Food defense practices of school districts in Northern U.S. states

by

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DEDICATION

To my parents

Irvin and Jeanne Peter

In 1951 my mother earned the first college degree within her extended family;

She is my role model for the value of higher education.

My father has enriched my life with his sense of curiosity;

He has filled my life with adventures and learning.

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ABSTRACT

This study assessed implementation of food defense practices in public schools in Montana, Wyoming, South Dakota, North Dakota, Iowa, Minnesota, and Wisconsin. The first phase involved a qualitative multi-site case study: one-day visits were made to five school districts in the states of Iowa, South Dakota, Minnesota, and Wisconsin. A principal, district foodservice director (FSD), two food production workers, and an emergency responder at each site were interviewed about food defense awareness and risk perception. Meal production and service were observed for implementation of food defense practices. In Phase Two 543 school food authorities or FSDs (36% percent of the population from 1,501 districts in seven Midwestern states) responded to an Internet-administered survey. Survey items included frequency of implementation of 31 food defense best practices adapted from the work of Yoon and Shanklin (2007a) and Yoon (2007). The survey included ten items assessing risk perception using Slovic's psychometric paradigm (1987). Items requested information about crisis management and food defense planning, food defense training, influence over districts' security policies, as well as operational and demographic characteristics.

Four themes emerged from the 25 interviews conducted during the site visit: low awareness, lack of concern, food not considered a potential danger, and how conflicting priorities influence security. Food defense was an unfamiliar concept among most interviewees. Many expressed the belief that food tampering was not likely in their schools because employees were trustworthy or location was too insignificant. Principals expressed concern for physical security measures but did not perceive their contribution to food defense. In most districts, the FSD was not included in district emergency response planning activities and communication about food defense did not occur between principals, FSD, and emergency responders. Some of the

interviewees had experience with food tampering incidents; seven incidents were reported, of which five had occurred in schools. Employees in a central kitchen facility were suspected in two of the school incidents, and three were perpetrated by students, indicating different sources of vulnerabilities.

Most (67.2% survey respondents reported district enrollment <2,500 students. Few (14.5%) had implemented a food defense plan; implementation was related to FSD involvement in crisis management planning and to FSD receiving food defense training. Thirteen practices were implemented most of the time (mean >4.0 on 5-point scale with 5 = *always*); most of these within control of FSD. Six practices were implemented less frequently (mean <3.0 on 5-point scale with 1 = *never*); three would require administrative action to implement, and two were related to FSD communication with emergency responders.

Mean values for "unknown risk" risk perception measures indicated some disagreement that intentional food contamination was a new risk for respondents and strong disagreement that they personally knew a lot about how terrorists could contaminate the food supply. The mean for the dread risk scale was 1.93 on a 4-point scale with 4 = *high*, similar to perceived risk of common everyday activities reported by Lee, LeMyre, and Krewski (2010). Compared to district administrators, FSDs perceived significantly greater personal control over both terrorism and food tampering risks.

CHAPTER ONE. INTRODUCTION

Concern about intentional contamination of food with chemical or biological agents has established food defense as an imperative for industries associated with the food supply (Jackson, 2009; Khan, Swerdlow, & Juranek, 2001; Sneed & Strohbehn, 2008). Attacks on the global food and water supply increased four-fold from 1970-1979 and 2000-2005 (Mohtadi & Murshid, 2009). The World Health Organization (WHO) has urged its Member States to recognize the potential for food to be deliberately contaminated, and therefore strengthen food production, processing, and preparation systems (WHO 2008). Busta (2010) identified disgruntled employees, extremist special interest groups, criminals and deviants, and terrorists as threats for intentional food contamination.

In 2004, the U.S. Department of Homeland Security (2004) issued Homeland Security Presidential Directive 9, which established a national policy to defend agriculture and the food system against terrorist attacks, disasters, and emergencies. Schools are one of several entities in the food system that have characteristics making them potential targets for those with terrorist motives. The purpose of this study is to investigate preventive measures being used in school nutrition programs to defend food against intentional contamination.

Background

Defense of the Food Supply in the United States

Acts of terrorism involving bombs and explosive devices are common occurrences around the world. Research has identified ways in which terrorism may spread to new targets, including the food supply. After the terrorist attacks of September 11, 2001, the U.S. government became proactive in thwarting initiatives that would harm its citizens by increasing

spending for food defense from $1 million in 2001 to $217 million for 2011 (Franco & Sell, 2010).

