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Adolescent Health Services: Access and Outcomes

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ADOLESCENT HEALTH SERVICES: ACCESS AND OUTCOMES

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ABSTRACT

Adolescence is a unique developmental period during which most lifelong mental health illnesses develop. This dissertation investigated barriers and facilitators to health care service access and delivery in adolescent populations.

The first chapter introduces trends in adolescent health, including physical, mental, and behavioral condition prevalence rates and risks. Patterns in health care utilization by age group and risks for underutilization were explored to understand the gaps in health care access for adolescent populations. As part of this dissertation, health care access and intervention delivery are explored through an implementation lens using the Practical, Robust Implementation and Sustainability Framework (PRISM) and utilizing data abstracted through a pediatric referral navigation system, both of which are introduced in this chapter. The methodology and introduction for each study is introduced during this chapter.

The second chapter is a qualitative exploration of facilitators and barriers in School-Based Health Center (SBHC) implementation and sustainability utilizing the Practical, Robust Implementation and Sustainability Framework (PRISM). In-depth interviews were conducted with 22 clinicians and school staff involved in the delivery or implementation of a SBHC in South Carolina. Deductive-inductive thematic coding was applied to the interviews guided by the domains found in the PRISM framework and analyzed across SBHC delivery model types; school-linked, telehealth, traditional, and mobile care. Isolated themes included requiring specifically trained staff, increased connection to patients and schools, increased service awareness, and technical/resource

limitations. Common themes including limitations and challenges to physical space, the increased opportunity for care coordination, clinician perspective on the role of school nurses in referral triage, and the impact of the COVID-19 pandemic on the role of school nurses.

The third chapter assesses mental health outcomes between patients utilizing care from a SBHC and traditional pediatric community clinics. Propensity score matching was used for 2:1 matching of the control (pediatric community clinics) and treatment (SBHC patients). Binary logistic and Poisson regression models were used to estimate differences in mental health care management and treatment outcomes between the control and treatment groups. This study found that patients seen in SBHCs had increased odds of being in counseling during the time of visit and decreased odds of any health care encounter and in the presence of a standardized mental health screening survey.

In the fourth chapter, predictors of mental health referral completion are explored using data from referrals to the Pediatric Support Service, a clinical navigation support service serving Upstate South Carolina. Logistic regression models showed that majority of referrals related directly to a patients behavioral/mental health, rather than potential risk factors. Males and patients aged 15 years were found to have an increased odds of referral noncompletion, suggesting demographic difference in healthcare seeking behaviors. Additionally, patients on Medicaid and patients with adjustment disorders were found to have greater odds of referral noncompletion.

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CHAPTER ONE

INTRODUCTION

An estimated 19-27% of adolescents reported having forgone healthcare, citing a variety of social and economic factors including health insurance coverage, availability of services, transportation, perceived symptoms, and predispositions toward healthcare.[1,2] The consequences of unmet healthcare needs for adolescent populations impacts not only current physical and mental health conditions, but lifelong career success, quality of life, and overall long-term health.[2] Susceptible to increased barriers to access due to constraints in age and dependence, adolescent populations are on the cusp of full autonomy and agency, but subject to the same transportation availability and financial status of their parents/guardians.[3,4] Further research to better identify facilitators that can address the barriers and improve access is needed to implement effective interventions and programs for adolescent populations.

Healthy development during adolescence is imperative to lifelong health and education and career achievement, during which adolescents are susceptible to physiological and behavioral changes due to puberty (young adolescence, 10 to 14 years) and the development of lifelong health behaviors.[5] The prevalence of chronic physical health conditions is estimated somewhere between 10-28% for adolescents, however this data relies on self-identification of symptoms and diagnoses, and is thus subject to underestimation.[6-8] Physical and behavioral health consequences of limited access to and utilization of healthcare services during this life phase have been well documented throughout current literature and include increased risk for chronic conditions (i.e. asthma and obesity), increased utilization of emergency services, decreased adherence to treatments and follow up visits, and increased prevalence and risk for poor long-term health.[9,10] In addition to physical health conditions, adolescents are at an increased risk for development of mental health conditions, with an estimated 10-20% prevalence and roughly 50% of lifelong mental illness beginning by age 14.[11-13] These conditions

are often left untreated and impact later life functioning, including increased health risks, increased healthcare service utilization, negative familial relationships, reduced skill development, and increased problematic health, social, and academic behaviors.[14]

A variety of individual, familial, social, and community characteristics have also been found to increase adolescents risk factors for mental and physical health conditions. These factors include experiences of adverse trauma, poverty, residential instability, disrupted attachment, poor housing, and lack of access to support facilities and services.[14] These health outcomes are exacerbated by decreased access to and utilization of healthcare services related to lower socioeconomic status where patients face increased barriers through reduced access to transportation, constraints in available time, under- or uninsured status, and increased distrust of medical services and professionals.[3]

While the burden of poor health outcomes and reduced access has been established, the implementation of interventions to reduce barriers to access and utilization remains understudied. Developed to provide healthcare services to children and adolescents directly through schools, school-based health centers (SBHCs) offer one pathway to reduce barriers to access, primarily targeting underserved populations in rural communities.[15] To mediate increased risks of under-utilization and service availability for adolescents, SBHCs provide evidence-based services to address a myriad of health needs to students, while reducing traditional barriers to care, often extending services to patients under or uninsured.[16] However, research into long-term sustainability and evaluation remains largely unstudied and presents a major gap in the long-term utilization and maintenance of these services.[16,17] Further compounded by the lack of research into the intended implementation success at reaching the targeted, highest risk populations.[18,19]

Additionally, utilization and service gaps for adolescents in condition identification and care maintenance are being addressed through targeted interventions like universal mental health screenings at all wellness visits, automatic referral triggers, or mental health services provided in schools to support health-seeking behaviors.[20,21] The goal of these interventions are to update screening guidelines to capture all patients regardless of symptom presentation or ability to self-identify and articulate needs and to link those with diagnosed conditions to specialty care and long-term maintenance. However, these interventions are subject to similar implementation challenges as those aimed at reducing access barriers. Namely, interventions do not always reach their intended population of high-risk adolescents or struggle to sustain the necessary care and delivery structures required to maintain implementation of services.[3,20,21]

The state of current research leaves a space for the application of implementation framework guided evaluation of services targeting gaps to healthcare access and utilization for adolescent populations. This dissertation will apply the Practical, Robust Implementation and Sustainability Model to explore the barriers and facilitators to implementing and sustaining different models of SBHCs throughout South Carolina, identifying differences in population characteristics and longitudinal mental and behavioral outcomes in SBHCs compared to a traditional pediatric clinic, and assessing the predictors of mental and behavioral health referral incompletion in a universal screening and connection program.[22] The overall goal of this dissertation is to explore barriers and facilitators to complete, sustainable, and intended service utilization and delivery for specific populations and conditions.

Adolescent Health

Majority (97%) of adolescents (12-17 years) consider themselves to be in good health and just under 5% reported missing 11 or more days of school in the last year due to illness or

injury in 2019.[23] However, adolescence is a developmental period subject to increases in risky health and social behaviors, as well as increased control over one's health and well-being.[9,24] Not only are risky health behaviors developed during adolescence, but the effects of early adoption persist into adulthood and increase risk for adverse health consequences over the lifetime. As evidence of this phenomenon, roughly 90% of current, daily smokers first tried smoking by 18 years old.[25] Healthy habits are also established and important in adolescence, during which rapid changes to physiological and behavioral health are impacted by the onset of puberty.[5] In this stage, the development and introduction to healthy behaviors can impact lifelong physical and mental health, interpersonal relationships and social skills, and educational and career achievement.[5,26]

Consequently, health seeking behaviors are also complex in adolescence. In a national study of 12,079 adolescents, just under 19% reported forgoing health care in the past year, of which, those participating in risky health behaviors were more likely to report underutilization of care (daily smoking increased to 26% and frequent alcohol use increased to 30% for adolescents underutilizing healthcare services).[2] Specific characteristics also predisposed adolescents from seeking appropriate care including families with low-socioeconomic status, uninsured, and existing risky health behaviors. Adolescents also reported several reasons for missed health care visits, including thinking the problem would go away (63% of respondents), fear of physician reaction or action (16%), inability to pay (14%), and concerns about confidentiality (12%). Additionally, treatment adherence is particularly low in adolescence and is negatively impacted by conflicting familial relationships, presence of mental health conditions, experiences of adverse social, emotional, or familial events, and patient beliefs or attitudes surrounding their disease and treatment plan.[4]

Adolescent Mental Health

Mental health conditions affect an estimated 10-20% of adolescents (10-19 years) globally and an estimated 16.5% in the US (6-17 years).[11,27] Attention-deficit/hyperactivity disorder (ADHD), anxiety, and depression are the most diagnosed mental disorders in US children. Approximately 9.4% of children aged 2-17 years have received an ADHD diagnosis, 7.1% have received an anxiety diagnosis, and 3.2% have diagnosed depression.[28] Of the estimated adolescents experiencing a mental health disorder, approximately 50.6% received any treatment in 2016.[27] These risks are increased for racial/ethnic minorities, who are also less likely to utilize mental health services and more likely to discontinue care.[3]

Adolescence (10-19 years) is an especially formative and challenging time for mental health. During this developmental stage, adolescents are at increased risk for mental health disorders due to changes in social and emotional wellbeing, increased awareness and exposure to adverse experiences, and greater independence and agency.[11,29] In fact, 50% of all mental illness begins by age 14 and the average delay between symptom onset and treatment is 11 years.[27] The impact of mental disorders is not isolated to mental health, but increases risk for individual's physical health, achievement, and development. The presence of a mental disorder during adolescence is associated with decreased lifetime economic potential, poor social relationships, increased morbidity and mortality due to cardiovascular disease, and an increased risk of chronic conditions (with population estimates around 13% of all condition onset).[29]

The treatment and screening of mental disorders in adolescence has long been subject to scrutiny for the apparent delays in diagnoses and failures of symptom-based screening to account for the heavy heterogeneity of disorders at this age. While early and consistent treatment has been found to mitigate the onset of lifetime physical, social, and economic consequences, most

mental disorders are left untreated or undertreated.[29] Similarly to how the adolescent stage affects the prevalence of mental disorders, adolescence poses increased challenges to treatment adherence. Transitioning to more autonomy, adolescents are often expected to take more responsibility for their healthcare and to develop a stronger sense of identity and independence, which may lead to conflicts with conditions and management that are outside of their control or that counteract this transition.[4] These challenges are increased with the presence of a mental disorder, diagnosed or not, that impair decision making, attention, and self-confidence.[24]

Current screening guidelines for mental disorders are pushing for universal screening at all mental health concerned visits or routing health service visits to ensure unbiased screening delivery and to promote screening regardless of obvious or self-identified symptoms. In the American Academy of Pediatrics (AAP) published guidelines for identifying and initially managing adolescent depression, the AAP advocates for universal assessments of mental health screeners as well as screeners for adverse childhood experiences, social determinants, relationships, and family and home environment.[30] The inclusion of risk factors for mental health conditions are included to help identify adolescents who are at risk for mental health conditions or who potentially have these conditions but might otherwise be missed on standardized assessments. Unfortunately, in pediatric care settings where universal screening is available, delivery systems struggle to connect their patients with specialty care and ensure long-term engagement with mental health services.[20]

The relationship between mental health disorders and lifetime health consequences has been documented.[29] However, research evaluating the implementation of targeted service delivery and treatment remains understudied. Majority of studies focus on changes to short term outcomes or on population demographics without exploring the long-term changes to outcomes

or comparisons across different contexts and delivery types. The application of an implementation framework to evaluate mental health disorder outcomes across multiple years and in different care settings, offers insight into the barriers and facilitators for service delivery to reach the highest risk populations and to sustain long-term adherence to treatment and health visits.

School-based Health

School-based health services were originally born from the need to decrease student absences from acute illness and to provide general health education and promotion.[15] Traditionally, school level population health and education were coordinated by school nurses employed by the school district.[31] In the 1960s, school nurses provided education, treatment for acute illness, and acted as a bridge between students and specialty care or a medical home.[15] Gradually, this role expanded to include additional services like vaccinations and continuity care. Eventually, through the 1970s and 80s these services came to be known as School-based Health Centers (SBHCs) and to provide access to nurse practitioners and pediatricians for students in need of services like chronic and acute care, mental and behavioral health management and screening, dental, and vision care.[16,32] According to the National School-Based Health Care 2016-2017 Census, conducted by the School-Based Health Alliance (SBHA), there are currently over 2,500 School-based Health Centers in operation throughout 48 states.[33] The number of SBHCs has grown rapidly from 1,135 in 1998-1999, and is projected to increase steadily in the coming years due to the expansion of telehealth based SBHCs and through changes in financial support.[33,34]

SBHCs are identified as healthcare service providers for students within a school setting.[35] SBHCs are not limited in the scope of services provided and can include acute illness

care, chronic care management, mental and behavioral health screening and management, dental health, and health education.[35,36] Supported by community partners, SBHCs offer access to healthcare services for students during school to mitigate traditional barriers to healthcare access, including, transportation, available parent or guardians, and scheduling.[36] According to the 2016-2017 census, just over 50% of SBHCs were supported by Federally-Qualified Health Centers, or Health Resources and Services Administration Health Center Program funded health care providers.[37] Other traditional supporters of SBHCs include local hospitals or medical centers (20%), non-profit/community-based organizations (9%), local health departments (6%), and the school system itself (6%). Similarly, to community sponsors, the funding sources for SBHCs vary on an individual basis. According to respondents to the 2016-2017 census, majority of SBHCs are funded by public insurance revenue and private insurance revenue. Additional funding comes from state and federal government, in-kind support, private foundations, patient fees, sponsor agencies, local government, and the school system. The ability for SBHCs to be grant funded offers an offset to the costs associated with providing healthcare services to under or uninsured populations.

Through the SBHA census data collection, the SBHA has defined four models of SBHCs as determined by the location of providers and patients.[38] In a traditional SBHC model, services are provided on site at the school with providers physically onsite. School-linked centers offer services to patients through a site near a school, with providers physically onsite. Mobile centers offer services through equipped mobile units parked near or at a school, with providers on the mobile unit. All three previously described models have variations where providers can be accessed using some form of telehealth. Lastly, telehealth-exclusive centers offer care to patients

through a fixed site at the school with providers available remotely, typically though a structure telehealth platform.

In the last decade, telehealth has emerged as a delivery model to provide access to patients and providers from remote locations.[34] Defined as the "delivery and facilitation of health and health-relates services…via telecommunications and digital communication technologies" including video conferencing and mobile apps, telehealth provides opportunities for increased access and agency for patients.[39] In the 2016-2017 census, 20% of all SBHCs reported using telehealth in some form within their model type.[38] This number jumped to roughly 80% of all SBHCs offering at least some services through telehealth in the 2020-2021 census.[40] Traditional models reported access to behavioral health providers via telehealth or onsite in 38% of SBHCs and via telehealth only in 23%.[34] Additionally, telehealth exclusive models offered access to physicians and nurse practitioners in 97 and 93% of SBHCs respectively, and access to behavioral health providers in 27%. As evidence to the expansion of available services, 52% of SBHCs utilizing telehealth in any form operated in rural areas, and 79% were operating in schools eligible for the Title I program, or federally funded schools supporting low-income students. Telehealth also offers a solution to maintenance and sustainability of SBHCs by providing access to providers for multiple sites on the same day and reducing resources in terms of availability of staff.[41] Additionally, telehealth models require the collaboration of outside SBHC providers and school nurses in facilitating visits and maintaining telehealth platforms that has the potential to mitigate school/health organization relationships and cohesive working environments vital to the long-term success of SBHCs.[41,42]

SBHCs provide healthcare services to students within the school environment to not only improve physical and mental health conditions, but to also decrease students' absence due to

acute and chronic conditions.[43] Current research has established strong associations between SBHC services and improved chronic conditions through care coordination and management for conditions like asthma and obesity-related illness.[16,44] Acting as an intermediary between students and specialty care, SBHCs provide healthcare access to patients with considerable care barriers and connections to outside primary and specialty care to patients.[36,41] Increasing access to chronic care coordination and management for physical, mental, and behavioral health conditions has been found to decrease absences for students who would otherwise need outside care. These results are also echoed in acute illness and injury by offering services and treatments in school to students who would otherwise be sent home or to outside medical care.[15]

SBHCs also offer a variety of services to address preventive care for students, through immunizations, health promotion, and education.[35] Services include programs to reduce and educate on substance abuse, reproductive health services and education, dental care, and vision care.[15] SBHCs are associated with decreases in teen pregnancy cases, substance abuse disorders, and increases in vaccine uptake.[45-47] Additionally, presence of a SBHC has been associated with increases in perceived overall health and healthy behaviors, like increased physical activity and healthy eating.[48] SBHCs also offer early detection and screening for mental and behavioral conditions through the school setting to identify students at increased risk for mental and behavioral conditions, including anxiety, depression, and ADHD.[49]

However, notable gaps persist within the current research. SBHC summaries often exist within a broad context and aim to describe services and population level outcomes. Rarely, do studies examine the benefits and limitations to SBHC services and conditions within different environments and serving different populations.[19] Majority of the data from the National Assembly on School-Based Health Care 2016-2017 census comes directly from traditional, on-

site school-based health centers.[37] It has not been until recently that research has begun to explore the effects, advantages, and disadvantages to SBHC delivery through telemedicine, via mobile units, or in conjunction with an off-site clinic.[34] Evaluation studies often focus on the existence of services and the potential association with changes to physical, mental, behavioral, and academic outcome, but fall short in examining these relationships long-term or through intended implementation studies to evaluate complete and accurate met needs.[50]

Practical, Robust Implementation and Sustainability Model (PRISM)

The Practical, Robust Implementation and Sustainability Model (PRISM) was developed as an expansion on the Reach, Effectiveness, Adoption, Implementation, Maintenance (RE-AIM) framework to include and explore the influence of contextual factors at multiple levels.[22] The purpose of this framework is for researchers and practitioners to understand and tailor health services to specific contexts to increase implementation success and feasibility, and eventually inform health service and resource allocation.[51] Developed to bridge the gap left by efficacy and effectiveness studies, PRISM offers a conceptual framework to identify robust and practical factors related to health intervention success in terms of adoption, implementation, maintenance, reach, and effectiveness.

PRISM explores unique elements or factors that affect RE-AIM at four distinct levels to understand the impact of different context and perspectives. The four levels are the program/intervention, the external environment, the implementation/sustainability infrastructure, and the recipients. By breaking down the levels of an intervention's implementation, the framework guide studies in assessing the success of each domain in supporting and achieving each element of RE-AIM. The focus shifts from broad RE-AIM constructs to include

perspectives in each domain of the intervention to garner barriers and facilitators to successful implementation.

PRISM is designed to be utilized during the planning, implementation, maintenance, and evaluation stages of studies. Several studies have successfully utilized the PRISM framework to develop interview guides and surveys of stakeholders to assess implementation success of healthcare delivery.[51-53]

Pediatric Support Services

To address barriers in healthcare service connection and utilization, a large hospital system serving Upstate South Carolina implemented a pediatric navigation system, the Pediatric Support Services (PSS) to aid in referral connection for pediatric and adolescent populations. Based on similar navigation services implemented across the country, PSS utilizes trained navigators to connect referred patients to services for mental and behavioral health conditions, food and housing resources, continued care, and family programming.[54,55] The goal of PSS is to provide support to patients and families identified by primary care providers as needing additional services and resources through referral connection of appropriate services and follow-up to ensure connection to services.

Dissertation Aims

The purpose of this dissertation is to examine facilitators and barriers to adolescent health care service delivery and access. This research was completed through an implementation science lens to assess challenges to existing care delivery in three programs aimed at delivery care to adolescent populations. All three studies included in this dissertation provide insight into the implementation successes and challenges of the programs they apply to. The specific aims of this dissertation are:

Aim 1: To explore the implementation process and success, as defined by the PRISM domains of complete and as intended implementation of the PRISM domains, of SBHCs using South Carolina as a case study for evaluation based on a multitude of contextual factors.

RQ 1: What factors influence SBHC implementation?

RQ 1.1 How do factors influencing SBHC implementation vary by delivery model?

Aim 2: To assess mental health service delivery and treatment outcomes between patients utilizing School-Based Health Centers and traditional pediatric community clinics.

RQ 1: Are there differences in mental health care service delivery between patients seen in SBHCs versus pediatric community clinics?

RQ 2: Are there differences in mental health outcomes between patients seen in SBHCs versus pediatric community clinics?

Aim 3: To investigate predictors of referral completion for mental health care services in a pediatric care navigation system.

RQ 1: Are the predictors of referral completion for pediatric populations referred through a pediatric navigation service to mental health related services?

