

THE FOOD SAFETY POLICY GAP:
ESSAYS ON EMERGENCY FOOD IN NORTH CAROLINA

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ABSTRACT

Ashley Chaifetz: The Food Safety Policy Gap: Essays on Emergency Food in North Carolina
(Under the direction of Pamela Jagger)

In an effort to detail, describe, categorize, and analyze the emergency food system of North Carolina, this research presents three essays focused on food pantry procedures as related to food safety. Given the focus on food insecurity, food safety is often a lower priority for food pantries; however, foodborne illness is a serious problem that affects 1 in 6 Americans each year. The first essay identifies and catalogues the standard operating procedures of 105 North Carolina food pantries, comparing those who partner with a formal food bank to those that operate independently, metropolitan with rural pantries, and food pantry managers who did and did not complete training in food safety. The second essay documents the food pantry supply chain and channels of distribution and evaluates them using a risk framework created specifically for emergency food. The results of the negative binomial analysis suggest that pantries that participate in a federal commodity program like TEFAP employ less risky practices, both in transport and storage ($p < 0.01$). The third essay employs a difference-in-difference design to analyze new online food safety guidelines created based on the results of the first essay. Its null findings on modified North Carolina Food Establishment Inspection Report questions suggest that further research is required in order to improve food safety at food pantries, while paired t-tests on an isolated sample suggest the online guidelines can be effective when viewing the guidelines is required and/or guaranteed. The overall findings of this research provide insight to the practices and supply chain of the North Carolina emergency food system, add to the literature at the cross-section of food safety, food security, and nutrition, and allowed for the creation of best practices guidelines specific to food pantries.

To my grandmothers, who never failed to ask when I would finish school and get a job.

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PREFACE

In the summer of 2008, hundreds of people were sick from eating a then-unknown contaminated food. At the time, it was the largest foodborne illness outbreak in a decade—and the end result was 1,442 confirmed cases of *Salmonella* Saintpaul (CDC, 2008). The Centers for Disease Control and Prevention and the Food and Drug Administration struggle to determine which product was the culprit; they warned the public that food was possibly tomatoes, jalapeno or Serrano peppers, or even cilantro.¹ The agencies were unable to trace the source of contamination to a particular location, going back and forth between Florida and Mexico for months. At the time, I watched a news broadcast in which the reporter detailed only four countries in the world that had been essentially “ruled out” in terms of supplying the product. I distinctly remember going to the grocery store with a list of tomatoes sanctioned by the FDA, as no product in particular had been officially recalled. Multiple tomato growers lost the ability to sell their tomatoes and left them to rot in the field, and it was eventually discovered that the cause of the illnesses were the peppers from Mexico.

To put it lightly, I was obsessed with this outbreak. Even then, I knew that our system was flawed. I just could not understand how and why, in a developed country like America, we could not figure out what was making people sick, or how people without healthcare would be able to get medical assistance for something so dire.² It was in this outbreak that my interests in food systems policy expanded to providing citizens with practical scientific information, but also in foodborne illness prevention—and I refuse to look back.

¹I was convinced they were looking for a salsa farm.

²In short, they aren’t always able to do so.

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LIST OF ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
CSR	Corporate Social Responsibility
DD	Difference-in-Difference
FDA	Food and Drug Administration
MSA	Metropolitan Statistical Area
NC	North Carolina
NCDA	North Carolina Department of Agriculture
OLS	Ordinary least squares
RTE	Ready-to-eat
SNAP	Supplemental Nutrition Assistance Program
SOPs	Standard operating procedures
TEFAP	The Emergency Food Assistance Program
TPB	Theory of Planned Behavior
USDA	United States Department of Agriculture

CHAPTER 1: FOOD SAFETY AND FOOD SECURITY IN AMERICA

1.1 Introduction

The safety (or lack thereof) of the American food supply is a significant problem facing individuals of all races, ethnicities, ages, and income levels. The 1993 *E. coli* O157:H7 outbreak stemming from Jack-in-the-Box hamburgers sparked two decades of research into the fields of microbiology, epidemiology, food technology, agricultural economics and regulatory theory. Every year, an estimated 48 million Americans (1 in 6) contract foodborne illness (Scallan et al., 2011a; Scallan et al., 2011b), stemming from grocery stores, hospitals, prisons, church banquets, county fairs, restaurants, private homes, schools, and even meal programs like Meals on Wheels (CDC Foodborne Outbreak Online Database, 2011; Vail, 2015). Analysis of data from the Centers for Disease Control and Prevention's (CDC) FoodNet revealed 9.4 million episodes of foodborne illness, defined as consumption of contaminated foods (CDC, 2012), occur each year due to major pathogens, excluding "unspecified agents" (Scallan, et al., 2011a). The estimated costs of foodborne illness in America each year is \$36 billion, with an average cost burden of \$3,630 per illness (Minor et al., 2014). With various publications on the innumerable aspects of foodborne illnesses, only recently has research has explored the potential connection between food-insecure populations and risk of foodborne illness, especially for emergency foods (c.f. Henley et al., 2012; Koro et al., 2010; Quinlan, 2013).

1.2 Emergency Food

Emergency food is the overarching term for foods distributed through shelters, food banks, food pantries, soup kitchens, backpack programs, and other institution-specific programs. Food

banks are large warehouse operations that store and distribute food from producers, retailers, federal commodity programs, and the food industry to the food pantries, which then distribute emergency food at the local level (Berner & O'Brien, 2004; Curtis & McClellan, 1995). Food emergencies can be often be categorized as “catastrophic and disaster events,” events that are seemingly exogenous rather than persistent (Altay & Green, 2005). Yet, the prevalence and perseverance of the emergency food networks, both formal and informal, across the country tell another story. Food banks and pantries are the largest part of the emergency food system, though individuals and families might also participate in community gardens, eat at church dinners, and accept foods from neighbors for sustenance.

In North Carolina, 27.3% of the children are categorized as food-insecure, but are only a portion of the total 1,863,330 North Carolinians who are food-insecure (Feeding America, 2013).³ While visiting a food pantry or food bank might be the result of a crisis for many of those in need, the food pantries consistently make available and provide complimentary sources of foods throughout the year. Feeding America is largest domestic hunger relief charity, providing 46.5 million people with 3.3 billion meals annually via their 200 member food banks and 60,000 food pantries (Feeding America, 2014). This network relies heavily on corporate sponsorship, retail and manufacturing donations, and the aforementioned federal commodity programs, namely The Emergency Food Assistance Program (TEFAP). Feeding America and its partners distribute 80% of all TEFAP items in the country (Feeding America, 2014). It is at the discretion of the food banks and food pantries to determine individual eligibility for the items (Bhattarai et al., 2005). As far as the goods at the pantries themselves, earlier research shows that grocery stores and food drives they play a large role worldwide, but they are not the only sources of food (Schneider, 2013). The food

³The U.S. Community Population Survey uses the prevalence of limited food per paycheck, the cost of goods, persistent feelings of hunger, and lack of money for food to assess food security (Coleman-Jensen, et al., 2012).

comes from a variety of places, from individuals and grocery stores to community gardens and restaurants (Bhattarai et al., 2005; Curtis and McClellan, 1995; Daponte and Bade, 2006; Davis et al., 2014; Teron & Tarasuk, 1999). More than one-third of supermarkets operate reclamation centers, which allow employees to sift through damaged goods in consideration for donation but they also donate prepared foods to soup and community kitchens, as well as pantries (Food Marketing Institute, 2005). Additionally, salvaged or gleaned foods from producers and distributors that might otherwise be thrown into the garbage are regularly donated (Slipchinsky & Alexander, 2008; Teron & Tarasuk, 1999). Hunters' cooperative organizations pay for the processing and distribution of hunted game, typically venison, for its donation to food banks and food pantries, with the prevalence of such organizations flourishing in certain communities over others.

The Bill Emerson Good Samaritan Food Donation Act alleviates liability concerns for the donated goods; every state has applied this federal rule of strict liability that applies to distributors of defective products when they cause injury, typically due to gross negligence, intentional misconduct, or recklessness (Morenoff, 2002). The Act was passed because large grocery chains were hesitant to donate expired and nearly-expired foods because of liability concerns, which would have been wasted as a result (Cohen, 2006). The legislation reduced questions regarding the donor's incentive to take care. In some states, a donor is protected from criminal and civil liability, while in others the donor protection is only civil. Additionally, some states, like Massachusetts, have created strict guidelines regarding food donation, given the lack of federal government oversight. Yet, the Act does not necessarily prohibit any particular foods for donation. To use a phrase coined by researchers at The Ohio State University, the supply chains and operating procedures of food pantries adhere to a "loosely-coupled system of standards," meaning that there is no overarching rule for which the pantries follow (Parker et al., 2012).

1.3 Food Safety and Risk

Overall, individuals consume more fresh fruits and vegetables than they have in the past, notoriously linked to foodborne illness, leading to increased interest and research into foodborne illness outbreaks and recalls (Beuchat, 1995; DuPont, 2007). In America, the current food safety system is the result of cooperation and management from many parts of the federal and state governments, including but not limited to the U.S. Department of Agriculture (and departments of agriculture at the state-level), the Food and Drug Administration, the Department of Defense, and state health departments. President Obama has proposed a single agency to oversee food safety policy in the United States, though its creation and implementation remains uncertain (Nixon, 2015).

A 2007 publication noted, “public concern about food safety is placing increasing pressure on government agencies to be more prescriptive and proactive in their regulation of the food industry” (Garcia Martinez et al., 2007, p. 299). Each state has different means and available funds for carrying out additional protective legislation (Jones et al., 2013). In rural populations, food systems governance issues require analyses of local urban and rural food policy, discussions of infrastructure and transportation, and programs related to food security. Rural sociologists have suggested that strengthening community structure has connections to improved food security, especially if the region can provide foodstuffs for its residents (Morton et al., 2005).

Yet, outbreaks (when a group of people consume the same contaminated food and at least two of them contract the same illness) and recalls (when a risky product is removed from store shelves) still occur and can do so at many points in the food system (CDC, 2012). Some private retailers from small mercantile shops to large grocery chains (like Wal-Mart and Carrefour) require their own stricter safety standards for use in the global market (Henson & Reardon, 2005; Reardon & Berdegue, 2002). Grocery stores have an incentive to set additional standards for “‘risky’ products such as fresh fruit and vegetables, meat and dairy products where pesticide residues and/or bacterial

contamination can produce short to medium term health problems amongst their clientele” (Henson & Reardon, 2005, p. 245). Third-party certifications can be the result of absent federal regulations, but also voluntarily adopted as insurance for the store and, more significantly, proof of a major shift to food-related self-governance (Hatanaka et al., 2005; Hatanaka et al., 2008).

A 2003 study by Frewer and Miles resulted in overt answers about the sources of food risk information, finding high levels of distrust in the food industry. Trust in information sources is “dependent upon contextual factors, such as time of measurement and specificity of information source” (Frewer & Miles, 2003, p. 267). To understand how a consumer considers a single purchase, researchers use contingent valuation and experimental auction markets to put a value on food safety, the transaction costs, the probability of foodborne illness, and cost-of-illnesses (Alfnes & Rickertsen, 2003; Caswell, 1998; Hayes et al., 1995; Shogren et al., 1999).

Grocery store products that are near or past their expiration dates are regularly donated to food pantries, or are heavily marked down to make them enticing to buyers. The stores can still profit and price-sensitive consumers can obtain products they might not have otherwise. Yet, these policies are regressive; that is, low-income customers disproportionately purchase the near or past-date foods. Except for infant formula, federal law requires no food dating, though that varies by state. If a date is used, the calendar date must give the month, day, and year, as well as “use before” or “best by.” “Sell by” dates are for the grocery stores, which tell the employees how long to display the product. The “use by” and “best by” dates are to show quality, not safety. While it is well-documented that the misinterpretation of food labels leads to millions of pounds of waste each year (Bloom, 2011; Gunders, 2012; Leib & Gunders, 2013), consumers continue to interpret the date, regardless of whether it is “best by” or “use by,” as the date by which the food should be thrown in the garbage. The risk associated with package dates is predominately perceived, for both perishable and non-perishable items (Tsiros & Heilman, 2005). The Food Safety and Inspection Service of the

USDA suggests the length of time and at what temperature the items should remain “good” past their respective expiration dates. The laws that state what foods can remain on the grocery store shelves or are required to be removed past its stamped date vary widely by state, and North Carolina has no additional food dating regulations beyond federal. Similarly, emergency food providers are typically seeking any and all available foods. The use of past-date foods is increasingly common; food banks and pantries often receive foods after a grocery store has pulled product from the shelves, usually at or near its package date.

With fewer and fewer grocery stores throughout the United States, nonmetropolitan residents are clearly disadvantaged in their access to food in general, especially if they do not own vehicles or have physical disabilities (Blanchard & Matthews, 2007). Additionally, low-income neighborhoods have fewer instances of grocery stores but have access to convenience stores, with predominately black and Asian neighborhoods at lower rates than white neighborhoods (Powell et al., 2007). The lack of access is shown to lead individuals to alternative food sources, including the pantries (Blanchard & Matthews, 2007; Smith & Morton, 2009). The food travels varying distances with varying levels of risk: hot backseats and trunks of cars, refrigerated vans, and so forth. Additionally and more importantly, the food handlers are typically volunteers. The role of the pantries and their volunteers in food provision is critical, yet have been excluded from food handling studies. While Akerlof’s (1970) paper on the market for “lemons” explains that the forces of the market will drive out those who offer “inferior goods,” food pantries with poor practices or contaminated food will likely continue to go untarnished given they are not inspected or regulated. Frequently, regulations are in place to protect the market, rather than the public (Antle, 1996) and the cost of compliance varies based on the size of firm (Antle, 2000).

1.4 Food Waste

Secondary to the issue of hunger is that of food waste—the pantries are able to intercept goods (both perishable and non-perishable) that might have otherwise been wasted, in the same vein as salvage groceries but with a social welfare mandate. Those goods are used to assist a hungry population and, given the rising interest in food waste, even more food is expected to be recovered in the future, some of which will be redistributed (Gustavsson et al., 2011). Like in the traditional food system, the variety of goods available to the recipients is much broader than before, especially as more emergency food is cooked at home (Daponte & Bade, 2006). As for the food itself, “agricultural and food products are increasingly viewed as a complex collection of quality attributes, many of which cannot be observed at either the points of purchase or consumption,” including food safety or any other information regarding the way the product is made (Henson & Reardon, 2005). Private standards from grocery stores, for example, can reduce costs and risks in the supply chains, but the supply chain does not always conclude at the grocery store (Henson & Reardon, 2005). Many food pantries also accept fresh fruits and vegetables, which present numerous opportunities for microbial contamination from farm to processor to consumer (Parker et al., 2012).

Food waste occurs at many parts of the supply chain (Parfitt et al., 2010), but at varying rates. “Food loss at the retail and consumer levels in the United States includes 14.8 billion pounds of fruit and 23.4 billion pounds of vegetables, valued at \$15.1 billion and \$27.7 billion, respectively, in 2008 retail market prices” (Buzby et al., 2011, p. 492). Those numbers might be overestimated “if a significant share of the food counted as lost was actually either donated to food banks and other charities or sold at discount food stores and eventually consumed” (Buzby et al., 2011, p. 506). Fruits and vegetables are wasted at the highest percentage (Jones, 2006; Gunders, 2012) and are rising in interest at the food pantries and banks, given their high nutritional value over the regularly-donated non-perishables. Studies suggest waste will be reduced when consumers better understand

when food is actually “bad” and buy “imperfect” fruits and vegetables (Gunders, 2012), though emergency food already consists of unsaleable produce and past- or near-date dairy products.

1.5 Corporate Social Responsibility

Corporate social responsibility plays a curious role in the distribution of emergency food, as many grocery stores receive tax credits and good social will by donating their near-date and slightly damaged items to food banks and food pantries. Grocery firms determined, likely via cost-benefit analysis, how to reduce financial loss of the unsaleables, as “the social responsibility of business is to increase its profits” (Friedman, 1970). Yet, the donated items are a direct result of grocery management’s notion that the items are good enough for those without means, but are unacceptable for store shelves. Research has shown that an ideal level of CSR exists for each firm, based on characteristics like size, research and development, and even consumer income, among other variables (McWilliams & Siegel, 2000; McWilliams & Siegel, 2001). The authors assume that the purpose of CSR is to maximize profit, but also that it is a form of investment.

In the case of emergency food, the profit motive exceeds its ethical and philanthropic components. At Food Lion stores (a subsidiary of Delhaize Group), the donation of near-date food comes as result of the corporation’s attempt to “address a growing need.” Yet, the program is described as a way to “limit the amount of food that might otherwise have to be thrown away, reducing food waste, and saving money on waste disposal” (Delhaize Group, 2012, p.84). The key part of this description is financial, as the food does not have to be (and is not) thrown away. Even with the Good Samaritan Act, one can understand level the detail needed for farmers and grocery stores to donate mass quantities of foods. According to Carroll (1991), one of the ethical components of CSR is to recognize and respect new ethical and moral norms, as well as prevent norms from being compromised in order to achieve corporate goals. This seminal article continues

to describe ethical responsibilities as the obligation to do what is “right, just, and fair” (Carroll, 1991, p.42).

But what is “right, just, and fair” is variable. If the donated foods are good enough to feed to one group of people, then they should be good enough for all groups. More importantly, if the policies are to prevent waste, then the grocery stores would be more prudent in their purchasing—but that could mean less profit, an output also determined by Aupperle et al. (1985). However, an analysis of supply chain CSR activities shows reduced transaction costs and risk, but also increased profit (Cruz, 2009). While the discipline of logistics had lagged in social responsibility as of 2002, Murphy and Poist concluded that the discipline would have to accept the concept to reach its full potential. Recognizing that the food industry’s corporate social responsibility strategies lengthen the supply chain, health and safety are key dimensions in the food supply chain framework (Maloni & Brown, 2006). The authors’ detail on this dimension include terrorist threats, traceability, labeling, and healthy lifestyles, and conclude the section by addressing the role food companies play in combatting hunger. Finally, as they suggest future research into the food industry and an examination of practicing established standards, Maloni and Brown address the public concern regarding supply chain CSR deficiencies, though they do not include emergency food. No matter the reasons, grocery stores are key components in shifting America’s fight against hunger and food insecurity.

1.6 Overview of Dissertation

The food pantries, in North Carolina and across the country, colossally depend on those philanthropic endeavors from grocery stores to farms to individuals, though not all food that is “recovered” and distributed to the emergency food system is necessarily saved from the dumpster. Given the lack of regulation and formal recommendations to the foods pantries, personal beliefs regarding food safety prevail at the pantry-level. While the organizational structure, standard

operating procedures, and supply chains of the food pantry system has remained understudied to this point, this dissertation seeks to decipher and analyze the following questions: Are the food pantries increasing the risk of foodborne illness due to their supply chains or on-site operating procedures? In this regulatory desert, how would new food safety guidelines influence on-site food handling and storage procedures? This dissertation is designed to answer those questions; it is a three-essay institutional analysis of North Carolina's food pantry supply chain and standard operating procedures, and includes the creation and analysis of food safety guidelines specific to emergency food distributors.

Explicitly, each chapter will address different questions within North Carolina's emergency food system using a novel set collected for this research.⁴ Each chapter includes an exploration into any effects regarding food bank partnership and location. The first essay (Chapter 2) examines the standard operating procedures (SOPs) regarding food pantry goods and categorizes those SOPs based on pantry characteristics, exploring foodborne illness risk as a result of self-regulated pantry standard operating procedures. The results of analyzing 105 food pantries across the state suggest the creation and implementation of guidelines for pantries in key areas from handwashing to time-temperature control, confirmed by statistically significant differences in practices based on food bank partnership. The second essay (Chapter 3) describes the food pantry supply chain and its nuances alongside the creation of a risk framework used to analyze the characteristics that shift foodborne illness risk within the supply chain. A negative binomial analysis of 30 risk factors yielded results indicating that food pantries that participate in federal commodity programs are likelier to be lower in risk ($p < 0.01$) than pantries that do not participate, among other characteristics. The results of this chapter provide a tool that pantry managers can use to identify risky supply chain behaviors

⁴Given that each essay (chapter) uses the same data set, which was collected for this research, the descriptions regarding county selection and food bank regions, sampling, data, and means of recruitment and collection will be somewhat repetitive throughout Chapters 2-4.

and evaluate how to improve their systems. The third essay (Chapter 4) uses a difference-in-difference model to examine whether and how the provision of online food safety information can improve food-handling behaviors at the food pantries. The empirical analysis of the guidelines, created explicitly for food pantry managers and delivered in the second round of pantry visits, resulted in few findings of significance, suggesting ineffective guidelines. However, for the food pantries that guaranteed their use of the videos, statistically significant improvements were revealed in certain procedures, like the use of thermometers in the refrigerators and freezers ($p < 0.01$) and the creation of recall plans ($p < 0.01$). The conclusive chapter suggests future research ideas as well as the potential for regulatory influence.

CHAPTER 2: EVALUATING NORTH CAROLINA FOOD PANTRY STANDARD OPERATING PROCEDURES: A MIXED-METHODS APPROACH⁵

2.1 Introduction

The national prevalence of food insecurity, which increased in 2008 alongside the recession, has remained essentially unchanged at 14.5% (Coleman-Jensen et al., 2013). Of the families deemed *very low food security* by the U.S. Community Population Survey, 99% reported worrying that the food would run out before they had the means to buy more and 97% reported that purchased food did not last and they lacked enough money obtain more (Coleman-Jensen et al., 2013). Nationally, North Carolina (NC) ranks 12th in terms of food-insecure children (Feeding America, 2013), with particular parts of the state staggeringly worse than others: 35.2% of children in Robeson and 34.4% of Scotland counties' children are food-insecure (Feeding America, 2013). While more than 2,500 agencies (e.g., pantries, shelters, and backpack programs) in North Carolina provide food and services to many families and individuals, the food pantries are unregulated by government and wholly understudied.

Fruits and vegetables are rising in demand for the food pantries and banks, given their high nutritional value. As a result of healthy eating efforts by experts at various levels, food banks and pantries often encourage the donation of perishable goods; for example, a Connecticut food bank accepts and then trims all produce donations that have at least 75% usable product (Slipchinsky & Alexander, 2008). Some food banks and pantries, including some sampled in this research, have also begun to host community gardens, which follow varied food safety guidelines (Chaifetz et al., 2015). However, fruits and vegetables, with their limited regulation, present a higher risk than many other

⁵A version of this chapter is under review at the *Journal of Food Protection*.

items found in the food pantries; produce commodities are the cause of 46% of foodborne illnesses and require cold storage procedures (Painter et al., 2013). At the same time, apples are ready-to-eat (RTE) items, meaning that a volunteer should wash his or her hands before packing them into the boxes for distribution. It is up to the food pantry manager to make procedural decisions.

The purpose of this research is to explore the standard operating procedures (SOPs) of food pantries in North Carolina and associated food safety risks, especially given the budding uptick in perishable goods. With limited sociodemographic characteristics, the study examines the relationship of those procedures within particular categories of food pantries, particularly those affiliated with a food bank versus those that operate independently, hypothesizing differences regarding centralized guidance.

2.2 Literature Review

Individuals who accept goods from food banks and pantries often still receive government assistance if they are eligible, typically in the form of food stamps, now the Supplemental Nutrition Assistance Program (SNAP), yet are unable to “make ends meet” with the resources they do have (Berner & O’Brien, 2004; Berner et al., 2008; Daponte & Bade, 2006; Paynter et al., 2011). Limited-resource individuals use various strategies to obtain a sufficient amount of food, including federal and state public assistance and buying particularly low-cost foods (Anater et al., 2011). An exploration of the growing relationship between grocery stores and emergency food providers in Delaware suggested that the safety net of government assistance had failed; it revealed a decline in access to grocery stores in urban areas, forcing individuals to seek out other means of food provision (Curtis & McClellan, 1995). Other research suggests that demographic variables further explain which households are likelier to visit food pantries, specifically that young, healthy adults were often food bank clients (Starkey et al., 1998), though another study found the users to be those with children and with higher housing costs (Daponte, 2000). Multinomial logit models based on

making one of four food assistance choices were used to examine the use of food stamps, using only a food pantry, partaking in both programs, or the use of neither; the author concluded that a longitudinal study, rather than a cross-sectional one, might bring different results (Daponte, 2000). In her paper on motivating behaviors in federal program participation, Jensen (2002) finds a statistical significance between food security and food stamp program participation, also considering the sex of the head of household and years of education in a bivariate model. The paper does not concentrate on long-term effects; her recommendations include a better understanding of the risks between food security and related health incomes (Jensen, 2002).

Qualitative studies explore coping strategies and other practices for food acquisition (Kempson et al., 2002b; Kempson et al., 2003; Schneider, 2013; Starkey et al., 1999; Teron & Tarasuk, 1999). With access to individuals, researchers were able to uncover particular struggles, including transportation (Starkey et al., 1998), but also uncertainty about the safety of the food received (Teron & Tarasuk, 1999). Studies that examine the nutritional aspects of low-income households include how the food was acquired initially and concerns about waste, including the consumption of road kill, dumpster-diving, and buying past-date goods (Kempson et al., 2002a; Kempson et al. 2002b; Kempson et al, 2003).