Terrorism in any form is a concern. Mohtadi and Murshid (2009) compiled a database of 25,594 incidents of terrorism between 1968 and 2006. After 1993, an increase in severity of terrorist acts was noted, with almost all of the events affecting more than 1000 casualties. These researchers also noted a trend away from attacks on airlines, military, and government targets, with a move to less protected, "softer" targets. Many experts consider the U.S. food industry to be a soft target, potentially vulnerable to acts of intentional contamination with chemical, biological, radiologic, or nuclear (CBRN) weapons.

Persons with criminal intent may also use the food chain to harm targeted or random individuals via food ingredients or water. Historically, acts of intentional food contamination on the food supply by criminals have greatly outnumbered terrorist attacks. Khan, Swerdlow & Juranek (2001) differentiated between a bioterrorist act and a *biocrime.* A biocrime is an act of intentional contamination of food or water carried out by individuals who act alone and are not associated with a named group. Persons who commit biocrimes act on personal motives such as revenge or extortion, whereas bioterrorist acts are planned by individuals or groups who want to cause fear, weaken government, damage the economy, or make their views known. Biocrimes and terrorist acts may involve chemical agents (including heavy metals), food additives, detergents (such as quaternary agents), fat-soluble vitamins, and non-metal ions (such as fluorine or iodine).

Terrorist groups are motivated by a desire for publicity to promote their political and ideological agendas. Primary motivations of terrorist attacks are to disrupt social life by causing physical, psychological, or economic damage (Bruemmer, 2003; Elad, 2005; Sobel, Khan, &

Swerdlow, 2002). The global food system has the ability to quickly move food around the world, a characteristic that is a detriment if the food supply is contaminated at an early point in the food supply chain. A CBRN attack that contaminates a large batch of food product could affect more people and create greater disruption than could be achieved by destroying the facility in which the food was processed.

United States Food Supply Vulnerabilities

The U.S. food industry has characteristics that make it a desirable vehicle to accomplish terrorist objectives. One characteristic has been the trend within the U.S. food system to increase the number of very large food processing facilities. Foods produced in these plants may be distributed globally. If intentional food contamination occurred in such a facility, many individuals across a widespread geographical area would be affected. Khan, Swerdlow, and Juranek (2001) described the far reaching effects of a salmonella outbreak caused by improper cleaning of a truck subsequently used to haul ice cream mix; that outbreak affected 224,000 persons in 41 states.

The globalization of the food supply contributes new risks. It is estimated imports make up 10 to 15% of foods and ingredients consumed in the United States (U.S. Department of Health and Human Services, Food and Drug Administration [FDA], 2011a). The majority (79%) of fish and shellfish consumed in the United States is imported, as is 32% of the fruit and nuts (Jerardo, 2008). These foods, along with fresh produce, are minimally processed and/or do not undergo heat treatment that would kill pathogens. Adulteration with pathogens is the cause of 10% of import violations (Unnevehr, 2010). Food imports from China, India, and Eastern Europe are expected to increase faster than those from other parts of the world (FDA, 2011a). Food imported from low-income countries had 605 import violations compared to 134 violations

from high income countries, with two-thirds of violations from chemical or microbial adulterants, filthy or decomposed appearance, or use of unregistered processes for canned food (Unnevehr, 2010). A global food system implies that an act of intentional food contamination could cause harm long distances from the source of the contamination and spread across a wide geographical area, making it difficult to identify the source of the contaminant. The Food Safety Modernization Act (2011) addressed some of these new risks with increased regulation for imported foods.

Busta (2010) identified disgruntled employees as a threat for intentional contamination of food. Food manufacturing jobs have the highest rates of injury and illness among all U.S. jobs, particularly in seafood product and dairy manufacturing industries (U.S. Bureau of Labor Statistics, 2010). Such jobs require little education and offer few opportunities for advancement. These conditions could provide reasons why workers might be careless, angry or vindictive, and provide motivations for intentions to commit murder, extortion, revenge, or be open to bribes to intentionally sabotage food.

