Exploring NCCARE360's Role in Addressing Food Insecurity: Onboarding Successes, Challenges, and Referral Outcomes Among Community-Based Organizations in the Piedmont Triad Region

By

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ABSTRACT

Given the integral role community-based organizations (CBOs) play in connecting individuals to essential resources and services, understanding how CBOs engage with NCCARE360 is essential to enhancing adoption, sustainability, and impact of the platform. This study explored how CBOs in the Piedmont Triad Region use NCCARE360, North Carolina's statewide coordinated care referral platform, to address food insecurity. A mixed methods approach was used to address the study's objectives. Focus groups explored the barriers to onboarding and retention that CBOs experience as well as the facilitators that keep CBOs active and engaged with NCCARE360. Aggregated CBO-level referral data from July 2023 – June 2024 was analyzed using logistic and negative binomial regression components to evaluate and interpret trends in referral patterns, workflows, service subtypes, and acceptance rates across CBOs to understand referral success. Training and capacity building and resource constraints were commonly reported onboarding and retention barriers of NCCARE360. Facilitators of onboarding and retention emphasized increased exposure for CBOs and the value of using NCCARE360 to connect patients to resources, improve coordinated care, and strengthen care management. The number of referrals received and accepted increased for certain service types, such as emergency food, food pantries,

and prepared meals. County-level differences were also noted, with Alamance County showing significant variations in referral acceptance rates, offering insights for best practices to improve NCCARE360 utilization in other counties. Results indicated that CBOs with consistent referral intake also accepted referrals more effectively, and that different CBOs and service subtypes played a crucial role in improving referral acceptance. Further research is needed to understand the specific challenges lower-performing CBOs face in delivering food security services through NCCARE360.

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SNAP	Supplemental Nutrition Assistance Program
FNS	Food Nutrition Service
COVID-19	Coronavirus disease 2019
CDC	Centers for Disease Control and Prevention
CBO	Community-based organizations
HOP	Healthy Opportunities Pilots
HSO	Human service organizations
ASSIA	Applied Social Sciences Index and Abstracts
BMI	Body mass index
AAA	Area agencies on aging
PRAPARE	Protocol for Responding to and Assessing Patients' Assets, Risks, and Experiences
FHLI	Foundational for Health Leadership and Innovation
NCDHHS	North Carolina Department of Health and Human Services
IRB	Institutional Review Board
FQHC	Federally qualified health center
ACES	Adverse childhood experiences

Chapter 1: Introduction

Food insecurity – the lack of consistent access to enough food for an active, healthy life, is a critical public health issue that affects population health outcomes by contributing to malnutrition, poor diet quality, and higher rates of chronic diseases such as obesity and diabetes (Lyonnais et al., 2020; United States Department of Agriculture, 2021). The problem of food insecurity remains widespread, affecting millions of households across the United States, with particularly high rates among low-income families, racial and ethnic minorities, and other vulnerable populations (Lyonnais et al., 2020).

In many communities in North Carolina, the coronavirus disease 2019 (COVID-19) pandemic has worsened existing barriers to accessing healthy food options. These barriers included shortages of shelf-stable items in grocery stores and limited availability of food that can be purchased with Supplemental Nutrition Assistance Program (SNAP) benefits, further widening health disparities among underserved populations (LeGreco et al., 2021). Furthermore, the reductions in funding for federal nutrition programs, including SNAP, were primarily due to the expiration of pandemic-related policies and waivers that temporarily increased benefits and expanded eligibility (Hurewitz et al., 2023). Therefore, funding levels have reverted to pre-pandemic norms. North Carolina ranks 10th in the nation for food insecurity, with cities in the Piedmont Triad Region reporting a higher rate at 16% for all households and 21% for families with children (Cummer et al., 2020). In previous studies, food insecurity was associated with poor diet quality and higher obesity rates, negatively impacting physical and mental health including psychological and emotional distress, mobility and functional limitations, and reduced quality of life (Cummer et al., 2020; Banks et al., 2021). The causes of these health

consequences varied based on race and demographics, further exacerbating the disparities between underserved populations (Banks et al., 2021).

Social determinants of health, defined as the social, economic, and behavioral factors affecting where people live, work, play, and age, have been proven to significantly influence health, including food insecurity, which impacts access to adequate, affordable, nutritious, and culturally relevant foods (Friedman & Banegas, 2018). Research showed that addressing unmet social needs such as food insecurity, housing instability, and transportation improved individual and community health (Gutschall et al., 2021; Busza et al., 2012). Studies suggested that food insecurity often coexists with other social and economic challenges such as financial hardship, social isolation, and housing instability, further compounding health risks (Friedman & Banegas, 2018). Whole-person healthcare has played a critical role in addressing patients' health and social needs by identifying food insecurity and connecting patients to food-related resources and services (Bank et al., 2021). Food insecurity screening interventions have helped providers understand health and social factors influencing patient outcomes and connect them to emergency food resources, government assistance, and community-based programs and services, promoting food security and improved diet quality (Stenmark et al., 2018). Since food insecurity often coincided with unmet social needs like transportation and housing, screenings facilitated community-clinical connections to prioritize specific needs and better coordinate healthcare and social services (Bank et al., 2021; Cruz et al., 2022). Implementing clinical food insecurity referral programs supported a more coordinated, holistic approach to care (Stenmark et al., 2018). Further evaluation is required to assess clinical food insecurity interventions, their impact on health outcomes, and the infrastructure required for healthcare systems to coordinate referrals to community organizations (Lundeen et al., 2017; Stenmark et al., 2018).

Studies suggested that addressing social determinants of health within healthcare systems was critical to influencing systems change to effectively address multiple levels of social influences and factors affecting individuals' health (Cruz et al., 2022). Leveraging technology-facilitated referral platforms proved to be effective in coordinating healthcare and health services to driving whole-person healthcare and minimizing healthcare utilization and costs, however, these strategies remained under-researched (Cartier et al., 2020; Hawkins et al., 2022; Johnson et al., 2024). The NCCARE360 referral platform facilitates connections between providers and community-based organizations (CBOs) through a technology-driven system, enabling providers to electronically link patients with unmet social needs to community resources, track referrals, and follow up to ensure resolution. Providers can initiate referrals related to housing, food, transportation, and interpersonal safety and toxic stress (NCCARE360, 2024). There is significant evidence reported that when health care and CBOs collaborated to address social needs that affect health, health outcomes improved, and costs decreased (Crook et al., 2021). CBOs played a vital role in addressing social determinants of health by providing essential services and resources to underserved populations. Providing support beyond clinical care, CBOs acted as a bridge between health systems and social services in their communities, enhancing service coordination and accessibility to address critical issues such as food insecurity (Crook et al., 2021).

This research study focused on CBOs across five counties in North Carolina's Piedmont Triad Region (Alamance, Guilford, Forsyth, Davidson, and Randolph counties) and their engagement with NCCARE360 to address food insecurity. By analyzing referral data, onboarding processes, and service coordination outcomes, the research study aimed to identify service gaps and opportunities for system improvements. This research study explored

NCCARE360's impact on food insecurity among CBOs in the Piedmont Triad Region (Alamance, Guilford, Forsyth, Davidson, and Randolph counties) and examined factors that influenced the onboarding, retention, and engagement of CBOs, as well as potential barriers, facilitators, and opportunities for its adoption and sustainability by CBOs. This research study provided critical insights into how effectively these organizations are connecting individuals to food resources and inform strategies to address food insecurity and health outcomes in underserved communities.

Figure 1. Geographical coverage of the Piedmont Triad Region, North Carolina (Legion, n.d.)

Background

Social determinants of health, such as food insecurity and housing instability, have influenced the distribution of resources and impacted individual health and social needs. The number of households in North Carolina that experienced food insecurity pre-COVID-19 pandemic was approximately 11% (NCDHHS, 2023). Food insecure households and individuals were consistently unable to access adequate nutrition for an active, healthy lifestyle (Coleman-

Jensen et al., 2019). Food insecurity often results from structural and economic constraints, with poverty serving as the primary contributor (NCDHHS, 2023). The North Carolina Justice Center's 2020 Poverty Report highlighted higher poverty rates for Blacks, Hispanics, and American Indians compared to Whites (Harris, 2020). Similarly, the North Carolina Institute of Medicine's Healthy North Carolina 2030 report revealed higher unemployment rates for Blacks, Hispanics, and American Indians compared to Whites and Asians (North Carolina Institute of Medicine, 2020). This was often exacerbated by limited education, affordable housing, healthcare, transportation, employment, and livable wage opportunities. Housing instability and neighborhood design influenced access to quality and affordable food markets. Moreover, those with limited resources were forced to prioritize between essential needs such as food, housing, childcare, and healthcare (NCDHHS, 2023).

Table 1. Poverty and Unemployment Rates by Race in North Carolina (U.S. Census Bureau, 2019; North Carolina Institute of Medicine, 2020)

Race	**Unemployment Rate**	**Poverty Rate**
Blacks	11.7%	22%
Hispanics/Latinos	7.1%	22%
American Indians	10.3%	26%
Asians	5.2%	8%
Whites	5.7%	9%

The Impact of the COVID-19 Pandemic on Social Needs and Health Disparities

The COVID-19 pandemic exacerbated existing unmet social needs such as food insecurity, housing instability, and lack of transportation across underserved communities, illuminating health disparities in social, economic, and health outcomes (Drake et al., 2024). Before the COVID-19 pandemic, at least 20% of households with children in North Carolina faced food insecurity and by 2021, the rate increased to 33% (Hurewitz et al., 2023). The Piedmont Triad Region's Food Nutrition Service (FNS) participation decreased in 2019 and continued to decrease in the first quarter of 2020, indicating slow improvements in addressing food insecurity. FNS participation peaked in September 2020 during the Covid-19 pandemic (Carolina Creative Works, 2022). During the COVID-19 pandemic, the rate of childhood food insecurity in North Carolina increased from 20% to 33% by September 2021 (Hurewitz et al., 2023). Due to this, Black and Hispanic households were almost twice as likely to experience food insecurity compared to other groups (Hurewitz et al., 2023). In rural areas in North Carolina, food insecurity was a growing concern, revealing historical and systemic inequities, exacerbated by socio-economic factors such as decades of economic downturn, limited employment, and education opportunities, and geographic isolation, contributing to disparities in food accessibility and availability in rural North Carolina (Gundersen & Ziliak, 2015; Coleman-Jensen et al., 2019).

The Need for Improved Coordination of Social Services and Healthcare

The urgency to address food insecurity stemmed from its profound impact on individual and community health. In accordance with the NCDHHS State Action Plan for Nutrition Security for 2023, the 2021 USDA Household Food Insecurity and Very Low Food Security report noted that 10.9% of North Carolina residents were food insecure (USDA Economic

Research Service, 2025; NCDHHS, 2023). Additionally, data from the 2021 American Community Survey 1-Year Estimates revealed that 13.6% of residents in North Carolina lived in poverty (U.S. Census Bureau, 2023; NCDHHS, 2023). The data revealed a notable overlap between food insecurity and poverty in North Carolina and the immediate need to connect financial instability with food insecurity.

In several studies, food insecurity was linked to poor dietary choices, increasing the risk of chronic diseases such as obesity, type 2 diabetes, hypertension, cardiovascular diseases, and kidney disease, as well as adverse mental health outcomes, disproportionately affecting communities of color and further straining healthcare systems (Drake et al., 2024; Lundeen et al., 2017; Gundersen & Ziliak, 2015; Cruz et al., 2022). These communities were affected by gaps in social determinants of health such as access to care, healthy food options, and opportunities for physical activity (Cruz et al., 2022). Moreover, these observed health disparities contributed to $150 billion in annual healthcare costs (Cruz et al., 2022). Addressing food insecurity remains a vital public health priority to advance health equity and reduce its long-term health and economic consequences (Gundersen & Ziliak, 2015; Coleman-Jensen et al., 2019).

While the COVID-19 pandemic created opportunities to increase federal funding through stimulus aid packages to address food insecurity, many of these solutions were discontinued once the public health emergency declaration ended on May 11, 2023, thus increasing the need for improved coordination of health care, social services, and public health (Hurewitz et al., 2023; Department of Health and Human Services, 2023). Coordinating community clinical connections for prevention and health provided the opportunity to address health disparities among underserved populations. As part of their recommendation to address social determinants of health, the Centers for Disease Control and Prevention (CDC) recommended coordinating

clinical services with community resources; however, limited research supported the effective strategies required to develop, implement, and sustain community clinical connections and linkages (Cruz et al., 2022).

Leveraging Coordinated Care Referral Networks

Facilitating coordinated care networks was critical to comprehensively addressing patients' complex health and social needs. By integrating systematic screening of social needs and using technology-facilitated referral systems during routine medical care, these networks effectively linked patients with community resources and social services to address unmet social needs, potentially improving health outcomes (Hassan et al., 2015). Research confirmed there was growing interest among healthcare providers to conduct systematic screening for patients to inform care plans and address unmet social needs by referring them to CBOs for support and assistance (Albertson et al., 2022).

Improving care coordination could contribute to decreased healthcare costs and utilization and improved health outcomes (Lundeen et al., 2017). Moreover, since social determinants of health influenced healthcare costs, quality, and outcomes, healthcare systems were motivated to develop cross-sector integration efforts to coordinate healthcare and health services to effectively address social determinants of health (Chagin et al., 2021). Research showed that food insecurity was the most prevalent social need reported, thus utilizing coordinated care referral platforms was seen as an effective way for healthcare providers to refer patients to community resources to address food needs. Moreover, addressing social needs gained interest among healthcare payers and providers due to the increased costs associated with patients' unmet social needs, demonstrating the urgency to incentivize value-based care (Chagin et al., 2021).

Introducing NCCARE360: A Statewide Network for Coordinated Care

NCCARE360, North Carolina's first statewide coordinated care network between healthcare and CBOs such as food pantries, shelters, faith-based organizations, non-profit organizations, and social service agencies was developed to address social determinants of health (NCDHHS, 2024). Priorities for NCCARE360 include coordinating medical care and social determinants of health such as housing, food, transportation, and interpersonal safety (NCDHHS, 2024). Through this platform, a two-way communication was created so healthcare providers could review health-related data and electronically refer patients to health services, community resources, and social services they need, follow up, and provide timely feedback to ensure referrals were successfully made to address unmet social needs and outcomes were reported and assessed in a central network (Drake et al., 2024). Furthermore, the platform could provide patients with specific accommodation resources based on their language preferences and physical limitations (Sandhu et al., 2022). This solution ensured accountability for services delivered, resolved referrals, and reported the outcomes of that connection. Research proved that accountability in the referral process was critical to effective care coordination (Albertson et al., 2022). Since 2019, there have been 2,862 organizations with 6,799 active programs that have been recruited and onboarded onto NCCARE360 platform. Additionally, since 2022, NCCARE360 received more than 184,000 referrals and served more than 95,000 clients statewide (NCCARE360, 2022). Despite its availability in all counties, NCCARE360 faced ongoing challenges with coordinated integration and sustainability.

Duke Health piloted the NCCARE360 implementation in a safety net pediatric clinic, a general pediatric clinic, and an adult family medicine clinic. Using the platform, users could place and view referrals to CBOs, identifying patients' unmet social needs and tracking their

referral outcomes. According to their findings, 60% of patients in a safety net pediatric clinic, 7% of patients in a general pediatric clinic, and 26% of chronic disease patients in an adult family medicine clinic had at least one social need (McPeek Hinz et al., 2023). Despite this, systematically screening and connecting patients to appropriate community resources and social services in a large and diverse healthcare system presented several challenges. High rates of clinical staff turnover, compliance and privacy concerns, inaccuracies in CBOs' repository databases, and referrals that exceed the capacity of CBOs were some of the reported challenges. Furthermore, the repository database for CBOs changed frequently, causing many organizations to stop accepting referrals based on funding or capacity. In some cases, where follow-up was conducted, referrals were transferred to other appropriate organizations automatically via the platform or manually (McPeek Hinz et al., 2023). Considering this, NCCARE360 showed promise in addressing unmet social needs, however, implementation challenges had to be addressed to ensure its efficacy in the context of a large and diverse healthcare system.

By utilizing local community resources and social assistance programs to respond to unmet social needs, NCCARE360 was a more effective and sustainable strategy for health prevention and healthcare management. NCCARE360 provided an innovative approach to accelerating the adoption of social needs screening and response in healthcare settings. The Healthy Opportunities Pilots (HOP) funded human service organizations (HSOs) in other areas across the state through the NC Medicaid Program to assess the impact of nonmedical interventions on health outcomes and costs. If successful, these interventions could be scaled statewide. HOP data enhanced integration of social needs into healthcare through value-based payment models and guided the recruitment of CBOs onto the NCCARE360 platform for improved coordination across North Carolina (Wortman et al., 2020).

Purpose and Significance of Research

Some counties in the Piedmont Triad Region have experienced higher levels of food insecurity, and the COVID-19 pandemic exacerbated these problems (Carolina Creative Works, 2022; County Health Rankings & Roadmaps, 2023; U.S. Census Bureau, 2024). Food accessibility was measured using the County Food Environment Index, which assessed access to healthy foods based on proximity to grocery stores, income-related cost barriers, and other factors, rating food environments on a scale from 0 (worst) to 10 (best) (County Health Rankings & Roadmaps, 2023). The Piedmont Triad Region averaged 6.75, which was influenced by a range of factors, including median household income, poverty rates, unemployment rates, and uninsured rates (County Health Rankings & Roadmaps, 2023). Additionally, the Food Environment Index measured the availability of healthy foods within a reasonable distance. Forsyth, Alamance, and Guilford counties scored lowest for this data, indicating that these counties are impacted by food deserts, unhealthy food outlets, and transportation barriers (Carolina Creative Works, 2022). Table 2 below presents data on food insecurity rates, poverty rates, and the food environment index for North Carolina and the Piedmont Triad Region (Guilford, Forsyth, Davidson, Randolph, and Alamance). Overall, the data suggests that counties with higher poverty rates tend to have higher food insecurity, though the food environment index varies. This could indicate differences in community resources, food access programs, or economic conditions.

Table 2. Food Insecurity, Poverty Rates, and Food Environment Index Scores in North Carolina (Carolina Creative Works, 2022; County Health Rankings & Roadmaps, 2023; U.S. Census Bureau, 2024)

County	Food Insecurity Rate	Poverty Rate	Food Environment Index
NC (overall)	12%	12.8%	6.8
Guilford	13%	14.8%	7.4
Forsyth	13%	14.8%	6.7
Davidson	14%	14%	7.3
Randolph	14%	15.5%	6.9
Alamance	13%	12.5%	7.0

Hospital data from Novant Health Medical Park Hospital and the 2021 Community Health Assessment highlighted access to care and resources, including adequate nutrition, as significant health priorities. The report revealed that Forsyth County's death rate from chronic diseases was higher than the state average (Novant Health, 2022). To address food insecurity,

Novant Health Medical Park Hospital described plans to strengthen partnerships with Second Harvest Food Bank and farm-to-table organizations and establish food pharmacies and food programs in primary care clinics to address access to care and resources. Ultimately, the project aimed to increase community resource referrals and connect individuals to appropriate community resources and social services (Novant Health, 2022). As part of Novant Health Medical Park Hospital's commitment to chronic disease management, the hospital provided screening services for hemoglobin A1C, cCholesterol, body mass index (BMI), and bBlood pPressure, as well as developed educational programs to identify chronic diseases in underserved populations and connect them with medical care. By increasing access to screenings and connections to care, patients could have the opportunity to obtain better health (Novant Health, 2022).

Challenges in Cross-Sector Integration and NCCARE360 Sustainability

Despite NCCARE360's availability in all North Carolina's 100 counties, several limitations were preventing CBOs from actively using the platform. Little was known about the extent to which CBOs reported being successfully engaged and prepared to provide support to individuals and families when referrals are received through NCCARE360. Further, the extent to which optimal engagement and initial onboarding may relate to referral readiness/referral volume and response/closing or completing of referrals as well as CBO retention in the system over time was poorly described.

Healthcare systems were key stakeholders in connecting patients to CBOs through NCCARE360. However, major systems like Atrium Health Wake Forest Baptist and Novant Health were not fully integrated, limiting coverage primarily to Forsyth County and surrounding areas (Novant Health, 2022; Atrium Health Wake Forest Baptist, 2024). This limited integration

hindered NCCARE360's effectiveness in this region, leading to fragmented care and underutilized coordinated services. While Cone Health was integrated, coverage gaps remained, especially outside Guilford County, leaving many residents without access to coordinated care and exacerbating health disparities, particularly around social determinants like food insecurity (*About Cone*, 2024).

Several studies examining cross-sector integration highlighted challenges in coordinating across various sectors and organizational levels. Differences in systems, infrastructure, funding sources, governance, and operations often hindered integration and collaboration, made it difficult to create effective partnerships for care coordination between healthcare and social services (Fichtenberg et al., 2020; Albertson et al., 2022). These barriers were compounded by underfunding in public health and healthcare, as well as differing funding models, where social services relied on grants and healthcare typically operated on service reimbursements. Significant costs were also associated with building the technology infrastructure necessary for cross-sector integration (Fichtenberg et al., 2020).

Despite growing interest in cross-sector integration, research reveals significant gaps in understanding its costs, financial sustainability, and effectiveness. Recent studies have shown inconsistent evidence that integration reduces healthcare costs or improves outcomes, with limited data on its impact on CBOs (Nohria et al., 2023; Fichtenberg et al., 2020). Health systems often resisted adopting referral platforms due to challenges such as limited provider capacity, low awareness of CBOs, and data interoperability issues (Gray et al., 2023). Therefore, best practices for successful integration from the CBO perspective remained unclear, highlighting further research was needed to assess the effectiveness and the resources required to sustain them (Nohria et al., 2023; Fichtenberg et al., 2020). While centralized referral platforms

could enhance care coordination and strengthen chronic disease prevention by connecting patients to community resources, further evaluation is essential to address these barriers and maximize their impact (Sandhu et al., 2022; Cruz et al., 2022).

Research Aims and Objectives

There were three specific aims of this research study, which assessed NCCARE360 engagement and CBO onboarding processes across Guildford, Forsyth, Alamance, Davidson, and Randolph counties in the Piedmont Triad Region in North Carolina.

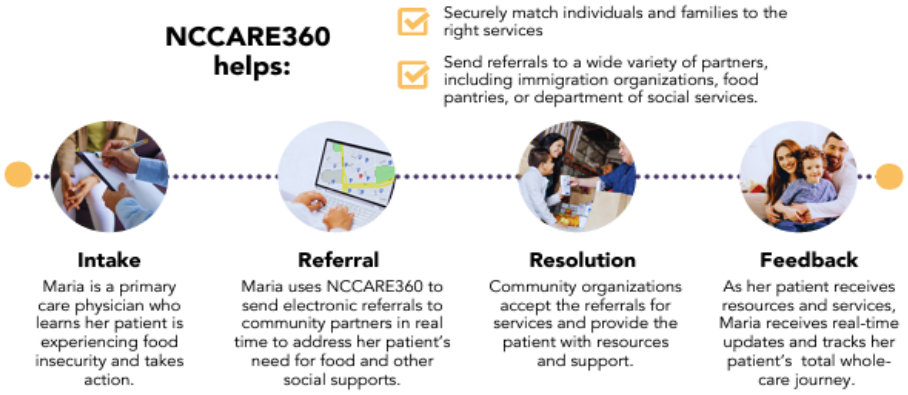
Quantitative: 1) Compare and contrast CBO referral workflows (depicted below in Figure 2) for food insecurity including service types, referral acceptance rates, average time to close cases, time to accept referrals, case referral and completion rates by county, and reasons for delays in referral acceptance across counties in the Piedmont Triad Region (including Randolph, Davidson, Alamance, Guilford, and Forsyth counties) via analysis of aggregated data at the county level.

Qualitative: 2a) Identify the factors contributing to the successful onboarding of CBOs onto the NCCARE360 platform from various perspectives and users at the organizational level.

2b) Identify the factors contributing to the retention of CBOs on the NCCARE360 platform.

3) Characterize the challenges hindering the onboarding of CBOs addressing food insecurity onto the NCCARE360 platform as reported by CBO leadership and staff.

Figure 2. NCCARE360 Referral Process: Workflow Overview (NCCARE360, 2023)



Enhancing CBO Engagement in NCCARE360 to Address Food Insecurity

The research study evaluated NCCARE360's effectiveness in addressing food insecurity by examining CBO engagement, referral workflows, and barriers to adoption. Using qualitative insights from CBO leaders and quantitative referral data, the research study identified key facilitators for onboarding and retention, as well as strategies to enhance communication, support, and enrollment. Findings provided actionable insights for improving resource connections, strengthening healthcare and social service coordination, and informing public health interventions to reduce food insecurity and health disparities across North Carolina.