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CHAPTER TWO

FACTORS OF SBHC IMPLEMENTATION: PRISM GUIDED QUALITATIVE EXPLORATION OF CLINICIANS AND SCHOOL STAFF

Abstract

School-Based Health Centers (SBHCs) provide access to clinicians and medical treatment and management through schools to address several barriers to care access. SBHCs have demonstrated success in addressing clinical care outcomes for patients, academic engagement and attendance, behavior and mental health conditions, and health care service utilization. The goal of this study was to examine the facilitators and barriers to SBHC implementation and sustainability utilizing the implementation science framework, Practical, Robust Implementation and Sustainability (PRISM), to guide the evaluation. In-depth interviews were conducted with 22 clinicians, care managers, and school staff to explore factors in care delivery and sustainability in SBHCs across South Carolina. Deductive-inductive codes following the RE-AIM constructs of PRISM were applied to the interviews. Themes were created based on the four domains of PRISM to compare implementation across different contexts, focusing on commonalities and differences across four SBHC model types: school-linked, telehealth, traditional, and mobile clinics. Common themes were found across all model types and highlighted challenges to the role of a school nurse in integrating with the SBHC, barriers and facilitators to physical space for care delivery, increased opportunity for care coordination and relationship building, the uniqueness of clinical operating outside of a clinical setting, and the importance of building trust with a unique patient population to foster patient self-advocacy. Themes diverged across models to highlight differences in necessary staff, resources and technology, opportunities for building trust with school staff and communities, and challenges to addressing service awareness.

Introduction

In 2017, over 2,000 School-Based Health Centers (SBHCs) were operating in the United States to provide clinical services to students during school hours.[1] This number has grown substantially in recent years with the expansion of services to include telehealth.[2,3] Services can include mental health evaluations and management, chronic illness care, acute care, sports physicals, immunizations, dental, and vision.[4] SBHCs are often employed to address traditional barriers to care access for pediatric populations by providing care through the school and to encourage academic engagement through continued care and treatment.[5,6]

SBHCs were initially developed to expand on the role of the school nurse, to diagnose, clinically treat, provide medication, and offer services beyond the scope of the role of a school nurse.[7] The effectiveness of SBHCs has been assessed through studies focusing on a variety of clinical care outcomes.[8] Chronic illness is addressed through ongoing management and treatment of conditions including asthma and obesity[9], as well as through preventative medicine.[8,10] School engagement and attendance is fostered through care delivery inside of the school, allowing students to be treated without missing school.[11,12] Additionally, SBHCs have demonstrated change on health behaviors and health seeking behaviors of adolescents.[13]

Conversely, implementation studies focusing on the success and challenges to implementing and sustaining SBHCs are often limited or lacking in scope. Evidence for SBHC impact on academic achievement and health outcomes lack comprehensive evaluations across stakeholders and methodologies.[9] Assessing implementation and care delivery across complex contexts or using data from multiple sites may strengthen findings, or offer insight into challenges and differences in expected outcomes in different settings.[14] Similarly, research findings have yet to be explored in the context of target populations or in studies designed to

assess effectiveness compared with SBHCs intended implementation goals.[15] Current research highlights a need for studies into the effectiveness of implementation with regard to multiple sites, contexts, and in the framework of implementation science to assess outcomes and delivery in a real world context.

The goal of this study was to explore barriers and facilitators to SBHC implementation and sustainability following the Practical and Robust Implementation and Sustainability Model (PRISM) across four distinct SBHC model types in South Carolina. PRISM was developed as a comprehensive model for evaluating health programming and interventions through the multiple perspectives influencing the RE-AIM domains; reach, effectiveness, adoption, implementation, and maintenance.[16] Under PRISM, implementation success is defined under four domains: the program, the external environment, the implementation and sustainability infrastructure, and the recipients. Through in-depth interview with individuals involved with the SBHC in both the organization delivery and school setting, this study triangulates multiple perspectives to explore the complexity of SBHC implementation and continued maintenance.

Methods

Theoretical framework

PRISM expands on the RE-AIM constructs to include four domains to evaluate program implementation and features. The program domain is assessed through the organization and patient perspective and refers to the elements of the intervention related directly to the organization and patient.[16] The organizational perspective of the program domain typically focuses on measures of organizational readiness, availability of evidence-based research, whether the program address barriers, and coordination across all stakeholders. The patient perspective focuses on measures of patient centeredness in program design, key barriers to

access, and transitions between program elements to ease utilization. The recipient domain is also assessed through the organizational and patient perspective. Under the organizational perspective, the recipient domain refers to the organizational health and culture, management communication, leadership, and data and decision support. The patient perspective refers to demographics and burdens that compete for patient's engagement in the program, and existing knowledge and beliefs surrounding the program. The external environment domain refers to factors related to the regulatory environment overseeing the program, community resources available for support, and any elements relevant to the external environment. The last domain is the implementation and sustainability infrastructure. This domain is characterized by measures related to the sustainability of the initial infrastructure. This includes factors like communication and relationship building, training and support of team members, capacity for adaptability, and initial plans for sustainability.

This study used PRISM during all phases of the design, data collection, and analysis. First, PRISM was used to guide the development of the interview guide following the four domains. The domains offer structured insight into contextual factors involved in the influence of RE-AIM constructs by assessing the constructs through different recipients or stakeholders at different levels.[17] Second, PRISM was used to inform and guide the protocol, recruitment, and analysis of interviews. Specifically, ensuring recruitment and inclusion of multiple perspectives to speak to the organization, relationship between stakeholders, and recipients in the form of school staff receiving SBHC services on a system-wide level. Lastly, PRISM was utilized to inform the development of the deductive codebook and the structure and application of codes throughout the analysis and development of themes. Each code was developed by RE-AIM construct and applied following PRISM domains.

Study design

This study was a case study of school health centers throughout South Carolina utilizing in-depth interviewing to examine barriers and facilitators to implementation and sustainability. For SBHCs previously implemented prior to the study, interview participants were instructed to think back to challenges from the implementation process and initial connection of services through the school system. Interviews were conducted with clinical staff and school staff to triangulate different perspectives across all four school health center model types: mobile, telehealth, traditional, and school-linked.[1] Mobile clinics provide care to students through a mobile clinical unit with a clinical team operating just outside of a school. Telehealth encompasses care delivered through video platforms to students at a school through a trained tele-presenter or school nurse who presents the visit to a clinician working in another location. Traditional clinics operate in a permanent office located within the school, with consistent access to a clinician. School-linked is similar to a traditional clinic but operates out of a shared health room or flexible space where resources need to be brought in with the clinical team. The study was approved by the Institutional Review Board at Clemson University, IRB2021-0837.

Participant recruitment

A network of key leaders in school health center implementation and maintenance was developed prior to study recruitment to advise on the interview question guide, study design, and participant recruitment. This network was created from seven members of the SC School-Based Health Collaborative (SC SBH). The SC SBH includes representatives from all SBHC delivery organizations throughout South Carolina, including clinicians from major health systems, local providers, representatives from the SC Department of Education, and the South Carolina Telehealth Alliance.[18] The network was approached individually for initial meetings to discuss

the study protocol, potential interview participants from their networks, and to discuss the SBHC model type specific to their network. All network members were from SBHC providers throughout SC.

Interview participants were recruited through purposeful sampling based on the network leader's organization reach and model type. At least one individual from the health system and one individual from the school system were the target for each network key leader to recruit. Larger organizations contributed larger potential participant pools to account for larger scale influence. Recruitment was also based on findings from the 2020-21 National Survey of School-Based Health Centers data, which found a significant increase to over 80% of school-health centers providing at least some services through telehealth.[3] Using these survey findings, recruitment was targeting telehealth providers for the majority of interviews, followed by mobile health, school-linked, and traditional models. To account for participant nonresponse, snowball sampling was used to target individuals involved directly in the implementation and delivery of school health centers by specific model types.

Data collection

Semi-structured interviews were conducted with individuals involved with school health centers from the health system and through the school. The interview questions were guided by PRISM and informed by the key leaders' network. Each interview question was developed to explore PRISM domains and are exemplified in Table 2.1. All interviews were conducted virtually, recorded, and professionally transcribed. Interviews were an average of 45:22 minutes long. The shortest interview was 27:10 minutes and the longest interview was 65:30 minutes long. All interviews took place in January and February 2022.

Data analysis

All interviews were coded following an inductive-deductive thematic analysis in Atlas.ti (version 22). The first three interviews were coded together by two coders following the deductive codebook developed from existing literature, conversations with the key leaders' network, and through PRISM domains (Appendix A). The final codebook was created with additional inductive codes added throughout the analysis process. One interview was coded by both coders independently and reviewed for consistency. Any code discrepancies were discussed by both coders until consensus was reached. All remaining interviews were coded by the a single interviewer following the previously developed codebook until the final interview was coded together by both coders to evaluate consistency with prior coding.

After the final coding, themes were constructed by both coders and an evaluation expert familiar with the content area, based on content within codes, patterns of connectivity across codes, and the PRISM domains. Themes were developed across model types, focusing on commonalities and isolated themes. Themes are presented by PRISM domains.

Results

Participant characteristics

This study included 22 total interviews, representing three school districts and six health care organizations. Seven were employed by the school or school district receiving school-health center services. Of these seven, four were school nurses and three were other staff members, all were female. Majority of the interviews were with individuals employed by the health system or the organization delivering the school-health center services (N=16). Of these, seven were part of managing or coordinating services and eight were clinicians. There was one male clinician, and the rest were female. The distribution of interview participants by role and model type is given in Figure 2.1. Majority of the interview participants had knowledge of more than one SBHC model

type, as exemplified by the overlapping model shades. For example, participant C14 represents a clinician with knowledge of traditional and telehealth SBHC models. SN20 represents a school nurse with knowledge of school-linked, telehealth, and mobile SBHCs.

Overview of results

This study identified several themes, stratified by model type, and presented by PRISM domains. Eight themes were identified across all model types and are given in the context of PRISM domains in Table 2.2. Isolated themes identified by specific model types are presented in full in Table 2.3.

Theme: *Barriers and facilitators of physical space*

All SBHC model types found challenges with physical space, whereas some model types benefited from space inherent to the model design. For school-linked and telehealth, shared space with school nurses often posed challenges to managing privacy.

> "Then the other rooms are shared spaces with the school nurse, which can be hectic at times depending on what's going on. If there's an injury and then two sick kids, we can't interrupt the nurse to pull a kid […] so some days our clinic schedule doesn't get – we don't get to see everybody we wanted to see based on what's going on in the health room because it's a lot of shared space." (A)

> "In our clinics where we don't have our own space, it does get crowded 'cause we're sharing this space with the nurse, so kids are coming in and out of there constantly. So sometimes we kinda have to pause our visit for a minute. We don't want the kid we're seeing to feel like they can't confide in the provider they're seeing." (G)

> "If you want to do a telehealth visit and there is a sick kid in your room waiting for a parent, you can't do it." (T)

Some interviewees even suggested that shared space confused students and families by muddling services provided by the school nurse with those provided by a school-health center.

> "I think it's always been confusing that because they're in the same space, so they think that it's the same, that they deliver the same service…even students, they are confused, parents are confused." (K)

Conversely, mobile units and traditional SBHCs benefit from a physical presence similar to that of a traditional clinical office, with availability to all traditional resources.

> "You have the ability to close the door to create a confidential and private space. Both rooms have a medical table as well as a desk for us to document our computer stuff…" (U)

> "…and for those schools where we're actually functioning out of those schools, typically if the space allows, they'll give us a little bit of space to actually put supplies…but that's rare that we have that space, so it's more ideal to operate off the [mobile] unit 'cause then we can stock it and, you know, have free reign to utilize it as we need to." (J)

Theme: *Care coordination and teamwork in patient care*

A key feature of school-based health is the availability of and connection to school staff and internal organizations to provide comprehensive care to patients, not restrictive to any one model type. In addition, operating in tangent with a school system offered opportunities for more comprehensive intake and information gathering for the SBHCs.

> "When we meet to talk about students, they also can listen to the details of what's happening in a child's learning experience and provide suggestions or things that we hadn't considered. And it's not just a mass – like, oh, that kid's got ADHD, or that kid's

got whatever, but just listening to some of the behaviors and patterns allowed them to think about is there a medical issue that might be resolved?" (L)

"Teachers will refer to us sometimes for ADHD issues, sometimes they'll have like IEP meetings, the Individual Education Plan meetings and something will come up in those meetings that will say, 'Oh well we've got this person here. Let me see if she can do an evaluation" or "She can help us get you the resources you need.' Some school's administrators directly call me and say, 'Hey, I've got problems with this kid' or 'I'm talking to this mom' or 'Can you add this kid to your schedule,' that type of thing." (A)

"We work clearly with the school district. The school district provides somebody that is a called an "on-sight facilitator" or [specific program] facilitator. That person's role is to conduct meetings weekly with support staff in the school and talk about those students that are flagging for attendance, behavior, and course performance. It provides input from different specialists to talk about each individual child and see what the best resources would be to kind of help with the interventions for this child to make this child successful." (A)

Theme: *Perspectives on the role of the school nurse as a gate keeper*

A frequently cited theme was that of the role of the school nurse in terms of the SBHC. In some cases, the school nurse was regarded as the gate keeper, or triage point for SBHCs by deciding whether to send or connect students with the SBHC.

"So 99 percent of the acute care visits gets screened by the school nurse first." (A).

"We tell the nurses that if it a true medical emergency, something that you would need, like that you would need to call 911 for they should go ahead and call 911, just because we wouldn't want to delay care." (B)

> “Because I've told our school nurses. I said, ‘Look, if you get a frequent flier into your school nurse office and they're constantly coming in, that's the student we need to see. That's the student that we need to have consent forms brought in. We need to have them enrolled so that perhaps you can use telehealth and explain the importance of regular medical care, regular visits to their pediatrician.’ Because what school nurses don't want to see is the same student coming in over and over because that means that there's other things happening.” (F)

However, some interviewees stressed the importance of not treating the school nurse as a triage point, or giving specific referral instructions, because this is outside of the scope of their training and job responsibilities.

> “What we tell school nurses is that we'll see anything that they would like to refer, provided the parent has given consent, except for true emergencies. If they have a real emergency, we want them to follow their emergency protocol and manage it accordingly. But we don't provide a list of potential diagnoses; people often ask that question. And the reason we don't do that is because then we're asking the school nurse to make a diagnostic decision, and that's not their role.” (C)

Theme: *The impact of COVID-19 on the traditional role of school nurses*

Several interviewees, specifically school nurses, noted the increase in responsibility of school nurses in leu of the pandemic. These new roles often include close contact tracing, dealing with sick students, and staying informed on and helping to enforce changing guidelines. This often gets in the way of assisting SBHCs or feeling like school nurses have enough time to refer students or conduct telehealth visits.

> “But with the small school district, your school nurse is doing multiple things and telehealth isn’t necessarily one of those things that she’s actively doing-especially now with all the paperwork and all the COVID stuff that’s coming in. It’s just difficult.” (F).
>
> “And then you put COVID on top of it, and everybody, of course, is like over it as it is. Then they've got all the COVID guidelines with schools. So, they're crazy busy as it is. I mean, I never realized how busy they are. They're super busy.” (N)
>
> “It's been a nightmare. It used to not be as bad, but then this year, they got too overwhelmed. They had hired people to do [contact tracing], they were too overwhelmed, and we were having to do – it's just, yeah, it was a nightmare, but, yeah, it's a lot, yeah. It's pushing a lot of nurses out, I can tell ya. I'm hanging in, but it's gotten better, but it was, yeah, difficult, for a little bit.” (Q)

Theme: *Clinical adapting to school policy and regulations*

Many clinician interviews described unique circumstances poised to care delivery when working within a school system and abiding by school policy and regulations. Adaptations included challenges to patient scheduling between school hours and avoiding core classes and testing and abiding by school policy regarding specific service delivery or COVID precautions.

> “So, for example, vaccinations or other types of testing. For example, there's a CDC guideline for universal HIV testing where we do testing starting at the age of 16. And the group that we take care of is a very high-risk group who would benefit from such universal testing, but we're not allowed to do that in the school, because it's HIV and that's a scary conversation sometimes.” (U)
>
> “In discussion with the school district and with Infectious Disease here at the hospital we decided that due to us not being able to do COVID testing that we could not do flu tests

and strep testing too. Initially it started because of the aerosolized you know COVID and we didn't want to be risking that, but it also is, 'Okay if you have a child that has all of these symptoms, they could be flu or they could be COVID.' And putting a kid through a flu test and then saying, 'Hey, it's not a flu, now you need to go get COVID tested,' it would be better suited for a pediatrician's office." (A)

"And we only pull from – we don't pull right from the middle school and high school. We don't pull from any core classes. We only pull from electives. So that's really kind of – you know, we have like an hour to try to see this grade." (O)

Theme: *The importance of relationship building and maintenance*

One of the most frequently cited facilitators to successful implementation and barriers to buy-in and trust building between health care organizations and schools were personal relationships. The stronger the relationship between clinical teams and school staff, the greater the buy-in and support from school administration, teachers, and school nurses.

"Yeah, so I think relationship building is huge, because it is a different concept than the district is used to. So, I have noticed that when the relationships are great with the schools and with the school administrators, we are very successful at those schools. When the relationship is not as great or the buy-in is not as great with administration our success as a school-based health center is not as great." (A)

"I think the main thing with school-based health for it to be successful it has to build up on your relationships, I think that's the key part. And when being a hospital system coming into a school system you have two different systems and you're having to learn to work together under the same roof and we're actually guests inside the school. So, once we realize that we can't do things exactly the way that we've always wanted to do them

and then they recognize hey we're actually there to help them and to help their students that relationship is built and we can be successful, but it has to get to that point." (A)

"I mean, really and truly it is a relationship-building. It's your relationship with people in the school, your relationship mainly with the school nurse, your relationship with the parents." (E)

Some interviewees also stressed the importance of relationship building within the whole community, to foster trust and awareness.

"Building relationships in the community, so for example, in rural communities where [organization] at that time didn't have a presence, a lot of what I would hear would be like, 'Well, why does [organization] wanna come here?' [...] So it took some time to really build the relationships not only with the school personnel, but even in the community, to help them understand. And when we built relationships with school nurses and the local community stakeholders, then the community has more trust in our services." (C)

Theme: *Exclusions and inclusions in goal tracking and planning*

Another key to successful implementation and maintenance are goal planning and program evaluation. Frequent and ongoing conversations about success and challenges in the delivery of SBHC services offers opportunity for adaptation and adjustments to be made to foster long term maintenance. Sharing progress and including schools in these conversations is also cited as key to success.

"I mean, we are constantly working with the district leaders. I give them a report every year [...] about the participation they have in their schools. That's why, again, this summer, we decided with the district 'Let's pull out of these other schools that are not

really active and let's put them and see what we can do in these ones that you guys have referred to.'" (C)

"Yeah, so we meet as a team monthly to make sure that we're meeting the needs of the students that we're serving, and that's internally with our school-based health center staff. Like I said, we meet periodically with the principals of the school to make sure that they feel the needs of the school are being met, and to get any feedback from them, and also kinda give them a 'How's it going?' on our end and things that we may need in order to make it successful. So, there's a lot of different layers to those conversations." (I)

However, many interviewees could not answer questions regarding goal planning, tracking data, or evaluating services. Frequently citing not being a part of those conversations, not knowing if they happened, or only receiving broad overviews and updates.

"I actually have not been part of any of those [goal planning] meetings […] I have requested to be part of those meetings, but they're dealing with it, so-I have no idea, honestly […] They did just have a meeting last week but honestly, I am generally kind of out of the loop." (S)

Theme: *Self-advocacy and building trust with unique patient population*

Unlike traditional care clinics, SBHCs rely on pediatric patient self-advocacy and must cultivate trusting relationships within the school and directly with students in order to create an environment where students feel comfortable seeking help, advocating for themselves, and accurately identifying symptoms.

"Just getting kids to understand their health. You know your body better than anybody else, and if you don't feel right, let us know. Let a parent know. Even through this season of COVID, we've had kids that will sit at school all day and be like 'Oh, my throat was

hurting.' So being an advocate for — I mean, you have some kids that are advocates. Don't get me wrong. But then you have other kids that they're not gonna advocate for their — now, I don't understand that, because if I'm not feeling well, I'm gonne put it out there." (H)

"Definitely, familiar faces. Not changing it up at all, we don't really have to change it up, we don't have a high turnover rate […] And then, even when [students] just pop in to the health room, we're speaking to them, and sometimes they see us in the hallway and they'll speak to us, and we just really kind of make 'em feel comfortable, though." (P)

Discussion

Commonalities

This study's objective was to explore factors related to the implementation and sustainability of SBHCs throughout South Carolina across several model types. These themes provide information that can provide useful in planning and sustainability meetings for new SBHCs and existing, to ensure full implementation and effectiveness of all SBHC model types. Across multiple perspectives and models, there were several common themes highlighting universal challenges to successful implementation and maintenance, as well as key features throughout the implementation process to aid in the startup and sustainability of SBHCs. By analyzing these interviews through the four PRISM domains, this study was able to triangulate perspectives across the program, external environment, the implementation and sustainability infrastructure, and the recipients.

Under the program domain, the concept of physical space was cited as both a barrier to and facilitator of successful integration and implementation of a SBHC. In all model types, some aspect of physical space was necessary to start services or to provide a secure and private space

for patient and clinician interaction. Specifically in school-linked and traditional models, physical space needs required more planning with the school system, a heavier reliance on accommodation from the school systems, and was often cited as a barrier to implementing new centers and being able to conduct a full schedule and visit. In mobile clinics, school-linked, and telehealth models, shared physical space was also found to be a barrier to trust building and privacy. Constant interruptions and the fear of interruption was often referenced by participants as a challenge to mitigating the trust and privacy traditionally expected in a clinical setting. Conversely, in mobile units and traditional clinics, the trust building, and privacy was mitigated by the physical look and presentation of a seemingly traditional clinical office within a school setting.

Another feature of identified under the program domain through the organizational perspective was the facilitation of care coordination and teamwork in patient care. In coordination with school staff and internal school programming, SBHCs are offered a unique opportunity for a more comprehensive view into patient health and well-being. Flexibility and availability for participation in schoolwide meetings or to work with school staff to identify students at risk or in need of clinical care offers clinicians the opportunity to identify students earlier and to have outside perspectives when assessing students' health.