Global Risk of Intentional Food Contamination

Mohtadi and Murshid (2009) acknowledged that the food chain is vulnerable to terrorist attacks, but questioned whether that vulnerability translated into risk. They compiled a data base of 448 global CBRN events between 1975 and 2005 and used those past events to estimate the risk of future large-scale events. Their research was based on the assumption that past experience with CBRN events is a good predictor of future events. They employed a statistical method called extreme value theory to estimate the probability of terrorist attacks affecting large numbers of victims. Extreme value theory procedures emphasize accurate prediction of values in the tails of a normal curve, not the values surrounding the mean. They observed that catastrophic

terrorist events were occurring more frequently and that the time between events was decreasing. They also reported major attacks with thousands of casualties were more likely to be caused by CBRN weapons rather than conventional weapons. They identified 448 attacks between 1950 and 2005 that used CBRN weapons; 12 of these cases involved attacks on food. The agents used in these attacks included *Salmonella tymphirium*, cyanide, nitric acid, rat poison, nicotine, bleach, ammonia, pesticide, and one unknown agent. China experienced the greatest number of attacks on the food supply (n = 5), followed by the United States (n = 3); single attacks occurred in Russia, Italy, and two undisclosed locations. Restaurants (n = 4) and schools (n = 3) were the most frequent targets for food-specific attacks. Mohtadi and Murshid (2009) concluded that by 2025, a CBRN attack causing 5000 casualties could be expected every 20 months. The probability of an attack directed at the food system specifically could not be determined because of the limited data available.

Reports of Intentional Contamination in the United States

To date, only one incident of intentional contamination of food in the UnitedStates has been considered an act by a terrorist group. This incident (Torok & Tauxe, 1997) involved intentional contamination with *salmonella* of self-service bars in restaurants by members of a religious sect. This group's objective was to influence an election by causing illness among likely voters. The group purchased a live culture of *S. tymphirium* and used it to contaminate coffee cream, salad dressings, and salad bars at ten different restaurants over a one-month period. Intentional contamination of the food was initially considered, but dismissed, because no motive was determined, no one claimed responsibility, and no disgruntled employees were identified. The authors recommended that, in the future, intentional contamination should be considered for any large outbreak having an unlikely pattern of contamination.

Ashford, et al. (2003) reviewed the biologic agents in foodborne illness outbreaks occurring from 1988 to 1999 using data from reports made by the Epidemic Intelligence Service of the U.S. Department of Health and Human Services Centers for Disease Control and Prevention (CDC). Of 1099 outbreaks reviewed four percent (n = 44) were considered caused by Class A agents. Intentional contamination was considered a likely cause in six of the cases. In 41 outbreaks, the infectious agent was unknown. The authors stated these agents were not commonly found in CDC investigations; illness from them, if not deemed an accident, should be considered as a case of intentional exposure by those who might be planning a biologic attack.

Outbreaks resulting from intentional contamination of food were most likely identified if they involved large numbers of people, were associated with commercial restaurants, the symptoms of illness manifested shortly after ingestion of food, or serious illness resulted (Batz et al., 2005). An analysis of 453 confirmed incidents of malicious contamination across the globe showed the majority occurred in the home or at work, and were perpetrated by relatives, co-workers, and/or acquaintances of the victims (Dalziel, 2009). Although the incidents occurring in retail foodservice venues were fewer in number (n = 85, or 17% of the 453), the average number of casualties (n = 40) per incident was highest in this group. Dalziel concluded that retail foodservice sites were points in the food chain where terrorists or criminals could cause the most harm. Retail foodservices may be classified as either commercial or non-commercial. Intentional contamination of food in a commercial foodservice setting, such as a chain restaurant, may result in widespread publicity and economic damage. Intentional contamination in a noncommercial foodservice setting, such as a school, could result in physical and psychological damage as well as social unrest.

The probability that one will be harmed by intentional food contamination is low, so this hazard may not be perceived as a risk by lay people. However, bioterrorism is a relatively new hazard; consequences of a bioterrorist attack are unknown, but it is likely that many people could become ill or die. Bioterrorism may be perceived by lay persons with a sense of dread. "Dread risk" is described by a psychometric paradigm of risk perception (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978; Slovic, 1987; Slovic, Fischhoff, & Lichtenstein, 1982). Little research has been done to determine whether a perception of dread risk is related to preventive action or emergency preparedness.