Comparing and Contrasting CBO Referral Workflows for Food Insecurity

Analyzing aggregated county-level data helped identify disparities and inefficiencies in referral processes by comparing referral trends and outcomes across service subtypes over the past 12 months. This informed service gaps and system improvements to ensure continued access to necessary resources and support.

Identifying Facilitators of Successful Onboarding of CBOs onto NCCARE360

Assessing the motivators and facilitators for CBOs to stay on the platform and the challenges that led them to discontinue use revealed factors influencing successful onboarding. Qualitative focus groups with CBO leadership and staff explored these facilitators, defining successful onboarding as completing registration and initiating at least one referral within three months.

Identifying Factors Affecting CBO Retention on the Platform

Determining the challenges that led to CBO disengagement and the motivations for continued use provided key insights into platform retention. Qualitative focus groups with CBO leadership and staff examined these factors, defining successful retention as maintaining at least one referral per month for a year.

Identifying the Barriers Hindering the Onboarding of CBOs Addressing Food Insecurity

To understand onboarding barriers faced by CBOs, qualitative focus groups with CBO leadership and staff identified key stakeholders and resources to improve onboarding and examine how food referrals were managed outside the platform.

Streamlining Communication and Providing Ongoing Assistance for CBOs

Sustained engagement and participation on NCCARE360 required effective communication and tailored support. Findings from this research study informed NCCARE360's implementation strategies, targeted outreach, and resource allocation to enhance CBOs' effectiveness in addressing food insecurity across North Carolina. This research study also provided insights into expanding coordinated care networks to address other social determinants

of health, such as housing, transportation, and interpersonal violence, maximizing NCCARE360's impact statewide.

Theoretical Framework

This research study was guided by the resource dependence theory, which provided a comprehensive framework for understanding how organizations managed their dependence on external resources for enhanced strategy, informed decisions, and improved practices. The theory was particularly applicable to the study's objectives and methods since it was well-suited to investigating the barriers CBOs encountered during the onboarding process, which often involved managing external resources, such as technology, capacity, or NCCARE360 support.

Healthcare organizations have faced increased environmental uncertainty as they encounter external competition and resource scarcity. Based on the resource dependence theory, healthcare organizations must reduce dependence on essential resources or determine how to control them for survival (Pfeffer & Salancik, 1978; Tan & Litsschert, 1994). In some instances, for maximized efficiency and reduced reliance on external resources, hospitals in resource-constrained markets adopted strict strategies, such as staff reductions whereas hospitals in resource-rich markets were more likely to implement resource-rich strategies to improve their operations. Thus, healthcare organizations in highly competitive markets prioritized strategic decisions to remain competitive by adapting to secure essential resources (Shin et al., 2020).

According to resource dependence theory, organizations lacked the necessary resources and capabilities to sustain themselves, making them dependent on external entities for survival (Pfeffer & Salancik, 1978; Tan & Litschert, 1994). Increasing uncertainty and competition intensified this reliance, prompting organizations to seek additional resources while attempting to maintain autonomy. The balance between dependence and independence was shaped by factors

such as resource availability and competitive pressures. Organizations adapted their structures and behaviors to access external resources more effectively, as research showed that environmental conditions influenced organizational power dynamics and interdependencies (Kaundinya, 2023). These external pressures impacted pricing, services, and operations, often navigated through interorganizational networks (Pfeffer, 1978).

Trust-based partnerships fostered collaboration, knowledge exchange, and resource optimization, particularly in healthcare settings (Mervyn et al., 2018). While external partnerships helped organizations acquire expertise, share risks, and improve efficiency, they also introduced challenges such as coordination difficulties, conflicting objectives, and reduced autonomy (Alderwick et al., 2021). One study highlighted how the resource dependence theory was implemented among healthcare organizations and CBOs as they navigated resource competition to influence tobacco marketing policies. Organizations competed for resources such as funding to sustain programs and initiatives and increased interdependence to access expertise and technical assistance for program implementation. In some cases, they also adjusted operations to align with funding sources and partners. While external funding was vital for activities such as training and capacity building, it led to decreased autonomy and an increased reliance on other organizations. Thus, organizations utilized strategies such as resource-sharing agreements, formal commitments, and shared timelines to maintain control and balance interdependencies (Leeman et al., 2022).

In the context of this research study, CBOs with limited funding and sustainability challenges struggled to effectively serve their communities and address food insecurity. As CBOs faced resource constraints such as reduced staff capacity, they were also challenged with pressure to improve their performance. Reduced influence limited their ability to drive systemic

change, while operational inefficiencies hindered access to training, technology, or expertise needed to increase their utilization of NCCARE360. Based on this theory, the impact of dependencies on the onboarding process and referral management through NCCARE360 was explored. This framework provided a comprehensive understanding of how navigating external resources and dependencies enhanced CBOs' effectiveness in addressing food insecurity and improving service delivery.

Summary

The purpose and significance of the research study were highlighted, demonstrating the urgency of leveraging coordinated care networks to effectively address social determinants of health, particularly food insecurity, among underserved populations in the Piedmont Triad Region of North Carolina. NCCARE360 facilitated coordinated care through the connection of healthcare providers with CBOs to address these various social determinants of health including housing, transportation, interpersonal violence, and food insecurity (NCDHHS, 2024). The research study used methods to assess onboarding effectiveness, identify challenges preventing CBOs from utilizing NCCARE360, and determine success factors, while also highlighting food insecurity referral trends in the Piedmont Triad Region (Alamance, Randolph, Davidson, Forsyth, and Guilford counties) through the analysis of aggregated data. The findings informed strategies to improve onboarding processes and increase successful resource connections, resulting in improved access to food resources and services. The evaluation of NCCARE360 provided valuable insight into effective cross-sector approaches to addressing social determinants of health. The research study's results are expected to assist public health practitioners in refining coordination and collaboration strategies to enhance access to critical

resources to mitigate health disparities, improve NCCARE360 implementation, and identify opportunities to expand its reach for maximizing community impact.

Chapter 2: Literature Review

Integrating healthcare and social services became a more popular strategy to address social determinants of health and improve health outcomes, particularly among underserved populations. Although evidence supported food insecurity screenings and interventions, gaps remained in the healthcare and social service systems (Cartier et al., 2020; McPeek Hinz et al., 2023). The literature review explored the existing body of research on cross-sector integration efforts, with a focus on the challenges and facilitators of successfully connecting healthcare services with CBOs to address food insecurity.

Literature Review Process

The methodology for the literature review involved conducting a systematic keyword search across multiple databases to identify pertinent literature on cross-sector healthcare collaborations and interventions addressing food insecurity and other social determinants of health, and their impact on healthcare utilization, costs, and patient health outcomes. The search covered peer-reviewed articles, systematic reviews, and meta-analyses published between 2012 and 2024, used keywords such as "screening + social needs + referrals," "eastern NC + food access + food insecurity," "food insecurity + referrals," "access to care," "community health centers," "needs assessment," "primary care," "referral and consultation," "social determinants of health," "underserved communities," and related terms. Boolean searches (AND, OR) were employed to refine and combine search terms. Databases searched included PubMed, Medline, Applied Social Sciences Index and Abstracts (ASSIA), and SocINDEX, chosen for their comprehensive coverage of biomedical, social science, and public health literature.

Screening criteria focused on studies evaluating cross-sector collaborations addressing social determinants of health and coordinated healthcare interventions targeting food insecurity, assessing associated health outcomes, and providing empirical or theoretical insights. Initial searches yielded 1,274 articles, which were further refined and analyzed based on their relevance to the research study's goals and objectives. This systematic approach generated valuable insights to inform policy and practice in addressing social determinants of health.

Literature Review

The Importance of Integrating Healthcare and Social Services

Research supported the increased need to integrate healthcare and social services to effectively reduce healthcare costs, enhance healthcare quality, and improve overall health outcomes. Integrated efforts and enhanced communication between healthcare organizations and CBOs were critical to improving health outcomes across underserved populations (Hawkins et al., 2022). For this to be successful and sustainable, buy-in from CBOs was imperative as these organizations served as a critical asset in serving underserved communities and a key resource in addressing patients' unmet social needs (Nohria et al., 2023). Furthermore, value-based care was being developed in healthcare organizations due to the increasing incentives to integrate healthcare and social services and reduce healthcare costs (Cartier et al., 2020). Hospitals shifted from traditional fee-for-service to value-based care reimbursement to address community and social factors affecting health. This approach aimed to reduce demand and costs for preventable conditions by focusing on value-based care (Lundeen et al., 2017). Health systems established promising value-based care models, including financial incentives to encourage healthcare organizations to partner with community-based organizations (Cartier et al., 2020). Therefore, continued funding was critical to support incentives for CBOs to utilize technology-facilitated

referral platforms to build capacity to support staff in responding to referrals to ensure successful resource connections for patients. Furthermore, integrating healthcare and social services achieved cost-effective, high-quality, and comprehensive care for all, particularly for underserved populations (Cartier et al., 2020).

Prior Research on Social Care Integration and Health Outcomes

Social determinants of health, such as housing, education, and income, played significant roles in shaping an individual's overall health, further demonstrating the strong correlation existed between adverse social determinants and poor health outcomes (Lian et al., 2021; Sandhu et al., 2022). Health disparities were exacerbated due to unmet social needs across underserved populations (Johnson et al., 2024). To effectively address patients' medical care and social needs, many healthcare organizations incorporated social risk screening assessments, electronic health records, and referrals into existing clinical workflows and processes to connect patients to CBOs and community resources (Cartier et al., 2020). For optimal success and operational efficiency, community resource navigators were integrated into the screening, referral, and follow-up phases of the workflow process (Emengo et al., 2020). An embedded workflow in existing operations using electronic health records or social risk assessment data facilitated the integration of screening for unmet social needs and referred the individual to a community resource provider that could assist them (McPeek Hinz et al., 2023). This strategic model utilized a coordinated approach to leverage community and social support to strengthen links with healthcare organizations and CBOs. To develop effective referral pathways, it was recommended that healthcare organizations utilize a community or state-level technology platform to motivate end users since implementing and onboarding a new organization took time, capacity, and

resources. Moreover, it was imperative to consider the financial costs of sustaining these platforms to ensure continuity in care coordination and referrals (Cartier et al., 2020).

Cross-sector integrations linking patients to healthcare and social services also enhanced patient adherence and retention, thus, improving overall health outcomes (Busza et al., 2012). Data showed that Medicaid-managed care models that provided social care services to Medicaid beneficiaries reduced healthcare utilization (Nohria et al., 2023). Depending on the state, healthcare organizations received financial incentives as part of their partnership with CBOs, or Medicaid benefits covered the costs of medical and social needs for Medicaid beneficiaries (Cartier et al., 2020). As an example, Medicaid reforms in Oregon helped establish over 16 coordinated healthcare organizations from 2010-2014, connecting Medicaid beneficiaries with community services and enhancing care coordination with providers. This reduced healthcare utilization and costs in primary care, emergency services, and hospitalizations (McConnell et al., 2017). In the years 2008 – 2011, national Medicaid acute care spending increased by an average of 3.7% and decreased by 1.7% from 2011 to 2012. The overall healthcare spending growth in 2014 increased from 2.9% in 2013 to 5.3% (McConnell et al., 2017). However, similar interventions and efforts in Colorado did not produce the same results due to limited investments in Medicaid reform (McConnell et al., 2017). The investment in technology-facilitated referral platforms and cross-sector collaborations proved critical to making these efforts a success, but more research remained necessary to demonstrate their value in decreasing healthcare utilization and costs and improving patient health outcomes in the long term. Additionally, ongoing evaluation was crucial for assessing referral processes, outcomes, and quality improvement for the platform to ensure design and implementation were aligned with a cost-effective, value-based, and efficient healthcare system (Cartier et al., 2020).

Evaluating Technology-Facilitated Referral Platforms and CBO Engagement

Research proved that select technology-facilitated referral platforms improved care coordination and addressed social determinants of health. Furthermore, it emphasized the need for ongoing support and incentives for CBOs, as well as further research to ensure their widespread and effective adoption (Cartier et al., 2020).

A mixed-method study conducted a landscape analysis of nine technology-facilitated referral platforms and thirty-five semi-structured key interviews to understand the early adopters' experiences of healthcare organizations that utilized electronic community resource directories and technology-facilitated referrals. Key informant interviews assessed multiple perspectives and adopters of various technology platforms. Results showed early adopters were motivated to invest in platforms for technology-facilitated referrals to address patients' unmet social needs and coordinate care services more efficiently (Cartier et al., 2020).

Several interviewees expressed a desire to increase their capacity by leveraging centralized lists of community resources for sending referrals electronically and tracking referral outcomes from CBOs (Cartier et al., 2020). Others were motivated by value-based payment models, which incentivized enhanced care coordination with CBOs to improve care, and health, and reduce costs (Steeves-Reece et al., 2022). Other factors that influenced adoption included platform selection criteria such as cost, mission alignment, vendor technical expertise, and perceived user friendliness and benefits (Cartier et al., 2020).

Primary adopters and users of the platform varied by the needs, resources, and capacity of each healthcare organization, with many including patient navigators, social workers, community health workers, care coordinators, volunteers, and others as critical staff to support adoption and implementation. In addition, the target patient population varied across sites based on general

and specialized services at each healthcare organization. The funding sources for platforms differed including grants, operational funds, and healthcare transformation funds. However, in all cases, healthcare organizations covered the direct costs of the CBOs' license or intentionally selected platforms that provided the product free to CBOs to reduce any financial barriers (Cartier et al., 2020). Despite eliminating direct financial costs, recruiting CBOs to utilize the platforms proved to be the most reported challenge due to limited resources and the lack of incentives for CBOs. Often, the resources required to adopt a platform and sustain implementation were limited. Additionally, interviewees reported reduced capacity preventing them from conducting staff training on using the platform or developing processes for monitoring and responding to referrals (Cartier et al., 2020).

According to the key informant interviews, there was no strong correlation between technology facilitators and barriers by organizations' size or sector. However, for many of the key informant interviews, only two individuals were interviewed, therefore, the results were likely not representative of all users' experiences. This research study focused solely on exploring the experiences of early adopters in the healthcare sector, highlighting the need for future research to examine the experiences of CBOs (Cartier et al., 2020). Despite limited research on CBOs' experiences, the research study aimed to bridge the gap by thoroughly analyzing the experiences of CBOs utilizing NCCARE360 to address food insecurity in underserved populations.

Exploring Factors Influencing CBO Utilization and Integration of Technology-Facilitated Referral Platforms

There were several important components such as trust, alignment, and shared power, that were integral to implementing successful cross-sector integration efforts (Fichtenberg et al.,

2020). Perspectives from CBOs from the Duke Health COVID Support Services Program demonstrated that these organizations valued direct communication to promote trust and power sharing for effective cross-sector integration efforts (Nohria et al., 2023). Community partners involved in the co-development with healthcare providers led to increased trust and the mobilization of community assets bolstered programs and resources to address social determinants of health (Cruz et al., 2022). Moreover, these CBOs were valuable to cross-sector integrated efforts as they facilitated social support and resource navigation, demonstrating their value and access in reaching underserved populations to address unmet social needs. Despite this significant strength, these organizations often had limited capacity that hindered them in addressing and managing the changing volumes of referrals, inhibiting their ability to respond promptly or effectively scale services (Nohria et al., 2023). CBOs were often staffed by volunteers and operated with little to no consistent funding to sustain their programs and services. (McPeek Hinz et al., 2023). Thus, limited capacity and inconsistent funding for CBOs hindered their ability to manage referrals and scale services effectively.

For healthcare organizations to have successfully tracked referral outcomes, CBOs had to adopt and utilize technology-enabled referral platforms (Cartier et al., 2020). The selection and implementation of technology-facilitated referral platforms by healthcare organizations was defined by the alignment with the technology platform's vision and goals, the ability to gain user acceptance, adoption, and buy-in, the creation of workflows to address challenges and inefficiencies, and the willingness to proactively resolve legal and privacy concerns (Cartier et al., 2020). For healthcare providers, staff were involved in determining the workflow to navigate referrals based on existing processes to maximize the team's capacity (McPeek Hinz et al., 2023). CBOs were more accepting of technology platforms when healthcare organizations

established buy-in by engaging community partners in the technology platform selection process, potential benefits of the technology platform were clearly explained, and dedicated staff provided support for ongoing communication, coordination, and technical assistance for the technology platform (Cartier et al., 2020). However, this was only successful when CBOs had shared power and responsibility, enhanced collaborations, and established trust (Cartier et al., 2020). CBOs responded positively when the value of integrating medical care and social services was effectively communicated to internal partners, leaders, decision-makers, and end users. This alignment enabled them to enhance their capacity to accept, resolve, and monitor referrals more efficiently. Embedding screening and referral processes into existing standard practices, organizational workflows, and job functions was also critical for increasing adoption, efficiency, and long-term sustainability (Cartier et al., 2020; Hawkins et al., 2021). For successful integrations, healthcare providers should align platform selection with organizational goals, actively engage CBOs in the process, provide ongoing support, and embed referral processes into standard practices to promote adoption and sustainability.

Further research proved essential to understanding the appropriate strategies for building trust and promoting shared responsibility for partners across different sectors (Fichtenberg et al., 2020). Studies did not utilize qualitative approaches to collect data from CBO leaders and program staff to understand how their capacity affects resource connections and program outcomes (Nohria et al., 2023). The research study addressed this gap and used mixed-method strategies, including qualitative approaches to collect data from various perspectives within CBOs that used (or did not use) NCCARE360. Through the involvement of CBO leaders and program staff, this research study examined the impact of CBO capacity on resource connections, referral trends, and program outcomes. The findings demonstrated a comprehensive

understanding of the challenges and opportunities for integrating healthcare and social services, offering insights more effective collaboration strategies to support improved patient health outcomes.

Existing Challenges and Gaps in Cross-Sector Coordination for Health Outcomes

Due to the significant impact social and economic factors has on health, a comprehensive and collaborative approach was integral to addressing health disparities and improving health outcomes across underserved populations. In some cases, enhanced coordination, integration, and collaboration with healthcare organizations and CBOs led to improve health outcomes (Fichtenberg et al., 2020). Unfortunately, there was limited evidence to support how to operationalize cross-sector approaches to successfully coordinate and integrate public health, healthcare, and social services, address key implementation challenges, and demonstrate long-term impact.

Current research provided mixed results, where some studies demonstrated the impact of cross-sector integrated efforts through improved healthcare benefits and reduced healthcare costs while others did not (Fichtenberg et al., 2020). For example, a systematic review conducted by DeMarchis et al., 2019 reported the impacts of healthcare-based food insecurity interventions, however, the findings were inconsistent. While moderate increases were observed in patient food insecurity intervention referrals and community resource use, mixed results were reported for health behavior changes such as increased fruit and vegetable intake (DeMarchis et al., 2019). This was likely due to the increased time required to adopt and maintain new lifestyle and behavioral factors, ongoing socioeconomic barriers that persisted and hindered behavior change, and environmental factors that influenced dietary habits and limited the short-term effectiveness of interventions. Moreover, while some studies reported positive impacts, fewer studies

evaluated the long-term impacts on health and utilization outcomes (DeMarchis et al., 2019). While these efforts were less common, effective coordination and integration were necessary to address the needs of underserved individuals and families, especially those with complex health and social needs (Fichtenberg et al., 2020). Investing in these integrated efforts is essential for overcoming the barriers that hindered progress in improving health and social outcomes.

While current research emphasized the importance of coordination and integration between healthcare and CBOs to address unmet social needs and improve patient health outcomes, limited research suggested how best to implement and sustain these cross-sector approaches. As current research reported mixed results, more comprehensive studies were required to determine best practices for enhancing coordination and integration between healthcare and CBOs to improve health outcomes among underserved populations. Thus, the research study addressed these gaps by analyzing the effectiveness and sustainability of cross-sector approaches like NCCARE360 and provided insights into best practices for addressing barriers and enhancing coordination and integration between NCCARE360 and CBOs that addressed food insecurity.

Impact and Cost-Effectiveness of Cross-Sector Integration Efforts

Several studies demonstrated the positive impacts of integration efforts on improved patient health outcomes and reduced healthcare costs. One 16-year longitudinal cohort study proved that cross-sector collaborations across public health, health care, and social services, significantly reduced cardiovascular disease, diabetes, and influenza deaths, demonstrating the value of integration efforts in addressing social determinants of health (Mays et al., 2016). The results suggested that increased public health and social service investments led to improved population health. Communities with higher investments in public health, parks, and libraries

reported better health outcomes. This demonstrated the vital importance of sufficient and sustainable funding and infrastructure for cross-sector integration efforts to effectively address social determinants of health (Mays et al., 2016). To build capacity and facilitate sustainability, it was critical to engage community partners early, collaborate on system and operations development, co-create processes, partner with an experienced to manage referrals, and leverage staff at all levels to implement the platform (Cruz et al., 2022).

Additionally, recent studies using 2014 and 2017 national survey data from the Area Agencies on Aging (AAA) found that the coordination and integration of healthcare and social services through various informal partnerships significantly reduced hospital readmission rates and avoidable nursing home use compared to AAAs with fewer partnerships (Brewster et al., 2018; Brewster et al., 2019). This research study demonstrated the impact of cross-sector collaborations to reduce healthcare utilization and costs among older adults (Brewster et al., 2018; Brewster et al., 2019). Moreover, in other studies, evaluations of Medicaid-accountable health organizations were found to significantly increase early prenatal care, which led to improved equitable access to prenatal care regardless of insurance type, generated improvements in healthcare quality and care, and reduced healthcare utilization and costs (Muoto et al., 2016; McConnell et al., 2017). However, due to limited evidence supporting the long-term impact of service integration efforts, additional research was needed to recommend strategic and cost-effective integration approaches to address patients' health and social needs, decrease healthcare utilization, and reduce healthcare costs.

Based on the current literature, ongoing evaluations of cross-sector integration efforts were critical to understanding and comparing potential benefits for wider-scale implementation (Fichtenberg et al., 2020). Moreover, collaborations with state and local community partnerships

for resources such as the USDA's Special Supplemental Nutrition Assistance Program for Women, Infants, and Children (WIC) and SNAP, were critical to expanding reach and impact to effectively address social determinants of health and improving health outcomes (McPeek Hinz et al., 2023). While several studies highlighted the positive impacts and potential benefits of cross-sector integration efforts of healthcare and social services, they also revealed several gaps in evidence regarding the overall impact and cost-effectiveness of these integration efforts. The research study addressed these gaps by providing strategic insights into effective integration approaches of NCCARE360, thereby contributing essential knowledge to inform policy and practice for adoption, implementation, and sustainability.

Evaluating Successful Resource Connections in Technology-Facilitated Referral Platforms

While many studies consistently demonstrated the success of using technology-facilitated referral platforms to address patients' unmet social needs, continued research was required to evaluate the impact, such as patients' connection to community resources to address unmet social needs once referred by healthcare providers. The American Academy of Pediatrics and the American Academy of Family Physicians promoted screening and referral strategies to facilitate improved access to community resources to address unmet social needs (Tyokighir et al., 2022; Verma et al., 2024). Moreover, other professional organizations across specialties recommended routine screening for social needs, such as the National Academies of Sciences, Engineering, and Medicine (Sandhu et al., 2022). Successful strategies included utilizing screening and risk assessment tools and accountable health community models to identify social risks and address social needs among Medicare and Medicaid beneficiaries (Steeves-Reece et al., 2022; Verma et al., 2024). As of January 1, 2024, the Centers for Medicare & Medicaid Services required hospitals to screen patients for various unmet social needs including food, transportation,

housing, violence, and utilities (Johnson et al., 2024). However, as organizations designed cross-sector collaborations and interventions and evaluated their impact, it was important to define what constituted a successful resource connection to community resources once a referral was initiated. For example, if a successful resource connection addressing food insecurity involved an individual's initial contact with a food pantry via telephone or SNAP enrollment, it was imperative to define what constituted a successful resource connection to evaluate the factors that facilitated or hindered patients' timely access to resources (Steeves-Reece et al., 2022).

