion of attention deficit hyperactivity disorder (ADHD) under the severe mental illness attribute level. Ultimately, they reached a consensus that mental illnesses as a category can range from mild anxiety to severe depression, and that, as such, with the stipulation of “severe,” the majority of providers would recognize the inclusion of ADHD. The experts concluded that providers would be familiar with green exercise studies that have shown the benefits of nature to provide attention restoration (Taylor & Kuo, 2009). An unlabeled design with attributes relevant to the patient types was used in this DCE. Other DCE studies have shown
that labeled designs can reduce the attention respondents give to the attribute levels with up to
24% of respondents choosing based on choice labels alone, suggesting that they choose
alternatives based on unobserved attributes (Blamey, Bennett, Louviere, Morrison, & Rolfe,
2000; de Bekker-Grob et al., 2010). An unlabeled design as used in this DCE forces respondents
to focus on the presented attribute levels in the choice set, rather than make decisions based on
alternative labels.

Table 3.1 Final attributes and levels chosen for the discrete-choice experiment

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<thead>
<tr>
<th>Patient Attributes</th>
<th>Attribute Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Condition</td>
<td>Diabetes</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
</tr>
<tr>
<td></td>
<td>Obese/Overweight</td>
</tr>
<tr>
<td></td>
<td>Severe Mental Health (e.g. ADHD, Anxiety, Depression, Stress)</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Age</td>
<td>Child (0-12yrs)</td>
</tr>
<tr>
<td></td>
<td>Teen (13-17yrs)</td>
</tr>
<tr>
<td></td>
<td>Adult (18-64 yrs)</td>
</tr>
<tr>
<td></td>
<td>Senior (65+ yrs)</td>
</tr>
<tr>
<td>Degree of Physical Mobility Demonstrated</td>
<td>No Limitations</td>
</tr>
<tr>
<td></td>
<td>Minor Limitations</td>
</tr>
<tr>
<td></td>
<td>Major Limitations</td>
</tr>
<tr>
<td>Treatment Adherence</td>
<td>Adherent</td>
</tr>
<tr>
<td></td>
<td>Not Adherent</td>
</tr>
<tr>
<td>Attitude Towards Nature</td>
<td>Enjoys Being Outside</td>
</tr>
<tr>
<td></td>
<td>Does Not Have a Preference</td>
</tr>
<tr>
<td></td>
<td>Dislikes Being Outdoors</td>
</tr>
</tbody>
</table>

**Construction of Choice sets**

A full-factorial design would require respondents to evaluate 576 alternatives (six
attributes with two to four levels). To make the survey more manageable, customized JavaScript
in Qualtrics allowed us to fully randomize the full factorial design, while autogenerating a
unique 10 question deck for each survey respondent. The JavaScript code randomized the attribute levels for both choice sets in the deck, drawing from the full factorial design and sub-selecting a manageable 20 alternatives (10 questions with 3 choices each) for each respondent. The creation of unique randomized 10 choice sets from the full factorial design allowed us to retain the full set of choices, enabling exploration of the main effects and possible interactions (de Bekker-Grob et al., 2010). This design allowed researchers to causally identify the relative importance of attributes and respondent characteristics. The choice task involved two patients described using the selected six attributes. Respondents chose their preferred patient to receive a nature-based physical activity prescription based on varying attribute-level combinations, allowing for the quantification of how these attributes affect healthcare providers’ choices. A copy of the DCE survey questionnaire is provided in Appendix A. Each patient vignette (Figure 3.1) is comprised of the six attributes and randomized levels. An opt-out alternative was used in this DCE. An opt-out give respondents the option of not choosing either of the patients for the prescription. This helps to capture when, in reality, the healthcare provider would not utilize a nature-based physical activity prescription for either patient.

**Vignette 1 out of 10**

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Condition</td>
<td>Obese/Overweight</td>
<td>Severe Mental Health</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Male</td>
</tr>
<tr>
<td>Age</td>
<td>Adult</td>
<td>Teen</td>
</tr>
<tr>
<td>Physical Mobility</td>
<td>Minor Limitations</td>
<td>Major Limitations</td>
</tr>
<tr>
<td>Treatment Adherence</td>
<td>Not Adherent</td>
<td>Adherent</td>
</tr>
<tr>
<td>Attitude Towards Nature</td>
<td>Enjoys Being Outdoors</td>
<td>Does Not Have a Preference</td>
</tr>
</tbody>
</table>

Q8. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.

- Patient A
- Patient B
- Neither

Figure 3.1. Example patient vignette and choice set from the DCE.
A paper survey was developed for participants who did not want to use the online survey. Using the AlgDesign package in R (Aizaki & Nishimura, 2008; Wheeler, 2014), the 10 choice sets were generated by first creating a full factorial design, then generating a fractional factorial design and repeating the random selection of alternatives from each fractional factorial design to create a 10-choice set deck that was randomly selected and equally presented the attribute levels across the 20 alternatives. Each choice set consisted of two patient alternatives and an opt-out option. When creating the choice sets for the paper survey, minimum overlap (within any choice set, the attribute level is not repeated across options) was maximized. This ensured that alternatives within a choice set did not repeat the same level of a given attribute, helping to draw the maximum information from the respondents (Ryan, Kolstad, Rockers, & Dolea, 2012). The questionnaires were completed by respondents, then mailed back to the research staff to be manually entered into the dataset.

The DCE survey included questions for the providers about their personal attributes (e.g., location of practice, years in practice, subspecialty, and age) along with familiarity with nature-based physical activity prescriptions (e.g., awareness of Park Rx, experience writing the prescription, professional education, continued education, and necessity of support resources to increase use of nature-based physical activity prescriptions). The DCE concluded with an open-ended question that asked participants, “Is there anything else you would like to share with us about how nature-based physical activity prescription programs should be implemented in your clinic?” Responses to this open-ended question were analyzed using a theme coding approach to identify key themes using a grounded theory approach (Heath & Cowley, 2004; Saldaña, 2015).

**Survey Design**

The DCE was primarily conducted online via the Qualtrics platform (with one set of providers receiving the paper survey). The DCE utilized the Qualtrics Anonymous Link function,
which is a basic hyperlink that does not collect any identifying information such as name, email address, or user’s IP address. However, by default, progress was saved as respondents took the survey so that they could close the browser window and return to finish it on that same device at a later date and time. This feature made the survey more user-friendly for time-pressured healthcare providers. Yet, to protect the integrity of the sample, the “Prevent Ballot-Box Stuffing” option was used, which prevented respondents from taking the survey more than once.

A brief online registration process included the informed consent form, a detailed description of the study, and anticipated length of the survey. Prospective participants read and indicated their willingness to participate by either opting into the study (e.g., electronically signing an informed consent form) or opting out by selecting to not participate. Study participants could choose to enter into a drawing for one of ten $100 gift cards as an incentive for participating in the study.

**Participants and Recruitment**

Eligible participants accessed the online DCE survey via Qualtrics to participate in the study. Healthcare providers were broadly defined to include discipline areas such as medical, health behavior, nutrition, therapy, etc., and therefore the survey could be completed by pediatricians, general practitioners, nurses, nurse practitioners, therapists, or other medical staff. Participants were deemed eligible if they currently provided care directly to patients and practiced that healthcare in the United States.

This study utilized a nonrandomized convenience sample of medical practitioners across the nation. Participants were recruited using four approaches. First, in collaboration with Park Rx America, an initial list of healthcare providers and healthcare institutions was created. Second, a snowball recruitment was used in which participants were instructed to invite other healthcare providers to become study participants (Polit & Beck, 2008). Third, a webpage was created and
added to Park Rx America’s website that outlined the study, gave information to frequently asked questions, and directly linked potential participants to the online study via Qualtrics. Fourth, social media channels, including Facebook and Twitter, along with blogs and newsletters, were used to promote the survey and distribute the Qualtrics survey link to broader healthcare organizations (e.g., Association for Nature and Forest Therapy), professional groups such as state chapters of the American Academy of Pediatrics, collaborative listservs (e.g., University of Washington’s Nature Health Listserv), and organization-level newsletters (e.g. Park Rx America, Recreation Northwest) in order to reach healthcare providers outside of our contact list.

The study used a modified Tailored Design Method for electronic surveys (Dillman, Smyth, & Christian, 2014). Following the protocol, an email invitation describing the survey and inviting participation was sent to participants between September 2018 and December 2018. An initial contact email was distributed to our contact list of providers in September 2018. Four follow-up emails were sent to the contact list, requesting them to forward the message to the healthcare providers in their network. This same protocol was applied to the social media channels. An initial message was posted in October 2018, followed by four reminder messages. Due to the snowball approach, it is difficult to calculate an accurate response rate. A total of 129 survey links were activated; of those, 81 surveys were completed. Excluding surveys where consent was not granted, a total of 75 surveys were included in the analysis.

**Sample Size Calculation**

Sample size calculation for healthcare DCE is still a developing topical area, and as such, rules of thumb around observations per choice set are still utilized. Pearmain and Swanson (1991) found that for DCE designs, sample sizes over 100 are able to provide a basis for modeling preferences. A more liberal sample size was proposed by Lancsar and Louviere (2008),
who found in their own empirical experience that more than 20 respondents per questionnaire is rarely needed to estimate reliable models. Sample size requirements for discrete-choice experiments (DCEs) as proposed by Johnson and Orme (2003) uses the formula: \( N > 500c / (t \times a) \). This formula suggests that the sample size ‘\( N \)’ required for the main effects is dependent on the number of choice tasks ‘\( t \)’, the number of alternatives ‘\( a \)’, and the number of analysis cells ‘\( c \)’ where in a main effects model ‘\( c \)’ is equal to the largest number of levels for any of the attributes. Based on the literature, Orme’s calculation would suggest a sample size of at least 67 to estimate a main-effects model; therefore, a sample size of \( n=75 \) is more than adequate for main-effects modeling. When considering all two-way interactions, ‘\( c \)’ is equal to the largest product of levels of any two attributes, which would require a sample size of \( n=267 \) to adequately model all two-way interactions; therefore, this study only used main-effects models in analyzing the data. Within the DCE literature, it is common practice to only include main effects since it is argued that such effects explain most of the variation in preferences (de Bekker-Grob, Ryan, & Gerard, 2012).

**Statistical Analysis**

Descriptive and inferential statistics were conducted using SPSS statistical software package, version 24 (IBM Corp, Armonk, NY). Methods to analyze DCEs put forth by Hauber et al. (2016) and Ryan (2004) guided the analysis. Analysis of DCE data involves regression models that have a categorical dependent variable (Hauber et al., 2016). Model selection is driven by the type of variables: either individual specific (respondent specific variables such as individual age which does not change over the choice sets in the DCE) or alternative specific variables (value for each question choice is driven by the attribute levels). While individual specific variables can be analyzed with multinominal logit models, alternative specific variables are better suited to conditional or mixed logit models (Crossiant, 2012; Park, 2009). Therefore,
since this DCE utilizes alternative specific variables, a conditional logit model was used to fit the model drawing upon the McFadden Choice Model (McFadden, 1974). Collinearity was assessed using variance inflation factor values. Respondents were asked to select either “Patient A,” “Patient B,” or “Neither” as their preferred patient to receive a nature-based physical activity prescription. Only 13 respondents chose the “Neither” option. When “Neither” was selected, participants were prompted with an additional question in which they were asked to select between “Patient A” or “Patient B” again. That forced selection was used in place of their “Neither” selection for all analyses.

The decision-making process within the DCE is a comparison of indirect utility functions. Drawing upon random utility theory, for each choice set it is assumed that the respondent would choose the alternative that led to a higher utility (e.g., value). As the participant makes a series of choices, they choose the alternative that leads to the higher level of utility (Ryan et al., 2012). This indirect utility function is expressed by Ryan and Gerard (2003, p. 55) as:

\[ U_{iq}(A) = v_{iq}(A) + \varepsilon_{iq} \]

where \( U_{iq}(A) \) represents the indirect utility function of individual \( q \) for good \( i \) with attributes \( A \), \( v_{iq}(A) \) represents the measurable components of utility estimated empirically, with \( i \), \( q \), and \( A \) as defined above, and \( \varepsilon \) reflects the unobservable factors, the subject will choose \( i \) over \( j \) if:

\[(v_{iq} + \varepsilon_{iq}) > (v_{jq} + \varepsilon_{jq})\]

or

\[(v_{iq} - \varepsilon_{iq}) > (v_{jq} - \varepsilon_{jq})\]

A regression analysis is able to linearly relate the probability of choosing one alternative (e.g., Patient profile) over another alternative to all the levels presented simultaneously. Hauber et al. (2016, p. 302) note:
this model assumes that the probability of choosing one profile is a linear function of the attribute levels in the profile. Thus, the model can be described as follows:

\[
\Pr(\text{choice}) = \beta_0 + \sum \beta_i x_i
\]

where \(x_i\) is the level of attribute \(I\), \(\beta_0\) is the intercept, and \(\beta_i\) is the preference weight for attribute \(i\).

Response data were analyzed using conditional logit models through the Cox regression function in SPSS. The conditional logit model assumes both random utility theory and Lancaster’s characteristics theory of value. It applies a logistic regression analysis over the utility equation; dummy coding was applied to the attribute levels using the last category (highest) as reference. The model relates choice to the attribute levels in each of the alternative profiles. A conditional logit (by Cox regression) model was selected due to its utilization of a logistic distribution (Kolstad, 2011) that has been a preferred approach in the DCE literature (de Bekker-Grob et al., 2008; Quaife, Terris-Presthold, Di Tanna, & Vickerman, 2018; Viney et al., 2002). A full model of the attribute levels including all respondents was developed that allowed for the determination of the overall, or mean, preferences of the sample. Models for each population were analyzed separately. Assuming that all attributes have an independent influence on a healthcare provider’s preference the following model was estimated:

\[
V = \beta_1 \text{Diabetes} + \beta_2 \text{Hypertension} + \beta_3 \text{Severe Mental Health} + \beta_4 \text{Obesity Overweight} + \beta_5 \text{Male} + \beta_6 \text{Female} + \beta_7 \text{Child} + \beta_8 \text{Teen} + \beta_9 \text{Adult} + \beta_{10} \text{Senior} + \beta_{11} \text{No Limitations} + \beta_{12} \text{Minor Limitations} + \beta_{13} \text{Major Limitations} + \beta_{14} \text{Not Adherent} + \beta_{15} \text{Adherent} + \beta_{16} \text{Dislike Outdoors} + \beta_{17} \text{No Preference Outdoors} + \beta_{18} \text{Enjoy Outdoors}
\]

where ‘\(V\)’ represents the utility derived for nature-based physical activity prescription. \(\beta_1\) to \(\beta_{18}\) are coefficient that indicate the relative importance of each attribute level. \(\beta_1\) to \(\beta_4\) are dummy variables of the attribute ‘health condition’, \(\beta_5\) to \(\beta_6\) are dummy variables of
the attribute ‘gender’, $\beta_7$ to $\beta_{10}$ are dummy variables of the attribute ‘age’, $\beta_{11}$ to $\beta_{13}$ are dummy variables of the attribute ‘degree of physical mobility demonstrated’, $\beta_{14}$ to $\beta_{15}$ are dummy variables of the attribute ‘treatment adherence’, and $\beta_{16}$ to $\beta_{18}$ are dummy variables of the attribute ‘Attitude Toward Nature’.

The individual coefficients represent the average relative utility, or preference, for that level of the attribute compared to the reference level. All levels for criteria are qualitative and data are dummy coded (1=chosen; 0=not chosen). The coefficients generated from the Cox regression model can be used to determine whether the attributes are statistically significant (shown by the significance level of the coefficient), the direction of importance (shown by the sign of the estimated coefficient), and the relative importance (shown by the size of the estimated parameter). Regression coefficients indicate the sign of the effect of a level on the likelihood of prescribing a nature-based physical activity prescription. The absolute value of the coefficients indicates the relative importance of particular levels of a criterion in comparison to other levels of all other criteria so that the criterion which has higher probability will have more likelihood to be used as the important one in selection of the alternative than other factors (i.e., the presence of that level will be of the highest utility in driving the decision to prescribe a nature-based physical activity prescription relative to the other levels).

Results

A total of 75 healthcare providers participated in the DCE study. Of the participants, 60 (80%) identified as female, while only 12 (16%) identified as male (Table 3.2). Nearly a third of participants were between the ages of 35 and 50 (n=24), with another third of participants falling between 51 and 75 years old (n=24). Participants represented a wide array of professional positions including: 2 academic medicine practitioners, 19 family medicine practitioners, 1 hospitalist, 1 internal medicine practitioner, 9 nurse practitioners/licensed practical nurses, 3
obstetricians, 19 pediatricians, 2 physical medicine and rehabilitation practitioners, 1 physician assistant, 4 preventive medicine/public health practitioners, and 12 other practitioners.

Participants reported a range of years practicing medicine: 48% (n=36) were less than 10 years into their career, while 18 (24%) had more than 25 years of experience. Participants practiced in 11 states. The majority of respondents (n=50; 66.7%) represented the South, with 18 (24%) participants representing the West; a few respondents participated from the Midwest (n=2; 2.7%) and Northeast (n=4; 5.3%). One participant did not respond to the question.
Table 3.2. Demographic and professional characteristics of respondents (n=75)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>12</td>
<td>(16%)</td>
</tr>
<tr>
<td>Female</td>
<td>60</td>
<td>(80%)</td>
</tr>
<tr>
<td>No Response</td>
<td>3</td>
<td>(4%)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 to 34 years</td>
<td>20</td>
<td>(26.7%)</td>
</tr>
<tr>
<td>35 to 50 years</td>
<td>24</td>
<td>(32%)</td>
</tr>
<tr>
<td>51 to 70 years</td>
<td>24</td>
<td>(32%)</td>
</tr>
<tr>
<td>71 years and older</td>
<td>1</td>
<td>(1.3%)</td>
</tr>
<tr>
<td>No Response</td>
<td>6</td>
<td>(8%)</td>
</tr>
<tr>
<td>Professional Position</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic Medicine</td>
<td>2</td>
<td>(2.7%)</td>
</tr>
<tr>
<td>Family Medicine</td>
<td>19</td>
<td>(25.3%)</td>
</tr>
<tr>
<td>Hospitalist</td>
<td>1</td>
<td>(1.3%)</td>
</tr>
<tr>
<td>Internal Medicine</td>
<td>1</td>
<td>(1.3%)</td>
</tr>
<tr>
<td>Nurse Practitioner/Licensed Practical Nurse</td>
<td>9</td>
<td>(12%)</td>
</tr>
<tr>
<td>Obstetrics &amp; Gynecology</td>
<td>3</td>
<td>(4%)</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>(16%)</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>19</td>
<td>(25.3%)</td>
</tr>
<tr>
<td>Physical Medicine &amp; Rehabilitation</td>
<td>2</td>
<td>(2.7%)</td>
</tr>
<tr>
<td>Physician Assistant</td>
<td>1</td>
<td>(1.3%)</td>
</tr>
<tr>
<td>Preventive Medicine/Public Health</td>
<td>4</td>
<td>(5.3%)</td>
</tr>
<tr>
<td>No Response</td>
<td>2</td>
<td>(2.7%)</td>
</tr>
<tr>
<td>Years Practicing Medicine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 5 years</td>
<td>19</td>
<td>(25.3%)</td>
</tr>
<tr>
<td>5 to 9 years</td>
<td>17</td>
<td>(22.7%)</td>
</tr>
<tr>
<td>10 to 14 years</td>
<td>6</td>
<td>(8%)</td>
</tr>
<tr>
<td>15 to 19 years</td>
<td>8</td>
<td>(10.7%)</td>
</tr>
<tr>
<td>20 to 24 years</td>
<td>6</td>
<td>(8%)</td>
</tr>
<tr>
<td>25+ years</td>
<td>18</td>
<td>(24.0%)</td>
</tr>
<tr>
<td>Location of Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>4</td>
<td>(5.3%)</td>
</tr>
<tr>
<td>Midwest</td>
<td>2</td>
<td>(2.7%)</td>
</tr>
<tr>
<td>South</td>
<td>50</td>
<td>(66.7%)</td>
</tr>
<tr>
<td>West</td>
<td>18</td>
<td>(24%)</td>
</tr>
<tr>
<td>No Response</td>
<td>1</td>
<td>(1.3%)</td>
</tr>
</tbody>
</table>
Participants’ Perceptions Regarding the DCE Vignettes

Respondents were asked to self-assess how difficult selecting their preferred patient to prescribe a nature-based physical activity prescription to from within the choice set was and how well they felt they understood the vignettes (Table 3.3). Respondents were split on the perceived difficulty of deciding between patients within the choice set: 44% (n=33) felt it was at least somewhat difficult; 26.7% (n=20) of respondents felt it was neither easy nor difficult, or at least somewhat easy. The majority of respondents (n=57, 76%) reported that they fully understood the vignettes, while 22.7% (n=17) felt they only partially understood the vignettes. No one reported not understanding the vignettes. These results indicate that while the vignettes themselves were understandable, the decision to pick a patient to receive the nature-base physical activity prescription was not as universally simple. This suggests that respondents did take the time to thoughtfully consider their response to each choice set throughout the ten vignettes.

Table 3.3. Participants’ ease of use and comprehension of the DCE vignettes

<table>
<thead>
<tr>
<th>Participants’ Rating of the DCE</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Difficulty Selecting Within Choice Set</strong></td>
<td></td>
</tr>
<tr>
<td>Extremely Difficult</td>
<td>3 (4%)</td>
</tr>
<tr>
<td>Somewhat Difficult</td>
<td>30 (40%)</td>
</tr>
<tr>
<td>Neither Easy nor Difficult</td>
<td>20 (26.7%)</td>
</tr>
<tr>
<td>Somewhat Easy</td>
<td>15 (20%)</td>
</tr>
<tr>
<td>Extremely Easy</td>
<td>5 (6.7%)</td>
</tr>
<tr>
<td>No Response</td>
<td>2 (2.7%)</td>
</tr>
<tr>
<td><strong>Understanding of the Vignettes</strong></td>
<td></td>
</tr>
<tr>
<td>Fully Understood</td>
<td>57 (76%)</td>
</tr>
<tr>
<td>Partially Understood</td>
<td>17 (22.7%)</td>
</tr>
<tr>
<td>Did Not Understand</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>No Response</td>
<td>1 (1.3%)</td>
</tr>
</tbody>
</table>
Familiarity with Nature-based Physical Activity Prescriptions

All respondents were asked to answer several questions that measured their familiarity and knowledge of nature-based physical activity prescriptions (Figure 3.2). Participants in the DCE overwhelmingly had some prior awareness of nature-based physical activity prescriptions prior to participating in the survey. Nearly 87% (n=65) of participants were aware of the concept before engaging in the DCE; only 13% (n=10) of participants had not heard of these health behavior intervention programs. Furthermore, more than 60% (n=46) of participants had previously personally written a park-based physical activity prescription for their own patients. As such, it is interesting to note that the majority of participants were making practice-informed decisions in the DCE choice sets based on their own history of prescribing nature-based physical activity to their own patients.