Significance of the Study

Schools are unique places in communities because they house large numbers of children most days and are responsible for the safe return of the children to their families at the end of the day (Greene, Barrios, Blair, & Kolbe, 2004). More than 55 million children, representing more than 17% of the total population of the United States, were enrolled in 132,000 kindergarten, elementary, middle, and high (K-12) schools across the United States in fall 2010 (U.S. Department of Education, National Center for Education Statistics, 2011). School meals programs have characteristics that may make them attractive targets for terrorist attacks or biocrimes via intentional food contamination. Young children are at high-risk for foodborne illness; their size and physiology would result in more severe reactions if they consumed contaminated food (Chung & Shannon, 2005). Widespread illness among a community's children would certainly cause fear and social disruption and result in increased media attention. Most school meals programs in the United States participate in the federal government's Child Nutrition Program; an attack on school meals could lead to distrust of the federal government. Some meals are produced in facilities as large as commercial food production facilities, with

distribution to numerous school sites. School meals programs have exacting specifications for their menu items, limiting the number of food processors willing to prepare products for that market; thus concentration exists in the school meals food system. Additional concentration comes through the use of commodity foods donated to each participant in USDA school meals programs. Schools received $1 billion in commodity foods from USDA in 2005-06 (USDA, Food and Nutrition Service [USDA-FNS], 2011). Half of these commodities, primarily meat, poultry, and frozen fruit were reprocessed into cooked meat products and fruit desserts at various food manufacturing locations; thus, contamination at the processing level could easily be targeted toward school children.

School districts have the option to participate in the Child Nutrition Program; this federally funded program fully or partially reimburses them for up to three meals per day on days school is in session: breakfast, lunch, and after school snack. The total cost to the federal government for all child nutrition programs is $1.375 billion (USDA-FNS, 2011). The National School Lunch Program serves meals to over 31 million children in 101,000 schools each school day (USDA-FNS, 2010b) while the school breakfast program serves 11.1 million meals in 87,000 schools (USDA-FNS, 2010a) and the after school snack program is active at 27,000 sites nationally (USDA-FNS, 2010c). In addition, this food assistance program continues during summer months with 133.8 million meals served at 38,500 sites in 2010 (USDA-FNS, 2011).

Given the characteristics of a large population of vulnerable children participating in a high number of school meal programs, as well as characteristics of child nutrition program administration, it is important that best practices be followed to protect food while in the district's custody. Previous research has assessed food defense practices in place at schools in the United States. The National Food Service Management Institute (NFSMI) and USDA-FNS

have developed guidance and training for foodservice personnel (USDA-FNS, 2004). Yet, it still is not clear the extent that best practice has been implemented.

Literature of food defense in schools included self-reported data from a sample of the 200 largest school districts that used a centralized production system or warehouse operation (Story, Sneed, Oakley, & Stretch, 2007), a sample of all school districts in the state of Kansas (Yoon & Shanklin, 2007a, 2007b, 2007c), and a national sample of districts with more than 7500 students (Yoon, 2007). This research assessed implementation of food defense recommendations developed by USDA through the original Biosecurity Checklist for Schools Foodservice Operations (USDABC) that contained 17 topics and 102 individual items (USDA-FNS, 2004). Condensed versions with fewer items were used by Yoon in the Kansas and national surveys (Yoon, 2007; Yoon & Shanklin, 2007a, 2007b, 2007c). These previous studies showed three categories of preparedness to be weak in school districts: communication, facility security, and utility security. In the national survey, Yoon (2007) attempted to determine regional differences among the USDA Risk Management Agency (USDA-RMA) Compliance Office regions, but two regions, Northern and Central, had small numbers of respondents, making comparisons among all regions difficult. Thus, little is known about implementation of food defense practices in districts with lower student enrollments (less than 7,500) or from districts in the Northern and Central regions of the United States. The Northern region includes seven states, three which are located along the U.S.– Canadian border (Montana, North Dakota, and Minnesota) and most have lower populations, fewer metro centers, and likely, fewer large school districts, than states in other USDA regions.

The purpose of this two-phase study was to determine the extent to which food defense best practices are implemented in U.S. schools. The study was designed to describe current

food defense practices of school meal programs in small, medium, large, and extremely large size school districts in the northern United States; identify perceived barriers to implementing food defense best practices in their schools; and describe stakeholders' perceptions of the risk of intentional food contamination.

The first phase used a qualitative approach with a multiple case study design of school districts in the USDA-RMA Northern Compliance region. A case study approach is appropriate for research questions with a "how" or "why" focus (Yin, 2008). The purpose of this phase of the study is to:

- Assess *how* selected school foodservice operators in districts with varying characteristics located in the USDA-RMA Northern Compliance Office region are currently implementing food defense practices related to physical security and communication.
- Investigate *why* communication and physical security aspects of food defense are implemented to a low degree in school foodservice operations.