An evaluation of referrals and resource connections was conducted to understand Duke Health's implementation and impact of NCCARE360 across 26 counties in North Carolina. Deidentified data, service domain, and case outcomes were gathered during two periods with different funding for resources and personnel, where federal funding was provided to support the use of NCCARE360 by CBOs during period 1, but not in period 2. As a result of the effective use of the NCCARE360 platform for placing and closing referrals, the reported closed-loop rates in periods 1 and 2 were very similar (99% vs 93%). However, there were substantial differences in the success rates of connecting patients to resources between the two periods (65% vs 38%). These differences reflected the difficulty in connecting patients to resources and highlighted the association between funding and support for CBOs (Johnson et al., 2024).

While various studies and organizational recommendations advocated for screening and referral strategies to connect patients with critical community resources for addressing unmet social needs such as food insecurity, gaps remained in understanding what constituted a successful connection once referred. Through an analysis of NCCARE360's implementation and impact, the research study addressed these gaps by providing valuable insights into the factors influencing successful resource connections and the barriers hindering successful connections

once referred.

Key Factors in Enhancing Patient Access to Community Resources through Referral Systems

The availability of easily accessible critical community resources appeared to be an important factor in resource connection success, with patients having a greater chance of successfully connecting to community resources when they were referred by a healthcare provider (Lian et al., 2021). In many cases, to determine the appropriate referral to community resources, unmet social needs were assessed by healthcare providers at federally qualified health centers (FQHCs), including risks for food insecurity, housing instability, utility needs, transportation needs, and interpersonal violence (Sandhu et al., 2022). A retrospective cohort study conducted in the southeastern United States utilizing FQHC screening data from the Protocol for Responding to and Assessing Patients' Assets, Risks, and Experiences (PRAPARE) found a strong association between referral connection success and social needs based on various demographic factors. According to the study, only 33% of patients were successfully connected to one or more of their referred community resources and 66% attempted to follow up (Lian et al., 2021). Additionally, referrals to community resources accessible by telephone or drop-in visits resulted in service initiation within four weeks of the initial referral, demonstrating the importance of easy access to community resources as a key factor associated in successful connections. Moreover, a higher percentage of patients were connected when referred to internal FQHC services or community resources addressing food, transportation, or financial assistance. This underscored the importance of reducing barriers and enhancing accessible solutions when it came to addressing patients' unmet social needs (Lian et al., 2021). Furthermore, patients' access to community resources improved when solutions were geographically convenient, embedded

within a healthcare system, and provided direct pathways for service access (Lian et al., 2021; Steeves-Reece et al., 2022).

Complex applications and systems hindered patients' access to resources and their willingness to seek resources (Steeves-Reece et al., 2022). The availability and accessibility of community resources, the coordination and integration of community resources into healthcare systems, and direct access to the services all improved patients' access to community resources (Lian et al., 2021). Moreover, this study used community resource navigators to follow up by telephone with patients who received referrals to collect data on resource connection outcomes (Lian et al., 2021; Friedman & Barnegas, 2018). Community resource navigators were crucial for coordinating referrals to CBOs and following up with patients promptly to ensure timely access to social services and community resources (Emengo et al., 2020). Therefore, following up on referrals and verifying the completion of referrals was crucial in evaluating service navigation (McPeek Hinz et al., 2023). However, challenges were observed as the community resource navigators were not always in contact with the patient long enough to track the referral status to resource connection (Lian et al., 2021; Friedman & Barnegas, 2018). Other studies found follow-ups within 30 days of the resource connection increased the likelihood of successful referrals to community resources and social services (Steeves-Reece et al., 2022). However, additional research was needed to evaluate larger sample sizes among programs with and without community resource navigator programs to understand the factors that hindered patients' connection to community resources (Lian et al., 2021). Research showed that successful connection to referred services was facilitated by simplified and streamlined pathways to access community resources and direct access to immediate patient benefits (Lian et al., 2021; Hawkins et al., 2021). However, additional research was needed on patients' ability to enroll in programs

or receive services to address unmet social needs and understand patients' experiences with resource connection along the screening and referral processes (Steeves-Reece et al., 2022).

In another study, screening and referral data from an FQHC were analyzed to determine barriers to referring patients to community resources. This study involved calling participants two weeks after they had completed a social needs screening and referral intervention during a clinic visit at an FQHC. Out of the 462 patients who were contacted for follow-up, 366 reported 537 barriers in total (Sandhu et al., 2022). Based on Levesque's conceptual framework, resource availability, acceptability, and approachability were the most frequent challenges to patients' access. Patients encountered challenges when healthcare providers initiated referrals during visits, and these challenges continued once the patient tried to connect to resources (Sandhu et al., 2022). Healthcare providers often had limited knowledge and time during clinic visits to connect patients to community resources to address health and social needs. There were also instances in which healthcare providers chose not to screen and refer for social needs to effectively address patients' immediate medical needs (McPeek Hinz et al., 2023). Therefore, understanding referral status and outcome feedback were crucial to patients' safety as they shift from different providers, potentially delaying or even omitting referrals due to fragmented care (Hawkins et al., 2022). Improved workflows and communication for initial referrals to community resources, along with more timely follow-ups, were key to enhancing care coordination and preventing delays in care and services (Sandhu et al., 2022). These studies highlighted the need to rethink how healthcare and CBOs collaborated to facilitate coordinated care, supporting patients' improved health and address their unmet social needs. Furthermore, healthcare organizations could advocate for policies to reduce system-level barriers and to increase investment in health and social care resources to ensure direct and timely access to

social services and community resource connections. The continued investment in and evaluation of healthcare systems and CBOs proved essential to addressing patients' unmet social needs and overcoming barriers to care (Sandhu et al., 2022).

Examining implementation and evaluation was critical to demonstrate the impact coordinated care networks and cross-sector integration efforts had on addressing patients' unmet social needs and improving health outcomes across underserved populations. A study evaluating the use of screening for unmet social needs at Denver Health and Hospital Authority's (FQHC) Accountable Health Communities model under the Centers for Medicare and Medicaid Services identified critical components necessary to inform the expansion of referral pathways to other healthcare systems. Using the Accountable Health Communities screening tool, needs across five domains were identified, including housing, food, transportation, utilities, and safety. Over 80% of caregivers who brought their children to the Denver Health and Hospital Authority completed the screening tool, with 33% reporting more than one social need where food insecurity was the most reported concern (Gray et al., 2023). This revealed that identifying these needs and connecting patients to resources tailored to meet them was crucial for initiating patient referrals to CBOs (Gray et al., 2023). The research study identified key components required to improve referral pathways to support NCCARE360 implementation and facilitate successful connections to CBOs addressing food insecurity, ensuring patients were connected to community resources and social services to improve their overall health and well-being.

Barriers and Facilitators in Addressing Food Insecurity in Healthcare Settings

Despite the clinical evidence for food insecurity screening, individuals' needs remained unmet. Recent qualitative research examined caregivers' barriers to and facilitators for disclosing household food insecurity spanning the levels of the social-ecological model, emphasizing the

need to assess the social conditions that led to household food insecurity. At the interpersonal level, healthcare providers needed education and training to stay current on food insecurity research, including risk factors, and ways to screen for it (Verma et al., 2024). Research showed that healthcare providers did not appropriately detect adverse childhood experiences (ACEs) early and effectively connect patients with food assistance programs due to a lack of training, guidance, and support (Verma et al., 2024; Stenmark et al., 2018). According to caregiver feedback, discussing food insecurity during patient visits helped de-stigmatize it, thus facilitating a supportive environment for patients and demonstrating that food was an integral part of overall comprehensive healthcare (Barnidge et al., 2020; Verma et al. 2024). Moreover, this could be enhanced by using standardized screening questions for assessment (Hawkins et al., 2022).

Considering insights on how best to address food insecurity when a person screened positive, caregivers recommended healthcare providers initiate referrals or provide information to community resources to reduce food insecurity. The results found that caregivers were interested in their healthcare providers advocating for their needs to create a less stigmatizing healthcare system (Barnidge et al., 2020). To promote whole-person care, researchers recommended screening for social needs in healthcare settings, enabling healthcare providers to address patient needs more effectively and leverage social services, community resources, and safety net programs to improve health outcomes (McPeek Hinz et al., 2023). In addition, engaging healthcare providers in coordinated efforts could have had a significant impact on how federal food assistance programs or local organizations assist their food-insecure patients (Barnidge et al., 2020).

Another study examined the factors contributing to food insecurity among older adults through the lens of the social-ecological model. Food insecurity was predicted by race, ethnicity,

level of education, and severity of depression at the intrapersonal level of the social-ecological model. At the interpersonal, institutional, organizational, and policy levels of the social-ecological model, older adults who lacked financial security, did not have private insurance coverage, and did not participate in SNAP were more likely to suffer from food insecurity (Goldberg & Mawn, 2015). According to the study's findings, these factors were crucial to identifying underserved populations via screening and providing information and community resources to reduce food insecurity across these populations. Implementing food insecurity screening measures allowed for ongoing tracking and monitoring of food insecurity across various demographic groups (Goldberg & Mawn, 2015). This study supported cross-sector collaborations to improve access to healthcare and community resources through a coordinated approach, effectively addressing patients' health and social needs. It also highlighted the need for multi-level interventions to address food insecurity among underserved populations effectively (Verma et al., 2024). While most researchers and healthcare providers supported the value of the screening and referral approach, several barriers were noted such as time, capacity, and financial constraints, limiting the implementation and sustainability of these efforts. In recent years, to combat these challenges, the Medicare and Medicaid programs began offering incentives for healthcare providers to encourage screening to address SDOH, thereby promoting their implementation. Moreover, ongoing evaluation was recommended to establish evidence-based best practices for addressing social determinants of health, supporting sustainable cross-sector integration efforts, and promoting sustainable interventions to reduce healthcare costs and utilization and improve patient health outcomes (Verma et al., 2024).

Summary

Cross-sector integration efforts faced significant challenges due to differences in infrastructure, funding models, capacity, governance, and operations across healthcare and social service organizations. Barriers such as underfunding in public health and healthcare prevented effective partnerships, while financial sustainability remained a challenge due to differing funding models—social services relied on grants, whereas healthcare was reimbursed based on services provided. Additionally, large-scale integration costs were required to build and sustain the technology infrastructure necessary for coordination between healthcare and CBOs (Fichtenberg et al., 2020). Existing research highlighted gaps in understanding cross-sector collaboration, particularly regarding financial sustainability and the impact on CBOs. Therefore, more research was needed to identify best practices for effective integration, develop strategies for sustaining partnerships, and ensure that cross-sector efforts lead to improved health outcomes and reduced healthcare costs (Nohria et al., 2023).

Technology-facilitated referral platforms, such as NCCARE360, could enhance care coordination and connect patients to community-based resources. However, challenges such as limited healthcare provider capacity, lack of awareness and access to CBOs, and data interoperability issues have hindered widespread adoption (Gray et al., 2023). While centralized referral systems strengthened community health infrastructure and sustainability, further research was needed to evaluate their long-term impact on patient outcomes (Cartier et al., 2020; Hawkins et al., 2022). This research study assessed NCCARE360's effectiveness in addressing food insecurity by examining how the platform facilitated referrals, connected patients to resources, and ensured successful resource connections. Through a mixed-methods approach—including qualitative insights from CBO leaders and staff and analysis of aggregated referral data—this

research study identified barriers and facilitators to platform adoption. The findings provided actionable strategies to improve engagement, streamline referral processes, and enhance the platform's ability to support CBOs in addressing food insecurity among underserved populations.

Chapter 3: Methodology

Research Design

This research study utilized a mixed-methods research design, integrating quantitative and qualitative approaches to comprehensively analyze NCCARE360's effectiveness in onboarding and retaining CBOs and to understand referral trends in the Piedmont Triad Region (Alamance, Forsyth, Davidson, Guilford, and Randolph counties). The quantitative component involved analyzing aggregated referral data across the defined geographical area from the NCCARE360 platform. In contrast, the qualitative component included virtual and in person focus groups with key stakeholders, such as leaders and staff from CBOs who use NCCARE360 and some not using the platform to respond to food-related referrals.

For this research study, a CBO was defined as a nonprofit and/or local government program positioned to address local needs and challenges to improve the health and well-being of the community. Utilizing a mixed methods approach facilitated a deeper understanding of the processes, challenges, and contextual factors that contributed to the success and retention of CBOs while also measuring outcomes of referral trends such as referral success rates, referral acceptance rates, average time to close cases, and time to accept referrals. Therefore, utilizing a mixed-methods approach helped to address these gaps in the current literature and inform strategies to support advancements for strengthening cross-sector integration efforts to address social determinants of health.

Study Setting

The research study's geographical area of focus was on five counties of the Piedmont Triad Region, including Alamance, Guilford, Randolph, Forsyth, and Davidson counties. This

region was chosen due to its mix of urban and rural communities, allowing for a comprehensive analysis of NCCARE360 utilization and impact among various CBOs that addressed food insecurity. These communities had a high prevalence of food insecurity and limited access to coordinated healthcare and social services (Carolina Creative Works, 2022; Piedmont Triad Regional Food Council, 2020). Many counties in the Piedmont Triad Region did not have complete NCCARE360 coverage. Healthcare systems such as Atrium Health Wake Forest Baptist and Novant Health played an important role in connecting patients to NCCARE360 in the Piedmont Triad Region. However, limited integration created coverage gaps, preventing patients from accessing coordinated care and social services, which contributed to fragmented care and may have exacerbated existing health disparities. And despite Cone Health's utilization of NCCARE360, coverage gaps existed. Therefore, the Piedmont Triad Region proved to be an excellent model for understanding challenges and opportunities of how coordinated care networks could be expanded and strengthened across the state. The study's results highlighted the need for more effective statewide solutions for addressing health disparities, social determinants of health, and access to care across urban and rural populations.

Study participants were staff at CBOs addressing food insecurity in Randolph, Forsyth, Guilford, Davidson, and Alamance counties that had actively engaged with NCCARE360 within the past 12 months, including some registered on the platform but remained inactive. The research study included a mix of rural and urban areas, focusing on CBOs, such as food pantries, community centers, and food distribution sites. The 2016 North Carolina County Classifications and North Carolina Department of Commerce County Profiles showed that Alamance was the most urban tourism-rich county, Davidson and Randolph were rural, and Forsyth and Guilford were urban (Afonso, 2016; North Carolina Department of Commerce, 2022). To participate in

the research study, the organizations had to have actively used NCCARE360 within the last 12 months for managing referrals, coordinating services, or tracking food insecurity outcomes. Additionally, study participants included some organizations registered on the platform but remained inactive. The research study included a variety of perspectives from different levels within the CBO, including managers, coordinators, and frontline staff who offered relevant perspectives in using NCCARE360 for food-related referrals. The research study's exclusion criteria included non-CBOs, organizations addressing food insecurity and not operating within the defined geographical area, individuals less than 18 years of age, and individuals not directly involved in the CBO's food insecurity initiatives or not using NCCARE360 in their roles.

Theoretical Framework

The research study examined the multi-level factors influencing NCCARE360's implementation and effectiveness to improve resource connections to address food insecurity in the Piedmont Triad Region utilizing the resource dependence theory. This theory provided a framework on understanding how organizations manage their reliance on external resources for better decision-making and practices (Kaundinya, 2023). This theory was ideal for examining the barriers CBOs faced during onboarding that impact retention, such as managing technology, capacity, or NCCARE360 support.

According to the theory, organizations made decisions in response to levels of uncertainty and/or scarcity of resources. As a result of this theory, healthcare organizations were able to better understand how pressure impacted their organization's strategies (Pfeffer & Salancik, 1978; Tan & Litschert, 1994). CBOs facing funding and resource limitations found it challenging to address food insecurity effectively and improve their performance through NCCARE360. By examining how external dependencies, such as access to resources and

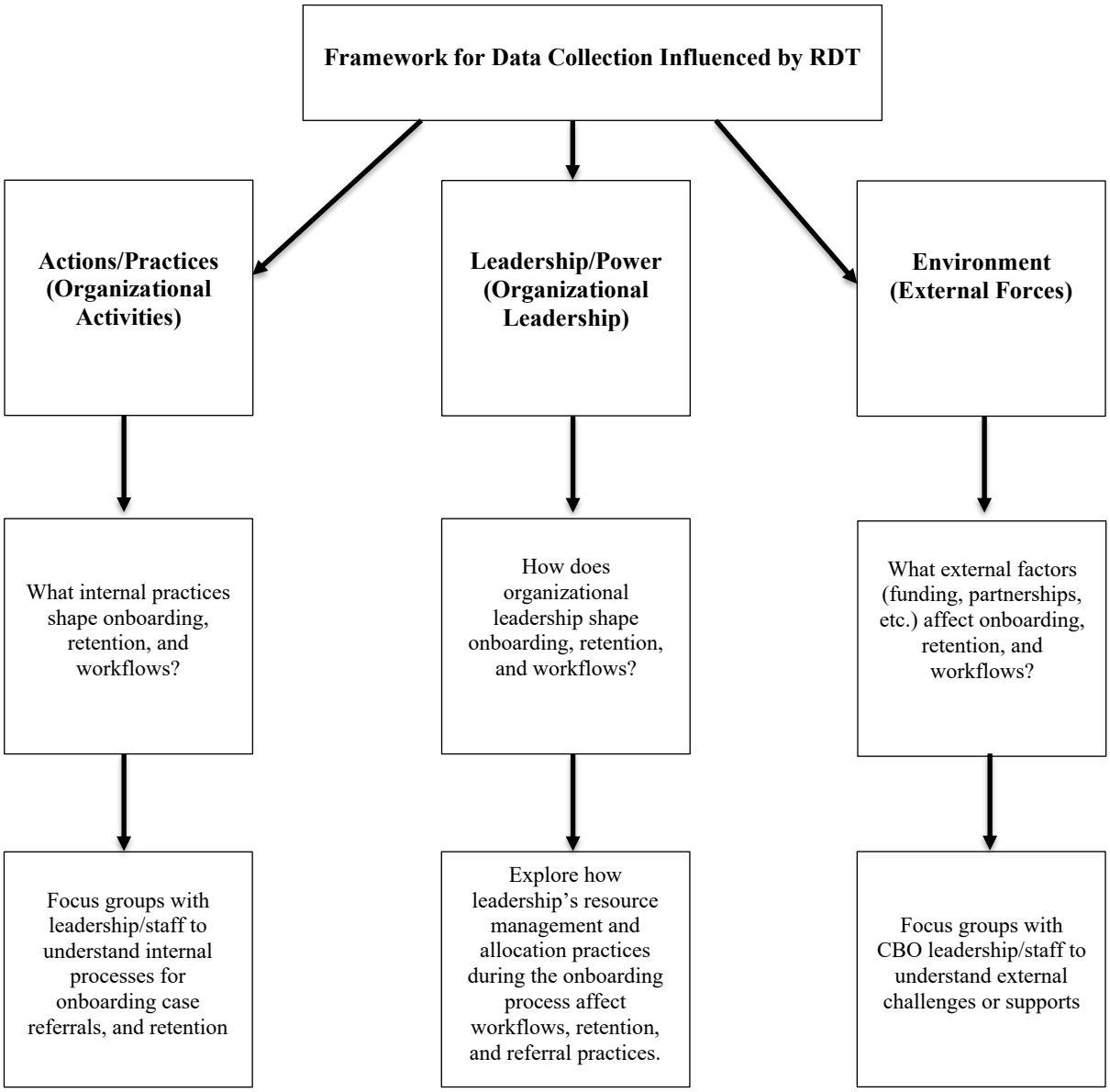
expertise, affected NCCARE360 referral management and onboarding, the study aimed to enhance CBO effectiveness.

Through the resource dependency theory, the research study:

- Explored how CBOs use NCCARE360 referral data to overcome onboarding challenges and manage food-related referrals.
- Identified factors that contribute to successful onboarding and retention through data and qualitative insights.
- Analyzed referral trends to detect service gaps and suggest improvements.

Figure 3 outlines how environmental factors, leadership practices, and organizational actions influence data collection strategies for understanding CBO onboarding, retention, and referral workflows in the NCCARE360 system.

Figure 3. Connecting Resource Dependency Theory to Data Collection Strategies for CBOs Using NCCARE360



Recruitment

In collaboration with the Foundation for Health Leadership and Innovation (FHLI), an email invitation and consent form were sent to potential CBOs meeting the inclusion criteria to share information about the research study. The research study included specific *inclusion criteria*: CBOs addressing food insecurity in Alamance, Guilford, Davidson, Forsyth, and Randolph counties, engaged with NCCARE360 for at least 12 months, or registered on the platform but not active. The research study's *exclusion criteria* were non-CBOs, or those not in the specified counties. Participants had the option to sign up for a virtual or in person focus group. Participants received an invitation with details about the focus group's purpose, format (virtual or in person), and consent requirements. They reviewed and signed a consent form outlining study objectives, data handling, and their rights. Once consent was obtained, participants selected their preferred focus group format and received confirmation with session details. Prior to the focus group, participants received a reminder with final instructions.

To ensure diverse representation across the defined geographical area, virtual focus groups were held at different times throughout the data collection period. An in person focus group was held at the NCCARE360 Fall Summit for the Piedmont Triad Region on October 10, 2024. To participate in person, inclusion criteria-eligible organizations signed up during summit registration or at the conference in person. To raise awareness and increase participation, the principal investigator participated in relevant meetings to network and recruit participants for the research study. Focus groups occurred during September, October, and November 2024 at varying times to ensure increased participation across the defined geographical area. All consent forms were obtained electronically and reviewed at the start of each session. The recruitment process was documented and tracked, including responses, follow-ups, and any issues

encountered. CBOs that did not initially respond to the invitation received follow-up emails and phone calls. Incentives were not offered for this research study. Once data collection was complete, analysis was conducted.

The research study aimed to conduct at least 8-10 focus groups or until data saturation was reached. Each focus group had no more than 8 participants. Multiple key personnel from each CBO who used NCCARE360 for food-related referrals in the defined geographical area were recruited to participate in focus groups to ensure comprehensive data collection and gather insights into the NCCARE360 onboarding and food-related referral trends.

Data Collection

The research methodology employed a mixed-methods approach to evaluate the effectiveness of NCCARE360 in successfully onboarding and retaining CBOs to connect patients to community resources to address food insecurity. The mixed-methods approach adopted in this research study combined quantitative data analysis with qualitative insights to comprehensively understand the factors facilitating the successful onboarding of CBOs onto the platform and identify the barriers hindering the process. Conducting focus groups to include diverse perspectives from NCCARE360 users identified perceived barriers and opportunities for improvement to inform action steps for improving the NCCARE360 onboarding process.

Quantitative Data Collection

Aggregated referral data (i.e., aggregated at the local CBO level) was obtained from the NCCARE360 platform, focusing on deidentified records from the Piedmont Triad Region (Alamance, Randolph, Forsyth, Guilford, and Davidson counties) in North Carolina. Key variables included referrals received, accepted, acceptance rates, resource types by each CBO

and socioeconomic data by county. Bivariate analysis and multivariate regression were used to assess referral trends and identify factors associated with successful referrals (received and accepted). The dependent variables analyzed were referral acceptance, total referrals received, and total referrals accepted, while covariates included county, CBO, referral subtype, month/year, food insecurity, food environment index, and socioeconomic index derived from socioeconomic data at the county level (poverty, unemployment, and SNAP participation rates).

Qualitative Data Collection

Focus groups were conducted with CBO staff functioning at various levels of the organization using NCCARE360 for food-related referrals. A semi-structured guide was developed to explore participants' experiences, barriers, and factors influencing referral success. Informed consent was obtained electronically and reviewed at the start of each session. Focus groups were held via video conferencing or in person, recorded for transcription and analysis, and triangulated to ensure credibility and reliability of the findings.

Ethical Considerations

All participants were provided informed consent before participation in the research study. No minors were involved in this research study. Data confidentiality was maintained by deidentifying referral records and securely storing focus group recordings and transcripts. Additionally, data provided by focus group participants was anonymous. The research study protocol was reviewed and approved by the institutional review board (IRB) to ensure ethical compliance. All key investigators completed the required IRB training to conduct research including the Collaborative Institutional Training Initiative (CITI) for Responsible Conduct of

Research - Social and Behavioral Responsible Conduct of Research Course 1 and Human Research – Social / Behavioral Research Investigators and Key Personnel.

Data Analysis

There were three specific aims of this research study, which assessed NCCARE360 engagement and onboarding processes across Guildford, Forsyth, Alamance, Davidson, and Randolph counties in the Piedmont Triad Region in North Carolina.