![Frequency of respondents’ self-reported knowledge and familiarity around nature-based physical activity prescriptions (n=65).](image)

Figure 3.2. Frequency of respondents’ self-reported knowledge and familiarity around nature-based physical activity prescriptions (n=65).
Educational and Resource Support Preferences

When healthcare providers were asked to report whether they had received adequate education to counsel patients in prescribed nature-based physical activity, more than 45% (n=34) of respondents did not feel that their education was adequate. Respondents who indicated a lack of adequate education were given a follow-up question in which they were asked to identify from a list of eight options what additional education they would like to receive that would support their use of nature-based physical activity prescriptions (Figure 3.3). The most popular option for additional education resources was continuing medical education (CME)/continuing education (CE) knowledge courses on nature-based physical activity programs (n=31, 91.2%). Other popular education resources selected by more than half of the respondents included a CME/CE webinar on integration of nature-based physical activity prescriptions into clinical practice (n=22, 64.7%), having access to online databases of local community park and recreation facilities and programs (n=20, 58.8%), a webcast on identifying the right nature-based physical activity prescription for your patient (n=18, 52.9%), and an educational session on integrating nature-based physical activity prescriptions into electronic health record systems (n=17, 50%). This shows that within the respondents there is a desire for more education around what nature-based physical activity prescription programs are, how to integrate these prescriptions into clinical practice and the electronic health record system, and how to utilize local resources to ensure that the right prescription is tailored to the patient.
Figure 3.3. Frequency of respondents’ preference for additional education resources to address their feeling of inadequate knowledge (n=34).

Participants were also asked to rate on a 5-point Likert scale the likeliness of the availability of six different resources to increase their willingness to increase their use of nature-based physical activity prescriptions. These six categories were selected from the literature as being key components to successful integration of physical activity health behavior interventions into clinical workflow (Figure 3.4). More than 71% of respondents across all six resources indicated that the presence of that indicated resource would make them either somewhat or extremely likely to increase their willingness to increase the use of nature-based physical activity prescriptions for their patients. Specifically, the incorporation of the nature-based physical
activity into the patients’ electronic health records was selected as being extremely likely to increase use of the prescriptions for patients (n=44, 58.7%). Both a structured prescription referral system (n=43, 57.3%) and access to information about parks (n=43, 57.3%) were frequently selected as being extremely likely to increase the provider’s willingness to increase use of nature-based physical activity prescriptions. These selected resources also mirror the stated preferences of the providers’ desire for additional education resources, suggesting that a greater emphasis on clinical workflow and access to local park and recreation knowledge are key to the establishment of a nature-based physical activity prescription program.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Extremely Likely</th>
<th>Somewhat Likely</th>
<th>Neither Likely nor Unlikely</th>
<th>Somewhat Unlikely</th>
<th>Extremely Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of a dedicated social worker or navigator</td>
<td>40</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Partnerships with county health departments</td>
<td>30</td>
<td>14</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Partnerships with recreation and park agencies</td>
<td>36</td>
<td>32</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Access to information about parks</td>
<td>43</td>
<td>22</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Structured prescription referral system</td>
<td>43</td>
<td>17</td>
<td>12</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Incorporation of prescription into patient electronic health records</td>
<td>44</td>
<td>16</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 3.4. Frequency of respondents’ stated likeliness of additional resources increasing their willingness to increase the use of nature-based physical activity prescriptions in their daily practice (n=75).
**Level Balance of the DCE Choice Sets**

Level balance of a DCE requires all levels of each attribute to appear with equal frequency across the alternatives in the choice sets (Ryan et al., 2012). In this case, each level of the gender and treatment adherence attributes should appear in 50% of the patient profiles. Each level of the health condition attribute should appear in 25% of the patient profiles. Both degree of physical mobility demonstrated and attitude toward nature attributes should have each of their levels appear in 33.3% of the patient profiles. The level balance of the design applied in this study is shown in table 3.4, which illustrates that the DCE design has a relatively even, level balance. A minimal overlap of attribute levels reduces the likelihood of collinearity among the attribute levels in the regression modeling of the DCE data.
Regression Models

The conditional logit model was run in SPSS through the Cox regression three times.

First, an analysis of the entire study sample was conducted to assess the averages. Second, a Cox regression was run to compare the preferences of providers who have personally written a nature-based physical activity prescription compared to providers who have not personally written such a prescription. Third, a Cox regression was run to compare the preferences of providers self-identified as having adequate education for physical activity counseling compared to providers who self-identified as having inadequate education for physical activity counseling.

A positive sign in front of the coefficient of the attribute levels indicates that the presence of this...
level in the choice set is considered to have a higher utility (preferable) compared to the reference level. A negative sign suggests that the attribute level has a lower utility (non-preferable). The levels are a mix of ordinal and nominal; therefore the reference level was selected as being the highest level.

**Cox Regression Model Full Results.** The full model results show that only the attributes health condition, degree of physical mobility demonstrated, and attitude toward nature had significant coefficients (Table 3.5). The coefficient of diabetes (p=.233) is non-significant, suggesting healthcare providers in this sample population do not distinguish their prescription between diabetes and obesity/overweight (reference category). The positive sign of the coefficient hypertension (β=.279, p=.012) and severe mental health (β=.214, p=.048) indicates that healthcare providers in this sample are more likely to prescribe nature-based physical activity to patients with those conditions compared to obese/overweight patients.

The negative sign of the coefficient no limitations (β=-.387, p<.001) and minor limitations (β=0.327, p=.001) indicates that compared to major limitations, providers are less likely to prescribe nature-based physical activity. Furthermore, the positive sign of the coefficient dislikes being outdoors (β=.792, p<.001) and does not have a preference (β=.187, p=.033) indicates that providers are more likely to prescribe nature-based physical activity to patients with either of these attributes relative to patients who enjoy being outdoors. There seemed to be no gender, age, or degree of physical mobility demonstrated difference.

The magnitude of the absolute attribute coefficient corresponds with the relative importance of the attributes. Respondents derived a greater utility from the ‘dislike being outdoors’, ‘no limitations,’ and ‘minor limitations’ than they did the specific health conditions or the ‘does not have a preference’. Although the other levels were not significant, diabetes (β=.124) and treatment adherence (β=.115) had next highest part-worth utility, followed by the
age and gender levels. Adult (β=-.078), though not significant, had the least utility for providers in the sample population.

Table 3.5. Relative preferences—full Cox regression main effects model from DCE (n=1500)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health Condition</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>.124</td>
<td>.104</td>
<td>.233</td>
</tr>
<tr>
<td>Hypertension</td>
<td>.279</td>
<td>.111</td>
<td>.012</td>
</tr>
<tr>
<td>Severe Mental Health</td>
<td>.214</td>
<td>.108</td>
<td>.048</td>
</tr>
<tr>
<td>Obesity/Overweight</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>.093</td>
<td>.077</td>
<td>.227</td>
</tr>
<tr>
<td>Female</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td>-.098</td>
<td>.109</td>
<td>.368</td>
</tr>
<tr>
<td>Teen</td>
<td>-.101</td>
<td>.107</td>
<td>.345</td>
</tr>
<tr>
<td>Adult</td>
<td>-.078</td>
<td>.113</td>
<td>.490</td>
</tr>
<tr>
<td>Senior</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Degree of Physical Mobility Demonstrated</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Limitations</td>
<td>-.387</td>
<td>.094</td>
<td>.000</td>
</tr>
<tr>
<td>Minor Limitations</td>
<td>-.327</td>
<td>.097</td>
<td>.001</td>
</tr>
<tr>
<td>Major Limitations</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Treatment Adherence</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Adherent</td>
<td>.115</td>
<td>.077</td>
<td>.136</td>
</tr>
<tr>
<td>Adherent</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Attitude Toward Nature</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dislikes being outdoors</td>
<td>.792</td>
<td>.101</td>
<td>.000</td>
</tr>
<tr>
<td>Does not have a preference</td>
<td>.187</td>
<td>.088</td>
<td>.033</td>
</tr>
<tr>
<td>Enjoys being outdoors</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Log likelihood of model without predictors=4337.8, p<.001
Log likelihood of model=4243.1, p<.001
ref=Reference category; SE=Standard Error
a.05 significance; b.01 significance; c.001 significance

**Cox Regression Model Prior Experience.** This model ran the subpopulation of participants who had previously prescribed a nature-based physical activity prescription (n=46) versus those participants who had no prior experience (n=29). Among the subgroup of providers
with previous experience, four levels were significant: no limitations (p<.001), minor limitations (p<.01), not adherent (p<.05), and dislike being outdoors (p<.001; Table 3.6). The negative coefficient for no limitations (β=-.493) and minor limitations (β=-.384) suggests that providers in the sample population are less likely to prescribe nature-based physical activity to patients with these traits compared to those with major limitations. These attribute levels were not significant for the subgroup of providers without prior experience, suggesting that those providers do not distinguish between patients with no limitations, minor limitations, or major limitations. The positive coefficient for not adherent (β=.199) shows that providers in the prior experience subgroup are more likely to prescribe the intervention to non-adherent patients compared with adherent patients. This level was not significant among the subgroup without experience. However, the positive coefficient of dislikes being outdoors (β=.784; β=.901) for the prior experience and no experience subgroups suggests that both subgroups of providers are more likely to prescribe outdoor physical activity to patients who dislike the outdoors compared to those who enjoy the outdoors. The subgroup with no prior experience model also found that the coefficient for hypertension (β=.449) was significant (p<0.05), suggesting that for those healthcare providers they are more likely to prescribe nature-based physical activity to those patients compared to obese/overweight patients. For both subgroups, the level ‘dislikes being outdoors’ had the highest utility value. Though not significant, adult (absolute β=.043) had the least utility for the prior experience subgroup, while the not significant not adherent (absolute β=.005) had the least utility for the no experience subgroup.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Previous Experience¹</th>
<th>No Experience²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient (SE)</td>
<td>Coefficient (SE)</td>
</tr>
<tr>
<td>Health Condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>.140 (.135)</td>
<td>.109 (.169)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>.186 (.139)</td>
<td>.449 (.190)</td>
</tr>
<tr>
<td>Severe Mental Health</td>
<td>.232 (.137)</td>
<td>.194 (.178)</td>
</tr>
<tr>
<td>Obesity/Overweight (ref)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>.128 (.098)</td>
<td>.039 (.124)</td>
</tr>
<tr>
<td>Female (ref)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td>-.186 (.137)</td>
<td>.043 (.183)</td>
</tr>
<tr>
<td>Teen</td>
<td>-.050 (.137)</td>
<td>-.147 (.173)</td>
</tr>
<tr>
<td>Adult</td>
<td>-.043 (.141)</td>
<td>-.131 (.189)</td>
</tr>
<tr>
<td>Senior (ref)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Degree of Physical Mobility Demonstrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Limitations</td>
<td>-.493 (.119)c</td>
<td>-.210 (.157)</td>
</tr>
<tr>
<td>Minor Limitations</td>
<td>-.348 (.127)b</td>
<td>-.263 (.153)</td>
</tr>
<tr>
<td>Major Limitations (ref)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Treatment Adherence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Adherent</td>
<td>.199 (.098)a</td>
<td>.005 (.127)</td>
</tr>
<tr>
<td>Adherent (ref)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Attitude Toward Nature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dislikes being outdoors</td>
<td>.784 (.127)c</td>
<td>.901 (.170)c</td>
</tr>
<tr>
<td>Does not have a preference</td>
<td>.166 (.112)</td>
<td>.227 (.142)</td>
</tr>
<tr>
<td>Enjoys being outdoors (ref)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

¹Log likelihood=2635.2, p<.001; ²Log likelihood=1598.9, p<.001
ref=Reference category; SE=Standard Error

a0.05 significance; b0.01 significance; c0.001 significance

**Cox Regression Model Adequacy of Education.** The final modeling examined the subgroups of participants who self-identified as having received adequate education to provide physical activity counseling and those who self-identified as having received inadequate education (Table 3.7). The dislikes being outdoors coefficient was significant and positive for both the adequate education group ($\beta=.702$, p<.001) and the inadequate group ($\beta=.903$, p<.001),
suggesting that relative to patients who enjoy being outdoors, those who dislike the outdoors are more likely to receive a nature-based physical activity prescription. The no limitations coefficient was significant and negative for both the adequate education group ($\beta=-.399$, $p<.001$) and the inadequate education group ($\beta=-.357$, $p<.05$), indicating that these patients without mobility limitations are less likely to receive a nature-based physical activity prescription compared to those with a major limitation. The inadequate education subgroup also had a significant negative coefficient for minor limitations ($\beta=-.420$, $p<.01$); healthcare providers within this group are less likely to prescribe nature-based physical activity for minor limitation patients relative to patients with major limitations. Both subgroups indicated that the level ‘dislikes being outdoors’ had the highest utility. Diabetes had the lowest utility for the adequate education subgroup, while the level ‘male’ had the lowest utility for the inadequate education subgroup.
**Table 3.7. Relative preferences—segmented Cox regression full effects model: providers with adequate education vs providers with inadequate education to provide nature-based physical activity counseling**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Adequate Education$^1$</th>
<th>Inadequate Education$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient (SE)</td>
<td>Coefficient (SE)</td>
</tr>
<tr>
<td>Health Condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.020 (.137)</td>
<td>0.257 (.161)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.239 (.147)</td>
<td>0.309 (.174)</td>
</tr>
<tr>
<td>Severe Mental Health</td>
<td>0.265 (.150)</td>
<td>0.149 (.158)</td>
</tr>
<tr>
<td>Obesity/Overweight</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.137 (.103)</td>
<td>0.032 (.116)</td>
</tr>
<tr>
<td>Female</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td>-0.064 (.147)</td>
<td>-0.149 (.164)</td>
</tr>
<tr>
<td>Teen</td>
<td>-0.050 (.143)</td>
<td>-0.169 (.162)</td>
</tr>
<tr>
<td>Adult</td>
<td>-0.063 (.152)</td>
<td>-0.104 (.168)</td>
</tr>
<tr>
<td>Senior</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Degree of Physical Mobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demonstrated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Limitations</td>
<td>-0.399 (.124)$^c$</td>
<td>-0.357 (.146)$^a$</td>
</tr>
<tr>
<td>Minor Limitations</td>
<td>-0.242 (.133)</td>
<td>-0.420 (.143)$^b$</td>
</tr>
<tr>
<td>Major Limitations</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Treatment Adherence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Adherent</td>
<td>0.148 (.103)</td>
<td>0.079 (.118)</td>
</tr>
<tr>
<td>Adherent</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Attitude Toward Nature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dislikes being outdoors</td>
<td>0.702 (.135)$^c$</td>
<td>0.903 (.153)$^c$</td>
</tr>
<tr>
<td>Does not have a preference</td>
<td>0.166 (.118)</td>
<td>0.204 (.133)</td>
</tr>
<tr>
<td>Enjoys being outdoors</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

$^1$Log likelihood=2378.3, p<.001; $^2$Log likelihood=1858.3, p<.001

ref=Reference category; SE=Standard Error

$^a$0.05 significance; $^b$0.01 significance; $^c$0.001 significance

**Discussion**

This study, to our knowledge, is the first of its kind to access the revealed preferences of healthcare providers and to identify which patient attributes are impactful upon the decision to engage a patient in a nature-based physical activity prescription. This DCE assessed the
preferences of healthcare providers to prescribe nature-based physical activity prescriptions based on select patient attributes. Attitude toward nature, specifically the level ‘dislikes being outdoors,’ was the most important to respondents. The mobility attribute levels ‘no limitations’ and ‘minor limitations’ were significantly less likely to receive a nature-based physical activity prescription compared to patients with major limitations. Additionally, the model revealed that patients with hypertension or severe mental health were significantly more likely to receive a nature-based physical activity prescription compared to patients who are obese/overweight. The results of the DCE showed that attitude toward nature, mobility, and health condition had the highest utility among respondents in the sample population and were significant predictors of the probability of a patient receiving a nature-based physical activity prescription. Other attributes, such as gender, age, and treatment adherence were not significant predictors of the probability of a patient receiving a nature-based physical activity prescription.

Across all models, ‘dislike being outdoors’ consistently ranked as having the highest utility for healthcare providers in the sample population. This finding was contrary to our hypothesis that providers would have a higher likelihood of prescribing nature-based physical activity to patients who enjoy the outdoors. However, the emergence of ‘dislike being outdoors’ as the highest utility level suggests that the scientific findings such as the importance of nature upon human health (Brymer et al., 2014; Grinde & Patil, 2009; Jerrett & van den Bosch, 2018) have been accepted by healthcare providers, therefore when a patient expresses a dislike of nature, they are viewed as having a higher need for an intervention compared to a patient who enjoys nature. One study participant noted, “I often tell my patients the benefits of being outdoors in nature and 'forest bathing' based on my own readings and encourage them to get outdoors.” The connection between nature and health is often constructed around a general lack of green exposure in society. “Nature deficit disorder” was coined by Richard Louv in 2008 to
describe the disconnection and alienation of humans from nature and the costs associated with the diminished use of the senses, attention difficulties, and higher rates of emotional and physical illnesses. While this term was originally used in context of children, it is also used to refer to adult disconnections. Since the early 2000s, there have been publications on the growth of a vitamin D deficiency in children (Kumar, Muntner, Kaskel, Hailpern, & Melamed, 2009); the American Medical Association has released a statement establishing that the human body needs 10-15 minutes of sun exposure at least twice a week to receive adequate amounts of vitamin D (Brender, Burke, & Glass, 2005). Another participant commented, “I have no hesitation recommending [nature-based physical activity] for my patients. Most certainly, if the AAP (American Academy of Pediatrics) made as a policy, our entire office would quickly adopt.” The results of this DCE suggest that healthcare providers in this sample population appear to value nature-based physical activity prescriptions as a way to address nature disconnect by focusing their efforts on patients who dislike being outdoors.

The emergence of ‘no limitations’ and ‘minor limitations’ as being less likely to trigger a nature-based physical activity prescription compared to patients with major limitations was also contrary to our expectations. However, the customizable flexibility of nature-based physical activity does offer a low-impact way to encourage patients to be more active though activities such as gardening and walking through nature. Furthermore, studies have shown that nature-related physical activities can lead to health impacts such as improvement of physical capacity, endurance, balance, mobility function, flexibility, and more (Zhang et al., 2017). The low-threshold for participating in activities such as forest bathing may be more appealing to both patient and provider and seen as a lower barrier physical activity than more demanding activities, such as gym-based workouts that require a higher financial involvement, higher level of knowledge and skills, and can be non-inclusive spaces for individuals with mobility limitations.
(Rashinaho, Hirvensalo, Leinonen, Lintunen, & Rantanen, 2007). It should be noted that it is unclear how the mobility attribute levels were interpreted relative to a measure of overall physical fitness. Future DCE studies could be used to further explore the connection between mobility and physical fitness to see if there is a significant interaction between the two, and if the utility of mobility endures relative to physical fitness.

Previously, the literature review in chapter two found that there is strongest evidence for the mental health benefits of nature. As such, the finding of this DCE that patients with hypertension and severe mental health were more likely to receive a nature-based physical activity prescription relative to being obese/overweight was not surprising. Across the literature, the connection between exposure to nature and positive mental health outcomes is substantiated (Van den Berg et al., 2016). One study participant noted, “[A]s a health educator and certified Nature and Forest Therapy Guide (through the Association of Nature and Forest Therapy) I have been giving my patients practices to do outside in nature—mainly patients with anxiety, stress, depression and hypertension.” The utility of nature-based physical activity prescriptions among healthcare providers is a concept that could be further explored in light of the recent opioid crisis in the United States. Pretty, Rogerson, and Barton (2017) point out that nature exposure reduces internal stress markers and that the knowledge of being treated with nature dosages can cause a release of endogenous opioids that are non-addictive similar to the effect of drug medication. One incongruous result was the emergence of diabetes being a non-significant and low utility attribute level. Numerous studies have examined physical activity prescriptions for patients with diabetes (e.g., Yom-Tov et al., 2017); indeed, when studies reference chronic diseases associated with inadequate physical activity, diabetes is often noted next to hypertension (Gribben, Goodyear-Smith, Grobbelaar, O’Neil, & Walker, 2000). It is unclear if the availability of diabetes health behavior programs such as Diabetes Prevention Program (DPP) and Diabetes
Self-Management Education and Support (DSMES) programs that have been shown to successfully lead to lifestyle changes (Eaglehouse, Kramer, Rockette-Wagner, Arena, & Kriska, 2015) impact how providers perceive the utility of a tailored nature-based physical activity prescription for their diabetic patients. Future studies could exclusively examine how specialists, including endocrinologists, weigh the utility of diabetic specialized health behavior programming such as DPP and DSMES compared to nature-based physical activity prescriptions.

Health conditions were treated in the singular within this DCE, while in reality many of these conditions have a high prevalence of either comorbidity such as obese/overweight and severe mental health or multimorbidity such as diabetes, obese/overweight, and severe mental health. Jones (2010) notes that general practice consultation with a patient is often reliant on the incorporation of guidelines written for a single disease which creates problems in terms of prioritizing health behavior interventions, trading off risks and benefits, and assessing overall quality of care. To date, there remain challenges and a limited evidence base for the management of many comorbidities, in part due to the challenge of handling the impact of comorbidity in randomized controlled trials and research experiments. Multimorbidity and comorbidity is common in clinical practice, however there is a paucity of evidence supporting targeted interventions (Smith, Soubhi, Fortin, Hudon, & O’Dowd, 2012). A study by the US Preventive Service Task Force found that adults who are obese/overweight and have additional cardiovascular disease risk factors are likely to have a moderate benefit from receiving behavioral counseling whereas adults without a prevalent chronic disease show little evidence of benefiting from behavioral counseling (USPSTF, 2016). One utility of a singularity approach in the DCE regarding the health condition attributes was the ability to identify which health condition providers see as having the higher utility for receiving a nature-based physical activity
prescription. While in the clinic many patients have comorbidities, the results of this DCE can be used to guide the development of future nature-based physical activity prescriptions targeted at the emergent salient health conditions as a first step towards further examination of comorbidities.