In the second phase of the study, a national survey (modified with permission by Yoon, 2007) will be electronically distributed to the population of school food authorities in the USDA-RMA-Northern region. Because no data from a national or regional sample has been collected since 2005, it is important to know whether school districts are making progress toward food defense, or whether the issue has taken a back seat to other priorities.

Research Questions

1. What recommended food defense practices are currently implemented by U.S. school districts participating in the National School Lunch Program in the USDA-RMA Northern Compliance Region?

2. What is awareness of risk regarding intentional food contamination held by district stakeholders: principals, emergency responders, foodservice directors, and production workers?

3. What is the relationship of demographic and operational characteristics to crisis management and food defense planning by public school districts?

4. What is the prevalence and the characteristics of food defense training activities among school district personnel?

Definitions

Biocrime: Intentional use or threat of use of a biological or chemical agent for revenge, extortion, or personal gain (Khan et al., 2001).

Bioterrorism: The intentional use of biological or chemical agents for the purpose of causing harm (USDA-FNS, 2004).

CBRN event: Any incident involving the deliberate use or possession of chemical, biological, or radio nuclear material, with intent to do harm, as well as any attack that poses a threat to the containment of these substances (Mohtadi & Murshid, 2009).

Centralized foodservice system: A food production facility in which food is produced for service off site in receiving kitchens, often a large production facility. No food is served onsite. Also known as a commissary foodservice system (NFSMI and USDA-FNS, 2002).

Food biosecurity: The protection of food from bioterrorism (USDA-FNS, 2004). This term is obsolete and has been replaced with 'food defense".

Food defense: activities associated with protecting food from intentional acts of contamination or tampering (FDA, 2011c).

On-site kitchen: a food production operation where food is prepared and served at the same site (NFSMI and USDA-FNS, 2002).

CHAPTER TWO. REVIEW OF LITERATURE

This chapter includes four major topics. The first is a characterization of the risk of intentional food contamination in a foodservice operation with discussion of past and potential agents, methods, targets, and perpetrators. A discussion of risk management recommendations follows. The third section reviews the research about current food defense practices in restaurants, country clubs, healthcare facilities and school foodservice operations. The final section describes the use of the psychometric paradigm to measure risk perception and reports research about risk perception and bioterrorism.

Risk of Intentional Food Contamination

Risk assessment of intentional food contamination should consider the characteristics of different microorganisms, food products, and the flow of food items from "stable-to-fork" (Elad, 2005). Radosavljevic and Belojevic (2009) proposed a model for analyzing the risk of bioterrorism attacks that included four components: perpetrators, agents, means and media of delivery, and target.

Perpetrators

The model for terrorist attacks proposed by Radosavljevic and Belojevic (2009) differentiated between types of perpetrators: government-supported perpetrators, terrorist groups, and individuals. The authors defined various levels of sophistication and motivation among these groups. Highly sophisticated terrorists were defined as those who would try to attack well-defended targets, would want to remain unknown, and would not have suicidal intent, whereas highly motivated, but poor or fanatical terrorists would be more likely to attack less-prepared venues, often referred to as *soft* targets (Radosavljevic & Belojevic, 2009).

Historically, the majority of incidents of intentional food contamination targeted specific individuals. Table 1 lists all confirmed incidents between 1950 and 2005 that occurred in schools or universities worldwide (Dalziel, 2009). The perpetrators of these incidents were diverse and included students, teachers, vendors, and foodservice workers. The dates indicate that more events occurred between 2000 and 2005 than in earlier decades.

Three confirmed incidents of intentional food contamination in the United States were committed by students (Dalziel, 2009). The ages of the students ranged from elementary school through high school. The targets included a teacher, the general student body, and a classmate. Two of the attacks involved a beverage and the third involved a dish served on the cafeteria line. The contaminants were mercury taken from a thermometer, acetone (found in nail polish remover), and rat poison. An incident in the Philippines also involved students, who stole a chemical from the school science lab and added it to the beverage of a classmate (Dalziel, 2009). Worldwide, three incidents have involved school employees, one by a teacher, one by a maintenance worker, and one by foodservice employees (Dalziel, 2009). None of these occurred in the United States.

A recent survey of 926 restaurant managers in South Carolina found that the managers reported 29 alleged food tampering incidents in their restaurants (Xirasagar, Kanwat, Smith, et al., 2010). Managers believed dissatisfied employees were the perpetrators of 11 of the incidents. Other employee-related reasons given were terminated employee (5 responses), recent hire (3 responses), and easy employee access to food storage areas (3 responses).