Patient characteristics of the program domain were expressed through perspectives on the role of the school nurse as a gate keeper were identified as vital to the perceptions on the role of the school nurse and how the SBHC operates with or around the school nurse. Several interviewees noted school nurses operated as gate keepers for the SBHCs, triaging patients and deciding who should be seen in the center, who should be sent home, or when to call emergency services. These interviewees often mentioned the heavy burden placed on the school nurse and

the difficulties of relying on the school nurse to make referrals and connect patients to the centers among their other roles. Some interviewees explicitly stated not treating school nurses as gate keepers because that would rely on nurses making clinical decisions and working outside of the scope of their role.

Because interviews took place in the beginning of 2022, many interviewees cited the impact of the COVID-19 pandemic on the traditional operation of the SBHCs. The impact of COVID-19 on the traditional role of school nurses created a time and resource burden on nurses that challenged the role of the nurses in turnover, connecting students to SBHC services, and being able to fulfill all of their roles. School nurses were left in charge of contact tracing, enforcing COVID-19 protocols, and the isolation of potentially positive students. Nurses often cited a lack of time and energy when faced with connecting students to SBHCs, especially though telehealth, where a school nurse might have to act as a tele-presenter.

Adaptation of SBHC programming was also influenced by the uniqueness of clinical operating within a school setting. Flexibility with scheduling and contacting patients was needed to work around school hours, deal with absent students, and to work with school policies of when students can be removed from class. Adaptability is also needed when planning service delivery and working within organizational guidelines and school system guidelines. For example, school policy with COVID-19 often prevented testing on site, which in turn prevented testing of all similar illnesses because of an overlap in symptoms.

One of the most cited facilitators of a successful SBHC was the ability to form relationships between the SBHC organization and the school. Stronger relationships were frequently described as the key to administrative buy-in and support. These relationships also expanded into the community when a community presence increased trust in the SBHC, and

awareness of services provided. Additionally, weak relationships were cited as a major contributor to failed implementation, low utilization, and low awareness. Without the support of the school or the engagement with the staff and community, the SBHC struggles to get referrals and provide effective services.

Lastly, under the recipient's domain through the organizational perspective, exclusions and inclusions in goal tracking and planning and self-advocacy and trust building with a unique patient population under the patient perspective were described as features inherent in the successes and challenges of a SBHC. Continued goal tracking and setting offered opportunities for real time adaptation and programmatic changes that allowed for efficient and effective sustainability of services. However, many interviewees noted a lack of involvement or understanding of goal tracking and planning. Often left out of conversations, many interviewees felt cut out of important decision-making while being the care deliverers.

Common to all SBHCs, was the need for students to self-advocate and feel comfortable with the SBHC staff and services so they would seek out help when needed. Similar to relationship building, have a presence and relationship within the schools and specifically with students, helps to increase feelings of trust and security between the patient and clinician which encourages students to utilize services and to rely on the SBHC.

Model Specific Outcomes

Several themes were specific to the SBHC model type being discussed. Four themes were identified for mobile clinics, two for traditional models, five themes were identified for telehealth, and one was identified for school-linked. These model specific themes are important to recognize during the planning and implementation of SBHCs to provide real world context for implementation challenges and facilitators. In the planning stage, identifying the target

population and school, and adjusting the SBHC model type based on recognized implementation research will allow for more efficient and successful implementation and long-term sustainability.

Mobile Units

One barrier to mobile health implementation is the need for specially trained drivers or a designated driver on staff to operate large mobile health units. However, mobile units offered several opportunities for initial engagement with schools and communities that foster increased awareness of SBHC services and relationship building. Mobile health units are typically easy to spot and recognizable clinical facilities that offer an opportunity to increase general awareness and acceptance of an organization. Additionally, by operating outside of a school, mobile units can offer care to families and community members, thus increasing awareness and providing services to a larger population. Lastly, for initial implementation and negotiations, mobile units require less support from schools. Mobile units don't rely on the school to create an office inside the building or to provide resources and materials. All clinicians and resources are available on the mobile unit, providing a unique opportunity for this model when working with more reluctant schools.

Traditional

Two key features isolated to traditional models of SBHCs were identified as successes of this model. Traditional models often provide access to clinical staff on a more regular basis, which allows for services to expand to include follow-up care and continuity care for chronic illnesses, acute care follow-up, and mental health management. These models also increase the presence of SBHC staff within the school, which increases awareness and acceptance of the clinician's presence within the school and provides opportunities for increases in utilization and

relationship building with students and staff. Schools with high need for clinical care and long-term management could benefit from the consistency offered by traditional clinics.

Telehealth

Several barriers were identified that work against the increase in care availability offered by telehealth services. During initial implementation and sustainability of telehealth resources, IT professionals are often needed during initial set-up and to troubleshoot problems with equipment. When telehealth is expanded to cover several schools, the need for more IT personnel will rise and present a unique challenge to maintaining services. Similarly, telehealth is often used to support clinical care access in rural areas. These areas are often challenged by weaker internet coverage and may require more initial planning and resource allocation to initiate and sustain. Telehealth also relies on the training and confidence of school nurses or employment of tele-presenters to conduct visits between clinicians and students. School nurses reported feelings of apprehension and a lack of time as barriers to telehealth utilization that need to be addressed to support a successful telehealth model. However, in leu of the COVID-19 pandemic, many interviewees noted feelings of gradual acceptance for telehealth in the general public. Because of increases in services provided virtually and a need for such services, people have been encouraged to use and accept telehealth moving forward.

School-linked

Lastly, school-linked SBHC models were found to have considerable overlap with one or more other models. However, unique to the school-linked model was the facilitation of patient and school trust and awareness through a unique presence within the school. Similar to increased presence of the traditional model, interviewees involved in the delivery of school-linked services often described increased staff time spent at school events and in relationship building with

individual staff members. Under this model, clinicians and organizations had increased presence within the school system as a whole and concentrated more on relationship building and addressing awareness gaps in the school and community. School-linked models may be beneficial to organizations and schools with a proximity and involvement in community health.

This study was subject to several limitations. Data was collected from participants identified through purposeful sampling and may not be representative or generalizable across all contexts and perspectives. The participants may over represent engagement and support with SBHCs; however, this was necessary to include participants across a multitude of contexts and delivery models. Additionally, while interviews remain anonymous, participants occasionally expressed reservations about sharing challenges, especially regarding funding, staff turnover, and supervision that may underestimate the impact of these factors on SBHC implementation and sustainability. Inherent to the study design, the coding and analysis is subject to researcher bias and subjectivity. This was addressed by the inclusion of an outside coder to develop the deductive codebook, code samples in the beginning, middle, and end of the study, and through member checking of themes after the analysis.

Conclusion

Through interviews with different stakeholders involved in the delivery and support of SBHCs, this study identified several important themes common to successful implementation and several themes unique to specific model types. Common themes focused on the challenges surrounding physical space, relationship building, the importance of adaptability in planning, and the opportunities for care coordination. Isolated themes included challenges to necessary personnel and resources, barriers to service awareness, and opportunities for care continuity. This study expanded on the current use of PRISM to compare themes across not only different

contexts, but also different model types and delivery. Future implementation and planning of SBHCs should utilize data and information from successful SBHCs and implementation studies to ensure effective and sustainable school health through complex and comparative evaluation and implementation science studies.

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Table 2.1 Interview questions alignment with PRISM domains	
PRISM	**Interview Questions**
Program Organizational perspective	Where does funding come from? How long is this supported?
Patient perspective	How are patients referred to the SBHC? How do you communicate with and reach your intended population?
External Environment	What organizations are involved in supporting your SBHC?
Implementation and Sustainability Infrastructure	How does your organization/school track success in service delivery and utilization? How is information shared with collaborators/users about SBHC success/challenges?
Recipients Organizational characteristics	Who is involved in setting SBHC goals and how is this process done? How are unforeseen barriers/facilitators addressed in planning?
Patient characteristics	What populations do you deliver care to? Insurance status, target population?

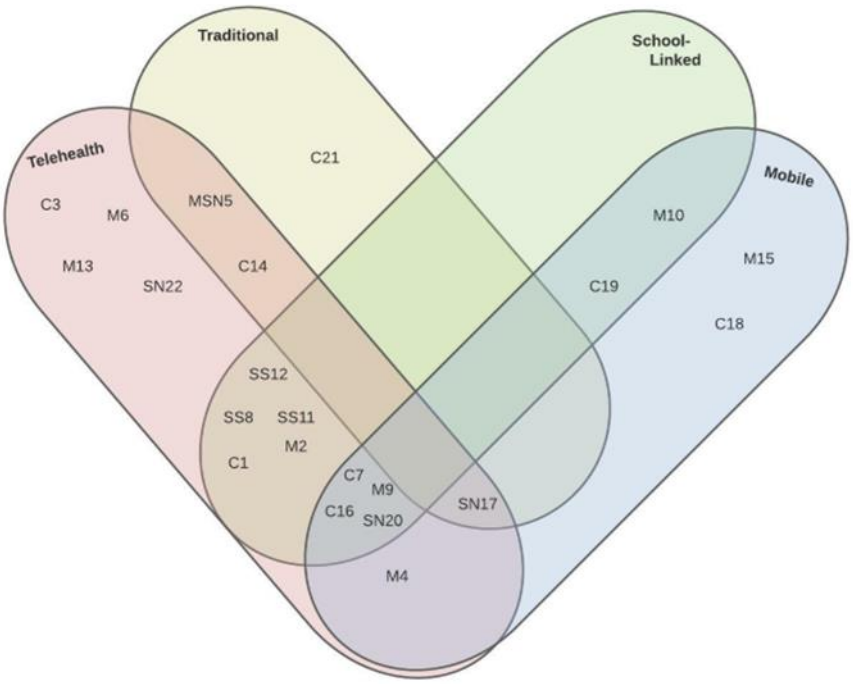

Figure 2.1 Final breakdown of interview participants by involvement in SBHC model type
Description: C is clinician, M is organization manager, SN is school nurse, SS is school staff. Overlapping areas represent participants with experience or knowledge of each model type overlapping.

Table 2.2 Common themes for all model types by PRISM domain	
PRISM Domain	**Themes**
Program Organizational perspective Patient perspective	***Theme:*** *Barriers and facilitators of physical space* ***Theme:*** *Care coordination and teamwork in patient care* ***Theme:*** *Perspectives on the role of the school nurse as a gate keeper*
External Environment	***Theme:*** *The impact of COVID-19 on the traditional role of school nurses* ***Theme:*** *Clinical adapting to school policy and regulations*
Implementation and Sustainability **Infrastructure**	***Theme:*** *The importance of relationship building and maintenance*
Recipients Organizational characteristics Patient characteristics	***Theme:*** *Exclusions and inclusions in goal tracking and planning* ***Theme:*** *Self-advocacy and building trust with unique patient population*

Table 2.3 Common themes by PRISM domain, stratified by model type				
PRISM Domain	**Mobile Unit**	**Traditional**	**Telehealth**	**School-linked**
Program Organizational perspective	***Theme:*** *Specialty staff and certifications unique to mobile units* In some cases, mobile units are such large vehicles, they require special licensure to operate. This requires a specific staff member to be certified or to arrange for a driver. "'cause the medical assistant or the nurse are typically – they have their CDL license, so that's who drives the unit to our location for the day." (R)		***Theme:*** *Reliance on IT for set up and maintenance* Unique to telehealth carts are IT personnel who are needed for initial set up and maintenance of telehealth resources. "And then for the telehealth, IT has to come out and, you know, do all the IT stuff to support the telehealth cart." (T)	
Patient perspective	***Theme:*** *Increased awareness of all services through recognizable mobile units* Mobile units are a larger entity parked outside or near schools which can attract attention and subsequently increase awareness of school-	***Theme:*** *Continuity care and consistent follow-up* Interviewees involved in traditional care models often cited the frequency of clinical days and the overall objective to focus on follow-up care and continuity care.	***Theme:*** *Challenges of remote services in rural communities* With target populations typically in settings far from access to traditional care practices, telehealth services are sometimes interrupted by challenges unique to	***Theme:*** *Facilitator of patient and school trust and awareness* An in-person presence fosters stronger relationships with the school and trust between clinicians and students.

	health centers, not typical of other SBHC models. “So, I think word of mouth and us providing that service and people just seeing it, I think that's a huge success. 'Cause, obviously, you can't miss this mobile unit, and so people are very inquisitive about it whenever they see it. They'll even come – we have been there and had parents come knock on the door and want to know exactly what we do.” (R)	“So, I work five days a week. I have scheduled patients that I see in the clinic that I'm based in that are typically ADHD kids that I'm following for medication refills, medication adjustments, that sort of thing, asthma patients that – the scheduled ones are the ones like, say, if I increase their controller medicine or if they're having trouble, just to kind of keep a follow up on all of them.” (N)	these areas, including internet services. “I will say that the only kind of problem or issue that we have had has been the Internet. But with the connectivity issues and things that we were having, there was just no way to say, "Oh, we're going to see six [patients] every day. Because what works for one school one day may not work in the same school the next day – or a different school the next day. And even when you go back to that school the following week, the setup may not work. So, we spend a good hour test-calling and equipment-checking when we get there in the mornings.” (D)	“So the second year really focused on our team educating the school staff. So that meant attending everything the schools did, every back to school event, every you know ball game, every carnival event, any time there would be staff or students or parents there to let us be visible and present to show that, ‘We are here and this is – we're part of this school. These are the things that we can offer.’ And when we did that the staff started buying in a lot more, because they started realizing what we could do. I think that was a huge part with the implementation of having a provider come into the school and just go straight to the health room and stay versus truly being in the hallways and being visible. So, if you're

				going to be a school that's locked in with – a school-based health center is locked in with the school you have to be visible and they have to know who you are. If they don't know who you are or when you're there, then it's not worth it." (A)
External Environment			***Theme:*** *The impact of COVID-19 on the gradual acceptance of telehealth services* Several interviewees noted a shift in acceptance of telehealth services over the past few years and cite the COVID-19 pandemic and the increased need for and delivery of telehealth services. "I think COVID kinda opened the world's eyes to the beauty of telehealth" (T) "So, people are more used to kind of the screen talk, so I think	

			that they're much better with it now. I mean, I think it's probably because of COVID because they kind of – I mean, you had to figure out – You know, it's like all of this I think has probably made it more comfortable, but before that I feel like it was kind of like people were – it seemed colder to be talking to somebody over the computer versus talking to them in person. But I think people are more receptive to it now than they were because – especially if you're talking about a hard topic. Like if you're talking about, you know, some kind of limited resources or if you're talking about mental health or something that's hard to talk about, but I feel like people are better talking about it now than they were pre-COVID." (Q)	

Implementation and Sustainability Infrastructure	***Theme:*** *Facilitates initial school buy-in by not requiring school space or resources* Mobile units offer a unique delivery model by providing their own space and not brining outside staff into the school. "So that has been a bit of a gamechanger for us in our conversations and in our attempt to get buy-in from administrators because that, in the past, was a challenge when we tried to get things started, is well, we really don't have space, we barely have space for our staff and our students. We don't have space for a team to come in." (J)	***Theme:*** *Facilitators of communication-consistency of appearance* Due to the full adoption of this model into the school, clinicians cited increased presence as a facilitator for relationship building and increasing awareness of services. "I mean, I have a lot more communication with the school staff. I talk to the principal, the assistant principal. Like the dean of students, we meet weekly to go over the kids that we see. Just because I'm there I think that – I mean, I talk to them more just to kind of push out services, and they just come by and talk to me whenever. But I just think it's because I'm there all the time and they know me." (N)	***Theme:*** *Reluctance to work with telehealth equipment, feelings of uncertainty with school nurses* Several interviewees noted feeling resistance from school nurses who either cited not feeling comfortable operating telehealth platforms, presenting to physicians, or feeling like a telehealth visit could work into their schedule. "So, I think some just – and some people I just think even though they've been trained, I don't know if they just don't feel comfortable with the technology. I mean, I've always told them, I promise I'm nice. I'm not going to yell at you. Because they were like, "Oh my gosh, I'm so sorry, I'm so sorry. I forgot how to do that. I am sorry. I'm like, it's fine. Don't	

			worry about it. It's fine. So maybe that could be kind of they just – their comfort level and – I don't know." (Q)	
Recipients Organizational characteristics			***Theme:*** *School nurse and school staff turn over* Interviewees cited school nurse turnover as a challenge to telehealth utilization, requiring new training each year, sometimes in the middle of a school year, and an adjustment to utilizing telehealth. "So, our biggest barrier/problem is when we get – it really is based on your relationship with the school nurse. So, a lot of times if there's a turnover, a new school nurse starts – if I know a school nurse is retiring or leaving or switching schools or whatever, I pretty much know that the next year is going to be very low numbers.	

			Because the first year of school nursing is so difficult to transition to for people." (H)	
Patient characteristics	***Theme:*** *Extension of services to families and community members* Because the mobile unit is working from outside the walls of a school, services can be offered to patients outside of the school, including community members and families of students. "And the good this about having the medical mobile unit is it's open to the community members. So, we are servicing the schools but we're also able to see-you know, there is an elementary school across the street, we can see the family members of the students of the school, we can see the staff members." (V)			

CHAPTER THREE

COMPARATIVE ANALYSIS OF MENTAL HEALTH OUTCOMES AND SERVICE: DATA FROM PATIENTS UTILIZING SBHC SERVICES VERSUS COMMUNITY PEDIATRIC CLINICS

Abstract

The most commonly diagnosed conditions among adolescents are anxiety, depression, behavior problems, and attention-deficit disorder (ADHD). Signs and symptom associated with mental health conditions are estimated to impact a third of adolescents and has continued to rise. School-based Health Centers (SBHCs) are one intervention to address mental health conditions in adolescent populations by providing services through schools for clinical support of management, diagnosis, and care coordination. Evidence for SBHCs effectiveness often focuses on changes to short-term health outcomes and utilization. The purpose of this study was to assess differences in health outcomes and utilization between SBHCs and a traditional pediatric community utilizing longitudinal data.

This study included retrospective chart review for 320 patients utilizing a SBHC or pediatric community clinic for mental health services. Patients were propensity score matched to adjust for significant demographic differences at baseline. Manual chart abstraction included data for medication adherence, emergency department visits, total health care encounters, presence of counseling services, and the presence of a standardized mental health condition screener. Generalized liner models were run for each health outcome to estimate differences between the two groups.

The study found significant decreases in the rate of health care encounters for SBHC patients compared to patients from the pediatric community clinic and a decrease in the odds of the presence of a standardized screening survey, and significant increases

in the odds of being in counseling during the visit. These findings may suggest decreased healthcare utilization due to better managed symptoms and care coordination to outside services.

Introduction

Signs and symptoms associated with mental health conditions are estimated to impact one third of adolescents aged 10-18, a trend that has been increasing over the last ten years.[1] The top diagnosed conditions affecting adolescents are anxiety, depression, behavior problems, and attention-deficit disorder (ADHD).[2] Increased risk for mental health conditions is exacerbated by experiences of adverse trauma, poverty, residential instability, and lack of access to support services.[3] Consequently, the majority of mental health conditions go undiagnosed or untreated. Barriers to care access can include insurance status, trusting medical professionals or adults with sensitive information, transportation to services, and the ability to self-identify symptoms or concerns.[4,5]

One intervention to address the impact of mental health conditions on adolescent populations and to address barriers to healthcare access and increased risk are School-based Health Centers (SBHCs). SBHCs offer access to medical professionals through the school system to bypass barriers to time, resources, and transportation.[6] Additionally, most SBHCs offer access to services to all students regardless of insurance status or ability to pay. It is estimated that 75% of SBHCs offer access directly related to the management and treatment of mental health conditions through mental health professionals, while almost all SBHC offer initial evaluations, screenings, and connections to specialty services for early identification and treatment.[7]

The association between SBHCs and school achievement, physical health outcomes, and short term increases in access and utilization have been demonstrated.[8-10] However, there is a current lack of longitudinal studies exploring the impact of SBHCs

on long term health outcomes and ongoing utilization. The goal of this paper is to examine the association between mental health management and treatment outcomes between patients receiving care from SBHCs and community pediatric clinics over a four-year period.

Methods

Study Participants

Retrospective data for patients seen in one of four SBHCs or one of two community pediatric clinics from August 1, 2017, to June 4, 2021, was used to identify the eligible population. Inclusion criteria included all patients with one or more of the following conditions: anxiety, depression, or ADHD, based on ICD-10 codes. Based on the distribution of ages, age was restricted to 11-14 for both the SBHC and pediatric clinic patients. To ensure at least one full year of data collection, the study entry date was limited to study years 1 through 4. This study was approved by the Institutional Review Board at Prisma Health, Pro00111795.

Data Collection and Study Variables

Demographic information on eligible study participants was collected through retrospective chart review.. Demographic information was automatically pulled for all eligible study participants and stored in a secure Research Electronic Data Capture (REDCap) server. The full list of demographic variables is given in Table 3.1. From study entry, a continuous measure of all healthcare encounters was created for each patient during the study period, Total Healthcare Encounters (THE). Additionally, the number of emergency department visits (ED visits) was calculated for each patient during

the study period. Insurance status was categorized as private, Medicaid, and uninsured. Race was categorized as Black, White, Hispanic, Other, and Unknown due to data distribution.