A somewhat new field of research examines the correlation between foodborne illness risk and minorities (c.f. Henley et al., 2012; Koro et al., 2010; Quinlan, 2013). Overall, rates of illness by pathogen are influenced by race, ethnicity, geographical region, age, education, and level of poverty (Chang et al., 2008). These papers are especially of interest in areas where food-insecure households are predominately minorities. Feeding America states that “some racial and ethnic groups in the U.S., including American Indians, Latinos and African Americans, are disproportionately at risk for food insecurity” (2013a). Surveys of WIC (Women Infants and Children program) recipients revealed low food safety knowledge (Scheule, 2004), as did surveys of food stamp program

participants (Wenrich et al., 2003). Quantitative research conducted at five FoodNet (CDC) sites showed average annual incidences of *Yersinia enterocolitica* was higher in both infant populations and minority populations, predominately African Americans (Jones et al., 2003; Ray et al., 2004). Studies on invasive *Salmonella* infections found that mean annual incidences were higher among blacks, Asians, and Hispanics than whites (Vugia et al., 2004). Quinlan's 2013 review of the literature compiles the bacterial causes of *Campylobacter*, *Salmonella*, *Shigella*, *Listeria*, *E. coli*, and *Yersinia* by race and ethnicity from 2008 to 2011, with incidences of *E. coli* O157:H7 highest among whites. In an 80-paper review, the author also reveals a lack of data that can absolutely correlate foodborne illness and food-insecurity. She writes, "There has been no research to date which has directly examined the safety of food service facilities in the food desert environment as compared to food service facilities available to populations of higher income" (Quinlan, 2013). This population would include those outside the typical market, like food pantry clients.

Particularly of importance are rural communities, given that they have a different sense of cultural, social, human, and political capital than those in urban and suburban areas (Flora et al., 2004). Research has shown a connection between community structure and food insecurity, even calling the limited supplies of affordable and nutritious foods "community-based" (Morton et al., 2005, p. 98). While the rural, agricultural community produces much of the American food supply, the residents do not necessarily have the same access to it (ERS, 2009). Moreover, there is no consensus as to what kinds of policies are "best" for rural communities, though descriptive data is ubiquitous (Brown & Schafft, 2011; Flora et al., 2004; Morton et al., 2005). Rural families sometimes experience limited grocery options; they might only be within driving distance of a single grocery store. A 2007 survey found food-insecure rural families were likelier to give and get food from their neighborhoods and families than in urban areas and have access to garden produce, suggesting higher fruit and vegetable consumption (Morton et al., 2008).

In addition to their commitment to social welfare, the food pantries are self-governed and have few ways to demonstrate the definitive importance of food safety to the donors beyond the overarching need for food. The issues of hunger and nutrition can supersede other concerns for the vulnerable populations served. The food pantries create rules and regulations in the absence of those created by government. Each food pantry operates with its own set of rules and norms, some of which are formalized and some that are informal. The food banks present constraints that are only theoretically formalized, as not all of them are interpreted in the same way, from distribution practices to the frequency of training requirements to the use of past-date items; the pantry managers do not necessarily know if they make food handling mistakes and sanctions are few, even by a food bank partner. To that end, pantries are “slow-moving institutions” with little incentive to adapt new standards (Roland, 2004). Without regulation, the managers can feel as though they have little impetus to change if the organization seems efficient and individuals are able to receive food, their main purpose. While rarely categorized in such a manner, some food pantries are fundamentally public-private partnerships, as they are private institutions that distribute federal commodity items.

Empirical evidence does not always support the assumptions of traditional policy and economic rationality is sometimes blind to “social rules, practices, and standards of accountability which at any time characterize an industry and its members” (Furger, 1997, p. 446). Without pantry empirics, there is little evidence as to what happens when a food-centric institution operates outside the market. Research has also shown that both intergovernmental actors and private actors increasingly design global food and agricultural governance, with various types of regulation (Fuchs et al., 2009). Food safety regulation has shown to be effective in the case where food industry organizations and producers are forced to accept standards due to economic effects (Havinga, 2006).

In the case of food pantries, the private actors have taken on key roles in rule-making and monitoring, even enforcement, though the evaluation of their effectiveness is uncertain.

2.3 Research Design

Acknowledging the paucity of data in this particular aspect of food research, primary data were created via interviews and observations at food pantries across the state of North Carolina.

2.3.1 Sample Selection

Given that there are thousands of food pantries in North Carolina, both population and food bank region were stratified to create a 12-county sample that is both a generalizable and representative sample of North Carolina. All counties in North Carolina that have at least 25% of the population in poverty have fewer than 60,000 people (USDA, 2013; SNAP, 2013). Given that rates of food security are correlated with total county population, four categories were created based on the nine urban, rural, and metropolitan divisions used by the U.S. Census Bureau. Counties were stratified by their metropolitan status (defined as being part of a Metropolitan Statistical Area (MSA) of 1 million or more, 250,000 to 1 million, and fewer than 250,000 people) and nonmetropolitan status (defined as urban or rural populations of varying levels adjacent and non-adjacent to metro areas). A random number generator was used to select 12 counties, 6 in metro areas. Every sampled county has a child food insecurity rate over 21% and four counties have an overall food insecurity rate over 20% (Gundersen et al., 2013). The county populations range from less than 20,000 people to nearly 500,000 (USDA, 2013; SNAP, 2013). The population make-up may or may not be reflective of the food pantry client population; this research did not survey the clients or include any demographic questions.

The food banks all fit under the Feeding America umbrella and are divided into seven regions, with one region overlapping others (NC Association of Feeding America Food Banks, 2014a). Each region encompasses from seven to more than 30 counties, plus partial counties. All

food bank regions are represented in the sampled food pantries. Details on each food bank region are presented in Table 2.1. Seventeen food pantries (16.2% of 105) are not partnered with a food bank, but operate independently. Partnership with a food bank brings certain benefits: the ability to collect food from particular suppliers (usually grocery stores), food safety training (at a rate variable by food bank), and access to participation in federal emergency food commodity programs (TEFAP and SNAP).

In each of the 12 sampled counties, a list of food pantries was created with relevant names, addresses, phone numbers, emails, and days/times of operation. Publicly-available information on the North Carolina food bank websites was reviewed and Web searches conducted for food pantries, including the names of counties alongside “food pantry” or “pantry,” but also their respective county seats, the names of cities mentioned on their county government websites, and Wikipedia pages. The Executive Director of the North Carolina Association of Feeding America Food Banks connected the researchers to essential individuals at each food bank, some of whom provided their lists of partner pantries.

2.3.2 Participant Recruitment

The managers who participated in the study represented food bank partners and independent food pantries, rural and urban areas, and three distribution practices. Each of the 282 known food pantries in the 12 counties was contacted by phone and/or email. Interviews were eventually conducted at 105 pantries statewide, a response rate of 37.2%. From February to May 2014, food pantry managers were recruited to participate in the interviews by phone and email with the same script. Every pantry was contacted twice, either by phone or email initially, and by phone in the second attempt. Email addresses could not be found for more than half of the food pantries. Of the obtained email addresses, 40 were wrong or no longer in-use, thus prompting a phone call. For the phone calls, messages were only left in the first round if the recording indicated that the

organization dialed was correct; that is, without a recording or organization mentioned on the recording, no message was left. The pantry managers were informed in the first conversation or email that the study focused on food safety and would require both an interview and the collection of observational data in the pantry. No interviews were conducted at pantries where the websites were entirely in Spanish, as callbacks were not received for any voicemails or emails. Only 3 pantry managers explicitly said that they did not want to participate or did not have the time to do so. Twenty-one of the known pantries have disconnected or unknown phone numbers, leaving their operation in question. Food bank employees suggested that their partner lists might not be up to date. As a result of the 177 pantries in the population that did not respond to the email or phone call, any estimates are subject to selection bias by the pantry managers that chose to participate. All procedures for this study were reviewed and determined to be “exempt” by the Institutional Review Boards of the University of North Carolina at Chapel Hill and North Carolina State University.

2.3.3 Survey Instrument

A self-administered questionnaire was used alongside the observation of criteria from a modified North Carolina Food Establishment Inspection Report (2012) to assess the standard operating procedures of the food pantry system within the state. The instrument included information on: 1) the sources and delivery methods of the foods, 2) kinds of foods distributed, 3) storage and distribution procedures, 4) supplier requirements, 5) use of past-date foods, and 6) information on recalls. Practices observed include behaviors on handwashing, bare hand contact with ready-to-eat foods, thermometer use, and general prevention of contamination, as per the Food Establishment Inspection Report. An image of the top portion of the first page of the report can be found in Figure 2.1.

2.3.4 Data Collection and Analysis

Pantry managers were interviewed in the food pantry for 40 minutes to two hours. Pantries were visited almost every day except Sunday, with the researcher conducting one to four interviews per day. Pantry operation schedules vary; some are open five days per week and others are open only once per month. Additionally, not all pantries carry out food distribution in the same way: some prepack bags of boxes of food items to hand out directly to clients, some do so as the clients arrive, and some let the clients choose. If possible, the pantry was visited during food distribution or while food bags were packed (n=70); if not, the pantry manager provided a tour of the pantry and explained its operating procedures (n=35). The participants received no compensation for their time. Each interview was handwritten or typed (Microsoft Word 14.4.3, Redmond, WA, 2011) and all handwritten notes were later typed. Data collection took place from February to June 2014.

The participants consented verbally to participate in the study. To address concerns about confidentiality, participants were informed that pseudonyms of the individuals and food pantries would be used in any publications, that participation is voluntary, and that questions could be skipped at any time. Interviews were conducted in a space at the food pantry chosen by the participant. Oftentimes, the participant preferred to “walk and talk,” answering the questions during the tour of the pantry and its operations. To provide an environment of trust, the intention of the interviewer was to display interest in the participant, avoid reactionary responses, and be mindful of his or her time.

Organizational and demographic data at the pantry and food bank levels were categorized as deemed appropriate. For each pantry, the city, county, food bank region (if partnered), and days per month in operation was recorded and numerically coded under a unique identifier. No missing data were imputed. Beyond additional questions regarding the supply chain and organizational readiness of the pantries, the interview questions regarding standard operating procedures resulted solely in dichotomous variables. These include but are not limited to knowledge about food recalls,

distribution of past-date foods, and on-site repackaging. Food Establishment Inspection Report scores were coded with number of demerit points (continuous variables) and if the action was unobserved or not applicable. Descriptive statistics have been generated for key variables, from volunteer duties to organizational set-up. To test hypotheses, associations between certain operating procedures and food bank partnership, training in food safety, or the rural-urban divide were examined using t-tests in Stata11.2 (Statacorp LP, College Station, Texas, 2009). The analysis shows the differences between diverse pantries and managers.

Passages from the full interviews were uploaded and thematically coded in NVivo10 (QSR International, Melbourne, Australia, 2014). The software allows for analysis based on certain themes, but also allows for queries of particular words, like “take at their own risk” or “ministry.” Themes established include: concerns about waste, worries about liability and/or sickness, and reasoning for (or against) the distribution of past-date items. The qualitative analysis provides a richness that cannot be found in a purely quantitative study, with the descriptive data revealing reasoning behind certain actions and procedures in the food pantries. While most of the qualitative insights are intertwined with the quantitative results, additional themes are situated in a latter section.

2.4 Empirical Results

2.4.1 Organization

The organization of each food pantry is structured differently, in terms of paid employees versus unpaid volunteers, the number of people it takes to run the operation, length of a typical volunteer shift, the ages of the volunteers, required trainings, and volunteer requirements, as well as their agency within the organization, namely who decides on quality and picks up the food. In general, volunteers stock the shelves and refrigerators, pack bags of food, and assist clients in completing the requisite paperwork (either for the federal programs or specific to the pantry). The interview questions focused on the structure of the pantries themselves, from the descriptions of the

managerial and volunteer activities and their respective responsibilities to the formalities of the organizations, including the provision of any guidelines or manuals that describe operations, details on types of food held at the pantry and their storage facilities, the distribution of past-date food items and reasoning behind any rules, requirements for suppliers, on-site repackaging of food, knowledge of recalls and recall plans, and food distribution procedures. Organizational variables are presented in Table 2.2. Though the questions were not asked, 16 pantry managers also reported that the pantry provided some form of financial assistance, from electric and gas bills to rent payments. Six pantries also distribute pet food, for either or both dogs and cats. The number of pantries that distribute the same bag to each client (n=47) is approximately the same as those who distribute based on family size (n=49), though some also distribute on an “emergency basis” (n=23).

While pantries describe the person in charge by varying titles, from coordinator to president, the most prevalent one was manager, which is used throughout this essay for brevity and ease. Less than one-third of the managers are paid, as shown in Table 2.2. In the religious institutions, the pantries are often part of a ministry—and to work in the pantry is part of one’s service to the church. To elaborate, a pantry manager expressed the sentiment of many when she said, “there’s an attitude of gratitude.” Most (80.2%) pantries have regular volunteers, defined as a person who repeatedly helps in the pantry for no wage, but also does not require training upon each visit. One pantry did not have volunteers at all, only paid staff. Only 48 of 105 pantries use a sign-in sheet to keep track of who is volunteering on any particular day. In the event of food-borne illness or recall, it could be difficult to decipher which volunteers might have been accomplices to poor practices or who might be at-risk for illness themselves. An outbreak is a “teachable moment,” but in this case, the manager might not know who needs the guidance.

In more than 90% of the pantries, the volunteers are responsible for deciding on the quality of the food, including its safety. In 77.2% of the pantries, the volunteers are also responsible for the

intake of the food, namely how and where it is stored, but also how quickly it is put away. Similarly, only 41.2% of the volunteers go through any training at the pantry, including but not limited to food safety. And while almost two-thirds of the pantries have volunteers that use personal vehicles to pick up the food, only 28.8% of the pantries have any sort of requirements for their volunteers to participate, cited as anything from a being member of the church to passing a formal background check. Twenty-one of the food pantries were part of a church ministry—either a food ministry or an outreach ministry. As a result, not all volunteers have the same information regarding the SOPs and what he or she does at home might be risky behavior.

2.4.2 Food Bank Partnership

Two-sample t-tests were performed on each pantry characteristic to understand any statistically significant differences between the food pantries that did and did not partner with a food bank, as depicted in Table 3. Food safety training for managers ($p < 0.01$), distribution of leftover prepared foods ($p < 0.05$), repackaging food on-site ($p < 0.1$), knowledge of recalls ($p < 0.1$), and the use of past-date foods ($p < 0.01$) were all associated with statistically significant differences in food bank partnership and have profound impacts on foodborne illness risk in the pantries. Of the 88 pantries that partner with a food bank, 74 participate in TEFAP, SNAP, or both programs. To participate in TEFAP, the USDA Food and Nutrition Service requires a non-discrimination training, which has been coupled with information provision in food safety by some food banks. Eleven food pantry managers cited the “anti-discrimination” or “civil rights” training when they were asked about training.

Of the 105 total pantries, 77 pantry managers have received some food safety training, with the difference between the food bank partners and independent pantries statistically significant at the 99% confidence level; 65 of those managers receive the training from the food bank, on varying schedules. Pantry managers also receive the same information without accredited food handling

certification. Accordingly, the rate at which the managers receive any food safety information is variable; responses included: every year, once every two years, once every three years, once every five years, given handouts yearly but no course requirement, only when a pantry first participates in TEFAP, twice per year, multiple times per year, and only if they “handle food” (rather than just store and distribute). Five pantry managers explained that the training at the food bank was geared towards food handling and preparation rather than storage—that the food bank should not require the training because they “don’t feed people.”

Given the desire to take whatever food is offered and comb through its contents later, most pantries have few requirements for their suppliers beyond type (no glass) and size of packaging. A minority (41.9% of the sample) of the food pantries repackages food on-site and does so with a statistically significant difference at the 90% confidence level between those who do and do not partner with the food bank. For the most part, this task involves repackaging multi-pound bags of dry goods like beans, rice, and sugar into small Ziploc bags, though managers also reported repackaging leftover pizza slices into single-serving bags as well as chopping and freezing fresh vegetables. Though the question was not asked, 23 pantry managers indicated that those who partake in any repacking or food handling activity must wear gloves.

The question on the distribution of past-date items resulted in straightforward responses on their use, both at home and in the pantry. The food banks sell what is called “salvage,” an assortment of items at a deeply discounted rate, often past the sell-by or use-by date on the packages. Some pantries will throw away the items if they are past today’s date and others will retain them for years to come. Of the 64 managers that explicitly stated they distribute past-date items, 59 of them were food bank partners, with the difference statistically significant at the 99% confidence level. Yet, the responses come alongside varied reasons, with that “yes to past-date” truly defined only for certain items. Managers explained rules that were often categorized by types of food like

dairy and meat and used determinations like “not long past” or “especially out of date;” they also created differentiations even within a rule for a certain product based on freezing. For example, some might only store meat for 2 weeks while others indicated that it is safe to distribute at any time as long as it is frozen. Twelve pantry managers were especially rigid regarding the expiration date of baby food, potentially due to the fact that infant formula specifically cannot be sold past the date on the packaging due to federal law. Overall, the managers have uneven information regarding the dates, leading to wasted items, a mis-education of sorts. Moreover, the transport of the items from grocery store to food bank to food pantry is moot if the managers fail to distribute the product—a waste of time and energy as well as food.

Recalls are one of the greatest disparities in the pantry manager knowledge base. Only 63.8% of pantry managers admitted to having up-to-date information regarding recalls, with 60 of the 67 pantries with recall information partnered with a food bank, statistically significant at the 90% confidence level. All of those pantries partnered with a food bank admitted that they received their recall information from the food bank. Even with the partnership, 36.2% of pantries do not have those details regularly provided by any agency, be it the food bank, the local health department, or even the Food and Drug Administration. Ten pantry managers stated that they assumed the food bank would remove any recalled items before distribution, though a recall might occur after they receive the items, or that they expected the food bank would contact them in the event of a recall even though it has never done so. Of the 52 pantries with a recall plan, managers can be solely responsible for learning about any contaminated items and removing them from the shelves, described as his or her “recall plan.” To elaborate, a pantry manager explained that “when the cantaloupes ‘got bad,’ they stopped giving them out.” Largely, the pantry managers lack the information needed to prevent the distribution of potentially contaminated, recalled food and, for that those that experience a recall, there are few steps in place to remove the items or provide

information to clients to do the same. The lack of preventative steps can lead to the distribution of contaminated food.

Yet, even with a precedent, a new manager might not have the specifics of how to deal with a recall or foodborne illness. While it lacks statistical significance, only 26 pantries have written standard operating procedures (23 of those pantries are food bank partners). The lack of written standard operating procedures (SOPs) results in a lack of access to information by volunteers in the event that the manager is not present. Similarly, even with a precedent, a new manager might not have the specifics of how to deal with a recall or foodborne illness. The interviewer directly asked about a protocol for ill volunteers—that is, if there was an explicit rule in place about illness and volunteering. Overwhelmingly, managers replied that the volunteers would not come to the pantry if they were sick or that they would be sent home otherwise. The responses highlight the need for written standard operating procedures, as not all individuals define illness in the same way; one individual might stay home if he has a sore throat while another volunteer might deem herself well enough to help in the pantry.

While the distribution of home-canned items is not statistically significant, it is of interest due to the fact that 17.1% of pantries distribute these especially-risky items. Home-canned items can be preserved in a safe manner, though there is no way to their safety if they are not labeled with the canning method and/or recipe. Additionally, many of the managers who offered the items did under the guide of “take at one’s own risk” (alongside other items); that is, they allow the clients to take the products if they so choose, but the products do not get put into the food boxes for direct distribution to clients. Conversely, other managers (n=7) refuse to distribute home-processed foods due to liability concerns, with one indicating that they arrive as a result of “cleaning out grandma’s closet.”

Many liability concerns center on prepared foods. Managers stated that they were “conscientious not to have a deep fryer and meat slicer” due to their dangerous nature, “wouldn’t give out leftover catered or home-canned” foods or “cooked food, leftover chicken, potato salad” or “anything with mayonnaise,” and that “the food safety course made her very nervous about cross-contamination.” One manager explained that she was not “worried about contamination” because they do not “serve fresh or prepared food.” Another said, “It’s not as critical since they don’t feed people—it would be more urgent that everybody knows how to handle food.” Other items of concern that were specifically mentioned: meat, Jell-O salad, baby food, and produce. Yet, food handling is not only about food preparation. Ready-to-eat foods not only involve hot meals; they comprise any foods that do not require further preparation, including fruits and vegetables, and require many of the same safety concerns, like handwashing.

Intertwined with the reasoning behind the standard operating procedures for many of the pantries was the policies established by the food bank. Of the 88 pantries that partner with a food bank, there were 49 managers who mentioned rules established by the food bank, with 85 total references. To begin, a manager explained that they “wouldn’t accept non-FDA/NCDA-approved foods, including game. We would take anything Manna deems acceptable and would think that Manna would want to approve it. We don’t have the capacity to determine safety of processors.” To elaborate, managers indicated that the food bank determined: the kinds of foods they distribute (beyond what they receive from the food bank); how often they can distribute; past-date food policies; the overall standard operating procedures; food safety training; when to pull recalled foods and what to do with them in the aftermath; client participation rules (based on address of residence); repackaging procedures; and the rules on donations from other suppliers. Sixteen managers explained that the food bank “unexpectedly” comes to inspect their operation at the rate of one to

two times per year, though they still varied in risky behavior. Overall, even with top-down policies, the food bank partners are imperfect when it comes to food safety.

2.4.3 Regional Differences

Two ways to break down the differences in the pantries are along the rural-urban divide and the metropolitan versus micropolitan (or neither) areas. In this study, the urban areas are characterized by high population density, but due to the fact that the density thins throughout the county and this research takes place at the county-level, the metropolitan designation is used to understand pantry differences as a result of population. The metropolitan designation comes from the U.S. Census Bureau, which has three categorizations: metropolitan, micropolitan, and neither. In these 12 counties, six of them are part of a metropolitan statistical area (MSA), though the cities within them might “feel rural.” Four counties are micropolitan and two have no designation, miles away from an urban area. The rural areas have been described as characteristically different in terms of access, leading to the test of any differences in the standard operating procedures, potentially as a result of poor information dissemination.

Two-sample t-tests were conducted on the same characteristics as in Table 2.3; the comparison of metropolitan food pantries with those that lack the designation is in Table 2.4. The lack of statistically significant differences based on population is notable, however, as it rejects any hypothesis that the rural areas lack access to the same information as the urban areas, especially in the event of foodborne illness or recall. These statistics also act as a robustness check against the previous data, further elaborating that the food bank differences are just that—and not hidden under another characteristic like metropolitan area. While the take-up of these practices did not reveal any differences based on population, the pantries stationed in a MSA were more likely to know about recalls, at a rate statistically significant at the 95% confidence level. Those pantry

managers could be more internet-savvy, have better access to national media, or be more generally aware of public health risks.

2.4.4 Food Establishment Inspection Report Questions

The Food Establishment Inspection Report is another way to measure the operating procedures of the food pantries; health inspectors in North Carolina use the same rubric to evaluate whether restaurants and other establishments are safe enough to sell food to the public. Depending on the type of pantry (distribution of non-perishables only; perishables and non-perishables; perishables and non-perishables as well as on-site food preparation), particular questions were scored. Additionally, for some questions, the action went unobserved, rather than lost points. Therefore, the total number of pantries for each question is varied, as are total scores. The total possible number of demerit points for each question is in Table 2.5 and is the same number that could be lost in the Food Establishment Inspection Report. Given that it is better to retain points, lower means for each characteristic in Tables 2.6 and 2.7 (analysis of differences based on food bank partnership and food safety training) are preferable. For example, a pantry manager who washes her hands before handling food loses no points.

For certain questions based on the Food Establishment Inspection Report, the number of pantries where the characteristic was not observed could be just as notable as when the question was scored, as depicted in Table 2.5. For example, handwashing, a particularly critical action, was not observed in 91 pantries, leaving only 13 pantries with scores on that question. There were two instances in which that action was scored: if a person washed his or her hands; or if a person directly touched a ready-to-eat food or participated in food preparation without doing so. Given that pantry operations were only observed once and for a short period of time, handwashing could be completed and go unobserved. In terms of bare hand contact with ready-to-eat foods, 50 pantries were not distributing foods at the time that fit the category and, in 19 other pantries, the action went

unobserved, with similar criteria as the previous question. Due to the small sample size, the pantries are divided into two groups, but not further. Two-sample t-tests were conducted and reported on selective questions—comparing food pantries with food bank partners with those that lack the designation in Table 2.6 and comparing pantries that have a manager who received food safety training with those who did not do so in Table 2.7.

While handwashing was rarely observed, handwashing sinks were available at every pantry. Pantries lost points because the sinks were harder to access, requiring a trip into another part of the building, or lacked supplies, like soap. Toilet facilities were also observed at almost all food pantries, with points lost due to the lack of toilet paper or soap. Given that many food pantries operate in churches or as a part of another larger organization, pantry managers were not always responsible for the cleanliness or stocking of the bathrooms. For each of these characteristics, there lacks a statistically significant difference in pantries that do and do not partner with a food bank; they are similar in practice regardless of the grouping. Toilet facilities were “constructed, supplied, and cleaned” with few demerit points in 99 pantries, with few differences across food bank partnership (Table 2.6) and food safety training (Table 2.7).

Thirty-six pantries (34.3%) lacked thermometers in all of their freezers and refrigerators; 10 additional managers stated that thermometers were used but were not observed by the interviewer. The inability to find the thermometer in an overstocked chest freezer is similar to not having one at all, given the incapacity to use it. Yet, the use of thermometers at the pantries partnered with a food bank ($n=74$) over an independent operation ($n=8$) was statistically significant at the 99% confidence level. The independent pantry managers, who lack explicit guidance from a parent institution, might not realize the importance of checking the temperature. Yet, all pantry managers need to: 1) keep a thermometer in the storage facilities and 2) keep records of their temperatures. A refrigerator needs to be below 40°F and a freezer below 0°F to prevent pathogen growth (United States Department of

Health and Human Services, 2009); keeping track of the temperature is the only way that someone can recognize a temperature change so that it can be corrected.