Table 1

Perpetrators, Agents, Media, and Location of Intentional Food Contamination Incidents

Year	Location	Type of School	Perpetrator(s)	Agent	Media
1979	USA	Elementary school	Angry students	Mercury from a thermometer	One teacher's mug of coffee
1992	China	University	Student who had been expelled	Arsenic	Flour stored in the foodservice kitchen
1998	United Kingdom	University	Maintenance worker	Mercury	Employees' tea kettle
2000	USA	Elementary school	Unknown	Rat Poison	Pot of thawing hot dogs
2000	USA	Middle school	Two 7th grade students	Rat Poison	Salsa served with school lunch
2002	China	School	Two foodservice workers	Tetramine (rat poison)	Food served for school breakfast
2002	China	Kindergarten	Owner of a rival kindergarten	Unknown	Corn porridge served for school lunch
2003	China	Primary school	Unknown	Tetramine	Baking powder stored in the school kitchen
2004	Thailand	Kindergarten	Teacher	Insecticide	Chocolate drink served to children
2004	USA	School	Student	Acetone	Beverage of a classmate
2005	Philippines	High School	Two students	Mercurial nitrate stolen from science lab	Water bottle of a classmate

Note: From Dalziel (2009).

Vendors have also been identified as perpetrators of intentional food contamination. (Xirasagar, Kanwat, Smith, et al., 2010) reported that restaurant managers attributed a problem with a vendor as the reason behind nine instances of suspected or confirmed food tampering. Whether these particular incidents were suspected or confirmed was not explained.

Intentional contamination of food with a biological or chemical agent would achieve terrorist objectives to cause mass illness or injury and create fear and panic (WHO, 2008). As recently as 2010, Al Qaeda announced a strategy of smaller attacks involving fewer operators, less expense, and less planning time (Shane, 2010). In December 2010 CBS news reported a credible threat of multiple attacks on food in hotels and restaurants as a manifestation of this new strategy (Keteyian, 2010).

The only documented case of intentional food contamination in the United States perpetrated by a group with terrorist intent occurred in 1984 and is documented by Torok et al. (1997) and Carus (2009). The perpetrators were members of a religious cult, called the Rajneeshees, that established a large community outside The Dalles, Oregon. The cult attempted to gain control of the county court in the November 1984 election by poisoning local citizens so that they would be ill and unable to vote. The cult produced its own supply of *Salmonella tymphirium*. At least eight members participated in pouring vials of the culture into exposed food items at 10 restaurants. Both customers and restaurant workers were included in the group of 751 persons who became ill from eating food from salad bars in the restaurants. At the time, the food infections were not considered to be a result of intentional contamination. More than a year passed before the outbreak was related to the cult.

Agents

Mohtadi and Murshid (2009) studied the use of CBRN weapons in terrorist attacks documented in unclassified sources. It has been noted that a tactical advantage of biological weapons is that an attack can go unnoticed while the bacteria incubates in the victims, infecting many before symptoms occur, making it difficult to identify and track the attack (Lesho, Dorsey, & Bunner, 1998). Another advantage for perpetrators is biological weapons cause casualties without destroying equipment or infrastructure (Lesho et al., 1998).

Graham and Talent (2009) noted that, unlike nuclear weapons, biological weapons present the opportunity to limit the effects of an attack *after* it has been initiated. Preparedness may lead to identification of an attack soon after it occurs, reducing illness and deaths. Biologic agents are inexpensive, compared to conventional weapons. The cost of producing mass casualties, in dollars per square kilometer was estimated at $1 for biological agents, $800 for nuclear weapons, and $2000 for conventional weapons (Lesho et al., 1998).

The CDC initiated lists of biological agents grouped into three categories: A, B, and C (Rotz, Khan, Lillibridge, Ostroff, & Hughes, 2002). Biological agents were categorized according to potential to affect public health, ability to be produced in large amounts, ease of dissemination, ability to spread through person-to-person contact, ability to cause fear in the public, and the need for public health officials to make new preparations to diagnose and monitor outbreaks. The effects of agents on a civilian population having a diversity of ages and states of health was used to categorize the agents (Rotz et al., 2002).

Microorganisms or toxins are biological agents that may be used to contaminate food. Analysis of past bioterrorism events revealed that agents were obtained from legitimate commercial culture collections, self-manufactured, stolen from laboratories, or were acquired

from natural reservoirs (Carus, 2009). Mixtures of soil and rotting vegetables, dead animals, and feces have been used by those with no technical knowledge (Dalziel, 2009).