Visit data for all mental health management or well-child visits was collected through retrospective chart review for each patient. Binary variables included: presence of a standardized screening survey, whether a patient was currently taking medication, whether a patient was currently enrolled in counseling, whether the visit was for a medication change, and whether a referral to outside care was made. The date of the encounter, type of visit (i.e. well-child, follow-up, or ADHD management), related screener score, and notes related to referrals, treatment, or medication were also collected as text entry. Data collection also included categorical variables for medication adherence and screener type. Medication adherence was measured based on prescription notes and classified as "fills prescription on time," "fills prescription early," or "fills prescription late." Screeners tracked as part of this study included 'Screen for Child Anxiety Related Disorders' (SCARED), 'Patient Health Questionnaire-2' (PHQ-2), PHQ-9, and the NICHQ Vanderbilt Assessment for both guardians and teachers.[11-13] All visit data was collected through REDCap surveys on each patient over the study period (Appendix C).

To create the treatment and control groups, the dataset was filtered in two ways. All first encounters with a SBHC were filtered out to the treatment group. Patients in the control group were limited to patients who had never been seen in a SBHC. To ensure the study entry was related to an appointment, both groups were restricted to office visits

only. Study filtering steps are detailed in Figure 3.1. Unmatched baseline characteristics and standardized mean differences are given in Table 3.1.

Propensity score matching was used in this study to reduce selection bias and to achieve balanced baseline groups to account for potentially confounding variables. A study sample was extracted using 2:1 propensity score adjusting for age, sex, race, ethnicity, insurance status, condition, and study entry year. Standardized mean differences of greater than 0.10 indicated significant difference between the two groups. Adequate matching was found from most variables in the model, given in Table 3.2.

Statistical Analysis

For this study, of the variables described above, five outcome variables were analyzed: THE, ED visits, medication adherence, current counseling, and presence of a screening survey. The proportion was determined for each outcome variable, stratified by treatment group. Medication adherence was reduced to a binary outcome of adherence and non-adherence. Early and late prescription refills were categorized as non-adherence. Binary logistic regression models were run for medication adherence, current counseling, and presence of a screener to estimate the difference in odds of each outcome variable by treatment group. Generalized linear models, modified Poisson regressions with log link, were run for count variables: THE and ED visits, to estimate odds ratios by treatment group. All models controlled for all baseline demographics: age, sex, race, ethnicity, insurance status, condition, and study entry. Data was analyzed using R, version 4 and a p-value $<.05$ was considered statistically significant.

Results

The study included 320 patients: 205 in the control group and 115 in the treatment group. In the control group, the mean age was 12.29 (SD=1.12), 49% were female, and 88% had Medicaid. In the treatment group, the mean age was 12.39 (SD=0.98), 53% were female, and 83% had Medicaid. Majority of both groups had diagnosed anxiety (64% in the control group, 60% in the treatment group) and almost half of each group had ADHD (48% in the control group, 49% in the treatment group). Demographics and baseline characteristics for the matched sample are given by treatment group in table 3.2.

Total Health Care Visits

The mean number of total health care visits over the study period for the combined groups was 11.17 (SD=10.64). The mean THE count was 7.67 (SD=9.11) in the treatment group and 13.14 (SD=10.95) in the control group. The rate of total health care visits was 1.59 times lower for the treatment group compared to the control group (95% CI=1.49 to 1.72, p<.001) (Table 3.4).

Emergency Department Visits

The mean number of emergency department visits over the study period for the combined SBHC and control groups was 1.76 (SD=2.69). Mean ED visits was 1.82 (SD=2.65) for the treatment group and 1.71 (SD=3.12) for the control group. The model did not show a significant difference in the rate of emergency department visits between the SBHC and control groups (p=0.102) (Table 3.5).

Medication Adherence

Medication adherence was documented in 492 mental health related visit notes. Majority of medication was documented as ‘adherence’ (77.6%). The proportion of adherence in the SBHC group was slightly higher than the community clinic (85.7% vs 79.6%). The model did not show significant difference in the odds of medication adherence between the SBHC and control group(p=0.065) (Table 3.3).

Counseling

A presence of current counseling resources was documented in 876 mental health related visits. Counseling was current during 18% of visits where a document of services was recorded for the combined total. Proportions were higher in the treatment group than the control group for current counseling (25.0% vs 14.5%) The model found the odds of a patient being in counseling are estimated to increase by 2.10 for SBHC patients, compared to those in the control group (95% CI = 1.43 to 3.05, p<.001) (Table 3.6).

Standardized Screening

The presence of a standardized screener (SCARED, PHQ, Vanderbilt Assessment) was recorded in 859 mental health related visits. In the combined SBHC and control sample, 37% of visits recorded one or more screeners. The model found a significant decrease in the odds of a screener being present in a visit by 0.65 for SBHC patients, compared to control patients (95% CI = 0.47 to 0.91, p=0.011) (Table 3.7).

Discussion

The goal of this study was to estimate the association between several longitudinal health outcomes between patients receiving care from SBHCs and community pediatric clinics. The study found significant differences in total health

encounters, the presence of counseling services during the time of visit, and in the presence of a standard screening survey. SBHC patients are more likely to be in counseling during their time of visit compared to patients seen in traditional clinics. With the recent emphasis on providing mental health counselors and professionals directly through the SBHCs, this group may have a more direct pathway to service access. Barriers to referral and service connection may be addressed through services offered in the school, or in tangent with the SBHC.. Additionally, the rate of health care visits was significantly lower for SBHC patients compared to traditional clinic patients. These results together may suggest increased care coordination to outside services that manage conditions outside of the health care setting. While this study controlled for variation in the treatment and control groups for insurance status and race, future research may benefit from additional analyses controlling for financial status or family status.

Patients seen in a SBHC were also found to be less likely to have a standardized mental health screener present during a visit compared to patients seen in traditional clinics. This could be due to the population being targeted by SBHCs compared to traditional clinics, as one with potentially less engagement with health care services. Similarly, SBHCs are points for care coordination and may delay screeners for later providers. Further research into differences in the populations of SBHCs and traditional clinics regarding health advocacy and engagement may offer insight into differences in care delivery or service utilization.

While this study describes differences between patient outcomes between SBHCs and traditional pediatric clinics, there are several limitations to the study design. Visit data was manually abstracted from visit notes and is subject to error and bias from the researcher. This limitation was mitigated through the development and use of scales and detailed protocols for data abstraction established by the researcher with a pediatric physician. Because of the nature of SBHCs as care coordinators, there is some overlap in the treatment and control groups. Lastly, data is subject to recorder bias from the physician at point of contact with the patient. Visit notes are mostly unstructured and rely on the physician to relay visit data and patient information.

Conclusion

This study found several differences in health outcomes between SBHCs and community pediatric clinics. Patients seen in SBHCs had increased odds of being in counseling during the visit and decreased odds of the presence of a standardized screening survey. SBHC patients also had a lower rate of health care visits compared to patients seen in traditional clinics. Utilizing longitudinal data and propensity score matching, this study begins to look at the association of SBHCs on long term health care access and services. Future research may benefit from studies utilizing longitudinal data sources examining health outcomes differences when controlling for economic, familial, and other health care utilization related risk factors.

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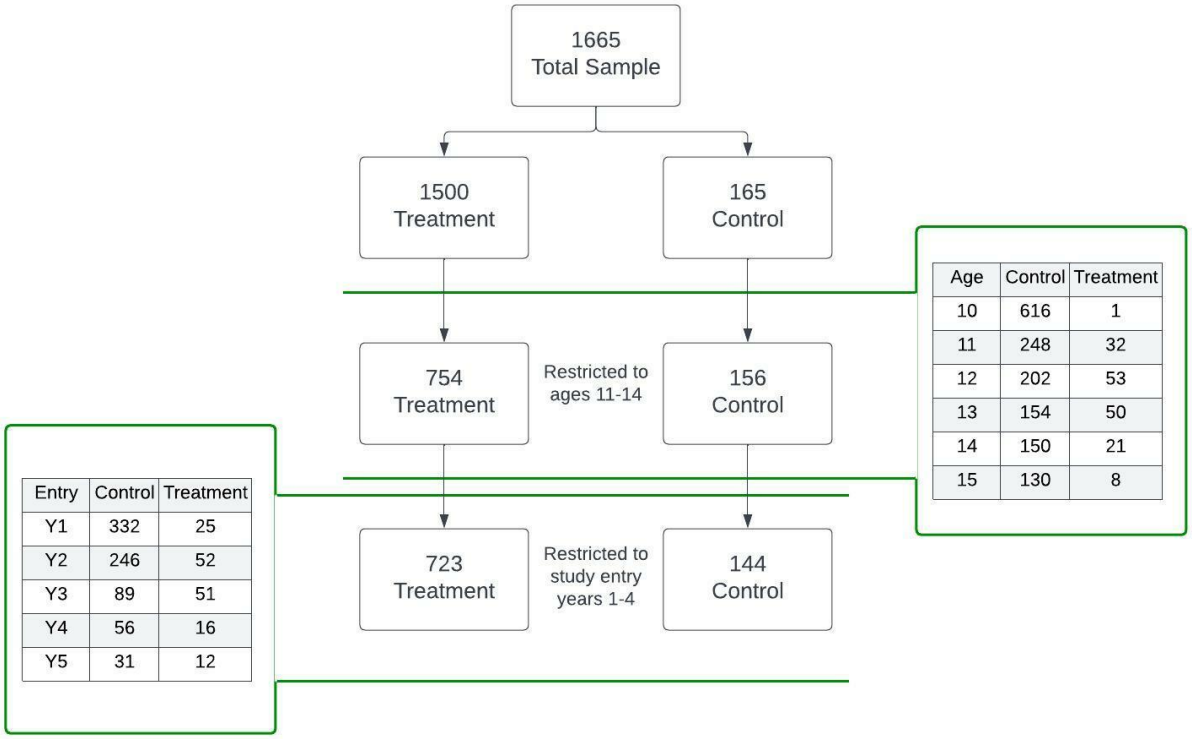
Table 3.1. Unmatched baseline demographics				
Variable, N (%)	Total Sample (N=867)	Control (N=723)	Treatment (N=144)	SMD**
Age*	12.30 (1.10)	12.29 (1.12)	12.39 (0.98)	0.0963
Sex				
Male	438 (50.5)	371 (51.3)	67 (46.5)	0.0957
Race				
Black	229 (26.4)	180 (24.9)	49 (34.0)	0.2009
Hispanic	268 (30.9)	235 (32.5)	33 (22.9)	0.2150
White	312 (36.0)	264 (36.5)	48 (33.3)	0.0666
Other	54 (6.2)	44 (6.1)	10 (6.9)	0.0347
Unknown	4 (0.5)	0 (0.0)	4 (2.8)	0.2382
Ethnicity				
Hispanic or Latino	267 (30.9)	234 (32.4)	34 (23.6)	0.1955
Non-Hispanic/Latino	596 (68.7)	488 (67.5)	108 (75.0)	0.1660
Unknown	3 (0.4)	1 (0.1)	2 (1.4)	0.1436
Insurance Status				
Medicaid	755 (87.1)	636 (88.0)	119 (82.6)	0.1506
Private	41 (4.7)	36 (5.0)	5 (3.5)	0.0748
Uninsured	71 (8.2)	51 (7.1)	20 (13.9)	0.2241
Condition				
Anxiety	552 (63.7)	466 (64.4)	86 (59.7)	0.0974
Depression	82 (9.5)	66 (9.1)	16 (11.1)	0.0656
ADHD	418 (48.2)	347 (48.0)	71 (49.3)	0.0262
Study Entry Year				
Y1	357 (41.2)	332 (45.9)	25 (17.4)	0.6441
Y2	298 (34.4)	246 (34.0)	52 (36.1)	0.0436
Y3	140 (16.2)	89 (12.3)	51 (35.4)	0.5617
Y4	72 (8.3)	56 (7.8)	16 (11.1)	0.1151
*Mean (SD) **SMD=Standardized mean difference				

Figure 3.1. Flow chart of filtering steps prior to propensity score matching



Age	Control	Treatment
10	616	1
11	248	32
12	202	53
13	154	50
14	150	21
15	130	8

Entry	Control	Treatment
Y1	332	25
Y2	246	52
Y3	89	51
Y4	56	16
Y5	31	12

Table 3.2. Baseline demographics for matched sample				
Variable, N (%)	Total Sample (N=320)	Control (N=205)	Treatment (N=115)	SMD**
Age*	12.32 (1.01)	12.33 (1.03)	12.29 (0.97)	0.0448
Sex				
Male	165 (51.6)	108 (52.7)	57 (49.6)	0.0622
Race				
Black	117 (36.6)	75 (36.6)	42 (36.5)	0.0013
Hispanic	87 (27.2)	57 (27.8)	30 (26.1)	0.0386
White	100 (31.2)	63 (30.7)	37 (32.2)	0.0310
Other	16 (5.0)	10 (4.9)	6 (5.2)	0.0154
Unknown	0 (0.0)	0 (0.0)	0 (0.0)	<0.0001
Ethnicity				
Hispanic or Latino	87 (27.2)	57 (27.8)	30 (26.1)	0.0386
Non-Hispanic/Latino	233 (72.8)	148 (72.2)	85 (73.9)	0.0386
Unknown	0 (0.0)	0 (0.0)	0 (0.0)	<0.0001
Insurance Status				
Medicaid	296 (92.5)	192 (93.7)	104 (90.4)	0.1189
Private	1 (0.3)	1 (0.5)	0 (0.0)	0.0988
Uninsured	23 (7.2)	12 (5.9)	11 (9.6)	0.1390
Condition				
Anxiety	180 (56.3)	114 (55.6)	66 (57.4)	0.0358
Depression	31 (9.7)	20 (9.8)	11 (9.6)	0.0064
ADHD	160 (50.0)	103 (50.2)	57 (49.6)	0.0135
Study Entry Year				
Y1	75 (23.4)	53 (25.9)	22 (19.1)	0.1610
Y2	136 (42.5)	89 (43.4)	47 (40.9)	0.0514
Y3	86 (26.9)	51 (24.9)	35 (30.4)	0.1240
Y4	23 (7.2)	12 (5.9)	11 (9.6)	0.1390
*Mean (SD) **SMD=Standardized mean difference				

Table 3.3. Analysis of parameter estimates of treatment group as predictor of care and service outcomes				
Parameter	Estimate	Standard Error	95% Confidence Interval	*P*
Medication Adherence*	-0.48	0.26	0.37, 1.03	0.065
THE**	-0.47	0.04	0.58, 0.67	<0.001
ED Visits**	0.14	0.09	0.97, 1.38	0.102
Counseling*	0.74	0.19	1.43, 3.05	<0.001
Screening Survey*	-0.43	0.17	0.47, 0.91	0.011
*Estimate is the average change in the log odds ratio **Estimate is the average change in the log rate ratio				

CHAPTER FOUR

PREDICTORS OF REFERRAL COMPLETION TO A PEDIATRIC NAVIGATION SERVICE

Abstract

Most adolescents have had a mental health disorder in the US during 2020, and an estimated 50% of any lifelong mental health conditions begins before the age of 14. Traditional barriers to care access are exacerbated in adolescence, where risks to health service utilization are challenged by increased risky health behaviors, transitions of care, and the development of health agency and autonomy. Pediatric navigation services offer assistance to adolescence and their families through care coordination and referral follow up. The purpose of this study was to explore predictors of referral completion for patients referred to mental health services through the Pediatric Support Service (PSS), a navigation system delivered by a large hospital system in South Carolina. The study sample included demographic and visit characteristic data from 789 unique referrals to the PSS. Adjusted odds ratios were calculated through binary logistic regressions models. The study found the odds of referral noncompletion was 1.40 times higher for males than females and an increase in the odds of referral noncompletion by 2.04 for patients aged 15 years. These results can be used to target navigation services as well as mental health services to ensure high risk groups are receiving services. Further research should consider the interaction between predictors.

Introduction

Approximately 50% of adolescents have had any mental health disorder in the US during 2020, according to data from the National Comorbidity Survey Adolescent Supplement (NCS-A).[1] Additionally, an estimated 50% of any lifelong mental health condition begins before age 14.[2] However, these conditions are often left undiagnosed and undertreated, negatively impacting later life functioning by increasing physical health incidence risk and negative health behaviors, reducing skill development, and increasing problematic health, social, and academic behaviors.[3]

Adolescence presents a unique phase in life where health and social behaviors are rapidly changing, and new patterns, habits, and norms are developing and will persist long into adulthood. During this developmental period, risky health behaviors and health seeking behaviors are increasing as control over one's health and well-being increases.[4] At this stage, adolescents are often expected to take more responsibility for their health, which can be associated with increased risk for healthcare avoidance, which is exacerbated by the presence of a mental health condition, diagnosed and undiagnosed.[4,5] As children age through adolescence, medical self-care and agency is a developing skill, which is often challenged by a rise in risky behaviors.[6] Many barriers to mental health seeking behaviors have been explored in this population, including inadequate mental health literacy, familial beliefs and stigma surrounding mental health, and increased desire for autonomy and self-sufficiency.[7] In addition to perceptual barriers to care access, the transition of care from pediatrics to adult care, or the changing health needs during adolescents often challenges health care service initiation and maintenance.[8]

One intervention designed to target underutilized mental health services is through pediatric referral navigation and care coordination. Navigation services can look different in every setting, but typically describe a 'navigator' within a healthcare setting that assists families with care coordination in the initial connection to and maintenance of services.[9] The goal of the navigator and navigation system is to bypass traditional barriers or challenges to care connection, including financial/insurance status, long wait times for mental health services, and caregiver demands, which are also influenced by the presence of mental health conditions. Navigation systems have found success in connecting families to appropriate care within a short time frame and offering flexible communication and scheduling to support families through the service connection process.[10]

Inadequate mental health care service utilization is associated with lifelong health consequences and persistence of lifelong mental health conditions and risky health behaviors documented.[11-14] Service connection for individuals with a mental health condition remains low and is often compounded by the symptoms and signs associated with mental health conditions.[15,16] Strategies to improve service connection often have contradictory results and are not specific to younger populations, where majority of mental health conditions begin.[17] The evaluation of specific pediatric mental health navigation delivery models remains understudied. The purpose of this study is to investigate predictors of referral completion based on demographic and referral characteristics of pediatric patients utilizing a pediatric referral navigation support service for mental health services. Identifying predictors of referral completion based on

demographic and referral characteristics will offer insight into patients who potentially require more service connection support or to highlight gaps in referral connections based on specific patient characteristics.

Methods

Pediatric Support Services

The Pediatric Support Services (PSS) is a comprehensive pediatric navigation system, modeled after best practices in pediatric navigation, with the objective of care coordination from pediatric primary care to additional care in a large hospital system in South Carolina. As a form of referral triage, navigators for the PSS receive referrals directly from pediatric primary care offices for mental health services, food and housing services, continued parenting education, and several other services aimed at improving the health and safety of children and their families. As part of this service, data is collected and tracked through secure REDCap surveys by navigators. This data includes demographic information, patient characteristics, referral notes and characteristics, reason for referrals, service provided, and connection to service status at 2 weeks.

Study design and participants

In this retrospective study, we selected patients who had been referred to the Pediatric Support Service (PSS) between September 2019 and April 2022. During this time period, 9436 patients were referred to services through the PSS, not exclusive to mental health services. The study sample included patients with mental health referrals to the PSS, aged 11 to 15. Mental health related referrals were flagged by navigators as referrals related to a mental health diagnosis or risk, and patients being referred to

specific mental health services within the hospital system. Patients with follow-up data on mental health referral completion were included in the study if their status was completed, not connected, or pending. Referral connection was determined through parent/guardian contact two weeks after initial referral. Referral connection was recorded as connected if patients had completed a visit to the service. Pending referred to patients on waitlists or those with appointments scheduled. Referrals categorized as not connected referred to patients who had been given a referral but had not used or made contact with the service. The dataset did not include patients with unknown connection status, declined, or existing services, as referral status could not be assumed or was not relevant to the present analysis. Filtering steps and total sample size are illustrated in Figure 4.1. This study was approved by the Institutional Review Board at Prisma Health, Pro00075111.

Predictor Variables

Demographic variables include age at the time of referral, identifying gender at time of referral, and race. Patient characteristics included insurance status, private or Medicaid coverage. Referral information includes if there was a mental health screener at the visit from which the referral was made, including PHQ-9, SCOFF, Vanderbilts, and SCARED screeners[18]; referral severity as routine, urgent, or emergency; the primary reason for referral, categorized into 7 groups: caregiver/family, developmental/behavioral, educational, high-risk social, medical, parent mental/behavioral, and parent mental/behavioral; and patient mental/behavioral reason for referral. For this study, patient mental/behavioral conditions were limited to

conditions with a prevalence within the sample at 5% or greater (rounded to the nearest whole number).

Outcome Variable

The outcome measure was a binary variable representing referral connection status. Referral status was categorized as 0, connected or 1, not connected. Not connected included patients with incomplete referral connections, pending referral connections, those on waitlists, or patients who had not contacted the referral practice. Connected included patients who has started services or with services in place with the referred service provider. Majority of the sample was connected to services throughout the study (65.9%).

Statistical analysis

Descriptive statistics were calculated for all variables on the total sample. Tests of independence between connected and not connected referral groups were run for all baseline demographics. An independent two-sample t-test was run on age. Chi-square tests were run for all other variables. Unadjusted odds ratios on the association of predictors and referral completion status were computed through logistic regressions for each independent variable. Adjusted odds ratios were computed through a binary logistic regression with all predictor variables, adjusting for potential confounders. Data were analyzed using R (version 4.1).