Pantries lost points for the prevention of contamination for various reasons: refrigerated items not in a refrigerator, stacked boxes of foods on the floor, questionable foods in the same box (molding or rotting vegetables), food left outside in the heat without a cooler, and even the suggestion by the pantry manager that something needed to be thrown away for various reasons. Two observations reported are only applicable to pantries that distribute perishable items: 1) food separated and protected; and 2) thermometers provided and accurate. Almost all observed pantries (95.2%) prevented during food preparation, storage, and display; 83 of the 99 pantries that do so are partnered with a food bank, statistically significant at the 90% confidence level. In this case, the independent pantries lost fewer points than the food bank partners; even without guidance, their SOPs were better. Generally, food was kept in an appropriate storage facility (pantry, freezer, refrigerator) and stored with products similar to it. For example, organized pantries keep all like items together within the refrigerator.

Sixteen pantry managers, without prompting, revealed that food bank employees come to inspect the pantry with some rate of regularity, usually once per year. Pantry managers also reported various standards sanctioned by their respective food banks (n=49)—on storage, refrigeration, paperwork, use of past-date foods, food handling certification, how much food to distribute per person, food pantry geographical service boundaries, and rules for shopping at the food bank. Yet, the failure for statistically significant differences in these observations suggests that pantry managers overall are either successful or unsuccessful at certain tasks, from stocking the bathrooms to washing their hands. Food bank partnership had little effect in those areas. Table 2.7 depicts the differences in same questions and observations in the food pantries when a manager had training in food safety, either required by the food bank or chosen by the independent food pantry managers.

Overall, Table 2.7 suggests that food safety training might be deficient. There lacks a statistically significant difference in all actions between pantry managers who did and did not receive training of some kind. The prevention of contamination during food preparation, storage, and display was the action that had the largest difference between pantry managers that did and did not receive training ($p < 0.10$). Furthermore, not every trained manager received the same training (i.e., curriculum) at the same frequency, which could be the reasoning behind the similarities of both manager types.

2.5 Additional Themes Established

In the following sections, the pantries are qualitatively described according to additional themes established in the interviews: donor concerns, distribution practices, and waste issues. Donor concerns are nested within safety and liability; Table 2.8 lists the four overall themes and their sub-classifications, which include the aforementioned safety and liability concerns and food bank policy. The themes could be categorized as the general reasoning behind the choice of standard operating procedures, but also paternalistic influence by the food banks. The analysis provides insight into how clearer food safety guidelines might better promote risk mitigation, confirming early hypotheses on inconsistency across pantries procedures.

2.5.1 Donor Concerns

While only three managers mentioned the Good Samaritan Act by name, the managers indicated they are generally concerned with safety and liability. Overall, they understand the nuances of the clientele and do not want to make them sick, but they also want to retain their relationship with the food bank, grocery stores, and local community. The managers continue to accept foods regardless of donor, but they might not distribute them to clients. Ten managers indicated that they receive food from the annual postal service food drive in the multiple thousands of pounds, but many also despised the age of the food they receive. One manager said that she would only use it if

it were within six months of the package date, but that she “had a lot of old food from the postal service drive that had to be trashed because it was 2011.” Another manager said, “there’s a lot of old food in the post office drive” while a third manager has “the volunteers pull past-date food from the postal service drive.” While the canned and packaged goods are not unsafe after years on the shelf, they do lose nutritional quality. The adage of “if we wouldn’t eat it, then it wouldn’t be served to the clients” is steadily spoken, though not everyone evaluates items in the same manner.

2.5.2 Distribution Practices

Twenty-three pantries operate on an emergency basis, providing food at any given moment a person is in need, but to operate entirely as an emergency pantry is rare ($n=2$). Forty-seven pantries distribute the food equitably per household, meaning that each family gets the same box of food. The Emergency Food Assistance Program (TEFAP) is responsible for part of the reasoning behind the equitable distribution, as the policy is that each person must get the same number of items supplied by TEFAP, unless the pantry runs short of an item. For example, a food pantry might receive 48 bottles of orange juice and 80 bags of chicken quarters; if the pantry was giving one item per person, then the 49th person would receive chicken but not orange juice. The TEFAP process is required to be entirely a first-come, first-served basis; foods cannot be saved for particular individuals. Pantries also give the same amount to each household so that they can prepack ($n=37$) the items and focus on distribution when the clients are on-site, though some pantries that prepack also do so based on family size. Pantry managers also indicated that when clients do not all receive the same items, they are subject to complaints and arguments.

Conversely, 49 pantries correlate the amount distributed to family size, with larger families receiving more food. The amount distributed is typically broken into groups: one to two people, three to four people, and five or greater people. If the bags are prepacked and distribution is based on family size, then the larger families tend to get multiple bags of the same food. What goes into

the bags is also contingent on the pantry, as some managers specialize the contents based on diet (e.g., low-sugar, vegetarians) or age (e.g., seniors, children). Yet, the amount that each pantry gives is variable as well; some pantries provide for up to 10 days of meals, while others only provide enough for 2-3 days. Others tailor the bags of food to plan for whole meals, rather than mismatched items. For example, if they distribute boxed potatoes, then they would provide milk as well. To that end, 11 pantries operate using a client choice model, allowing the clients to “shop” and choose for themselves, usually following a rubric that explains how many items an individual can take from each category. Waste-focused, clients only take what they might want or need, rather than what they might be given.

2.5.3 Waste Issues

Given that food pantries can be the distributors of food that would have been wasted, waste ideologies were revealed over the course of the interview. Oftentimes, these responses came as a result to a question regarding the spontaneity of donations; for example, a western pantry manager explained that “the Bush’s baked beans truck had a wreck and they didn’t want to take the cans back to Tennessee and so they were donated to the pantry.” On the other hand, the managers indicated that they did not want to throw items away (n=14), but that they would in the case of bad smells, torn or broken packaging, or when it seemed generally unsuitable for consumption (e.g., mold). They might conceal the trashed items so that the clients and donors do not see the items in the garbage bin. Six managers explained that they use “common sense” to determine the safety and quality of the food, though that method is unreliable. While quality might be evaluated by sight, foodborne pathogens can neither be seen nor smelled.

Managers use the information they have to decide on their respective operating procedures. They are conscientious about the issues of waste and spoilage and 52 of them stressed that concern. Some managers return or refuse items that cannot be stored on-site or if the length of time until the

next distribution date is too far away. For this reason, many distribute fruits and vegetables on the day of or after they are received. Dairy and eggs are rarely chosen as items for distribution due to the cold storage requirement.

2.6 Limitations

A larger, more diverse sample of food pantries would reduce threats to internal validity, even though the sample is purposeful. Similarly, given that not every pantry manager in the counties responded to the recruitment email or phone call, there remains a selection bias of the pantries in the sample. Pantry managers could have feared the researchers reporting their undesirable procedures to the food bank. On the other hand, some pantries could have been a part of previous studies (at the University of North Carolina at Chapel Hill, North Carolina State University, or North Carolina A&T University) and might be fatigued by participatory research. Generalizability remains a concern, given that all pantries are located within North Carolina and in only 12% of its counties. The results allow for extrapolation to other, similar counties within the state, though there will be limitations on doing so to other states, given that their regulations on food banks and pantries are likely to differ.

This data only provides a “snapshot” of the pantries; that is, only one event has been recorded for each pantry. The volunteers (and thus, the practices) can vary week-to-week, or month-to-month, or at whatever rate the pantry operates. Additionally, given that the managers knew the study’s focus was on food safety, it is possible that they responded with the answers they might think the interviewer might want to hear, rather than what is true, making the observations even more critical. Yet, there was little indication that responses did not correspond with the action, given that most visits occurred while the food pantry was open and distributing food (n=70).

2.7 Conclusions: Policy Implications and Future Research

The results of this study imply that there is much room for improvement in terms of food safety training and, likely, available resources. It adds to the current literature by addressing the differences in food pantry operating procedures, in terms of differences between: independent pantries and those partnered with a food bank metropolitan versus rural; pantries where the managers do and do not receive any food safety training. Individuals who receive the foods from the pantries are food-insecure—meaning that this population could have higher risk of foodborne illness without operational change, regardless of food bank partnership.

To start, the Centers for Disease Control and Prevention estimate that washing hands with soap water can reduce diarrheal illness in people with weakened immune systems by 58% and the number of people who get sick over by 31% (CDC, 2014). Given its importance, handwashing should be a regular action for all pantry participants and is potentially easy to implement task given the regularity of well-stocked and available bathrooms. Furthermore, pantries would reduce the risk of foodborne illness by obtaining more regular information on recalls, creating strict rules for what they will and will not distribute (e.g., home-processed, past-date), and having set procedures on repackaging items, from glove use to packaging, dating, and labeling. While the managers use the dates as guides for packaged foods, including meat, they use their eyes to analyze bread and pastries. While some of the pantry managers had readily available information for their volunteers to decipher “how long is too long,” it was inconsistent across both regions and partnerships. There remains an incorrect association between the package dates and safety, rather than quality, simply characterized by a pantry manager who explained, “no one wants old meat.”

And, that most pantry managers lack information on food recalls is a public health failure. The qualitative analysis revealed inconsistencies in how the food banks operate, from the information they provide to their partners to the means by which they do so. While many of the

food banks email regular briefings on recalled items, the provision of that information is variable amongst regions, leaving the pantry managers to independently find and dispense any recall information, as well as dispose of the recalled items or notify the clients. The data show that few managers haven taken that initiative, or even realized that they should do so. Individuals and organizations should be able to easily obtain information from the Food Drug and Administration given that the agency has the authority and means to distribute it in a methodical way—and the managers should know to seek out said information.

Still, individuals might not actualize a task if they don't fully recognize its importance, shown in the food pantries with thermometers in the freezer that rarely get read. Pantry managers can be left to explain any science behind a procedure, and might not know the reasoning. Therefore, a simple, easy-to-access set of guidelines to explain the importance of such actions would benefit the members of the food pantry community, both those who are partnered with a food bank and independent. Written standard operating procedures allow for the manager to answer each question only once as well as provide agency for volunteers to learn the answers to questions regarding how and why things get done. Even more, tracking information like refrigerator temperatures and sources of food allow for backwards induction in the event that a client does get sick from the food, as products are then traceable and questionable procedures identifiable. Overall, a new instrument or policy intervention might prove to be more effective than that curriculum or format currently in use, as the information in the food safety trainings has not fully been actualized its participants.

Further research into more pantries must replicate these results and should be undertaken as funding permits. The dynamics may be similar in the pantries that partner within a food bank region, but the analysis of a larger sample population might reveal a more nuanced set of results. Lastly, current and future research can add to the richness of this new field by incorporating details on the emergency food supply chain and food acquisition practices centered on food-insecure populations,

stagnant at almost one in seven Americans (Coleman-Jensen, et al., 2012). The research regarding emergency food operations is far from complete.

Table 2.1 Pantry partnerships by food bank region

Food Bank Partner	No. of counties in sample	Main location	% of pantries in sample
Food Bank of the Albemarle	1	Elizabeth City	2.9%
Food Bank of Central and Eastern NC	3	Raleigh	13.3%
Inter-Faith Food Shuttle (IFFS) ⁶	2	Durham	1.0%
Manna Food Bank	3	Asheville	10.5%
Second Harvest Food Bank of Metrolina	2	Charlotte	18.1%
Second Harvest Food Bank of Southeast NC	1	Fayetteville	12.4%
Second Harvest Food Bank of Northwest NC	2	Winston-Salem	24.8%
No food bank partner	12	N/A	16.2%

⁶The Inter-Faith Food Shuttle region overlaps other food bank regions.

Table 2.2 Food pantry organizational characteristics

Pantry Characteristics	No. of food pantries with characteristic	Food bank partners	Independent pantries
Paid manager	43	35	8
Managers trained in managing volunteers	31	27	4
Regular volunteers on each shift	81	67	14
Use of sign-in sheet	48	41	7
Volunteers responsible for intake of food	78	66	12
Volunteers decide on quality of foods	91	76	15
Volunteers drive own vehicle to pick up food	61	50	11
Volunteers trained	42	37	5
Volunteer requirements	29	24	5
Total pantries	105	88	17

Table 2.3. Average prevalence of particular pantry characteristics by food bank partnership

Characteristic	No. of pantries	Food bank partnership means	Independent pantry means
Food safety training by manager	77	0.81 ^{***} (0.40)	0.35 (0.49)
Protocol for sick volunteers	32	0.29 (0.46)	0.41 (0.51)
Accepts home-canned foods	18	0.18 (0.39)	0.13 (0.34)
Distributes leftover prepared foods	21	0.24 ^{**} (0.43)	0.00 (0.00)
Supplier requirements	20	0.18 (0.38)	0.31 (0.48)
Repackage food on-site	44	0.46 (0.50)	0.24 (0.44)
Know about recalls	67	0.68 [*] (0.47)	0.44 (0.51)
Have recall plan	52	0.60 (0.49)	0.44 (0.51)
Use a first-in first-out system	81	0.84 (0.37)	0.87 (0.35)
Distributes past-date items	64	0.67 ^{***} (0.47)	0.31 (0.48)
Written SOPs	26	0.26 (0.44)	0.18 (0.39)

Notes: Standard deviations in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. There are 88 pantries in the sample that partner with a food bank and 17 pantries that are independent. In each category, some interviewed managers did not respond to the question. For example, only 87 responses were recorded for food bank partner pantries in the question regarding a recall plan. Each variable is dichotomous.

Table 2.4. Average prevalence of particular pantry characteristics by metro area

Characteristic	No. of pantries	Metro area means	Not metro area means
Food safety training by manager	77	0.71 (0.46)	0.78 (0.41)
Protocol for sick volunteers	32	0.28 (0.45)	0.38 (0.49)
Accepts home-canned foods	18	0.19 (0.40)	0.14 (0.35)
Distributes leftover prepared foods	21	0.25 [*] (0.44)	0.11 (0.31)
Repackage food on-site	44	0.43 (0.50)	0.41 (0.50)
Know about recalls	67	0.71 [*] (0.46)	0.53 (0.51)
Have recall plan	59	0.60 (0.50)	0.53 (0.51)
Use a first-in first-out system	81	0.83 (0.38)	0.88 (0.34)
Distributes past-date foods	64	0.59 (0.50)	0.66 (0.48)
Written SOPs	26	0.26 (0.44)	0.22 (0.42)

Notes: Standard deviations in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. There are 68 pantries located in a metropolitan area and 37 pantries located outside of a metropolitan area. In each category, some interviewed managers did not respond to the question. For example, only 67 responses were recorded for metropolitan area pantries in the question regarding a recall plan. Each variable is dichotomous.

Table 2.5 Possible demerit points for selected Food Establishment Inspection Report questions

Inspection Report Questions	Demerit points	No. of pantries observed	No. of pantries unobserved
Hands clean and properly washed	4	13	91
No bare hand contact with ready-to-eat (RTE) foods	3	26	19
Handwashing sinks supplied & accessible	2	104	0
Food in good condition, safe & unadulterated	2	102	1
Food separated & protected	3	93	1
Food contact surfaces: cleaned & sanitized	3	37	10
Thermometers provided & accurate	1	82	7
Contamination prevented during food preparation, storage, & display	2	99	5
Non-food contact surfaces clean	1	104	0
Toilet facilities: properly constructed, supplied, and cleaned	1	99	4

Note: For these questions, total pantries are 104, rather than 105. One pantry is a garden operating as a pantry.

Table 2.6 Average Food Establishment Inspection Report demerit points by food bank partnership

Inspection question/Observation	No. of pantries	Food bank partner means	Independent pantry means
Hands clean and properly washed	13	1.64 (1.75)	3.00 (1.41)
Handwashing sinks supplied & accessible	104	0.09 (0.39)	0.00 (0.00)
Food in good condition, safe & unadulterated	102	0.07 (0.33)	0.07 (0.26)
Food separated & protected	93	0.08 (0.44)	0.00 (0.00)
Food contact surfaces: cleaned & sanitized	37	0.35 (0.77)	0.00 (0.00)
Thermometers provided & accurate	82	0.39*** (0.49)	0.88 (0.35)
Contamination prevented during food preparation, storage & display	99	0.22 (0.52)	0.00 (0.00)
Non-food contact surfaces clean	104	0.03 (0.18)	0.00 (0.00)
Toilet facilities: properly constructed, supplied, and cleaned	99	0.06 (0.24)	0.06 (0.25)

Note: Standard deviations in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Only the observations where the action was observed are included in the analysis, meaning that the sample for the questions on handwashing is 104, while the sample for thermometers question is only 82. The question regarding bare hand contact with food is not included on this table. T-tests could not be performed because all scored pantries are partnered with a food bank.

Table 2.7 Average Food Establishment Inspection Report demerit points by food safety training

Inspection question/Observation	No. of pantries	Food safety training means	No training means
Hands clean and properly washed	13	1.82 (1.66)	2.00 (2.83)
No bare hand contact with RTE foods	26	0.88 (1.30)	0.00 (0.00)
Handwashing sinks supplied & accessible	104	0.08 (0.36)	0.07 (0.38)
Food in good condition, safe & unadulterated	102	0.04 (0.26)	0.15 (0.46)
Food separated & protected	93	0.07 (0.43)	0.09 (0.43)
Food contact surfaces: cleaned & sanitized	37	0.44 (0.85)	0.00 (0.00)
Thermometers provided & accurate	82	0.40 (0.49)	0.55 (0.51)
Contamination prevented during food preparation, storage & display	99	0.23* (0.54)	0.04 (0.20)
Non-food contact surfaces clean	104	0.03 (0.16)	0.04 (0.19)
Toilet facilities: properly constructed, supplied, and cleaned	99	0.07 (0.25)	0.04 (0.20)

Note: Standard deviations in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Only the observations where the action was observed are included in the analysis, meaning that the sample for the questions on handwashing is 104, while the sample for thermometers question is only 82.

Table 2.8. Themes established via qualitative analysis (N=88)

Themes	Sub-classifications within theme
A. Distribution	<ol style="list-style-type: none"> 1. Based on family size 2. Equitable distribution 3. Emergency distribution
B. Waste concerns	<ol style="list-style-type: none"> 1. Otherwise wasted items provide food to pantry 2. To not throw away items that could be used
C. Sickness concerns	<ol style="list-style-type: none"> 1. Worries about clients getting sick 2. Rules on past date foods: yes and no 3. Explicit mentions of lawsuits 4. Donors and items donated
D. Food bank restrictions	<ol style="list-style-type: none"> 1. Follows whatever food bank establishes 2. Wants to “pass” food bank inspection

Figure 2.1 Image of Food Establishment Inspection Report

Food Establishment Inspection Report										Score: _____	
Establishment Name: _____					Establishment ID: _____						
Location Address: _____											
City: _____					State: North Carolina						
Zip: _____					County: _____						
Permittee: _____											
Telephone: _____											
<input type="radio"/> Inspection <input type="radio"/> Re-Inspection											
Wastewater System:											
<input type="radio"/> Municipal/Community <input type="radio"/> On-Site System											
Water Supply:											
<input type="radio"/> Municipal/Community <input type="radio"/> On-Site Supply											

Date: _____ Status Code: _____

Time In: _____ Time Out: _____

Category#: _____

FDA Establishment Type: _____

No. of Risk Factor/Intervention Violations: _____

No. of Repeat Risk Factor/Intervention Violations: _____

Foodborne Illness Risk Factors and Public Health Interventions											
Risk factors: Contributing factors that increase the chance of developing foodborne illness. Public Health Interventions: Control measures to prevent foodborne illness or injury											
Compliance Status								OUT	CDI	R	VR
Supervision .2652											
1	IN	OUT	N/A	PIC Present; Demonstration - Certification by accredited program & performs duties				2	0		
Employee Health .2652											
2	IN	OUT		Management, employees knowledge; responsibilities & reporting				3	1.5	0	
3	IN	OUT		Proper use of reporting, restriction & exclusion				3	1.5	0	
Good Hygienic Practices .2652, .2653											
4	IN	OUT		Proper eating, tasting, drinking or tobacco use				2	1	0	
5	IN	OUT		No discharge from eyes, nose or mouth				1	0.5	0	
Preventing Contamination by Hands .2652, .2653, .2655, .2656											
6	IN	OUT		Hands clean & properly washed				4	2	0	
7	IN	OUT	N/A	NO	No bare hand contact with RTE foods or pre-approved alternate procedure properly followed				3	1.5	0
8	IN	OUT	N/A		Handwashing sinks supplied & accessible				2	1	0

Good Retail Practices											
Good Retail Practices: Preventative measures to control the addition of pathogens, chemicals, and physical objects into foods.											
Compliance Status								OUT	CDI	R	VR
Safe Food and Water .2653, .2655, .2658											
28	IN	OUT	N/A		Pasteurized eggs used where required				1	0.5	0
29	IN	OUT			Water and ice from approved source				2	1	0
30	IN	OUT	N/A		Variance obtained for specialized processing methods				1	0.5	0
Food Temperature Control .2653, .2654											
31	IN	OUT			Proper cooling methods used; adequate equipment for temperature control				1	0.5	0
32	IN	OUT	N/A	NO	Plant food properly cooked for hot holding				1	0.5	0
33	IN	OUT	N/A	NO	Approved thawing methods used				1	0.5	0
34	IN	OUT			Thermometers provided & accurate				1	0.5	0
Food Identification .2653											
35	IN	OUT			Food properly labeled: original container				2	1	0
Prevention of Food Contamination .2652, .2653, .2654, .2656, .2657											
36	IN	OUT			Insects & rodents not present: no unauthorized				1	0	0

CHAPTER 3: RISK ANALYSIS OF THE EMERGENCY FOOD SUPPLY CHAIN

3.1 Introduction

For the majority of people who seek food assistance, food pantries have become a fixed part of household food sources, even though they called “emergency food” (Feeding America, 2011). Unlike the supply chain that ends at the grocery store, non-profit hunger relief organizations largely rely on donations and only some consistently know when they will receive a food donation or the details of its transport, from length of travel time to means of transportation. To date, research has generally omitted to describe or evaluate the safety of the food pantry supply chain. Even with pantry participation in the federally-funded TEFAP and SNAP, emergency food tends to be stationed outside the traditional market and its supply chain remains understudied and forgotten. This chapter seeks to analyze and evaluate the supply chain risks, as well as determine any reasoning that motivates their procedures.

Beyond adherence to the Bill Emerson Good Samaritan Act, food pantries are not currently regulated. The pantries intercept foods (perishable and non-perishable) that might have otherwise been wasted but the safety of these foods and their respective supply chains is in question given the lack of any requirements or regulation. Yet, North Carolina requires that donated meat products come from an inspected source, be free of microbiological spoilage, and kept stored under adequate refrigeration temperature, not that the pantries are inspected (2 N.C.A.C. 9C.0304, 2013). However, a dearth of public information specific to emergency food distribution has led to asymmetric information regarding food safety amongst the approximately 2,500 food pantry managers in North Carolina. Without regulations, many food pantry managers might not know what information they

need or recognize contamination along the supply chain, which could be categorized as ethically irresponsible. The food pantries create their own rules and procedures, though they are rarely formalized.

While the use of road kill, gleaned and salvaged foods, and game have been mentioned as food sources in papers on food insecurity, the academic literature does not yet address the particular details of the emergency food supply chain (Kempson et al., 2002b; Kempson et al., 2003). While the literature regarding food donation is significant, it does not thoroughly incorporate food safety into its main hypotheses, even in studies of the supply chain and donation forecasting (Davis et al., 2013a; Davis et al., 2013b). Studies show that “more research is needed to identify which foods, and where along the food production, marketing and consumption chain, the greatest inroads can be made to efficiently minimize food waste and maximize the share of food production that is ultimately consumed by humans.” (Buzby et al., 2011, p. 512). A 2007 survey found food-insecure rural families were likelier to give and get food from their neighborhoods and families than in urban areas and have access to garden produce (Morton et al., 2008). The food in the rural pantries might also be influenced by this occurrence, as their methods and strategies to ensure food safety are divergent given the distance from the food bank (Davis et al., 2014).

Generally, food and agricultural supply chains are increasing in length as a result of globalization (Henson & Reardon, 2005; Nadvi, 2004). Yet, donated foods can be considered “higher risk,” due to length of travel and storage locations (Finch & Daniel, 2005). This article addresses the transport practices, storage procedures, and gaps in knowledge regarding the emergency food supply chain of North Carolina. The purpose of this research is to characterize and empirically analyze the supply process and provide insight on improvement regarding food safety in the emergency food supply chain.

3.2 Literature Review: Supply Chain Management and Risk Frameworks

Overall, the supply chain literature does not focus on what happens to food after it is purchased or donated, which is when the foods move to the emergency food providers. A team of engineers at North Carolina A&T State University and NC State University researched the Food Bank of Central and Eastern North Carolina, focusing on the control mechanisms and supply chain leading to the partner agencies from the food bank itself, rather than a complete picture of how food arrives to the pantries, sometimes as the result of waste prevention (Davis et al., 2013a; Davis et al., 2013b). On the other hand, adequate training and education are needed to fully inform consumers and emergency food providers with relevant food safety practices, as food supply chain differences can have a foundational effect on health (Raspor, 2008). To illustrate, a grower might make decisions based on particular risks and desired outcomes, but fail to account for other effects, or might not find recommended practices conducive to his or her farm (Parker et al., 2012). In effect, growers and distributors have varied practices at each part of the supply chain but their products might be stored together in the food pantry. There is an unknown level of risk regarding each product, but minimizing that risk is critical for all pantries. Depending on the state, the growers can and do receive tax deductions for donated produce, gleaning rather than leaving the crops in the field (Selfa & Qazi, 2005).