Beyond examining the relative utility of patient attributes, this study also examined potential barriers to healthcare providers engaging in nature-based physical activity prescriptions. In this study, 45% of respondents felt they lacked adequate education to provide physical activity counseling. A lack of formal education on physical activity promotion has been frequently cited as a barrier for healthcare providers, negatively impacting their provision of physical activity counseling to patients (Bull, Schipper, Jamrozik, & Blanksby, 1995; Huijg et al. 2015; Sassen, Kok, & Vanhees, 2011). Cardinal, Park, Kim, and Cardinal (2015) note that more than half of U.S. trained physicians in 2013 received no formal education in physical activity. Physicians in the United States are increasingly being called to provide physical activity counseling in alignment with national policies, such as Healthy People 2020 and the National Physical Activity Plan, but are ill-prepared to meet these demands. One study found that only 23% of physicians were familiar with the American College of Sports Medicine guidelines for developing exercise prescriptions and 78% felt there was a need to include medical school curriculum to educate future providers on the medical aspects of exercise (Williford, Barfield, Lazenby, & Olson, 1992). Another study found that primary care physicians’ skills to provide physical activity counseling were low—self-efficacy and knowledge for counseling were reported at a mean of roughly 50 out of a 100-point scale (Smith et al., 2015). The self-reported perceived inadequacy of education within this study mirrors the findings of other studies that consistently report that health care providers are underprepared to engage patients in physical activity counseling and prescriptions.
Regardless of a providers’ prior education or self-efficacy to provide counseling, the reality within the clinics dictates that providers increasingly provide such counseling and prescriptions to their patients in accordance with emerging national policies and a shifting perspective of health care towards a patient-centric approach. This suggests a need for comprehensive interventions that address the specific educational needs of both providers and patients. The stated desire for additional education highlighted a need for integrating nature-based physical activity prescriptions into the clinic paired with improved knowledge of and access to park and recreation resources. Beyond designing focused patient health behavior interventions, the findings of this DCE suggest an equal importance in customizing clinical implementation with focused efforts to educate and support providers with the necessary tools to engage patients in physical activity counselling and refer patients to local, natural, outdoor environments.

Study respondents highlighted these themes in their comments in response to the open-ended question. Participants emphasized the need for community recreation resource information. According to one participant, the implementation of a program “would need good accessibility information,” or as one respondent noted, “I think partnering with city/national organizations to have scheduled activities makes writing a prescription easier and makes patients more likely to go.” Another participant commented on a need to integrate community knowledge into clinical systems: “I think if there was a way to write electronic prescriptions for getting outside or take part in guided forest therapy group with a Forest Therapy Guide, through our records system, it could be offered in our clinic by the doctors; the nurse practitioner, health educator and health coach.” The desire for integration, however, seems to be frustrated by existing institutional structures. As one respondent noted, “I have not made headway with information systems in my institution to add this to e-prescribing. [I] need an information
systems consultant to guide them,” while a different respondent remarked that, “Right now too many additional clicks to make it part of workflow,” and yet another stated, “It would be nice to have a more stream-lined way to print out Parks Rx prescriptions within our EMR system.”

These key conceptual themes were reiterated in the measurement of what additional resources would increase the willingness of providers to increase their use of nature-based physical activity prescriptions. Three themes emerged regarding what healthcare providers want and need to systematically implement nature-based physical activity prescriptions: 1) usefulness of facilitators and external partnerships, 2) improved access to recreation resources, and 3) codified structured referral and/or integration of the prescription workflow into the electronic medical record. Elements of these themes can be found in clinical nature-based physical activity programs. For example, the Miami Dade program emphasizes its partnership between healthcare providers and the local Department of Parks, Recreation and Open Spaces to facilitate the program, while also using an electronic referral system that streamlines the process (Messiah et al., 2016). The DC Park Rx program uses a web-based park data repository to generate a Park Page™ summary that is linked to the electronic health record system (Zarr, Cottrell, & Merrill, 2017). While the examination of nature-based physical activity programs in healthcare is an emerging field, the consistent reiteration of these three components suggests that they are critical to the feasibility, and perhaps the sustainability, of such health behavior programs within clinical workflow.

**Limitations**

This study had some limitations. First, DCEs are hypothetical tools that reveal preferences that may be different from healthcare providers’ actual behaviors and real-world choices. However, a recent study suggests that DCEs have a moderate accuracy when predicting health-related choices, and they do so with a relatively high sensitivity, suggesting a reasonable
degree of external validity (Quaife, Terris-Prestholt, Di Tanna, & Vickerman, 2016). There is a need for additional DCE studies that provide a clearer assessment of patient attributes upon providers’ intent to treat using a nature-based physical activity prescription. Second, we utilized a snowball approach to grow our sample population. While nearly 40% of our sample had not previously personally written a nature-based physical activity prescription, there is a possibility that the snowball approach favored a self-selection of providers who are generally optimistic regarding the utility of these prescriptions. Third, a majority of respondents were female who had an awareness of nature-based physical activity prescriptions prior to participating in the study. A replication of this study inclusive of more men may reveal a provider gender bias that did not emerge in our study. Fourth, the small overall sample size (n=75) limited the extent of our analysis, excluding interaction terms. Further studies with a larger sample size would be useful to examine two-way effects and potential significance of interaction terms. However, the main model that this study utilized does provide insight into what attribute levels may be most salient to providers that can be further explored in future studies. Finally, this study asked health care providers to respond to the concept of nature-based physical activity prescriptions, rather than using popular terms such as Park Prescription or Nature Prescription. Health care providers have been exposed to the concept of physical activity prescriptions due in part to the pervasive nature of health behavior interventions such as Exercise is Medicine, which has led to an almost universal concept of physical activity prescriptions and physical activity counselling. As such, by adding the parameter of “nature-based” to that ubiquitous phrase of “physical activity prescriptions,” the study was able to evoke an environmentally specific use of physical activity prescriptions without distracting providers into a dialogue around what constitutes a park, or even more challenging, how much green is needed for a space to be natural. To date, there is no
consensus as to what Park Prescriptions are, and in absence of a universally acceptable term, it seemed logical to add a modifier to an existing, well-defined term.

**Future Studies**

While this study revealed the relative utility of patient attributes to providers in the sample population, there are several questions that remain to be answered. Future research can build upon this study by considering additional health conditions and their utility relative to providers’ medical specialty. One respondent noted that, “I would like more information about what patients are likely to benefit, what conditions can see improvement, and number-needed-to-treat.” Additional studies could investigate further patient attributes such as the impact of race/ethnicity, socioeconomic status, and geographic location. Specifically, future research could focus on examining the continuum between rural and urban populations to see if the location of the patient and/or provider affects the utility of patient attributes towards likelihood to prescribe nature-based physical activity. An interesting finding of this DCE was the non-significance of age and gender upon likelihood to receive a nature-based prescription. As noted in chapter two, a majority of studies have focused on the utility of nature-based prescriptions for children. Further studies should grow beyond that a priori focus on youth and begin to assess the usefulness of these prescriptions across the life span. Future research can also explore what climatic regional trends might exist and how those trends might inform the language used to promote these prescriptions. Seasonality remains an unknown regarding the perceived viability of nature-based physical activity prescriptions. For instance, it is unknown if the nature-based physical activity programs are likely to succeed in year-round mild climates in places such as California while being unsuitable for winters in the Midwest. Additionally, the examination of needed education was restricted in this DCE. An entire DCE study could be conducted to assess what educational programs and resources are actually deemed useful by healthcare providers. Furthermore, this
study identified the importance of utilizing electronic medical records to support the integration of nature-based physical activity prescriptions in clinical workflows. Further studies are needed to assess how to best connect the electronic medical records and recreation resources to integrate nature-based physical activity within the clinic.

**Conclusion**

This study provides the first, to our knowledge, assessment of patient attributes using a DCE to better understand which attributes are most salient to the decision-making of healthcare providers to prescribe nature-based physical activity. Within the literature on nature-based physical activity programs, this study provides a unique perspective by focusing on healthcare providers’ revealed preferences for utilizing these prescriptions. Future research is needed to continue to understand what educational and resource needs are necessary for successful implementation in clinics. As one participant noted, “A standardized office policy to prescribe such a program could/would and should be implemented.”

There has long been an intuitive connection between exposure to nature and human health, as John Muir in 1901 noted:

> thousands of tired, nerve-shaken, over-civilized people are beginning to find out that going to the mountains is going home; that wilderness is a necessity; and that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life.

As social issues such as a growing disconnect from nature, higher incidents of chronic disease, evolving roles of technology, and the design of our environmental spaces continue to inform our discourse on human health and well-being, the concept of utilizing nature to mitigate the negative impact of these factors on community health continues to be explored and assessed by the scientific community (Barnes et al., 2019; Keskinen, Rantakokko, Suomi, Rantanen, &
Portegijs, 2018; van Heezik & Brymer, 2018). Increasingly studies are finding that contact with nature can lead to positive health outcomes (Hofmann, Young, Binz, Baumgartner, & Bauer, 2017; van den Bosch & Ode Sang, 2017). Despite the popular marketing of the national Park Rx movement that Park Rx is for “every American,” there is no one size fits all approach for nature-based physical activity prescriptions. Success of a behavioral health program requires a targeted, community-specific approach. For instance, selling the concept of “green” or “park” is very different within a geographic divide of urban versus rural, and is further complicated when social-demographic factors such as culture, gender, and age are factored into the design of the nature-based physical activity prescription program. Maier and Jette (2016) argued that “it is not enough, however, for healthcare providers to simply ‘prescribe’ green exercise; efforts must be made to help make programs tailored to populations’ needs” (p. 797). That sentiment points to the need for further research to assess how these prescriptions can best be integrated into the clinical workflow.

By surveying providers to identify an ideal target population for nature-based physical activity prescriptions, this DCE study has harnessed the clinical experience and expertise of healthcare providers and identified ways to supplement medical providers’ current efforts by revealing who healthcare providers perceive to be ideal patients for nature-based physical activity prescriptions. Within the medical community, exercise has been validated as an effective evidence-based medicine (Green et al., 2018); what needs further examination is what happens when the exercise prescription is targeted within a nature setting. As such, in attempting to build further clinical evidence to the effectiveness of nature-based physical activity prescriptions, it stands that by identifying which patients’ providers are most likely to engage in these programs, then such a clinical trial has a higher likelihood of successful implementation and completion due to the implicit buy-in from providers. Studies have shown that providers’ practice is
influenced by their own characteristics that can influence their approach to patient healthcare (Bélanger et al., 2015; Berger, 2008). By identifying one default patient group that providers prefer to prescribe nature-based physical activity prescriptions to, the task of designing a community-centered nature-based physical activity prescription program can be constructed and implemented to the strength of both provider preference and patient resonance through refined and targeted messaging and language, both in-clinic and throughout the prescription process (e.g., Armit et al., 2009).
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CHAPTER 4: DESIGN OF A PARK PRESCRIPTION PROGRAM INFORMED BY THE PERSPECTIVES OF PATIENTS AND HEALTHCARE PROVIDERS:
A STUDY PROTOCOL

Abstract

Insufficient physical activity levels result in health conditions that cost over $100 billion a year in the United States for the appropriate care. By integrating physical activity counseling into clinical practice, and by incorporating park and recreation resources into physical activity prescriptions, medical providers can help patients manage chronic diseases via local, culturally-appropriate health behavior interventions.

The GoalRx Prescription Trial (GPT) was designed to leverage community resources in order to provide tailored park prescriptions for patients served by federally qualified health centers in rural North Carolina. These interventions were based on the 5 A’s and the RE-AIM models. Focus groups were used to guide the development of the protocol used to integrate the GPT into the clinical workflow. A park audit tool was developed, and a database of local park and recreation programs and resources was created to bridge the knowledge gap between community partners and medical providers. A customized web-based application was built for pairing the parks and programs database with information from the patients’ electronic health records, thus creating a tailored parks prescription based on individual factors during the pre-scheduled clinic visit. Once a prescription was devised, a Fitbit Flex 2 was assigned to the patient for monitoring the physical activity of the patient, and SMS text messages were sent to record self-identified compliance and offer encouragement and reminders of goals, battery charging, and follow-up appointment times.

The use of eHealth technologies along with the seamless integration of the health behavior counseling into the established clinical protocols allowed for a customized approach for
each patient’s prescription, whether that resulted in the patient’s participation in the park-based physical activity prescription group or either of the two control groups (the home/indoor physical activity prescription group or the healthy eating prescription group). All patients were assessed at baseline and again at a three-month follow-up upon the completion of the intervention.

Contrary to perceived barriers of safety and willingness to participate, actual patient barriers included lack of transportation and self-efficacy. For patients who were able and willing to participate, this was made possible by the database of programs that provided options based on geography. Tailored health behavior interventions were prescribed that used personal leisure preferences along with the recommendation of the healthcare provider and biometric data pulled from the electronic health record. The protocol demonstrated the feasibility of incorporating community-clinical partnerships within standard clinical practice. This patient-centered care approach offers a higher standard of medical care, connecting patients to their healthcare teams and allowing for increased patient motivation in making longer-lasting changes to their personal health behaviors.
Introduction

Over a lifetime, personal behaviors have the greatest influence on health compared to other health determinants. In the U.S., nearly 90% of personal health care expenditures are spent on direct care, leaving limited resources for changing health behaviors (NEHI, 2017). More than $117 billion in annual healthcare costs in the United States are the result of insufficient physical activity levels (CDC, 2018). This has led to researchers advocating for further integration of physical activity counseling into standardized clinical practice (e.g., Berra, Rippe, & Mason, 2015; Harrabi & Al Ghamdi, 2014; James et al., 2017a). Medical providers are interested in using physical activity prescriptions to help patients manage their chronic disease (Wessel, 2017). A randomized control trial found that physical activity counseling by primary care physicians significantly increases physical activity (James et al., 2017a). Another study found that physical activity can be increased in mid-to-older age adults most successfully through tailored approaches (Armit et al., 2009). A systematic review of the effectiveness of physical activity interventions found evidence that the uptake of physical activity can result in long-term increased activity and fitness (Müller-Reiemenschneider, Reinhold, Nocon, & Willich, 2008). Other studies have examined the implementation and uptake of physical activity prescription programs, finding that they could be translated into routine clinical practice (Eakin, Brown, Marshall, Mummery, & Larsen, 2004; Patel, Schofield, Kolt, & Keogh, 2011).

Public health research has found that contact with nature is an underutilized health resource (Blaschke, O’Callaghan, & Schofield, 2017; Herzog, Chen, & Primeasu, 2002) despite evidence showing that exposure to nature is a key component to mental wellness (Razani, Meade, Schudel, Johnson, & Long, 2015; Sims-Gould, Vazirian, Li, Remick, & Khan, 2017) and that community-based physical activity programs can successfully lower perceived stress (Hazer, Formica, Dieterlen, & Morley, 2018). Research has also shown that outdoor parks and recreation
facilities can increase physical activity levels (e.g., Calogiuri, Nordtug, & Weydahl, 2015; Kaczynski & Henderson, 2007). A review of outdoor physical activity referrals by healthcare providers, from Green Prescriptions to Park Prescriptions (Park Rx), suggested that participants engaged in a Park Rx program will benefit from increased physical activity (Christiana, Battista, James, & Bergman, 2017; James, Hess, Perkins, Taveras, & Scirica, 2017b; Pfeiffer, Clay, & Conatser, 2001; Razani et al., 2015 & 2018; Zarr, Cottrell, & Merrill, 2017). While a more holistic approach that includes the role of parks in the healthcare system is being advocated (Mowen, Barrett, Graefe, Kraschnewski, & Sciamanna, 2017), a gap remains between the number of patients who medical providers believe would benefit from physical activity counseling and those receiving tailored prescriptions from their medical provider (Kolasa & Rickett, 2010). There is an opportunity to incorporate nature-based physical activity counseling into clinical settings that could leverage park and recreation resources to address individual and community health through physical activity as a health behavior intervention that can be implemented as a local, culturally-appropriate program.

**Clinical Intervention Models**

Despite evidence that health behavior counseling promotes physical activity and can improve nutrition, it is not widely practiced. For example, a majority of completely sedentary U.S. adults in 2012 were not told by a health care provider to increase their exercise levels (Loprinzi & Beets, 2014). Part of the issue is that health care professionals, including primary care doctors, may lack knowledge to effectively counsel patients on activity and physical activity program options. For example, a study of medical students’ perceptions of their own competency regarding patient-centered physical activity prescriptions indicated less than moderate competency at performing several important physical activity prescription behaviors such as designing a physical activity prescription (Vallance, Wylie, & MacDonald, 2009).
Cifuentes, Glasgow, and Stange (2008) found that the successful implementation of physical activity counseling relied on teamwork, clearly defining new roles within the clinic, routine of the patient encounter, systematically assessing health behaviors to utilize that information, community linkages, and the robustness of the clinical information systems.

The Exercise is Medicine movement in the United States has been successful in part due to its promotion and utilization of a standardized approach to systematically assess and prescribe physical activity (Lobelo, Stoutenberg, & Hutber, 2014; Sallis, 2015). Success of physical activity prescription programs is often attributed to their multilevel approach to patient counseling (Alexander et al., 2011; AuYoung et al., 2016). Physical activity prescription programs in clinical care have successfully utilized a 5 A’s approach (Peterson, 2007) in order to provide successful tailored patient prescriptions. Originally created for smoking cessation, the 5 A’s Behavior Change Model (Figure 4.1) has been adapted for use in obesity counseling and physical activity counseling (AuYoung et al., 2016; Fiore et al., 2008).

The 5 A’s model prompts healthcare providers to engage the patient and ensure that they provide comprehensive counseling that leads to a personalized (tailored) prescription for physical activity through five intentional steps. Assess prompts healthcare providers to explore with the patient their beliefs and knowledge about physical activity, as well as determine how active the patient currently is on a regular basis. Advise calls upon the healthcare provider to educate the patient on the health risks of inadequate physical activity levels and the personal benefits of being more active, and that they recommend a “dose” of physical activity that the patient should be achieving in a week. Agree prompts a co-negotiation process in which the provider and patient collaboratively set physical activity goals based on the patient’s interests and confidence in their ability to change their behavior. Assist focuses on identifying personal barriers, strategies to overcoming the barriers (such as specific problem-solving techniques), and
providing resources on recreation resources. Arrange takes the specifics of the prescription negotiated in the earlier stages of the model and specifies a plan for follow-ups, check-ins, and progress reports, as well as motivational messages.

![Diagram of the Five A’s model](image)

Figure 4.1. Five A’s of physical activity counseling adapted from AuYoung et al. (2016) based on the original model conceptualized by Fiore et al. (2011).

Partnerships among medical providers, community partners, and patients are likely to succeed when awareness regarding how terms are being operationalized, and a sensitivity to knowledge and barriers, guides the creation of tailored health interventions. The Five A’s model requires that terms be mutually understood between provider and patient. Currently, a lack of universally understood health behavior terms (e.g., exercise, nutrition, physical activity) can make clinical-community partnerships challenging. However, careful attention to defining terms and using intentional language can help to bridge the communication divide between healthcare
providers and patients, resulting in mutually termed tailored prescriptions that foster health behavior change. For instance, rather than healthcare providers simply telling patients to exercise more, there is a need to first assess how the patient conceptualizes exercise before a tailored goal can be made. By utilizing the Assess, Advise, and Agree stages to co-negotiate terms and language, healthcare providers can learn how to better meet the needs of patients and be conscious of creating a tailored prescription that resonates with the patient.

A study of the Five A’s in weight loss counseling found that 83% of physicians routinely used at least one of the Five A’s; often Asking and Advising patients to lose weight but rarely Assessing, Assisting, or Arranging (Alexander et al., 2011). The Five A’s model is intended to influence patients to be more motivated to change. Fostering confidence in their ability to change, can, as a result, increase their likelihood to change (Fiore et al., 2008). Use of the 5 A’s model is a manageable, evidence-based, health behavior intervention strategy that has the potential to improve the success of nature-based physical activity prescriptions within clinical care.

The Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework, developed by Glasgow, Vogt, and Boles (1999) provides a model for evaluating public health interventions with a lens towards real-world complex settings rather than optimized research settings. The RE-AIM framework is intended to be applied throughout all stages of the research cycle as a planning and evaluation model to answer the question, “Which complex intervention, delivered by what type of staff will be most cost effective, under which conditions, and for what outcomes?” (Gaglio, Shoup, & Glasgow, 2013, p. e46). An increasing focus has been on utilizing the RE-AIM model within dissemination efforts to measure the public health impact of an intervention (Lewis, Napolitano, Buman, Williams, & Nigg, 2017). The RE-AIM framework has been used to guide the integration and dissemination of a youth Park Rx program.
(Messiah, Jiang, Kardy, Hansen, Nardi, & Forster, 2016) and a physician-based physical activity prescription program in Finland (Aittasalo, Miilunpalo, Ståhl, & Kukkonen-Harjula, 2007), among other primary care-based physical activity prescriptions (Eakin et al., 2004). Furthermore, there is an increasing call among researchers to use technology alongside the RE-AIM model to advance physical activity intervention research (Lewis et al., 2017). As such, both the 5 A’s and the RE-AIM model offer established and valid ways for designing innovative park-based physical activity interventions.

Use of eHealth Tools

While technology has been blamed for a significant increase in sedentary behaviors over the past 50 years, technology as a health promotion tool has significantly evolved over the past 15 years, leading to the emergence of eHealth tools (Clark & Sugiyama, 2015; Lupton, 2015). Eysenbach (2001, p. e20) defined eHealth as:

an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.