Elad (2005) described the difficulties associated with producing biologic agents. Accidental death or injuries from production of the weapons may draw attention to the perpetrators and lead to their discovery. The effectiveness of biological agents is influenced by virulence, ability to multiply once released, and degree of contagiousness. Once disseminated, changes in the appearance, taste, or smell of the food may lead to detection and rejection by the intended targets.

The highest CDC priority, Category A, includes six biological agents rarely seen in the United States and unlikely to be familiar to public health officials. Of these six, the one that could be spread through food is botulism toxin (Sobel et al., 2002). The next level of agents, Category B, includes foodborne pathogens such as *Salmonella*, *Shigella* spp*, E. coli* 0157:H7, and toxins from *Clostridium perfringens* and *Staphylococcus*. These agents cause illness, but rarely death if medical care is available (Rotz et al., 2002). Radosavljevic and Belojevic (2009) suggested that highly sophisticated perpetrators will use sophisticated Class A agents whereas more common Class B agents would likely be used by terrorist groups that are highly motivated and/or have fewer resources.

Botulism toxin is considered the most toxic biochemical compound. Arnon et al. (2001) suggested that intentional use of botulism toxin be considered with any botulism outbreak, especially those with a large number of cases, an unusual toxin type, or multiple simultaneous outbreaks.

Means and Medium of Delivery

Food is a difficult vector for causing mass injuries because it may undergo several cleaning, trimming, washing, and heating processes from harvest to consumer, all which dilute any contaminant added early on in the farm-to-fork journey (Mara & McGrath, 2009). Water can be easily contaminated. Category A agents, including anthrax, plague, tularemia, and botulism toxin can be distributed in water supplies. They are stable in water from 8 days to 2 years, depending on the organism (Burrows & Renner, 1999). Category B agents also pose threats to water supplies, specifically Brucella, cholera, *Salmonella*, *Shigella*, cryptosporidium, ricin toxin, and enteric viruses. All are definite or probable threats to water supplies and are stable in water (Burrows & Renner, 1999). Although bacterial cells such as *Vibrio cholerae*, *Salmonella*, *Shigella*, and tularemia are inactivated by chlorine, other agents are resistant (*Clostridium perfringens*, cryptosporidia) or the response to chlorine is unknown (Burrows & Renner, 1999).

Toxins vary in threat presented to the water supply. Botulism, a Category A agent, is inactivated by chlorine, air, and sunlight. Burrows and Renner(1999) reported it to be impractical for use in poisoning a water supply. Ricin and staphylococcal enterotoxin B are category B agents. Of these, ricin is most dangerous when inhaled and not reported as a threat to water supplies. In contrast, staphylococcal enterotoxin can persist in water and cause illness if consumed. Charcoal filters are effective in removing the toxin from water, but the effects of chlorine on the toxin are unknown (Burrows & Renner, 1999).

Enteric viruses, such as rotavirus, are threats to water supplies. Individuals who consume as few as 6 particles in one day have a 25% risk of becoming ill with vomiting and diarrhea (Burrows & Renner, 1999).

The FDA (n.d.) identified four foodservice practices that increase the potential for harm to large human populations if food is contaminated. They relate to the risk presented by large batches of food which, if contaminated, would expose large numbers of consumers to the contaminant. The practices are: preparation or holding of food in a large batch size; uniform mixing of large batches of food; and ease of access to the food while it is held in large batches. A fourth practice is common to all conventional foodservice production systems: rapid consumption of the product after preparation. A short time period between production and consumption of food allows little time to discover any contamination of the food before many individuals have been exposed to it.

Schools using a commissary quantity food production system exhibit all of these factors. In such a system food is prepared in large batches at a single site, then divided and transported to multiple serving sites, where it is served shortly after delivery. Large batches are a concern because a pathogen or toxicant introduced into a large batch has the potential to harm many people at multiple sites. One small action could lead to injury in all parts of a community. Commissary food production systems may be attractive targets to terrorist groups because their goals include causing fear and social disruption, which would be achieved by contaminating a batch of food that reached most of the children in a school district. For example, the Jefferson County school district located in Kentucky prepares up to 60,000 meals per day that are distributed to 140 satellite units; this production scope is similar to that of a small processing facility (NFSMI, 2002).

Targets

Radosavljevic and Belojevic (2009) described targets as direct or indirect. The direct targets are those killed or injured. The indirect targets were defined as political or economic.