Furthermore, there are various kinds of risk: to one's self, to other people, and to society (Frewer et al., 1994). Individuals have suggested a greater level of risk for others or for society than one's self, allowing for individuals to think food safety information is for others, rather than themselves. How to communicate risk uncertainty has been consistently challenging; a 2002 study found that individuals want information as soon as it is available, preferring the uncertainty to lack of action (Frewer et al., 2002). Researchers found that the public understands that a foodborne illness outbreak is an evolving process but that they want the ability to make "fully informed food

choices under conditions of risk uncertainty through the presentation of all relevant information in an understandable and intelligible way” (Frewer et al., 2002, p. 370). Managers, volunteers, and clients of food pantries may or may not have the relevant information.

The emergency food supply chain differs from a traditional supply chain in various ways, but most importantly, the recipients of the items (i.e., the food pantries) have little control over it. The supply chain literature is heavily qualitative, with various suggestions for both improvement as well as further research into the field. Generally, this literature poses the question: Is enough being done to mitigate risk? To analyze the supply chains, authors have created their own frameworks for analysis, though some compile previous research. In their review, Jüttner et al. (2010) examine the means for assessing risk sources and “chaos effect” of complex supply chains, categorizing risk mitigation strategies alongside risk drivers: 1) avoidance, 2) control, 3) cooperation, and 4) flexibility. They conclude by suggesting that assessing risk sources is the first agenda item in further research; more positive research needs to be done to be able to establish a set framework can be developed, as well as empirically-grounded research. Tang (2006) compares established supply chain risk management frameworks to those in practice, but suggests new models for risk mitigation given that the models lack disruption risks. Beamon (1998) reviews the literature on multi-stage modeling, laying out performance measures but ultimately suggesting more models.

Yet, supply chains are generally complex; Lambert and Cooper explain, “Strictly speaking, the supply chain is not a chain of businesses with one-to-one, business-to-business relationships, but a network of multiple businesses and relationships” (2000, p. 65). Oftentimes, case studies are used to better understand any particular sophistications. For Lambert and Cooper (2000), 90 in-depth interviews in 15 companies regarding nine supply chains allowed for the categorization of processes: 1) the supply chain network structure; 2) the supply chain business processes; and 3) the management components, leading to the creation of a supply chain management (SCM) framework

focused on value. Zsidisin et al. (2000) published an exploratory study on minimizing supply chain risk but attribute quality-related risk to the supplier and dynamic customer demands. As Vlajic et al. (2012) concentrate on vulnerability, they also request and present an integrated network that would support the design of robust supply chains. Using meat as the sample product, their analysis reaches from farmers to retail outlets and heavily stresses cost-benefit analysis.

Conversely, research into the humanitarian aid supply chain tends to center on disaster relief (c.f. Balcik et al., 2008; Balcik et al., 2010; Thomas & Kopczak, 2005; Van Wassenhove, 2006), which requires the coordination of numerous non-governmental agencies, can be unpredictable, and involve resource scarcity. Even with the few similarities, that literature does not examine American emergency food as part of the humanitarian aid supply chain.

Overall, the food donation supply chain and its nuances are incompletely documented in the academic literature, important especially as the clients have limited resources in the event of foodborne illness. While some food sources were expected, like grocery stores and federal government commodities, the likelihood and frequency of garden harvest, hunted game, gleaned fruits and vegetables, salvaged leftover catered and restaurant meals, and even meat and dairy from local producers were uncertain, with questionable means of transport and containers. This paper describes and empirically analyzes the supply chain of the redistributed goods using a novel data set and risk framework.

3.3 Research Approach

3.3.1 Sample Selection

Given the more than 2,500 food pantries in North Carolina, a stratified random sample of 12 counties was used to achieve a generalizable and representative sample of North Carolina that could later be extrapolated to the larger American population. Levels of food security and poverty were considered as variables for stratification, but food security rates are correlated with population

in both populous and sparse counties. All counties in North Carolina that have at least 25% of the population in poverty have fewer than 60,000 people (USDA, 2013; SNAP, 2013). Given that correlation, four categories were created based on the nine urban, rural, and metropolitan divisions used by the U.S. Census Bureau. Counties were stratified by their metropolitan status (defined as being part of a Metropolitan Statistical Area) and nonmetropolitan status. A random number generator was used to achieve 12 counties, six in metropolitan statistical areas, four in micropolitan areas, and two rural counties not adjacent to metro areas.

Each food bank region consists of seven to more than 30 counties, plus partial counties. Of the pantries that participated (n=105), 17 of them did not partner with a food bank (16.2%) and 88 were partnered with at least one food bank (83.8%). One food pantry has had a long-time partnership with its local food bank but no longer uses it as a supplier due to requisite paperwork; as a result, many of the variables analyzed in this paper have n=87, not 88. Three food pantries are entirely mobile markets; that is, no food is stored, but is distributed directly from the food bank's vehicle. Given the disparities across counties and food bank regions, the pantries are also not equally distributed across food bank regions, with 23.3% of the pantries associated with a single food bank.

3.3.2 Participant Recruitment

In the 12 counties, a list of food pantries was created with relevant names, addresses, phone numbers, emails, and days/times of operation. In addition to reviewing publicly-available information on the North Carolina food bank websites, Web searches were conducted for food pantries, using the word “food pantry” or “pantry” alongside a variety of terms, including county names. The Executive Director of the North Carolina Association of Feeding America Food Banks introduced the researcher by email to requisite individuals at each food bank, some of whom provided their partner (pantry) lists.

Numerous food bank employees explained that the lists sometimes include pantries that no longer exist, as turnover is frequent. Thirty-six pantries were eliminated from the original lists, given that they are no longer in operation, even though they remained on the partner food bank's website. All 282 known pantries in the 12 counties were contacted, resulting in 105 interviews—a 37.2% response rate. The pantry managers were informed in the first conversation or email that the research focused on food safety and would require both an interview and the collection of observational pantry data. Only three managers explicitly said that they did not want to participate.

Each pantry was contacted twice, either by phone or email initially, and by phone in the second attempt. Email addresses could not be found for more than half of the food pantries and, of the obtained email addresses, 40 were wrong or no longer in-use, prompting a phone call. For the phone calls, messages were only left in the first round if the recording indicated that the organization dialed was correct; that is, without a recording or organization mentioned on the recording, no message was left. Pantry managers were initially contacted from February to May 2014 and on-site visits and interviews occurred from February to June 2014. The study is limited due to the selection bias of the participants, though the estimated impact on the supply chain analysis is minimal.

3.3.3 Survey Instrument

In this research, a partially-structured interview was designed and executed to identify, describe, categorize, and analyze the supply chain for North Carolina food pantries. The interview, conducted as part of the companion study regarding standard operating procedures (Chapter 2), consisted of eight multi-part questions on the sources of food distributed at the pantry, the respective delivery methods, length of travel from the suppliers, regularity of sources, and percentage of all foods from said source. Other questions resulted in the description of the kinds of foods donated, storage procedure (refrigerator, freezer, pantry, no on-site storage), any supplier requirements, repackaging and processing details, and traceability of items held on-site. The

questions are both open-ended and discrete (yes-no). Content validity was assessed and the questions were pilot-tested on two pantry managers outside the sample counties and by North Carolina Cooperative Extension researchers for accuracy and extensiveness. The Institutional Review Boards of the University of North Carolina at Chapel Hill and North Carolina State University reviewed the study and its components, determining it to be “non-human subjects research.”

3.3.4 Data Collection

Each interview and food pantry observation lasted from 40 minutes to 2 hours, depending on the verbosity of the manager and the busyness of the pantry. Each participant consented orally to the interview. The participating pantry managers did not receive any compensation. Each interview was typed or handwritten during the conversation; interviews initially handwritten were typed (Microsoft Word 14.4.3, Redmond, WA, 2011) at a later date. Pantry schedules can vary greatly, from distribution once per month to five days per week. When possible, the pantry was visited during food distribution or while bags were packed (n=70); otherwise, the pantry manager explained the organization’s procedures and provided a full tour of the pantry (n=35).

To address concerns about confidentiality, participants were informed that pseudonyms for the individuals and food pantries would be used in any publications, that participation is voluntary, and that questions could be skipped at any time. Interviews were conducted in a space at the food pantry chosen by the participant. Oftentimes, the participant would answer the questions at the same time as providing a tour of the pantry and its operations, though some interviews were conducted while seated. To provide an environment of trust, the intention of the interviewer was to display interest in the participant, avoid reactionary responses, and be mindful of time.

Each interview was manually coded by assigning a unique identifier to each pantry. The variables and codes were entered into an Excel spreadsheet (Microsoft Corporation, Redmond,

Washington, 2011) to count, summarize, and categorize trends in participant responses. The data were then entered into Stata11.2 (Statacorp LP, College Station, Texas, 2009) and merged with data from the companion study on standard operating procedures for quantitative analysis. Data are considered statistically significant at the 90% confidence level ($p < 0.10$). No missing data were imputed. Mean scores and standard deviations were calculated for each question. Passages from the full interviews were also coded in NVivo10, allowing for analysis based on certain themes (QSR International, Melbourne, Australia, 2014). The qualitative analysis is supplementary and provides reasoning behind certain actions and operating procedures.

3.4 Descriptive Data Analysis

In this section, distribution and storage practices, food sources, supply chain details will be discussed. To elaborate, those specifics include time in transit, methods of delivery, and traceability. Paired t-tests were performed on various pantry characteristics, including distance from supplier, traceability, and on-site storage facilities. A limited typology regarding fruit and vegetable access and local and regional food systems can be found in Appendix A.

3.4.1 Distribution and Storage

Eighty-two of the participating food pantries (78.1%) distribute both perishable and non-perishable items. Twelve of the pantries (11.4%) serve food prepared in an on-site kitchen in addition to distributing bags of food. Nine pantries (8.6%) only distribute non-perishable foods. Of the pantries that partner with a food bank ($n=88$), 74 of them (70.5%) participate in at least one federal commodity program, either The Emergency Food Assistance Program (TEFAP) or the Supplemental Nutrition Assistance Program (SNAP) or both. Both TEFAP and SNAP items are available to approved pantries depending on availability, administrative upkeep, and storage facilities. While TEFAP provides predominately nonperishable food to the food banks, it also includes fresh and frozen fruit and meat products (TEFAP, 2013). A participating pantry must be able to take any

items given, requiring at least a freezer. The TEFAP and SNAP items must be stored on separate shelves than other pantry items.⁷

The majority (97.1%) of all visited pantries have an on-site pantry or closet for storing items; the remaining 2.86% are purely mobile markets. Eighty-five (80.9%) pantries own or have access to a refrigerator or walk-in cooler to store perishable items, while 93 pantries (88.6%) own or have access to a chest freezer, upright freezer, or walk-in freezer for storage. Yet, access to cold storage does not always mean that the space is unlimited. Figure 3.1 depicts the various food categories of the food pantries, with meat (which includes beef, poultry, fish, pork), some fruits and vegetables, dairy, eggs, deli/lunch meat, game, some bread and pastries, and leftover cooked items in need of refrigeration or freezing. While it has been well-acknowledged that food pantries distribute canned and packaged goods, the prevalence of perishable items has now been calculated at both food bank partners and independent pantries. In the sample, 48.6% of the pantries distribute fresh dairy products (shelf-stable milk is considered a packaged item), 43.8% distribute eggs, 88.6% distribute fruits and vegetables, and 85.7% distribute meat, from chicken to pork to beef. The data does not include the specificities as to how each of those kinds of items travels to the pantries.

With certainty, clients in metropolitan areas are likelier to receive a more diverse set of foods in the bags at the food pantries—that is, the foods are likelier to come from various suppliers. Yet, an increased number of suppliers do not mean that the foods are inherently unsafe, but that there is a probability of increased risk due to the multiple changes in environment (e.g., temperature, packaging, storage facility). Pantry managers indicated that they would not accept perishable items if they cannot be appropriately stored on-site or distributed immediately. The food banks offer full pallets of certain items, from lemons to tomatoes to potatoes, but the managers will refuse them if

⁷Every pantry manager interprets this rule differently. For example, some food pantries designate certain shelves within a freezer for TEFAP items while other managers will have another freezer for their storage. With no explicit connection to food safety, the interviewer did not tally this detail.

they do not have the capacity to transport the pallet, distribute the items before they perish, or store them. Figure 3.2 categorizes the location where certain types of items are stored within the pantry. The options are limited: they distribute the items immediately, store in a refrigerator or freezer (sometimes a walk-in model), or put onto the shelves in the pantry itself. Canned and packaged items are not included in this figure; they are always stored on pantry shelves (n=102).

The highest risk items are the perishable items that are not stored in a cold environment, but stored in the pantry. To elaborate, of the 93 pantries that distribute fruits and vegetables, 28.0% of them store them in the pantry. Zero pantry managers indicated that they store meat in the pantry, but some (n=4) leave meat on the counter until distribution, as do six pantries with dairy items and four with eggs. While this action might seem innocuous, the perishable items require cold storage.

3.4.2 Food Sources

The types of food suppliers are in Table 3.1, as are the raw numbers of the pantries that use each source. On average, a single pantry receives food from 3.73 sources. The maximum number of food source categories used by a single food pantry is eleven (n=1) and the minimum number of source is one (n=16). For the food pantries that have a partnership with a food bank, it tends to be the largest source of food; 14 pantries receive 100% of the food from their food bank partner. Each pantry manager also explained approximately how much food was received from each category, with the average amounts listed in Table 3.1. For those that partner with the food bank, it is the pantry's predominant source of food, averaging 71.5%. On the other hand, even though many (n=17) food pantries distribute home-processed foods, it makes up a very small percentage of the total food distributed from that pantry (0.7%). Yet, the risk of contamination is higher for the home-processed canned items, given the uncertainty of their processing procedures.

Table 1 includes a list of the reported food sources for the food pantries, as well as an “other” category in which pantries mentioned a food source not otherwise indicated, typically a

distributor or local food corporation (n=7). While food banks and food drives are the most common sources of food, a quarter of all pantries use grocery stores, discount grocery stores, and/or local farms and gardens (community, school, and prison). Of the 105 total pantries, 52 of the managers stated that they always know when they will receive a food donation. Pantries with surprise donations (n=36) do not always have appropriate storage for the items. Furthermore, donors sometimes leave food for the manager to find the next day; it has been left outside of the pantry, critical due to the lack of time-temperature control.

Foods that are processed at home are considered especially risky, given the unknown specifics regarding processing and food handling. The eighteen managers that distribute (or allow for the distribution of) home-processed items equal 17.1% of the pantries, almost one in five. One of the pantries actually cans on-site, but an inquiry into methodology resulted in the response, “these are not recipe foods.” The clients might not have the information regarding the riskiness of the items, especially when food pantry staff places them on the “take at your own risk” shelf alongside past-date items that lack the same risks. The acceptance and distribution of home-processed foods is discouraged across all food bank regions, though inconsistently followed. Of all participating pantries, the independent pantries that distribute home-processed foods equal 1.9% of all pantries, while the food bank partners are 14.3% of all pantries, six partnered with a single food bank. The same county with the higher prevalence of garden and farm produce than other counties also contains the highest raw number of food pantries that distribute home-processed items. Yet, another, micropolitan county that makes up only 7.6% of the overall sample has 17.6% of the food pantries that distribute home-processed food and those pantries make up 37.8% of the participating pantries in the county.

3.4.3 Transportation

Unlike other food supply chains, the emergency food supply chain does not consist of one specific item, like meat, dairy, vegetables, or eggs, each with different transport needs. Yet, while all of the aforementioned items are cold-chain (i.e., require cold storage), the vehicles are not necessarily temperature-controlled, allowing for an increased risk of contamination. Each pantry manager seeks to find food sources to fulfill its client base and does so as needed—with one source or up to ten sources. Figure 3.3 summarizes the overall supply chain options for any single food pantry. The product flow, or supply chain, for food pantry items is especially difficult to chart, given its complex nature.

While Figure 3.3 depicts the potential routes for any single item of food that results in distribution from a food pantry, the life of the distributed food can be lengthy. Figure 3.3 does not include the supply chain for the items directly before they arrive at grocery stores, restaurants, or distribution centers, only the sources previous to the pantry (c.f. Davis et al., 2013a; Davis et al., 2013b). To elaborate, food from the food bank also comes from numerous sources, each which traveled varying lengths of time and in unknown conditions to arrive at the food bank, where it remains until a food pantry manager retrieves it. Meat is an especially popular item among clients, characterized by managerial sentiments “the more meat, the more people” and “people will wait in a line for meat.” For a product as simple as hunted venison, an individual could process it at home or give it to a certified processor via an organization like Hunters for the Hungry or Backyard Bow Pro, both prominent in parts of North Carolina. Table 3.2 shows the food sources by type of food.

Overall, the emergency food supply chain is increasingly complicated. Each pantry that receives bread, for example, could receive that product from one of four types of places. Furthermore, a single food pantry often receives a product like bread from numerous sources, typically on different days of the week. Eggs, when delivered by a donor, can be either purchased in

a store, from a farm, or even come from one's personal henhouse. Only one pantry in the sample candled eggs on-site.⁸ The food pantry managers and volunteers use their discretion to decide whether the product is safe or "good" enough to distribute.

3.4.4 Transport Times

The number of minutes it takes for the food to be transported from its source to the food pantry can be found in Table 3.3. Used in North Carolina, the 2009 Food Code stipulates that four hours is the maximum length of time that food can be left without refrigeration or freezing before it should be thrown away (United States Department of Health and Human Services, 2009). Minutes rather than mileage are used for comparability. Mileage allows for inconsistent time in transit; for example, depending on location, five miles can mean five or 25 minutes. Because mileage fails to capture the length of time for potential temperature shifts while food is in transit, the average number of minutes the food travels from one point to another from each type of food source is shown in Table 3.3. The observations included are only those where the food pantry manager was able to answer the question. For both gardens and food drives, one minute in transit is utilized due to the fact that the food is already on-site. For the pantries that distribute produce from gardens, seven of them have a garden on-site and one pantry is a garden only; it has no other food source.

However, if food is delivered by truck from a distant food bank (or any other source) and the truck makes multiple stops, the length of that drive might not be captured, as the true length of time in transit is likely unknown by the pantry manager. Yet, the food from the food banks dwarfs any other source in terms of maximum time to destination, and 49 pantry managers explained that it takes more than 30 minutes for the food to travel to the pantry and 11 of them stated it took at least one hour, but as many as two hours. When food is delivered by the food bank, it will travel in a refrigerated truck, but the managers could only approximate the time from the initial location to the

⁸Candling is the process by which one can check on the growth of the embryo to see if the egg has been fertilized.

destination, as there is no way to know the length of time or number of stops in-between destinations. When a refrigerated truck is kept at the appropriate temperature, then the minutes in transit are less essential. However, as shown in Figure 3.4, the refrigerated truck is not the common method of transport, as most pantry managers pick up the food bank items via one's personal vehicle, be it car, truck, or organizational van.

The inability for food pantry managers to provide the number of minutes, or miles, that the food traveled is also of note and found in the last column of Table 3.3. The lack of knowledge is critical due to the potential lack of temperature control. Perishable items might remain in the trunk of one's car or bed of a pick-up truck before they arrive at the pantry. Given that food drive items tend to be packaged or canned, the time in transit matters less than if the food is highly perishable, like game meat or garden harvest. In the case of food drives, individuals tend to deliver the food to the church or organization and the pantry manager retrieves it from a bin on-site.

Even though all pantries indicated the time in transit was fewer than four hours, paired t-tests were performed on the distances from each location type to understand any statistically significant differences between the pantries that did and did not partner with a food bank, as shown in Table 3.4. The sample in this analysis only includes the food pantries that used said source for each question. The distance from the grocery stores ($p < 0.05$) and farms ($p < 0.05$) were each associated with statistically significant differences in food bank partnership even with small sample sizes ($n=36$ and $n=4$, respectively). For the other locations, there was no statistically significant difference between the pantries that do and do not partner with a food bank.

Correspondingly, paired t-tests were also performed on the distances from each location type to determine any statistically significant differences between the pantries that are and are not in metropolitan areas. This analysis should be more robust, given that the pantries in metropolitan areas are likelier to have near access to numerous sources. However, as shown in Table 3.5, these

results only somewhat validate earlier hypotheses regarding food access. The distances from the big box stores and farms were each associated with statistically significant differences ($p < 0.05$) when the pantries are located in metropolitan areas.

For the most part, the average time in transit is lengthier when the pantry is in a non-metropolitan area, but not statistically different. While the extremes are critical, the means provide little insight. Given that salvage grocery stores are rarely frequented ($n=2$), there are too few observations to include in the analysis. The food pantries that distribute hunted game rarely knew from how far it came ($n=13$). Still, this analysis only includes time in transit, not means of delivery.

3.4.5 Methods of Delivery

The interviews also tried to capture the methods of delivery for each food source. That is, when a food pantry is receiving food from a local farm, the researcher directly asked how the items travel to the pantry, shown in Figure 3.4 alongside other sources and means of delivery. Of the pantries that get vegetables from community, school, and even prison gardens ($n=33$), seven of them have the garden on-site.

The designation “delivered” indicates not only that the food was delivered by an individual, but also that the pantry manager does not know the details of its delivery. Of the 30 pantries that receive produce (sometimes gleaned) from farms, 25 of them have those items delivered, sometimes by the farmers. Unlike grocery stores, gardens and farms have their own operating procedures that may or may not follow best practices, leading to variable foodborne illness risk. While food drives typically consist solely of non-perishable items, the other food sources can be a mixture of both non-perishable and perishable goods, some frozen and some refrigerated, both requiring low temperatures so that the items do not defrost or get into the “danger zone” above 41°F (United States Department of Health and Human Services, 2009). While six of the pantry managers explained that they used coolers for transport (typically required by the grocery stores to pick-up

food), only four of them stated that they used freezer blankets. For the most part, a pick-up from the food bank often requires more space than a typical sedan, leading to the rental and borrowing of trailers, box trucks, vans, and pick-up trucks, especially if the items include TEFAP or SNAP or both. Few other donations are similar in size require special transportation.

3.4.6 Traceability

The pantry managers were also asked about the traceability of items. Traceability is the ease by which the manager would be able to determine the original source of an item. This question was to determine how difficult it would be to react to an ill client claiming foodborne illness contraction from an item in the pantry. To further explain, during the interview, items from six categories were chosen for questioning: grain, meat, packaged (can, package, or jar) items, fruits and vegetables, eggs, and dairy. The interviewer asked about the item's origin (supplier) and length of time spent in the pantry. Some pantries distribute many types of items, but did not have all of them in stock. Other pantries never distribute certain categories (e.g., meat or dairy) and thus do not stock them.

As shown in Table 3.6, most pantry managers were able to answer this question. Fruits and vegetables do not have such labels and often get combined with other like items. Conversely, packaged goods were the hardest to trace, but they are clearly labeled by brand. That particular category came with the overall lowest traceability rate of 75.3%, with the other items at least 89% traceable. Once packaged items are categorized within the pantry (for example, all cans of corn together, regardless of brand), they are harder to trace based on supplier. Given that TEFAP and SNAP items have identifying (non-brand) labels, certain food bank items tended to be simpler to trace. None of the home-processed foods were labeled with details on how the food was processed, with few labeled at all. Without labels or dates, it would be difficult to find the contamination source in the event of foodborne illness.

Given the sheer number of food pantries that are partnered with a food bank, it would seem as though a few independent pantries could skew the analysis. In Table 3.6, paired t-tests on the pantry manager's ability to trace the sources of certain items were performed to test any statistically significant differences between them. For pantries that distribute fruits and vegetables and are partnered with a food bank, the managers are better able to trace the source of the product, statistically significant at the 95% confidence level. The distribution of other items revealed no statistically significant differences based on food bank partnership, meaning that the food bank partnership bears little influence on traceability.

Even with the small sample size, the pantries were further divided into groups: food bank partners in metropolitan and non-metropolitan areas (n=6 counties in each designation). Table 3.7 comprises the results of paired t-tests on the pantry manager's ability to trace the sources of certain items, but only for those that partner with a food bank. The pantries in rural areas do not have the statistically significant differences initially hypothesized, at least in terms of traceability of their food items. Here, the food pantries not located in metropolitan areas were better able to trace their canned goods, statistically significant at the 95% confidence level. A divide in food access may remain but the within-pantry differences based on population are lacking. Overall, the canned goods have less risk for contamination on-site, as they do not require freezing or refrigeration. Given the package labels, they are generally easier to trace than fruits and vegetables.

3.5 Emergency Food Supply Chain Risk Analysis

To date, few characteristics and methods of analysis mentioned in the supply chain literature really capture the details of the emergency food supply chain of North Carolina. The food pantries lack formal contingency plans and fail to evaluate their suppliers for any sort of supply risk. The dearth of professional staff might play a role, though the literature has not yet evaluated that aspect. If a risk has not yet materialized into known foodborne illness, it might be difficult to justify any

time and cost of its mitigation, as the lack of illness suggests the lack of a problem. To that end, there are likely many points along the supply chain that are risky, rather than one centralized problem, and outside factors might be correlated with those risky choices.

3.5.1 Risk Identification and Creation of Framework

In this case, 30 procedural characteristics have been marked as risky; while one might not result in foodborne illness, every additional characteristic increases the risk of doing so. Many of them are considered risky due to the lack of knowledge regarding them, including the lack of information regarding means of transportation and number of minutes in transit. They have been totaled to provide a total “risk score.” The risks are not weighted; that is, there is no reliable way to analyze how certain risks might be worse than others, given the specificity required of the data. The complete list of risks is provided in Table 3.8 and the total number of risks for each pantry is the explanatory variable of interest.