Results

The sample consisted of 789 unique patient referrals, mean age of 13.02 (SD=1.39) (61.5% female, 69.2% Non-Hispanic White, and 52.2% Medicaid). The

primary condition present was anxiety (53.5%). Most of the referrals made were routine (83.1%) and a mental or behavioral health screener was recorded in 48.3% of visits ending in a referral. The connected sample included 520 patient referrals, with a mean age of 13.00 years (SD=1.37). The not connected sample included 269 patient referrals with a mean age of 13.00 (SD=1.42). Significant differences were found between the two groups on several variables: gender, referral severity, and grief/loss. Full demographics for the study sample are presented in Table 4.1.

Two models were run for each predictor variable with the referral outcome of not connected, compared to those connected to services. In the unadjusted model, each predictor variable was run in a separate model. Under the unadjusted models, the study found two significant results. The unadjusted odds of not completing referrals was 1.40 times higher for males compared to females (95% CI= 1.04 to 1.89, p=.027). The unadjusted odds of completing a referral 2.27 higher for patients diagnosed with suicidal ideation, compared to those without (95% CI=1.25 to 44.17, p=.007).

The second model adjusted for all predictor variables with the same outcome variable as the unadjusted models. This model showed several significant results. Consistent with the unadjusted model, the adjusted odds of not completing a referral was 1.42 times higher for males compared to females, when adjusting for all other study variables (95% CI= 1.02 to 1.97, p=.035). The difference in adjusted odds of referral completion between patients with and without suicidal ideation was not statistically significant when adjusting for all other predictor variables (p=0.530). The adjusted odds of not completing a referral was 1.44 times higher for patients with Medicaid compared

to patients with private insurance (95% CI= 1.03 to 2.01, p=.035). The adjusted odds of referral completion was 2.94 times higher for patients diagnosed with adjustment disorders compared to those without (95% CI= 1.19 to 7.14, p=.019). The adjusted odds of not completing a referral was also significantly higher by 2.04 for patients aged 15 years when compared to patients aged 11 (95% CI= 1.20 to 3.47, p=.009). All odds ratios are presented in Table 4.2.

Discussion

This study revealed several important findings. Based on the study sample, majority of patients utilizing the mental health navigation system were referred for anxiety, depression, non-specific behavioral problems, and ADHD, which echo national findings of the most commonly diagnosed mental disorders in children.[19] The overwhelming majority of primary referral reason being for patient mental/behavioral health condition suggests that referrals are based on diagnosis or suspected diagnosis of a mental or behavioral health condition, when compared to other symptoms and risk factors for mental health conditions, like high-risk social factors or familial status and relationships. Additionally, under half of visits requiring a referral to navigation services recorded a mental or behavioral health screener. This may be indicative of patients with existing conditions requiring new services, or this could be attributed to the diagnosis of and subsequent referral to specialty services being based on easily identifiable symptoms and signs, or self-identification of symptoms of mental health conditions.[20]

In both the unadjusted and adjusted models, males were more likely of not completing referrals when compared to females. The results may suggest a difference in

health care seeking behaviors between males and females that has not yet been decisive in the literature but are similar to patterns in utilization of preventative services.[21] The differences may also be attributed to increased health literacy in females compared to males.[7,22] The unadjusted model also found patients diagnosed with suicidal ideation were more likely to complete referrals, but this association became insignificant when adjusting for other variables in the model. Similar studies assessing the relationship between suicidal ideation and health seeking behaviors found a decreased association between the two.[7] The conflicting results and change to insignificance when adjusting for other predictors suggests that relationship between suicidal ideation and referral completion may be mediated by one or more variables in the study, like referral severity.

In the adjusted model, three predictors were found to increase the likelihood of referral noncompletion. Patients aged 15 years were found to be more likely of referral noncompletion. This is consistent with some data suggesting decreases in healthcare utilization during young adolescence, which may be attributed to increased desire for autonomy and independence or subsequent decreases in self-identification of need for specialty care.[8] Patients with Medicaid were found to be more likely or referral noncompletion compared to patients with private insurance. These results suggest a continued barrier of financial and insurance status on the likelihood of patients utilizing healthcare services. Conversely, patients diagnosed with an adjustment disorder were more likely to complete referrals. This may be due to the nature of the condition, external factors related to adjustment disorders, or the types of referrals and services utilized by patients seeking care coordination from the navigation system.

Several limitations were inherent to this study design. Data was recorded through manual data recording and abstraction by referral navigators. The data is thus subject to error related to manual data tracking but was mitigated through the training of navigators in data recording. The smaller sample size of several predictor variables may underestimate the effects of the variable on referral status. Patients and caregivers who could not be reached for follow-up were excluded from this study and may influence the results of this study. Because data was limited to a single health system covering a single geographic area and working within the system for service connection, results may not be generalizable across different settings and in different healthcare systems. Predictors may be specific to the population or geographic location being served. Additionally, connection to services may be confounded by long wait times for services, which may underestimate service connection for specific services or conditions.

Conclusion

This study has important implications, not only for navigation services, but for the treatment and management of mental and behavioral health conditions. Results can be used by navigators to target patients at higher risk for referral noncompletion, or to adjust follow up times for referral connection follow-up to offer greater support. These results may also be applied to treatment and management in similar ways, targeting resources to groups with highest risk for service nonconnection. Because adolescence is a time of increased agency and autonomy over one's own healthcare, health care providers and care coordinators should focus on direct patient literacy and service utilization concerns, like patient/provider trust, to overcome barriers that develop over time in young

adolescents. Additional focus and resources should target male patients and to patients covered under Medicaid, to address gaps in service connection at the demographic level. Future research should explore the changes to referral completion for referrals made to specialty care for risk factors as opposed to mental and behavioral health conditions to investigate associations with referral completion and early condition risk factors.

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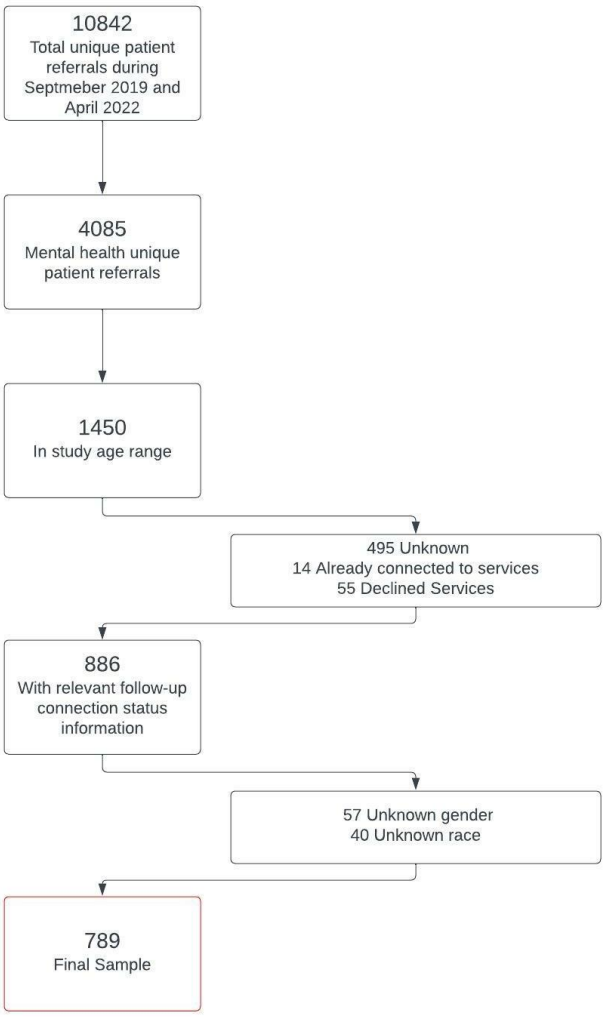

Figure 4.1. Flow chart of study filtering from full PSS referrals

To be read from top to bottom as starting sample at top and final sample on bottom, left as sample size at each filtering stage and right as detailed removal counts.

Table 4.1. Baseline demographics at time of referral				
Variable, N (%)	**Total** (N=789)	**Connected** (N=520)	**Not Connected** (N=269)	**p-value**
Age at Referral (SD)	13.06 (1.39)	13.00 (1.37)	13.00 (1.42)	0.2023
Gender*				0.0325
Male	304 (38.5)	186 (35.8)	118 (43.9)	
Female	485 (61.5)	334 (64.2)	151 (56.1)	
Race				0.4338
Non-Hispanic White	546 (69.2)	350 (67.3)	196 (72.9)	
Non-Hispanic Black	112 (14.2)	77 (14.8)	35 (13.0)	
Hispanic	81 (10.3)	57 (11.0)	24 (8.9)	
Other	50 (6.3)	36 (6.9)	14 (5.2)	
Insurance Status				0.1744
Private	377 (47.8)	258 (49.6)	119 (44.2)	
Medicaid	412 (52.2)	262 (50.4)	150 (55.8)	
Screener with Referral**				0.2781
Yes	380 (48.3)	258 (49.7)	122 (45.7)	
No	406 (51.7)	261 (50.3)	145 (54.3)	
Referral Severity***				0.0011
Routine	652 (83.1)	414 (79.8)	238 (89.5)	
Urgent	61 (7.8)	45 (8.7)	16 (6.0)	
Emergency	72 (9.2)	60 (11.6)	12 (4.5)	
Referral Condition				
ADHD	173 (21.9)	112 (21.5)	61 (22.7)	0.7829
Adjustment disorder	36 (4.6)	29 (8.7)	7 (2.6)	0.0858
Anxiety	422 (53.5)	277 (53.3)	145 (53.9)	0.9251
Behavioral	174 (22.1)	108 (20.8)	66 (24.5)	0.2632
Depression	233 (29.5)	164 (31.5)	69 (25.7)	0.1018
Family stressor	100 (12.7)	67 (12.9)	33 (12.3)	0.8934
Grief/loss	56 (7.1)	34 (6.5)	22 (8.2)	0.4814
Suicidal Ideation	72 (9.1)	58 (11.2)	14 (5.2)	0.0088
COVID related stressor	74 (9.4)	55 (10.6)	19 (7.1)	0.1400
Primary Referral Group				
Caregiver/Family	66 (8.4)	40 (7.7)	26 (9.7)	0.4161
Developmental/behavioral	12 (1.5)	8 (1.5)	4 (1.5)	1.0000
Educational	60 (7.6)	34 (6.5)	26 (9.7)	0.1530
High-risk social	27 (3.4)	21 (4.0)	6 (2.2)	0.2637
Medical	21 (2.7)	15 (2.9)	6 (2.2)	0.7582
Parent mental/behavioral	12 (1.5)	7 (1.3)	5 (1.9)	0.8019

*Gender is categorized by identifying gender at time of referral. Transgender patients are classified as their identifying gender.

**3 missing values

***4 missing values

Table 4.2. Unadjusted and adjusted incidence rate ratios with outcome variable of not connected (Total sample=789)				
Connected (N=520)	**Not Connected (N=269)**			
	Unadjusted		**Adjusted**	
Predictors	**Odds Ratios (95% confidence intervals)**	***p****	**Odds Ratios (95% confidence intervals)**	***p****
Age *(ref-11)*				
12 years old	1.28 (0.79, 2.08)	0.3077	1.43 (0.87, 2.38)	0.1614
13 years old	0.98 (0.59, 1.62)	0.9304	1.17 (0.68, 2.00)	0.5732
14 years old	1.15 (0.70, 1.87)	0.5794	1.28 (0.76, 2.18)	0.3516
15 years old	1.61 (0.99, 2.61)	0.0531	2.04 (1.20, 3.47)	0.0085
Gender *(Ref-female)*				
Male	1.40 (1.04, 1.89)	0.0270	1.42 (1.02, 1.97)	0.0351
Race *(Ref-Non-Hispanic White)*				
Non-Hispanic Black	0.81 (0.52, 1.26)	0.3485	0.67 (0.42, 1.07)	0.0906
Hispanic	0.75 (0.45, 1.25)	0.2710	0.47 (0.33, 0.99)	0.4583
Other	0.69 (0.37, 1.32)	0.2653	0.77 (0.39, 1.52)	0.4545
Insurance *(Ref-Private)*				
Medicaid	1.24 (0.92, 1.67)	0.1520	1.44 (1.03, 2.01)	0.0348
Screener *(Ref-No)*				
Screener Present	0.85 (0.60, 1.08)	0.2851	0.98 (0.70, 1.37)	0.9027
Severity *(Ref-Routine)*				
Urgent	0.62 (0.34, 1.12)	0.1115	0.59 (0.30, 1.14)	0.1185
Emergency	0.35 (0.18, 0.66)	0.1225	0.40 (0.15, 1.08)	0.0696
Condition *(Ref-No)*				
ADHD	1.07 (0.75, 1.52)	0.7135	0.79 (0.53, 1.18)	0.2497
Adjustment disorder	0.45 (0.20, 1.05)	0.0640	0.34 (0.14, 0.84)	0.0185
Anxiety	1.03 (0.76, 1.38)	0.8656	0.80 (0.55, 1.16)	0.2432
Behavioral	1.24 (0.87, 1.76)	0.2263	0.97 (0.64, 1.48)	0.9010

Depression	0.75 (0.54, 1.04)	0.0862	0.92 (0.63, 1.36)	0.6870
Family stressor	0.95 (0.61, 1.48)	0.8050	0.81 (0.49, 1.33)	0.4017
Grief/loss	1.27 (0.73, 2.22)	0.3963	1.03 (0.53, 2.02)	0.9320
Suicidal Ideation	0.44 (0.24, 0.80)	0.0072	0.74 (0.29, 1.89)	0.5304
COVID related stressor	0.64 (0.37, 1.11)	0.1109	0.70 (0.39, 1.24)	0.2188
Primary Referral Group *(Ref-No)*				
Caregiver/Family	1.28 (0.77, 2.15)	0.3436	1.26 (0.67, 2.39)	0.4701
Developmental/behavioral	0.97 (0.29, 3.24)	0.9549	1.02 (0.28, 3.65)	0.9788
Educational	1.53 (0.90, 2.61)	0.1177	1.50 (0.85, 2.62)	0.1592
High-risk social	0.54 (0.22, 1.36)	0.1918	0.57 (0.21, 1.53)	0.2639
Medical	0.77 (0.29, 2.00)	0.5894	0.72 (0.27, 1.96)	0.5248
Parent mental/behavioral	1.39 (0.44, 4.42)	0.5787	1.59 (0.46, 5.47)	0.4607
*p-value refers to significance between not connected and connected referrals in the unadjusted model ** p-value refers to significance between not connected and connected referrals in the adjusted model				

CHAPTER FIVE
CONCLUSION

The purpose of this dissertation was to explore factors and challenges in adolescent health service access. **Aim 1** examined factors influencing SBHC implementation through in-depth interviews with stakeholders involved directly in the delivery and maintenance of SBHCs, guided by the PRISM framework. Aim 2 Examined service and outcome differences between patients seen in SBHCs and traditional pediatric clinics. **Aim 3** assessed predictors of referral completion for patients utilizing a pediatric navigation system for mental health service connection. The studies presented in this dissertation all add evidence to factors and challenges associated with health care service delivery and access for adolescent populations. This information may be useful for intervention and public health planning to ensure effective implementation of interventions and programming.

Overview of Dissertation Findings

Themes in SBHC implementation

Chapter two explored factors influencing the implementation and sustainability of SBHCs across South Carolina. Semi-structured interviews, guided by the PRISM framework, were conducted with 22 clinicians, managers, and school staff involved in the delivery or support of a SBHC model. Codes and subsequent themes were developed following implementation domains outlined by PRISM.

Common themes highlighted challenges around physical space in school settings, key features to relationship building, the importance of adaptability and readiness in planning and maintenance of services, and increased opportunity for care coordination across health services, school services, and community support. Model specific themes

included challenges to staffing specific to service start up and maintenance, barriers to service awareness on the school and community level, and increased opportunity for care continuity and follow-up.

Mental health service and outcome difference in SBHCs vs pediatric clinics

Chapter three examined mental health care outcomes and service delivery for patients seen in SBHCs compared to patients seen in traditional pediatric clinics. The study included retrospective chart review and visit characteristic data for 320 participants. The sample was extracted using 2:1 propensity score matching to balance baseline demographics: age, sex, race, ethnicity, insurance status, condition, and study entry, between patients seen in the SBHC and patients seen in pediatric clinics. Binary logistic regression models were used to estimate odds differences between the SBHC and pediatric clinic groups for medication adherence (categorized as adherence and non-adherence), engagement with counseling during time of service, and presence of a standardized mental health screening survey. Poisson regression estimated odds differences between the two groups for total health care encounters (a count variable of health care visits during the study time period) and emergency department visits (during the study time period).

This study found significant differences in one healthcare outcome: currently in counseling, and two health care service delivery measures: presence of a standardized mental health screening survey and total health care encounters. Patients seen in SBHCs had significantly lower odds of both service delivery measures compared to patients seen in pediatric clinics. However, patients seen in SBHCs had significantly higher odds of

currently being in counseling at the time of visit. These results may suggest greater care coordination in SBHC to outside services or school resources, including counseling, which reduces overall burden of disease, symptoms, and subsequent health care service utilization.

Predictors of referral completion

Chapter four investigated predictors of referral completion to mental health care services for an adolescent population. Referrals were triaged by a care coordination service, the Pediatric Support Service, which connects patients to appropriate services within the health system. This study included demographic and referral follow-up data for 789 patients triaged through the PSS. Adjusted odds ratios were used to estimate the change in odds of referral completion based on several potential predictors, including demographic variables, insurance status, presence of a standardized mental health screener during the visit, referral severity (urgent, routine, or emergency), primary reason for referral, and primary mental/behavioral condition.

The study found significant changes to the odds of referral noncompletion for four variables in the adjusted model. The odds of not completing a referral was significantly higher for males than females, for patients with Medicaid compared to those with private health insurance, for patients with an adjustment disorder diagnosis, and patients aged 15 years old. These findings are not only useful for targeting navigation service follow-up and service connection resources, but for clinicians and public health interventions and programming as a whole to target groups with lower odds of referral completion who are also at increased risk for mental health conditions and severe mental health conditions.

Concluding remarks

Dissertation strengths and limitations

Several strengths were demonstrated in this dissertation. During chapter two, the unique application of an implementation science framework expands the scope of current SBHC evaluation research to optimize effectiveness and service delivery for health and school systems. Data from this study can be used in program planning, service connection and initial development, and in maintenance or sustainability planning. This study expanded on overviews of SBHC effectiveness studies, to explore unique challenges and strengths across different SBHC model types and contexts. Multilevel perspectives offered insight into challenges from different viewpoints and experiences that highlight facilitators for adaptation that might otherwise remain concealed. Chapter three also expanded on current literature to include longitudinal data over four years to examine differences in care delivery and outcomes for SBHCs compared to pediatric clinics. Additionally, this study included three of the most commonly diagnosed mental health conditions for adolescence to compare outcomes across conditions and broad care delivery. Propensity score matching of the treatment and control groups allowed for adequate achievement of balance between potentially confounding variables prior to data collection of outcome variables, which reduces the potential for bias in the results and conclusions. In the fourth chapter, predictors of referral completion were assessed utilizing data from a large hospital system-wide navigation service for triaging most mental health service referrals. This population offered access to a sample representative

of the community in which it served and increases the generalizability of results by reducing selection bias.

However, this dissertation was not without its limitations. Chapter two data was collected from participants identified by key leaders in SBHC implementation and management in South Carolina. This group may be representative of a group with higher levels of engagement and support for SBHCs than their peers who did not participate in interviews. Additionally, while interviews remain anonymous, participants occasionally expressed reservations about sharing challenges, especially regarding funding, staff turnover, and supervision that may underestimate the impact of these factors on SBHC implementation and sustainability. Chapter three and four both relied on a combination of retrospective chart review and manual data abstraction, both of which are subject to error in data entry. Results are dependent on an adolescent patient for self-identification, which is recorded by a provider in a medical chart, which is then abstracted by researchers (chapter three) and navigators (chapter four). While steps were taken to standardize medical classifications and standards of treatment and service delivery, the final classification and interpretation was left to the researcher and navigator in chapter four. Additionally, the broad scope of some measure used throughout the study may mask the effects associated with this variable. For example, standardized screeners recorder in chapters three and four include the presence of a Vanderbilt Assessment, which can only be completed by parents and teachers. This measure is not wholly indicative of providers issuing the screener, as seen with the PHQ-9 and SCARED screeners and may mask the differences in administration of screeners during visits.

Implications and future directions

The findings presented in this dissertation have important implications for adolescent health care access and delivery. Effective and optimal program and intervention delivery is vital to ensuring the most at risk adolescents for mental health conditions and health service underutilization are targets for intervention aimed at reducing these risks. For SBHCs, implementation strategies should focus on early relationship building between health organizations and school systems to foster strong networks to support intervention implementation and maintenance. With increased stakeholder engagement at each level, opportunities to address barriers to physical space, resources, personnel, and the role of staff from health organizations and schools can be planned for at an early stage. This will also engage both organizations in service awareness and clarity between time and resources required by each organization for the specific model being implemented. Regardless of model type, strong foundations between organizations increases the opportunity for care coordination between health services and school services and programming. Care connection between SBHCs and schools can increase care from early identification of mental health conditions, earlier access to treatment, and potentially care coordination into school programming, like counseling. Emphasis on continual goal tracking and program planning for SBHCs is also important to engage all levels of program care delivery and support to foster comprehensive examinations of success and challenges, and to provide multiple perspectives for early identification and increased capacity for adaptation. These

foundations may be carried over to increase delivery of health services through the SBHC to encourage better health outcomes for patients.