Quantitative Data Analysis

1. Compare and contrast CBO referral workflows for food insecurity including service types, referral acceptance rates, average time to close cases, time to accept referrals, case referral and completion rates by county, and reasons for delays in referral acceptance across counties in the Piedmont Triad Region [including Randolph, Davidson, Alamance, Guilford, and Forsyth counties] via analysis of aggregated data at the county level. This analysis compared total referrals received, accepted, acceptance rates, and types of resources referred over a 12-month period (July 1, 2023 – June 30, 2024). Descriptive statistics summarized referral outcomes, while logistic and negative binomial regression tests assessed differences and disparities in referral trends across the Piedmont Triad Region (Alamance, Randolph, Forsyth, Guilford, and Davidson counties) to inform service gaps and propose improvements.

Measurement

Outcome Variables:

1. Total Referrals Received

Definition: The total number of incoming referrals sent to the CBO for services each month.

How it is measured: The total number of referrals received by CBOs from providers each month.

2. Total Referrals Accepted

Definition: The total number of referrals reviewed and accepted each month by the CBO deemed eligible for further action

How it is measured: The number of referrals each month that met the criteria for acceptance, such as eligibility for services.

3. Referral Acceptance Rates

Definition: The percentage of referrals accepted each month by the receiving CBO out of total referrals made.

How it is measured: The acceptance rate was calculated by dividing the number of accepted referrals by the total number of referrals each month and multiplying by 100.

Covariates:

1. Service Subtypes

Definition: The count and categorization of the different types of food services referred each month to understand distribution patterns based on referral status and CBO.

How it is measured: Services were categorized based on their type (food pantry, emergency food, etc.) using the NCCARE360 platform data and counted.

2. County

Definition: The geographical region where the CBO operated (Alamance, Guilford, Forsyth, Davidson, and Randolph)

How it is measured: County data was recorded from the NCCARE360 platform, identifying the region of service.

3. CBO Name

Definition: The name of the CBO providing services, used to track specific organization participation and outcomes.

How it is measured: CBO names were deidentified and recorded based on the organization listed in the NCCARE360 platform.

4. Food Insecurity

Definition: The proportion of individuals in each county who experienced a lack of consistent access to enough food.

How it is measured: County-level data on food insecurity rates was pulled from the County Health Rankings and Roadmaps (2023).

5. Food Environment Index

Definition: A measure that combined factors like food access, availability, and affordability within a county.

How it is measured: County-level data on food insecurity rates was pulled from the County Health Rankings and Roadmaps (2023).

6. Poverty Rate

Definition: The reported percentage of individuals who lived below the federal poverty line within a county.

How it is measured: County-level data on poverty rates was sourced from the U.S. Census Bureau (2024) and NC Budget & Tax Center (2024).

7. Unemployment Rate

Definition: The reported percentage of individuals within a county who were unemployed and seeking work.

How it is measured: County-level data on unemployment rates was sourced from the Data Commons (2023) and NC Budget & Tax Center (2024).

8. SNAP Participation Rate

Definition: The reported percentage of individuals within a county who were receiving SNAP benefits.

How it is measured: County-level data on SNAP participation rates was sourced from the NC Budget & Tax Center (2024).

9. Month/Year

Definition: The time period during which data on referrals and services was collected.

How it is measured: Referral data was reported monthly over a 12-month period based on NCCARE360 platform data. Each referral was categorized by month and service type from July 1, 2023 – June 30, 2024.

10. Socioeconomic index

Definition: A composite index was created to include poverty, unemployment, and SNAP participation rates

How it is measured: Poverty strongly correlated with both SNAP participation ($r=0.796$, $p<0.01$) and unemployment ($r=0.757$, $p<0.01$), while unemployment and SNAP participation were highly correlated ($r=0.990$, $p<0.01$). Given these strong correlations, multicollinearity was a concern, so SNAP, unemployment, and poverty were combined into a composite index to reduce redundancy. The socioeconomic index was used in all analyses, except in the correlation analysis, where poverty, unemployment, and SNAP participation rates were analyzed separately.

Statistical Tests

Descriptive statistics summarized the total number of referrals received and accepted, and the acceptance rate across counties and CBOs, along with county-level socioeconomic factors, using means, standard deviations, and frequencies.

1. Referrals:

    - Total Referrals Received
    - Total Referrals Accepted
    - Referral Acceptance Rate

2. County-Level Socioeconomic Factors:

    - Food Insecurity Rate
    - Food Environment Index
    - Poverty Rate
    - Unemployment
    - SNAP participation rates

Bivariate analysis explored relationships between various variables:

1. Crosstabulation of Service Subtype and County:

    - Purpose: Examined how service subtypes (food pantry, emergency food, etc.) vary across counties.
    - Test: Chi-square test of independence assessed whether the distribution of service subtypes differed significantly across counties.
    - Variables: Service Subtypes and county.

2. Correlation Analysis:

- Purpose: Explored relationships between outcome variables and covariates (e.g., referrals, acceptance rates, socioeconomic factors).
- Test: Spearman correlation was used to examine the strength and direction of relationships between:
- Outcome Variables: Total referrals received, total referrals accepted, referral acceptance rate.
- Covariates: Food insecurity, food environment index, poverty, unemployment, SNAP participation rates, and county.

Multivariate analysis assessed relationships between multiple independent variables and outcomes:

1. Kruskal-Wallis Test

- Purpose: Compared referral acceptance rates across different CBOs and counties.
- Test: The Kruskal-Wallis test assessed whether there were statistically significant differences in acceptance rates across CBOs or counties.
- Variables: Referral acceptance rate, socioeconomic index, CBO, and county.

2. Negative Binomial Regression

- Purpose: Modeled the total number of referrals received and referrals accepted, accounting for the effects of county and service subtype.
- Test: Negative binomial regression analyzed the count data for total referrals received and accepted while controlling for county and service subtypes.
- Variables: total referrals received, total referrals accepted, county, socioeconomic index, and service subtypes

3. Logistic Regression

- Purpose: Modeled the likelihood of referral acceptance versus no referrals, based on service subtype, CBO, and socioeconomic factors.
- Test: Logistic regression assessed the odds of a referral being accepted.
- Variables: The outcome variable was referral acceptance (binary: accepted or zero referrals), and socioeconomic index.

4. Negative Binomial Regression

- Purpose: Modeled the number of referrals accepted (for non-zero counts), considering the effects of CBO and service subtypes.
- Test: Negative binomial regression was used to predict the count of accepted referrals for organizations that had non-zero counts.
- Variables: The outcome variable was non-zero accepted referrals, with covariates including CBO and service subtypes.

5. Trend Analysis

- Purpose: Examined the trend in the number of referrals received and the total number of referrals accepted over a 12-month period. County-level trends in referrals accepted and acceptance rates were also analyzed to identify variations across counties.
- Test: Time series analysis assessed the trend of referrals received, referrals accepted, and acceptance rates for each county over time.
- Variables: Total referrals received, total referrals accepted, referral acceptance rate, county, and month/year

Qualitative Data Analysis

2a. Identify the factors contributing to the successful onboarding of CBOs onto the NCCARE360 platform from various perspectives and users at the organizational level. This assessed and identified the motivations and facilitators for CBOs to stay on the platform and determined the challenges that led them to discontinue using the platform. This data enhanced the knowledge and understanding of how food insecurity was managed from a case management perspective across various CBOs and helped identify current referral methods used by these organizations, which can be coordinated with NCCARE360. This aim was explored through qualitative focus groups with CBO staff to understand the facilitators of successful onboarding on the NCCARE360 platform. Thematic coding and bivariate analysis were used to identify common barriers, motivations, and factors influencing onboarding and retention.

2b. Identify the factors contributing to the retention of CBOs on the NCCARE360 platform. Further analysis determined the challenges that led CBOs to discontinue using the platform and assess the motivations and facilitators for CBOs to stay on the platform. This data improved the knowledge and understanding of how food insecurity was managed from a case management perspective across various CBOs, ensuring the platform remains a valuable tool for these organizations. This aim was explored through qualitative focus groups with CBO staff to understand the facilitators of successful retention of NCCARE360. Thematic coding and bivariate analysis were used to identify common barriers, motivations, and factors influencing onboarding and retention.

3. Characterize the challenges hindering the onboarding of CBOs addressing food insecurity onto the NCCARE360 platform as reported by CBO leadership and staff. Further analysis revealed the barriers faced by CBOs during the onboarding process, identifying key stakeholders and

resources required to improve onboarding and understand how food referrals were managed outside the platform. This aim was addressed through qualitative focus groups with CBO staff to gather in-depth insights into the specific administrative and capacity challenges they encountered. Data analysis included thematic coding to identify common barriers and actionable recommendations for improving the onboarding process.

All focus groups were recorded and transcribed via Microsoft Teams, ensuring accurate capture of verbal interactions. The transcripts were reviewed for accuracy, anonymized to protect participant privacy, and then coded using NVivo software. Coding was guided by a preliminary coding framework based on the research questions and an initial reading of the transcripts. As new themes emerged during the coding process, the framework was refined iteratively. A thematic analysis was conducted to identify common themes, success factors, and barriers related to referral processes. Using content analysis, themes, patterns, and keywords discovered in focus group transcripts were categorized and quantified. By identifying and counting specific topics, such as referral barriers and success factors, and comparing their occurrence across focus groups, a quantitative analysis of key issues and patterns was provided. Key points were illustrated by detailed descriptions and illustrative quotes. Qualitative findings were triangulated with quantitative results to provide a comprehensive understanding of the factors that influenced successful referrals and resource connections through NCCARE360, ultimately guiding recommendations for improving the platform's efficiency in addressing food insecurity (Tyokighir et al., 2022).

Measurement

Qualitative analysis focused on key themes related to CBO onboarding and engagement with NCCARE360. Monthly referral data from NCCARE360 referral records (July 1, 2023 –

June 30, 2024) were reviewed and focus groups with CBO staff provided qualitative insights. NVivo was used to code and analyze qualitative data related to perceived benefits and challenges, reoccurring themes, perceived benefits.

The following qualitative measures were used:

- **Successful onboarding** referred to CBOs completing the registration process and accepting at least one referral through the platform within the first three months.
- **Successful retention** was defined as CBOs maintaining a consistent referral activity (at least one accepted referral per month) for a minimum of one year.
- **Active organizations** included CBOs signed up on NCCARE360 and had accepted at least one referral through the platform in the last 12 months.
- **Inactive organizations** were CBOs signed up on NCCARE360 and had not accepted at least one referral through the platform in the last 12 months.
- **Usage and motivation** assessed the duration of NCCARE360 use and reasons for initial sign-up and continued engagement.
- **Perceptions and impact** captured views on NCCARE360, its benefits, and its impact on CBO operations and services.
- **Challenges and satisfaction** explored barriers encountered while using NCCARE360, as well as satisfaction with data quality and platform functionality.
- **Staff engagement** examined the level of staff involvement in NCCARE360 use, including any resistance or reluctance.
- **Training and support** needs were assessed based on feedback regarding areas where additional training or platform improvements were needed.

- **Onboarding and incentives** explored suggestions for improving onboarding processes and potential incentives to encourage active participation.

Limitations

Potential limitations in the research study included the quality and completeness of referral data. Ongoing collaboration with FHLI assisted with addressing data validation and integrity verification throughout the research study period. In addition, the research study provided recommendations for future research using NCCARE360 to test whether the research study's findings could be generalized to other counties or regions in North Carolina.

Generalizing the findings to other regions or technology-based platforms was challenging due to regional differences in healthcare infrastructure and community resources, limiting the applicability of these results to other counties or similar platforms across North Carolina. Selection bias may have occurred if certain types of CBOs or individuals were more inclined or able to participate in focus groups during data collection. This could have influenced responses and impacted the qualitative data gathered. To reduce selection and response bias, recruitment focused on a diverse sample, including a wide scope of CBOs, ensuring representation from both urban and rural areas within the defined counties, and engaging with CBOs with varying levels of experience (at least 12 months) and NCCARE360 involvement. These limitations could have skewed the findings and limited the generalizability of the results to the broader population of CBOs using NCCARE360 to address social determinants of health across the Piedmont Triad Region or other regions.

Participants were assured anonymity and confidentiality. Additionally, triangulation was used to validate themes, insights, and trends, further addressing response bias.

Summary

The methodology evaluated NCCARE360's effectiveness in connecting patients to community resources to address food insecurity. By employing a mixed-methods approach, the research study provided a comprehensive understanding of the factors influencing referral success and barriers, guiding future improvements in cross-sector collaborations and interventions to effectively address food insecurity.

Chapter 4: Results

This research study identified themes and findings that explored the successes and barriers influencing CBO utilization of NCCARE360 and referral patterns. Data collected during the research study included interview data from focus groups and monthly aggregated referral data across select CBOs in Alamance, Davidson, Guilford, Randolph, and Forsyth counties. This analysis aimed to answer the following research objectives including qualitative and quantitative data analysis: 1) characterize the challenges hindering the onboarding of CBOs addressing food insecurity onto the NCCARE360 platform as reported by CBO leadership and staff. 2a) Identify the factors contributing to the successful onboarding of CBOs onto the NCCARE360 platform from various perspectives and users at the organizational level. 2b) Identify the factors contributing to the retention of CBOs on the NCCARE360 platform. 3) Compare and contrast CBO referral workflows for food insecurity including service types, referral acceptance rates, average time to close cases, time to accept referrals, case referral and completion rates by county, and reasons for delays in referral acceptance across counties in the Piedmont Triad Region (including Randolph, Davidson, Alamance, Guilford, and Forsyth counties) via analysis of aggregated data at the county level.

Quantitative analysis

Various statistical tests were used to conduct quantitative analysis to accommodate overdispersion and zero-inflation in the data. The selected statistical tests identified trends in referral acceptance across counties in the Piedmont Triad Region, including Randolph, Davidson, Alamance, Guilford, and Forsyth counties, based on service types, referral acceptance rates, and socioeconomic factors (poverty, SNAP, and unemployment). They also provided

insights into referral activity within the 12-month period across the defined geographical area. The statistical tests aimed to address excess zeros in the data, examine relationships between predictors and the count of referrals accepted and received, and assess group-level differences that might not be apparent due to overdispersion in the data.

Descriptive Statistics

Table 3 provided descriptive statistics for various continuous variables related to referrals and county-level socioeconomic factors across 1,260 observations. Socioeconomic data was obtained from the U.S. Census Bureau (2024), Data Commons (2023), County Health Rankings and Roadmaps (2023), and the NC Budget & Tax Center (2024). The total number of referrals received across different counties in the region ranged from 0 to 40, averaging 0.78 (SD = 3.20). The total number of referrals accepted ranged from 0 to 14, averaging 0.32 (SD = 1.46). Across the data, acceptance rates varied from 0% to 100%, averaging 4.48% (SD = 17.96). The food environment index scores spanned from 6.70 to 7.40, averaging 7.04 (SD = 0.24). The food insecurity rate ranged from 13.0 to 14.0, averaging 13.20 (SD = 0.40). The poverty rate varied from 12.50% to 15.50%, averaging 13.98% (SD = 1.09). The unemployment rate spanned from 3.00% to 3.60%, averaging 3.25% (SD = 0.22). The SNAP participation rate spanned from 13.0% to 16.0%, averaging 14.73% (SD = 1.06). Based on the data, there were wide variations in referral outcomes and county-level socioeconomic indicators across the sample.

Table 3. Descriptive Statistics for Referrals and County-Level Socioeconomic Factors

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
Total Referrals Received	1260	0	40	0.7754	3.20214
Total Referrals Accepted	1260	0	14	0.3214	1.46465

Acceptance Rate	1260	0	100	4.4759	17.95681
Food Environment Index	1260	6.7	7.4	7.0403	0.24471
Food insecurity	1260	13	14	13.2	0.40016
Poverty Rate	1260	12.5	15.5	13.9752	1.09441
Unemployment Rate	1260	3	3.6	3.2537	0.22197
SNAP participation rate	1260	13	16	14.7349	1.06331
Valid N (listwise)	1260				

Rockefeller Harris, L., & Hodges-Copple, S. (2024), U.S. Census Bureau (2024), Data Commons. (2023), and County Health Rankings & Roadmaps (2023)

Bivariate Analysis

Chi-Square Test of Independence to Examine How Service Subtypes Vary Across Counties

Variations in referrals by service subtype were revealed in the crosstabulation for Alamance, Davidson, Forsyth, Guilford, and Randolph counties. The total number of referrals was 1,260, with activity varying across each county. There were seven different service subtypes, and each had a total of 180 referrals evenly distributed across all counties. Since each CBO offered the same seven service subtypes, each service subtype was reported by every CBO each month. Alamance County had the highest total number of referrals (n=419, 33.3%), while Randolph County had the lowest (n=84, 6.7%). For all service subtypes, Alamance County had the most referrals (n=59-60), while Randolph County has the fewest (n=12).

Table 4. Crosstabulation for Referrals by Service Subtypes and County

Service Subtype * County Crosstabulation	County	Total						
			Alamance	Davidson	Forsyth	Guilford	Randolph	Total
Service Subtype	Emergency Food	Count	59	24	36	49	12	180

		% of Total	4.70%	1.90%	2.90%	3.90%	1.00%	14.30%
	Food Pantry	Count	60	24	36	48	12	180
		% of Total	4.80%	1.90%	2.90%	3.80%	1.00%	14.30%
	Infant Formula/Food	Count	60	24	36	48	12	180
		% of Total	4.80%	1.90%	2.90%	3.80%	1.00%	14.30%
	Medically Tailored Meals	Count	60	24	36	48	12	180
		% of Total	4.80%	1.90%	2.90%	3.80%	1.00%	14.30%
	Prepared Meals	Count	60	24	36	48	12	180
		% of Total	4.80%	1.90%	2.90%	3.80%	1.00%	14.30%
	Produce Prescription/Voucher	Count	60	24	36	48	12	180
		% of Total	4.80%	1.90%	2.90%	3.80%	1.00%	14.30%
	SNAP/WIC/Other Nutrition Benefits	Count	60	24	36	48	12	180
		% of Total	4.80%	1.90%	2.90%	3.80%	1.00%	14.30%
Total	Count		419	168	252	337	84	1260
	% of Total		33.30%	13.30%	20.00%	26.70%	6.70%	100.00%

Correlation Analysis to Identify Relationships Between Referral Metrics and Socioeconomic Factors

Correlation analysis was conducted to measure the strength and direction of the relationship between the continuous variables. Because the data was not normally distributed, the Spearman's rho correlation was used for analysis.

There was a significant positive relationship between the total referrals received and total referrals accepted ($r=0.807$, $p<0.01$), therefore indicating as the number of referrals received increased, the number of accepted referrals also increased. The correlation analysis revealed no significant relationship between the food environment index and the total referrals received (r=-

0.015, p = 0.592). Similarly, there was no significant relationship between food insecurity and the total referrals received (r = 0.005, p = 0.868).

Referral acceptance rate had weak negative correlations with food insecurity (r=-0.114, p<0.01), poverty (r=-0.231, p<0.01), unemployment (r=-0.113, p<0.01), and SNAP participation (r=-0.117; p<0.01). Poverty had a strong positive correlation with both SNAP participation rates (r=0.796, p<0.01) and unemployment (r=0.757, p<0.01), showing that higher poverty rates were associated with higher SNAP participation and higher unemployment rates. Food insecurity had a positive correlation with poverty (r=0.165, p<0.01) and a negative correlation with unemployment (r=-0.399, p<0.01) and SNAP participation (r=-0.322; p<0.01). Similarly, unemployment had a strong positive correlation with SNAP participation rates (r=0.990, p<0.01). All these variables were highly correlated, which could lead to multicollinearity issues.

Table 5. Spearman's Rho Correlation Between Total Referrals Received, Total Referrals Accepted, and Food Environment Index

			Total Referrals Received	Total Referrals Accepted	Food Environment Index
Spearman's rho	Total Referrals Received	Correlation Coefficient	1	.807**	-0.015
		Sig. (2-tailed)	.	<.001	0.592
		N	1260	1260	1260
	Total Referrals Accepted	Correlation Coefficient	.807**	1	0.03
		Sig. (2-tailed)	<.001	.	0.279
		N	1260	1260	1260
	Food Environment Index	Correlation Coefficient	-0.015	0.03	1
		Sig. (2-tailed)	0.592	0.279	.
		N	1260	1260	1260

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6. Spearman's Rho Correlation Between Acceptance Rate and County-Level Socioeconomic Factors

			Acceptance rate	Food insecurity	Poverty	Unemployment	SNAP
Spearman's rho	Acceptancerate	Correlation Coefficient	1	-.114**	-.231**	-.113**	-.117**
		Sig. (2-tailed)	.	<.001	<.001	<.001	<.001
		N	1260	1260	1260	1260	1260
	Food insecurity	Correlation Coefficient	-.114**	1	.165**	-.399**	-.322**
		Sig. (2-tailed)	<.001	.	<.001	<.001	<.001
		N	1260	1260	1260	1260	1260
	Poverty	Correlation Coefficient	-.231**	.165**	1	.757**	.796**
		Sig. (2-tailed)	<.001	<.001	.	<.001	<.001
		N	1260	1260	1260	1260	1260
	Unemployment	Correlation Coefficient	-.113**	-.399**	.757**	1	.990**
		Sig. (2-tailed)	<.001	<.001	<.001	.	<.001
		N	1260	1260	1260	1260	1260
	SNAP	Correlation Coefficient	-.117**	-.322**	.796**	.990**	1
		Sig. (2-tailed)	<.001	<.001	<.001	<.001	.
		N	1260	1260	1260	1260	1260

**. Correlation is significant at the 0.01 level (2-tailed).

Multivariate analysis

Acceptance Rates Across CBOs Using the Kruskal-Wallis Test

The Levene's test indicated a violation of the assumption of homogeneity of variances, while tests for normality, linearity, and independence of errors revealed significant deviations from the assumptions of normality and linearity. Since variance was not homogenous, traditional ANOVA methods were not used. Kruskal-Wallis was used to compare distributions across

multiple groups to determine if statistically significant differences existed. The p-values were adjusted using the Bonferroni correction to ensure multiple comparisons were accounted for. Based on the Kruskal-Wallis test results, the test statistic across acceptance rates and CBOs was <0.001, illustrating there was a significant difference in acceptance rates across the different CBOs. There were pairs showing significant and non-significant differences compared to others. Several pairwise comparisons showed significant differences between acceptance rates across CBO (p-value < 0.05), especially between:

- Organization D (Forsyth County) vs. Organization A (Alamance County)
- Organization D (Forsyth County) vs. Organization L (Alamance County)
- Organization E (Guilford County) vs. Organization L (Alamance County)
- Organization E (Guilford County) vs. Organization A (Alamance County)
- Organization H (Forsyth County) vs. Organization L (Alamance County)
- Organization H (Forsyth County) vs. Organization A (Alamance County)
- Organization G (Forsyth County) vs. Organization A (Alamance County)
- Organization G (Forsyth County) Organization L (Alamance County)
- Organization M (Alamance County) vs. Organization L (Alamance County)
- Organization M (Alamance County) vs. Organization A (Alamance County)
- Organization N (Davidson) vs. Organization L (Alamance County)
- Organization N (Davidson) vs. Organization A (Alamance County)
- Organization O (Guilford County) vs. Organization A (Alamance County)
- Organization O (Guilford County) vs. Organization L (Alamance County)
- Organization P (Guilford County) vs. Organization L (Alamance County)
- Organization P (Guilford County) vs. Organization A (Alamance County)

- Organization Q (Randolph) vs. Organization A (Alamance County)
- Organization Q (Randolph) vs. Organization L (Alamance County)

Many comparisons did not show significant differences between acceptance rates across CBOs (p-value > 0.05), especially between:

- Organization A (Alamance County) vs. Organization L (Alamance County)
- Organization D (Forsyth County) vs. Organization E (Guilford County)
- Organization D (Forsyth County) vs. Organization P (Guilford County)
- Organization D (Forsyth County) vs. Organization O (Guilford County)
- Organization D (Forsyth County) vs. Organization H (Forsyth County)
- Organization E (Guilford County) vs. Organization P (Guilford County)
- Organization E (Guilford County) vs. Organization H (Forsyth County)
- Organization E (Guilford County) vs. Organization O (Guilford County)
- Organization H (Alamance County) vs. Organization P (Guilford County)
- Organization H (Forsyth County) vs. Organization O (Guilford County)
- Organization I (Alamance County) vs. Organization F (Alamance County)
- Organization K (Alamance County) vs. Organization J (Guilford County)
- Organization M (Alamance County) vs. Organization G (Forsyth County)
- Organization N (Forsyth County) vs. Organization Q (Randolph)
- Organization N (Forsyth County) vs. Organization M (Alamance County)
- Organization O (Guilford County) vs. Organization P (Guilford County)

In comparison to other organizations, large organizations such as Organization D (Forsyth County), Organization H (Forsyth County), Organization P (Guilford County), and Organization Q (Randolph County), small organizations like Organization E (Guilford County),

Organization M (Alamance County), Organization N (Davidson County), and Organization O (Guilford County), and medium-sized Organization G (Forsyth County) exhibited the most significant differences in acceptance rates ($p < 0.05$). On the other hand, there were several organizations that show no significant difference ($p > 0.05$) in acceptance rates when compared with others. Most comparisons demonstrated significant differences between specific organizations in terms of acceptance rate, but some comparisons did not show a meaningful difference, which indicated similar acceptance rates between these organizations. For example, no significant differences were observed between pairs from Guilford County, such as Organization O vs. Organization P and Organization E vs. Organization P.