Some risks might be clear (e.g., lack of recall knowledge, repackaging items), the lack of recall plan indicates that contaminated food could continue to be distributed. Given the rule that perishable food should be placed into cold storage after a maximum of four hours, the failure to do so or know about the transportation of the food are each considered to be a risk. On the surface, some behaviors might not suggest that they are especially risky, but additional actions increase the risk; the analysis is completed with the count of all risky behaviors as the outcome variable. For example, if a pantry manager does not know where its meat originated and that is its only risk factor, the pantry is relatively safe in comparison to a pantry manager that does not know the origin of its meat and eggs, does not know about food recalls, stores its meat and eggs on counter during distribution, and repackages food on-site. Table 3.9 shows the total number of risks alongside the raw number of pantries that have that number of risks. While there are 30 risks on the list, no pantry has more than fourteen and no fewer than one risk.

3.5.2 Method of Analysis

Three models were run using the interview data to assess certain supply chain procedures and how they impact the risk level of the food pantries. The descriptive statistics for all food pantries is in Table 3.10; the same information is broken down by food bank partnership in Appendix B, Tables B.1 and B.2.

The key independent variable of interest is the risk score. The risk score is a count variable with binary indicators for all dependent variables. The model evaluates the importance of organizational characteristics including paid manager, regular (repeated) volunteers, supplier requirements, and types of food distributed. The baseline model is as follows:

$$(RISK\ SCORE) = \beta_0 + \beta_1(FB) + \beta_2(TS) + \beta_3(DT) + \beta_4(PM) + \beta_5(RV) + \beta_6(SR) + \beta_7(FT) + \varepsilon \quad (3.1)$$

where FB is a dichotomous variable for food bank partnership, TS is a dichotomous variable for participation in TEFAP or SNAP or both, DT is a vector of dichotomous variables for food distribution (pre-packing the items, packing as they go, and client choice),⁹ PM is a dichotomous variable for paid manager, RV is a dichotomous variable for regular volunteers, SR is a dichotomous variable for having supplier requirements, and FT is a vector of dichotomous variables designating the type of food distributed (only non-perishable foods, perishable and non-perishable foods, or pantries that distribute perishables and non-perishables but also prepare and serve foods). The β_0 is the constant and the ε is the error term. Tests for multicollinearity, and all other statistical analysis, were performed in Stata11.2. The pairwise correlations did not show high levels of correlation between any two variables. A logged independent variable is not used given that the food pantries can have a zero risk score.

⁹For pre-packed items, the bags or boxes of food are packaged ahead of distribution, rather than during it (pack as they go). A client choice model means that the food pantry is set up like a grocery store and the clients are able to choose items from different categories, in varying quantities—for example, meat, canned vegetables, bread, grains, and dairy.

While an OLS model is included in Table 3.11, the risk score is a count variable so a negative binomial or Poisson model is the best fit. For the aforementioned regression, a Poisson model was run and a goodness of fit test calculated. Given the statistical significance of the test's outcome, the model was rejected. As a result, a negative binomial model was utilized. However, the marginal effects of both models, in addition to the coefficients of the OLS model, are reported in Table 3.10.

Given that they are the majority (n=88), the same model was used to examine the influence of the same procedures but only for food pantries that partner with a food bank.

$$(RISK\ SCORE) = \beta_0 + \beta_1(TS) + \beta_2(DT) + \beta_3(PM) + \beta_4(RV) + \beta_5(SR) + \beta_6(FT) + \varepsilon \quad (3.2)$$

The control variables are the same as previously stated but lack the food bank indicator. A Poisson model was run; the goodness of fit test determined that a negative binomial model is a better fit. To adjust for any heteroskedasticity, robust standard errors were calculated and provided in both models. While clustering at the food bank level was considered, it was rejected given that some pantries are independent, but also that each food pantry might not be truly representative of a food bank given the small number of observations in some regions.

3.5.3 Empirical Results

Empirical results for both models are presented in Tables 3.11 and 3.12. Table 3.11 presents the marginal effects that came as result of Equation 3.1, evaluated using the negative binomial model. The estimations show that food bank partnership can increase the number of risks of a food pantry by 1.47, statistically significant at the 90% confidence level. This result is hypothesized to come as result of the increased activities in general at the food pantries that partner with a food bank. Conversely, participation in either TEFAP or SNAP or both leads to an approximate decrease in risk score by 2.86, statistically significant at the 99% confidence level. Given that most food pantries that partner with a food bank also participate in a federal commodity program, this decrease is substantial.

The results show no significant effect for having regular volunteers or requirements for those that supply food. Furthermore, a paid manager increases the risk score by a statistically significant 1.39 points but a paid manager is only found in 40.95% of the sampled pantries: eight in independent pantries and 35 at food bank partnered pantries.

Food distribution practices revealed a relative statistical significance, both in process and in types of food. The client choice model brought a decrease in 1.69 points compared to the referent “pack as they go” category, statistically significant at the 90% confidence level, which pre-packing the items showed no significant effect. In comparison to the pantries that also prepare food, the distribution of perishable and non-perishable items decreased the level of risk by 2.57 points and solely distributing non-perishable items decreased the risk by 3.88 points, both statistically significant at the 99% confidence level.

The marginal effects are similar when the observations only include the food bank partners, as their numbers essentially drive the sample due to their size (as per Equation 3.2). However, with only the food bank partners are analyzed, the effects are larger, as seen in Table 3.12. Participation in the federal commodity programs (TEFAP and/or SNAP) and the types of foods distributed impact the risk score in large and significant ways. For example, participation in either TEFAP or SNAP or both results in an approximately 3.15 point decrease in the overall risk score, statistically significant at the 99% confidence interval. And, when compared to pantries that also cook and serve food on-site, the distribution of perishables and non-perishables decreases the overall risk score by approximately 2.39 points and the distribution of only non-perishables decreases the overall risk score by approximately 4.78 points, both statistically significant at the 99% confidence level. While regular volunteers and supplier requirements were both hypothesized to negatively influence the scores, no significant effect was found.

3.6 Limitations

While the overall supply chain (Figure 3.3) might be generalizable to food pantry supply chains nationwide, this analysis allows for continued uncertainty on delivery mechanisms and sources in other states, as state regulations and food bank rules differ from North Carolina. Still, metropolitan areas in North Carolina might not mirror those of much-larger metropolitan areas, like New York, Los Angeles, or Houston. Larger networks and accessibility to foods of all kinds might allow for increased diversity of sources and foods. Furthermore, the food brought to the food pantries is often distributed too quickly to truly trace, begging the question of the importance of the detail required to truly trace the items in the event of foodborne illness or recall. It does suggest, however, that keeping a list of clients' addresses or phone numbers would be of additional assistance. However, the impact of poor practices varies amongst pantries, as some pantries distribute to ten families per month and others to hundreds.

While this sample is purposeful, threats to internal validity could be reduced with a larger sample of food pantries. Additionally, a selection bias remains of the pantries that are in the sample, as not every pantry manager in the selected counties responded to the recruitment phone call or email. However, managers who were discouraged by the inclusion of the language in the email (i.e., food safety) might also be those who are least confident in their practices, meaning that the analysis in this paper is the upper-bound. Generalizability remains a concern, given that all pantries are located within North Carolina and in only a fraction of its counties. The results might allow for extrapolation to other, similar counties within the state, though the supply chains and regulations might differ elsewhere.

Like many previous studies, this one suffers from omitted variable bias. To perform the best analysis, more characteristics on each pantry would need to be collected on analyzed, like the details of which kinds of food travel from which source for what length of time. Lastly, given the newness

of the risk framework, the marginal effects of the negative binomial models might be skewed. To best understand its effectiveness, it should also be tested with additional pantries or even with the full sample of pantries in a single region or county. Given the differences across pantries, the results from analyzing the framework are limited. To that end, the pantries that are “riskier” are likely to be doing more activities within the pantries, from transporting and storing more types of items to receiving food from myriad locations. The pantries that only distribute non-perishables or only have foods from the food bank have fewer potential ways to increase or decrease their respective scores.

3.7 Conclusions and Future Research

While the food banks have refrigerators and freezers, as well as dedicated staff and food safety policies, the supply chain is intrinsically complicated to understand. In the event of a foodborne illness or recall, even if a pantry manager knew that the recalled cantaloupe, for example, came from the food bank or food drive, it could remain difficult to trace, depending on the previous points within the supply chain. To that end, if a large distributor like a food bank or wholesaler combines perishable unwrapped products like fruits and vegetables from various suppliers and then distributes the items, they become harder to trace. The same problem can also occur in the food pantries, as they combine like items on-site.

Furthermore, while this analysis adds to the literature, it remains incomplete. An interesting data set would combine the information in Figure 3.1 and Table 3.4. At the time the data was collected, a multi-part question regarding type of item (e.g., ground beef), source of item (e.g., local farm), and minutes in transit was not presented. A comparative case study of high-risk items and their specific supply chains would allow for a richness not provided. As explained by a pantry manager, “being admirable can be devastating.”

Given the expense, it is unlikely that the pantries will invest in refrigerated trucks, but increased information on and access to coolers and freezer blankets would lessen the risk of

contamination due to a lack of time-temperature control. As for the increased distribution of perishable items like dairy, fruits and vegetables, and meat, the pantry managers would be able to accept a full pallet of a particular item if they had the space for its contents, or if there was a way to share with other emergency food distributors in the area, including but not limited to soup kitchens and shelters. At this junction, pantry managers in certain areas have been discouraged from doing so.

Limited regulatory policy regarding time-temperature control and proper storage could improve supply chain procedures, as would providing educational materials, so that managers and volunteers would have full information regarding foodborne illness risk. To the extent that the food banks can add to their procedures, they might also be an ideal institution to implement and enforce such policies for their partners. They might also be able to assist with increasing cold storage on-site so that the pantries are capable of accepting more perishable items. Most simply, the food pantry managers should learn more about the mechanisms that drive the supply chain—from how the food is delivered to the length of time it spends in the car. To that end, the pantry managers can supply their volunteers with instructional information and details on the best ways to transport food and keep it as safe as possible.

From a policy perspective, this paper provides support for certain operating procedures over others (e.g., storage facilities) and dispels the notion that the rurally-located food pantries operate in significantly different way than those in metropolitan areas. Similarly, it shows that federal regulation and any requirements to receive TEFAP or SNAP drastically decrease other risk factors. Even when individuals face bureaucratic red tape, they continue through the process to procure food, which can inevitably lead to safer food pantries.

Table 3.1 Sources of food (N=105)

Food Source	No. of Pantries using source	Average % of food from source by volume
Food Bank	87	71.5%
Restaurants	24	5.5%
Grocery stores	51	24.1%
Big box stores	24	12.4%
Discount grocery stores	27	21.2%
Salvage grocery stores	2	2.5%
Home-processed	17	0.7%
Local farms	30	4.4%
Gardens	33	6.1%
Food drives	75	21.3%
Hunted game	13	2.9%
Other sources	7	38.0%

Table 3.2 Known food sources by type of food.

Source	Meat	Fruits & vegetables	Dairy	Eggs	Bread
Food bank	X	X	X	X	X
Farm		X	X	X	
Grocery store	X	X	X	X	X
Garden		X			
Food drive and/or individual donation *	X	X	X	X	X
Bakery					X
Processor	X				
Distributor	X				

*In addition to store-bought items, this category includes venison processed at home, as well as any other home food preservation, like jellies, jams, pickles, canned vegetables, and canned fruits.

Table 3.3 Food transit times (N=105)

Food source	Average no. of minutes in transit	Median transit time	Min. transit time	Max. transit time	% of pantries that could not report transit times ⁺
Food Bank	46.4	45	5	120	20.7%
Restaurants	14.7	11	2	45	45.8%
Grocery stores	10.1	6.5	1	90	29.4%
Big box stores	19.1	15	2	90	25.0%
Discount grocery stores	14.1	10	2	75	25.9%
Salvage grocery stores	7	7	7	7	50.0%
Home-processed	4	5	1	5	76.5%
Local farms	7.8	8	5	10	86.7%
Gardens	1.1	1	1	2	76.5%
Food drives	8.6	4	1	30	82.3%
Hunted game	5	5	5	5	92.3%
Other sources	11	11	2	20	71.4%

Note: All times in minutes.

⁺This percentage is only of the food pantries that distribute said items, not of all pantries.

Table 3.4 Distance food travels from various types of locations in minutes, by food bank partnership

Characteristic	No. of pantries with characteristic	Food bank partner mean distance	Independent pantry mean distance
Distance from restaurants	13	13.40 (13.86)	19.00 (13.45)
Distance from grocery stores	36	7.27* (4.14)	21.71 (30.42)
Distance from big-box stores	21	21.57 (21.27)	11.00 (3.08)
Distance from discount groceries	20	14.83 (18.88)	12.57 (7.16)
Distance from farms	4	10.00* (0.00)	5.50 (0.71)
Distance from gardens	7	1.25 (0.50)	1.00 (0.00)
Distance from food drives and individuals	10	7.64 (10.44)	8.67 (10.02)

Notes: Standard deviations in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Only the observations where the action was observed are included in the analysis, meaning that the sample for the question on restaurants is 13, while the sample for big box stores is 21. The food from farms and gardens is perishable, while the food from all sources is a combination of perishable and non-perishable.

Table 3.5 Distance travels from various types of locations in minutes, by metropolitan status

Characteristic	No. of total pantries with characteristic	Metro area mean distance	Non-metro area mean distance
Distance from restaurants	13	13.9 (13.79)	17.33 (14.57)
Distance from grocery stores	36	7.73 (5.57)	16.20 (26.18)
Distance from big-box stores	21	11.93** (7.34)	30.63 (26.38)
Distance from discount groceries	20	14.75 (17.23)	11.25 (6.29)
Distance from farms	4	5.50** (0.71)	10 (0.00)
Distance from gardens	7	1.20 (0.45)	1.00 (0.00)
Distance from food drives and individuals	10	6.79 (10.74)	10.67 (8.14)

Notes: Standard deviations in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Only the observations where the action was observed are included in the analysis, meaning that the sample for the question on restaurants is 13, while the sample for big box stores is 21. The food from farms and gardens is perishable, while the food from all sources is a combination of perishable and non-perishable.

Table 3.6 Traceability of items and food bank partnership

Characteristic	No. of pantries	Food bank partner means	Independent pantry means
Ability to trace source of grain	66	0.93 (0.25)	1.00 (0.00)
Ability to trace source of meat	68	0.91 (0.29)	0.75 (0.50)
Ability to trace source of canned foods	97	0.77 (0.43)	0.69 (0.28)
Ability to trace source of vegetables	55	0.94** (0.23)	0.50 (0.71)
Ability to trace source of eggs	25	0.96 (0.21)	1.00 (0.00)
Ability to trace source of dairy	19	0.88 (0.33)	1.00 (0.00)

Notes: Standard deviations in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Only the observations where the action was observed are included in the analysis, meaning that the sample for the question on grain is 66, while the sample for dairy is 19.

Table 3.7 Traceability of items by food bank partners, by metropolitan status

Characteristic	No. of pantries	Metro area pantry means	Non-metro area pantry means
Ability to trace source of grain	59	0.90 (0.30)	1.00 (0.00)
Ability to trace source of meat	64	0.90 (0.31)	0.94 (0.25)
Ability to trace source of canned foods	81	0.70** (0.46)	0.92 (0.28)
Ability to trace source of vegetables	53	0.92 (0.27)	1.00 (0.00)
Ability to trace source of eggs	23	0.94 (0.25)	1.00 (0.00)
Ability to trace source of dairy	17	0.86 (0.36)	1.00 (0.00)

Notes: Standard deviations in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Only the observations where the action was observed are included in the analysis, meaning that the sample for the question on meat is 64, while the sample for dairy is 17.

Table 3.8 Food pantry risk factors (N=105)

Risk	No. of pantries with risk
<u>Traceability</u>	
Cannot trace meat	9
Cannot trace vegetables	6
Cannot trace eggs	3
Cannot trace dairy	4
Manager did not receive food safety training	28
Manager does not learn about food recalls	37
Manager knows about recalls but has no recall plan	14
Fails to have written SOPs	79
Has written SOPs but they are not modeled by manager	2
Distribute food from gardens	33
Distribute home-processed foods	17
Distribute leftover prepared foods	21
Repackage foods on site	44
Handle ready-to-eat foods	31
<u>Storage</u>	
Meat storage is not the freezer	27
Dairy storage is not cold storage	1
Egg storage is not cold storage	3
Fruit and vegetable storage is not cold storage	26
<u>Does not know transportation means for food from:</u>	
Food bank	15
Restaurants	8
Grocery stores	8
Big box stores	1
Discount groceries	6
Salvage groceries	1
Farms	25
Gardens	25
Food drives and individuals	63
Other food sources	3
Of hunted game	10
Of home-processed foods	15

Table 3.9 Number of risks per number of pantries (N=105)

Total no. of risks	No. of pantries with that no. of risks
1	5
2	13
3	14
4	16
5	11
6	10
7	11
8	10
9	6
10	3
11	2
12	3
14	1

Note: There are 30 risk factors, but the food pantry with the highest number of risky behaviors has 14.

Table 3.10 Descriptive Statistics (N=105)

Characteristic	Observations	Mean	Std. Dev.	Min.	Max.
Food bank partner	105	0.84	0.37	0	1
TEFAP/SNAP participation ⁺	104	0.71	0.45	0	1
Pack items as they go	105	0.52	0.50	0	1
Pre-pack items	105	0.35	0.48	0	1
Client choice	105	0.11	0.31	0	1
Paid manager	105	0.41	0.49	0	1
No. of paid staff	104	1.94	4.98	0	31
Regular volunteers	104	0.81	0.39	0	1
Supplier requirements	101	0.19	0.40	0	1
Type of food distribution					
Perishables, non-perishables, and food preparation	105	0.12	0.33	0	1
Perishables and non-perishables	105	0.77	0.42	0	1
Non-perishables only	105	0.09	0.28	0	1

⁺TEFAP/SNAP participation can mean either TEFAP or SNAP or both programs.

Table 3.11 Coefficients and marginal effects from three models (N=100)

Characteristic	OLS model N=100	Poisson model N=100	Negative binomial model N=100
Food bank partner	1.71* (0.89)	1.49** (0.68)	1.49* (0.69)
TEFAP/SNAP participation	-3.03*** (0.84)	-2.86*** (0.66)	-2.86*** (0.66)
<u>Food distribution process</u>			
Pre-pack items	-0.56 (0.59)	-0.58 (0.58)	-0.58 (0.58)
Client choice	-1.49** (0.76)	-1.69* (0.95)	-1.69* (0.94)
Paid manager	1.34 (0.55)	1.40*** (0.50)	1.39*** (0.51)
Regular volunteers	0.44 (0.59)	0.54 (0.53)	0.54 (0.54)
Supplier requirements	-0.31 (0.83)	-0.35 (0.77)	-0.33 (0.78)
<u>Type of foods distributed</u>			
Perishables and non-perishables	-3.04*** (0.89)	-2.57*** (0.61)	-2.57*** (0.61)
Non-perishables only	-4.32*** (1.09)	-3.89*** (0.89)	-3.88*** (0.89)
Constant	8.42	2.13	2.13
R-squared	0.33		
Pseudo R-squared		0.10	

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

For food distribution process, the referent category is to pack as they go. For the type of foods distributed, the referent category includes the pantries that distribute perishables, non-perishables, and prepare foods. For the Poisson and negative binomial models, the marginal effects are presented; coefficients are available from the author upon request.

Table 3.12 Marginal effects for food bank partners only (N=82)

Characteristic	Negative binomial model N=82
TEFAP/SNAP participation	-3.15*** (0.59)
<u>Food distribution process</u>	
Pre-pack items	-0.79 (0.64)
Client choice	-1.71* (0.89)
Paid manager	1.85*** (0.62)
Regular volunteers	0.72 (0.60)
Supplier requirements	0.21 (1.07)
<u>Type of foods distributed</u>	
Perishables and non-perishables	-2.39*** (0.68)
Non-perishables only	-4.78*** (1.41)
Constant	2.37

Notes: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

For food distribution process, the referent category is to pack as they go. For the type of foods distributed, the referent category includes the pantries that distribute perishables, non-perishables, and prepare foods. Coefficients are available from the author upon request.

Figure 3.1 Percentage of pantries that distribute certain categories of items (N=105)

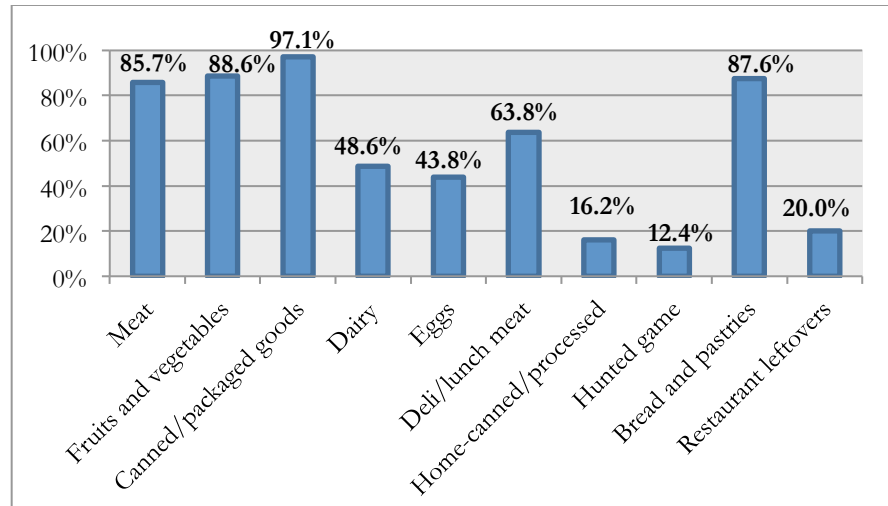


Figure 3.2 Storage locations in the pantry, by perishable item (N=105)