Additionally, care continuity exists through care coordination and referrals to outside services or special services. To facilitate the care transition or initial introduction of services to an adolescent patient, navigation services will benefit from research highlighting groups with increased likelihood of referral noncompletion, to identify groups which may require additional support. Because adolescent engagement with health care services is challenges by competing demands from increased risky health behaviors, increased health care agency and autonomy, and the onset of mental health conditions, ensuring adequate implementation of programming designed to overcome barriers to care access is especially important.

The findings presented in this dissertation reveal several potential areas for future research. Cost-benefit analyses of SBHC by model type are vital to the complete analysis of implementing and sustaining SBHCs. Research exploring barriers and facilitators to implementing SBHCs in the context of funding will provide additional information to be used in initial implementation planning and decrease the risk of failed interventions. To further examine the effectiveness of SBHCs on health care outcomes and service delivery, research with more specific independent variables may offer insight into the differences and limitation of SBHC service delivery. Future research may also benefit from including analyses of care coordination to internal school programming and its effect on SBHC and health care utilization overall. Lastly, further research on predictors of referral noncompletion can be strengthened through studies with perspectives from

patients, including studies on satisfaction and engagement with navigation services, and studies designed to track characteristics of patients with unknown referral connection statuses, which may account for many noncompletion and health care avoidance.

APPENDICES

Appendix A – Interview Guide

1. To start, please tell me about yourself and your role within the school-based health center?
    a. Profession
    b. Daily involvement in maintenance or delivery of services
    c. How does the SBHC affect your responsibilities or workload?
    d. What do you see your role as in maintaining the success or your SBHC?

2. Please give me an overview of how your school-based health center is organized?
    a. What school-based health center model does your SBHC use/follow?
    b. What organizations are involved in supporting your SBHC?
    c. How is care delivered? Where are clinicians, where are students?
    d. Who staffs or works in and with the SBHC?
    e. Where does funding come from? How long is this supported?
    f. What populations do you deliver care to?
        i. Probe for insurance status of patients
        ii. Probe if this is the same as their target population
    g. How are patients referred to your SBHC?

Next, I would like to ask you some questions about how your SBHC plans your approach / efforts each year.

3. Who is involved in setting SBHC goals and how is this process done?
    a. Organizations involved / people involved / frequency of planning efforts
    b. How are unforeseen barriers/facilitators addressed in planning?

Next, I would like to ask you a couple of questions about SBHC implementation

4. What factors acted as barriers to the implementation of your SBHC?
5. Are there specific personnel (roles) in the partnering health setting that were/are needed to support the implementation and maintenance of your SBHC?
6. What kind of support from community, schools, and healthcare partners is required to sustain the SBHC?
7. What resources needed to be in place to implement your SBHC?
    a. Probes for personnel, system-wide, in schools, partnerships
8. How do you communicate with and reach your intended population?
    a. What is the ideal scenario and what is needed to support this?

Next, I would like to ask you some questions about SBHC evaluation

9. How does your organization/school track success in service delivery and utilization?
10. How is information shared with collaborators/users about SBHC successes/challenges?

Lastly, I would like to ask you just a couple of questions about future and how you would describe your ideal SBHC program.

11. What do you see as the next steps for your SBHC?
12. If you had no restrictions or barriers, how do you think the SBHC would best fit in your schools?
    a. What would be ideal?
    b. What needs to happen to support this?
13. Do you have any additional comments regarding the implementation or sustainability of your SBHC?

Appendix B– Qualitative Codebook by RE-AIM Construct

Code Group	Code	Definition
Reach	Patient demographics	Comment on patient demographics seen in the SBHC (including insurance status, race, ethnicity, SES)
	Population demographics	Comments on the demographic makeup of the population where services are delivered (larger description of community status, not specific to SBHC population)
	Target population	Description of who SBHC services were intended for (specific illness, population, care gap)
	Utilization	Comments on the number of participants seen by the SBHC
Effectiveness	Visit type	Description of what students are seen in the SBHC for (acute care, chronic illness, mental health)
	Goal setting	Description of when goals are set, how, and who is involved (team meetings to discuss planning and addressing challenges)
	Tracking success	Description of evaluation efforts (who is involved, how often it's done, what is tracked, how information is shared)
	Ideal SBHC	Description of their ideal SBHC (what needs to be done to support this, what does this look like)
Adoption	Setting	Description of the physical setting, where is care delivered (including what is needed or missing in the setting)
	Team members	Description of staff needed to support the SBHC on both school and organizational side (including gaps in staffing)
	Community support	Comments on partnering organizations/personnel that support the SBHC (outside referral support, internal school programming)
	School nurse	All comments on the role of the school nurse in supporting the SBHC (including their daily responsibilities)
	School support	Description of who is involved in supporting or implementing the SBHC at the school (school admin, school nurse)

	Service connection	Description of the early conversations to start the partnership and introduce SBHCs to schools (did organization reach out, school?)
Implementation	Resources	Description of physical resources needed to support and operate SBHC (telehealth equipment, medical equipment)
	Funding	Comments on funding source, when grants are funded through, Medicaid reimbursement, long-term funding planning
	Staff time	Comments on the personnel time and effort needed, expansion on who staff the SBHC to include time spent specifically supporting SBHC
	School policy	Cross-code for adaptations made based on school related policy or regulations (when students can be pulled from class to go to SBHC)
	Organization policy	Cross-code for adaptations made based on organization policy or infrastructure (schedule based on clinical hours)
	Adaptations	Code all mentions of adaptation made during implementation or ongoing service delivery (include mentions of when and reason)
Maintenance	Model shift	Comments on changes to model type or delivery care over the years (switch from traditional to telehealth, consider cross-codes)
	Funding changes	Comments on changes to funding source
	Program timeline	Description of how long a SBHC has been in operation (includes comments on starting year)
	Future planning	Comments on what future planning entails (including conversations/meetings to discuss and specific plans)
Overall	Covid-19	Adaptations or challenges due to COVID-19 related policy or restrictions (cross-code with school or organization policy)
	Barrier	Cross-code with all codes if it is mentioned as a challenge, barrier, or in a negative context
	Facilitator	Cross-code with all codes if it is mentioned as a facilitator, necessity, positive to sustaining/implementing service delivery

Appendix C – REDCap Codebook

Project Home | Project Setup | Online Designer | Data Dictionary | Codebook

Codebook

Data Dictionary Codebook

06/21/2022 12:19am

Collapse all instruments

#	Variable / Field Name	Field Label *Field Note*	Field Attributes (Field Type, Validation, Choices, Calculations, etc.)
Instrument: **Static Information** (static_information)			Collapse
1	record_id	Record ID	text
2	record_id_5f4b29	Record ID	text
3	mrn	MRN	text, Identifier
4	name	Name	text, Identifier
5	ethnicity	Ethnicity	text
6	race	Race	text
7	sex	Sex	text
8	insurance	Insurance	text
9	age	Age	text
10	study_entry	Study Entry	text
11	comorbidities	Comorbidities	text
12	department	Department	text
13	anxiety	Anxiety	text
14	depression	Depression	text
15	adhd	ADHD	text
16	ptsd	PTSD	text
17	dis_eating	Disordered Eating	text
18	autism	Autism	text
19	dis_sleep	Disordered Sleep	text
20	headache	Headache	text
21	abdominal_pain	Abdominal Pain	text
22	behavior	Behavior	text
23	emotional	Emotional	text
24	academic	Academic	text
25	hx_mb	hx mb	text
26	other_emotional	Other Emotional	text
27	chronic_pain	Chronic Pain	text
28	allergies	Allergies	text
29	pscores	PScores	text
30	clinic	Clinic	text
31	distance	Distance	text
32	psm	PSM	text
33	ed_visits	Emergency Visits	text
34	total_encounters	Total Encounters	text

35	family_status	Family Status	checkbox 1, family_status___1, Two parents 2, family_status___2, One parent 3, family_status___3, Extended family 4, family_status___4, Siblings 5, family_status___5, Foster care 6, family_status___6, Guardians 7, family_status___7, Other
36	pcp	PCP	yesno 1, Yes 0, No
37	static_information_complete	Section Header: *Form Status* Complete?	dropdown 0, Incomplete 1, Unverified 2, Complete
Instrument: **Mental Health Encounters** (mental_health_encounters)			Collapse
38	encounter_date	Encounter Date	text (date_ymd)
39	visit_description	Visit Description	text
40	condition	Condition	checkbox 1, condition___1, ADHD 2, condition___2, Anxiety 3, condition___3, Depression 4, condition___4, Other
41	diagnosis_codes	Diagnosis Codes	text
42	screening	Screening	yesno 1, Yes 0, No
43	screener_provided Show the field ONLY if: [screening] = '1'	Screener Provided	checkbox 1, screener_provided___1, SCARED 2, screener_provided___2, PHQ-9 3, screener_provided___3, PHQ-3 4, screener_provided___4, Vanderbilt (teacher) 5, screener_provided___5, Vanderbilt (parent) 6, screener_provided___6, Other
44	screener_score Show the field ONLY if: [screener_provided(1)] = '1'	SCARED Score	text
45	phq_score Show the field ONLY if: [screener_provided(2)] = '1'	PHQ-9 Score	text
46	phq_3_score Show the field ONLY if: [screener_provided(3)] = '1'	PHQ-3 SCORE	text
47	vanderbilt_teacher_score Show the field ONLY if: [screener_provided(4)] = '1'	Vanderbilt (teacher) score	text
48	vanderbilt_parent_score Show the field ONLY if: [screener_provided(5)] = '1'	Vanderbilt (parent) score	text

49	other_screener_score Show the field ONLY if: [screener_provided(6)] = '1'	Other screener score	text
50	medication	Medication	yesno 1 Yes 0 No
51	medication_adherence Show the field ONLY if: [medication] = '1'	Medication Adherence	radio 1 Fills prescription on time 2 Fills early 3 Fills late
52	medication_change	Medication Change	yesno 1 Yes 0 No
53	cureent_counseling	Current counseling	yesno 1 Yes 0 No
54	iep	IEP	yesno 1 Yes 0 No
55	school_plan	504	yesno 1 Yes 0 No
56	referral_made	Referral Made	yesno 1 Yes 0 No
57	referral_to Show the field ONLY if: [referral_made] = '1'	Referral to	text
58	treatment_notes	Treatment Notes	text
59	medication_notes	Medication Notes	text
60	visit_notes	Visit Notes	text
61	mental_health_encounters_complete	Section Header: *Form Status* Complete?	dropdown 0 Incomplete 1 Unverified 2 Complete

Appendix D – Chapter 3 R Code

```
#Dissertation Aim 2
#June 2022

#Libraries to download
library(deSolve); library(tidyverse); library(readxl); library(shiny);
library(DataCombine); library(readxl); library(dplyr); library(lubridate); library(ggplot2);
library(zoo);
library(ggrepel); library(ggpubr); library(tidyr); library(hrbrthemes);
library("RColorBrewer"); library(psych); library(MatchIt); library(writexl);
library(rollmatch); library(stddiff); library(tableone); library(knitr); library(csv);
library(nnet); library(biostat3); library(tidyft); library(stargazer);
library(PSAgraphics); library(data.table);

#Working directory
setwd("H:\\Dissertation\\Aim 2\\Final Code and Data")

#Reading in data
data = read_excel("H:\\Dissertation\\Data.xlsx")

###################################Summary
Statistics###################################
#Dataset length
length(data$mrn)
#>81393
length(unique(data$mrn))
#>6053

##Dataset Contents
ls(data)
summary(data)

#Visit Type Counts
table(data$visit_type)
#>Office visit: 19062
#>Appointment: 11992

#Department Counts
table(data$department)
#>Peds Clinic: 58205
#>Peds CPM-West: 18912
#>Berea: 1087
#>Gec: 352
```

```
#>Lakeview: 1286
#>Tanglewood: 1546

########################Cleaning Dataset/Creating New
Variables#######################
#Pulling year and making own category
data$year<- as.POSIXct(data$encounter_date, format="%Y-%m-%d")
data$year<-format(data$year, format="%Y")

data$Y1<-ifelse(data$year=="2017", 1, 0)
data$Y2<-ifelse(data$year=="2018", 1, 0)
data$Y3<-ifelse(data$year=="2019", 1, 0)
data$Y4<-ifelse(data$year=="2020", 1, 0)
data$Y5<-ifelse(data$year=="2021", 1, 0)

#Categorizing year, as numeric for caliper
data$year[data$Y1==1]<-1
data$year[data$Y2==1]<-2
data$year[data$Y3==1]<-3
data$year[data$Y4==1]<-4
data$year[data$Y5==1]<-5

#Categorizing sex
data$Male<-ifelse(data$sex==1, 1, 0)

#Categorizing age
data$Age10<-ifelse(data$age==10, 1, 0)
data$Age11<-ifelse(data$age==11, 1, 0)
data$Age12<-ifelse(data$age==12, 1, 0)
data$Age13<-ifelse(data$age==13, 1, 0)
data$Age14<-ifelse(data$age==14, 1, 0)
data$Age15<-ifelse(data$age==15, 1, 0)


#Creating as factor
data$age_cat<-as.factor(data$age)

#age squared
data$age2<-data$age^2

#Categorizing Race
data$Black<-ifelse(data$race=="Black or African American", 1, 0)
data$White<-ifelse(data$race=="White or Caucasian", 1, 0)
data$Hispanic<-ifelse(data$race=="Hispanic", 1, 0)
```

```
data$Other<-ifelse(data$race=="Asian" | data$race=="Biracial or Multiracial" |
data$race=="Other" | data$race=="American Indian or Alaska Native", 1, 0)
data$Unknown<-ifelse(data$race=="Patient Refused" | data$race=="Unknown" |
data$race==0, 1, 0)

#Cleaning dataset for race
data$race[data$Black==1]<- 1 #Black
data$race[data$Hispanic==1]<- 2 #Hispanic
data$race[data$White==1]<- 3 #White
data$race[data$Other==1]<- 4 #Other
data$race[data$Unknown==1]<- 5 #Unknown
table(data$race, useNA="always")

#Categorizing Ethnicity
data$Hispanic_Latino<-ifelse(data$ethnicity=="Hispanic or Latino", 1, 0)
data$NonHispanic_Latino<-ifelse(data$ethnicity=="Non-Hispanic or Non-Latino", 1, 0)
data$Ethnicity_Unknown<-ifelse(data$ethnicity=="Refused/Declined" |
data$ethnicity=="0", 1, 0)

data$ethnicity[data$Hispanic_Latino==1]<- 1 #Hispanic
data$ethnicity[data$NonHispanic_Latino==1]<- 2 #Non-hispanic
data$ethnicity[data$Ethnicity_Unknown==1]<- 3 #Unknown
table(data$ethnicity, useNA="always")

#Categorizing Insurance Status
table(data$insurance_type)
data$Medicaid<-ifelse(data$insurance_type=="Medicaid" |
data$insurance_type=="Medicaid MCO" | data$insurance_type=="Managed Care" |
data$insurance_type=="Tricare" | data$insurance_type=="Pending Medicaid", 1, 0)
data$Private<-ifelse(data$insurance_type=="Blue Cross" |
data$insurance_type=="Commercial" | data$insurance_type=="Other" |
data$insurance_type=="Liability", 1, 0)
data$Uninsured<-ifelse(data$insurance_type=="Self-Pay" | data$insurance_type=="0", 1,
0)

data$insurance[data$Medicaid==1]<- 1 #Medicaid
data$insurance[data$Uninsured==1]<- 2 #Uninsured
data$insurance[data$Private==1]<- 3 #Private
table(data$insurance, useNA="always")

#Creating Clinic variable
data$Clinic<-ifelse(data$department=="PEDS SBHC-BEREA MS"|
data$department=="PEDS SBHC-E GVILL COL" | data$department=="PEDS SBHC-
LAKEVIEW MS" | data$department=="PEDS SBHC-TANGLEWOOD", 1, 0)
```

```
data$sbhc<-ifelse(data$department=="PEDS SBHC-BEREA MS"|
data$department=="PEDS SBHC-E GVILL COL" | data$department=="PEDS SBHC-
LAKEVIEW MS" | data$department=="PEDS SBHC-TANGLEWOOD", 1, 0)
table(data$Clinic)
table(data$sbhc)



##############################Creating study
subset##############################
#Separated treatment and control groups prior to subset to capture overlap in groups;
data1=data %>%
  group_by(mrn) %>%
  mutate(Clinic=ifelse(sum(Clinic)>=1, 1,0)) #all students seen in the sbhc have all
encounters marked as treatment group

table(data1$Clinic)
#>71172 control
#>10221 treatment

sbhc1<-subset(data1, sbhc==1) #filtering out sbhc population, baseline eligability
peds1<-filter(data1, Clinic==0) #filtering out anyone ever seen in the sbhc


##########################Creating variable for all medical
encounters##########################
datac<-subset(sbhc1, visit_type=="Appointment" | visit_type=="Consult"|
visit_type=="Clinical Support"| visit_type=="Evaluation"| visit_type=="Office Visit"|
visit_type=="Immunization"| visit_type=="Nurse Only"| visit_type=="Office Visit"|
visit_type=="Social Work"| visit_type=="Telemedicine"| visit_type=="Telephone")
id=data.frame(table(datac$mrn))
id=rename(id,mrn=Var1,n_id=Freq)
datac=merge(datac,id,by="mrn")
table(datac$n_id)

datac1<-subset(peds1, visit_type=="Appointment" | visit_type=="Consult"|
visit_type=="Clinical Support"| visit_type=="Evaluation"| visit_type=="Office Visit"|
visit_type=="Immunization"| visit_type=="Nurse Only"| visit_type=="Office Visit"|
visit_type=="Social Work"| visit_type=="Telemedicine"| visit_type=="Telephone")
id1=data.frame(table(datac1$mrn))
id1=rename(id1,mrn=Var1,n_id=Freq)
datac1=merge(datac1,id1,by="mrn")
table(datac1$n_id)
```

```
############################Applying filters separetly to datasets then merging back#########################
#Filtering students of interest in treatment group
datab<-subset(datac, visit_type=="Office Visit") #Only keeping office visits to ensure actual visit type
datab1<-datab[order(datab$mrn, datab$encounter_date, decreasing=FALSE),] #sorting by encounter date so first encounter is on top
datab2 <- datab1[!duplicated(datab1$mrn), ] #To capture single visit for baseline and matching
sbhc <- subset(datab2, anxiety==1 | depression==1 | adhd==1) #Limiting to students with any of the following conditions

#Filtering students of interest in control group
datac2<-subset(datac1, visit_type=="Office Visit") #Only keeping office visits to ensure actual visit type
datac3<-datac2[order(datac2$mrn, datac2$encounter_date, decreasing=FALSE),] #sorting by encounter date so first encounter is on top
datac4 <- datac3[!duplicated(datac3$mrn), ] #To capture single visit for baseline and matching
peds <- subset(datac4, anxiety==1 | depression==1 | adhd==1) #Limiting to students with any of the following conditions


#megring datasets
alldata<-rbind(peds, sbhc)
table(alldata$Clinic)
#>1500 control
#>165 treatment

###############Creating baseline table for unmatched sample by treatment group###############
#Restricting dataset to create a more matched sample and to reduce uneven-ness in treatment and controls
table(alldata$age, alldata$Clinic)
alldata<-filter(alldata, age<15)
alldata<-filter(alldata, age>10)
table(alldata$age)

table(alldata$year, alldata$Clinic)
alldata<-filter(alldata, year<5)
table(alldata$Clinic)

#Including binary variables to get st. diff for all categories
```

```
vars<-c('age', 'Male', 'Black', 'Hispanic', 'White', 'Other', 'Unknown', 'Hispanic_Latino',
'NonHispanic_Latino', 'Ethnicity_Unknown', 'Medicaid', 'Private', 'Uninsured', 'anxiety',
'depression', 'adhd', 'Y1', 'Y2', 'Y3', 'Y4')
BaselineUnmatched2<-CreateTableOne(vars=vars, strata='Clinic', data=alldata,
test=FALSE)
table<-print(BaselineUnmatched2, smd=TRUE, contDigits=4, pDigits=4)
write.table(table, file="unmatched_baseline3.txt", sep=',', quote=FALSE, row.names=T,
col.names=T)

BaselineUnmatched2_1<-CreateTableOne(vars=vars, data=alldata, test=FALSE)
table2_1<-print(BaselineUnmatched2_1, contDigits=4, pDigits=4)
table(alldata$Y4)

#Calculating Propensity Scores for Unmatched Data
original<-glm(Clinic ~ age + Age11 + Age12 + Age13 + Age14 + Male + Black +
Hispanic + White + Other + Unknown + Hispanic_Latino + NonHispanic_Latino +
Ethnicity_Unknown + Medicaid + Private + Uninsured + anxiety + depression + adhd +
Y1 + Y2 + Y3 + Y4, data=alldata, family=binomial('logit'))
original$model
summary(original)
O.out<-original
alldata$PScores<-O.out$fitted.values #Moving PScores to full dataset
alldata$Dept<-ifelse(alldata$Clinic==1, 1, 0)
table(alldata$Dept)
sbhc<-subset(alldata, Dept==1)
peds<-subset(alldata, Dept==0)
hist(sbhc$PScores, main="PScores SBHC Clinic", freq=FALSE, breaks=25,
xlim=c(0,0.775), ylim=c(0,25))
hist(peds$PScores, main="PScores Peds Clinic", freq=FALSE,
breaks=25,xlim=c(0,0.775), ylim=c(0,25))
hist(alldata$PScores, main="PScores Combined Unmatched", freq=FALSE, breaks=50,
xlim=c(0,0.775), ylim=c(0,20))
summary(sbhc$PScores)
summary(peds$PScores)
summary(alldata$PScores)
sd(sbhc$PScores)
sd(peds$PScores)
sd(alldata$PScores)


##############################Propensity Score
Matching##############################
#Caliper matching, set caliper to .25 will adjust to PS in model
#Exclude reference groups in model
```

```
#Include all interactions not within single categories (i.e. age*Black, not Black*White)
#distance="gam" for model to run; investigate reasoning???
matches<-matchit(Clinic ~ age + Male + Black + Hispanic + Other + Unknown +
Hispanic_Latino + Ethnicity_Unknown + Medicaid + Uninsured + anxiety + depression
+ adhd + Y2 + Y3 + Y4 + age*Male + age*Black + age*Hispanic + age*Other +
age*Unknown + age*Hispanic_Latino + age*Ethnicity_Unknown + age*Medicaid +
age*Uninsured + age*anxiety + age*depression + age*adhd + age*Y2 + age*Y3 +
age*Y4 + Male*Black + Male*Hispanic + Male*Other + Male*Unknown +
Male*Hispanic_Latino + Male*Ethnicity_Unknown + Male*Medicaid +
Male*Uninsured + Male*anxiety + Male*depression + Male*adhd + Male*Y2 +
Male*Y3 + Male*Y4 + Black*Hispanic_Latino + Black*Ethnicity_Unknown +
Black*Medicaid + Black*Uninsured + Black*anxiety + Black*depression + Black*adhd
+ Black*Y2 + Black*Y3 + Black*Y4 + Hispanic*Hispanic_Latino +
Hispanic*Ethnicity_Unknown + Hispanic*Medicaid + Hispanic*Uninsured +
Hispanic*anxiety + Hispanic*depression + Hispanic*adhd + Hispanic*Y2 +
Hispanic*Y3 + Hispanic*Y4 +Other*Hispanic_Latino + Other*Ethnicity_Unknown +
Other*Medicaid + Other*Uninsured + Other*anxiety + Other*depression + Other*adhd
+ Other*Y2 + Other*Y3 + Other*Y4 + Unknown*Hispanic_Latino +
Unknown*Ethnicity_Unknown + Unknown*Medicaid + Unknown*Uninsured +
Unknown*anxiety + Unknown*depression + Unknown*adhd + Unknown*Y2 +
Unknown*Y3 + Unknown*Y4 + Hispanic_Latino*Medicaid +
Hispanic_Latino*Uninsured + Hispanic_Latino*anxiety + Hispanic_Latino*depression +
Hispanic_Latino*adhd + Hispanic_Latino*Y2 + Hispanic_Latino*Y3 +
Hispanic_Latino*Y4 + Ethnicity_Unknown*Medicaid + Ethnicity_Unknown*Uninsured
+ Ethnicity_Unknown*anxiety + Ethnicity_Unknown*depression +
Ethnicity_Unknown*adhd + Ethnicity_Unknown*Y2 + Ethnicity_Unknown*Y3 +
Ethnicity_Unknown*Y4 + Medicaid*anxiety + Medicaid*depression + Medicaid*adhd +
Medicaid*Y2 + Medicaid*Y3 + Medicaid*Y4 + Uninsured*anxiety +
Uninsured*depression + Uninsured*adhd + Uninsured*Y2 + Uninsured*Y3 +
Uninsured*Y4 + anxiety*depression + anxiety*adhd + anxiety*Y2 + anxiety*Y3+
anxiety*Y4+ depression*adhd + depression*Y2 + depression*Y3 + depression*Y4 +
adhd*Y2 + adhd*Y3 + adhd*Y4, data=alldata, distance="gam", reestimate=FALSE,
ratio=2, caliper=.25)
summary(matches, ab=TRUE) #Looking at summary stats, treatment n=120, control
n=216
m.data<-get_matches(matches) #Pulling out matches into separate dataset
matches$model #Looking at model included in matches
M.out<-matches #Pulling out matches
m.data$PSM<-m.data$distance #Pulling out PScores
sbhc_m<-subset(m.data, Clinic==1) #separating matched data by treatment
peds_m<-subset(m.data, Clinic==0) #separating matched data by control
#plotting
hist(sbhc_m$PSM, main="PScores SBHC Clinic", freq=FALSE, xlim=c(0,1),
ylim=c(0,15)) #freq=FALSE to get density instead
```

```
hist(peds_m$PSM, main="PScores Peds Clinic", freq=FALSE, xlim=c(0,1),
ylim=c(0,15))
hist(m.data$PSM, main="PScores Matched Combined", freq=FALSE, xlim=c(0,1),
ylim=c(0,15))
#Mean PS by group after matching
summary(peds_m$PSM)
summary(sbhc_m$PSM)
summary(m.data$PSM)
sd(m.data$PSM)
sd(peds_m$PSM)
sd(sbhc_m$PSM)

BaselineMatched<-CreateTableOne(vars=vars, strata='Clinic', data=m.data, test=FALSE)
table<-print(BaselineMatched, smd=TRUE, contDigits=4, pDigits=4)
write.table(table, file="Matched_baseline4.txt", sep=',', quote=FALSE, row.names=T)

###################Exporting matched dataset for manual
abstraction###################
write.csv(m.data, "H:\\Dissertation\\Aim 2\\Final Code and Data\\matched_data5.csv",
row.names=TRUE)

table(datac4$department, datac4$Clinic)

BaselineMatched<-CreateTableOne(vars=vars, data=m.data, test=FALSE)
table<-print(BaselineMatched, smd=TRUE, contDigits=4, pDigits=4)
write.table(table, file="Matched_baseline5.txt", sep=',', quote=FALSE, row.names=T)

########################################Analysis#############################
#######
#Uploading new dataset from REDCap
#Reading in data
Full = read_csv("H:\\Dissertation\\Aim 2\\Final Code and Data\\FullData.csv")
table(Full$clinic, useNA='always')

Full$insurance[Full$insurance==""]<-NA

#Adding study entry
Full$year<- as.POSIXct(Full$study_entry, format="%m/%d/%Y")
Full$year<-format(Full$year, format="%Y")
Full$Y1<-ifelse(Full$year=="2017", 1, 0)
Full$Y2<-ifelse(Full$year=="2018", 1, 0)
Full$Y3<-ifelse(Full$year=="2019", 1, 0)
Full$Y4<-ifelse(Full$year=="2020", 1, 0)
table(Full$year)
```

```
#Categorizing year, as numeric for caliper
Full$entry[Full$Y1==1]<-1
Full$entry[Full$Y2==1]<-2
Full$entry[Full$Y3==1]<-3
Full$entry[Full$Y4==1]<-4
Full$entry[Full$Y5==1]<-5
table(Full$entry)

#Pulling data through repeated measures
Full%>%
  fill(sex) %>%
  fill(age) %>%
  fill(race) %>%
  fill(ethnicity) %>%
  fill(anxiety) %>%
  fill(insurance) %>%
  fill(depression) %>%
  fill(adhd) %>%
  fill(entry)

Full$Medicaid<-ifelse(Full$insurance=="Medicaid" |  Full$insurance=="Medicaid
MCO" | Full$insurance=="Managed Care" |  Full$insurance=="Tricare" |
Full$insurance=="Pending Medicaid", 1, 0)
Full$Private<-ifelse(Full$insurance=="Blue Cross" | Full$insurance=="Commercial" |
Full$insurance=="Other" | Full$insurance=="Liability", 1, 0)
Full$Uninsured<-ifelse(Full$insurance=="Self-Pay" | Full$insurance=="0", 1, 0)
Full$insurance[Full$Medicaid==1]<- 1 #Medicaid
Full$insurance[Full$Uninsured==1]<- 2 #Uninsured
Full$insurance[Full$Private==1]<- 3 #Private
table(Full$insurance, useNA="always")

Full2 <- subset(Full, insurance==1 | insurance==2)

###count outcomes
#ED visits
ed<-glm(ed_visits~clinic + age + sex + race + ethnicity + insurance + anxiety + adhd +
depression + entry, data=Full, family=poisson())
summary(ed)
ci.ed=eform(ed)
ci.ed

#THE
hcv<-glm(total_encounters~clinic + age + sex + race + ethnicity + insurance + anxiety +
adhd + depression + entry, data=Full, family=poisson())
```

```
summary(hcv)
ci.hcv=eform(hcv)
ci.hcv

#Binary outcomes
#Medication adherence
medah<-subset(Full2, medication_adherence==1 | medication_adherence==3)
medah$medication_adherence[medah$medication_adherence==1]<-1 #Medicaid
medah$medication_adherence[medah$medication_adherence==3]<-0 #Private
table(medah$medication_adherence)
med<-glm(medication_adherence~clinic + age + sex + race + ethnicity + insurance +
anxiety + adhd + depression + entry, data=medah, family=binomial)
summary(med)
ci.med=eform(med)
ci.med

#Counseling
couns<-glm(cureent_counseling~clinic + age + sex + race + ethnicity + insurance +
anxiety + adhd + depression + entry, data=Full2, family=binomial)
summary(couns)
ci.couns=eform(couns)
ci.couns

table(Full$sex, useNA='always')
#Screener
screen<-glm(screening~clinic + age + sex + race + ethnicity + insurance + anxiety + adhd
+ depression + entry, data=Full2, family=binomial)
summary(screen)
ci.s=eform(screen)
ci.s

####################Additional analysis####################
table(Full$medication_adherence, useNA='always')
table(Full$medication_adherence, Full$clinic)

summary(Full$total_encounters)

summary(Full$ed_visits)

table(Full$cureent_counseling, useNA='always')
table(Full$screening, useNA='always')
```