One of the interesting benefits of incorporating eHealth technologies into health behavior interventions is its ability to provide customized approaches for each patient. Goal setting theory (Strecher et al., 1995) predicts that setting specific goals leads to better performance when compared to vague, non-quantitative goals such as “be more physically active”. Goal-setting for behavior change has been shown to be more effective than other approaches (Pearson, 2012). Historically, evidence from randomized trials showed that if medical providers formalized their
counseling (through written prescriptions rather than providing verbal advice), patients were more likely to adhere to the recommendations (e.g., Swinburn, Walter, Arroll, Tilyard, & Russell, 1998). Patient goal-setting can be done through interactive technology platforms and non-clinical members of the patient’s healthcare team (Bodenheimer & Handley, 2009). A study examining the integration of intervention of health behavior counseling in an electronic health record found that a shared goal-setting tool had successful usability (Chrimes, Kitos, Kushniruk, & Mann, 2014). Shared decision-making engages patient and provider in a mutual negotiation process in order to develop more tailored achievable chronic disease management goals.

In today’s clinical setting, eHealth tools support a patient-centered care approach that better connects patients to their healthcare teams, making it easier to collect patient specific data, analyze it, and apply tailored care embedded in the clinical environment (Shaw et al., 2017). Shaw et al. (2017) developed a model of eHealth that defined three domains of eHealth: 1) using eHealth to monitor, track, and inform individual health, 2) using eHealth to support communication between the patient and healthcare provider, and 3) using eHealth to collect, manage, and utilize health data for customized care. It was argued that eHealth initiatives including elements from all three domains would be the most successful (Shaw et al., 2017). Three barriers to health behavior counseling are repeatedly cited: lack of time, knowledge, and resources (Berry, Flynn, Seiders, Haws, & Quach, 2014; Kolasa & Rickett, 2010; Patel et al., 2011). However, eHealth tools potentially offer effective ways to reduce these barriers and streamline the integration of health behavior counseling and the prescription of health behavior changes in the daily clinical workflow by incorporating the three domains of the eHealth model.

As such, a nature-based physical activity prescription program could benefit from utilizing technology that helps to collect and track individual physical activity levels (e.g., consumer fitness trackers), while also increasing communication around the behavior change between the
patient and provider (e.g., SMS text messaging), and that incorporates the use of these eHealth tools into a centralized data repository (e.g., electronic medical record and prescription app compatibility).

A review of wearable patient monitoring solutions (such as fitness trackers and heart rate monitors) identified 20 articles published between 2015 and 2017 that used the technology to address chronic conditions, rehabilitation, cardiovascular disease, falls, and mental health (Baig, GholamHosseini, Moqee, Mirza, & Linden, 2017). These consumer-wearable activity trackers were found to be valid for recording steps, and the interdevice reliability of Fitbit monitors to be generally high (Evenson, Goto, & Furberg, 2015). Reviews and meta-analyses of text message-based interventions (e.g., Buchholz, Wilbur, Ingram, & Fogg, 2013; Head, Noar, Iannarino, & Harrington, 2013; Militello, Kelly, & Melnyk, 2012) have indicated that tailored interventions to the individual, particularly when also targeting a specific condition, yields larger effect sizes than not tailoring. One study using a wearable sensor (Fitbit One) and SMS text messaging found that these technologies had a positive (if waning) impact at increasing physical activity levels among patients (Wang et al., 2015). Another study found that in examining four case studies, there were varying levels of success using wearable fitness trackers; in response to their review of the case studies, the authors presented several useful questions to guide the selection and integration of physical activity trackers in health behavior research (Turner-McGrievy et al., 2018). Lobelo et al. (2016) noted that the prevalence of mHealth (mobile Health) software applications and wearable trackers has led to a saturated market where few devices collect and report the health data consistent with evidence-based guidelines, and often because of their consumer-oriented design, they do not meet the Health Insurance Portability and Accountability Act (HIPPA) guidelines for healthcare data. While the use of eHealth tools and integration feasibility is supported in the literature (Coleman et al., 2012; Grant, Schmittdiel, Neugebauer, Uratsu, &
Sternfeld, 2014), future interventions need to carefully consider what technology is used and how that technology will be integrated into a useful workflow for the healthcare team to support the use of nature-based physical activity prescription programs.

**Study Purpose**

Thus, this paper used the insights provided by focus groups to guide the development of a controlled clinical protocol for a tailored park prescription program that will be used to integrate that Park Rx program within the clinical workflow of Federally Qualified Health Centers in rural North Carolina. The goal was to create a study protocol grounded in the literature, that addresses the specific needs of the rural low-income community, and that fits into the natural rhythms and processes of the selected rural clinics in North Carolina. This paper outlines in full the study protocol developed based on the aforementioned perspectives and research.

The primary study objective of this clinical protocol is to investigate the effectiveness of a park-based physical activity prescription intervention that utilizes eHealth tools (e.g., fitness trackers, SMS text messaging, and an electronic medical record integrated provider web-based application) to increase time spent in moderate-to-vigorous physical activity as assessed by accelerometry. Secondary objectives of this clinical protocol are to investigate the intervention’s effectiveness for:

- improving the participants’ objectively measured physical health;
- improving the participants’ self-reported mental wellbeing as measured by the PHQ-9;
- encouraging the participants’ adherence to their tailored prescription by engaging them in self-reporting texts and receipt of motivational SMS messages; and,
streamlining the participants’ enrollment into physical activity counseling through the use of a preferences survey in the web-based application that generates customizable prescriptions automatically for the providers.

**Materials and Methods**

Two focus groups with healthcare providers (n=24) and two focus groups with adult patients with or at risk for diabetes and hypertension (n=6) were conducted by the research team to involve the key stakeholder of our intervention pilot study in assessing their respective knowledge of community-based recreation and healthy eating resources; in evaluating how key terms, such as physical activity, were operationalized; and in identifying barriers that could prevent the adoption of tailored-health behavior interventions, such as Park Prescriptions. Focus group questions examined four general topics:

1) **Wellness Advice**: Are patients receiving in-clinic advice regarding physical activity (PA)? What information is typically included in PA advice? How is the advice being delivered to patients?

2) **Content**: What is meant by PA? What barriers challenge patients' PA? What motivates successful lifestyle changes?

3) **Knowledge Acquisition**: How knowledgeable are you about community resources for PA? Where do you get your information regarding PA? Whom do you trust to provide information about PA?

4) **Implementation**: Do you see value in PA counseling to improve health outcomes? Would the use of an app that provides community resource knowledge be useful for creating tailored prescriptions for PA? Would SMS prompts encouraging prescription compliance be beneficial?
All focus groups were audio-recorded and transcribed using NVivo (Version 11.4.3). Data were analyzed using an inductive thematic approach (Auerbach & Silverstein, 2003). Two researchers independently coded, subsequent themes were compared, and then were negotiated to agreement. The data analysis began by first reading and re-reading the focus group transcripts several times for each question within the four general topics areas. Second, repeated ideas were identified within a particular topic area. Coding and specific themes emerged from the raw data. This process was conducted independently by two authors. The resulting codes and themes were reviewed by the authors to determine new insights and other valuable information for further exploration. This collaborative coding and theme review process minimizes individual researcher bias.

Several themes and sub-themes emerged from the data around knowledge of community physical activity resources, definitions for physical activity, and barriers to being physically active that were used to inform the creation of our study protocol. Key findings found that healthcare providers lack extensive knowledge of community resources, making it difficult to recommend parks for green exercise; as such, any intervention would need to provide a comprehensive repository of localized information. Patients demonstrated an extensive knowledge of what local recreation resources exist but may not know how to access them. This suggested a need for basic site information and contact information to be shared as part of the prescription. Healthcare providers conceptualized physical activity as a gym or community center-based exercise, specifically mentioning an increase in walking as an example. Patients took a broader conceptualization of physical activity and identified it as any general exercise, regardless of location. The difference in conceptualization suggested that patients would more readily understand a nature-based physical activity prescription, but that providers would need initial messaging to explain why such a prescription is valuable to their patients. Healthcare
providers described park safety as a significant barrier to physical activity, citing notable concern over not having the local information to select safe parks, whereas patients stated the major barriers to be childcare, transportation, and self-efficacy. The individual nature of barriers suggested a need for flexible, co-negotiated prescriptions where the patient and provider would work together to identify what activity and where best fit the patient to minimize potential constraints to the behavior.

Furthermore, healthcare providers voiced their interest in an intervention program that would facilitate the formal prescription of tailored behavioral health changes around physical activity and healthy eating. Many providers stated a belief in the value of providing a formal prescription over verbal advice, citing its value to better guide patients into the new behavior. Importantly, the focus groups found that patients were interested in, and valued, receiving a tailored health behavior prescription. These insights highlighted a need for a protocol that would generate tailored written prescriptions that would focus on one active change. Patients mentioned that anything that helps manage their chronic disease, promote weight-loss, or improve their health overall was important. Several patients stated a preference for a personalized (tailored) prescription that would help them focus on a specific goal and remarked that SMS text messaging would be a useful tool to provide ongoing encouragement and support. Patients liked the idea of having a communication channel to help hold them accountable to their health behavior prescription. Both healthcare providers and patients voiced that receiving a physical activity tracker (Fitbit) would help encourage the maintenance of increased physical activity levels. The insights and feedback gained from these focus groups was used to inform the development of this clinical protocol, including the use of physical activity trackers, text message reminders, and motivational messages. This clinical protocol is based on The Standard Protocol Items: Recommendations for Intervention Trials (SPIRIT). The SPIRIT guidance
document for clinical trials was used as a checklist to ensure the content of this protocol covered all recommended information that supported the quality of the trial (Chan et al., 2013).

Study Design

The GoalRx Prescription Trial (GPT) was a three-arm pilot controlled clinical trial to examine park-based physical activity prescription levels and two control groups. Participants in all arms completed assessments at baseline (T0), and a three-month follow-up at the completion of the intervention (T1). Participants self-enrolled into one of three groups: the park-based physical activity prescription group, the home/indoor physical activity prescription control group, and the healthy eating prescription control group (received no physical activity prescription beyond standard generic advice that is already clinical practice).

Study Setting

The GPT was conducted in Federally Qualified Health Centers in two rural counties in North Carolina. Participants were recruited face-to-face during their general wellness visits to the clinic. They were recruited across three clinical sites with the assistance of two onsite behavioral health clinicians (BHCs) from the clinic sites. The outdoor park exercise component of the intervention was conducted at local and state parks throughout the targeted counties. The home/indoor physical activity prescriptions were conducted either at the participants’ homes or at one of the community or commercial recreation facilities in the two counties. The amenities of these parks and recreation facilities were audited and catalogued by the research team as a database for the intervention using a park audit tool specifically designed for the clinical trial (Schultz, Bocarro, Lackes, & Floyd, 2018; Appendix B).

Eligibility Criteria

Patient participants were selected for inclusion on the basis of appropriate criteria. Participants had to meet all of the following requirements:
• Adult (18 years of age or older)
• Reside in either of the two selected North Carolina counties
• Have a clinical diagnosis for pre-diabetes, diabetes mellitus, hypertension, or have undiagnosed hypertension [determined by blood pressure thresholds]
• Willing to receive a health behavior prescription
• Able to read and speak English

Patients were excluded from the study due to any of the following criteria:

• Unwilling to sign an informed consent form
• Documented severe alcoholism or drug abuse that could significantly affect their ability and likelihood to comply with the study requirements
• Female patients who were pregnant or planned to become pregnant within six months
• Non-ambulatory patients and patients consulted or scheduled for surgery at the time of baseline data collection
• Patients planning to move from the study area during the next six months

All patients seen at the three clinics for a general wellness visit were screened for eligibility to participate in the study; interested patients were briefed at the clinic by the BHC during which the study purpose, duration, benefits, and registration into the GPT was presented. Eligible interested patients were enrolled in the intervention with the BHC through an app enrollment process that included an electronic informed consent form. Assessment questions were integrated into the patient preference survey that the BHCs administered to screen for conditions or risk factors that required further assessment by the primary physician before engaging in a physical activity.
Intervention

A customized web-based application was developed for the GPT that integrated information about patients related to their chronic disease, physical activity preferences, and nutrition behaviors in order to generate multiple tailored goals for each of the three intervention groups from which one intervention is selected and prescribed to the patient as part of their chronic disease management care. The GPT app pairs patient health data from the electronic medical record with stated patient preferences and triggers app-integrated SMS motivation and compliance messaging directly to the patient.

Each study participant was required to complete the participant interview that confirms demographic and health information, asks questions around medication compliance, diabetes management knowledge (if applicable), healthy eating, and physical activity to generate tailored prescription goal options. The BHC then helped the patient assess the options and co-negotiated one health behavior prescription (self-selected into the intervention arms). Each participant was given a paper copy of their prescription, along with a copy of their informed consent form. Protocols were developed to ensure consistent implementation by the study team and BHCs. All participants were enrolled for approximately three months.

Adherence to all intervention components was monitored and recorded by study staff. Prior to the intervention, the BHCs participated in a training led by the lead author to familiarize them with all aspects of the study protocol, go over the details required for successfully enrolling a participant, and ensure they were comfortable with navigating and using the GPT app.

Group 1—Park-Based Physical Activity. Participants interested in a self-guided physical activity prescription could opt for an outdoor park-based activity of their choice. Participants reviewed the list of potential activities generated from their preference selection and displayed by location. If a park-based physical activity prescription was selected, the following
parameters were determined by the BHC in consideration of the participant’s interest, physical ability, and overall health needs:

- Location
- List of days of the week to do a session
- Duration of the session in minutes
- Start date
- End date
- Activity type

This resulted in a tailored prescription that read: “Do <activity type> for <duration per session> minutes on <list of days of the week> each week at <location> until <end date>.”

**Group 2—Home/Indoor Physical Activity Control Group.** Participants interested in a home/indoor physical activity prescription could opt for an activity of their choice. Participants reviewed the list of potential activities generated from their preference selection and displayed by location. If a home/indoor physical activity prescription was selected, the following parameters were determined by the BHC in consideration of the participant’s interest, physical ability, and overall health needs:

- Location
- List of days of the week to do a session
- Duration of the session in minutes
- Start date
- End date
- Activity type

This resulted in a tailored prescription that read: “Do <activity type> for <duration per session> minutes on <list of days of the week> each week at <location> until <end date>.”

**Group 3—Healthy Eating Control Group.** Participants interested in a healthy eating prescription could receive a healthy eating prescription and handout related to (1) eating fruits and vegetables, (2) controlling portion size, (3) limiting sugary beverages, (4) eating meals at
home, or (5) eating fast food. BHCs were required to construct the <activity> as a verb-led statement (i.e., eat X more vegetables, or portion out X in a measuring cup) consistently to ensure that the automated SMS workflow read grammatically correctly, resulting in one of the following five tailored prescriptions (with printed handout):

1. If there is interest around choosing more fruits and vegetables, then provide him/her with www.ncfamilieseatingbetter.org/EFNEP/links/handouts/Handout3-ChoosingFruitsAndVegetables.pdf
   Tailored Prescription: I will eat x [fruits and/or vegetables] y days per week (name specific days of the week here) for z weeks.
   Another example: I will wash and cut [fruits and/or vegetables] when I bring them home from the store and put them in easy-to-grab containers y days per week (name specific days of the week here) for z weeks.

2. If there is interest around portion control, then provide him/her with www.ncfamilieseatingbetter.org/EFNEP/links/handouts/Handout8-SmartSizePortions.pdf
   Tailored Prescription: When I eat x, I will y [e.g., portion it out in a measuring cup, put it in a small bowl and put the bag back in the pantry] y days per week (name specific days of the week here) for z weeks.

3. If there is interest around limiting sugary beverages, then provide him/her with www.ncfamilieseatingbetter.org/EFNEP/links/handouts/Handout21-SmartDrinkChoices.pdf
   Tailored Prescription: I will drink x cups of water (If they have a specific water bottle they use, how many times will they fill it up and finish it?) y days per week (name specific days of the week here) for z weeks.
Another example: I will limit myself to x (cups/liter) (soda, sweet tea, etc.) per (week/day) for z weeks.

1. If there is interest around eating more meals at home, then provide him/her with www.ncfamilieseatingbetter.org/EFNEP/links/handouts/Handout4-PlanDinner.pdf
   Tailored Prescription: I will make (lunch/dinner) at home x times per week (name specific days of the week here) for z weeks.

5. If the participant eats fast food frequently and does not feel he/she is ready to change that, then provide him/her with www.ncfamilieseatingbetter.org/EFNEP/links/handouts/Handout20-SmartChoicesFastFood.pdf
   Tailored Prescription: I will limit myself to x trips to fast food restaurants per (week/day) for z weeks.

   Another example: When I order from fast food restaurants, I will [e.g., order a kids’ meal, skip the fries/order small fries instead of large, order a sandwich without cheese and without sauce)] x days per week (name specific days of the week here) for y weeks.

Participants in the healthy eating control group also received generic advice from the BHC to be more physically active in accordance with the existing clinical standard of care:

1) Participants perceived to be ready to increase physical activity:
   “In addition to your healthy eating prescription that we selected today, try to increase your physical activity to reach 150 mins/week of moderate intensity aerobic physical activity.”

2) Participants perceived to be mostly sedentary or with compounding health concerns:
   “In addition to your healthy eating prescription that we selected today, try to increase your physical activity by breaking up your bouts of sedentary activity.”
**Fitbit Use Across All Three Groups.** All study participants across the three groups were provided with a Fitbit Flex 2 to measure their physical activity levels and instructed by the BHC on its proper use, including how and when to charge it, wear use instructions, and data sync protocols, at the end of the baseline appointment. Each participant received a paper copy of the Fitbit instructions along with an appointment reminder card prompting them to return to the clinic in two weeks to sync their Fitbit, return for their three-month follow-up appointment, and to return to the clinic to do a final Fitbit sync after the three-month appointment.

For both the baseline and three-month follow up data collection periods, participants were required to complete a one-week acclimatization period with their Fitbit. During this acclimatization period, they were required to wear the device at all times (i.e., at least 10 hours while awake), with the exception of charging or showering. Participants then continued wearing the device for an additional one-week period to provide the study data.

The BHCs were responsible for the assignment and distribution of the Fitbits to eligible study participants at the baseline appointment. When a participant was enrolled in the study, the BHC:

1. Selected a Fitbit and recorded the Fitbit ID into the study app prior to handing the fully charged device to the participant.
2. Demonstrated to the participant how to charge the device using the provided dongle and how to recognize when the Fitbit battery needed to be charged.
3. Fitted the device to the participants’ non-dominant hand and explained how to operate the clasp to ensure the Fitbit was worn and not lost.
4. Explained to the participant that they are required to wear the device for at least 10 consecutive hours a day (this should be during their awake hours). Participants were
advised that the Fitbit is water-resistant and can be worn while swimming but could be removed for showering and charging.

5. Reminded the participant to charge the device every four days to avoid a dead battery. Participants automatically received reminder SMS texts about this throughout their wear time.

6. Explained to the participant to return with the Fitbit to the clinic at the end of the two-week wear period to return the device for syncing.

The BHCs were also responsible for reassignment and distribution of the Fitbits to eligible study participants at the three-month follow-up appointment. To redistribute the Fitbits for the follow-up wear period, the BHCs:

1. Selected the participant’s original Fitbit according the participant’s record in the GPT app. In instances where the original Fitbit was lost or destroyed, a new Fitbit was distributed.

2. Reviewed and re-demonstrated how to charge the device using the provided dongle.

3. Re-fit the device to the participant’s non-dominant hand, reviewing how to operate the clasp.

4. Reminded the participant of the required daily wear times.

5. Reminded the participant to charge the device every four days. SMS reminders automatically were sent to the participant with this message throughout their wear period.

6. Explained to the participant that they would return to the clinic at the end of the two-week wear period to return the device for syncing, at which point they were sent home with the Fitbit to keep.

**SMS Text Message Use Across All Three Groups.** The GPT app integrated automated SMS text messaging prompts for the duration of the participants’ prescription (see Appendix C
for specific messages). The SMS messaging functioned to assess participant compliance with the prescription and provide motivational messaging around participant adherence to their health behavior prescription and Fitbit protocol. Participants were automatically enrolled in an interactive text messaging campaign as part of the SMART goal intervention. Participants could opt-out of the SMS messages at the baseline visit by declining the service with the BHC or by texting “STOP” to any message during the study.

A two-way tailored text message system was used to collect information from the participant regarding their prescription compliance, while also providing a motivational message in response to the participant’s reply. Participants received an initial message that notified them of being enrolled in SMS reminders for their intervention prescription. Integrated theory of health behavior change (Ryan, 2009) was used as a framework for this health intervention and the SMS component. Social cognitive theory (Bandura, 2004; Glanz, Rimer, & Viswanath, 2008) constructs such as self-efficacy were utilized in the SMS by recommending making changes and providing positive feedback (“Keep it up!); reinforcement was the basis of the feedback response system, intended to increase the likelihood of repeated positive behavior.

Self-monitoring questions were used to establish if the participant had acted upon the action specified in their prescription in the last week (e.g., attending yoga class), and if they did the specified action, then how many times they completed the action in the past week (Figure 4.2). Participants were asked to reply to these messages and immediately received an automated feedback response message tailored to whether or not they had met their goal (as self-reported).
Figure 4.2. Example of the SMS feedback response system for park-based physical activity prescriptions. Green boxes are messages sent to the patient; blue boxes are messages received from the patient.

Each prescription group had automatically generated prescription compliance messages and reminders to charge the Fitbit, as well as a series of messages to alert the participant to upcoming clinic visits. The self-monitoring questions were developed to help prompt the participant to assess their recent actions and receive motivational messages customized to their intervention goal type and recent self-reported success. Participants automatically received a Fitbit reminder – “Avoid a low battery level. Remember to charge your Fitbit tonight.” – every four days during the two-week Fitbit wear periods. At the end of the two-week trial, participants received a different Fitbit reminder – “It’s time to return to the clinic to sync your Fitbit. Please remember to drop off your Fitbit within the next week.” – prompting them to return to the clinic to return and sync their Fitbit. Participants received a reminder SMS for their three-month follow-up clinical appointment with the BHC. At the end of the three-month intervention, the SMS system was used to assess the usefulness of the text messages towards adhering to their
prescription. After answering the evaluation questions, study participants received a thank you message for participating in the study.