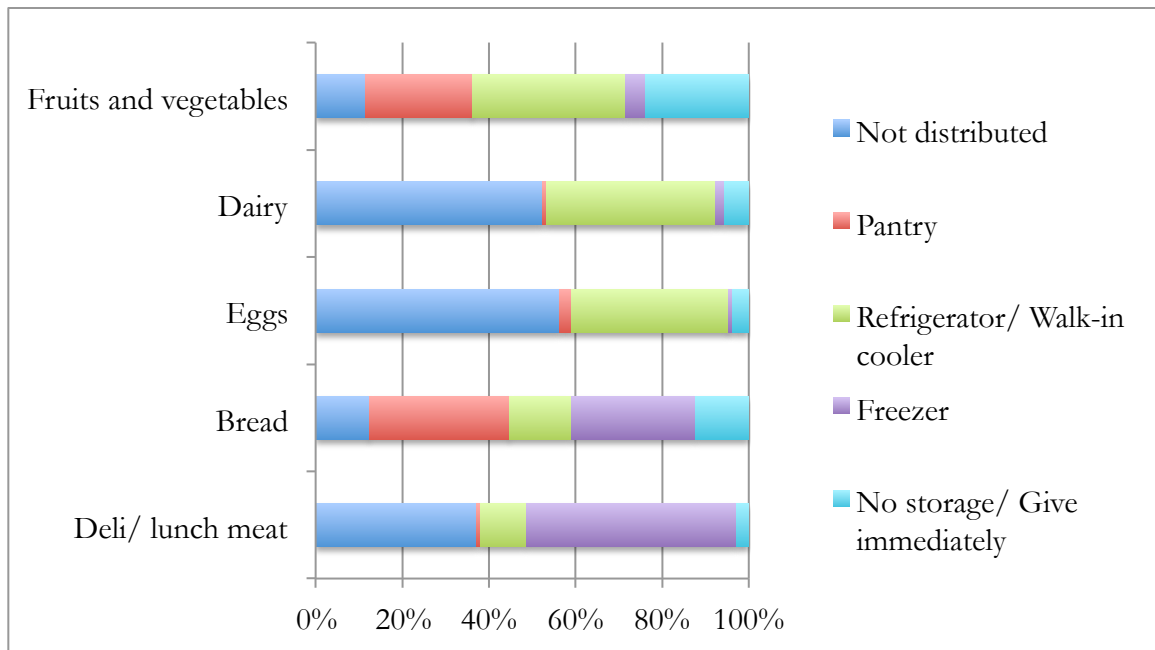
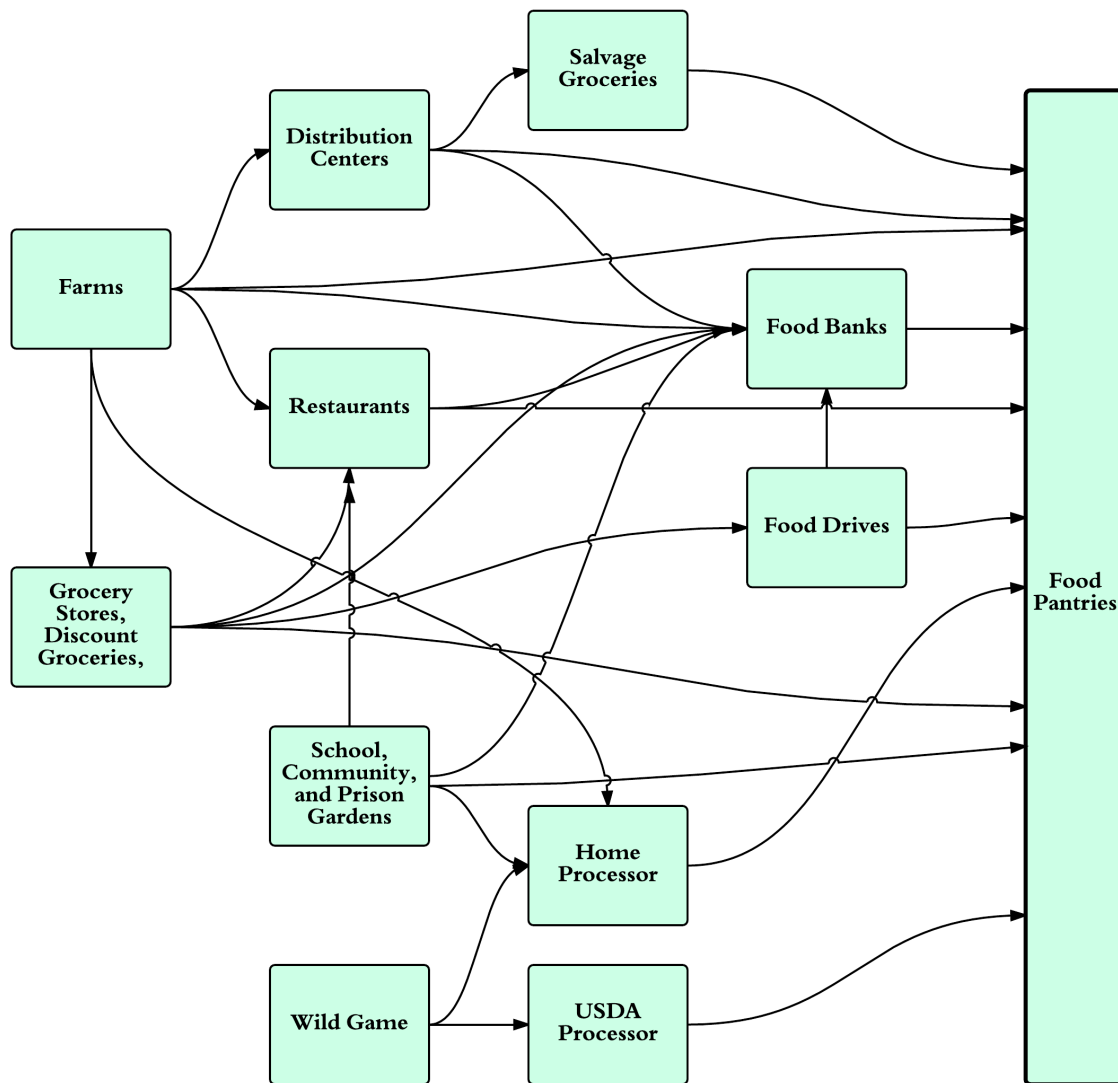
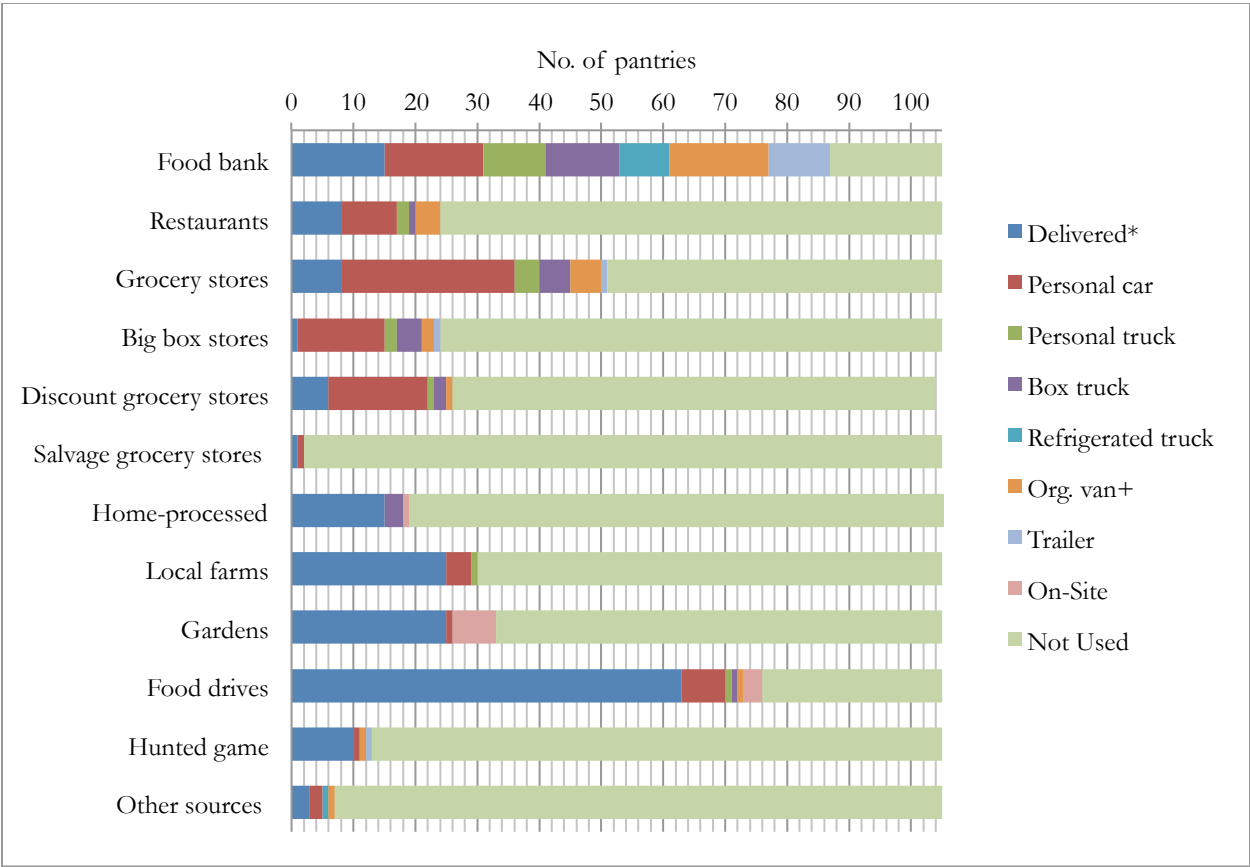


Figure 3.3 Complete supply chain for food pantries



Notes: The parts of this supply chain that are entirely unregulated include: school, community, and prison gardens, wild game, any home-processed items (including game), and the food pantries.

Figure 3.4 Food sources and means of delivery (N=105)



Notes:

*Delivered means by an individual in an unknown vehicle type.

+Org. van refers to the van owned by the organization, including but not limited to churches.

CHAPTER 4: EVALUATING FOOD SAFETY GUIDELINES IN FOOD PANTRIES

4.1 Introduction and Motivation

Earlier analysis found that North Carolina food pantries had few formal standard operating procedures related to food safety and that those that did were variable by pantry. Given the lack of state and local regulations, the managers and food handlers, as well as their food bank partners, are left to create any procedures and policies in terms of what foods they accept, how they are stored, what foods they will distribute, and who can receive the goods. The initial round of interviews and observations indicated that the food handlers and pantry managers inconsistently receive food safety or handling information and training, information about recalls and foodborne illness outbreaks, or have particular requirements regarding their suppliers (donors) and supply chains, as seen in Chapters 2 and 3. Overall, the emergency food system lacks common guidelines for food handling or procedural advice, even for those who seek it. Given the entrenched food insecurity¹⁰ of many of food pantry clients, they are less likely to have affordable and available medical access in the event of foodborne illness, making the implications significant given the vulnerable population.

4.2 Theoretical Frameworks: Food Handling and the Theory of Planned Behavior

The literature at the cross-section of food safety and food handling is vast. It repeatedly reveals that education increases knowledge of best practices, although there are various studies that also depict instances in which it is difficult to improve behavior. To begin, Altekruse et al. (1999) interviewed 19,536 adults in eight American states and found that risky food handling and

¹⁰This study uses the USDA definition for food security: “the condition assessed in the food security survey and represented in USDA food security reports—is a household-level economic and social condition of limited or uncertain access to adequate food” (USDA, 2014).

consumption practices were not uncommon and 19% of respondents failed to adequately wash their hands or cutting boards after contact with raw meat and poultry. The authors concluded that more education is needed to reduce the prevalence of such behaviors. Similarly, Green et al. (2007) collected observational and interview data on 321 food workers' hand hygiene practices and found that handwashing was more likely to occur when workers received food safety training ($p < 0.001$), there were multiple sinks ($p < 0.001$), and the sink was within eyesight ($p < 0.01$). Glove use and handwashing were found to be related but negatively correlated; the results showed that workers who wear gloves do not remove them and wash their hands.

Commonly used in food handling research, the Theory of Planned Behavior (TPB) is used to predict a range of behaviors based on previous behavior, but also attitudes and social factors (Ajzen & Fishbein, 1970). Researchers have shown that the TPB can be used in single-behavior predictions as well as extended to more complex situations in food handling (Philip & Anita, 2010). The authors couple the TPB with interviews to evaluate the impact of food hygiene training on a convenience sample of 249 food handlers, some of which had previous training. Pre and post training data showed no significant differences in mean scores, though the handlers may have a greater intent to carry out safe food handling practices even though it was not shown to be statistically significant, revealing that the training does not necessarily contribute to better behavior.

Oftentimes, research incorporated the Theory of Planned Behavior into understanding past behavior (Mari et al., 2012; Mullan & Wong, 2009), even though past behavior has also been argued not to be a predictor of later behavior (Ajzen, 2002). Mullan and Wong (2009) found perceived behavioral control (PBC) to be the most significant predictor of intention in their 109 study participants, suggesting that the intention to prepare food in a specific way was not necessarily in their control, with past behavior predicted an additional 3% of variance in that intention. Other researchers found that the Theory of Planned Behavior combined with an analysis of past behavior

reveals superior predictive power over the original version in two longitudinal studies of young adults and adults (Mari et al., 2012). What is questionable, however, is the ability for past behaviors to predict future ones. Mullan and Wong (2009) note that Ajzen and Fishbein (2005) found it “not useful” to measure past behavior, concluding that future research should work to establish better predictors of food handling behavior, as well as the use of the TPB in food handling studies. A second study using the TPB by Mullan and Wong (2010) showed increased knowledge and PBC but the food hygiene intervention did not improve behavior, similar results to a study that specifically looked at handwashing and food thermometer use in food preparation at home (Shapiro et al., 2011). As the authors anticipated, they found that the intention to use food thermometers was predicted by the attitudes towards their use ($p < 0.05$), as well as subjective norms ($p < 0.001$) and perceived control of using them ($p < 0.001$). And, while most people agreed that handwashing is necessary, more research is needed to convince them to do so (Shapiro et al., 2011).

Yet, the Theory of Planned Behavior is not the only method of analysis in food handling studies. A group of young adults were observed and questioned to assess their food handling behavior in home kitchens, measured against the Partnership for Food Safety Education’s Fight Back! Recommendations of clean, separate, cook, and chill (Abbot et al., 2009). Overall, the best practices scores for food safety behaviors were poor, with few participants reporting pre-food preparation handwashing with soap and water and thermometer use for animal proteins, even though two-thirds of participants gave correct answers on the food safety knowledge questions (Abbot et al., 2009). Using the same recommendations, Anderson et al. (2004) videotaped 99 mostly-female participants in their homes while preparing a meal, with almost all participants cross-contaminating their foods by failing to wash their hands after handling raw meat or poultry. Yet, the authors explain that the results are not generalizable to the entire population. To determine procedural knowledge of food safety and study associated risk of a single meal, 25 participants cooked the same dish with chicken

artificially contaminated with *Lactobacillus casei*, which was tested both before and after preparation to quantify bacterial transfer (Fischer et al., 2007). The findings of that research confirm the assumption that “cross-contamination is the dominant route of exposure to pathogenic bacteria” (Fischer et al., 2007, p. 1074). Even for the seven participants that made no handwashing or cutting board (cleaning and rinsing) mistakes, they did not obtain a high reduction level of bacteria in the finished product, and the authors articulate that the results can only be interpreted within the context of this study’s design.

Yet, while consumers might have the requisite food safety knowledge, in question is whether that knowledge, or intent, translates into behavior. Despite training, Clayton et al. (2002) found that 63% of the food handlers studied knowingly did not carry out best practices due to barriers in the kitchen. The study also explains that the food handlers did not carry out the food safety practices at the rate at which they thought they did; in fact, it was lower, particularly for food handling (Clayton et al., 2002). Another study found that 90% of participants reported washing his or her hands before food preparation and after handling raw poultry but only 47.6% were observed washing their hands after handling the raw food (DeDonder et al., 2009). Only 7% adhered to the instructions on the labels, even though USDA’s Food Safety and Inspection Service had recently changed them due to a *Salmonella* outbreak (DeDonder et al., 2009). Other literature using observational data found that handwashing is likelier to occur in environments where the food handlers have had food safety training and have sinks readily available (within sight), though handwashing was seen as a practice done in conjunction with food preparation (Green et al., 2006; Green et al., 2007). An Environmental Health Specialists Network (EHS-Net) study found older workers and managers to be more likely to wash their hands than younger workers and non-managers, though the authors stated that more research was needed to determine the particularities and reasoning behind the practices (Green et al., 2005). While, Green and Selman (2005) identified various reasons that

participants in 11 focus groups did not perform best practices, from lack of training and consequences to structural environment, the study is purely qualitative, lacks statistical analysis, and not generalizable. Another research team trained a systematic random sample of 402 employees in 31 restaurants in three Midwestern states and instances of handwashing improved significantly, but the authors of the study stated that while the employees had more knowledge ($p < 0.05$), it was the only behavior tested with such improvement (Roberts et al., 2008).

On the other hand, without formalized training in food safety, food handlers at home and work might not have full information about best practices. In a study focused on low-income consumers with high-risk family members, many did not utilize online resources to attain food safety information (Kwon et al., 2008). The researchers found great disparity between ideas on appropriate thawing methods or ability to understand “doneness” in prepared foods, with notable differences by racial groups (Kwon et al., 2008). A microbiological survey of home kitchens found poor levels of hygiene and limited food safety knowledge coupled with a lack of responsibility in communal kitchens in the United Kingdom (Sharp & Walker, 2003). None of the users of the kitchens had any training in food safety and visual assessments of the kitchens did not correlate with cleanliness, later evaluated by total viable counts and coliforms (Sharp & Walker, 2003). More importantly, the occasional official cleaning of the kitchens had little effect due to the daily lack of cleaning of “hazardous” sites within the kitchens (Sharp & Walker, 2003). A study consisting of mostly elderly participants stated that a change in behavior is correlated with knowledge of safe practices, and that handlers and consumers must be willing to change (Losasso et al., 2012). Lastly, certain foods continue to be especially risky when prepared at home; of the outbreaks caused by home-prepared foods from 1999 to 2008, 38% were caused by foodborne botulism in home-canned vegetables (Date et al., 2011).

The emergency food system of North Carolina includes approximately 2,500 food pantries,

shelters, backpack programs, and soup kitchens affiliated with Feeding America food banks, as well as hundreds more independent food pantries. The distributed items are both perishable and non-perishable; the food pantries require cold storage and food handling education. The employees and volunteers repackage the bulkier food items, handle and prepare ready-to-eat foods, create and evaluate their own storage facilities and procedures, and must prevent contamination. Given the lack of regulation and general education regarding emergency food storage distribution, food handling, and operating procedures amongst food bank partners and independent pantries, food safety guidelines were created and evaluated by researchers at North Carolina State University and the University of North Carolina at Chapel Hill.

4.3 Intervention: Video Guidelines

Given that a majority of food pantries distribute perishables and non-perishables but do not prepare food (78.1% of the first-round sample), the guidelines focused on that pantry type (rather than non-perishables only or pantries that also prepare food). These pantries distribute canned and packaged goods, alongside a combination of meat, dairy, and/or produce. For the most part, the pantries already have refrigerators and/or freezers for their use, though they are limited in size and storage ability. Some food pantries pre-pack the food, some pack as they distribute, and some allow for the clients to “shop” the pantry and choose what they would like to take. The amount of food that a client receives might be the same for each household or based on size of family, depending on the food pantry standard operating procedures (SOPs).

In 2001, Medeiros et al. published recommendations for food safety education, focusing on five constructs: personal hygiene, adequate cooking, avoidance of cross-contamination, safe temperatures, and foods from unsafe sources, all of which should be specifically-targeted messages to the audience in question. A programming model of an adult education program should have a primary goal that “effectively responds to the target public’s expressed need(s) identified in the

planning subprocess” (Boone et al., 2002, p.47). Following that model, the intervention guidelines included the production of a variety of materials focusing on key topics where it has been repeatedly demonstrated that the pantry managers lack particular information or are practices with higher risk for foodborne illness. Using the preliminary results of the first round of interviews, certain procedures were identified as the focus of the guides: 1) general food safety information; 2) time-temperature control; 3) handwashing; 4) cross-contamination; 5) assistance with the creation of written standard operating procedures; 6) information on food dating and the safety of using past-date foods; 6) information on unsafe packaging, and 7) regular access to food recall information.

Bruhn et al.’s (2014) new research on food safety education for volunteers and community groups shows that online information prevails over the workshop setting in terms of gained knowledge. In Richard et al. (2013), the researchers showed that that simple, photograph-centric lessons increased food safety and handling knowledge in populations that struggled with literacy, scoring pre- and post-test knowledge and behavior. While this population does not have the same restrictions, pictures and videos are a straightforward way for employees and volunteers to understand pantry standard operating procedures without a lengthy course in food handling. As a result of that research, the planned intervention is available online and is brief, interesting, and informative. Each module focuses on a particular area of concentration and is a video presentation that is played in English directly from a website without a password or any requisite software. There are four modules, three of which were evaluated. The final module focuses on past-date foods and is not related to food safety, only food waste reduction. The guidelines match the Feeding America guidelines as well as the 2009 Food Code (NC Food Establishment Inspection Report) criteria.

For the information that might be repeatedly accessed, posters for hanging in the pantry itself were also made available. For example, a flowchart depicting how to determine when a can should be discarded is provided. A fill-in-the-blank document was created and provided to serve as a

template for crafting written standard operating procedures, similar to the templates available¹¹ for creating a food safety plan for the USDA Good Agricultural Practices audit. All materials, including additional signs and checklists, continue to be available online through the North Carolina State University food safety portal and are directly mentioned in the videos.¹²

4.4 Empirical Strategy

As a study cannot evaluate the effects of a pantry receiving and not receiving the treatment, this study incorporates a research design that randomly assigns pantries to a treatment (i.e., the provision of the online intervention guidelines) or to a “control” (also referred to as “business as usual”) assignment (Holland, 1986; Rubin, 1986). The random assignment is the preferred approach, as it can lessen the effect of any confounding variables and their effect on the treatment. The effect of the randomized treatment reveals the likely outcome for each group in the population when treated and not treated, averaged. Following Rubin’s (2008) paper, this research attempted to achieve balance in the treatment and control conditions and be objective in assigning those conditions. In this case, the design is a case control study with randomization. The randomization is not plagued by ethical concerns regarding its distribution given that all pantries all have access to the guidelines; all original participants were provided them either via email or in person after the second visit if they were in the “control” group. The guidelines remain publicly available and searchable to any additional pantry managers who seek food safety information.

4.4.1 Data

Primary data were created from semi-structured interviews and observations at food pantries across the state of North Carolina. Given the thousands of food pantries in North Carolina, both population and food bank region were stratified to create a 12-county sample that is both a

¹¹For example, North Carolina State University has a Fresh Produce Safety Plan available: <http://www.ces.ncsu.edu/wp-content/uploads/2014/04/Fresh-Produce-Safety-Plan-2013.pdf>

¹²All materials can be found at: <http://foodsafety.ces.ncsu.edu/food-pantries-and-food-banks/>

generalizable and representative sample of North Carolina. Given that rates of poverty and food security are correlated with total county population in both directions, four categories were created based on the nine urban, rural, and metropolitan divisions used by the U.S. Census Bureau. Counties were stratified by their metropolitan status (defined as being part of a Metropolitan Statistical Area (MSA) of 1 million or more, 250,000 to 1 million, and fewer than 250,000 people) or nonmetropolitan status. A random number generator was used to select 12 counties, six in metro areas. The county populations range from less than 20,000 people to nearly 500,000 (USDA, 2013; SNAP, 2013). Every sampled county has a child food insecurity rate over 21% and four counties have an overall food insecurity rate over 20% (Gundersen et al., 2013). The population make-up may or may not be reflective of the food pantry client population; this research did not survey the clients or include any demographic questions.

In each of the 12 sampled counties, a list of food pantries was created with relevant names, addresses, phone numbers, emails, and days/times of operation. Publicly-available information on the North Carolina food bank websites was reviewed and Web searches conducted for food pantries, including the names of counties alongside “food pantry” or “pantry,” but also their respective county seats and cities. The Executive Director of the North Carolina Association of Feeding America Food Banks connected the researcher to essential individuals at each food bank, some of whom provided their lists of partner pantries.

Each food bank region encompasses from seven to more than 30 counties, plus partial counties ((NC Association of Feeding America Food Banks, 2014b). In the first round of interviews, all food bank regions are represented in the sampled food pantries (n=105). Partnership with a food bank brings certain benefits: the ability to collect food from particular suppliers (typically grocery stores), food safety training (at a rate variable by food bank), and access to participation in federal

emergency food commodity programs (TEFAP and SNAP). Seventeen food pantries (16.2% of 105) do not partner with a food bank, but operate independently.

While the first round of interviews and observations took up to two hours each, in the second visit, pantry managers were interviewed in the food pantry for approximately one hour.¹³ Pantries were visited on all days except Sunday and took place initially from February to June 2014 and then from November 2014 to January 2015. Pantry operation schedules vary; some are open multiple days per week and others are open only once per month. Additionally, not all pantries carry out food distribution in the same way: some prepack bags of boxes of food items to hand out directly to clients; some do so as the clients arrive; and some let the clients choose. Three of the pantries changed their distribution procedures to a client choice model in between the two visits. If possible, the pantry was visited during food distribution or while food bags were packed (n=70 in the first round and n=51 in the second round); if not, the pantry manager provided a tour of the pantry and explained its operating procedures (n=35 in the first round and n=9 in the second round). The participants received no compensation for their time.

The participants consented verbally to participate in the study. To address concerns about confidentiality, participants were informed that pseudonyms of the individuals and food pantries would be used in any publications, that participation is voluntary, and that questions could be skipped at any time. Interviews were conducted in a space at the food pantry chosen by the participant. Oftentimes, the participant preferred to “walk and talk,” answering the questions during the tour of the pantry and its operations. Each second-round interview was handwritten so that they could be conducted in any environment; the notes were later typed into Microsoft Excel (Microsoft Corporation, Redmond, Washington, 2011) to code them for analysis.

¹³The second-round interviews required fewer introductions and explanations regarding the research.

4.4.2 Evaluation Materials

A self-administered questionnaire was used alongside the observation of criteria from a modified Food Establishment Inspection Report (2012) to assess the standard operating procedures of the North Carolina food pantry system. This report's contents are the criteria used by health inspectors to evaluate whether restaurants and other food establishments are safe enough to sell to the public. The evaluation materials included information on: 1) the sources and delivery methods of the foods, 2) kinds of foods distributed, 3) storage and distribution procedures, 4) supplier requirements, 5) use of past-date foods, and 6) information on recalls. Practices included behaviors on handwashing, bare hand contact with ready-to-eat foods, thermometer use, and general prevention of contamination, as per the Food Establishment Inspection Report. Any questions omitted from the standard report were due to the fact that the food pantries in this sample do not prepare food; they only store, repackage, and distribute food. The Food Establishment Inspection Report scores were coded with number of demerit points or if the action was unobserved or not applicable.

For each pantry, the city, county, food bank region (if partnered), and days per month in operation was recorded and numerically coded under a unique identifier. No missing data were imputed. The interview questions regarding standard operating procedures resulted in dichotomous, categorical, and continuous variables. The supplemental questions include but are not limited to knowledge about food recalls, distribution of past-date foods, and on-site repackaging.

4.4.3 Sample

All food pantries (n=282) in the 12 North Carolina counties sampled were contacted twice by email and/or phone from February to May 2014, using the same "pitch." The total number of pantries listed includes all known, operating pantries in each county. Food pantries that are no longer in operation were eliminated (n=36), even if they are still posted on the respective food

bank's website. Many organizations documented online as food pantries are not pantries, but shelters, residential homes, providers of financial assistance, or are duplicates under a similar (sometimes previous) organization name.

Every pantry manager was contacted twice, either by phone or email initially, and by phone in the second attempt. Email addresses could not be found nor acquired for more than half of the food pantries. Of the obtained email addresses, 40 were wrong or no longer in-use, thus prompting a phone call. In the first round of data collection, messages were only left for the phone calls if the recording indicated that the organization dialed was correct; that is, without a recording or organization mentioned on the recording, no message was left. The pantry managers were informed in the first conversation or email that the study focused on food safety and would require both an interview and the collection of observational data in the pantry. Only three pantry managers explicitly said that they did not want to participate or did not have the time to do so. Twenty-one of the known pantries have disconnected or unknown phone numbers, leaving their operation in question. Food bank employees repeatedly suggested that their partner lists might not be up to date. As a result of the 177 pantries in the population that did not respond to the email or phone call, any estimates are subject to selection bias by the pantry managers that chose to participate.