Appendix E – Chapter 4 R Code

```
#Dissertation Aim 3
#June 2022

library(deSolve); library(tidyverse); library(readxl); library(shiny);
library(DataCombine); library(readxl); library(dplyr); library(lubridate); library(ggplot2);
library(zoo);
library(ggrepel); library(ggpubr); library(tidyr); library(hrbrthemes);
library("RColorBrewer"); library(psych); library(MatchIt); library(writexl);
library(rollmatch); library(stddiff); library(tableone); library(knitr); library(csv);
library(nnet); library(biostat3); library(tidyft); library(stargazer);

setwd("H:\\Dissertation\\Aim 3")

###Reading in data
data = read.csv("H:\\Dissertation\\Aim 3\\data2.csv")

##Dataset Contents
ls(data)

summary(data)

###Dataset length
length(data$mrn)
#>12764
length(unique(data$mrn))
#>10842

####################################Mental Health Referrals
Only############################
table(data$referral_outcome_needed_pr)
#>4401 needed (1-yes, 2-no)

MH<-subset(data, referral_outcome_needed_pr==1)
#>4401 obs
length(unique(MH$mrn))
#>4035

###############Cleaning data and adding variables for full dataset
#Creating age
MH$ref.date<- as.Date(as.POSIXct(MH$referral_date, format="%m/%d/%Y"))
MH$dob2<- as.Date(as.POSIXct(MH$dob, format="%m/%d/%Y"))
```

```
MH$referralage<-floor(difftime(MH$ref.date, MH$dob2, units="days")) #calculating
like this because of data mistakes
MH$referralage<-(MH$referralage/365)
MH$referralage<-round(MH$referralage, digits=0)
MH$referralage<-as.numeric(MH$referralage)
table(MH$referralage)

#######Cleaning insurance
MH$Private<-ifelse(MH$insurance___1==1 | MH$insurance___2==1 |
MH$insurance___3==1 | MH$insurance___4==1 | MH$insurance___5==1 |
MH$insurance___6==1 | MH$insurance___7==1 | MH$insurance___8==1 |
MH$insurance___9==1 | MH$insurance___10==1 | MH$insurance___19==1 |
MH$insurance___22==1 | MH$insurance___23==1 | MH$insurance___26==1 |
MH$insurance___27==1, 1, 0)
MH$Medicaid<-ifelse(MH$insurance___11==1 | MH$insurance___12==1 |
MH$insurance___13==1 | MH$insurance___14==1 | MH$insurance___15==1 |
MH$insurance___16==1 | MH$insurance___17==1 | MH$insurance___18==1 |
MH$insurance___28==1, 1, 0)
MH$Uninsured<-ifelse(MH$insurance___25==1, 1, 0)
MH$Other<-ifelse(MH$insurance___20==1| MH$insurance___21==1 |
MH$insurance___24==1, 1, 0)


###############Restricting dataset to ages 11-
15####################################
MH<-subset(MH, referralage>10)
MH<-subset(MH, referralage<16)
length(unique(MH$mrn))
#1450

###############Making datasets for each referral by patient
#Checking how many repeated referrals
#gives frequency per id
id=data.frame(table(MH$mrn))
id=rename(id,mrn=Var1,n_id=Freq)
MH=merge(MH,id,by="mrn")
table(MH$n_id)
#>1:1337
#>2:204
#>3:33


##########Making varaibles binary#################################
###gender
```

```
MH$male<-ifelse(MH$gender==1,1,0)
MH$female<-ifelse(MH$gender==2,1,0)
MH$mtf<-ifelse(MH$gender==3,1,0)
MH$ftm<-ifelse(MH$gender==4,1,0)
MH$gender_unknown<-ifelse(MH$gender==5,1,0)
MH$gender_other<-ifelse(MH$gender==6,1,0)
##race
MH$white<-ifelse(MH$ethnicity==1,1,0)
MH$black<-ifelse(MH$ethnicity==2,1,0)
MH$hispanic<-ifelse(MH$ethnicity==3,1,0)
MH$multiracial<-ifelse(MH$ethnicity==4,1,0)
MH$asian<-ifelse(MH$ethnicity==5,1,0)
MH$race_other<-ifelse(MH$ethnicity==6,1,0)
MH$race_declined<-ifelse(MH$ethnicity==7,1,0)
MH$race_unknown<-ifelse(MH$ethnicity==8,1,0)
MH$american_indian<-ifelse(MH$ethnicity==9,1,0)
MH$pacific_islander<-ifelse(MH$ethnicity==10,1,0)
##ethnicity
MH$nonhispanic<-ifelse(MH$race_ethnicity==1,1,0)
MH$hispanic<-ifelse(MH$race_ethnicity==2,1,0)
MH$ethnicity_declined<-ifelse(MH$race_ethnicity==1,1,0)
MH$ethnicity_unknown<-ifelse(MH$race_ethnicity==1,1,0)

###############Dataset for first referrals only#################################
#Pulling out first referrals for baseline tables and main analysis
MH1<-MH[order(MH$mrn, MH$n_id, decreasing=FALSE),] #sorting by referral date so
first referral is on top
MH1<-MH1[!duplicated(MH1$mrn),] #removing duplicates after first referral; MH1 is
all first referrals
#>1450 (combination of all referral counts)

#MH2<-slice(group_by(MH, mrn), -1)
#MH2<-MH2[order(MH2$mrn, MH2$referral_date, decreasing=FALSE),]
#MH2<-MH2[!duplicated(MH2$mrn),] #MH2 is all second referrals
#>107 (combination of 2, 3 referrals)

#MH3<-slice(group_by(MH, mrn), -1)
#MH3<-slice(group_by(MH3, mrn), -1)
#MH3<-MH3[order(MH3$mrn, MH3$referral_date, decreasing=FALSE),]
#MH3<-MH3[!duplicated(MH3$mrn),] #MH3 is all third referrals
#>7 (combination of 3 and 4 referrals)
```

```
################################Baseline
demographics##############################
summary(MH1$referralage)
sd(MH1$referralage)
#>Mean: 10.65, sd:4.432
table(MH1$gender)
#>Male: 1800
#>Female: 2038
#>Transgender female- male to female: 7
#>Transgender male- female to male: 4
#>None: 7
#>Other: 1
table(MH1$ethnicity)
#>Caucasian/White: 2823
#>Black/Af Am: 440
#>Hispanic: 249
#>Biracial/multi: 225
#>Asian: 27
#>Other: 12
#>Declined: 32
#>Unknown: 44
#>American Indian or Alaskan Native: 3
#>Native Hawaiian or other Pacific Islander: 2
table(MH1$race_ethnicity, useNA="always")
#>Non Hispanic or Non Latino: 3288
#>Hispanic or Latino: 319
#>Declined: 82
#>Unknown: 8
table(MH1$screening_completed)
#>1379 completed (0-No, 1-Yes)

#Including binary variables to get st. diff for all categories
vars<-c('referralage', 'gender', 'ethnicity', 'race_ethnicity', 'screening_completed', 'Private',
'Medicaid', 'Other', 'Uninsured', 'referral_acuity')
  BaselineUnmatched<-CreateTableOne(vars=vars, factorVars=vars,
strata='service_outcome', data=MH1, test=FALSE)
table1<-print(BaselineUnmatched, contDigits=4, pDigits=4)
write.table(table1, file="baseline.txt", sep=',', quote=FALSE, row.names=T,
col.names=T)

##########MH2###########
#summary(MH2$referralage)
#sd(MH2$referralage)
#>Mean: 10.79, sd:4.224
```

```
#table(MH2$gender)
#>Male: 139
#>Female: 164
#>Transgender female- male to female: 0
#>Transgender male- female to male: 1
#>None: 0
#>Other: 0
#table(MH2$ethnicity)
#>Caucasian/White: 215
#>Black/Af Am: 34
#>Hispanic: 20
#>Biracial/multi: 22
#>Asian: 3
#>Other: 0
#>Declined: 5
#>Unknown: 5
#>American Indian or Alaskan Native: 0
#>Native Hawaiian or other Pacific Islander: 0
#table(MH2$race_ethnicity)
#>Non Hispanic or Non Latino: 256
#>Hispanic or Latino: 25
#>Declined: 7
#>Unknown: 0
#table(MH2$screening_completed)
#>100 completed (0-No, 1-Yes)

###############MH3###############
#summary(MH3$referralage)
#sd(MH3$referralage)
#>Mean: 9.821, sd:4.164
#table(MH3$gender)
#>Male: 13
#>Female: 15
#>Transgender female- male to female: 0
#>Transgender male- female to male: 0
#>None: 0
#>Other: 0
#table(MH3$ethnicity)
#>Caucasian/White: 19
#>Black/Af Am: 3
#>Hispanic: 1
#>Biracial/multi: 4
#>Asian: 0
#>Other: 0
```

#>Declined: 1
#>Unknown: 0
#>American Indian or Alaskan Native: 0
#>Native Hawaiian or other Pacific Islander: 0
#table(MH3$race_ethnicity)
#>Non Hispanic or Non Latino: 25
#>Hispanic or Latino: 1
#>Declined: 0
#>Unknown: 0
#table(MH3$screening_completed)
#>5 completed (0-No, 1-Yes)

##Exploring connection rates
table(MH1$service_outcome)
#>connected: 1347
#>pending: 453
#>not connected: 388
#>unknown: 702
#>no contact: 449
#>declined: 154
#>existing services: 44
#>declined follow up: 17

#table(MH2$service_outcome)
#>connected: 109
#>pending: 20
#>not connected: 30
#>unknown: 58
#>no contact: 42
#>declined: 13
#>existing services: 3
#>declined follow up: 3