Outcomes

**Primary Outcome.** The primary outcome for the study is the mean difference in weekly physical activity from baseline (T0) to post-intervention (T1) as measured by the Fitbit Flex 2 between the park-based physical activity intervention group and the control groups. Physical activity is defined by the total daily step count as measured by the Fitbit Flex 2 and the total active minutes per day. The accuracy of consumer wearable activity monitors has been formally assessed. While the algorithm used by Fitbit company products is proprietary, it has been used and validated in health research (Evenson et al., 2015; Takacs et al., 2014, Tully, McBride, Heron, & Hunter, 2014). The primary aim was to evaluate whether the park-based physical activity intervention resulted in a greater change in objectively measured physical activity compared to either the home/indoor physical activity control group or the healthy eating control group, and if any physical activity changes were sustained and adopted as a lifestyle behavior for the duration of the intervention. It was hypothesized that participants in the park-based physical activity intervention would increase their average steps/day and minutes of active time/day in T1 compared with T0 and when compared to the other intervention groups.

**Secondary Outcomes.** The secondary outcomes measures included an assessment of the relationship between the intervention and biological markers of health, including height and weight (in light clothing without shoes), systolic and diastolic blood pressure, HbA1c or available glucose test (if applicable), and depression screen score using the PHQ-9 collected at both T0 and T1 wellness visits to the clinic. The PHQ-9 is the depression module of the self-administered Patient Health Questionnaire and is a validated measure of depression severity wherein a PHQ-9 score of 5, 10, 15, and 20 represent mild, moderate, moderately severe, and
severe depression (Kroenke, Spitzer, & Williams, 2001). The secondary outcome measures in this study are defined as the differences in mean values in the intervention and the control groups at three-month follow-ups in mental wellbeing and physical health. It was anticipated that participants in the park-based physical activity intervention group would show significant changes in these measures, while those in the control groups would show no significant change. Other measures collected include potential covariates such as employment status, race/ethnicity, age, and gender.

Secondary outcomes from the SMS text messages included the total number of SMS messages sent, number of SMS messages responded to, number of SMS messaged ignored, and opt-out rate (overall and by intervention group). These measures helped assess the overall reach and impact of the feedback system. The SMS compliance messaging was used to determine prescription compliance rates. Through the self-evaluation questions, we measured if the participant followed their health behavior prescription that week, and if so, how many times. This allowed us to calculate a compliance rate per participant and per intervention goal type. In turn, this data was analyzed in conjunction with the participant’s tailored intervention goal and can be triangulated with the Fitbit and individual biometric data.

**Sample Size Calculation**

This protocol was used to conduct a controlled trial pilot study. One goal of pilot studies is to identify unforeseen problems with ambiguous criteria, misinterpretation of survey items, and feasibility of the protocol (Thabane et al., 2010). As such, we used the formula for calculating sample size in pilot studies developed by Viechtbauer et al. (2015). Problems with a prevalence of 5% would almost certainly be identified with a 95% confidence level in a pilot study including 59 participants. Accounting for an anticipated drop-out rate of 20%, this yields a
needed sample size of n=71. We opted for an enrollment of n=25 per group, or n=75 participants in total.

**Recruitment**

Patients who lived in either of the two targeted counties in North Carolina and were patients of the partner clinics were recruited for the GPT by the BHCs at the respective sites. Recruitment occurred with a two-month open enrollment period beginning February 7, 2018 and ending April 6, 2018. The three-month follow-up appointments ran May through September 2018. To increase interest in the GPT, the study team partnered with the BHCs to promote the study by hanging up recruitment flyers in the clinic and handing out flyers to patients, as well as educating front desk staff and primary-care physicians of the study and encouraging them to refer patients to the study.

As an incentive for participating in the GPT study, patients received the Fitbit to keep upon the completion of the study (or at the time they withdrew from the study). An informational handout detailing how to set up the Fitbit as a private account, tips for getting started with the Fitbit, and a link to the online user’s manual was provided to the participants at the end of the study.

The main recruitment mechanism for the GPT was through wellness visits with the BHC. During those already scheduled visits, patients were given detailed information regarding study design (e.g., SMART goal, Fitbit, and SMS), duration of the study, and an informed consent form. Prospective participants read and electronically signed an informed consent form. Patients who declined to sign the informed consent form were not included in the study, did not receive a Fitbit, and did not receive any SMS reminders. Only patients who opted into the study had their information accessible to the NC State research team via the GPT app.
Participant Timeline

Participants were engaged in a three-month intervention prescription. Baseline of the data collection required the patient to complete their wellness visit, enroll in the study, receive their Fitbit, wear the Fitbit for two-weeks, and then return the Fitbit to the clinic for syncing. Patients also began receiving the SMS messages that would be sent throughout the entire study period. The follow-up data collection required the patient to return to the clinic for a three-month follow-up wellness visit, re-receive the Fitbit, wear the Fitbit for two-weeks, then return to the clinic to sync the Fitbit, and respond to the final SMS messages. Figure 4.3 illustrates the participation flow and includes the timeline of enrollment, intervention components, measures, and clinic visits for participants across all three months of the intervention.

Assignment of Interventions

Participants were self-enrolled into either a treatment or control prescription on a first-served basis until the sample size was reached. Once the trial slots were filled, additional patients could receive an intervention prescription as part of their clinical healthcare but were not included in the study. The BHCs used the GPT app and patient preference survey to co-negotiate the final intervention prescription with each patient based on the patient’s medical needs, preference, and willingness to begin changing the health behavior. Due to the nature of the intervention and study logistics, participants and study staff were not blinded to the group allocation.
Figure 4.3. Flow of participants throughout the GPT pilot study.
Data Collection and Analysis

Data Collection. Patient biometric data was pulled from the electronic medical record into the GPT app. The BHCs used the GPT app to confirm the patients’ date of birth, gender, race/ethnicity, height and weight (which automatically calculated the body mass index), systolic and diastolic blood pressure, PHQ-9 score, and HbA1c or available glucose reading (if applicable). These values were captured at both the baseline and three-month follow-up appointments.

Fitbit Data Collection

The Fitbit Flex 2, a three-axis accelerometer, has capacity for seven days of detailed minute-by-minute data storage; with daily totals saved for up to 27 days. At the end of a two-week wear period, participants returned to the clinic to sync their Fitbit. For the first data syncing, participants returned their devices to their FQHC. Study team members collected the devices and manually synced all devices to the unique Fitbit accounts through a Fitbit dongle set up on a researcher’s computer through the online Fitbit portal. Step and activity data were extracted from the Fitbit website via a third-party program called Fitabase (Small Steps Labs, LLC, San Diego, CA). All activity data were exported from Fitabase in an Excel format, allowing for easier data analysis of a fully merged dataset. The second Fitbit syncing was led by the BHCs at the clinic. BHCs installed the mobile Fitbit app onto their cell phones and used the app’s Bluetooth capacity to wirelessly sync the patients’ Fitbits. BHCs were given access to the Fitabase platform where they confirmed each Fitbit was successfully synced prior to giving the participant materials instructing them on how to convert the Fitbit into a personal account. Participants who failed to return their Fitbits were contacted by the BHCs via phone as a reminder. In instances where a participant’s phone number had been disconnected, or if a participant was unable to be reached by phone, a letter was sent from the clinic to the
participant reminding them to return their Fitbit and asking for their help in successfully completing the reminder of the study protocol.

Limitations of the activity monitor used in this study should be noted. First, even when worn correctly, the device may underrepresent or overrepresent the amount of physical activity performed by each participant (Alharbi, Bauman, Neubeck, & Gallagher, 2016). To reduce intra-participant variability, the same monitor was distributed to the same participant throughout the study. To minimize the chance of being lost or damaged between the data collection periods, the study staff collected the devices and redistributed them at the beginning of the three-month follow-up data collection period. In the event that a device was lost, damaged, or broken during the study, a new device was assigned, and if available, the one-week acclimatization periods from the original and replacement device were analyzed to assess the reliability between devices; data adjustments were applied as needed. Collecting Fitbit data requires the participants to remember to wear the Fitbit and to keep it charged, both of which can create inconsistencies in the number of eligible daily activity data.

SMS messaging was used to send reminders every four days during the two-week Fitbit data collection to encourage proper charging. Further, consumer activity monitors such as the Fitbit Flex 2 have a streamlined and unobtrusive form, accommodating various clothing styles to minimize no-wear compared to less aesthetically conscious clinical grade monitors. The use of consumer activity monitors lessens the potential for participants fearing or encountering social stigma for wearing a device over several weeks.

**SMS Data Collection**

After developing a SMS communication strategy and library of messages, we utilized Twilio (San Francisco, California), a cloud communications company that supports programmable SMS. The Twilio platform functioned as a gateway provider, integrated into the
app, and provided support for organizing and sending SMS messages on a predetermined schedule. Messages were recorded in a log, allowing us to measure undelivered and unanswered texts, as well as tracking all sent and received messages between the system and participants.

**Data Management.** All participants were given a unique identification number. This identification number was used on all measurements collected. All data was de-identified from any patient number or participant identifiers using the unique identification number to ensure that all participants were assured their identity remained completely anonymous and unidentifiable. All datasets are de-identified, and no names are part of the datasets. A master participant identity log only includes participant phone numbers and identification numbers. This log is kept separately from the main research data under password protection and only exists to allow for the correct unification of the de-identified patient data and the SMS logs which are recorded by participant phone number. All datasets are under password protection. Datasets are stored on a secure computer within the Department of Parks, Recreation, and Tourism Management at NC State University. All data is held in strict confidence.

**Participant Biometric Data**

The GTP app integrates the participant’s electronic medical record along with the selected intervention prescription and assigned Fitbit in one comprehensive study record. Secure download of the participant biometric data is ensured using a two-factor authentication log in for study team members with an authorized account. All log-ins and downloads within the app are recorded and monitored to ensure that the security protocol has not been broken, in accordance with HIPPA protection guidelines for electronic datasets.

**Fitbit Data**

Prior to distribution of the Fitbits, the study team assigned a unique study ID to each Fitbit device. Each ID was used to create a separate online account through the Fitbit website.
(Ortiz et al., 2016). Device set-up was simplified by associating all 150 individual Fitbit accounts with one email address. By adding a “+” and the device’s study ID to the original email address (NCSUFitbit@gmail.com), 150 individual email addresses (NCSUFitbit+12345@gmail.com) were recognized by the Fitbit site while Google’s Gmail, which does not recognize the “+” or the numbers that follow the “+”, views the 150 addresses as the same and simultaneously links them all to a single email address. The research team used these accounts to generate access to all devices via Fitabase and facilitate the mass export of the synced data.

The study team’s management of the accounts on the Fitbit website ensures that participants are not able to access activity history, nutrition trackers, earn badges, or participate in social media interfaces and other online functions that could act as potential confounders. Participants were not allowed to sync their Fitbit using the mobile phone app because this would require logging into the study-managed account. Additionally, the Fitbit Flex 2 does not have a digital feedback display that shows PA levels or steps taken, serving to blind the Fitbit which further reduces the likelihood for confounding influences on PA levels. To ensure that the tracker lights were not influencing the results, the daily step total was set to 100,000 for each device, ensuring that only one white light was ever lit on the device.

**SMS Data**

Twilio automated the programmatic SMS messaging, Access to the Twilio logs was restricted to authorized research staff and required a two-factor authentication log-in. Logs were exported from Twilio as an Excel file. Study staff replaced the patient phone number with the patient identification key and stripped the file of the phone number prior to any analysis.

**Statistical Analysis.** Descriptive and inferential analyses will be performed using SPSS (Version 24). Patient biometric data from the GPT study will be presented, including descriptive and intent-to-treat analyses and \( t \) tests of pre-post intervention changes in body mass index,
systolic and diastolic blood pressure, glucose measures, PHQ-9 depression score, daily step count, average active minutes, and self-reported prescription adherence.

**Fitbit Data Analysis**

Data will be cleaned by establishing non-wear time cut points for the Fitbit. Using the timestamp within the data set, the first week of data (acclimatization period) for each of the two-time periods will be examined and removed from the final data set when a full 14 days of wear are present. The data set will be examined for outliers and removed. At least five days of valid data are required per time period for the individual Fitbit data to be included in the analysis. Valid data is defined as a 24-hour period in which at least ten hours of data wear time was recorded that included both a morning and afternoon window. Non-wear time will be analyzed as a run of zero counts lasting more than 60 minutes (Bassett, Mahar, Rowe, & Morrow, 2008).

Descriptive statistics will be calculated for each variable including demographic characteristics and physical activity. Analysis of Covariance with repeated measures will be used to examine the results. Models will be run to conduct two analyses: 1) Examining changes in the total weekly step counts during the baseline and post-intervention period; 2) Examining changes in total active minutes per week during the baseline and post-intervention period. Analysis will be run both within groups (e.g., treatment and control) and between groups. Statistical significance is defined as a p value of <0.05. Tableau (Version 2018.2.3) will be used to visualize the step data and create comparison graphs of the patient data between the intervention groups.

**SMS Data Analysis**

The SMS protocol included a weekly text message sent Friday at 10:00am, which asked participants to report how many times in the past week they followed through on their prescribed activity (e.g., How many times this week did you engage in walking at the park?). A score will
be assigned to each goal based on self-monitoring data from participants. For example, if a participant was prescribed to walk at the park three days a week, a score of 10 will be given if the participant reported 3 days of walking, a score of 5 if the participant reported 2 days, a score of 1 if 1 day is reported. A summary score will be calculated each of the 12 weeks, a higher score indicative of higher overall prescription adherence. Analysis of the stored SMS data logs will include participant adherence in responding to the prompts (defined as the proportion of self-monitoring texts received of the number expected over the 3-month period (n=12)). Total adherence and adherence by study week will be analyzed using chi-squared tests and t tests.

Ethics and Dissemination

**Research Ethics Approval.** This study and all its associated forms and resources was approved by the Institutional Review Board at NC State University.

**Declaration of Interests.** This project was funded by the North Carolina Division of Public Health's Community and Clinical Connections for Prevention and Health Branch, in collaboration with Goshen Medical Center, Inc. Representatives from the North Carolina Division of Public Health's Community and Clinical Connections for Prevention and Health Branch and Goshen Medical Center, Inc. were involved in the conceptualization of the study and had some input into the design. All other aspects of the study were managed by the NC State research team and the BHCs.

**Dissemination Policy.** The research data was compiled and written into a final summary report for the North Carolina Division of Public Health's Community and Clinical Connections for Prevention and Health Branch. The research data was also compiled into several poster presentations at international conferences. In addition, we intend to share key findings that will be written into a paper and submitted for publishing in a peer-reviewed journal.
Discussion

This study designed and implemented a clinical protocol to deliver tailored physical activity health behavior prescriptions to assist low-income rural patients in better managing their health. The GPT was successfully adopted at our three clinic locations by our BHCs. Feedback from the BHCs indicated high levels of patient interest in receiving a tailored physical activity prescription to address salient health concerns. The BHCs involved with the implementation of the pilot study found the GPT protocol process useful for engaging patients in conversations about health behavior changes and quickly generating tailored prescriptions based on patients’ preferences and lifestyles. The National Physical Activity Plan calls for healthcare systems to increase the priority of physical activity assessment, advice, and promotion (2016). The GPT protocol promotes equitable physical activity by promoting physical activity in the healthcare setting and prioritizing local recreation community-based resources to identify free and low-cost recreation resources. Cost and time are frequently cited barriers to engaging in physical activity (Reichert, Barros, Domingues, & Hallal, 2007; Salmon, Owen, Crawford, Bauman, & Sallis, 2003). A meta-analysis of exercise attitudes of rural Americans frequently cited the inability to afford a gym membership and difficulties with transportation to a fitness center (Wilcox, Oberrecht, Bopp, Kammermann, & McElmurray, 2005). By focusing on free or low-cost local recreation options (calculated by a geographic buffer zone using the patient’s home, worksite, and place of worship if appropriate) the GPT identified resources that were appealing to the patient and fit within their perceived constraints of money and time. Green spaces, parks, and waterways provide a counter narrative to the value of gym memberships and build upon the value of health and nature that is recently prevalent in the literature (Gladwell, Brown, Wood, Sandercock, & Barton, 2013; Wolf & Wohlfart, 2014). Park-based physical activity prescriptions, as used in this study, transcend economic and geographic barriers to health
behavior changes (Garrin, 2015). Furthermore, this pilot study protocol utilizes Fitness trackers and SMS text messages to close the information cycle between patients receiving a prescription and whether they actually adhered to the prescription, providing necessary feedback to healthcare providers. Patients wore the fitness tracker an average of 10 out of the 14 days, and 97% (n=56) of patients opted to receive SMS. These eHealth tools were overall successfully adopted by rural adults in the sample population.

Lessons Learned

There have been several important lessons learned as we rolled out the pilot of the GPT program. To ensure that the customized web-based application would meet the needs of our BHCs, we engaged in a year-long iterative process of designing, testing, and refining the app to ensure that its features and workflow would fit into the patient encounter with minimal disruption. Despite the care in designing the app, we learned from our BHCs that the geolocation function of the preferences survey was not working well. Continuous communication during the initial two-week roll out of the pilot allowed us to quickly respond and troubleshoot features that were not functioning up to the rigors of daily clinical workflow. Second, within the first few weeks of use, small errors in the code emerged. The clear delineation of a technical support protocol allowed us to quickly and efficiently record and fix these coding issues as they emerged. Having a dedicated research staff member who monitored the health of the technology, conducted weekly check-ins with the BHCs, and liaised with our app developer ensured that we were able to respond to issues as they arose and quickly provide solutions. This attention to technical support was also crucial in confirming to our medical partners our dedication to helping improve patient care by prioritizing their concerns and building solutions off of their feedback. Studies that plan to use various eHealth tools should factor in a timeframe for running a test trial on the systems to troubleshoot unforeseen issues prior to the launch of the formal study. Third,
community and academic partners should be prepared to spend substantial time ensuring all necessary legal protections are in place for conducting a healthcare intervention, such as a memorandum of understanding among all partners, a data use agreement with the clinical entity, patient authorization forms in addition to informed consent forms, and the ubiquitous institutional review board approval. Fourth, in debriefing with our BHCs, we found that one critical modification to the protocol would be to ensure that one academic research staff member be fully cleared to have unfettered access in the clinic regarding the study. We relied on our BHCs to execute the full study protocol, however with the natural fluctuation of the clinic including key staff turnover, we lost our trained BHC and support staff mid-study due to non-study related personnel changes. Ensuring clinic access by one research staff member would have allowed us to continue collecting Fitbit data while the replacement clinic staff completed their onboarding process. Additionally, while the SMS text messaging was automated, it is important to ensure that study staff are monitoring the logs daily to avoid inappropriate auto-replies to patients. For instance, we had one patient reply to the self-monitoring prompt with a message that his son had been killed and that was why he had not been completing his prescription. The automated messages continued to send an, “I’m sorry I don’t understand your response,” and was not noticed by study staff until towards the end of the study when logs were pulled. While patients were informed not to send personal information about their medical care via the SMS system, the realistic feel of the pre-designed messages led to several patients candidly discussing their inability to afford their medication and other life struggles that went unanswered by study staff. In future applications, having a staff member dedicated to daily monitoring of the SMS logs would ensure that patients reaching out with stated needs are identified and appropriately channeled to the proper care within the clinic.
Finally, careful consideration should be given to the timing of the open patient enrollment and necessary length of enrollment. Due to logistical constraints, we had to shorten our enrollment down from a three-month to a two-month window entering into spring. The unseasonably cold weather was noted by our BHCs as having a negative impact on patients’ willingness to consider an outdoor prescription, having arrived in coats to the clinic. Subsequent studies should consider the impact of weather patterns and seasonality affects when determining the optimal time for launching a nature-based physical activity program in their own clinic settings. Considerations around creating a program that works for the local community based on social norms of outdoor behavior is also an important factor for the ultimate success of these nature-based programs. For example, northern climates might consider how a spring/summer prescription can be adjusted for fall/winter activities, while a more southern climate might be more concerned with how to adjust activity prescriptions for the height of summer heat. Future studies might also consider what an ideal enrollment window for their study is, based on how many providers are participating in the study and at what average daily unique patient encounter rate, and adjust the open enrollment accordingly.

**Future Plans**

The initial pilot of this protocol shows the viability of seamlessly integrating tailored park-based physical activity prescriptions into a patient’s primary care appointment. The next steps are to test the scalability of the protocol and examine ways to ensure its cultural sensitivity for diverse populations. Furthermore, we hope to further integrate the patient specific external data sources (SMS messages, fitness tracker) into the electronic health record to provide more comprehensive care for patients with chronic diseases. For instance, the commonly cited barriers to physical activity for diabetic patients are a fear of hypoglycemia and uncertain knowledge about insulin pharmacokinetics (Brazeau, Rabasa-Lhoret, Strychar, & Mircescu, 2008).
Unmanaged diabetic patients could benefit from the integration of daily physical activity and glucose monitoring logs that can be used to refine patient specific insulin formulas, helping to mitigate hypoglycemic episodes and encourage increased physical activity levels by identifying the patient’s unique physiologic responses to physical activity types and the subsequent insulin sensitivity changes that lead to episodes of hypoglycemia and hyperglycemia.