Acceptance Rates Across Counties Using the Kruskal-Wallis Test

Similarly, the test statistic across acceptance rates and counties was <0.001, suggesting there was a significant difference in acceptance rates across the different counties. There were significant differences in the comparisons of acceptance rates between Alamance and all other counties (Randolph, Davidson, Forsyth, and Guilford). However, there are no significant differences between the counties in other pairwise comparisons.

1. Several pairwise comparisons showed significant differences between acceptance rates across counties (p-value < 0.05), especially between:
    - Randolph County vs. Alamance County
    - Davidson County vs. Alamance County
    - Forsyth County vs. Alamance County
    - Guilford County vs. Alamance County

2. Several pairwise comparisons showed no significant differences between acceptance rates across counties (p-value > 0.05), especially between:

- Randolph County vs. Davidson County
- Randolph County vs. Forsyth County
- Randolph County vs. Guilford County
- Davidson County vs. Forsyth County
- Davidson County vs. Guilford County
- Forsyth County vs. Guilford County

In summary, Alamance County showed significant differences in acceptance rates relative to other counties, but most other county comparisons showed no significant differences.

Negative Binomial Regression

Count data were analyzed using a negative binomial regression model and a Poisson log link function. This model assessed overall trends of the total referrals received and provided further understanding on which service subtypes were associated with more or fewer referrals. Due to observed multicollinearity between county and socioeconomic index ($r=0.829$, $p< 0.001$), the county variable was removed from the model. The data suggested a reasonable goodness of fit for the model with the deviance (3019.140, value/df = 2.411). The pearson chi-square statistic (8673.222, value/df = 6.927), revealed overdispersion in the data as predicted. The omnibus test revealed the likelihood ratio chi-square is 2007.090 and was statistically significant ($p <.001$), suggesting the predictors (service subtypes and socioeconomic index) contributed to explaining the variation of total referrals received. Based on the test of model effects, service subtype (289.296, $p < .001$) and socioeconomic index (poverty, SNAP, and unemployment, 359.287, $p < .001$) were significant predictors of the total referrals received. Therefore, the type of service provided, particularly emergency food, food pantry, and prepared meals, and socioeconomic factors significantly influenced the number of referrals received by CBOs.

The model's parameter estimates provided insights into the predictors and their influences on referrals received. The model provided a statistically significant ($p < .001$) intercept of -1.583, indicating that referrals were low in the absence of service subtypes and socioeconomic factors. This represented the baseline number of the total referrals received for the reference category of service subtype and when the socioeconomic index equals zero. For the service subtypes, the coefficients for emergency food ($\beta = 1.920$), food pantry ($\beta = 2.125$), and prepared meals ($\beta = 1.105$) were statistically significant ($p < .001$) and had referrals higher than the reference category (SNAP/WIC/Other Nutrition Benefits). The service subtypes infant formula/food, medically tailored, and produce prescription/voucher had coefficients of -32.081 and showed no estimates due to absence of referrals received for these services. Additionally, there was a statistically significant relationship between the total referrals received and socioeconomic index ($\beta = -0.946$). Thus, there was an inverse association between the total of referrals received and socioeconomic index.

Table 7. Omnibus Test for Model Fit for Referrals Received

Omnibus Test[a]		
Likelihood Ratio Chi-Square	df	Sig.
2007.09	7	<.001

Dependent Variable: ReferralsReceived_sum
Model: (Intercept), Service Subtype, Socioeconomicindex[a]
a. Compares the fitted model against the intercept-only model.

Table 8. Goodness of Fit and Model Information Criteria (Referrals Received)

Goodness of Fit[a]	Value	df	Value/df
Deviance	3019.14	1252	2.411
Scaled Deviance	3019.14	1252	
Pearson Chi-Square	8673.222	1252	6.927
Scaled Pearson Chi-Square	8673.222	1252	
Log Likelihoodb	-1755.384		

Akaike's Information Criterion (AIC)	3526.769		
Finite Sample Corrected AIC (AICC)	3526.884		
Bayesian Information Criterion (BIC)	3567.879		
Consistent AIC (CAIC)	3575.879		

Dependent Variable: ReferralsReceived_sum
Model: (Intercept), Service Subtype, Socioeconomicindex[a]
a. Information criteria are in smaller-is-better form
b. The full log likelihood function is displayed and used in computing information criteria.

Table 9. Tests of Model Effects for Referrals Received (Type III)

	Type III		
Tests of Model Effects	Wald Chi-Square	df	Sig.
(Intercept)	30.36	1	<.001
Service Subtype	289.296	3	<.001
Socioeconomic index	359.287	1	<.001

Dependent Variable: ReferralsReceived_sum
Model: (Intercept), Service Subtype, Socioeconomicindex

Table 10. Parameter Estimates for Predictors of Referrals Received

			95% Wald Confidence Interval		Hypothesis Test		
Parameter Estimates	B	Std. Error	Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-1.583	0.1433	-1.864	-1.302	122.076	1	<.001
[Service Subtype=Emergency Food]	1.92	0.15	1.626	2.214	163.784	1	<.001
[Service Subtype=Food Pantry]	2.125	0.1482	1.835	2.415	205.717	1	<.001
[Service Subtype=Infant Formula/Food]	-32.081a	.	.	.	.	.	.
[Service Subtype=Medically Tailored Meals]	-32.081a	.	.	.	.	.	.
[Service Subtype=Prepared Meals]	1.105	0.1616	0.788	1.422	46.791	1	<.001
[Service Subtype=Produce Prescription/Voucher]	-32.081a	.	.	.	.	.	.
[Service Subtype=SNAP/WIC/Other Nutrition Benefits]	0b	.	.	.	.	.	.
Socioeconomic index	-0.946	0.0499	-1.044	-0.849	359.287	1	<.001

(Scale)	1c						

Dependent Variable: ReferralsReceived_sum
Model: (Intercept), Service Subtype, Socioeconomicindex
a. Hessian matrix singularity is caused by this parameter. The parameter estimate at the last iteration is displayed.
b. Set to zero because this parameter is redundant.
c. Fixed at the displayed value

An examination of the total referrals that were accepted along with the ways in which different service subtypes and socioeconomic factors were related to the likelihood that a referral led to a follow-up was examined in this model using a negative binomial regression model and a Poisson log link function. It also revealed which service subtypes were likely to be acted upon once referred. Due to observed multicollinearity between county and socioeconomic index ($r=0.829$, $p< 0.001$), the county variable was removed from the model. The data suggested a reasonable goodness of fit for the model with the deviance (1707.094, value/df = 1.363). This model fitted the data better with a better goodness of fit statistic and lower deviance and AIC. The pearson chi-square statistic (4858.432, value/df = 3.881), revealed some overdispersion in the data as predicted. The omnibus test revealed the likelihood ratio chi-square (622.675) was statistically significant ($p <.001$), confirming the predictors (service subtypes and socioeconomic index) contributed to explaining the variation of total referrals accepted. Based on the test of model effects, service subtype (56.567, $p < .001$) and socioeconomic index (poverty, SNAP, and unemployment, 80.464, $p < .001$) were significant predictors of the total referrals accepted. Therefore, the type of service provided, particularly emergency food, food pantry, and prepared meals, and socioeconomic factors significantly influenced the number of referrals accepted by CBOs. However, the previous model revealed that service subtype may have had a greater impact on referrals received than accepted.

The model's parameter estimates provided insight into the predictors and their influences on the total referrals accepted. The model provided a statistically significant ($p <.001$) intercept of -1.765, indicating that referrals were low in the absence of service subtypes and

socioeconomic factors. This represented the baseline number of the total referrals accepted for the reference category of service subtype and when the socioeconomic index equals zero. For the service subtypes, the coefficients for emergency food (β=1.195), food pantry (β=1.414), and prepared meals (β=1.154) were statistically significant (p <.001) and had referrals higher than the reference category (SNAP/WIC/Other Nutrition Benefits). The service subtypes infant formula/food, medically tailored, and produce prescription/voucher had coefficients of -31.513 and showed no estimates due to absence of referrals accepted for these services. Additionally, there was a statistically significant relationship between the total referrals accepted and socioeconomic index (β=-0.573). Thus, there was an inverse association between the total of referrals accepted and socioeconomic index. The results suggested that some service subtypes were more effective at generating referrals than others, and that socioeconomic factors played an important role in the total referrals accepted.

Table 11. Omnibus Test of Model Fit for Referrals Accepted

Omnibus Test[a]		
Likelihood Ratio Chi-Square	df	Sig.
622.675	7	<.001

Dependent Variable: ReferralsAccepted_sum
Model: (Intercept), Service Subtype, Socioeconomicindex[a]
a. Compares the fitted model against the intercept-only model.

Table 12. Goodness of Fit and Model Information Criteria (Referrals Accepted)

Goodness of Fit[a]	Value	df	Value/df
Deviance	1707.094	1252	1.363
Scaled Deviance	1707.094	1252	
Pearson Chi-Square	4858.432	1252	3.881
Scaled Pearson Chi-Square	4858.432	1252	
Log Likelihoodb	-997.749		
Akaike's Information Criterion (AIC)	2011.497		
Finite Sample Corrected AIC (AICC)	2011.612		
Bayesian Information Criterion (BIC)	2052.608		

Consistent AIC (CAIC)	2060.608		

Dependent Variable: ReferralsAccepted_sum
Model: (Intercept), Service Subtype, Socioeconomicindex[a]
a. Information criteria are in smaller-is-better form.
b. The full log likelihood function is displayed and used in computing information criteria.

Table 13. Tests of Model Effects (Type III): Predictors of Referrals Accepted

	Type III		
Tests of Model Effects	Wald Chi-Square	df	Sig.
(Intercept)	167.9	1	<.001
Service Subtype	56.567	3	<.001
Socioeconomic index	80.464	1	<.001

Dependent Variable: ReferralsAccepted_sum
Model: (Intercept), Service Subtype, Socioeconomicindex

Table 14. Parameter Estimates for Predictors of Referrals Accepted

			95% Wald Confidence Interval		Hypothesis Test		
Parameter Estimates	B	Std. Error	Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-1.765	0.1712	-2.1	-1.429	106.328	1	<.001
[Service Subtype=Emergency Food]	1.195	0.193	0.817	1.574	38.34	1	<.001
[Service Subtype=Food Pantry]	1.414	0.1885	1.045	1.784	56.333	1	<.001
[Service Subtype=Infant Formula/Food]	-31.513a	.	.	.	.	.	.
[Service Subtype=Medically Tailored Meals]	-31.513a	.	.	.	.	.	.
[Service Subtype=Prepared Meals]	1.154	0.1939	0.774	1.534	35.448	1	<.001
[Service Subtype=Produce Prescription/Voucher]	-31.513a	.	.	.	.	.	.
[Service Subtype=SNAP/WIC/Other Nutrition Benefits]	0b	.	.	.	.	.	.
Socioeconomic index	-0.573	0.0639	-0.698	-0.448	80.464	1	<.001
(Scale)	1c						

Dependent Variable: ReferralsAccepted_sum
Model: (Intercept), Service Subtype, Socioeconomicindex
a. Hessian matrix singularity is caused by this parameter. The parameter estimate at the last iteration is displayed.

b. Set to zero because this parameter is redundant.
c. Fixed at the displayed value.

Managing Zero-Inflated Data

While zero-inflated models were not available in SPSS, a two-part approach was used to analyze the data including logistic regression to model the likelihood of having a zero outcome and a Poisson regression/negative binomial model to assess the non-zero counts. Combining these predictions from both models helped estimate the likelihood of a zero count and the distribution of the non-zero counts.

Logistic regression modeling was used to examine the likelihood of zero referrals (referrals accepted vs. zero referrals) with predictors including service subtype, socioeconomic index, and CBO name. At baseline, referrals were unlikely to be accepted under default conditions. The constant ($\beta = -2.507$) was highly significant suggesting that without predictors, the model was essentially predicting non-acceptance for nearly all cases. The odds ratio $Exp(\beta)=0.082$ indicated only an 8% chance of acceptance under baseline conditions. The Wald statistic (551.885) confirmed the constant's significance, while the standard error (S.E.=0.107) suggested a precise estimate. In general, these results suggested that the model was heavily skewed towards predicting non-acceptance. The chi-square value (286.788, $p < 0.001$) of the omnibus tests of model coefficients revealed the logistic regression model significantly improved prediction over the null model. The contingency table for the Hosmer and Lemeshow test showed observed vs. expected values for referrals accepted, with the model fitting the data well, as evidenced by the nonsignificant results (Chi-square = 12.191, $p = 0.094$). As suggested by cox & snell R^2 (0.204) and nagelkerke R^2 (0.491), 20–49% of the variance in the dependent variable (referralsaccepted_nonzero_vs_zero) with several individual service subtypes and CBOs showing strong associations with the outcome. Service subtype and CBO Name were key

significant predictors ($p < 0.001$), with several individual service subtypes and CBOs showing strong associations with the outcome. However, while the classification table performed well in predicting referrals that were not accepted (99.3%) with a high overall prediction accuracy of 93.1%, it struggled to predict referrals that were accepted (16.8%), revealing challenges associated with imbalanced data. The low accuracy for accepted referrals could be attributed to zero inflation in the data as there was an excess of zero outcomes (non-acceptances) creating a significant imbalance between accepted and non-accepted referrals. Of service subtypes, emergency food, food pantry, and medically tailored meals demonstrated significant influence.

In the analysis, service subtype 0 (emergency food) served as the reference group for baseline comparison. Service subtype 1 (food pantry) was not statistically different in terms of accepted referrals compared to the reference group ($\beta = -0.553$, $Exp(\beta) = 0.575$, $p < 0.091$). Service subtype 2 (infant formula/food; $\beta = -20.034$, $Exp(\beta) = 0.000$, $p < 0.994$) and 4 (prepared meals; $\beta = -20.034$, $Exp(\beta) = 0.000$, $p < 0.994$) had a high negative association with accepted referrals compared to the reference group, suggesting it was less likely to result in accepted referrals. Service subtype 3 (medically tailored meals; $\beta = -8.58$, $Exp(\beta) = 0.424$, $p < 0.012$), 5 (produce prescription/voucher; $\beta = -20.034$, $Exp(\beta) = 0.000$, $p < 0.001$), and 6 (SNAP/WIC/other nutrition benefits; $\beta = -1.674$, $Exp(\beta) = 0.187$, $p < 0.001$) had a significant negative association with accepted referrals compared to the reference group, suggesting it was less likely to result in accepted referrals. Based on the model, food pantry services were not statistically significantly different from emergency food services in terms of the likelihood of the total accepted referrals while infant formula/food, medically tailored meals, prepared meals, produce prescription/voucher, and SNAP/WIC/other nutrition benefits all had higher negative associations with accepted referrals compared to emergency food services. Additionally, the

model also showed that socioeconomic index (β= 10.028, Exp(β) = 22644.13, p > 0.05) does not significantly impact the likelihood of referrals accepted. In the analysis of CBOs, Organizations F and I (CBO Names 3 and 6 of Alamance County) were statistically significant (p < 0.05), indicating that they had a meaningful impact on the referrals accepted compared to the reference group. The remaining organizations, including CBOs of Guilford (E, O, P, J) Forsyth (D, G, H), Alamance (M, K, L), Randolph (Q), and Davidson (N) exhibited p-values greater than 0.05, indicating that they did not have a significant effect on the referrals accepted in comparison to the reference group (Organization A, Alamance County).

Table 15. Variables in the Equation: Initial Model with Stepwise Selection

Variables in the Equation	B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	-2.507	0.107	551.885	1	<.001	0.082

Table 16. Model Summary: Goodness of Fit

Model Summary	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	387.010a	0.204	0.491

Table 17. Classification Table: Predicted vs. Observed Outcomes for Referrals Accepted

		Predicted		
Classification Table[a]		referralsaccepted_nonzero_vs_zero		Percentage Correct
	Observed	0	1	
Step 1	Referrals accepted_nonzero_vs_zero .00	1157	8	99.3
		79	16	16.8
	Overall Percentage 1.00			93.1

a. The cut value is .500

Table 18. Hosmer-Lemeshow Goodness of Fit Test

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	12.191	7	0.094

Table 19. Omnibus Tests of Model Coefficients

Omnibus Tests of Model Coefficients	Chi-square	df	Sig.
Step 1	286.788	21	<.001
	286.788	21	<.001
	286.788	21	<.001

Table 20. Variables Not in the Equation and Overall Model Statistics

Variables not in the Equation			Score	df	Sig.
Step 0	Variables	Service Subtype	105.012	6	<.001
		Service Subtype(1)	14.362	1	<.001
		Service Subtype(2)	17.124	1	<.001
		Service Subtype(3)	17.124	1	<.001
		Service Subtype(4)	5.131	1	0.024
		Service Subtype(5)	17.124	1	<.001
		Service Subtype(6)	0.615	1	0.433
		Socioeconomic index	37.166	1	<.001
		CBO Name	129.672	14	<.001
		CBO Name(1)	7.339	1	0.007
		CBO Name(2)	7.339	1	0.007
		CBO Name(3)	3.985	1	0.046
		CBO Name(4)	0.325	1	0.568
		CBO Name(5)	7.339	1	0.007
		CBO Name(6)	3.985	1	0.046
		CBO Name(7)	5.875	1	0.015
		CBO Name(8)	5.875	1	0.015
		CBO Name(9)	34.174	1	<.001
		CBO Name(10)	3.436	1	0.064
		CBO Name(11)	5.204	1	0.023
		CBO Name(12)	7.339	1	0.007
		CBO Name(13)	7.339	1	0.007
		CBO Name(14)	5.204	1	0.023
	Overall Statistics	240.506	21	<.001	

Table 21. Logistic Regression Results: Predictors of Referral Acceptance Rates

Variables in the Equation		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1a	Service Subtype			18.821	6	0.004	
	Service Subtype(1)	-0.553	0.327	2.861	1	0.091	0.575
	Service Subtype(2)	-20.034	2687.198	0	1	0.994	0
	Service Subtype(3)	-20.034	2687.198	0	1	0.994	0
	Service Subtype(4)	-0.858	0.34	6.371	1	0.012	0.424
	Service Subtype(5)	-20.034	2687.198	0	1	0.994	0
	Service Subtype(6)	-1.674	0.398	17.674	1	<.001	0.187
	Socioeconomic index	10.028	19336.486	0	1	1	22644.128
	CBO Name			39.128	14	<.001	
	CBO Name(1)	-31.91	22857.126	0	1	0.999	0
	CBO Name(2)	-41.077	40382.771	0	1	0.999	0
	CBO Name(3)	-0.939	0.467	4.039	1	0.044	0.391
	CBO Name(4)	-13.591	22511.318	0	1	1	0
	CBO Name(5)	-31.91	22857.126	0	1	0.999	0
	CBO Name(6)	-0.939	0.467	4.039	1	0.044	0.391
	CBO Name(7)	-21.659	40188.051	0	1	1	0
	CBO Name(8)	-0.818	0.46	3.165	1	0.075	0.441
	CBO Name(9)	-0.038	0.434	0.008	1	0.93	0.962
	CBO Name(10)	-2.851	131.231	0	1	0.983	0.058
	CBO Name(11)	-3.572	131.233	0.001	1	0.978	0.028
	CBO Name(12)	-41.077	40382.771	0	1	0.999	0
	CBO Name(13)	-41.077	40382.771	0	1	0.999	0
	CBO Name(14)	-22.102	35599.44	0	1	1	0
	Constant	9.531	17606.771	0	1	1	13777.503

a. Variable(s) entered on step 1: Service Subtype, Socioeconomicindex, CBO Name.

A negative binomial model was used to assess the non-zero counts and account for overdispersion. The likelihood ratio chi-square (906.153, $p < 0.001$) revealed that the models demonstrated a good fit to the data, suggesting that the fitted model significantly improved upon the intercept-only model. Additionally, the deviance (502.280, value/df = 0.405), pearson chi-square (885.410, value/df=0.715), AIC (983.296), and the BIC (1091.212) further supported the model's good fit. The results revealed statistically significant effects of CBOs on the outcome variable. In particular, organizations such as A (Alamance County, $\beta = 4.488$, $p < 0.001$), F ($\beta = 3.177$, $p = 0.002$), I (Alamance County, $\beta = 4.005$, $p < 0.001$), J (Guilford County, $\beta = 4.473$, $p < 0.001$), K (Alamance County, $\beta = 3.818$, $p < 0.001$), and L (Alamance County, $\beta = 4.488$, $p < 0.001$) showed positive and statistically significant associations with higher referrals accepted. Therefore, these CBOs were more likely to accept referrals compared to the reference group (Organization Q, Randolph County). On the contrary, CBOs of Guilford (E, O, P) Forsyth (D, G, H), Alamance (M), and Davidson (N) did not show significant effects on referral outcomes ($p > 0.05$), suggesting that referrals from these organizations were not significantly different from the reference group (Organization Q, Randolph County) in terms of referrals accepted.

The results also revealed statistically significant effects of service subtypes on the outcome variable. Service subtypes such as emergency food services ($\beta = 1.241$ $p < 0.001$), food pantries ($\beta = 1.166$, $p < 0.001$), prepared meals ($\beta = 1.067$, $p < 0.001$) showed positive and statistically significant associations with higher referrals accepted. Therefore, referrals for these services were more likely to be accepted compared to the reference group (SNAP/WIC/other nutrition benefits). On the contrary, other service subtypes such as infant formula/food, medically tailored meals, produce prescription/vouchers, and SNAP/WIC/other nutrition benefits did not show significant effects on referrals outcomes ($p > 0.05$), suggesting that referrals from

these organizations were not significantly different from the reference group (SNAP/WIC/other nutrition benefits) in terms of referrals accepted. This suggests that referrals for these services did not significantly affect the likelihood of referral acceptance.

Table 22. Goodness of Fit Statistics for Model Predicting Nonzero Outcome

Goodness of Fita	Value	df	Value/df
Deviance	502.28	1239	0.405
Scaled Deviance	502.28	1239	
Pearson Chi-Square	885.41	1239	0.715
Scaled Pearson Chi-Square	885.41	1239	
Log Likelihoodb	-470.648		
Akaike's Information Criterion (AIC)	983.296		
Finite Sample Corrected AIC (AICC)	984.042		
Bayesian Information Criterion (BIC)	1091.212		
Consistent AIC (CAIC)	1112.212		

Dependent Variable: nonzerooutcome
Model: (Intercept), CBO Name, Service Subtype[a]
a. Information criteria are in smaller-is-better form.
b. The full log likelihood function is displayed and used in computing information criteria.

Table 23. Omnibus Test for Model Predicting Nonzero Outcome

Omnibus Testa		
Likelihood Ratio Chi-Square	df	Sig.
906.153	20	<.001

Dependent Variable: nonzerooutcome
Model: (Intercept), CBO Name, Service Subtype[a]
a. Compares the fitted model against the intercept-only model.