In the first round of interviews and observations, 105 food pantry managers participated and 82 of them do not serve food but do distribute perishable goods. Three of those pantries were entirely mobile markets; that is, they do not store any items. The 79 remaining pantries became the full sample for the second round of interviews and evaluation of the guidelines and email addresses were acquired for all managers. Half of the pantries ($n=40$) were randomly selected to receive the materials. Of the 79 pantries, a new person managed six of them by the second visit and three were

no longer operating as food pantries.¹⁴ Two had closed completely (one by the food bank due to safety concerns) and the third had transformed into a prepared breakfast program. Nineteen pantries of the original 79 were not revisited for various reasons: no longer in operation (n=3), failure to respond to email (n=12), management changes (n=2), and failure to reschedule (n=2). As a result, 60 food pantries in 11 counties were visited two times and 27 of them were those that received the intervention by email.

In the second round, the 79 pantry managers whose pantries distribute both perishable and non-perishable items but do not serve food as part of the pantry were contacted by email in October and November 2014. In that recruitment email, they were provided with some of the initial results from the original study and were asked if the researcher could return to the pantry for more interview questions and observational data collection. Half of the managers (n=40) were also provided with links to the online food safety guidelines, which they were encouraged to watch. If they did not respond to the email, they were sent a second email approximately one month later, followed by a phone call. In this data and its analysis, only five food bank regions are represented. Certain counties (and thus, the partnered food banks) had low representation in the first round and, within those areas, respective pantries were dropped in the second round due to distribution practices (i.e., all pantries in the second round distribute both perishables and non-perishables). One food bank operates in a way that excluded it from this portion of the study; its affiliates do not store food, but distribute it immediately after it is delivered. That these food banks are absent does not suggest that the study will be any less generalizable, the food pantries within that region have not shown to have significantly more or less risk than the others. All analysis was completed in Stata11.2 (Statacorp LP, College Station, Texas, 2009). All procedures for this study were reviewed and

¹⁴While analysis of the pantries with new managers was considered, the sample was incredibly small in terms of food pantries that changed management over the course of the study and were visited twice.

determined to be “exempt” by the Institutional Review Boards of the University of North Carolina at Chapel Hill and North Carolina State University.

4.4.4 Assignment to Treatment and Control Groups

Within this sample, there are regions classified as urban, rural, and suburban, towns and cities of high and low rates of poverty, pantries that distribute to fewer than 10 families per month to hundreds, and individuals with varying levels of food handling knowledge. A random set of pantries, rather than certain counties, received the online food safety guidelines. Indeed, the potential for a pantry-to-pantry spillover effect is possible; if a pantry is in a small county where they are used to sharing resources and managers work with individuals who run a “control” pantry, that pantry might obtain some of the curriculum’s effects via casual conversation of the newfound knowledge or proclivity towards “keeping up” with the other pantries. The effects were predicted to be small amongst the treatment and control groups, given that some pantries already perform some of the actions to be analyzed. Overall, the control group has a strict absence of treatment.

The sample is as isomorphic as possible; that is, it is identical to the larger population in most respects, varying within the state population of North Carolina. However, the analysis of the guidelines shows some outcome bias, as the pantries must opt-in to be interviewed. While there is some concern about external validity, because of the participatory choice, the randomization at the second stage is part of the design to lower that threat. Even though the method incorporates randomization, the overall effect could be biased due to selective participation by the pantries.

4.4.5 Descriptive Statistics

Descriptive statistics have been generated for key variables (from the modified Food Establishment Inspection Report), from volunteer duties to organizational set-up. Table 4.1 includes the descriptions of each question, as well as short titles for each question that are used in the remainder of the paper and the maximum points that could be demerited for each question. The

descriptive statistics for all food pantries that participated in both rounds can be found in Table 4.2, alongside paired t-tests of demerited points for each question by round. While many behaviors improved (lost fewer points) by the second round, only few have statistically significant differences between the first and second rounds. Observed at a much higher rate in the second round, hand contact with ready-to-eat foods (RTE) decreases by an average of approximately 0.068 points, statistically significant at the 95% confidence level. Food pantries were also likelier to receive foods from approved sources in the second round, statistically significant at the aforementioned level.

Descriptive statistics were also generated for categories of summed questions: reporting, personal hygiene, hands and handwashing, food storage, and equipment. For example, all questions related to clean hands were added together to create an overall “hands and handwashing” score. Table 4.3 provides those paired t-tests by category, alongside the list of questions included in each category. The shifts by round and category are minimal; only the “hands and handwashing” category resulted in a statistically significant decrease in points ($p < 0.05$). Tests for multicollinearity were performed; pairwise correlations did not show high levels of correlation between any two variables.

4.4.6 Difference-in-Difference

To measure the effectiveness of the guidelines in decreasing foodborne illness risk, a difference-in-differences (DD) model at the pantry level is used, where the outcome is the shift in the average Food Establishment Inspection Report scores and supplemental data after the delivery of the intervention and a second round of interviews and observations at all pantries. In this OLS analysis, one can determine the effect of food safety materials on foodborne illness risk and the magnitude of the effect, both on particular questions and overall scores. First, a DD model is specified to estimate the effect of the intervention on various behaviors. This initial specification takes the following form:

$$Y_{it} = \beta_0 + \beta_1 post_t + \beta_2 treat_i + \beta_3 (treat_i \times post_t) + \varepsilon_i \quad (4.1)$$

where Y_{it} estimates the average effect of the modified Food Establishment Inspection Report scores of pantry i in round t . $Post_t$ is a dummy variable equal to 1 for the period after the intervention has been distributed and 0 before distribution, $treat_i$ is a dummy variable equal to 1 for the pantries who received the intervention. β_0 is the constant and ϵ_{it} is the residual error term. The following specification includes a vector of control variables (Z_{it}), including food bank partnership:

$$Y_{it} = \beta_0 + \beta_1 post_t + \beta_2 treat_i + \beta_3 (treat_i \times post_t) + Z_{it}\theta + \epsilon_{it} \quad (4.2)$$

The β_1 variable represents the differences for the two groups before and after the guidelines are implemented and β_2 variable represents the differences for the groups that did and did not receive the intervention, for specific questions and for an overall composite score. β_3 represents the change in demerit points on those pantries that received the intervention versus those that did not receive it by round. A logged independent variable is not used given that the food pantries can have a zero change.

In total, there are 55 possible points that can be demerited. Given that it is preferable not to receive demerits, a lower score is superior to higher score. Given that some actions went unobserved, three different summed total scores are also analyzed, each in an attempt to be both inclusive of all actions and observations as possible. Supplemental questions on home-canned foods, food safety training, knowledge of recalls and foodborne illness outbreaks, supplier requirements, and the use of past-date items are also compared amongst their differences in means across time periods.

Half of the sample population was provided the guidelines via email with the encouragement to watch the video presentations. There was no guarantee that each pantry manager watched them or, furthermore, chose to implement the guidelines as suggested. To that end, the group is best categorized as “intent to treat” rather than treated. As a result, additional associations between certain Food Establishment Inspection Report questions, as well as other actions, and viewing the

videos were examined using paired t-tests. The analysis shows the differences between those pantries that did and did not view the video guidelines (treatment and control groups, respectfully). This analysis was completed as certain managers directly revealed if they viewed the guidelines.

4.5 Results and Discussion

In this section, the empirical results that reveal the causal effects of the intervention across pantries are presented. The DD model indicates average treatment effects stemming from the reception of the online video guidelines.

4.5.1 Difference-in-Difference Results

First, a model is estimated that solely examines the effect of the intervention of each question of interest. The results of this model are presented in Table 4.4. While 60 pantries were visited twice, the number of observations for each question does not total 120 given that some actions went unobserved in each round. The coefficients should be interpreted with caution, but the statistical significance remains accurate. Of note is the fact that there are numerous zeroes in this data set and OLS is not efficient when the data is populated with many zeroes. While the questions each have a set maximum score, they are not count variables given that it is possible to receive a score that ends in .5 and is thus not an integer. Similarly, for the 4-point questions, the possible demerits are not a consecutive loss; one can lose 0, 2, or 4.

While for many of the questions, the average effect on the food pantries is lessened scores, the overall treatment effect of the guidelines is null. Even though there are statistically significant results for particular *Post* variables, there are no statistically significant effects of the intervention on the treated group rather over those who did not receive the videos. As the exact questions were asked in both rounds, the mere presence of the researcher potentially led to change in certain categories. For example, the researcher asked about the food sources or suppliers, leading the

manager to seek out that information even before the second recruitment email, resulting in a statistically significant, or even reduced, *Post* variable but not *PostxTreat* variable.

Given that previous research showed statistically significant differences between food pantries that do and do not partner with a food bank, the model used in Table 4.4 controls for that partnership. Similar to the previous results, the effects of the intervention on these questions are not found to be statistically significant, but there are certain actions that were found statistically significant for those pantries that partner with a food bank. These results were expected given the earlier research, but also due to the fact that many of the food banks provide some level of guidance and information to its partners. Consequently, participation in and certification by an accredited food handling certification program is statistically significant at the 99% confidence level for those pantries that partner with a food bank. While the handwashing variable was omitted due to collinearity in both models, the analysis of the second model (Table 4.5) shows a statistical significance at the 90% confidence level for two hand hygiene-related actions of the food bank partners: 1) no bare hand contact with ready-to-eat foods and 2) handwashing sinks supplied and accessible. The food bank partners were also likelier to have and use thermometers in their refrigerators and freezers, statistically significant at the 99% confidence level. Similarly, Table 4.6 groups and then sums the questions by category: reporting, personal hygiene, hands and handwashing, food storage, and equipment, controlling for food bank partnership. When the questions are grouped by category, as in Table 4.6, the same DD analysis resulted in fewer demerited points by the food bank partners in terms of the reporting questions, statistically significant at the 95% confidence level.¹⁵ Still, in the second round, only five pantries operate independently while all remaining pantries are food bank partners—12% of the overall sample rather than the 16.2% of the

¹⁵The results of the DD analysis of the variables summed by category but without a control for food bank partnership are also null and can be found in Appendix C, Table C.2.

first round. Many of the original independent pantries only distributed non-perishable goods and, thus, did not warrant second round participation. This point remains meaningful given the consistent statistically significant impact of food bank partnership.

Additional versions of the model allowed for the control of food safety training, written standard operating procedures, and/or regular volunteers, but all versions lacked statistical significance of the effect of the intervention on all Food Establishment Inspection Report questions.¹⁶ Not all procedures were observed in every pantry, resulting in missing data and making a total possible score for each pantry varied and incomparable.

To elaborate, three scoring schemes were devised in an attempt to capture the overall score, totaling the observed characteristics with the most prevalent observations. The schemes are similar to the means by which the health inspectors score restaurants, using the same weighted scores, but with fewer questions. The independent variable for the first model was the sum of 20 questions (43 maximum points), while second one included 21 (45 maximum points) and the third one included 22 questions (48 maximum points). The largest number of points any pantry lost was nine. Table 4.7 shows the overall score DD results with each of those models, controlling for food bank partnership.¹⁷ While the interaction term was not statistically significant for any of the total-sum models, the coefficients suggests that minor decreases in the number of demerited points were achieved and that food bank partnership is correlated with almost an one-point decrease in the model with the largest number of observations (Total1).

4.5.2 Empirical and Analytical Concerns

One of the biggest shortcomings of this analysis is the inability to require the pantry managers to watch the aforementioned videos. Given that the use of the guidelines was voluntary, it

¹⁶The author can provide these results upon request.

¹⁷The results for the total-sum models without additional controls can be found in Appendix C, Table C.3.

is hypothesized that many food pantry managers did not watch them, either by choice or forgetfully. To examine the same actions but only looking at the food pantries where the manager indicated that he or she did or did not watch the videos (n=18 pantries), paired t-tests on particular, critical questions were performed. The results of that analysis are in Table 4.8. As per the University of North Carolina and North Carolina State University Institutional Review Boards, the managers were not directly asked if they watched the videos; managers chose to report that information on their own.

For the pantry managers that reported they did watch the videos, their scores averaged zero (no demerited points) on question 6 (handwashing), relative to those who stated that they did not watch (2.5 average demerits), statistically significant at the 90% confidence level. In terms of statistical significance, the results were similar for questions 11 (food in good condition, safe, & unadulterated), 14 (food-contact surfaces: cleaned & sanitized), and 34 (thermometers provided & accurate), all with lower scores for those who watched the videos and statistically significant at the 90% confidence level. The biggest difference between the pantries where the manager viewed the videos came with question 37 (contamination prevented during food preparation, storage, and display); the difference in this case was statistically significant at the 99% confidence level for those who watched.

The supplemental questions regarding the food pantry SOPs also yielded differential results, found in Table 4.9. All of these variables are dichotomous; a score of 1 means the action was performed. Of the 18 pantries analyzed, 15 of them are food bank partners. Those managers who viewed the videos were likelier to have written standard operating procedures (61.1%) and those who did not view them had written SOPs at a much lower rate (16.7%), statistically significant at the 99% confidence level. However, in this case, the results are endogenous; that is, the food pantries that had written SOPs did not, for the most part, do so as a result of the intervention but had them

from the beginning. This analysis then suggests the opposite correlation: food pantries with written SOPs are led by managers who are interested in food safety education, leading those individuals to watch the videos and learn more.

Similarly, the pantry managers who viewed the videos were twice as likely to have a recall plan ($p < 0.01$). While the differences are not statistically significant, the managers who viewed the videos were more likely to have requirements for their food suppliers and have regular recall information. Furthermore, while every participant was directly asked about food safety training, none of the individuals who saw the videos recognized them as food safety training or stated that was the source of their training.

4.6 Limitations

Yet, the positive results regarding the intervention are ambiguous. Given that not every pantry manager in the counties responded to the second recruitment email or phone call, there remains a selection bias of the pantries that are in both the first round as well as the second round of the sample. For the second round specifically, the pantry managers might have feared the researcher reporting any undesirable procedures to the food bank, especially as they had heard the questions previously and knew what would be asked in the interview. Any estimates are hence subject to selection bias by the food pantry managers that chose to participate. Moreover, turnover is high amongst food pantry managers; six of food pantries from the first round had new managers in the second round, even though the gap in visits and the gap in email or phone communication was less than six months.

Additionally, the rate of attrition was higher than expected, leading to a smaller data set than expected at the time of research design. Furthermore, a larger sample of food pantries across NC would reduce threats to internal validity. While the two rounds of data provide richer detail on North Carolina's emergency food system than a single round, the lack of various "events" for each

pantry means that certain days or groups of people might be captured (positively or negatively) but might not be indicative of average daily pantry operations. To that end, this analysis only includes the food pantries that are visited twice. Predominately, it is also a within-pantry, rather than across-pantry analysis.

Although the results of the DD models imply that no significant changes were made on individual questions as a result of the intervention, the paired t-tests on regarding video viewing suggest other outcomes. If the managers were required to watch the videos, then the results might have been more significant. That being said, the delivery of the guidelines remain in question; while the managers do receive information regarding the pantry via email, the researcher remains outside that network of trust.

Overwhelmingly, the results of this study imply that there is still more room for improvement in terms of food safety education and training. For the most part, the food pantry managers have not yet actualized the tasks, even with the repeated visits and questioning regarding food safety. While online trainings might work with certain groups (c.f. Bruhn et al., 2014), it seems as though an on-site educator might be more effective, given the diversity across food pantries. A mandatory training with an examination might also prove to be a better means to address any issues, especially if it includes an educator who can answer questions or provide advice specific to each pantry's situation and location.

This study relies on the Internet and email access for the success of the intervention; given that many food pantry managers had to be called to schedule the second visit, there is also the chance that they did not receive the emails or are unresponsive in that venue. For at least three managers, they do not have personal email addresses; they have all food pantry information and inquiries sent to their respective church secretary who relays the message or information to the pantry manager. Even if they received the emails and responded by phone or email for scheduling

purposes, they would have been less likely to view the online guidelines. While the manager's age was not asked nor recorded, it is also possible that older managers are less likely to use email for regular correspondence and the Internet as their main reference.

4.7 Policy Implications and Conclusion

Critically, this study's results fit squarely within Philip and Anita's (2010) aforementioned research. Even with the intent to carry out safe food handling, Phillip and Anita explained, "Comparisons of food handler data (n=249) pre and post food hygiene training revealed no significant differences in the mean scores for the food handlers' direct measure of attitude towards carrying out safe food handling practices, irrespective of industry sector or food hygiene training method" (2010, p. 986). There does, however, seem to be an increased interest in learning about food recalls and written standard operating procedures; during the interviews, when questions related to those topics were asked, those who did not receive top-down information from the food bank regularly inquired about where they might find that information. Furthermore, timing might be of interest; for some pantries to make real changes in their structure, they might require repeated interactions with the materials and, potentially, a longer time period to implement new procedures.

While these results add to the literature regarding emergency food operating procedures in North Carolina, they have not proven to provide a reasonable means for improved behavior. As stated, the individuals had no particular incentive to watch the videos or take on the provided guidelines given that the purveyor of the information is not responsible for their actions; that is, there is no recognition for following the instructions. It remains uncertain whether private charity, unlike regulated corporations, recognizes the risks of foodborne illness and has the incentive to take precaution. While regulatory action might seem intrusive, forceful, or even paternalist, it might also be the best way to prevent foodborne illness in this case and with this vulnerable population. Without operational change, food pantries are likely to continue to perform risky actions that

increase the chance of contamination. Lastly, further research into food pantries (including those outside of North Carolina) and the greater emergency food system might provide insights and nuances not reflected in this study.

Table 4.1 Food Establishment Inspection Report questions and point values

Ques.	Explanation	Short Title	Value
1	Certification by accredited program	Certification	2
2	Management, employees knowledge; responsibilities & reporting	Knowledge	3
3	Proper use of reporting, restriction & exclusion	Reporting	3
4	Proper eating, tasting, drinking or tobacco use	Proper eating	2
5	No discharge from eyes, nose, and mouth	No discharge	1
6	Hands clean & properly washed	Hands clean	4
7	No bare hand contact with ready-to-eat foods or pre-approved alternate procedure properly allowed	RTE	3
8	Handwashing sinks supplied & accessible	Sinks	2
9	Food obtained from approved source	Approved source	2
10	Food received at proper temperature	Proper temp.	2
11	Food in good condition, safe & unadulterated	Good condition	2
13	Food separated & protected	Protected food	3
14	Food-contact surfaces: cleaned & sanitized	Clean surfaces	3
15	Proper disposition of returned, previously served, reconditioned, & unsafe food	Proper disposition	2
26	Toxic substances properly identified stored & used	Toxic subs.	2
34	Thermometers provided & accurate	Thermometers	1
35	Food properly labeled: original container	Proper labels	2
36	Insects & rodents not present; no unauthorized animals	Rodents	2
37	Contamination prevented during food preparation, storage, & display	Contamination	2
38	Personal cleanliness	Cleanliness	1
39	Wiping cloths: properly used & stored	Cloths	1
42	Utensils, equipment & linens: properly stored, dried, & handled	Utensils	1
45	Equipment, food & non-food contact surfaces approved, cleanable, properly designed, constructed, & used	Surfaces cleanable	2
47	Non-food contact surfaces clean	Non-food surfaces	1
48	Running water available	Water	2
51	Toilet facilities: properly constructed, supplied & cleaned	Toilets	1
52	Garbage & refuse properly disposed; facilities maintained	Garbage	1
53	Physical facilities installed, maintained & clean	Physical fac.	1

Note: A score of half the total points can be received. For example, a 3-point question can lose 0, 1.5, or 3 points.

Table 4.2 Descriptive statistics and paired t-tests for all pantries in both rounds

Ques.	Short Title	Obs. (R1/R2) ⁺	First round means	Second round means
1	Certification	60/60	0.667 (0.951)	0.733 (0.972)
2	Knowledge	60/60	0.133 (0.504)	0.200 (0.584)
3	Reporting	60/60	0 (0)	0.050 (0.272)
4	Proper eating	60/59	0.033 (0.181)	0 (0)
5	No discharge	60/60	0 (0)	0.417 (0.265)
6	Hands clean	4/19	1.5 (1.915)	0.737 (1.522)
7	RTE	14/50	0.786** (1.33)	0.18 (0.653)
8	Sinks	60/59	0.083 (0.381)	0.034 (0.260)
9	Approved source	60/60	0.216** (0.599)	0.100 (0.399)
10	Proper temp.	58/60	0.172 (0.131)	0.017 (0.131)
11	Good condition	59/59	0.068 (0.314)	0.068 (0.314)
13	Protected food	58/58	0.086 (0.469)	0 (0)
14	Clean surfaces	23/40	0.261 (0.689)	0.150 (0.456)
15	Proper disposition	38/59	0.158 (0.547)	0.051 (0.289)
26	Toxic subs.	52/60	0.038 (0.278)	0 (0)
34	Thermometers	53/53	0.415 (0.497)	0.330 (0.449)
35	Proper labels	59/59	0.254 (0.544)	0.186 (0.508)
36	Rodents	60/59	0.017 (0.129)	0.034 (0.183)
37	Contamination	57/59	0.158 (0.492)	0.237 (0.567)
38	Cleanliness	59/60	0.017 (0.130)	0 (0)
39	Cloths	36/37	0 (0)	0 (0)

Table 4.2, *continued*

Ques.	Short Title	Obs. (R1/R2) ⁺	First round means	Second round means
42	Utensils	18/28	0 (0)	0.018 (0.094)
45	Surfaces cleanable	60/59	0.050* (0.219)	0 (0)
47	Non-food surfaces	60/59	0.033 (0.181)	0.008 (0.065)
48	Water	59/58	0 (0)	0 (0)
51	Toilets	57/58	0.070 (0.258)	0.017 (0.131)
52	Garbage	60/59	0.033 (0.181)	0 (0)
53	Physical fac.	59/58	0 (0)	0 (0)

Notes: Standard deviations in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

⁺(R1/R2) is defined as the number of observations in round one followed by the number of observations in round two, by question.

Table 4.3 Paired t-tests of demerited points by category

Category	Ques.	Obs. (R1/R2) ⁺	First round means	Second round means
Reporting	1, 2, 3	60/60	0.8 (1.232)	0.983 (1.487)
Personal hygiene	4, 5, 38	59/59	0.051 (0.222)	0.042 (0.267)
Hands & handwashing	7, 8, 48	14/48	0.857** (1.292)	0.188 (0.665)
Food storage	9, 10, 11, 13, 15, 34, 35, 36, 37	32/53	1.594* (1.521)	1.104 (1.253)
Equipment	26, 39, 45, 47, 51, 52, 53	30/35	0.1 (0.548)	0.028 (0.169)

Notes: Standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

⁺(R1/R2) is defined as the number of observations in round one followed by the number of observations in round two, by question.

Question numbers 6, 14, and 42 were eliminated due to small sample size. For analysis with their inclusion, see Appendix C, Table C.1.

Table 4.4 Difference-in-difference results, by category

Ques.	Post	Treat	Treat x Post	Obs.	R-squared
<i>Reporting</i>					
1: Certification	0.242 (0.234)	0.269 (0.249)	-0.391 (0.354)	120	0.013
2: Knowledge	0.197 (0.153)	0.027 (0.133)	-0.289 (0.191)	120	0.033
3: Reporting	0.091 (0.633)	0.000 (0.000)	-0.091 (0.063)	120	0.045
<i>Personal hygiene</i>					
4: Proper eating	-0.030 (0.030)	0.007 (0.048)	-0.007 (0.048)	119	0.017
5: No discharge	0.015 (0.015)	05.09e ⁻¹⁸ (1.96e ⁻¹⁷)	0.059 (0.075)	120	0.024
38: Cleanliness	8.50e ⁻¹⁷ (7.08e ⁻¹⁷)	0.037 (0.037)	-0.370 (0.037)	119	0.029
<i>Hands and handwashing</i>					
7: RTE	-0.62 (0.429)	-0.05 (0.785)	0.05 (0.807)	64	0.085
8: Sinks	-0.059 (0.105)	-0.084 (0.092)	0.022 (0.111)	119	0.019
<i>Food storage</i>					
9: Approved source	-0.303** (0.127)	0.178 (0.207)	0.044 (0.235)	120	0.075
10: Proper temp.	0.030 (0.030)	0.038 (0.038)	-0.069 (0.049)	118	0.018
11: Good condition	0.063 (0.044)	0.148* (0.088)	-0.137 (0.088)	118	0.028
13: Protected food	-0.156 (0.111)	-0.156 (0.111)	0.156 (0.111)	116	0.044
14: Clean surfaces	-0.071 (0.227)	-0.063 (0.290)	-0.072 (0.323)	63	0.021
15: Proper disposition	0.003 (0.114)	0.159 (0.191)	-0.253 (0.204)	97	0.039
34: Thermometers	-0.085 (0.125)	0.059 (0.138)	0.009 (0.187)	106	0.013
35: Proper labels	-0.094 (0.139)	-0.059 (0.142)	0.057 (0.194)	118	0.006
36: Rodents	-9.60e ⁻¹⁷ (0.043)	-0.039 (0.030)	0.038 (0.058)	119	0.008
37: Contamination	0.022 (0.112)	0.052 (0.133)	0.125 (0.208)	116	0.021

Table 4.4, *continued*

Ques.	Post	Treat	Treat x Post	Obs.	R-squared
<i>Equipment</i>					
26: Toxic subs.	6.31e ⁻¹⁷ ** (2.78e ⁻¹⁷)	0.080 (0.079)	-0.080 (0.79)	112	0.031
42: Utensils	-9.60e ⁻¹⁷ *** (-1.07e ⁻¹⁶)	-1.07e ⁻¹⁷ * (3.93e ⁻¹⁷)	0.038 (0.039)	46	0.056
45: Surfaces cleanable	-0.061 (0.042)	-0.024 (0.056)	0.024 (0.056)	119	0.028
47: Non-food surfaces	-0.014 (0.034)	0.007 (0.048)	-0.022 (0.050)	119	0.010
51: Toilets	-0.067 (0.046)	0.007 (0.069)	0.029 (0.078)	115	0.021
52: Garbage	-0.061 (0.042)	-0.061 (0.042)	0.061 (0.042)	119	0.045

Notes: Robust standard errors reported in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Question 6 was omitted due to collinearity. Questions 39, 48, and 53 are omitted due no changes in scoring; all pantries lost zero points in both rounds.