**Conclusion**

As the proliferation of commercially available fitness trackers and mobile device platforms evolves on the market, the appeal of the devices and decreasing costs have led to more people self-monitoring their health behavior. While research has integrated wearable devices and SMS text messaging into health behavior interventions across a range of populations, little attention has been directed into the usability and acceptability of these approaches for low-income rural adult patients managing a chronic disease. Although our medical partners had voiced concerns that low-income rural adult patients would not engage with SMS text messages or comply with a fitness tracker protocol, we found that not only were these perceptions inaccurate, patients were generally excited to use the Fitbits and receive feedback text messages. While there are some barriers such as internet access, the low-cost of SMS messages (roughly $0.005 per message) and the affordability of fitness trackers make this technology beneficial for automating data collection and providing long-term engagement and support for health behavior interventions such as Park Prescription programs. In contrast to much work that has emphasized generalized physical activity interventions, this research demonstrates the feasibility of tailored health behavior interventions and the value of creating community specific data repositories and resources that allow for quick and automated generation of tailored prescriptions. Reducing the burden on healthcare providers to have extensive local knowledge of resources and self-generate
tailored prescriptions led to an increased likelihood of preventative interventions being integrated into patient care.
REFERENCES


CHAPTER 5: CONCLUSION

While the benefits of nature are shown to be effective (Barton & Pretty, 2010) with even just five minutes of exposure (Neill, Gerard, & Arbuthnott, 2018), there is a need to explore to what degree Park Rx programs improve health outcomes for select patient groups. Park Rx programs range from interpretive programs to clinically implemented efforts with varying degrees of documented outcomes and success measures. Despite the popular marketing of the national Park Rx movement touting that Park Rx is for “every American” (ParkRx, 2018), there is no one size fits all approach for nature-based physical activity prescriptions. Motivations, barriers, and constraints are uniquely personal concepts, and as such, health behavior interventions need to be tailored to the individual. Success of a nature-based physical activity behavioral health program requires a targeted, community-specific approach that can cater to the localized needs of an individual. Promoting the concept of “green” or “park” is very different within a geographic divide of urban versus rural and is further complicated when social-demographic factors such as culture, gender, and age are factored into the design of the nature-based physical activity prescription program. Maier and Jette (2016) argued that “it is not enough, however, for healthcare providers to simply ‘prescribe’ green exercise; efforts must be made to help make programs tailored to populations’ needs” (p. 797). Establishing the effectiveness of nature-based physical activity prescriptions is predicated upon knowing 1) for which patients the concept is applicable, 2) what health condition(s) can be improved by this type of prescription, and 3) how these health behavior programs can be streamlined into clinical practice. Thus, this dissertation sought to examine the concept of behavioral health implementations through nature-based physical activity prescriptions as they relate to patient wellbeing and a salutogenic clinical healthcare approach. To do so, the dissertation involved three distinct but entwined steps that examined, assessed, and tested the concept of nature-based
physical activity prescriptions from a leisure-informed clinical viewpoint to determine how these programs can be designed and implemented to positively impact patient health outcomes.

**Summary of Findings**

The second chapter (first manuscript) was a scoping literature review examining nature-based physical activity prescription programs to assess what scientific evidence exists for the health outcome impact of clinically-based programs. That review examined the quality of the identified studies to assess the study designs, target populations, health outcomes, and demonstrated success of the interventions, as well as identify key areas for further study. What emerged was a limited theoretical and empirical research body regarding Park Rx; however, the initial studies do suggest that these programs can be a feasible clinical approach for addressing patients’ mental and physical wellbeing. A review of existing literature provided a starting point for assessing and understanding how these programs had been used as well as commonly cited barriers, and was foundational in identifying what patient attributes, healthcare provider barriers, and systematic clinic-based concerns to explore in the second and third manuscripts. To date, no systematic literature review has focused on clinically-based Park Rx programs. As such, this study contributes to the literature by focusing on Park Rx programs at the clinical end of the spectrum and presents an overview of the scientific evidence for the impact of these programs.

Chapter three (second manuscript) presented the findings of a discrete-choice experiment that examined the why of nature-based physical activity prescription programs, to see for whom and what attributes healthcare providers are likely to view utility in prescribing nature-based physical activity prescriptions to patients. This DCE provided additional context for healthcare providers’ prescription behavior and gave an insightful look at the concept of implementation for a scientifically established target population and not an a priori population that is often seen in the literature. For example, while many studies to date have focused on youth, the results of this
DCE suggest that healthcare providers themselves do not prefer nature-based physical activity prescriptions for any one age, and as such, a wider application of age groups should be represented in future studies to better assess health outcomes. Additionally, this DCE suggests that healthcare providers consider patient attributes such as mobility, health condition, and attitude toward nature more important in the consideration of treatment than attributes such as age, gender, or treatment adherence. Furthermore, by examining providers’ needs around education and resource support, this study helps grow a basis for implementation strategies that includes a streamlined clinical approach with eHealth technologies, as well as the integration of readily accessible community-centric recreation resource information. What emerged strongly from the DCE was the need to further explore how to integrate nature-based physical activity prescriptions into a standardized clinical approach.

From a scholarly standpoint, this paper contributed as the first to use a DCE to analyze healthcare providers’ perspectives on patients’ attributes as an influence upon prescription behavior. The application of random utility theory and Lancaster’s characteristics theory of value were useful for this analysis and would be recommended for use in other recreation-based community-clinical research. There are few studies that have expressly focused on the preferences and prescription tendencies of healthcare providers as it relates to Park Rx style programs, therefore this study contributes substantially to the literature by focusing on healthcare providers preferences, barriers, and needs.

Chapter four (third manuscript) built upon the DCE findings and examined a nature-based physical activity prescription program protocol utilizing eHealth technologies in an effort to codify the feasibility and utility of the program within a clinical setting as a valid and impactful prescription to address patients’ wellbeing. The protocol integrated the feedback gained from focus groups with patients and healthcare providers, exploring their perceptions
guided by the Five A’s to better understand the group’s knowledge of physical activity and local resources, explored the perceived value of integrating eHealth technologies into a tailored prescription, and ultimately informed the custom design of the protocol for the study locations. Utilizing the knowledge gained in the first two papers, the protocol was grounded in the available evidence and science, while also striving to be designed for the unique features and needs of the study population and communities.

The contribution of this paper is its comprehensive outline of a clinical protocol as well as the detailed information provided regarding the use of the eHealth technologies. Few protocol papers have been published that articulate the steps of a clinical trial around nature-based physical activity (Messiah et al., 2016; Müller-Riemenschneider, et al., 2018; Razani et al., 2016). Furthermore, the rapid emergence of new technologies makes it necessary to have scientific evidence regarding the use and validity of these tools within the health behavior intervention (Lobelo et al., 2016). As such, the contribution of this paper is the comprehensive protocol and evidence of success in using Fitbit Flex monitors, SMS text messaging, and an electronic health record integrated web application to generate tailored health prescriptions as well as monitor adherence and impact of the prescription for each patient. Within the leisure research literature, there are no protocol papers to date that outline the process of implementing a community-clinical nature-based physical activity prescription program as shown by the literature review. Therefore, this study helps to bridge the gap between medical, public health, and leisure practitioners by providing a template for creating community specific programs that can be used by researchers and professions in the leisure field to engage local healthcare systems in growing nature exposure programs.
Limitations and Future Research

Intentionally for both the second and third manuscript, the terminology “nature-based physical activity prescription” was used in lieu of more popular terms such Park Rx or Green Exercise to ensure that the focus of respondents and healthcare providers was on programs that utilized physical activity prescriptions that were intentionally seeking to increase a patient’s nature exposure. While the use of that term was intended to provoke a clinical perspective, it might not have resonated with individuals who are specifically attuned to various linguistic terms. Further research is needed to examine what terminology is perhaps better suited for a clinical/research application versus a patient or community population facing term. Furthermore, there is a conflation of terms that emerges throughout the literature, such as Park Rx, Green Exercise, Nature Exercise, and Green Prescriptions, which do not always have the same definition, despite being used interchangeably. For instance, Green Prescriptions are one problematic term used to refer to the New Zealand clinical programs that do not actually specifically denote time spent outdoors or in nature, but rather just engagement in recreation programing that takes place both indoors and outdoors (e.g., Anderson, Taylor, Grant, Fulton, & Hofman, 2015; Croteau, Schofield, & McLean, 2006; Elley, Kerse, Arroll, & Robinson, 2003).

Additionally, future research needs to move forward by continuing to examine the continuum of nature-based prescriptions from the heavily clinically-based interventions to the more relaxed community-based efforts as explored in chapter one of this dissertation. Language is critical in facilitating successful integration of a target population into a nature-based physical activity prescription program; if the message does not resonate with the audience, then it is difficult to create buy-in. Appropriate language for target audiences directly changes and influences nature-based physical activity prescription programs. For instance, if a nature-based physical activity prescription program was implemented in a clinic for all ages, the term “trail”
may be off-putting to older adults, whereas the term “walking path” could be more appropriate. Or, if a program is targeting youth, then refining and testing messaging in-clinic for two audiences – both the child and the accompanying adult caregiver – is needed. Arsenijevic and Groot (2017) found that the effects of physical activity prescriptions on physical activity levels were influenced by program characteristics and the design of the study; they advocated that future studies needed to target particular groups to account for the populations’ preferences and needs. Given the lack of evidence for nature-based physical activity prescriptions, it seems prudent to continue focusing on identifying which populations can be reached via providers (as begun by the DCE), and then refining the implementation process.

Generalizability of this dissertation should be considered with respect to the methodologies used. Discrete-choice experiments analyze the attributes and levels selected; limiting the DCE to six attributes reduces mental fatigue of participants but also reduces possible comparisons of the various patient attributes. As such, it is possible that a health condition with even higher utility exists but was not represented in this DCE. Furthermore, additional patient attributes should be studied for their impact on the providers’ likelihood to prescribe a nature-based physical activity prescription. Regarding the clinical protocol, the development and implementation was guided by the perspectives of rural North Carolina providers and patients; the sample cannot be considered representative of providers and patients in other locations. With few studies conducted in rural or suburban U.S. settings, it is recommended that future research include such communities to add to the knowledge of how nature-based physical activity prescription programs can successfully create community-clinical connections that support health behavior changes.

One complication to future studies is the lack of community recreation data sources that can be readily utilized to inform healthcare providers. Local efforts to integrate data repositories,
such as NCCARE360, make the point that connecting individuals to community resources is inconsistent and not coordinated. They suggest the development of a tool to make it easier to connect people with the resources they need to be healthy (NCCARE360, 2018). Existing bodies of knowledge within communities about their recreation resources (both physical locations and amenities, and programming options) vary greatly from community to community. Prior to building the clinical protocol and web-based application, a comprehensive audit of local recreation spaces had to be completed for the rural North Carolina counties. The scalability of clinical nature-based physical activity prescription programs is limited by the lack of local data sources. Platforms such as Park Rx America offer the web-based repository for such localized data, but for communities without existing data repositories, park audit tools, like the one developed during this dissertation (Appendix B), should be utilized, to integrate the information into eHealth solutions.

This dissertation examined the impact of green space centric nature-based physical activity prescriptions. As shown in the literature review, to date, clinical studies have focused on green spaces as opposed to blue spaces, even though water spaces are shown to have equal positive health outcomes as green spaces (Foley & Kistemann, 2015; Völker & Kistemann, 2011). Future research is needed to explore how an expansion of nature spaces could help engage broader audience. For example, an inner-city youth sailing program not only exposes the youth to outdoor recreation, but also provides positive benefits of health and wellbeing. Moving forward, the incorporation of blue space prescription programs into the same dialogue as green space prescription programs offers the ability to explore how to better tailor options that meet the preferences of a broader population. To that point, as the research moves forward, it is possible that the term Park Rx is better left as a population facing term, in favor of nature-based prescription programs utilized by clinical and research individuals to better encompass the green
spaces, blue spaces, and even brown spaces (i.e., desert landscapes, rocky landscapes) that afford quality nature exposure.

**Implications and Outlooks for Potential Research**

A consideration in both of the studies is the importance of the rapid evolution of technologies and the frontiers of eHealth that change represents. As the validity of commercial physical activity monitors is continuously updated in the research (e.g., Evenson, Goto, & Furberg, 2015; Kooiman et al., 2015), what has emerged are considerations for how common design features (e.g., connectivity, display screens, notifications) can be utilized to create closed-loop communication systems with health records and SMS data collection platforms, as well as collecting additional biometric data such as heart rate, sleep, and energy expenditure. The aesthetics and design of physical activity monitors, user interface design of apps, and the integration of multiple data sources opens a realm of possibilities for continuous, low-cost monitoring of health behaviors that can be integrated into the design of health behavior interventions. The importance of user experience in designing electronic health record interfaces that compile and synthesize the possible data sources for each patient is also an evolving consideration that will impact willingness of use and perception regarding the ease of use. While the monitors and devices will continue evolving, the utility of those devices remains grounded in their ability to capture patient data, which allows for unprecedented customization of health approaches for the patient which can also be aggregated to drive recreation resource planning in communities. This dynamic creates several opportunities and challenges.

From a leisure perspective, the continued rise in popularity and adoption of Park Rx programs creates higher demand and may lead to increased use of local recreation resources that has both a positive and negative outcome. While there are existing data on estimated visitation volume and visitor demand shifts from climate impacts such as longer peak and shoulder seasons
in some parks, and overall increasing populating of parks and outdoor recreation areas, there is no data to forecast volume due to Park Rx programs. The National Park Service was tasked with a dual purpose in the Organic Act of 1916 to preserve the flora and fauna of the ecological landscapes while also facilitating the enjoyment of those spaces for this and future generations (Winks, 1996). While leisure spaces such as parks, trails, rivers, and bodies of water can be used at local, state, and national levels for the purposes of creating healthier populations, the increased enjoyment of those spaces can also negatively impact the health of the landscape. Such a contrasting duality has long been at the heart of outdoor recreation management and suggests that the efforts of organizations such as SH/FT to facilitate partnerships between outdoor recreation, conservation, land management, and health care is both timely and critical to the sustainability of nature-based physical activity prescription programs. The SH/FT Rx challenge encourages daily interactions with nearby nature, such as local gardens and parks, that is supplemented by weekly, monthly and annual/biannual excursions to bigger and wilder natural areas (SH/FT JH, 2018; Figure 5.1).

Figure 5.1. The SH/FT Rx challenge pyramid.
The early leadership of the NPS in the Park Rx movement is another indication that the development of these programs, when done in partnership with recreation resource managers and leisure professionals, can be done in a way that creates a win-win situation for both humans and the environment. While to date there has not been a level of uptake with Park Rx programs that has caused concerns about increased demand and visitor impacts on park and recreation areas, increasing desire to scale these programs means there is an opportunity to proactively design solutions for outdoor recreation planning and management before significant negative impact on resources and experiences occurs. A classic example within outdoor recreation management is the utility of the recreation opportunity spectrum (ROS). Manning (2011, p. 196) defines the ROS “as an organizing framework for thinking about recreation opportunities. It explicitly recognizes that experiences derived from recreation activities are related to the settings in which they occur, and that settings in turn are a function of resource, social, and managerial factors.” The ROS provides a framework, linkages, that consider how opportunities for connecting with the natural environment is likely to be enhanced through limited development of the setting. In turn, application of ART suggests that mental restoration is best supported in natural environments (Kaplan, 1995). Utilizing these frameworks together helps to guide recreation managers towards a proactive modification and redesign of landscape use that will help to integrate these recreation spaces into public health with thoughtful consideration as to how to link recreation activities (Park Rx) with leisure settings, individual motivations, and benefits. Jubenville and Becker (1983) argued that if recreational resources are consistently managed for well-defined and publicly known opportunities, then both the visitor and manager will benefit. Visitors are likely to have higher satisfaction with their selected opportunity, while managers will likely need less regulatory measures to control inappropriate visitor use. ROS provides a framework for matching desired visitor experiences with available opportunities and can help
inventory local park networks for managers to proactively consider where various popular Park Rx (e.g., nature walks, forest bathing, dog walking, etc.) can be integrated or enhanced within local systems that may or may not have the current capacity for accommodating. For instance, a park system that is highly developed for youth programming and large sport field complexes can benefit by pairing ROS and ART to consider what landscapes could be modified to afford a broader recreation opportunity to a diverse community. Incorporation of a leisure informed lens ensures that as Park Rx programs are scaled within the health community, park and recreation managers are prepared to meet the prescription demands and optimize referrals to appropriate landscapes in an attempt to increase the likeliness of visitor satisfaction.

Potential research lines could also begin to explore how Park Rx relates to several foundational leisure concepts. Leisure socialization is one such concept. Kelly (1999, p.142) defined socialization as a “dialectical process that continues through the life course;” humans are socialized into leisure though experiences and choices and as such, through leisure socialization learn how to engage in leisure. Across the life course, there is an interesting perspective to explore whereby individuals who have received a Park Rx enter into a new phase of leisure socialization; first, learning an activity, then examining how that learned activity matures, and lastly, seeing how that learned activity develops long-term within that individual’s life. Leisure motivation constructs are used to explain leisure behaviors. One critical assumption of those constructs is the idea that people engaging in leisure have undergone some degree of socialization by which a connection between needs arousal and subsequent satisfaction can be found through specific leisure experiences. This raises the question, “To what degree can leisure socialization lead to higher adherence of Park Rx and a maturation of the leisure behavior across the life course?” Research is needed to understand how the leisure socialization process might influence individuals’ beliefs that participation in the activity will satisfy select needs. Leisure
socialization allows individuals to gain specialized knowledge, skills, norms, and attitudes that create a foundation to move from recreationalist novice to leisure specialist.

Building upon the initial leisure socialization concept, the construct of leisure specialization defines “a continuum of behavior from the general to the particular, reflected by equipment and skills used in the sport and activity setting preferences” (Bryan, 1977, p. 175). Does the reception of a Park Rx and leisure socialization lead to leisure specialization? Consider a Park Rx that takes advantage of a city’s bike share program. Will the degree of leisure socialization received by the patient affect both prescription adherence and the evolution of the leisure activity into one of specialization? These questions consider the human need to grow within an activity. It considers the trajectory of an individual moving from a casual cyclist into a specialized road cyclist. An interesting perspective here is the concept of developing norms; as a person progresses along towards specialization, there is typically an adoption of new norms that accompany the activity. One potential research avenue is to explore the relationship between an individual’s experience along the specialization continuum and the adoption/normalization of health behavior changes. The leisure concept of specialization states that an individual engaged in a recreation activity is likely to become more specialized overtime; as that degree of specialization occurs, the activity is likely to become more central to an individual’s life. As such, is it feasible to utilize the framework of the specialization concept to predict how a Park Rx might lead to maintained health behavior changes? Manning (2011, p. 249) notes that “[i]ndividuals evolve along the specialization continuum at least partly as a function of assimilating the specialized worldview outlined by leisure social worlds. One additional dimension of specialization is its relation to place attachment (Mowen, Graefe, & Virden, 1998).

In an increasingly diverse America with concerns about the future of environmental stewardship, Park Rx programs could prove to be an impactful way to engage non-traditional
populations with the natural landscape and foster place attachment, a sense of place, and belonging that in turn paves the way for future participation in the protection of and ecologically sensitive use of these landscapes. By using this three-tiered approach of local, state, and national nature access, there is the potential to grow specialized programming that helps to educate populations’ prior engagement with more ecologically sensitive areas. For instance, urban programs such as The Neighborhood Ecology Corps (2017) promote environmental literacy while exposing youth to local, state, and national parks, as well as preserves and refuges. A partnership between this program and local healthcare providers is just one of many potential models for growing nature-based physical activity prescription programs along that continuum that caters to needs unique to each community. The concept of environmental socialization is a previously utilized leisure research lens for identifying socialization forces that foster concern and care for natural environments. One study utilized environmental socialization to examine how childhood play situated in natural environment experiences can stimulate environmentalism and environmental preferences across life domains (Bixler, Floyd, & Hammitt, 2002). Studies in this area refer to a general preference among adults for green environments rather than built environments, reflecting the biophilia hypothesis that all humans are innately connected and drawn to nature. However, the approach of environmental socialization raises the potential for examining how socio-physical aspects of natural environments appeal to humans, and how place attachment can relate to a sense of joy and restoration as well as environmental activism. To this point, an additional research line might consider how Park Rx as a mechanism for nature exposure could be assessed for its impact upon nature appreciation, a desire to learn about nature, and theoretically, environmentalism behaviors. The Dunlap-Heffernan Thesis evolved in leisure research positing that there is a positive association between outdoor recreational participation and pro-environmental behavior, and that intuitively there will be differences
between/among various types of outdoor activities concerning their impact on pro-environmental behaviors (Dunlap & Heffernan, 1975). Leisure research has focused on the positive connection between a person’s level of environmental concern/behavior and personal participation in outdoor recreation (Teisl & O’Brien, 2003).

Outdoor recreation is an important mechanism for fostering nature appreciation, building social connections, and improving mental and physical health. As such, it seems intuitive that green exercise, nature-based physical activity, and outdoor recreation continue integrating and developing new theoretical models and community programming platforms. The leisure research field offers a range of conceptual knowledge that can be harnessed to help create, understand, and evaluate participant involvement in Park Rx programs. From a public health and medical perspective, Park Rx programs utilize nature exposure dosage to craft the specifics of frequency, duration, intensity; however, leisure research can inform the personalized specifics of what activity and where in order to create a fully tailored prescription. Generic Park Rx programs run the risk of directing patients to activities and/or environments that might be new or unfamiliar to them. The integration of a leisure lens and sensitivity to concepts such as leisure preferences, motivations, constraints and negotiations, socialization, and theories like the Theory of Planned Behavior facilitate the creation of individual sensitive and centric programs. Application of leisure concepts, constructs, and theories also guide our understanding of the Park Rx programs and eventual evaluation of participant engagement and success adhering to their prescription. This dissertation was grounded in the leisure and health literature and focused on integrating a leisure lens with public health and healthcare theories and constructs. The creation of the clinical protocol built upon the leisure concepts to explain why people engage in leisure and what prevents them from engaging in leisure, in order to inform a prescription process that ultimately was personalized to each individual patient rather than a general approach utilized in other Park
Rx intervention studies. As such, this dissertation sought to reposition the concept of Park Rx as a health care initiative into a leisure informed community-clinical approach that examines the utility of natural outdoor environments and examines how individuals’ relationships to various environments can lead to health benefits, but also how leisure activity interests are shaped by individual needs, motivations, and satisfaction. Moving forward, there is an opportunity for the leisure field to become a more engaged leading partner in not only facilitating community time outside for health benefits, but also in guiding healthcare partners and communities in responsible and sustainable use of the natural ecology that will support a long-term advancement in quality of life in communities across the United States.
REFERENCES


Appendix A: Discrete-choice Experiment Survey

Nature-based Physical Activity Prescriptions Survey

Welcome to the Nature-based Physical Activity Prescription Study!

All healthcare professionals (e.g., medical, behavioral health, nutrition, etc.) are invited to participate. No experience with nature-based physical activity prescriptions is necessary to complete the survey.

We are inviting you to take part in a research project that is exploring which patient groups are perceived to benefit from receiving a nature-based physical activity prescription from their healthcare provider.