Table 24. Tests of Model Effects for Nonzero Outcome

	Type III		
Tests of Model Effects	Wald Chi-Square	df	Sig.
(Intercept)	44.168	1	<.001
CBO Name	108.828	8	<.001
Service Subtype	0.482	2	0.786

Dependent Variable: nonzerooutcome
Model: (Intercept), CBO Name, Service Subtype

Table 25. Parameter Estimates for Nonzero Outcome

Parameter Estimates	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	-4.845	1.0354	-6.874	-2.816	21.898	1	<.001
[CBO Name=Organization A]	4.488	1.0288	2.471	6.504	19.029	1	<.001
[CBO Name=Organization D]	-28.354a	.	.	.	.	.	.
[CBO Name=Organization E]	-28.354a	.	.	.	.	.	.
[CBO Name=Organization F]	3.177	1.0444	1.13	5.224	9.255	1	0.002
[CBO Name=Organization G]	1.925	1.091	-0.213	4.064	3.115	1	0.078
[CBO Name=Organization H]	-28.354a	.	.	.	.	.	.
[CBO Name=Organization I]	4.005	1.0433	1.96	6.049	14.735	1	<.001
[CBO Name=Organization J]	4.473	1.0333	2.448	6.498	18.742	1	<.001
[CBO Name=Organization K]	3.818	1.0345	1.79	5.846	13.619	1	<.001
[CBO Name=Organization L]	4.488	1.0288	2.471	6.504	19.029	1	<.001
[CBO Name=Organization M]	0.688	1.2439	-1.75	3.126	0.306	1	0.58
[CBO Name=Organization N]	-7.55E-15	1.4308	-2.804	2.804	0	1	1
[CBO Name=Organization O]	-28.354a	.	.	.	.	.	.
[CBO Name=Organization P]	-28.354a	.	.	.	.	.	.
[CBO Name=Organization Q]	0b	.	.	.	.	.	.
[Service Subtype=Emergency Food]	1.241	0.2781	0.696	1.786	19.909	1	<.001
[Service Subtype=Food Pantry]	1.166	0.2762	0.625	1.707	17.819	1	<.001
[Service Subtype=Infant Formula/Food]	-30.913	839066.3623	-1644570.764	1644508.938	0	1	1
[Service Subtype=Medically Tailored Meals]	-30.913	839066.3623	-1644570.764	1644508.938	0	1	1
[Service Subtype=Prepared Meals]	1.067	0.2864	0.506	1.628	13.889	1	<.001
[Service Subtype=Produce Prescription/Voucher]	-30.913	839066.3623	-1644570.764	1644508.938	0	1	1

[Service Subtype=SNAP/WIC/Other Nutrition Benefits]	0b	.	.	.	.	.	.
(Scale)	1c						
(Negative binomial)	1c						

Dependent Variable: nonzerooutcome
Model: (Intercept), CBO Name, Service Subtype
a. Hessian matrix singularity is caused by this parameter. The parameter estimate at the last iteration is displayed.
b. Set to zero because this parameter is redundant.
c. Fixed at the displayed value

For both negative binomial regression models, the data revealed that socioeconomic index was statistically significant, positively impacting referral counts and reducing zero referrals. Also, different service types had varying effects on the likelihood of referrals. Several CBOs in Alamance and Guilford counties showed a statistically significant positive association with higher referral acceptance rates based on a two-part model addressing zero inflation, and service subtypes such as emergency food services, food pantries, and prepared meals were more likely to be accepted. Furthermore, these models did not show any statistically significant relationship between socioeconomic index and referral acceptance. As indicated by the AIC, the two-part model (AIC=985.272) had a better fit to the data, accounting for both the probability of a non-zero outcome via logistic regression and the count of referrals via negative binomial regression. The single negative binomial regression model (AIC=1790.182) suggested that it was less optimal in comparison.

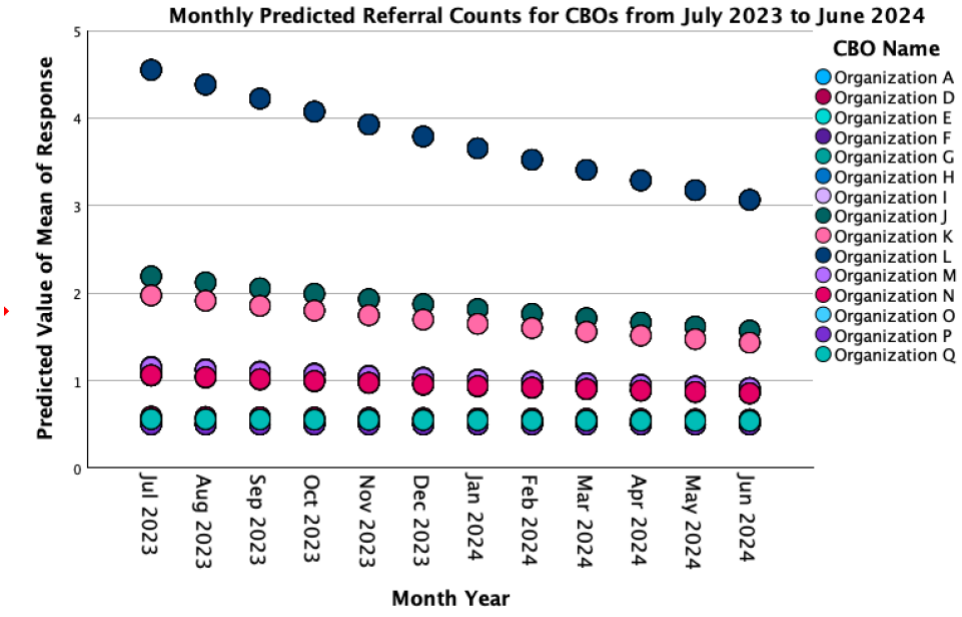
Trend Analysis

Time-series plots

Across the 15 CBOs, the predicted mean values for referrals received showed varied trends over the 12-month period from July 2023 to June 2024. Organizations L (Alamance County), J (Guilford County), and K (Alamance County) exhibited a gradual decline in referrals, with Organization L (Alamance County) starting with a predicted mean of about 4.5 referrals

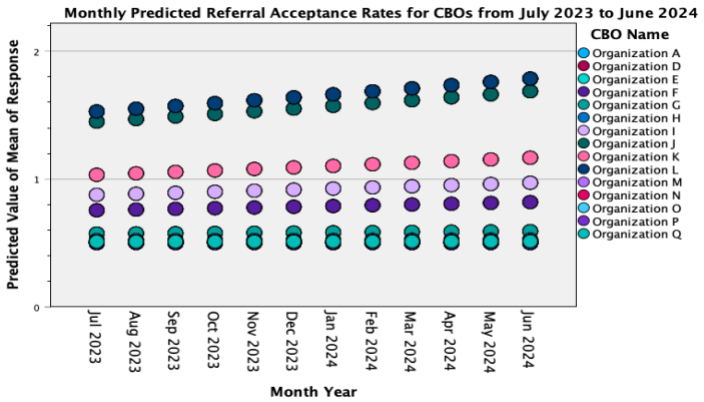
received in July 2023 and steadily decreased to about 3.2 by June 2024. Organizations J (Guilford County) and K (Alamance County) followed a similar pattern, with a predicted mean of about 2 referrals received in July 2023 and decreased to approximately 1.5 by June 2024, with Organization J (Guilford County) consistently maintaining higher referrals received than K (Alamance County). Organizations M (Alamance County) and N (Davidson County) showed a more stable and slower decline, starting with a predicted mean of about 1.3 referrals received in July 2023 and ended just below 1 by June 2024, with Organization M (Alamance County) consistently maintaining slightly higher referrals than N (Davidson County). The remaining CBOs maintained a consistent referral count of approximately 0.5 referrals received throughout the 12-month period. These trends highlighted the varied referrals patterns across CBOs, suggesting that some CBOs, particularly those with higher referral counts received, experienced a gradual decline in referrals, while others showed stable or low referrals received over time. The observed trends in referrals received could appear less variable or more stable due to zero-inflation.

Figure 4. Trends of the predicted mean values for referrals received



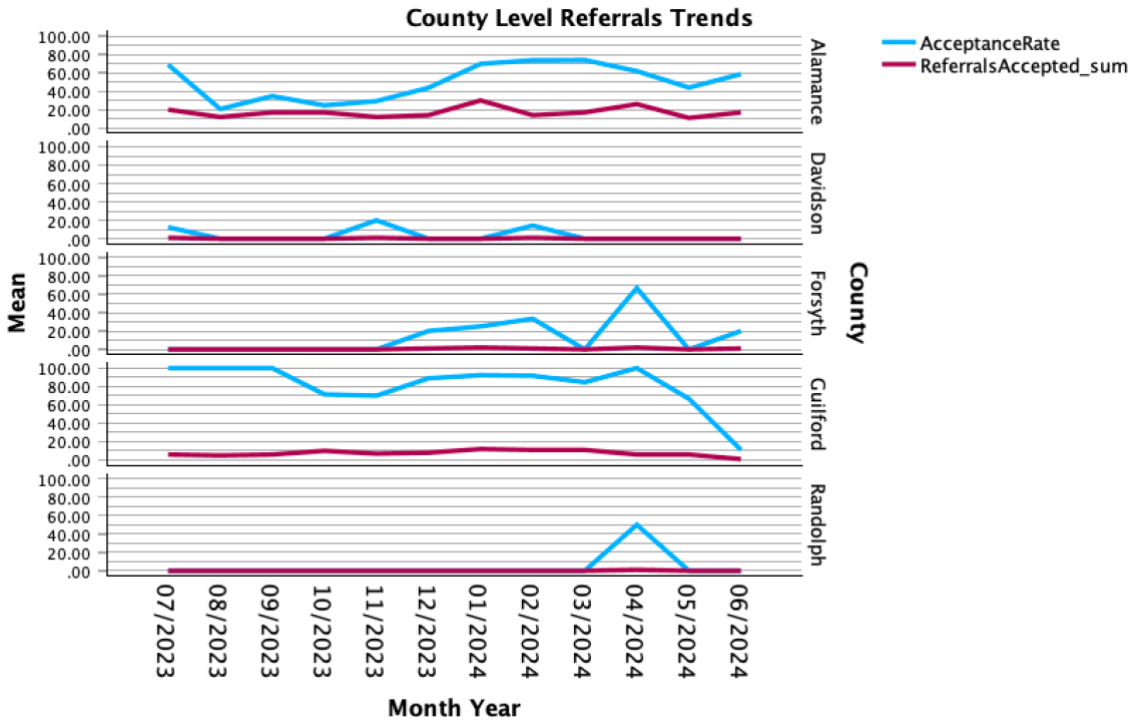
Similarly, the predicted mean values for referrals accepted illustrated varied trends over the 12-month period from July 2023 to June 2024. Organizations L (Alamance County) and J (Guilford County) displayed a steady increase in the referrals accepted, with a predicted mean of about 1.5 in July 2023 and gradually increased to about 1.8 by June 2024, with Organization L (Alamance County) slightly accepting more referrals than J (Guilford County). Organization K (Alamance County) had a more stable trend starting with a predicted mean of approximately 1 and increased steadily to about 1.2 by June 2024. Organization M (Alamance County) demonstrated similar trends with a predicted mean of about 0.9 and experienced a gradual increase to 1 by June 2024. Organization F (Alamance County) exhibited no change in the predicted means of referrals accepted, maintaining a consistent predicted mean of 0.8 over the 12-month period. The remaining organizations consistently had a predicted mean of 0.6 for referrals accepted throughout the 12-month period, with Organization G (Forsyth County) performing slightly better than the others in this group. While some CBOs showed steady increases in referrals accepted over time, others maintained stable levels. There appeared to be differences in the ability of organizations to accept referrals, with some growing slightly, while others resurging or demonstrating little improvement. The observed trends in referrals accepted could appear less variable or more stable due to zero-inflation.

Figure 5. Trends of predicted mean values for referrals accepted



Moreover, the line graph of referral trends for acceptance rates and total referrals accepted across Alamance, Davidson, Forsyth, Guilford, and Randolph counties suggested key insights about performance and trends at the county level. Alamance County had the strongest performance revealing a steady increase in referral acceptance rates and total referrals accepted. The observed peaks in acceptance rates for Davidson, Forsyth, Guilford, and Randolph counties from February – April 2024 increased referrals accepted in this period. This could be due to resources for short term funding that may have improved referral processes during this period. Additionally, Randolph County revealed significant lower total referrals accepted and poorer performance compared to the other counties which could suggest fewer community resources, lack of awareness or engagement with NCCARE360, or communication and/or coordination barriers among referral partners such as FHLI or Unite Us.

Figure 6. County Level Trends of the Total Referrals Accepted and Acceptance Rates



Qualitative Analysis

Data was collected over a three-month period where a total of 4 focus groups were conducted, one in-person and three virtual. Focus groups continued until data saturation was reached and no new concepts or themes were revealed. The focus groups provided CBO staff and leaders with an opportunity to engage with one another and share their experiences with NCCARE360. All focus group questions explored the following broad themes with each participant: onboarding barriers reported by CBO leadership and staff, facilitators contributing to successful onboarding, facilitators contributing to successful retention of CBOs, and retention barriers. Additional probing was used to elicit greater detail dependent upon each participant's response. Focus group participants included perspectives from staff and leaders at the organizational level from Randolph, Davidson, Alamance, Guilford, and Forsyth counties. All the CBOs involved in the research study provided emergency food, SNAP/WIC, and/or food pantry services for clients in need in the CBO's service area. Of the CBOs that participated in the research study, 8 were large sized organizations, 2 were medium sized organizations, and 7 were small sized organizations. Table 26 listed below summarizes additional information about the CBO and the focus group they participated in, as well as the county, organizational category, and size of the organization.

Table 26. Focus Group Participation Overview by Organization, County, Category, and Size

Focus Group	Organization	County	Category	Size
1 (In-person)	Organization A	Alamance	Small Organization	0-10 employees
	Organization B	Statewide	Large Organization	50+ employees

	Organization C	Statewide	Large Organization	50+ employees
	Organization D	Forsyth	Large Organization	50+ employees
	Organization E	Guilford	Small Organization	0-10 employees
2 (Virtual)	Organization F	Alamance	Small Organization	0-10 employees
	Organization G	Forsyth	Medium Organization	10-50 employees
	Organization H	Forsyth	Large Organization	50+ employees
	Organization I	Alamance	Large Organization	50+ employees
	Organization J	Guilford	Large Organization	50+ employees
3 (Virtual)	Organization K	Alamance	Medium Organization	10-50 employees
	Organization L	Alamance	Small Organization	0-10 employees
	Organization M	Alamance	Small Organization	0-10 employees
4 (Virtual)	Organization N	Davidson	Small Organization	0-10 employees
	Organization O	Guilford	Small Organization	0-10 employees
	Organization P	Guilford	Large Organization	50+ employees
	Organization Q	Randolph	Large Organization	50+ employees

All focus groups were transcribed and analyzed using NVivo 14. Prior to analysis, transcripts for each focus group were deidentified to ensure confidentiality and reduce bias. Themes were identified inductively where transcripts were reviewed by the principal investigator, who searched for initial themes and concepts. The research study's focus group findings and thematic and content analysis revealed four key themes: onboarding barriers, barriers to retention, facilitators of retention, and onboarding facilitators.

Training and capacity building needs and resource constraints were the most cited onboarding and retention barriers for CBOs across all focus groups. The results revealed that barriers stemmed from limited funding, staff capacity, or lack of long-term financial support, which impeded several CBOs' adoption and sustainability of NCCARE360. In addition, NCCARE360 referral data at the CBO level revealed that while more than 75% of CBOs are registered with NCCARE360, only 35% had been successfully onboarded and only 23% had been successfully retained. The results suggested that training and capacity building were essential to strengthening communication and coordination to improve the effectiveness of referral management, ensuring adherence to proper referral procedures, and enhancing retention of CBOs using NCCARE360. Since many CBOs operated with limited staff capacity and faced high turnover rates, there was a need for additional technical assistance and human resources support to enable them to effectively address food-related needs within their communities.

Food services remained the most frequently referred service domain through NCCARE360, underscoring the importance of overcoming onboarding and retention challenges to support CBOs in meeting the growing demands of their clients. Tables 27–30 listed below summarizes key themes, findings, and participant insights on onboarding barriers, retention challenges, and the factors that facilitated both onboarding and long-term engagement. Despite

training, capacity building, and resource constraints being significant onboarding and retention barriers, there was strong interest among CBOs in using NCCARE360. Onboarding and retention facilitators highlighted several CBOs' enthusiasm for NCCARE360 and underscored the value of a streamlined referral system that improves efficiency, addresses complex health needs, and enhances cross-sector coordination to better serve their communities. By addressing these barriers and strengthening facilitators, NCCARE360 could be further enhanced through the fostering collaboration, streamlining coordinated care, enhancing service delivery, and improving health outcomes across communities.

Table 27. Barriers to Onboarding and Utilization of NCCARE360: Themes, Findings, and Participant Insights

Theme: Onboarding Barriers

Subthemes	Findings	Illustrative Quotes	Frequency	Notes
Lack of Training and Capacity Building	Participants noted limited staff capacity as often only one full-time employee (FTE) actively manages NCCARE360 referrals. Additionally, they discussed issues related to a lack of workflow integration and limited usability due to insufficient training.	"Change in staff and lack of knowledge transfer hinder the ability of organizations to effectively manage referrals through the platform". FG 4, participant O "No one received training to use the platform. The importance of thorough training for all case managers to access and understand the platform is essential. Training would clarify expectations and ensure that their efforts align with what is required, fostering better mutual understanding between their organization and the platform administrators". FG 3, participant L	FG 1: 10 mentions FG 2: 5 mentions FG 3: 4 mentions FG 4: 3 mentions	All 4 focus groups identified staff training, organizational capacity and staff turnover, and transitions as key challenges reducing the engagement and utilization of NCCARE360.
Resource Limitations	Based on limited organizational and staff capacity among CBOs, resource limitations reduced the consistent adoption and sustainability of NCCARE360.	"CBOs experience frustration and challenges, especially when they are underfunded or lack adequate incentives to stay active on the platform". FG 1, participant B "Some CBOs face challenges with sustainability once funding ends, leaving gaps in knowledge and expertise among staff". FG 1, participant C	FG 1: 11 mentions FG 2: 6 mentions FG 4: 5 mentions	3/4 focus groups consistently discussed resource constraints as a significant barrier preventing CBOs from actively using NCCARE360.
Resistance to New Technology	Several participants discussed their hesitancy to use the platform due to existing databases and/or processes they are already required to use for reporting and not wanting to use another one. Adding another system to maintain was not appealing to many CBOs. To reduce administrative burdens and adequately address the needs of	"Some organizations continue using informal or legacy systems (e.g., notebooks) because they trust what they've been doing, even if it is less efficient than using a platform like NCCARE360". FG 1, participant C "There is resistance from CBOs to adopt new technology, especially when they feel it doesn't address their current needs or doesn't offer a clear improvement". FG 1, participant D	FG 1: 3 mentions FG 2: 2 mentions	2/4 of focus groups, particularly those in medium and large organizations, discussed challenges with staff acceptance of and the adoption of new technological tools like NCCARE360.

	CBOs, participants expressed a desire to align NCCARE360 with current tools and systems.	"Some CBOs are hesitant to join NCCARE360 because they are already burdened with extensive reporting requirements. Adding another system to maintain is unappealing, making it challenging to encourage peer agencies to participate". FG 2, participant E		
Outreach Barriers	Several barriers related to language and cultural differences impeded effective use of NCCARE360. The lack of translation services was a significant barrier in connecting clients to services, especially those who are new to the country. This barrier complicated the referral process and affects the ability of CBOs to fully support clients' needs. Other challenges remained with traction and awareness and gaps in outreach and resource visibility efforts, which impact the widespread adoption of NCCARE360 despite its advantages.	"Some organizations (e.g., Hispanic-serving, refugee-serving) feel overlooked and are not adequately engaged". FG 1, participant B "Language challenges (e.g., lack of translation services) are a significant barrier, particularly when working with clients who are new to the country. This complicates the referral process and affects the ability of CBOs to fully support clients' needs". FG 1, participant A "Challenges remain with traction and awareness, echoing past difficulties with North Carolina's 211 system, which struggled with widespread adoption despite its advantages. Other states, like Connecticut and Texas, have successfully promoted similar systems, highlighting a gap in North Carolina's outreach and resource visibility efforts". FG 2, participant J	FG 1: 3 mentions FG 2: 1 mention	In 2/4 focus groups, all participants reported CBOs challenges related to translation services and effective promotion for NCCARE360.
Program Availability and Coordination Challenges	Challenge arose when referrals are made to food-related programs that are not immediately available or require pre-planning. For example, if a client was referred for a nutritional program that isn't currently running, the referral had to be declined or directed to another county with an active program. Advance coordination of participant needs with program schedules could help improve this process.	"Programs often follow a structured schedule (e.g., a six-session series), making it difficult for clients to join mid-way, as they would miss foundational elements". FG 2, participant H	FG 2: 3 mentions	In focus group 2, all participants expressed the difficulty in coordinating programs and aligning the availability of services across different organizations using NCCARE360.

Table 28. Barriers to Retention and Utilization of NCCARE360: Themes, Findings, and Participant Insights

Retention Barriers

Subthemes	Findings	Illustrative Quotes	Frequency	Notes
Funding and Resource Support	Funding was recommended to support CBOs with large service areas by offering boots-on-the-ground support and real-time feedback for NCCARE360 implementation and supporting the upgrading of existing equipment to facilitate easier referral connections. Moreover, incentives such as providing funding for staff training or supporting the upgrade of equipment to facilitate easier referral connections to reduce barriers for CBOs and enhance their ability to effectively use the NCCARE360 platform. In addition to dedicated funding, participants reported a desire to hire FTEs to focus on onboarding and standardizing organizational practices for NCCARE360, making it easier for new employees to meet expectations quickly and contribute effectively, and reducing the need to absorb additional long-term staffing costs. Financial incentives were also needed to effectively promote NCCARE360 for CBOs who were not using the platform and address CBO capacity in utilizing the platform.	"When CBOs are well-funded, they are more effective in connecting patients to resources. A well-funded network of CBOs leads to a higher success rate in referrals". FG 1, participant C "When funding is lacking, organizations struggle to use platforms effectively and often feel overlooked". FG 2, participant H "Given the shortfall that so many organizations are experiencing from traditional funding sources in the nonprofit world, financial incentives are needed". FG 4, participant P	FG 1: 11 mentions FG 2: 6 mentions FG 4: 5 mentions	Increased funding and resource support was cited as a critical need in 3/4 of the focus groups.
Technology Integration and System Improvements	Clients and CBOs desired a more streamlined experience across multiple domains, as the current system is cumbersome, especially when dealing with complex needs. While the referral process was aimed to facilitate planning and coordination of referrals and services to address clients' needs, there was a desire for a more	"There are consistent issues with inaccurate data capture and reporting from the system. Some data is not being recorded properly, and there are discrepancies in how certain categories are calculated, leading to misleading outcomes.	FG 1: 2 mentions FG 2: 2 mentions FG 3: 1 mention FG 4: 1 mention	All 4 focus groups cited enhanced technology integration and system improvements as facilitators to the

	comprehensive approach that incorporates real-time feedback from end-users to ensure the platform addresses the needs of clients and all stakeholders to increase engagement and commitment to onboarding and using the platform.	For example, some questions in the intake forms do not align with the services offered, causing issues with how data is categorized and reported". FG 4, participant O		successful onboarding of CBOs onto NCCARE360.
Coordination and Communication Challenges in Referral Management	Improved coordination remained needed for clients with multiple needs such as food and housing, to ensure all needs are addressed. Additional support was requested for referral requests that are often vague and do not include the type of services needed, especially with clients who have more complex needs. Prompt follow-up was needed to ensure open referrals are updated and cases are resolved to result in successful connections to effectively address client needs. There was also a need for improved communication and engagement among referring organizations, CBOs, and clients to effectively address service gaps. Moreover, regional coordination challenges arose as all discussed that many CBOs within the same county or region often lack awareness of each other's activities or participation with NCCARE360, further complicating collaboration and service delivery.	"Multiple referrals for the same client (e.g., food and transportation) need more coordination and follow-up to ensure all needs are met". FG 1, participant A "There is a lack of follow-up on open referrals, leading to gaps in service delivery and clients not receiving the necessary resources". FG 2, participant I "Some organizations are not fully aware of their involvement or the role they play in the referral process". FG 3, participant K "Waitlists are a significant barrier to ensuring clients get the services they need, and there is a need for protocols around how and when clients are placed on waitlists to fully meet the goal of serving the client". FG 1, participant B "Receive a lot of referrals that don't happen to be eligible for our organization/service area". FG 4, participant N "One issue is that case notes cannot be edited, only deleted, which has	FG 1: 5 mentions FG 2: 4 mentions FG 3: 2 mentions FG 4: 4 mentions	Participants in all 4 four focus groups identified examples in which organizations fail to monitor referrals or solve cases. Unresolved referrals, a lack of follow-up, the difficulty of managing multiple referrals, and limited awareness about platform activities were identified as barriers to effective referral management.

		led to some difficulties. If a person is entered into the system by one office but later visits another, the case may be duplicated if the case manager doesn't check the profile first. Additionally, when a client is already receiving services from another agency, there's a risk of overwriting existing case notes if the wrong profile is selected. To avoid this, staff must carefully check for existing profiles before proceeding with new entries". FG 4, participant O		
Training and Capacity Building Needs	Referring organizations need training to ensure proper procedures are followed for referral initiation and eligibility screening. Additional training was discussed as a need for improvement to ensure proper referral processes and eligibility assessment are conducted and referrals initiated align with the CBOs services to reduce workflow inefficiencies that may impact timely service delivery.	"Need for training on proper referral procedures, emphasizing the importance of ensuring eligibility screening is done correctly to avoid delays in providing critical services". FG 4, participant P "Training is essential for staff to ensure proper referral initiation and eligibility assessment. There's a need for more in-depth and personalized training, particularly for organizations in specific regions". FG 1, participant E "Effective training ensures that referrals meet the necessary criteria and have a higher chance of success". FG 2, participant G	FG 1: 10 mentions FG 2: 5 mentions FG 3: 4 mentions FG 4: 3 mentions	Across all 4 focus groups, training and capacity building needs were consistently discussed as barriers to retention. All participants shared their experience with receiving incorrect or inadequate referrals due to referring organizations not conducting a proper eligibility assessment to ensure the CBO can adequately respond to the client's needs.