Table 4.5 Difference-in-difference results by category, controlling for food bank

Ques. No.	Food Bank	Post	Treat	Treat x Post	Obs.	R-squared
<i>Reporting</i>						
1: Certification	-0.727*** (0.262)	0.286 (0.238)	0.277 (0.248)	-0.435 (0.341)	120	0.065
2: Knowledge	0.021 (0.125)	0.196 (0.155)	0.027 (0.133)	-0.288 (0.193)	120	0.035
3: Reporting	0.017 (0.016)	0.089 (0.063)	-0.001 (0.001)	-0.089 (0.063)	120	0.045
<i>Personal hygiene</i>						
4: Proper eating	0.022 (0.016)	-0.032 (0.031)	0.007 (0.048)	-0.005 (0.048)	119	0.019
5: No discharge	0.024 (0.023)	0.014 (0.015)	-0.001 (0.002)	0.060 (0.077)	120	0.026
38: Cleanliness	0.010 (0.011)	-0.001 (0.001)	0.037 (0.037)	-0.036 (0.036)	119	0.030
<i>Hands and handwashing</i>						
7: RTE	0.201* (0.108)	-0.604 (0.434)	-0.050 (0.791)	0.058 (0.814)	64	0.089
8: Sinks	0.067* (0.038)	-0.063 (0.106)	-0.085 (0.093)	0.026 (0.112)	119	0.022
<i>Food storage</i>						
9: Approved source	0.123 (0.179)	-0.311 (0.127)	0.177 (0.207)	0.051 (0.233)	120	0.079
10: Proper temp.	0.017 (0.132)	0.029 (0.030)	0.038 (0.038)	-0.068 (0.048)	118	0.019
11: Good condition	0.079** (0.039)	0.060 (0.044)	0.149* (0.088)	-0.134 (0.123)	118	0.034
13: Protected food	0.059 (0.046)	-0.159 (0.114)	-0.157 (0.112)	0.159 (0.114)	116	0.047
14: Clean surfaces	-0.192 (0.341)	-0.076 (0.227)	-0.049 (0.297)	-0.077 (0.328)	63	0.028
15: Proper disposition	0.126* (0.068)	-0.006 (0.116)	0.166 (0.193)	-0.253 (0.192)	97	0.048
34: Thermometers	-0.519*** (0.112)	-0.059 (0.119)	0.062 (0.126)	-0.003 (0.178)	106	0.454
35: Proper labels	0.067 (0.119)	-0.098 (0.141)	-0.059 (0.143)	0.061 (0.196)	118	0.007
36: Rodents	0.027 (0.017)	-0.002 (0.043)	-0.031 (0.031)	0.040 (0.058)	119	0.011
37: Contamination	0.131 (0.092)	0.014 (0.113)	0.049 (0.133)	0.135 (0.203)	116	0.027

Table 4.5, *continued*

Ques.	Food Bank	Post	Treat	Post x Treat	Obs.	R-squared
<i>Equipment</i>						
26: Toxic subs.	0.023 (0.025)	-0.002 (0.003)	0.079 (0.079)	-0.078 (0.078)	112	0.033
42: Utensils	0.014 (0.018)	-0.001 (0.002)	-0.002 (0.002)	0.040 (0.041)	46	0.059
45: Surfaces cleanable	-0.060 (0.079)	-0.057 (0.039)	-0.023 (0.056)	0.020 (0.054)	119	0.042
47: Non-food surfaces	-0.022 (0.046)	-0.013 (0.036)	0.007 (0.048)	-0.024 (0.051)	119	0.013
51: Toilets	-0.037 (0.082)	-0.065 (0.043)	0.008 (0.068)	0.027 (0.077)	115	0.024
52: Garbage	-0.071 (0.078)	-0.056 (0.039)	-0.059 (0.041)	0.056 (0.039)	119	0.072

Notes: Robust standard errors reported in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Question 6 was omitted due to collinearity. Questions 39, 48, and 53 are omitted due no changes in scoring; all pantries had and lost zero points in both rounds.

Table 4.6 Difference-in-difference results by summed category, controlling for food bank

Category	Food Bank	Post	Treat	Treat x Post	Obs.	R-squared
Reporting	-0.688** (0.311)	0.572 (0.371)	0.303 (0.324)	-0.813 (0.481)	120	0.049
Personal hygiene	0.056 (0.029)	-0.019 (0.036)	0.042 (0.060)	0.019 (0.097)	118	0.016
Hands & handwashing	0.208* (0.111)	-0.586 (0.439)	0.2 (0.759)	-0.208 (0.785)	62	0.109
Food storage	0.182 (0.359)	-0.403 (0.355)	0.654 (0.558)	-0.181 (0.661)	85	0.071
Equipment	0.078 (0.061)	-0.149 (0.152)	-0.153 (0.154)	0.227 (0.174)	65	0.030

Notes: Robust standard errors reported in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Like in Table 4.3, question numbers 6, 14, and 42 were eliminated due to small sample size.

Table 4.7 Total-sum difference-in-difference results, controlling for food bank

Ques.	Food bank	Post	Treat	Treat x Post	Obs.	R-squared	Max. points demerited
Total1	-0.856* (0.471)	-0.129 (0.647)	0.525 (0.736)	-0.224 (0.937)	93	0.028	8.5
Total2	-0.454 (0.572)	-0.447 (0.800)	0.863 (1.015)	-0.663 (1.184)	78	0.048	9
Total3	-1.007 (0.738)	-1.762* (0.994)	.5 (0.941)	-0.238 (1.156)	47	0.089	9

Notes: Robust standard errors reported in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Total1 includes questions 1, 2, 3, 4, 5, 8, 9, 10, 11, 13, 26, 34, 35, 36, 37, 38, 45, 47, 51, and 52. Total2 includes all of questions in Total1 plus question 15. Total3 includes all of the questions in Total2 plus question 7.

Table 4.8 Average demerit points for Food Establishment Inspection Report questions by video viewership

Ques.	Obs.	Viewed videos	Did not view videos
1: Certification	36	0.444 (0.856)	0.778 (1.00)
4: Proper eating	36	0 (0)	0 (0)
6: Hands clean	7	0* (0)	2.50 (1.914)
7: RTE	21	0 (0)	0.50 (1.167)
9: Approved source	36	0.22 (0.647)	0.333 (0.686)
10: Proper temp.	35	0.056 (0.236)	0 (0)
11: Good condition	36	0* (0)	0.278 (0.669)
13: Protected food	35	0 (0)	0 (0)
14: Clean surfaces	18	0* (0)	0.30 (0.671)
15: Proper disposition	29	0 (0)	0.267 (0.704)
34: Thermometers	32	0.267* (0.458)	0.558 (0.496)
35: Proper labels	36	0.167 (0.383)	0.389 (0.698)
37: Contamination	36	0.056** (0.236)	0.556 (0.856)
47: Non-food surfaces	36	0 (0)	0.056 (0.236)

Notes: Standard deviations reported in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 4.9 Average prevalence of particular pantry characteristics by video viewership

Characteristics	Obs.	Viewed videos	Did not view videos
Written SOPs	36	0.611*** (0.502)	0.167 (0.383)
Food safety training by manager	36	0.667 (0.485)	0.778 (0.428)
Supplier requirements	34	0.412 (0.507)	0.176 (0.393)
Know about recalls	36	0.833 (0.383)	0.667 (0.485)
Recall plan	36	0.889*** (0.323)	0.444 (0.511)

Notes: Standard deviations reported in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

CHAPTER 5: CONCLUSIONS AND FUTURE RESEARCH

5.1 Contributions to the Literature

Even with precautions along much of the supply chain, individuals still get sick from foodborne illness. While various means exist for individuals to receive food safety information, many people still operate outside that arena—and that foodborne illness prevention work is not nearly complete. Food safety research is evolving and improving as it begins to include fields like nutrition and health behavior in the context of food security studies, yet more research is needed to better understand the rules and norms of the institutions that influence, create, and enforce food safety policy. In an effort to add to this body of research, this dissertation examined the North Carolina emergency food system through the standard operating procedures and supply chains of the food pantries. To begin, the collection of a novel data set allows for the empirical analysis of pantry characteristics never before quantified, beginning with the differences of the food pantries that partner with a food bank and those that are independent, but also exploring the hypotheses that the rurally-located pantries are distinct in terms of food access and that managers who have received training in food safety will lead “safer” pantries. While each chapter examines different facets of the food pantries, the results of each suggest that regulatory policy at some level should be introduced—at least as an attempt to move towards a better guarantee of safety and lessened risk of foodborne illness. While food bank employees might regularly visit multiple food pantries, many pantry managers suggested that they had not visited other pantries nor did they have guidance on how to operate, even those with food bank partnerships. The pantries lack a network for gathering and dispensing information similar to other institutions, from churches to restaurants to government

agencies, for designing operations. The food pantry managers do not overtly focus on the value of safety in the supply chain or on-site; they lack a “strong food safety culture” (Powell et al., 2011; Yiannas, 2009).

5.2 Chapter 2 Conclusions

In Chapter 2, the mixed-methods analysis of the food pantries’ standard operating procedures revealed myriad information previously unavailable. Even while the food banks make strides in their dissemination of food safety information, the pantry managers do not always interpret that guidance equally. Furthermore, the reasoning behind certain actions (i.e., discarding past-date foods, use of thermometers, distribution of home-canned items, determination of what is “good”) was inconsistent, suggesting a new food safety educational tool for many of those who currently receive guidance and a publicly-available tool for those who have never received any information but seek pantry-specific information. The analysis assisted in categorizing the food pantries in terms of distribution and storage practices, concerns about waste, the types of food distributed, and regional disparities, as well as comparisons of those pantries that partner with a food bank versus those that are independent. It dispelled any notion that the pantries in rural areas have procedures that are overtly less safe than the food pantries in metropolitan areas; given the prevalence of web access, they have the same ability to receive information from the food banks or elsewhere. Additionally, Chapter 2 revealed that the sentiment of the pantry managers towards the food bank was mixed in terms of recall expectations, food safety (and non-discrimination) training, inspections, on-site rules and restrictions, and even ordering procedures. Detailed rules and regulations were rarely enough to end the partnership, as access to deeply-discounted food remains enough to uphold any relationship.

5.3 Chapter 3 Conclusions

Chapter 3 provides an in-depth analysis of the nuances of the food pantry supply chain, while at the same time creating and using a new risk analysis framework specific to the pantries and based on their actions. Early into the data collection, it became apparent that the supply chain and storage procedures were inconsistent across pantries but also within food bank regions. Again, and even with only food partners, regional differences lacked statistical significance. This analysis also revealed the diversity of food choices offered by the pantries: fruits and vegetables (88.6%), meat (85.7%), fresh dairy (48.6%), bread (87.6%), and eggs (43.8%), in addition to the canned and packaged options (97.1%), but also their multiple storage options. The storage differences led to the creation of the risk framework and its subsequent analysis, given that 30 risky behaviors in storage (beyond the lack of thermometers) and supply chain procedure were likely directly leading to contaminated food, particularly the lack of cold storage for perishable items and on-site food repackaging but also the uncertainty of transportation methods and traceability of products, unwritten standard operating procedures, and lack of information regarding food recall. Even though the “riskiest” food pantry had only 14 of these identified procedures and practices, the standard deviations for most of them were large enough to suggest that each one mattered. To that end, TEFAP/SNAP participation came with a large decrease in risk score, statistically significant at the 99% confidence level, and acts as a robustness check that rules and regulations can influence risk in the food pantries, given the requirement that managers must complete paperwork and regular training to receive the items. The overall analysis truly provides a new snapshot regarding what matters in the determinants of a food-safe food pantry and its respective supply chain.

5.4 Chapter 4 Conclusions

Given the analysis in Chapters 2 and 3, the analysis in the fourth chapter comes alongside the creation of food safety guidelines specific to food banks and food pantries. Addressing the issues

that emerged from the first round of data, the guidelines are based on the results of the previous chapters, though the lesson is in their delivery. A random half of the original sample of food pantries that distribute both perishable and non-perishable items were provided the new online video guidelines by email, but the difference-in-difference analysis resulted in predominately null findings. While the information in the guidelines is critical, the dissemination of the information might have been better actualized if it was delivered in-person, by an authority figure, in a group setting, or with its potentially deadly consequences encouraged. Future research into the best delivery for particular populations might assist in statistically significant results, as what works for one population does not necessarily work in all groups or communities. Likewise, researchers could test the same guidelines in another setting—potentially even via the food bank, which is where so many pantry managers get their current information. Feeding America, as well as many of its local affiliates, has shown an interest in the analysis and guidelines given their convenience and accessibility. To extend this research, the guidelines could be tested using food pantry managers in other states, which would strengthen their overall value and generalizability. Research into the organizational readiness of the food pantries might provide additional insight into the mechanics of the organizations and how to best provide and execute an adult education program related to volunteers and food handling.

5.5 Regulatory Concerns and Implications

Overwhelmingly, the major foodborne pathogens (*E. coli* O157:H7, *Salmonella*, *Campylobacter*, *Listeria monocytogenes*) are attributed to fresh foods, from pork, beef, and chicken to sprouts, fruits, and seeded vegetables to dairy products (Interagency Food Safety Analytics Collaboration, 2015). As food banks and food pantries seek to increase the amount of fresh foods (i.e., perishable items) that they distribute, understanding how to keep them safe becomes increasingly important. At the least, and perhaps most importantly, guidelines that articulate how to be compliant with the Good Samaritan Act and prevent contamination should be available, rather than the current reliance on

reactionary efforts in the event of a foodborne illness outbreak. Similarly, a shift in food safety culture is likely more challenging in institutions that are older, making such information increasingly critical (even if not regulated by law).

There remains a tradeoff between concerns (and policies) regarding food safety, food security, and nutrition, given the prospective increased risk of foodborne illness with those items. To that end, if increased regulations are found to be the best means to change behavior, their implementation could lead to the closure of food pantries due to cost or bureaucracy, increasing the number of hungry families and individuals. State and local health departments might be the best venue for encouraging or requiring formal procedures, though that shift could require legislative change.

While there are states (e.g., Iowa and Massachusetts) that require food pantry inspections and/or have more stringent rules regarding donation, their operating procedures and supply chains have not yet been analyzed. Those states would be an excellent place to begin to determine the effect of rules on food safety risk in the food pantries—as well as how they are implemented and enforced. If the rules and regulations are not enforced, they have little effect. The level at which regulations might make sense in North Carolina remains in question, as well as the capacity for lower levels of government to take on another institution to monitor. Regulations can be costly, to those who are targeted and those who must enforce them; in this case, it might be most effective to operate under a pay-to-play scheme. For example, the food pantries that wanted to operate within the state would have to pay for an annual inspection by health inspectors, assuming an inspection is needed to execute and enforce the food safety guidelines.

5.6 Overall Conclusions

Regardless of regulatory measures, the food pantry managers should take precaution in serving, storing, and distributing food, either using the new online food safety guidelines for food

pantries, food handling information disseminated by the food bank, or curriculum they might find elsewhere. Foodborne illness in the United States represents a burden of approximately \$36 billion per year, with an average cost burden per illness at \$3,630 (Minor et al., 2014). These numbers could be reduced with knowledge and behavioral changes at multiple points in the food system, including the food pantry level.

The majority of the food pantries have a food bank partner—and they are often the suppliers of the perishable items. Food bank policy includes food safety training at variable rates,¹⁸ but it concludes with a test of knowledge rather than behavior, fitting with the analysis in Chapter 2 that the managers who received training had few differences from those who lacked food safety education. But, as Chapter 3 results included a more positive food safety culture correlated with TEFAP rules, federal commodity program participation would be a natural place to require certain procedures within the food pantries.

Conclusively, this newness of this research should not go unnoticed. Regardless of income level, consumers should have access to food that is safe, requiring all supply chain actors to do their respective parts. Unlike other food systems institutions, the food pantries are private (predominately faith-based) organizations that provide a public good; that designation does not mean they should be treated as outliers in terms of food safety and handling information. The data collected and analyzed in this research is novel and provides access to a new narrative regarding the North Carolina emergency food system. Given its observational specificities, this proprietary data could not have been collected via survey or phone call. Its acquisition will lead to further research projects, including but not limited to organizational readiness, but also greater, timely policy questions surrounding food waste or the normative dimensions of corporate social responsibility. While the food pantries are not original topics of study, previous research on food pantries had not centered

¹⁸For example, the Food Bank of Central and Eastern North Carolina requires that the pantry managers obtain ServSafe certification every two or three years, depending on whether the training is completed online or in person.

on its food safety aspects, but namely on its food insecurity components. Additionally, this dissertation project adds to our understanding of issues at the cross-section of food waste, food insecurity, and food safety; it is the result of domestic policies long studied separately but now analyzed as policies that can influence the outcomes of the others.

APPENDIX A: LOCAL FOODS, ACCESS, AND PANTRY TYPOLOGY

The understanding of how local food systems operate in terms of emergency foods is an integral part of this study. Critically, the details on the supply chain are highly variable depending on the food pantry. Research has revealed that low-resource individuals do not have consistent nor equitable access to fresh produce, including through the emergency food system (Robinson et al., 2007). Large anti-hunger organizations like Feeding America seek to increase local and regional foods to families in need as well as diversify healthy food options (Feeding America, 2015a; Feeding America, 2015b). However, that research does not necessarily encapsulate North Carolina. A random selection of three NC pantries resulted in three very different food source and transport assortments:

- 1) Six sources: food delivered by the food bank in a refrigerated truck; food delivered infrequently from restaurants; food picked up from numerous grocery stores by volunteers in their personal vehicles; home-processed foods delivered though never distributed; and an on-going on-site food drive
- 2) Five sources: food picked up from the food bank in the manager's vehicle; food purchased from the grocery store once per year; food purchased from a big-box store three to four times per year; and one to two food drives per year with food delivered to the pantry
- 3) Two sources: delivered food by the food bank once per month plus the ability to drive to and shop at the food bank once each quarter; and produce gleaned from local farms each summer and delivered.

As a result, the pantries have been further compartmentalized, leading to a limited typology. Given the county-level differences and sample size, an overarching typology that generalizes North Carolina food pantries might not be truly reliable.

While it might be counter-intuitive to previous research on outreach in rural areas, the rural pantries in the sample are not the ones who distribute farm and garden harvest or hunted game. Overall, the food pantries in metropolitan areas are likelier to have more diverse food sources. For the pantries in metropolitan areas, the average number of sources of food is 4.01; in micropolitan areas, the average number of sources is 3.28 but, in rural areas, the average is only 2.86. Of the 30

food pantries that get food from farms, 63.3% of them are in metropolitan areas (n=19) and the remaining 36.7% are in micropolitan areas (n=13), with none in rural areas. The collection and distribution of leftover fast food, restaurant items, and catered events is predominately a metropolitan occurrence. While less than a quarter of the sampled pantries (n=24) distribute these foods, 79.2% of those that do so are in metropolitan areas. Those pantries are also affiliated with two particular food banks, which might help to initiate those food sources.

Of the 33 food pantries that receive food from gardens, 69.7% are in metropolitan areas, 27.3% are in micropolitan counties, and 3.0% are in neither. A single county is over-represented, with 36.4% of the pantries that distribute garden produce situated inside of it, a higher percentage than the county represents in the overall sample. The county might support community, school, and prison gardens to a greater extent than do other counties, but no indication of garden prevalence or policy were discovered. To that end, the same county distributes hunted game at higher instances than do other counties. To elaborate, 30.8% of all pantries that distribute game are from a single county and the next-highest prevalence of game distribution is in a nearby county (23.1%). Furthermore, organizations that distribute game and wild fish are not prevalent in all areas equally, as they require neighboring areas for hunting and fishing. Similarly to garden harvest distribution, 76.9% of pantries that distribute game are in metropolitan areas and 23.1% are in micropolitan areas, none in rural areas.

APPENDIX B: ADDITIONAL SUPPLY CHAIN DESCRIPTIVE STATISTICS

Earlier analysis comprises the descriptive statistics for each of the following supply chain characteristics; this Appendix includes the same statistics, but separated by food bank partners and independent pantries. There are few differences of note beyond the number of paid staff members for each kind of agency; the food bank partners tend to be larger organizations, reflected in their larger numbers of staff. Additionally, there are no independent pantries that operate using a client choice model in the sample, which is why that characteristic is not included in Table B.2. To that end, only food bank partners have access to the federal commodity programs (TEFAP and SNAP).

Table B.1 Descriptive statistics for food bank partners

Characteristic	Observations	Mean	Std. Dev.	Min.	Max.
TEFAP/SNAP participation ⁺	88	0.84	0.37	0	1
Pack items as they go	88	0.48	0.50	0	1
Pre-pack items	88	0.39	0.49	0	1
Client choice	88	0.13	0.33	0	1
Paid manager	88	0.39	0.49	0	1
Paid staff	86	2.07	5.40	0	31
Regular volunteers	85	0.79	0.41	0	1
Supplier requirements	85	0.18	0.38	0	1
Type of food distribution					
Perishables, non-perishables, and food preparation	88	0.14	0.35	0	1
Perishables and non-perishables	88	0.83	0.38	0	1
Non-perishables only	88	0.02	0.15	0	1

⁺TEFAP/SNAP participation can mean either TEFAP or SNAP or both programs.

Table B.2 Descriptive statistics for independent pantries

Characteristic	Observations	Mean	Std. Dev.	Min.	Max.
Pack items as they go	17	0.77	0.44	0	1
Pre-pack items	17	0.18	0.39	0	1
Paid manager	16	0.47	0.51	0	1
Paid staff	16	1.31	2.06	0	7
Regular volunteers	16	0.88	0.34	0	1
Supplier requirements	17	0.31	0.48	0	1
Type of food distribution					
Perishables, non-perishables, and food preparation	17	0.06	0.24	0	1
Perishables and non-perishables	17	0.47	0.51	0	1
Non-perishables only	17	0.41	0.51	0	1

APPENDIX C: ADDITIONAL EVALUATION TESTS

In an attempt to be as inclusive as possible, Table C.1 shows the results of paired t-tests of summed characteristics by category. However, given the high number of unobserved pantries in questions 6 (hands clean and properly washed), 14 (food contact surfaces: cleaned and sanitized), and 42 (utensils, equipment, and linens: properly stored, dried, & handled), the number of observations is especially low in the latter three categories. However, even with the small sample size, the hands and handwashing category lowered by almost two points in the second round, statistically significant at the 90% confidence level.

For similar reasons as the previous table, Table C.2 includes the same questions in its difference-in-difference model, though all categories fail to yield any statistically significant results. However, Table C.3 includes the most inclusive scoring schemes, with 20, 21, and 22 total questions (Total1, Total2, Total3, respectively). Yet, those summed evaluations result in null findings.

Table C.1 Paired t-tests of demerited points by category

Category	Ques.	Obs. (R1/R2) ⁺	First round means	Second round means
Reporting	1, 2, 3	60/60	0.8 (1.232)	0.983 (1.487)
Personal hygiene	4, 5, 38	59/59	0.051 (0.222)	0.042 (0.267)
Hands & handwashing	6, 7, 8, 48	4/18	3.5* (3.109)	1.028 (2.003)
Food storage	9, 10, 11, 13, 14, 15, 34, 35, 36, 37	14/37	1.857 (1.416)	1.324 (1.421)
Equipment [^]	26, 39, 42, 45, 47, 51, 52, 53	15/21	0 (0)	0.048 (0.218)

Notes: Standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

⁺(R1/R2) is defined as the number of observations in round one followed by the number of observations in round two, by question.

[^]Only one observation in this category is not zero.

Table C.2 Difference-in-difference results by category

Ques.	Post	Treat	Treat x Post	Obs.	R-squared
Reporting	0.530 (0.368)	0.296 (0.323)	-0.771 (0.489)	120	0.026
Personal hygiene	-0.0156 (0.035)	0.043 (0.060)	0.016 (0.096)	118	0.011
Hands & handwashing	-0.604 (0.433)	0.2 (0.753)	-0.216 (0.779)	62	0.105
Food storage	-0.394 (0.351)	0.639 (0.543)	-0.169 (0.652)	85	0.069
Equipment	-0.15 (0.151)	-0.15 (0.151)	0.213 (0.163)	65	0.027

Notes: Robust standard errors reported in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Like in Table 4.3, questions 6, 14, and 42 were eliminated due to small sample size.

Table C.3 Total-sum difference-in-difference results

Ques.	Post	Treat	Treat x Post	Obs.	R-squared	Max. points demerited
Total1	-0.159 (0.641)	0.457 (0.729)	-0.232 (0.936)	93	0.015	8.5
Total2	-0.485 (0.784)	0.890 (0.994)	-0.683 (1.169)	78	0.044	9
Total3	-1.667 (0.978)	.5 (0.930)	-0.238 (1.147)	47	0.072	9

Notes: Robust standard errors reported in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Total1 includes questions 1, 2, 3, 4, 5, 8, 9, 10, 11, 13, 26, 34, 35, 36, 37, 38, 45, 47, 51, and 52. Total2 includes all of questions in Total1 plus question 15. Total3 includes all of the questions in Total2 plus question 7.

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