Thank you for your interest in this study being conducted by NC State University, in partnership with Park Rx America. This study has been approved by NC State University's Institutional Review Board.

What will it involve and what happens to the information that is collected?

If you decide to participate in this study, we will ask you to complete a survey. We anticipate that it will take approximately 10-15 minutes to complete the survey. You can choose to enter into a drawing to win one of ten $100 gift cards.

The survey will ask questions about you and your practice (e.g., state where you practice, your age, years of practice, etc.). You will also be presented with a series of vignettes that describe different types of patients. The vignettes will depict specific characteristics of patients; you will be asked to pick which patient is best suited for receiving a nature-based physical activity prescription.

We will also ask you how much you know about nature-based physical activity prescriptions, such as what they are and how they are given. Finally, we will ask for your opinions about partnerships with health navigators, parks and recreation agencies, and other non-medical partners.

All of the information that you provide in the survey will be strictly confidential. Your individual responses to the survey questions will be anonymous, as they will be grouped together with the responses provided by all the healthcare providers who complete the survey.
Informed Consent

By checking the box below, you acknowledge that you have read the information in this study, that your participation in the study is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.

By selecting the box below "I consent, I wish to participate" you are indicating your agreement to the following:

- I have read the information about this study.
- I understand that my participation in this study is voluntary.
- I understand that I am free to withdraw my participation at any time during completion of the survey by closing the browser window. All responses to questions will be optional and no attempt will be made to coerce any information out of participants.
- I understand that responses I provide to the survey questions will be anonymous, and that no personally identifiable information about me will appear in any report or article based on the findings of this study.
- I understand that there are minimal risks associated with participation in this research, and that there are no direct benefits to my participation in the research. The indirect benefits are increased knowledge regarding what attributes are key to prompting the prescription of nature-based physical activity, which will help guide the development of nature-based physical activity prescription clinical programs.
- I understand that I can request a copy of this consent form and/or a summary of the study results by contacting either Dr. Jason Bocarro (jnbcarr@ncsu.edu or 919-513-8025) or Courtney Schultz (clschul2@ncsu.edu or 262-490-2151).
- I understand that if I feel I have not been treated according to the descriptions in this form, or my rights as a participant in research have been violated during the course of this project, I may contact Jennie Ofstein, Regulatory Compliance Administrator at irb-director@ncsu.edu or by phone at 1-919-515-4514.

☐ I consent, I wish to participate  
☐ I do not consent, I do not wish to participate

Eligibility Questions

Q1. Do you provide direct health services to patients (e.g., medical, behavioral health, nutrition, etc.)? Select one.
   - Yes
   - No

Q2. Are you currently practicing health care in the United States? Select one.
   - Yes
   - No
If you answered YES to BOTH Question 1 and Question 2 you are eligible for this study. Please continue onto Question 3.

If you answered NO to EITHER Question 1 OR Question 2 you are ineligible for this study. Thank you for your willingness to participate in our study!

Section 1: Background About You

The following questions ask about the characteristics of the medical providers responding to the survey to ensure we have collected information from a representative cross-section of medical practitioners across specialties and networks.

Your answers are strictly confidential and will not be linked to you in any way.

Q3. In which U.S. state do you primarily practice medicine? Select one.

- Alabama
- Alaska
- Arizona
- Arkansas
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Georgia
- Hawaii
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Mississippi
- Missouri
- Montana
- Nebraska
- Nevada
- New Hampshire
- New Jersey
- New Mexico
- New York
- North Carolina
- North Dakota
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- Rhode Island
- South Carolina
- South Dakota
- Tennessee
- Texas
- Utah
- Vermont
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming
Q4. What best describes your current role? Select one.

- Academic Medicine
- Allergy & Immunology
- Dietetics & Nutrition
- Emergency Medicine
- Family Medicine
- Geriatrics
- Hospitalist
- Internal Medicine
- Medicine Genetics
- Nuclear Medicine
- Nurse Practitioner/Licensed Practical Nurse
- Obstetrics & Gynecology
- Occupational Health
- Ophthalmology
- Osteopathic Manipulative Treatment
- Otolaryngology
- Pathology
- Pediatrics
- Physical Medicine & Rehabilitation
- Physician Assistant
- Preventive Medicine/Public Health
- Psychiatry
- Research Medicine
- Surgery
- Other

Q5. How many total years have you practiced medicine? Select one.

- Less than 5 years
- More than or equal to 5 years and less than 10 years
- More than or equal to 10 years and less than 15 years
- More than or equal to 15 years and less than 20 years
- More than or equal to 20 years and less than 25 years
- More than or equal to 25 years
- Prefer not to say

Q6. What is your age? Select one.

- 18 to 34 years old
- 35 to 50 years old
- 51 to 70 years old
- 71 years and older
- Prefer not to say
Q7. To which gender identify do you most identify? Select one.

- Male
- Female
- Non-binary/third gender
- Prefer not to say

Section 2: Patient Vignettes Introduction

For the next few minutes, we are going to ask you to act as if you were about to make a treatment decision for which patient will receive a nature-based physical activity prescription, Patient A or Patient B. We would like you to think about each vignette as if you were making a treatment decision for the patients in the real world. For each pair of patients, please indicate which patient you would prefer to receive the nature-based physical activity prescription.

You can state that you do not prefer either patient for a nature-based physical activity prescription by choosing ‘Neither’. If you choose ‘Neither’ as your preferred option, then we would still like you to indicate whether Patient A or Patient B would be the most preferable to you (i.e., the least bad) for a nature-based physical activity prescription.

The vignette will display Patient A and Patient B side-by-side for your comparison as shown below. In each vignette, Patient A and B will present a combination of characteristics from the following 6 categories:

1. Type of Health Condition
   - Diabetes, Hypertension, Obese/Overweight, Severe Mental Health (e.g., ADHD, Anxiety, Depression, Stress)
2. Gender
   - Female, Male
3. Age
   - Child (0-12yrs), Teen (13-17yrs), Adult (18-64yrs), Senior (65+yrs)
4. Degree of Physical Mobility Demonstrated
   - No Limitations, Minor Limitations, Major Limitations
5. Treatment Adherence
   - Adherent, Not Adherent
6. Attitude Towards Nature
   - Enjoys Being Outdoors, Does Not Have a Preference, Dislikes Being Outdoors
### Vignette 1 out of 10

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health Condition</strong></td>
<td>Obese/Overweight</td>
<td>Severe Mental Health</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Male</td>
<td>Male</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>Adult</td>
<td>Teen</td>
</tr>
<tr>
<td><strong>Physical Mobility</strong></td>
<td>Minor Limitations</td>
<td>Major Limitations</td>
</tr>
<tr>
<td><strong>Treatment Adherence</strong></td>
<td>Not Adherent</td>
<td>Adherent</td>
</tr>
<tr>
<td><strong>Attitude Towards Nature</strong></td>
<td>Enjoys Being Outdoors</td>
<td>Does Not Have a Preference</td>
</tr>
</tbody>
</table>

Q8. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.

- Patient A
- Patient B
- Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)
  - Patient A
  - Patient B

### Vignette 2 out of 10

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health Condition</strong></td>
<td>Severe Mental Health</td>
<td>Diabetes</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>Adult</td>
<td>Child</td>
</tr>
<tr>
<td><strong>Physical Mobility</strong></td>
<td>No Limitations</td>
<td>Major Limitations</td>
</tr>
<tr>
<td><strong>Treatment Adherence</strong></td>
<td>Adherent</td>
<td>Not Adherent</td>
</tr>
<tr>
<td><strong>Attitude Towards Nature</strong></td>
<td>Dislikes Being Outdoors</td>
<td>Does Not Have a Preference</td>
</tr>
</tbody>
</table>

Q9. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.

- Patient A
- Patient B
- Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)
  - Patient A
  - Patient B
### Vignette 3 out of 10

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Condition</td>
<td>Severe Mental Health</td>
<td>Hypertension</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Male</td>
</tr>
<tr>
<td>Age</td>
<td>Teen</td>
<td>Adult</td>
</tr>
<tr>
<td>Physical Mobility</td>
<td>Major Limitations</td>
<td>Major Limitations</td>
</tr>
<tr>
<td>Treatment Adherence</td>
<td>Adherent</td>
<td>Not Adherent</td>
</tr>
<tr>
<td>Attitude Towards Nature</td>
<td>Does Not Have a Preference</td>
<td>Dislikes Being Outdoors</td>
</tr>
</tbody>
</table>

**Q10. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.**

- [ ] Patient A
- [ ] Patient B
- [x] Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)
  - [ ] Patient A
  - [ ] Patient B

### Vignette 4 out of 10

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Condition</td>
<td>Hypertension</td>
<td>Severe Mental Health</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Age</td>
<td>Adult</td>
<td>Child</td>
</tr>
<tr>
<td>Physical Mobility</td>
<td>No Limitations</td>
<td>Minor Limitations</td>
</tr>
<tr>
<td>Treatment Adherence</td>
<td>Not Adherent</td>
<td>Adherent</td>
</tr>
<tr>
<td>Attitude Towards Nature</td>
<td>Enjoys Being Outdoors</td>
<td>Enjoys Being Outdoors</td>
</tr>
</tbody>
</table>

**Q11. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.**

- [ ] Patient A
- [ ] Patient B
- [ ] Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)
  - [ ] Patient A
  - [ ] Patient B
Vignette 5 out of 10

<table>
<thead>
<tr>
<th>Health Condition</th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese/Overweight</td>
<td>Diabetes</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Age</td>
<td>Adult</td>
<td>Child</td>
</tr>
<tr>
<td>Physical Mobility</td>
<td>Major Limitations</td>
<td>Major Limitations</td>
</tr>
<tr>
<td>Treatment Adherence</td>
<td>Adherent</td>
<td>Adherent</td>
</tr>
<tr>
<td>Attitude Towards Nature</td>
<td>Dislikes Being Outdoors</td>
<td>Enjoys Being Outdoors</td>
</tr>
</tbody>
</table>

Q12. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.

- Patient A
- Patient B
- Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)

○ Patient A
○ Patient B

Vignette 6 out of 10

<table>
<thead>
<tr>
<th>Health Condition</th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Mental Health</td>
<td>Obese/Overweight</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Age</td>
<td>Teen</td>
<td>Adult</td>
</tr>
<tr>
<td>Physical Mobility</td>
<td>No Limitations</td>
<td>Major Limitations</td>
</tr>
<tr>
<td>Treatment Adherence</td>
<td>Not Adherent</td>
<td>Adherent</td>
</tr>
<tr>
<td>Attitude Towards Nature</td>
<td>Does Not Have a Preference</td>
<td>Dislikes Being Outdoors</td>
</tr>
</tbody>
</table>

Q13. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.

- Patient A
- Patient B
- Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)

○ Patient A
○ Patient B
## Vignette 7 out of 10

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health Condition</strong></td>
<td>Hypertension</td>
<td>Diabetes</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Male</td>
<td>Male</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>Senior</td>
<td>Teen</td>
</tr>
<tr>
<td><strong>Physical Mobility</strong></td>
<td>Major Limitations</td>
<td>Minor Limitations</td>
</tr>
<tr>
<td><strong>Treatment Adherence</strong></td>
<td>Not Adherent</td>
<td>Not Adherent</td>
</tr>
<tr>
<td><strong>Attitude Towards Nature</strong></td>
<td>Dislikes Being Outdoors</td>
<td>Dislikes Being Outdoors</td>
</tr>
</tbody>
</table>

**Q14. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.**

- [ ] Patient A
- [ ] Patient B
- [ ] Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)
  - [ ] Patient A
  - [ ] Patient B

## Vignette 8 out of 10

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health Condition</strong></td>
<td>Obese/Overweight</td>
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</tr>
<tr>
<td><strong>Gender</strong></td>
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<td>Male</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>Child</td>
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</tr>
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<td><strong>Attitude Towards Nature</strong></td>
<td>Enjoys Being Outdoors</td>
<td>Dislikes Being Outdoors</td>
</tr>
</tbody>
</table>

**Q15. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.**

- [ ] Patient A
- [ ] Patient B
- [ ] Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)
  - [ ] Patient A
  - [ ] Patient B
Vignette 9 out of 10

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Condition</td>
<td>Diabetes</td>
<td>Obese/Overweight</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Male</td>
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<td>Adult</td>
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<tr>
<td>Attitude Towards Nature</td>
<td>Does Not Have a Preference</td>
<td>Enjoys Being Outdoors</td>
</tr>
</tbody>
</table>

Q16. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.

- Patient A
- Patient B
- Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)
  - Patient A
  - Patient B

Vignette 10 out of 10

<table>
<thead>
<tr>
<th></th>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Condition</td>
<td>Diabetes</td>
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<td>Gender</td>
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<tr>
<td>Attitude Towards Nature</td>
<td>Dislikes Being Outdoors</td>
<td>Enjoys Being Outdoors</td>
</tr>
</tbody>
</table>

Q17. Which patient would you be most likely to give a nature-based physical activity prescription? Select one.

- Patient A
- Patient B
- Neither (if neither is your preferred option please indicate whether Patient A or Patient B would be most preferable to you, i.e. the least bad, for a nature-based physical activity prescription)
  - Patient A
  - Patient B
Section 3: Ease of Patient Vignettes

Q18. How difficult did you find answering the patient vignettes in the previous section? Select one.
   ○ Extremely easy
   ○ Somewhat easy
   ○ Neither easy nor difficult
   ○ Somewhat difficult
   ○ Extremely difficult

Q19. To what extent did you understand the patient vignettes in the previous section? Select one.
   ○ Fully understood the vignettes
   ○ Partially understood the vignettes
   ○ Did not understand the vignettes

Section 4: Familiarity with Nature-based Physical Activity Prescriptions

We are interested in understanding how prevalent familiarity and knowledge of nature-based physical activity prescriptions are among medical providers.

This information will help us to determine what approaches might increase the rate of nature-based physical activity prescriptions.

Q20. Were you aware of nature-based physical activity prescriptions prior to participating in this survey? Select one.
   ○ Yes
   ○ No

Q21. Have you personally written a nature-based physical activity prescription for a patient? Select one.
   ○ Yes
   ○ No

Q22. Do you feel you have received adequate education to counsel patients in prescribed nature-based physical activity? Select one.
   ○ Yes
   ○ No
Q23. What additional education would you like to receive that would support your use of nature-based physical activity prescriptions? Check all that apply.

- CME/CE Knowledge Course on nature-based physical activity prescriptions
- CME/CE Knowledge Course on providing physical activity counseling to patients
- CME/CE Webinar on integrating nature-based physical activity prescription programs into your practice
- CME/CE Webcast on identifying the right nature-based physical activity prescription for your patient
- Access to online database of local community parks and recreation facilities and programs
- Onsite training around physical activity counseling
- Onsite training focused on local park and recreation resources
- Educational session on integrating nature-based physical activity prescriptions into electronic health record systems

Q24. How likely would the availability of each of the following resources increase your willingness to increase use of nature-based physical activity prescriptions?

<table>
<thead>
<tr>
<th>Resource</th>
<th>Extremely likely</th>
<th>Somewhat likely</th>
<th>Neither likely nor unlikely</th>
<th>Somewhat unlikely</th>
<th>Extremely unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of a dedicated social worker or navigator</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Partnerships with county health departments</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Partnerships with recreation and park agencies</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Access to information about parks</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Structured prescription referral system</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Incorporation of prescription into patient electronic health records</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Q25. Is there anything else you would like to share with us about how nature-based physical activity prescription programs should be implemented in your clinic? Tell us below!

_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
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_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________
_____________________________________________________________________________

The survey is now complete.

Thank you for your help in completing this survey!

We appreciate your time and effort to help us better understand how nature-based physical activity prescriptions can be integrated into patient healthcare.

If you have any questions or comments about the project you can contact the project manager, Courtney Schultz by phone: 919-515-3276 or email: clschul2@ncsu.edu.
OPTIONAL GIFT CARD ENTRY

If you would like to enter the drawing to win one of ten, $100 gift cards, please enter your contact information below.

This page will be removed from your completed responses by the research team to ensure that your answers remain confidential and will not be associated with your personal information.

First Name: ____________________________________________________________

Last Name: ____________________________________________________________

Phone Number: ________________________________________________________

Email: ________________________________________________________________
Park Rx Audit Tool: Outdoor Facilities

Instructions:
Before beginning, review the PRxAT training guide and the audit tool on QuickTapSurvey. Try to locate a map of the park and park information prior to the onsite audit.

You can scroll between the questions as you complete the park audit. When you are finished it is important to go back and make sure you have completed all the questions. There is an optional comments section at the end of the audit. Please feel free to record any notes or comments in this box.

Section 1: Park Information
This section is used to record information about the park audit visit. Answer all questions completely and accurately as this information will help create the basis of the park profile.

Q1. Observer Name
Record your full name.

Q2. Date of Audit
Record the date of the audit using mm/dd/yyyy format.

Q3. Park Address/Location
Record the full address of the park if available (ex. 123 Main Street, Goldsboro NC 12345) or some other identifying location information (e.g., nearest intersection)

Q4. Park County
Select the appropriate county (1=Sampson; 2=Wayne) that the park is situated within.
- If 1 is selected, go to question 5.
- If 2 is selected, go to question 6.

Q5. Park Name Sampson County
Select from the pull-down menu.
- Answer 1: Autryville Park
- Answer 2: Curtis D. Cain Memorial Park
- Answer 3: Fisher Drive Park
- Answer 4: Garland Park
- Answer 5: Town Park
- Answer 6: Harrells Community Playfield
- Answer 7: James L. Newkirk Memorial Park
- Answer 8: Royal Lane Park
- Answer 9: Sampson Center Park
- Answer 10: Weeks Park
- Answer 11: Western District Park
- Answer 12: Mountain to Sea Trail
Q6. Park Name Wayne County
Select from the pull-down menu.
- Answer 1: Bentonville Battlefield
- Answer 2: Berkeley Park
- Answer 3: Charles B Aycock Birthplace
- Answer 4: Cliffs of the Neuse State Park
- Answer 5: Daughtry Field
- Answer 6: Dees Memorial Park
- Answer 7: Fairview Park
- Answer 8: H.V. Brown Park
- Answer 9: Herman Park
- Answer 10: Henry C. Mitchell Park
- Answer 11: J.R. Peele
- Answer 12: Main Street Park
- Answer 13: Martin Luther King Park
- Answer 14: Mina Weil Park
- Answer 15: Mountain Bike Trail
- Answer 16: Goldsboro Municipal Golf Course
- Answer 17: Nelson Street Park
- Answer 18: North End Park
- Answer 19: Old Waynesborough State Park
- Answer 20: Peacock Park
- Answer 21: Quail Park
- Answer 22: South End Park
- Answer 23: Stoney Creek Park
- Answer 24: Veterans Memorial Park
- Answer 25: Westbrook Park

Q7. Park Contact Number
List an official phone number for the park. May be found onsite on park information signs or filled in from park website.

Q8. Park Hours of Operation: Monday-Friday Opening Time
List the time the park opens Monday – Friday (e.g. Sunrise, 6a). May be found onsite on park information signs or filled in from park website. If an actual time is given list the numeric time (e.g. 8a NOT 8 or 8am)

Q9. Park Hours of Operation: Monday-Friday Closing Time
List the time the park closes Monday – Friday (e.g. Sunset, 8p). May be found onsite on park information signs or filled in from park website.

Q10. Park Hours of Operation: Saturday-Sunday Opening Time
List the time the park opens Saturday-Sunday (e.g. Sunrise, 6a). May be found onsite on park information signs or filled in from park website.
Q11. Park Hours of Operation: Saturday-Sunday Closing Time
List the time the park closes Saturday-Sunday (e.g. Sunset, 8p). May be found onsite on park information signs or filled in from park website.

Q12. Park Classification
Select the appropriate classification of the park
- Answer 1=City/local Park
- Answer 2=County Park
- Answer 3=State Park

Q13. ADA Accessible
Assess the park for its overall accessibility for individuals in a wheelchair or mobility limitations. A park is considered accessible if it has one or more amenities that are accessible including: drinking fountains, parking areas, restrooms, walkways and trails. Select the option that applies:
- Answer 1=Yes
- Answer 2=No

Section 2: Park Activities and Amenities
This section asks about the activity areas and amenities in the park. When assessing the park, you are recording whether one or more of that facility/amenity is present or if it is not present. Categories are not exclusive. For example, a grass athletic field could be recorded as a Football Field, Soccer Field, and Mixed Used Field depending on the size and characteristics of the field.