Table 29. Successful Facilitators of Retention and Utilization of NCCARE360: Themes, Findings, and Participant Insights

Facilitators of Retention

Subtheme	Findings	Illustrative Quotes	Frequency	Notes
Resource coordination and care management	NCCARE360 was viewed as an innovative tool to connect clients to services, benefits, resources, and care management and streamline referrals to improve coordination of care.	"The ability to pull data quickly and analyze its impact on referrals and clients served is essential for improving coordination and demonstrating the platform's effectiveness". FG 1, participant C	FG 1: 5 mentions FG 2: 3 mentions FG 3: 1 mention FG 4: 4 mentions	All 4 focus groups emphasized the value of using NCCARE360 to connect patients to resources, improve coordinated care, and strengthen care management.
Value proposition	NCCARE360 was viewed as a valuable program because it provides free access to CBOs, offering a cost-effective alternative to other tools that typically charge high fees.	"A high value for startups and small non-profit getting established and wanting to increase exposure through the referral platform". FG 4, participant P	FG 4: 3 mentions	All participants in focus group 4 discussed the positive return on investment for small nonprofits and CBOs participating in NCCARE360.

Table 30. Successful Onboarding Facilitators of NCCARE360: Themes, Findings, and Participant Insights

Onboarding Facilitators

Subtheme	Findings	Illustrative Quotes	Frequency	Notes
Streamlined Referral System	Improved integration with existing systems across multiple domains could make referrals for complex needs like food, housing, and transportation more fluid and seamless to effectively improve coordination of care and address clients' needs.	"A key benefit of NCCARE360 is its potential as a "one-stop shop" for referrals, becoming more effective as more CBOs and other providers join the network" FG 2, participant F "The platform's potential lies in creating a streamlined process, where clients can be directed to a dedicated service provider, ensuring efficient and focused support for various client needs". FG 4, participant Q	FG 1: 2 mentions FG 2: 1 mention FG 3: 1 mention FG 4: 2 mentions	All 4 focus groups discussed how NCCARE360 has the potential to streamline and unify statewide referral processes and improve client information flow, services, and tracking.
Increased Visibility and Growth	As noted, a major benefit to using NCCARE360 was increased CBO exposure and access to more referrals, which can help organizations grow and gain recognition.	"Organizations are more likely to participate and use the system if they understand its long-term benefits". FG 4, participant N	FG 1: 1 mention FG 2: 1 mention FG 3: 1 mention FG 4:1 mention	All focus groups discussed the benefits of using NCCARE360, including the planning and coordination of services to address clients' needs.

The analysis of CBO level aggregated referral data served as a foundation for drawing conclusions regarding the qualitative measures identified. The following conclusions were drawn and presented in Table 31 below.

Table 31. Summary of CBO Referral Activity on NCCARE360

Category	Details
Successful Onboarding	6 CBOs onboarded and accepted at least one referral within the first three months of registration: - Alamance (4) - Davidson (1) - Guilford (1)
Successful Retention	3 CBOs maintained at least one accepted referral per month for a minimum of one year: - Alamance (2) - Guilford (1)
Active Organizations	13 CBOs signed up and accepted at least one referral in the last 12 months: - Alamance (6) - Guilford (2) - Forsyth (3) - Randolph (1) - Davidson (1)
Inactive Organizations	2 CBOs in Guilford County were registered but had not accepted a referral in the last 12 months.

Table 32 listed below provides an analysis of CBOs at various stages of engagement with NCCARE360, categorizing them based on recruitment, onboarding, and retention outcomes. Leadership, resource management, system integration, workflows, support/technical assistance, cultural considerations, training, collaboration, and referral coordination were highlighted as key challenges and facilitators. Insights gained from these analyses provided a deeper understanding of what influenced successful and sustained platform participation.

Table 32. Characterization of CBOs Based on Recruitment, Onboarding, and Retention Status

Category	Organizations Successfully Recruited but Not Onboarded Well	Organizations Successfully Recruited and Onboarded but Not Retained	Organizations Successfully Recruited, Onboarded, and Retained
Number of CBOs	2	13	9
Leadership Challenges	Limited staff capacity; often only one FTE manages referrals	Inconsistent leadership practices in managing and supporting NCCARE360	Leadership providing consistent support for continued use
Resource Management	Insufficient resources for training and onboarding	Resource limitations (e.g., funding, staff) impacting sustainability	Adequate resources for training, equipment upgrades, and ongoing support
Systemic Barriers	Lack of workflow integration with existing tools/systems	Hesitancy to add another system; integration challenges	Improved system integration, reducing administrative burdens
Workflows and Processes	Inefficient or unclear workflows during onboarding	Lack of clear workflows leading to poor engagement and retention	Clear workflows that are effective and sustainable
Support and Engagement	Limited support during onboarding; lack of real-time feedback	Lack of follow-up and real-time feedback affecting continued use	Real-time feedback and continuous support enhance retention
Cultural and Language Barriers	Language/cultural barriers; lack of translation services	Cultural or language challenges with referrals or understanding services	Effective support for culturally diverse populations
Training and Capacity Building	Insufficient training for staff or volunteers	Need for dedicated FTEs for training and onboarding	Ongoing training and staff support for seamless service delivery
Collaboration and Communication	Lack of coordination among organizations within the region	Regional coordination issues; lack of awareness of other CBOs' activities	Effective collaboration among CBOs, regions, and NCCARE360 users
Referral and Service Coordination	Referrals made to unavailable programs or services	Referrals often vague, incomplete, or difficult to coordinate	Effective, comprehensive coordination across multiple complex needs (e.g., food, housing)

Conclusion

Overall, the models suggested that various CBOs and service subtypes played crucial roles in determining referral acceptance, and these factors should guide strategic decisions for improving referral acceptance rates. Qualitative analysis revealed that training and capacity building needs and resource constraints were critical onboarding and retention barriers reducing the utilization of NCCARE360 among many CBOs. Enhanced training and capacity building were integral to strengthening the coordination of resources and effectiveness of referral management to improve the retention of CBOs using NCCARE360.

Moreover, quantitative analysis showed a significant increase in referrals received and accepted which was demonstrated by specific service subtypes, including emergency food, food pantry, and prepared meals, while socioeconomic factors (poverty, SNAP, unemployment) did not appear to significantly influence referral acceptance in the two-part model addressing zero-inflation. Moreover, there were significant differences between acceptance rates in Alamance County compared to other counties (Randolph, Davidson, Forsyth, and Guilford), but pairwise comparisons between the other counties did not reveal significant differences, suggesting that their acceptance rates were more uniform. Referral trends across counties revealed that Alamance County could serve as a model to identify best practices for improving referral processes across the underperforming counties. Moreover, peaks in referral acceptance rates indicated there may be conditions that increased referral acceptance that should be further explored. Referral trends varied greatly across CBOs, resulting in clusters of non-significant differences between specific CBOs, which suggested similar outcomes within those organizations (e.g., Randolph County vs. Davidson County or Guilford County vs. Forsyth County organizations). The data also suggested that CBOs that received referrals consistently

performed similarly in terms of accepted referrals as well. The results also revealed that further research was needed to better understand the specific challenges lower-performing CBOs face in coordinating referrals and delivering food-related services through NCCARE360.

Chapter 5: Discussion

This research study served as a pilot study to inform themes related to NCCARE360 onboarding, engagement, and implementation in Alamance, Davidson, Guilford, Forsyth, and Randolph counties. Major themes addressed challenges hindering the onboarding of CBOs and factors contributing to the successful onboarding and retention of CBOs addressing food insecurity and using NCCARE360. Aggregated CBO level referral data was used to compare referral trends and identify disparities and inefficiencies in referral processes. The cumulation of this data analyzed reasons for delays and provided context and deeper insights into referral workflow challenges.

Summary of Findings

Key Findings on CBO Onboarding and Referral Activity

Based on the results, 6 CBOs (Alamance: 4, Davidson: 1, Guilford: 1) successfully onboarded and accepted at least one referral through NCCARE360 within the first three months of registration, 3 CBOs (Alamance: 2, Guilford: 1) maintained consistent referral activity (at least one accepted referral per month) for a minimum of 12 months, 13 CBOs (Alamance: 6, Guilford: 2, Forsyth: 3, Randolph: 1, Davidson: 1) signed up and accepted at least one referral in the last 12 months, and 2 CBOs in Guilford County were inactive (registered on NCCARE360 but did not accept any referrals in the last 12 months). This data supported Alamance County having the highest utilization and referral activity with NCCARE360 compared to the other counties. In particular, the most common barriers to onboarding and retention included training and capacity building, limited resources, and challenges with referral coordination. Facilitators to onboarding and retention included CBOs' enthusiasm to use NCCARE360 to streamline referrals

and improve coordination of care. To appropriately address onboarding and retention challenges, tailored training, capacity building, and technical support were critical to support improved referral coordination and management, adherence to procedures, and CBO retention on NCCARE360. Additionally, providing support to address technical and staff capacity needs was essential to address staff capacity challenges and high turnover across CBOs. Moreover, strengthening the facilitators of onboarding and retention could enable NCCARE360 to become a more effective tool in fostering collaboration, improving service delivery related to food needs, and enhancing health outcomes across communities.

Observed differences in referral trends across CBOs suggested that some CBOs may face different challenges in managing referrals through NCCARE360. Overall, some CBOs struggled with declining referrals whereas others maintained stable or low referral activity. Comparisons across CBOs showed that Organization D (Forsyth County), Organization E (Guilford County), Organization H (Forsyth County), Organization M (Alamance County), Organization G (Forsyth County), Organization O (Guilford County), Organization N (Davidson County), Organization P (Guilford County), Organization Q (Randolph County) had the most significant differences ($p < 0.05$) in acceptance rates. It appeared that these CBOs accepted referrals at different rates, where many were accepting fewer referrals over time. There were significant differences in referral acceptance practices, suggesting that CBOs may benefit from targeted interventions to address their challenges or improved processes to make NCCARE360 more accessible. Further research should be conducted to distinguish higher performing CBOs from lower performing ones to suggest opportunities for improvement to enhance the onboarding and retention of CBOs utilizing NCCARE360. In particular, understanding how resource availability, staff capacity, and

organizational processes could contribute to increased referral acceptance rates was critical to improving the number of accepted referrals.

On the other hand, Organization A (Alamance County), Organization D (Forsyth County), Organization E (Guilford County), Organization H (Forsyth County), and Organization N (Forsyth N) showed no significant difference ($p > 0.05$) in acceptance rates when compared with others. These CBOs served as benchmarks for others in determining best practices for referral workflows and strategies to improve the onboarding and retention of CBOs utilizing NCCARE360. By identifying factors influencing acceptance rates in higher performing counties, such as funding, staff capacity, and partnerships, these CBOs could provide insight into the need for customized strategies to improve referral intake and retention processes of NCCARE360.

County Disparities and Opportunities for Improving NCCARE360 Referral Activity

The results revealed lower referral activity in Randolph County compared to the other counties suggesting a need for strategic efforts to increase engagement and address barriers among CBOs addressing food insecurity in this area. Since Alamance County had the highest acceptance rates and referral activity compared to the other counties, it was important to explore the unique factors that contributed to its success and the disparities observed in the other counties. Disparities could stem from differences in resource allocations, community needs, and services available. Referrals received and accepted had a positive relationship, underscoring the importance of ensuring CBOs build capacity to handle more referrals and maintain high acceptance rates. The lack of significant differences in referrals among Randolph, Davidson, Forsyth, and Guilford counties suggested potential similarities in referral processes, community characteristics, or resource availability, which could inform broader regional strategies to improve the utilization of NCCARE360. Therefore, organizational factors or characteristics were

likely to have had a significant impact on referral acceptance rates. Implementation partners such as United Way of North Carolina and Unite Us could provide tailored support to CBOs addressing food insecurity in Alamance, Davidson, Guilford, Forsyth, and Randolph to increase the utilization of NCCARE360 to ensure these CBOs can handle more referrals. Additionally, an opportunity exists to develop tailored strategies based on the success of NCCARE360 utilization in Alamance County, aimed at identifying best practices that influenced these outcomes to provide targeted support to CBOs with lower referral activity. This approach would help uncover effective strategies and strengthen support for CBOs in counties with lower referral engagement.

Based on the non-significant pairwise comparisons within counties, the referral trends indicated that some CBOs had similar acceptance rates such as Guilford and Forsyth counties. This presented opportunities to strengthen regional partnerships and collaborations within counties to enhance efficiency and service delivery by leveraging resources, streamlining processes, and building capacity to support increased use of NCCARE360 to address food insecurity. Strengthening networks facilitated better referral activities and outcomes, leading to improved coordination and a greater collective impact within the county.

Key Findings on Referral Service Subtypes and Socioeconomic Factors

Based on the results, CBOs should prioritize emergency food, food pantry, and prepared meals as these service subtypes demonstrated a significant positive impact on referral acceptance. Service subtype appeared to have a greater impact on referrals received. If referral acceptance rates were low for particular service types, this finding could guide targeted strategies to increase referral acceptance, such as improved communication, coordination, resource allocation, or process improvements. On the contrary, referrals for infant formula/food, medically tailored meals, and produce prescriptions/vouchers were absent. This could indicate a

lack of demand, accessibility issues, or service gaps revealing further investigation required to address these gaps and improve utilization.

In addition, the negative binomial regression model results indicated that areas with high socioeconomic metrics (poverty, SNAP, and unemployment) required tailored strategies, since they were associated with a lower number of referrals and acceptances. However, while socioeconomic factors could influence the total referrals, they did not explain whether referrals were accepted once zero-inflation was addressed. The statistical analysis tests conducted to address zero inflation revealed that socioeconomic factors did not significantly influence referral acceptance rates after accounting for zeros. These findings could suggest that other factors such as community resources, organizational capacity, service availability, and referral management played an integral role in determining referral success.

Strategies for Enhancing Onboarding, Retention, and Referral Capacity in CBOs

The quantitative and qualitative analyses suggested that successful onboarding and retention were strongly linked to CBOs' ability to handle referrals effectively. Training and capacity building were identified as key barriers to CBO onboarding and retention, suggesting that staffing, funding, and technical resource gaps should be addressed immediately. CBOs in counties with lower referral activity, like Randolph County, reported an immediate need for training and resources to help them build capacity to handle referrals and adopt best practices from more successful CBOs, like those in Alamance County. Additionally, while more than 75% of CBOs were registered with NCCARE360, only 35% had been successfully onboarded and only 23% had been successfully retained. This research study suggested that NCCARE360 was more likely to be utilized by CBOs when capacity, funding, and training limitations were addressed. It was important for CBOs to have adequate resources, staffing, and organizational

practices in place to effectively accept and manage referrals. Thus, CBOs with lower referral activity could benefit from strategic support, funding, and technical assistance to build their organizational capacity to handle referrals effectively and support engagement with NCCARE360. Similarly, tailored strategies were also necessary for service subtypes with fewer referral acceptances, such as infant formula/food and medically tailored meals, revealing that CBOs could also benefit from tailored assistance to enhance referral activity for these services. By enhancing partnerships and collaborations within counties, CBOs could increase referral activities, improve efficiency, and strengthen their capacity to address food insecurity.

Additionally, comprehensive training and technical assistance were needed to address technical barriers and training gaps. As reported in the qualitative analysis and supported by the quantitative analysis, many CBOs faced challenges with navigating NCCARE360, tracking referrals, receiving incomplete referrals/client information, and addressing system errors, reducing the likelihood of successful case resolutions. The lack of consistent training contributed to delays in referral workflows, which impacted how quickly cases were resolved. Lack of standardized referral workflows also contributed to referral delays by causing inconsistencies in communication between referring and receiving organizations. Moreover, these CBOs had limited staff capacity to process referrals promptly and provide timely follow up, thus impeding timely processing of cases. Additionally, disparities in resources existed across CBOs and counties, contributing to delays in referral workflows, which requiring further investigation to create an efficient coordinated referral process. Thus, training gaps contributed to decreased engagement and utilization of NCCARE360 among CBOs addressing food insecurity. Despite resource constraints, staff capacity, and skepticism about its value, CBOs differed in their readiness to adopt NCCARE360 and better training was mentioned as a key opportunity to

overcome these barriers. Improving NCCARE360-related workflows was essential to overcoming these barriers, including automating reminders for referral follow-ups, standardizing referral workflow procedures to reduce delays, providing a directory of active providers/partners on the platform to increase visibility and communication, engaging multiple counties/regions in the area through training and technical assistance, and addressing the anticipated high demand for services that could lead to waitlists.

Implications

The analyses emphasized the importance of tailored strategies for CBOs to overcome resource constraints, streamline referral processes, and increase referral acceptance rates. Key recommendations include: implementation partners such as United Way of North Carolina and Unite Us providing technical, training to improve coordination and communication with CBOs and human resources support to CBOs with lower referral activity, evaluating and replicating successful organizational and referral practices in Alamance County to improve engagement in counties with lower referral activity, strengthening partnerships and collaborations within and across counties in the Piedmont Triad Region to reduce inefficiencies and improve referral acceptance rates, and addressing gaps in service subtypes with absent referrals to optimize utilization and effectively address food insecurity.

While food was a top service referral in NCCARE360, some referrals remained open until services were no longer needed, which could span over 30 days, demonstrating that food referrals require ongoing engagement until the referrals are successfully resolved. This also likely contributed to delays in the referral workflow process as well as many CBOs had limited staff capacity to manage the volume of NCCARE360 referrals. Additionally, if a client had complex needs requiring multiple referrals, delays were likely to occur, resulting in many open

referrals past 30 days. For this reason, CBOs need adequate staffing and resources to increase their organizational capacity for managing long-term cases effectively, maintain communication with clients, and provide consistent, high-quality support to ensure cases are resolved in a timely manner. Furthermore, prolonged open referrals could signal inefficiencies in the referral process or gaps in services, which could delay access to critical resources for clients in needs. Implementation partners must prioritize providing prompt service and technical assistance as questions, concerns, and/or feedback arise when utilizing NCCARE360 to reduce workflow inefficiencies. Providing solutions to these challenges could help NCCARE360 improve service delivery and foster improved care coordination to reduce food insecurity.

The analysis revealed that service subtypes (food pantry, emergency food, and prepared meals) and socioeconomic factors (SNAP, poverty, and unemployment) significantly impacted total referrals for CBOs in Alamance, Davidson, Guilford, Forsyth, and Randolph counties. To best meet the community's needs, resource allocation on food pantries, emergency food, and prepared meals services must be prioritized as these service types consistently received higher referral levels. Moreover, as counties with higher socioeconomic challenges face barriers in accessing referrals, there is a need for improved outreach and coordination within counties and across the Piedmont Triad Region to enhance efficiency and service delivery to support increased use of NCCARE360 to address food insecurity. Implementation partners need to help CBOs overcome organizational barriers to increase referral utilization. Strategies like streamlining referral processes and enhancing community awareness are critical to ensuring that people know about the platform when seeking food assistance. Further, funding remains a critical component in building CBO capacity and strengthening coordinated care networks within

counties and across the Piedmont Triad Region, allowing referral processes to be sustained, service delivery to be improved, and resources to be made more accessible to those in need.

The results suggest that while food insecurity is prevalent in the Piedmont Triad Region (Alamance, Randolph, Guilford, Forsyth, and Davidson counties), CBOs lack the capacity to accept the referrals received. This could be due to limited participation from health systems in the Piedmont Triad Region utilizing NCCARE360, which are essential for connecting patients to services through the platform. The lack of integration could have hindered the platform's effectiveness, contributing to fragmented care and reduced referral activity in the region. Therefore, there is an opportunity to strengthen health systems in the Piedmont Triad Region with NCCARE360 to enhance coordination and support for CBOs addressing food insecurity in this area. Health system buy-in is critical to improve participation and coordination of services through NCCARE360 (Centers for Medicare & Medicaid Services, 2022). Thus, there is an opportunity for health systems to make targeted investments in CBOs to enhance their capacity to use NCCARE360 effectively and handle more referrals. Without sustained targeted investments for CBOs to use NCCARE360, existing disparities may widen. Moreover, state and local policymakers must prioritize cross-sector partnerships between health care and social services and sustained funding to help CBOs meet increasing demands and coordinate care effectively.

Limitations

During focus group recruitment, several key limitations emerged. Local health departments noted minimal referrals from healthcare providers using NCCARE360. As a result, some CBOs chose not to participate in the research study due to low referral activity. Additionally, major hospitals in the Piedmont Triad did not participate in NCCARE360, leading

to fragmented care and insufficient data on patient needs. This affected the coordination of social services referrals, creating inefficiencies and potential service gaps, which hampered the platform's ability to address regional health issues. The lack of data and fewer referrals from major healthcare systems could make it difficult for CBOs to deliver services where they are most needed, resulting in inefficiencies and unmet needs.

Recruitment was hindered by the timing of data collection occurring from September 2024 - November 2024, as many CBOs were occupied with fundraising, grant writing, program planning, and fiscal year-end activities. Moreover, the absence of participant incentives further reduced engagement in the focus groups. Furthermore, Hurricane Helene (September 2024) also diverted attention toward response and recovery efforts in Western North Carolina, limiting availability for participation in focus groups for many CBOs. The timing of the study, particularly in the context of disaster recovery, hindered participant engagement and availability. Finally, area collaboratives and coalitions indicated that food pantries were overwhelmed with managing multiple platforms, decreasing their interest in adopting NCCARE360. While most CBOs addressing food insecurity were aware of NCCARE360, they did not actively use it due to the significant effort required to use the platform and its misalignment with nonprofit workflows, which often faced capacity limitations. Instead, many agencies and CBOs focused on prioritizing data entry into other systems, such as the Homeless Management Information System (HMIS), commonly used by medical practices, shelters, and emergency assistance programs to track health information and services, and Second Harvest databases, which supported documentation, service tracking, and minimizing service duplication. As a result, these existing systems were more integrated into their operations, making the adoption of NCCARE360 more challenging and less feasible.

Another limitation identified during focus group recruitment was the initial overestimation of CBOs on the NCCARE360 platform across the five counties. Originally projected at 353 food serving CBOs, further data mining revealed that only a small subset of CBOs were actively addressing food insecurity across the five counties: 8 CBOs in Alamance, 5 in Davidson, 8 in Forsyth, 12 in Guilford, and 2 in Randolph. This discrepancy highlighted the challenge of relying on inflated numbers for participation and engagement.

The aggregated CBO-level referral data used in this study has several limitations. First, the data exhibited overdispersion, where the variance exceeds the mean, potentially affecting the accuracy of significance tests. Additionally, referral counts did not follow a normal distribution because they were discrete, which required specialized statistical methods to ensure accurate analysis. Furthermore, the data was zero-inflated, indicating an underutilization or limited access of services. The prevalence of zeros and overdispersion in the data could indicate broader issues in service accessibility that warrant further investigation. As a result, alternative modeling approaches required the use of R or Stata, as SPSS did not have built-in capability for zero-inflation models, which would have been more suitable for future analyses. In addition, the referral data only encompassed the 12-month period from July 2023 to June 2024, so longitudinal studies were needed to better understand referral trends, workflow processes, facilitators of success, and barriers to implementation across CBOs.