#table(MH3$service_outcome)
#>connected: 6
#>pending: 1
#>not connected: 6
#>unknown: 6
#>no contact: 5
#>declined: 1
#>existing services: 0
#>declined follow up: 0

```
MH1_c<-subset(MH1, n_id>1) #Wanting to see referral completion for first referrals where referral is made again
table(MH1_c$service_outcome)

table(MH1$Private) #>1740
table(MH1$Medicaid) #>2009
table(MH1$Other) #>58
table(MH1$Uninsured) #>158

#table(MH2$Private) #>120
#table(MH2$Medicaid) #>172
#table(MH2$Other) #>4
#table(MH2$Uninsured) #>16

#table(MH3$Private) #>8
#table(MH3$Medicaid) #>20
#table(MH3$Other) #>0
#table(MH3$Uninsured) #>1


######################################### Running exploratory stats
##############################################

##Referral completion by dataset
table(MH1$service_outcome, exclude=NULL)


######################################## Baseline Table
############################################################
#Formatting necessary variables as factors for baseline table to print out as categorical where stored numeric
varsN<-c('age___1', 'age___2', 'age___3', 'age___4', 'age___5', 'gender', 'ethnicity',
'race_ethnicity', 'Private', 'Medicaid', 'Uninsured', 'Other', 'screening_completed',
'identify_primary_needs___1', 'identify_primary_needs___2',
'identify_primary_needs___3', 'identify_primary_needs___4',
'identify_primary_needs___5', 'identify_primary_needs___6',
'identify_primary_needs___7', 'identify_primary_needs___8',
'primary_mental_behav_patient___1', 'primary_mental_behav_patient___2',
'primary_mental_behav_patient___3', 'primary_mental_behav_patient___4',
'primary_mental_behav_patient___5', 'primary_mental_behav_patient___6',
'primary_mental_behav_patient___7', 'primary_mental_behav_patient___8',
'primary_mental_behav_patient___9', 'primary_mental_behav_patient___10',
'primary_mental_behav_patient___11', 'primary_mental_behav_patient___12',
'primary_mental_behav_patient___13', 'primary_mental_behav_patient___14',
```

```
'primary_mental_behav_patient___15', 'primary_mental_behav_patient___16',
'primary_mental_behav_patient___17', 'primary_mental_behav_patient___18',
'primary_mental_behav_patient___19', 'primary_mental_behav_patient___20',
'primary_mental_behav_patient___21', 'primary_mental_behav_patient___22',
'primary_mental_behav_patient___23', 'primary_mental_behav_patient___24',
'primary_mental_behav_patient___25', 'primary_mental_behav_patient___26',
'primary_mental_behav_patient___27', 'primary_mental_behav_patient___28',
'primary_mental_behav_patient___29', 'primary_mental_behav_patient___30',
'primary_mental_behav_patient___31')
MH1[,varsN] <- lapply(MH1[,varsN] , factor)
#Compiling variables wanted in baseline table
vars<-c('referralage', 'age___1', 'age___2', 'age___3', 'age___4', 'age___5', 'gender',
'ethnicity', 'race_ethnicity', 'Private', 'Medicaid', 'Uninsured', 'Other',
'screening_completed', 'identify_primary_needs___1', 'identify_primary_needs___2',
'identify_primary_needs___3', 'identify_primary_needs___4',
'identify_primary_needs___5', 'identify_primary_needs___6',
'identify_primary_needs___7', 'identify_primary_needs___8',
'primary_mental_behav_patient___1', 'primary_mental_behav_patient___2',
'primary_mental_behav_patient___3', 'primary_mental_behav_patient___4',
'primary_mental_behav_patient___5', 'primary_mental_behav_patient___6',
'primary_mental_behav_patient___7', 'primary_mental_behav_patient___8',
'primary_mental_behav_patient___9', 'primary_mental_behav_patient___10',
'primary_mental_behav_patient___11', 'primary_mental_behav_patient___12',
'primary_mental_behav_patient___13', 'primary_mental_behav_patient___14',
'primary_mental_behav_patient___15', 'primary_mental_behav_patient___16',
'primary_mental_behav_patient___17', 'primary_mental_behav_patient___18',
'primary_mental_behav_patient___19', 'primary_mental_behav_patient___20',
'primary_mental_behav_patient___21', 'primary_mental_behav_patient___22',
'primary_mental_behav_patient___23', 'primary_mental_behav_patient___24',
'primary_mental_behav_patient___25', 'primary_mental_behav_patient___26',
'primary_mental_behav_patient___27', 'primary_mental_behav_patient___28',
'primary_mental_behav_patient___29', 'primary_mental_behav_patient___30',
'primary_mental_behav_patient___31')
#Baseline table code
BaselineMH1<-CreateTableOne(vars=vars, factorVars=varsN, includeNA=TRUE,
data=MH1, test=TRUE) #In future: include STRATA command to stratify by referral
completion
table<-print(BaselineMH1, contDigits=4, pDigits=4)
write.table(table, file="Baseline.txt", sep=',', quote=FALSE, row.names=T) #Exporting
baseline table

table(MH1$referral_acuity, useNA='always')
#   1    2    3   <NA>
#  213  223 3288  133
```

```
#Primary need for first referral
data<-subset(MH1, service_outcome==1 | service_outcome==2 | service_outcome==3)

vars2<-c('identify_primary_needs___1', 'identify_primary_needs___2',
'identify_primary_needs___3', 'identify_primary_needs___4',
'identify_primary_needs___5', 'identify_primary_needs___6',
'identify_primary_needs___7', 'identify_primary_needs___8')
RefReason<-CreateTableOne(vars=vars2, factorVars=vars2, data=data, test=FALSE)
table2<-print(RefReason, contDigits=4, pDigits=4)
write.table(table2, file="referralreason.txt", sep=',', quote=FALSE, row.names=T,
col.names=T)



table(MH1$identify_primary_needs___1) #Caregiver/family
table(MH1$identify_primary_needs___2) #Developmental/behavioral
table(MH1$identify_primary_needs___3) #Educational/pre-school
table(MH1$identify_primary_needs___4) #High-risk social
table(MH1$identify_primary_needs___5) #Legal
table(MH1$identify_primary_needs___6) #Medical
table(MH1$identify_primary_needs___7) #Mental/behavioral health-PARENT
table(MH1$identify_primary_needs___8) #Mental/behavioral health-PATIENT



########Looking at primary reason medical patient######
vars3<-c('primary_mental_behav_patient___1', 'primary_mental_behav_patient___2',
'primary_mental_behav_patient___3', 'primary_mental_behav_patient___4',
'primary_mental_behav_patient___5',
'primary_mental_behav_patient___6','primary_mental_behav_patient___7',
'primary_mental_behav_patient___8', 'primary_mental_behav_patient___9',
'primary_mental_behav_patient___10',
'primary_mental_behav_patient___11','primary_mental_behav_patient___12','primary_m
ental_behav_patient___13','primary_mental_behav_patient___14',
'primary_mental_behav_patient___15','primary_mental_behav_patient___16','primary_m
ental_behav_patient___17','primary_mental_behav_patient___18','primary_mental_beha
v_patient___19',
'primary_mental_behav_patient___20','primary_mental_behav_patient___21','primary_m
ental_behav_patient___22','primary_mental_behav_patient___23',
'primary_mental_behav_patient___24',
'primary_mental_behav_patient___25','primary_mental_behav_patient___26','primary_m
ental_behav_patient___27','primary_mental_behav_patient___28',
```

```
'primary_mental_behav_patient___29', 'primary_mental_behav_patient___30',
'primary_mental_behav_patient___31')
PatientMed<-CreateTableOne(vars=vars3, factorVars=vars3, data=data, test=FALSE)
table3<-print(PatientMed, contDigits=4, pDigits=4)
write.table(table3, file="PatientMed.txt", sep=',', quote=FALSE, row.names=T,
col.names=T)



##############################################################################
#########
###################################Analysis#################################
########
#Cleaning dataset for baseline table
length(data$mrn)
#>886

#Gender
data$Gender[data$gender==1]<-'Male'
data$Gender[data$gender==2]<-'Female'
data$Gender[data$gender==3]<-'Female'
data$Gender[data$gender==4]<-'Male'
data$Gender[data$gender==5]<-'Unknown'
table(data$Gender)
#Dropping unknown from gender
data<-subset(data, !Gender=='Unknown') #Drop 2
#>829

#Race
data$Race[data$ethnicity==1]<-0 #White
data$Race[data$ethnicity==2]<-1 #Black
data$Race[data$ethnicity==3]<-2 #Hispanic
data$Race[data$ethnicity==4]<-3 #Other
data$Race[data$ethnicity==5]<-3 #Other
data$Race[data$ethnicity==6]<-3 #Other
data$Race[data$ethnicity==7]<-'Declined'
data$Race[data$ethnicity==8]<-3 #Other
data$Race[data$ethnicity==9]<-3 #Other
data<-subset(data, !Race=='Declined') #Drop 7
#>822

#Ethnicity
data$Ethnicity[data$race_ethnicity==1]<-0 #Non-Hispanic
```

```
data$Ethnicity[data$race_ethnicity==2]<-1 #Hispanic
data$Ethnicity[data$race_ethnicity==3]<-'Unknown'
data$Ethnicity[data$race_ethnicity==4]<-'Unknown'
data<-subset(data, !Ethnicity=='Unknown') #Drop 13 and 31 NA
#>778

#Race2
data$Race2[data$Race==0 & data$Ethnicity==0]<-0 #Non-his white
data$Race2[data$Race==1 & data$Ethnicity==0]<-1 #Non-his black
data$Race2[data$Race==2 | data$Ethnicity==1]<-2 #Hispanic
data$Race2[data$Race==3]<-3 #Other
table(data$Race2)



#Insurance
data$Insurance[data$Private==1]<-0
data$Insurance[data$Medicaid==1]<-1
data$Insurance[data$Other==1]<-'Other'
data$Insurance[data$Uninsured==1]<-'Other'
data<-subset(data, !Insurance=='Other') #drop 38
#>740
table(data$Insurance)
#Screener
data$Screener[data$screening_completed==1]<-'Yes'
data$Screener[data$screening_completed==0]<-'No'


#Primary Referral Category
data$Category[data$identify_primary_needs___1==1]<- 'Caregiver/Family'
data$Category[data$identify_primary_needs___2==1]<- 'Developmental/Behavioral'
data$Category[data$identify_primary_needs___3==1]<- 'Educational'
data$Category[data$identify_primary_needs___4==1]<- 'High-Risk Social'
data$Category[data$identify_primary_needs___6==1]<- 'Medical'
data$Category[data$identify_primary_needs___7==1]<- 'Parent Mental/Behavioral'
data$Category[data$identify_primary_needs___8==1]<- 'Patient Mental/Behavioral'

##reordering referral acuity
data$severity[data$referral_acuity==1]<-3 #emergency
data$severity[data$referral_acuity==2]<-2 #urgent
data$severity[data$referral_acuity==3]<-1 #routine

data$referral_acuity<-factor(data$referral_acuity)
data$severity<-factor(data$severity)
```

```
data$age2<-factor(data$referralage)
summary(data$referralage)
sd(data$referralage)

##################################combined pending and not
connected#############
table(data$service_outcome)
data2<-data
data2$service_outcome[data2$service_outcome==3]<-2 #combining pending and not
connected
table(data2$service_outcome)

#Baseline demographics
vars2<-c('age2', 'Gender', 'Race2', 'Insurance', 'Screener', 'severity',
'primary_mental_behav_patient___1', 'primary_mental_behav_patient___2',
'primary_mental_behav_patient___3', 'primary_mental_behav_patient___5',
'primary_mental_behav_patient___7', 'primary_mental_behav_patient___9',
'primary_mental_behav_patient___10', 'primary_mental_behav_patient___17',
'primary_mental_behav_patient___30', 'identify_primary_needs___1',
'identify_primary_needs___2', 'identify_primary_needs___3',
'identify_primary_needs___4', 'identify_primary_needs___6',
'identify_primary_needs___7')
#Baseline table code
BaselineDem<-CreateTableOne(vars=vars2, factorVars=vars2, includeNA=TRUE,
strata='service_outcome', data=data2, test=TRUE)
table2<-print(BaselineDem, contDigits=4, pDigits=4)
write.table(table2, file="BaselineDem.txt", sep=',', quote=FALSE, row.names=T)
#Exporting baseline table

connected<-subset(data2, service_outcome==1)
not<-subset(data2, service_outcome==2)
summary(connected$referralage)
sd(connected$referralage)
summary(not$referralage)
sd(not$referralage)

####adjusted regression model####
adjmodel2<-multinom(service_outcome~age2 + Gender + as.character(Race2) +
Insurance + Screener + severity + primary_mental_behav_patient___1 +
primary_mental_behav_patient___2 + primary_mental_behav_patient___3 +
primary_mental_behav_patient___5 + primary_mental_behav_patient___7 +
primary_mental_behav_patient___9 + primary_mental_behav_patient___10 +
primary_mental_behav_patient___17 + primary_mental_behav_patient___30 +
identify_primary_needs___1 + identify_primary_needs___2 +
```

```
identify_primary_needs___3 + identify_primary_needs___4 +
identify_primary_needs___6 + identify_primary_needs___7, data=data2)
summary(adjmodel2)
RR2<-exp(coef(adjmodel2))
RR2
z2<-summary(adjmodel2)$coefficients/summary(adjmodel2)$standard.errors
pval2<-(1-pnorm(abs(z2), 0, 1))*2
pval2
ciadj2<-confint(adjmodel2, level=0.95)
exp(ciadj2)

#unadjdusted age
unadj<-multinom(service_outcome~as.character(age2), data=data2, log=TRUE)
summary(unadj)
RRage<-exp(coef(unadj))
RRage
zage<-summary(unadj)$coefficients/summary(unadj)$standard.errors
pval_age<-(1-pnorm(abs(zage), 0, 1))*2
pval_age
ciage<-confint(unadj, level=0.95)
exp(ciage)


#unadjdusted Gender
unadj2<-multinom(service_outcome~as.character(Gender), data=data2, log=TRUE)
summary(unadj2)
RRg<-exp(coef(unadj2))
RRg
z_gender<-summary(unadj2)$coefficients/summary(unadj2)$standard.errors
pval_g<-(1-pnorm(abs(z_gender), 0, 1))*2
pval_g
ci_gender<-confint(unadj2, level=0.95)
exp(ci_gender)

#unadjusted Race2
unadj35<-multinom(service_outcome~as.character(Race2), data=data2, log=TRUE)
summary(unadj35)
RRr<-exp(coef(unadj35))
RRr
z_race2<-summary(unadj35)$coefficients/summary(unadj35)$standard.errors
pval_r2<-(1-pnorm(abs(z_race2), 0, 1))*2
pval_r2
ci_race2<-confint(unadj35, level=0.95)
exp(ci_race2)
```

```
#unadjusted Insurance
unadj5<-multinom(service_outcome~as.character(Insurance), data=data2, log=TRUE)
summary(unadj5)
RRI<-exp(coef(unadj5))
RRI
z_ins<-summary(unadj5)$coefficients/summary(unadj5)$standard.errors
pval_ins<-(1-pnorm(abs(z_ins), 0, 1))*2
pval_ins
ci_ins<-confint(unadj5, level=0.95)
exp(ci_ins)

#unadjusted Screener
unadjSc<-multinom(service_outcome~as.character(Screener), data=data2, log=TRUE)
summary(unadjSc)
RRsc<-exp(coef(unadjSc))
RRsc
z_s<-summary(unadjSc)$coefficients/summary(unadjSc)$standard.errors
pval_s<-(1-pnorm(abs(z_s), 0, 1))*2
pval_s
ci_s<-confint(unadj5, level=0.95)
exp(ci_s)

#unadjusted Severity
unadj6<-multinom(service_outcome~as.character(severity), data=data2, log=TRUE)
summary(unadj6)
RR6<-exp(coef(unadj6))
RR6
z_st<-summary(unadj6)$coefficients/summary(unadj6)$standard.errors
pval_st<-(1-pnorm(abs(z_st), 0, 1))*2
pval_st
ci_st<-confint(unadj6, level=0.95)
exp(ci_st)

#unadjusted ADHD
unadj7<-multinom(service_outcome~as.character(primary_mental_behav_patient___1),
data=data2, log=TRUE)
summary(unadj7)
RR7<-exp(coef(unadj7))
RR7
z_1<-summary(unadj7)$coefficients/summary(unadj7)$standard.errors
pval_1<-(1-pnorm(abs(z_1), 0, 1))*2
pval_1
```

```
ci_1<-confint(unadj7, level=0.95)
exp(ci_1)

#unadjusted adj disorder
unadj8<-multinom(service_outcome~as.character(primary_mental_behav_patient___2),
data=data2, log=TRUE)
summary(unadj8)
RR8<-exp(coef(unadj8))
RR8
z_2<-summary(unadj8)$coefficients/summary(unadj8)$standard.errors
pval_2<-(1-pnorm(abs(z_2), 0, 1))*2
pval_2
ci_2<-confint(unadj8, level=0.95)
exp(ci_2)

#unadjusted anxiety
unadj9<-multinom(service_outcome~as.character(primary_mental_behav_patient___3),
data=data2, log=TRUE)
summary(unadj9)
RR9<-exp(coef(unadj9))
RR9
z_3<-summary(unadj9)$coefficients/summary(unadj9)$standard.errors
pval_3<-(1-pnorm(abs(z_3), 0, 1))*2
pval_3
ci_3<-confint(unadj9, level=0.95)
exp(ci_3)

#unadjusted behavioral
unadj10<-multinom(service_outcome~as.character(primary_mental_behav_patient___5),
data=data2, log=TRUE)
summary(unadj10)
RR10<-exp(coef(unadj10))
RR10
z_4<-summary(unadj10)$coefficients/summary(unadj10)$standard.errors
pval_4<-(1-pnorm(abs(z_4), 0, 1))*2
pval_4
ci_4<-confint(unadj10, level=0.95)
exp(ci_4)

#unadjusted depression
unadj11<-multinom(service_outcome~as.character(primary_mental_behav_patient___7),
data=data2, log=TRUE)
summary(unadj11)
RR11<-exp(coef(unadj11))
```

```
RR11
z_5<-summary(unadj11)$coefficients/summary(unadj11)$standard.errors
pval_5<-(1-pnorm(abs(z_5), 0, 1))*2
pval_5
ci_5<-confint(unadj11, level=0.95)
exp(ci_5)

#unadjusted family
unadj12<-multinom(service_outcome~as.character(primary_mental_behav_patient___9),
data=data2, log=TRUE)
summary(unadj12)
RR12<-exp(coef(unadj12))
RR12
z_6<-summary(unadj12)$coefficients/summary(unadj12)$standard.errors
pval_6<-(1-pnorm(abs(z_6), 0, 1))*2
pval_6
ci_6<-confint(unadj12, level=0.95)
exp(ci_6)

#unadjusted grief
unadj13<-
multinom(service_outcome~as.character(primary_mental_behav_patient___10),
data=data2, log=TRUE)
summary(unadj13)
RR13<-exp(coef(unadj13))
RR13
z_7<-summary(unadj13)$coefficients/summary(unadj13)$standard.errors
pval_7<-(1-pnorm(abs(z_7), 0, 1))*2
pval_7
ci_7<-confint(unadj13, level=0.95)
exp(ci_7)

#unadjusted SI
unadj14<-
multinom(service_outcome~as.character(primary_mental_behav_patient___17),
data=data2, log=TRUE)
summary(unadj14)
RR14<-exp(coef(unadj14))
RR14
z_8<-summary(unadj14)$coefficients/summary(unadj14)$standard.errors
pval_8<-(1-pnorm(abs(z_8), 0, 1))*2
pval_8
ci_8<-confint(unadj14, level=0.95)
exp(ci_8)
```

```
#unadjusted covid
unadj15<-
multinom(service_outcome~as.character(primary_mental_behav_patient___30),
data=data2, log=TRUE)
summary(unadj15)
RR15<-exp(coef(unadj15))
RR15
z_9<-summary(unadj15)$coefficients/summary(unadj15)$standard.errors
pval_9<-(1-pnorm(abs(z_9), 0, 1))*2
pval_9
ci_9<-confint(unadj15, level=0.95)
exp(ci_9)

#unadjusted caregiver
unadj16<-multinom(service_outcome~as.character(identify_primary_needs___1),
data=data2, log=TRUE)
summary(unadj16)
RR16<-exp(coef(unadj16))
RR16
z_10<-summary(unadj16)$coefficients/summary(unadj16)$standard.errors
pval_10<-(1-pnorm(abs(z_10), 0, 1))*2
pval_10
ci_10<-confint(unadj16, level=0.95)
exp(ci_10)

#unadjusted developmental
unadj17<-multinom(service_outcome~as.character(identify_primary_needs___2),
data=data2, log=TRUE)
summary(unadj17)
RR17<-exp(coef(unadj17))
RR17
z_11<-summary(unadj17)$coefficients/summary(unadj17)$standard.errors
pval_11<-(1-pnorm(abs(z_11), 0, 1))*2
pval_11
ci_11<-confint(unadj17, level=0.95)
exp(ci_11)

#unadjusted educational
unadj18<-multinom(service_outcome~as.character(identify_primary_needs___3),
data=data2, log=TRUE)
summary(unadj18)
RR18<-exp(coef(unadj18))
RR18
```

```
z_12<-summary(unadj18)$coefficients/summary(unadj18)$standard.errors
pval_12<-(1-pnorm(abs(z_12), 0, 1))*2
pval_12
ci_12<-confint(unadj18, level=0.95)
exp(ci_12)

#unadjusted social
unadj19<-multinom(service_outcome~as.character(identify_primary_needs___4),
data=data2, log=TRUE)
summary(unadj19)
RR19<-exp(coef(unadj19))
RR19
z_13<-summary(unadj19)$coefficients/summary(unadj19)$standard.errors
pval_13<-(1-pnorm(abs(z_13), 0, 1))*2
pval_13
ci_13<-confint(unadj19, level=0.95)
exp(ci_13)

#unadjusted medical
unadj20<-multinom(service_outcome~as.character(identify_primary_needs___6),
data=data2, log=TRUE)
summary(unadj20)
RR20<-exp(coef(unadj20))
RR20
z_14<-summary(unadj20)$coefficients/summary(unadj20)$standard.errors
pval_14<-(1-pnorm(abs(z_14), 0, 1))*2
pval_14
ci_14<-confint(unadj20, level=0.95)
exp(ci_14)

#unadjusted parent
unadj21<-multinom(service_outcome~as.character(identify_primary_needs___7),
data=data2, log=TRUE)
summary(unadj21)
RR21<-exp(coef(unadj21))
RR21
z_15<-summary(unadj21)$coefficients/summary(unadj21)$standard.errors
pval_15<-(1-pnorm(abs(z_15), 0, 1))*2
pval_15
ci_15<-confint(unadj21, level=0.95)
exp(ci_15)

#unadjusted patient
```

```
unadj22<-multinom(service_outcome~as.character(identify_primary_needs___8),
data=data2, log=TRUE)
summary(unadj22)
RR22<-exp(coef(unadj22))
RR22
z_16<-summary(unadj22)$coefficients/summary(unadj22)$standard.errors
pval_16<-(1-pnorm(abs(z_16), 0, 1))*2
pval_16
ci_16<-confint(unadj22, level=0.95)
exp(ci_16)
```