Q14. Outdoor Sports Facilities and Amenities
Select all that apply
- Answer 1: Athletic Track
  - Running track, often enclosing a grass field, that has marked running lanes for track and field activities
- Answer 2: Baseball/Softball Field
  - A field that has a backstop and often (but not always) a diamond shaped infield surface made of gravel or dirt, and a partially-or-fully-fenced perimeter.
- Answer 3: Basketball Court
  - Can be a full court (2 hoops) or just a single half-court design (1 hoop).
- Answer 4: Disc Golf Course
  - A course designed for players to throw a flying disc into a basket or at a target.
- Answer 5: Fitness Stations
  - Fitness equipment or stations where visitors can perform varying exercises (e.g., chin ups, box step-ups). Can be multiple pieces of equipment or stations either together or spread out.
- Answer 6: Football Field
  - Flat, open space designed for football by the presence of goal posts, lines and other facility features specific to football.
- Answer 7: Golf/Driving Range
  - Area where golfers can play a full game of golf, or can practice their golf swing.
• Answer 8: Horseshoe Pits
  - A set in a grass or sandbox area with two stakes placed apart from one another.
• Answer 9: Multi-Game Court Paved
  - Paved area that is painted with games such as hopscotch, four square, tetherball, bocce, lawn bowling, etc. As distinguished from "Basketball Court" which is single use.
• Answer 10: Open Green Space-Small
  - A space that is mowed/cut to be available for active (e.g., Frisbee, kite flying) or passive (e.g., reading, picnics) use. Land does not need to be flat, but is intended for visitor use. Any green space that is less than 1/3 acre or 5 tennis courts.
• Answer 11: Open Green Space-Medium
  - A space that is mowed/cut to be available for active (e.g., Frisbee, kite flying) or passive (e.g., reading, picnics) use. Land does not need to be flat, but is intended for visitor use. Approximately 16,000 sq ft or 1/3 acre or 5 tennis courts.
• Answer 12: Open Green Space-Large
  - A space that is mowed/cut to be available for active (e.g., Frisbee, kite flying) or passive (e.g., reading, picnics) use. Land does not need to be flat, but is intended for visitor use. Any continuous green space that is greater than 16,000 sq feet or 1/3 acre or 5 tennis courts.
• Answer 13: Playground
  - Includes any equipment such as swings, slides, or play structures designed for children.
• Answer 14: Pickleball Court
  - A designated court designed primarily for Pickleball play.
• Answer 15: Pump Track/Dirt Bike Jump Park
  - A continuous loop of dirt berms and rollers that can be rode continuously.
• Answer 16: Rock Climbing/Rock Wall
  - Natural rock formation or artificial rock walls that allow participants to climb up, down or across in a designated location.
• Answer 17: Skate Park
  - Structure designated for skateboarding (or biking, rollerblading, etc.). It is often concrete with a bowl-like structure or ramps and other obstacles to engage in tricks, jumps, etc.
• Answer 18: Soccer Field-Small
  - Flat, open space designed for soccer ranging from an open area with painted lines to a full field with goal posts. Unsuitable for regulation games. (Approximately 20,000 sq ft; roughly 0.5 acre or 8 tennis courts)
• Answer 19: Soccer Field-Large
  - Flat, open space designed for soccer ranging from an open area with painted lines to a full field with goal posts. Large field also suitable for regulation lacrosse and other field sports. (Approximately 49,500 – 78,000 sq ft; roughly 1.3 acres or 16 tennis courts)
• Answer 20: Tennis Courts
  - A distinct triangular activity area marked with lines on a hard surface. May have a net and boundary markers available, but not necessarily a ball or rackets.
• Answer 21: Volleyball Courts
  o Rectangular sand or grass area with poles for a net to be erected. May have a net and boundary markers available, but not necessarily a ball or other equipment.
• Answer 22: Fishing Area
  o Natural water areas (e.g., pond, lake, stream) that are designated locations for fishing.
• Answer 23: Kayak/Canoe/Paddleboard Access
  o Natural water areas (e.g., pond, lake, stream) that are designated locations for participants to launch a personal craft or rent one.
• Answer 24: Motorized Boat Launch/Marina
  o A ramp on the shore by which boats can be moved to and from the water.
• Answer 25: Natural Swimming/Beach Area
  o A natural beach area along a river, pond, or lake that has a designated access point to the water for swimming.
• Answer 26: Swimming Pool
  o A pool of any depth greater than 12 inches in which the water is continuously present.
• Answer 27: Splash Pad
  o A water play area designed for children in which water spouts from poles, toys, or ground jets. The water largely drains almost immediately and thus there is no standing water.
• Answer 28: Other (Please specify in text)

Q15. General Park Amenities
Select all that apply
• Answer 1: Drinking Fountains
• Answer 2: Food for Sale/Concessions
• Answer 3: Grills
• Answer 4: Park Shelter(s)
• Answer 5: Picnic Tables
• Answer 6: Public Restrooms
• Answer 7: Seating/Benches
• Answer 8: Trash Cans
• Answer 9: Vending Machines

Q16. Additional Park Features
Select all that apply
• Answer 1: Camping Sites
  o Designated sites for camping that can be either reserved or available on a first come basis.
• Answer 2: Community Gardens
  o Garden space open for the cultivation of fruits/vegetables/herbs.
• Answer 3: Miniature Train
  o Ridable miniature railway capable of carrying people.
• Answer 4: Nature Center
  Center designed to educate people about nature and the environment.
• Answer 5: Ornamental/Decorative Gardens
  o Gardens for trees, plants and flowers for ornamental purposes.
• Answer 6: Rental Equipment
  o Fee-based rental by the hour or day of various recreation equipment.
• Answer 7: Showers/Bath House
  o A building with baths for communal use, often where campers or swimmer can change clothes.
• Answer 8: Visitor Center
  o Physical location that provides park visitors with information pertinent to their visit.
• Answer 9: Water Feature/Fountain
  o Landscape feature ranging from fountains, pools, ponds, cascades and streams for ornamental purposes.
• Answer 10: Other (Please specify in text)

Q17. Pets
Select all that apply
• Answer 1: Allowed On-Leash
• Answer 2: Allowed Off-Leash
• Answer 3: Designated Dog Park/Area
  o Park area (usually fenced) that is a designated space where dog owners can allow their pets to roam/run freely.
• Answer 5: Waste Bags Provided
• Answer 6: No Pets Allowed

Q18. Trail Present
Are there trails present in the park?
• If Yes: Skip to Q19.
• If No: Skip to Q23.

Q19. Trail Surface
Select all that apply
• Answer 1: Paved Surface
  o E.g., concrete, blacktop or brick.
• Answer 2: Unpaved Surface
  o E.g., crushed gravel, sand, dirt, or woodchips.
• Answer 3: Paved and Unpaved Surface
  o Mixed surface within one trail.
• Answer 4: Water
  o Paddling trail along a river, creek or body of water.
Q20. Trail Difficulty
Select all that apply
- **Easy** = no slope; flat from side-to-side
- **Moderate** = medium incline or grade from side-to-side; may make walking somewhat of a challenge for an older or disabled individual
- **Difficult** = steep incline or grade from side-to-side that could cause someone to lose their balance; may make walking very challenging for an older or disabled individual; not suitable for wheelchairs

Q21. Trail Length
Select all that apply
- Answer 1: Less than a half mile
- Answer 2: 0.5 to 1 mile
- Answer 3: 1 to 5 miles
- Answer 4: 5 to 10 miles
- Answer 5: 10 or more miles

NOTE: When selecting the trail length options, identify the longest trail and select all options equal to and lower than that value. For example, if the longest trail is 3 miles you would select Answer 1, Answer 2, and Answer 3.

Q22. Trail Layout
Select all that apply
- Answer 1: Loop
  - Trail that brings you back to the place you start without walking on the same path.
- Answer 2: Linear
  - Trail designed to be walked from one place to another. To return to the place you start, you must walk on the same path.

Q23. Options for Getting to the Park
Select all that apply
- Answer 1: Onsite Parking Lot
- Answer 2: Parking on Street
- Answer 3: Bus Stop
- Answer 4: Greenway Trail
- Answer 5: On-Street Bike Route
- Answer 6: Bike Racks
Q24. Natural Features of the Park
Select all that apply
- Answer 1: Pond/Lake
- Answer 2: Creek/Stream
- Answer 3: River/Channel
- Answer 4: Shoreline/Beach
- Answer 5: Natural Springs
- Answer 6: Natural Wooded Areas
- Answer 7: Wetlands
- Answer 8: Other (Please specify in text)

Q25. Comments Section
Use this space to record any observations, questions, or comments you have regarding the audit questions and answers.

Completed Park Audit Screen
Park Rx Audit Tool: Indoor Facilities

Instructions:
Before beginning, review the PRxAT training guide and the audit tool on QuickTapSurvey. Try to locate facility information prior to the audit.

You can scroll between the questions as you complete the facility audit. When you are finished it is important to go back and make sure you have completed all the questions. There is an optional comments section at the end of the audit. Please feel free to record any notes or comments in this box.

Section 1: Facility Information
This section is used to record information about the facility audit visit. Answer all questions completely and accurately as this information will help create the basis of the facility profile.

Q1. Observer Name
Record your full name.

Q2. Date of Audit
Record the date of the audit using mm/dd/yyyy format.

Q3. Facility Address/Location
Record the full address of the facility if available (ex. 123 Main Street, Goldsboro NC 12345) or some other identifying location information (e.g., nearest intersection)

Q4. Facility County
Select the appropriate county (1=Sampson; 2=Wayne) that the facility is situated within.
- If 1 is selected, go to question 5.
- If 2 is selected, go to question 6.

Q5. Facility Name Sampson County
Select from the pull-down menu.
- Answer 1: Bellamy Recreation Center
- Answer 2: Sampson Center
- Answer 3: Coharie Tribal Recreation Center

Q6. Facility Name Wayne County
Select from the pull-down menu.
- Answer 1: W.A. Foster Recreation Center
- Answer 2: Herman Park Center
- Answer 3: Senior House
- Answer 4: Goldsboro Family YMCA
Q7. Facility Contact Number
List an official phone number for the facility. May be found onsite on park information signs or filled in from facility website.

Q8. Facility Hours of Operation: Monday-Friday Opening Time
List the time the facility opens Monday – Friday (e.g. Sunrise, 6a). May be found onsite on information signs or filled in from facility website.

Q9. Facility Hours of Operation: Monday-Friday Closing Time
List the time the facility closes Monday – Friday (e.g. Sunset, 8p). May be found onsite on information signs or filled in from facility website.

Q10. Facility Hours of Operation: Saturday-Sunday Opening Time
List the time the facility opens Saturday-Sunday (e.g. Sunrise, 6a). May be found onsite on information signs or filled in from facility website.

Q11. Facility Hours of Operation: Saturday-Sunday Closing Time
List the time the facility closes Saturday-Sunday (e.g. Sunset, 8p). May be found onsite on information signs or filled in from facility website.

Q12. ADA Accessible
Assess the facility for its overall accessibility for individuals in a wheelchair or mobility limitations. A facility is considered accessible if it has one or more amenities that are accessible including: drinking fountains, parking areas, restrooms, walkways, and pool lifts. Select the option that applies:
- Answer 1=Yes
- Answer 2=No

Section 2: Facility Activities and Amenities
This section asks about the activity areas and amenities in the facility. When assessing the facility, you are recording whether one or more of that facility/amenity is present or if it is not present. Categories are not exclusive. For example, a basketball court could be recorded as a Basketball Court, Multi-sport Court, and Volleyball Court depending on the size and characteristics of the court.

Q13. Indoor Sports Facilities and Amenities
Select all that apply
- Answer 1: Gymnasium
  - A building, often comprised of a singular large room, equipped for physical exercise.
- Answer 2: Recreation/Fitness Center
  - A building, comprised of several rooms or activity areas, that houses exercise equipment for physical exercise.
- Answer 3: Weights/Weight Room
  - A room containing equipment for weight training, may include free weights or cable machines.
• Answer 4: Cardio Studio/Equipment  
  o Area that facilitates raising the heart rate, often includes treadmills, stationary bikes or stair machines.
• Answer 5: Basketball Court  
  o Rectangular floor, typically with tile or wood. Can be a full court (2 hoops) or just a single half-court design (1 hoop).
• Answer 6: Volleyball Court  
  o Rectangular area with poles for a net to be erected. May have a net and boundary markers available, but not necessarily a ball or other equipment.
• Answer 7: Tennis Court  
  o A distinct triangular activity area marked with lines on a hard surface. May have a net and boundary markers available, but not necessarily a ball or rackets.
• Answer 8: Athletic Track  
  o Running track, often enclosing a court, that has marked running lanes for track and field activities.
• Answer 9: Racket Sports  
  o Often a multipurpose court with a playing surface that integrates multiple racket sports into one surface.
• Answer 10: Fitness Studios  
  o Room or area designated for group fitness classes such as yoga, spin, or fitness classes.
• Answer 11: Pool  
  o A pool of any depth greater than 12 inches in which the water is continuously present.
• Answer 12: Sauna/Steam Room/Hot Tub  
  o Small room used as a hot-air or steam bath. Large tub filled with hot aerated water.

Q14. Youth Sports and Recreation Programs:  
Select the option that applies
• Answer 1=Yes
• Answer 2=No

Q15. Youth Fitness and Exercise Programs:  
Select the option that applies
• Answer 1=Yes
• Answer 2=No

Q16. Options for Getting to the Facility  
Select all that apply
• Answer 1: Onsite Parking Lot
• Answer 2: Parking on Street
• Answer 3: Bus Stop
• Answer 4: Greenway Trail
• Answer 5: On-Street Bike Route
• Answer 6: Bike Racks
Q17. Comments Section
Please record any questions, concerns, or remarks you have about the facility audit.

Completed Facility Audit Screen
Park Rx Audit Tool: Data Management Protocol

Instructions:
When you have returned from auditing in the field, you will need to connect the iPad to a Wi-Fi connection to upload the data to the online data repository. After each outing, please upload the completed audits. You will also update the Facility-Activities spreadsheet to reflect all possible activities from the compendium that can be conducted within each activity area type.

Steps to Upload:
1. Connect the iPad to a Wi-Fi signal
2. Open the QuickTapSurvey App; once connected to a Wi-Fi signal the data should automatically sync to the online website.
3. Check the status of the upload.
4. Send a confirmation email to Courtney.
Healthy Eating Control Group Participants Workflow

Fitbit Reminder for Healthy Eating Control Group

This workflow sends a reminder every four days for two weeks to help remind the patient to charge their Fitbit. This will initialize after the first patient office visit and at the three-month follow-up appointment.

Inputs

- end_dateFitbit – Two-week end date after which no more reminders are sent

Initialization

This occurs after the BHC configures the tailored prescription parameters at the end of the patient intervention if the patient opts-in to receive text messages.
"Remember to wear your Fitbit for the next two weeks and charge your Fitbit every 4 days."

Repeat Every Four Days at 6pm Until End (This will be a two-week period from the date of the tailored prescription creation)

Message "Avoid a low battery level. Remember to charge your Fitbit tonight."

Responses

If <today> >= <end dateFitbit>:
End process

Send once 15 days after the tailored prescription parameters are generated.
Message "It’s time to return to the clinic to sync your Fitbit. Please remember to drop off your Fitbit within the next week."

Responses

If <today> >= <end dateFitbit>:
End process

Study Follow Up Messages for Healthy Eating Control Group

This workflow sends a message at the end of the three-month intervention after they have completed their second two-week Fitbit trial. This is sent 3 months and 3 weeks after the initial tailored prescription initiation.

Inputs

- end_date – A date after which no more texts are sent

Repeat Every Friday at 10am Until End
Message “Did receiving the text messages help you towards your goal to eat healthier?” (choices: Yes/No)
Responses
If receive “Yes” or “No”:
  • If receive “Yes or No” Send: "Thank you for participating in our Thinking Outside the Pillbox Study. We hope that your healthy eating prescription has helped you reach a healthier you!"
If <today> >= <end date>:
  End process

Home/Indoor Physical Activity Control Group Participants Workflow

This workflow sends a reminder once a week to check if the patient enrolled in the program type. Then sends a reminder once a week to check if the patient has started attending the program type. Then sends a reminder once a week to check if the patient participated in the program type that past week.

Inputs
  ● Friend-name of support person listed in interview
  ● name - name of physical activity program coordinator
  ● number - phone number of contact
  ● program type - the name of the program
  ● end_date - date after which no more reminders are sent

Initialization
This occurs after the BHC configures the tailored prescription at the end of the patient intervention if the patient opts-in to receive text messages.
"You have been signed up for reminders to enroll in <program type>"
"Remember to contact <name> at <number> to sign up."

Repeat Every Friday at 10am Until Receive YES response or END Process
Message
"Have you contacted <name> at <number> to enroll in <program type>? (choices: Yes/No)"
Responses
If receive “Yes”:
  1. Send: "Way to go! <program type> is a great way to be active."
If receive “No”:
  • Send: "Remember to do so as soon as you can!"
If <today> >= <end date>:
  • End process

Repeat Every Friday at 10am Until Yes Response or End Process
Message
"Have you started attending <program type>? (choices: Yes/No)"
Responses
If receive “Yes”:
  • Send: “Did you attend <program type> this week?” (choices: Yes/No)
If receive “Yes:
Send: “Keep it up! Making changes can be hard, you are doing great!”
If receive “No”:
Send: “Start with small changes and build up. There is work to be done to reach your goal, but you can do it!”

If receive “No”:
  ● Send: "Remember to do so as soon as you can!"
If <today> >= <end date>:
  ● End process

Repeat Every Friday at 10am Until Yes Response or End Process
Message
"Did you attend <program type> this week? (choices: Yes/No)"
Responses
If receive “Yes” Send one:
  ○ “Way to go! Stick with it.”
  ○ “Good job! <program type> is a great way to keep moving.
  ○ “You are doing an awesome job taking control of your health by being more active.”
  ○ “Well done! Keep going to <program type>.”
  ○ “Nice work! You are going a great job of being more active.”
If receive “No” Send one:
  ○ “Tomorrow’s a new day, try to make <program type> this week.”
  ○ “Making change is hard, keep working toward being more active.”
  ○ “Not every day is perfect, commit to making tomorrow a day of change.”
  ○ “Struggling to stay active with <program type>? Try reaching out to <friend> for support.”
  ○ “Don’t let last week define you! Recommit to attending <program type> this week.”
  ○ “Each day is a new chance to make a better choice for your health. Decide to make time for <program type>.”
If <today> >= <end date>:
  ● End process

Fitbit Reminder for Home/Indoor Physical Activity Control Group

This workflow sends one reminder every four days for two weeks to help remind the patient to charge their Fitbit. This should initialize after the first patient office visit and at the three-month follow-up appointment.

Inputs
  ● end_dateFitbit – Two-week end date after which no more reminders are sent

Initialization
This occurs after the BHC configures the tailored prescription parameters at the end of the patient intervention if the patient opts-in to receive text messages.
"Remember to wear your Fitbit for the next two weeks and charge your Fitbit every 4 days."
Repeat Every Four Days at 6pm Until End (This will be a two-week period from the date of the tailored prescription creation)
Message
"Avoid a low battery level. Remember to charge your Fitbit tonight."
Responses
If <today> >= <end dateFitbit>:
End process

Send once 15 days after the tailored prescription parameters are generated.
Message
"It’s time to return to the clinic to sync your Fitbit. Please remember to drop off your Fitbit within the next week.”
Responses
If <today> >= <end dateFitbit>:
End process

Study Follow Up Messages for Home/Indoor Physical Activity Control Group
This workflow sends a message at the end of the three-month intervention after they have completed their second two-week Fitbit trial. This is sent 3 months and 3 weeks after the initial tailored prescription initiation.

Inputs
● program type - the name of the program
● end_date – A date after which no more texts are sent

Repeat Every Friday at 10am Until End
Message
“Did receiving the text messages help you towards your goal to participate in <program type>?”
(choices: Yes/No)
Responses
If receive “Yes” or “No”:
• If receive “Yes or No” Send: "Thank you for participating in our Thinking Outside the Pillbox Study. We hope that your physical activity prescription has helped you reach a healthier you!”
If <today> >= <end date>:
End process

Park-based Physical Activity Treatment Group Participants Workflow
This workflow sends a reminder once a week to check if the patient has acted upon their park-based physical activity prescription.

Inputs
● physical_activity - The name of the physical activity to remind the user to do
● location - The location of the physical activity
● mins - The number of minutes to remind the user to perform the activity
● days - The days of the week to remind the user to do the activity
● end_date - A date after which no more texts are sent

**Initialization**

**Message**
"You have been signed up for reminders to engage in *physical activity*.

**Repeat Every Friday at 10am Until End**

**Message**
"Have you engaged in *physical activity* this week" (choices: Yes/No)

**Response**
If receive “Yes”:
- First Send: “How many times this week did you engage in *physical activity*?”
- After receiving reply response First Send: “Keep it up! Making changes can be hard, you are doing great!”

If further receive “Yes” Send one:
- “Way to go! Stick with being more active.”
- “Good job! *physical activity* is a great way to keep moving.
- “You are doing an awesome job taking control of your health by being more active.”
- “Well done! Keep going to *physical activity*.”
- “Nice work! You are doing a great job of being more active.”

If receive “No”:
- First Send: “There is work to be done to reach your goal, but you can do it. Start with small changes and build up.”

If further receive “No” Send one:
- “Tomorrow’s a new day, try to make *physical activity* a priority this week.”
- “Making change is hard, keep working toward being more active.”
- “Not every day is perfect, commit to making tomorrow a day of activity.”
- “Struggling to stay active with *physical activity*? Try reaching out to <friend> for support.”
- “Don’t let last week define you! Recommit to engaging in *physical activity* this week.”
- “Each day is a new chance to make a better choice for your health. Decide to make time for *physical activity*.”

If <today> >= <end date>:
- End process

**Fitbit Reminder for Park-based Physical Activity Treatment Group**

This workflow sends one reminder every four days for two weeks to help remind the patient to charge their Fitbit. This should initialize after the first patient office visit and at the 3-month follow-up appointment.

**Inputs**
- end_date

**Initialization**
This occurs after the BHC configures the tailored prescription parameters at the end of the patient intervention if the patient opts-in to receive text messages. "Remember to wear your Fitbit for the next two weeks and charge your Fitbit every 4 days."

*Repeat Every Four Days at 6pm Until End (This will be a two-week period from the date of the tailored prescription creation)*

Message
"Avoid a low battery level. Remember to charge your Fitbit tonight."

Responses
If <today> >= <end dateFitbit>:
End process

*Send once 15 days after the tailored prescription parameters are generated.*

Message
"It’s time to return to the clinic to sync your Fitbit. Please remember to drop off your Fitbit within the next week.”

Responses
If <today> >= <end dateFitbit>:
End process

**Study Follow Up Park-based Physical Activity Treatment Group**

This workflow sends a message at the end of the three-month intervention after they have completed their second two-week Fitbit trial. This will be sent 3-months and 3-weeks after the initial prescription generation.

**Inputs**
- physical_activity - The name of the physical activity to remind the user to do
- end_date – A date after which no more texts are sent

*Repeat Every Friday at 10am Until End*

Message
“Did receiving the text messages help you towards your goal to engage in <physical activity>?" (choices: Yes/No)

Responses
If receive “Yes” or “No”:
- If receive “Yes or No” Send: "Thank you for participating in our Thinking Outside the Pillbox Study. We hope that your park-based physical activity prescription has helped you reach a healthier you!"

If <today> >= <end date>:
End process

**Generic Three-month Appointment Reminder for All Intervention Groups**

This workflow sends one message 85 days after the initial tailored prescription to remind patients of their upcoming follow up appointment at the clinic

**Inputs**
• number—Phone number for the patient’s primary clinic
• end_date—A date after which no more texts are sent

Send 85 days after the initial tailored prescription
Message
“It’s almost time for your three-month follow up with your health care provider at Goshen. Contact <number> to confirm your appointment.”
Responses
If <today> >= <end date>:
End process