Data limitations at the CBO level made assessing key metrics such as the average time to close cases, the time to accept referrals, and case referral and completion rates difficult, since these measures were not available or included in the dataset. This objective initially sought to examine referral success rates, closed-loop referral rates, types of resources referred, and time to connection over the past 12 months. However, data limitations restricted access to time-to-

connection and closed-loop referral rate data. Moreover, future research should consider analyzing CBO-level data directly provided by organizations rather than relying solely on implementation partners to understand these measures.

Conclusion

A significant difference observed between referral acceptance rates across Alamance, Davidson, Guilford, Forsyth, and Randolph counties suggested a need for further research at the organizational and county levels to better understand operations, capacity, resources, services, and community context. As a result, determining why some CBOs performed better or worse in terms of referral acceptance rates could provide insights into how to improve performance across for all users and increase NCCARE360's onboarding and retention. CBOs with lower referral activity could benefit from additional support to increase their engagement with clients and referral networks in their counties. According to the resource dependency theory, strategic collaboration was fundamental to nonprofit organizations if they were to secure resources and reduce uncertainty (Guo & Acar, 2005). These organizations could gain access to resources such as funding, technical assistance, and capacity by establishing partnerships with other CBOs, coalitions, NCCARE360 implementation partners, and local governments in the Piedmont Triad Region, reducing operational challenges and improving referral pathways and service delivery for communities in need. Additionally, addressing the onboarding barriers and strengthening the facilitators, could also help to significantly improve NCCARE360’s impact on food insecurity and health outcomes across the Piedmont Triad region and beyond. Further, improving communication and promotion of NCCARE360 would raise awareness of services available through CBOs that address food insecurity and support those in need. This research study revealed that CBOs can accept and manage referrals more effectively if resources and effective

organizational practices were available, therefore, addressing these factors could improve the overall success and retention of CBOs utilizing NCCARE360 to combat food insecurity.

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Appendix A. IRB Approval

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board
Willis Building · Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · **rede.ecu.edu/umcirb/**

Notification of Initial Approval: Expedited

From: Biomedical IRB

To: Breyana Davis

CC: Doyle Cummings

Date: 9/11/2024

Re: UMCIRB 24-001401
Exploring NCCARE360's Role in Addressing Food Insecurity: Onboarding Successes, Challenges, and Referral Outcomes Among Community-Based Organizations in the Piedmont Triad Region

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) occurred on 9/11/2024. The research study is eligible for review under expedited category # 6,7. The Chairperson (or designee) deemed this study no more than minimal risk.

As the Principal Investigator you are explicitly responsible for the conduct of all aspects of this study and must adhere to all reporting requirements for the study. Your responsibilities include but are not limited to:

1. Ensuring changes to the approved research (including the UMCIRB approved consent document) are initiated only after UMCIRB review and approval except when necessary to eliminate an apparent immediate hazard to the participant. All changes (e.g. a change in procedure, number of participants, personnel, study locations, new recruitment materials, study instruments, etc.) must be prospectively reviewed and approved by the UMCIRB before they are implemented;

2. Where informed consent has not been waived by the UMCIRB, ensuring that only valid versions of the UMCIRB approved, date-stamped informed consent document(s) are used for obtaining informed consent (consent documents with the IRB approval date stamp are found under the Documents tab in the ePIRATE study workspace);

3. Promptly reporting to the UMCIRB all unanticipated problems involving risks to participants and others;

4. Submission of a final report application to the UMICRB prior to the expected end date provided in the IRB application in order to document human research activity has ended and to provide a timepoint in which to base document retention; and

5. Submission of an amendment to extend the expected end date if the study is not expected to be completed by that date. The amendment should be submitted 30 days prior to the UMCIRB approved expected end date or as soon as the Investigator is aware that the study will not be completed by that date.

The approval includes the following items:

Name	Description
BDavis_Disseration_proposal_Ch.1-3_08.12.docx	Study Protocol or Grant Application
ECU Informed-Consent-09.06.24.docx	Consent Forms
Focus Group Guide (1).docx	Interview/Focus Group Scripts/Questions
Updated_Email for In Person Focus Group_9.3.docx	Recruitment Documents/Scripts
Updated_Email for Virtual Focus Groups_9.3.docx	Recruitment Documents/Scripts
Updated_Phone Script_9.3.docx	Recruitment Documents/Scripts

For research studies where a waiver or alteration of HIPAA Authorization has been approved, the IRB states that each of the waiver criteria in 45 CFR 164.512(i)(1)(i)(A) and (2)(i) through (v) have been met. Additionally, the elements of PHI to be collected as described in items 1 and 2 of the Application for Waiver of Authorization have been determined to be the minimal necessary for the specified research.

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418

Appendix B. Informed Consent Form

Title of Research Study: Exploring NCCARE360's Role in Addressing Food Insecurity: Onboarding Successes, Challenges, and Referral Outcomes Among Community-Based Organizations in the Piedmont Triad Region

Principal Investigator: Breyana Davis, MPH
Institution, Department or Division: Department of Public Health, Brody School of Medicine
Address: 115 Heart Drive Mailstop 660. Greenville, NC 27834
Telephone #: 252.744.5185

Researchers at East Carolina University (ECU) and the Foundation for Health Leadership and Innovation (FHLI) study issues related to society, health problems, environmental problems, behavior problems and the human condition. To do this, we need the help of volunteers who are willing to take part in research.

Why am I being invited to take part in this research?
You are invited to participate in this research because you were actively involved with NCCARE360 within the last 12 months in addressing food insecurity in Alamance, Randolph, Davidson, Forsyth, and Guilford counties in the Piedmont Triad region. Your unique perspective and experiences with the platform will help us understand how well it supports community-based organizations and where improvements can be made. The decision to participate is entirely up to you. By participating in this study, we hope to learn more about the effectiveness of NCCARE360 in facilitating referrals and managing food insecurity and to identify any challenges or successes you've encountered in using the platform. Your input will be crucial in helping us enhance the system and better support organizations like yours in the future.

Are there reasons I should not take part in this research?
You should not take part in this research if you were not actively involved with NCCARE360 within the last 12 months in addressing food insecurity or if you are not a representative of a community-based organization (CBO) in Alamance, Randolph, Davidson, Forsyth, and Guilford counties in the Piedmont Triad region. Additionally, if you are under 18 years of age or do not have direct experience with the platform and its referral processes, you may not meet the eligibility criteria for this study. These conditions ensure that participants can provide relevant insights and experiences necessary for the research.

Where is the research going to take place and how long will it last?
The research will be conducted virtually to increase participation and will also include an in person focus group at the Piedmont Triad Region Summit on October 11, 2024. You are welcome to join a session that is convenient for your schedule. The total amount of time you will be asked to volunteer for this study is approximately 1 hour per session. The study will take place over the next 2 to 3 months, depending on the timing of your participation.

What will I be asked to do?

You will be asked to participate in a focus group session, either virtually or in person at the NCCARE360 Fall Piedmont Triad Region Summit on October 11, 2024. During the focus group, you will discuss your experiences with NCCARE360 and share your insights on its effectiveness and any challenges you've encountered.

Each session will last approximately 1 hour. You will be asked questions about your use of NCCARE360, including how well it supports food insecurity efforts, any difficulties you have faced, and suggestions for improvement. These questions are designed to gather detailed feedback on the platform's performance. There are no specific procedures or tests involved beyond the focus group discussions. However, if you participate virtually, you will need a stable internet connection and a quiet space for the session.

To ensure accuracy, the focus group may be audio-recorded. Recordings will be used solely for research purposes, transcribed, and analyzed. Only the research team will have access to these recordings. The audio files will be stored securely and identified only by a code, not by your name. They will be kept for the duration of the study and destroyed after the research is completed, typically within a few months of data collection. You will have the opportunity to agree to or decline participation in the recording process. Informed consent is required to participate in this study. Participants will be assured of anonymity and confidentiality unless participants provide informed consent to have their organizations identified in the study's results.

What might I experience if I take part in the research?
There are minimal risks associated with participation in this study. There is minimal risk that a data breach may occur. Organizations may experience operational disruptions as a result of participating in the focus group or may experience reputational risk if they choose to participate in the study and be identified. Organizations may benefit by contributing to improving processes for successful onboarding and retention of CBOs addressing food insecurity on NCCARE360, potential networking opportunities fostering knowledge sharing and collaboration, and enhanced visibility for organizations that opt to be identified. Additionally, participation may help inform policymakers, practitioners, and funders about effective strategies for leveraging coordinated care networks to address social determinants of health, potentially leading to broader system improvements in addressing food insecurity.

Will I be paid for taking part in this research?
We will not be able to pay you for the time you volunteer while being in this study.

Will it cost me to take part in this research?
It will not cost you any money to be part of the research.

Who will know that I took part in this research and learn personal information about me?
ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- The FHLI and its administrators may use this information to strategically plan how to support CBOs who are currently using NCCARE360, including addressing challenges associated with onboarding to recruit more CBOs and increase their utilization of NCCARE360 to address unmet social needs in North Carolina.

- The University & Medical Center Institutional Review Board (UMCIRB) and its staff have responsibility for overseeing your welfare during this research and may need to see research records that identify you.

How will you keep the information you collect about me secure? How long will you keep it?
The information collected during this study will be kept secure using several measures. For electronic data, including audio recordings, we will use encrypted files and password-protected systems to ensure that only authorized research team members can access the data. Physical documents, if any, will be stored in locked cabinets in secure areas.

Audio recordings of focus groups or interviews will be kept for the duration of the study, typically a few months. After this period, the recordings will be transcribed and the original audio files will be securely deleted. The transcriptions will be stored electronically with identifiers removed, so your personal information will not be linked to the data. Recordings and transcriptions will be used solely for research purposes and will not be used for teaching or presentations. Any information used in future research will be stripped of identifying details to protect your privacy. Data will be kept for as long as needed for the study, up to a year, and then destroyed to ensure confidentiality.

What if I decide I don't want to continue in this research?
You can stop at any time after it has already started. There will be no consequences if you stop and you will not be criticized. You will not lose any benefits that you normally receive.

Who should I contact if I have questions?
The people conducting this study will be able to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator at 336.944.3723 (days).

If you have questions about your rights as someone taking part in research, you may call the ECU University and Medical Center Institutional Review Board (UMCIRB) at phone number 252-744-2914 (days). If you would like to report a complaint or concern about this research study, you may call the Director for Human Research Protections, at 252-744-2914.

Is there anything else I should know?
Your information collected as part of the research, even if identifiers are removed, will not be used or distributed for future studies.

Before deciding to participate, please note that your involvement is entirely voluntary, and you can withdraw at any time without affecting your relationship with NCCARE360. Confidentiality will be maintained as much as possible, but complete privacy cannot be guaranteed. There is no direct compensation for participation, but your input will help improve the NCCARE360 platform. If you have any questions or concerns, you can contact the research team for more information.

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

_____ _____

Participant's Name (PRINT) Signature Date

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

_____

Person Obtaining Consent (PRINT) Signature Date

Appendix C. CEPH Competencies Addressed

DrPH Health Policy Administration and Leadership Dissertation Approval Form

Name: Breyana Davis Student ID: B01394115 Major: Health policy, administration, and leadership

Course of Enrollment: PUBH 9000 Dissertation Research Completed Final Product: Dissertation

To be completed by DrPH student:

The DrPH dissertation must demonstrate synthesis of foundational and major competencies where the student produces a high-quality written professional product(s) that is an appropriate contribution to the field of public health, and their educational and professional goals. The DrPH competencies should be addressed in the spaces below and included as part of the dissertation product. This can be as a separate page of the dissertation.

List the 4 DrPH Foundational Competencies addressed in the dissertation.

1. Design a qualitative, quantitative, mixed methods, policy analysis or evaluation project to address a public health issue
2. Propose strategies for health improvement and elimination of health inequities by organizing stakeholders, including researchers, practitioners, community leaders, and other partners
3. Integrate knowledge, approaches, methods, values, and potential contributions from multiple professions and systems in addressing public health problems
4. Propose human, fiscal, and other resources to achieve a strategic goal

List at least 2 HPAL, concentration competencies addressed in the dissertation.

1. Create and assess programs that facilitate improvements in rural health and to reduce health disparities
2. Assess and enhance leadership skills (such as negotiation, mediation and collaboration) that empower organizations/communities to address challenging issues

Describe in 2 paragraphs (200 to 400 words) how the proposed dissertation synthesized the selected competencies above with explanation for how each competency was attained. Number, name each competency, then provide explanation for how competency was attained.

DrPH Foundational Competencies

1. Design a qualitative, quantitative, mixed methods, policy analysis or evaluation project to address a public health issue.

The research study utilized a mixed-methods approach to evaluate the implementation and utilization of NCCARE360 by CBOs addressing food insecurity in the Piedmont Triad Region (Alamance, Randolph, Guilford, Forsyth, and Davidson counties). To provide a comprehensive understanding of the facilitators and barriers that influence successful referrals and resource connections through NCCARE360, quantitative referral data and qualitative insight from focus groups were triangulated. The results provided recommendations for improving the platform's efficiency in addressing food insecurity.

2. Propose strategies for health improvement and elimination of health inequities by organizing stakeholders, including researchers, practitioners, community leaders, and other partners.

As part of the research study, key stakeholders such as the Foundation of Health Leadership and Innovation, North Carolina Division of Public Health, and CBO staff and leaders explored ways to improve CBO capacity, enhance referral pathways, and strengthen cross-sector partnerships to facilitate NCCARE360 utilization in the Piedmont Triad Region (Alamance, Randolph, Guilford, Forsyth, and Davidson counties). The findings led to strategies and recommendations designed to improve patient access to food-related resources, address disparities in food insecurity interventions, and strengthen regional networks to increase CBO reach and impact.

3. Integrate knowledge, approaches, methods, values, and potential contributions from multiple professions and systems in addressing public health problems

In this research study, knowledge, approaches, and methods were brought together from public health, healthcare systems, health policy, social work, healthcare administration, and community-based organizations to highlight the interconnected role of various professions in promoting health equity across sectors. This research study adopted an interdisciplinary approach to ensure that findings could be effectively translated into strategies to enhance coordination among healthcare providers, social service organizations, and governmental public health.

4. Propose human, fiscal, and other resources to achieve a strategic goal.

The research study underscored the critical need for CBO capacity-building and sustainable funding to maximize NCCARE360's impact. To ensure long-term sustainability, technical assistance, cross-sector collaboration, and strategic technology investments were emphasized. Further, the research study highlighted the need for ongoing training and awareness campaigns to ensure widespread adoption and effective use of the platform.

HPAL Concentration Competencies

1. Create and assess programs that facilitate improvements in rural health and to reduce health disparities.

An analysis of referral trends and factors affecting successful connections identified service gaps and barriers faced by CBOs, including resource constraints, technical challenges, and capacity limitations. Improving NCCARE360's use and retention in underserved and rural areas requires targeted outreach, tailored training, and stronger healthcare and social service partnerships. Expanding its impact and addressing health disparities in North Carolina also depend on sustainable funding, cross-sector collaboration, and community engagement.

2. Assess and enhance leadership skills (such as negotiation, mediation and collaboration) that empower organizations/communities to address challenging issues

The research study found that cross-sector collaborations strengthened NCCARE360's food insecurity referral network but faced challenges in aligning stakeholder priorities. It proposed training and capacity-building to enhance partnerships and explored how leadership skills helped organizations navigate funding, resource, and engagement barriers. Improving NCCARE360's coordination of health and social services requires ongoing investment in collaborative problem-solving, training, and strategic planning.

Appendix D. Definitions and Significance of Key Terms and Partners

The following key terms and partners are defined for this research study, including their significance.

Technology-facilitated platforms offer healthcare organizations an innovative way to refer to CBOs, featuring core capabilities like social risk screening, community resource directories, referral management, care coordination, privacy protection, system integration, and reporting and analytics (Cartier et al., 2020).

In 2019, *NCCARE360* was developed through a partnership between the North Carolina Department of Health and Human Services (NCDHHS), Unite Us, NC 211, the United Way, and the Foundation for Health Leadership & Innovation (FHLI). NCCARE360 is a coordinated care network that includes healthcare, government, CBOs, and nonprofits, addressing medical care and social needs in North Carolina via the Unite Us platform. Unite Us also provides technical assistance, community engagement, network optimization, and user support (McPeek Hinz et al., 2023; Huber et al., 2023).

Unite Us, an NCCARE360 implementation partner, coordinates cross-sector networks to address social determinants of health and improve population outcomes. Their platform integrates healthcare services with community resources, securely identifying, delivering, and paying for services to meet patients' social needs. This technology facilitates referrals to community resources, improving health outcomes and centralizing health metrics and outcome data to support increased investment in community resources and public health infrastructure (McPeek Hinz et al., 2023; Huber et al., 2023).

In partnership with NCCARE360, *United Way of North Carolina 211* connects North Carolina individuals and families to free and secure information on local community resources and social services by dialing 2-1-1, a statewide resource database and call center that facilitates coordination. United Way of North Carolina is the statewide member organization for other local United Way organizations and also serves as the statewide administrator of the NC 211 system (NCDHHS, 2024).

Foundation for Health Leadership and Innovation (FHLI) is a nonprofit organization that prioritizes programs and partnerships to improve coordination and strengthen collaborations to advance strategy and health issues, improve population health outcomes, and drive innovation for whole-person healthcare. NCCARE360 is made possible through the public-private partnership between NCDHHS and FHLI (NCDHHS, 2024).

Unmet social needs are social, economic, and environmental factors such as food, transportation, housing, and violence associated with adverse patient health outcomes (Johnson et al., 2024). *Social determinants of health* refer to the social, economic, and behavioral factors determined by where individuals live, learn, work, play, worship, and age (Friedman & Banegas, 2018). Addressing unmet social needs and social determinants of health will influence choices and systems to support healthy individuals, communities, and environments (Gutschall et al., 2021; Busza et al., 2012).

As defined by the U.S. Department of Agriculture (USDA), *food insecurity* is an individual's inability to consistently access enough food to live a healthy and active lifestyle (Lyonnais et al., 2020; USDA, 2021). The prevalence of food insecurity is linked with adverse health outcomes, causing increased health disparities and disproportionate impacts on rural and underserved communities (Lyonnais et al., 2020).

Appendix E. Focus Group Guide

Welcome:

My name is Breyana Davis and I am a doctoral student at East Carolina University. I am facilitating today's focus group.

Overview:

Thank you for participating in this focus group to gather valuable insights into the engagement of Community-Based Organizations (CBOs) addressing food insecurity with NCCARE360. Your input is crucial for enhancing the effectiveness of the platform and improving access to health services and resources across historically marginalized communities in North Carolina.

This discussion is scheduled for 60 minutes. You are welcome to leave the session at any time.

Ground Rules:

- Confidentiality: Everything shared in this group will remain confidential.
- Respect: Please respect each other's opinions and allow everyone a chance to speak.
- Recording: With your consent, this session will be recorded to ensure we capture all the details accurately.

Participant Introductions: Let's start with brief introductions. Please tell us your name, your organization, and your role within the organization.

Discussion Questions:

1. **Usage and Motivation**:
    - What motivated your organization to sign up for NCCARE360?
    - How did your need for certain resources play into that decision?
2. **Perceptions and Impact**:
    - What is your current perception of NCCARE360 and its potential benefits?
    - Can you give an example of how NCCARE360 positively impacted your organization's operations and services?
3. **Challenges and Satisfaction**:
    - Has your organization observed any challenges when using NCCARE360? How do these issues relate to your organization's reliance on the platform?
    - How satisfied are you with the quality of data and information available through NCCARE360? How do you think the availability of these resources impacts your satisfaction?
4. **Staff Engagement**:
    - How engaged are your staff members in utilizing NCCARE360? How does this involvement reflect your organization's need for the platform?
    - Does your organization encounter any resistance or reluctance among staff in utilizing NCCARE360? If so, how?

5. **Benefits and Realization**:
    - What benefits did you see from using NCCARE360? Have these benefits met your expectations and align with your organization's needs?
6. **Resource Allocation**:
    - How did your organization decide to allocate resources, such as staff time and budget, to support using NCCARE360? Why do you think this investment is important for your organization?
7. **Training and Support**:
    - Are there areas where additional training or support would be beneficial? If so, which areas and how?
    - Are there specific features or functionalities in the NCCARE360 platform you want to be added or enhanced? How would these additions make a difference for your organization?
8. **Onboarding and Incentives**:
    - How can NCCARE360 improve onboarding support for new CBOs?
    - What incentives would encourage active participation from CBOs in NCCARE360? How would these incentives address your organization's needs?
9. **Feedback and Improvements**:
    - Have you sought feedback from other organizations or colleagues who have experience with NCCARE360?
    - What conditions or changes would make NCCARE360 more appealing to other organizations? How would these changes impact the way you use the platform?

Closing Remarks:

We will analyze the data collected and share a summary of our findings with you upon request. If you have any additional thoughts or questions after today, please feel free to contact me at davisbre21@students.ecu.edu.

Your insights are invaluable, and your contribution will play a significant role in shaping the future of NCCARE360. I appreciate your time and commitment to improving access to community services. Thank you once again for your participation.

Appendix F. Draft Recruitment Email for Virtual Focus Groups

Subject: Invitation to Participate in Virtual Focus Groups on NCCARE360 and Food Insecurity in the Piedmont Triad Region

Dear [Recipient's Name],

I hope this message finds you well. My name is Breyana Davis, and I am conducting research in collaboration with FHLI on the impact of NCCARE360 on food insecurity in the Piedmont Triad Region as part of my dissertation study. The counties of focus are Alamance, Randolph, Davidson, Guilford, and Forsyth.

This research study aims to understand the referral trends, onboarding successes, and challenges faced by community-based organizations like yours in utilizing NCCARE360 to address food insecurity. Your insights are invaluable to us and will significantly contribute to our understanding of how the platform supports organizations in achieving their mission in addressing food insecurity.

The virtual focus groups will be an opportunity to share your experiences with NCCARE360, discuss the successes and challenges you have encountered, and provide feedback on the platform's effectiveness in managing referrals and addressing food insecurity.

Details of the Focus Group:

- **Date and Time:** [Proposed Dates and Times]
- **Duration:** Approximately [Duration]
- **Registration links:** [include Zoom registration links for participant sign up]

Your participation will involve sharing your experiences and opinions in a group setting with other organizations. Informed consent is required to participate in this research study. Participants in focus groups will be assured of anonymity and confidentiality unless participants provide informed consent to have their organizations identified in the research study's results. Your contribution will help improve the platform and better support organizations in the Piedmont Triad Region.

Please sign up for a virtual focus group that works best for your schedule using the registration link. If you have any questions or need further information, feel free to contact me directly at davisbre21@students.ecu.edu or 336.944.3723.

Thank you for considering this opportunity. We look forward to your participation and appreciate your support in advancing research on this important topic.

Sincerely,

Appendix G. Draft Recruitment Email for In Person Focus Group

Subject: Join Us at the 2024 NCCARE360 Fall Summit: Participate in Our Focus Group on Food Insecurity

Dear [Recipient's Name],

I hope this message finds you well. My name is Breyana Davis, and I am conducting research in collaboration with FHLI on the impact of NCCARE360 on food insecurity in the Piedmont Triad Region as part of my dissertation study. I am excited to invite you to an in person focus group taking place at the NCCARE360 Fall Summit for the Piedmont Triad Region on October 10, 2024.

Focus Group Details:

- **Focus Group Date and Time:** [Date and Time of the Focus Group]
- **Location:** [Location within the Summit Venue]

The focus group will be an opportunity to share your experiences with NCCARE360, discuss the successes and challenges you have encountered, and provide feedback on the platform's effectiveness in managing referrals and addressing food insecurity.

How to Participate:

1. **Register in Advance:** You can sign up for the focus group through the conference registration process. Please select the focus group session when registering.
2. **Sign Up Onsite:** If you prefer to register at the conference, visit the registration table at the summit to sign up for the focus group.

Your participation will involve sharing your experiences and opinions in a group setting with other organizations. Informed consent is required to participate in this research study. Participants in focus groups will be assured of anonymity and confidentiality unless participants provide informed consent to have their organizations identified in the research study's results. Your contribution will help improve the platform and better support organizations in the Piedmont Triad Region.

If you have any questions or need further information, feel free to contact me directly at davisbre21@students.ecu.edu or 336.944.3723.

Thank you for considering this opportunity to share your valuable insights. We look forward to your participation at the NCCARE360 Fall Summit.

Sincerely,