Attacks might weaken trust in government (political) or cause changes in food buying if a brand or commodity was found to be contaminated (economic). Stinson's (2010) econometric model of the effects of a major food terrorism event in the United States predicted a loss of $190 billion in real gross domestic product over the five-year post-attack period.

One school-related event of possible intentional contamination in North Dakota illustrated both political and economic consequences (Steinberg et al., 2006). The illness caused so many children at the elementary school to vomit that the local fire department was called to hose off the playground. The contaminant was traced to flour tortillas, but never identified. After this outbreak, some parents lost confidence in the program and some reportedly feared that the government was poisoning their children. Participation in the school meals program dropped and food donations by the schools to the local food pantry were discouraged.

Targets were described by (Radosavljevic & Belojevic, 2009) as *hard* or *soft* depending on the level of sophistication needed to breach the target. Hard targets are well-known venues that house important people and are well protected. Soft targets are public places occupied by ordinary citizens. Food defense practices were designed to make targets less soft.

Schools have unique characteristics that make them different from other soft public settings (Greene et al., 2004). They are places where all of a community's children are concentrated in a few readily identifiable locations on scheduled days of the year. Attacks on schools would cause fear because parents trust schools to keep their children safe during the school day. A large percentage of families in a community would be affected by an attack on a school, which could cause great disruption.

Intentionally contaminated food served to children presents a greater risk than food served to adults because children are more vulnerable to toxic agents. Chung and Shannon

(2005) elaborated on several factors that make children especially susceptible to toxin agents; they breathe more frequently each minute and are closer to the ground than adults, giving them more exposure to biologic or chemical agents carried in the air. In addition, children are susceptible to dehydration from diarrhea or vomiting that might occur after exposure to a foodborne agent. Children also have more skin surface relative to body size than adults and would sustain more damage from dermal exposure. They are more susceptible to hypothermia from decontamination processes. Vaccines and antibiotics that are available to adults for many of the CDC Class A agents have not been tested on children and the doses are not standardized.

Table 1 lists instances of intentional food contamination occurring in schools or universities between 1950 and 2005, as identified by Dalziel (2009). Dalziel included only those cases documented by two reliable sources. Newspaper reports were used only if they reported criminal charges or confirmed cases. Most incidents occurred in China or the United States and involved kindergartens, elementary, middle, and high schools, and universities. In seven of the 11 cases, school meals or snacks were the media by which the poison was transmitted to children; however other students were more frequent perpetrators than foodservice employees. When the attacks were targeted toward an individual, the agent was added to a serving of beverage. In the other cases the agent was mixed into dry powders or batches of cooked cereal, broth, or salsa and led to many more illnesses.

Many schools use commissary food production systems where food is prepared in bulk in one location and transported to multiple serving sites. In a nationwide sample of 353 school districts, 14.2 % prepared all food in a central kitchen, with no service onsite. An additional 40.5% of districts had a central kitchen, but onsite food production in some of their schools (NFSMI, 2004).

Commissary production systems require trucks and vans to deliver food to school service sites. Food is vulnerable to intentional contamination during transportation because it may be left unguarded if interruptions occur during the loading or unloading process. The greatest risk occurs if food is transported in bulk instead of individually sealed portions. If food is not secured during transit, bulk food in containers could be intentionally contaminated or swapped with counterfeit or adulterated substitutes. In the NFSMI (2004) study, districts with a single central kitchen had a maximum of 80 delivery sites, with 1-5 sites the most frequent response. For facilities that used a combination of both central and onsite kitchens, almost all made daily deliveries to their satellite sites, which numbered from 1 to 200 sites (NFSMI, 2004).

An advantage of a commissary kitchen is food can be prepared in bulk using the operation's preferred recipes and ingredients. Labor efficiency is maximized with bulk production; however bulk ingredients held in storage are vulnerable to contamination. Liquids, powders, or granular products are of particular concern because an undetected contaminant could uniformly be distributed throughout. Two incidents reported in Table 1 involved contamination of dry powders held in storage: baking powder and flour.

Food production processes in large commissary kitchens are more likely to be automated than in onsite or smaller centralized operations. Fewer workers are required, leaving fewer individuals to observe the food at all stages of production, which could present opportunities for intruders or other employees to contaminate food.

Risk Management Recommendations

Key Principles of Food Defense

In 2002, the Fifty-Fifth World Health Assembly adopted a resolution that recognized the threat of CBRN weapons against civilians (World Health Organization [WHO], 2008). The

group identified food as a likely vector for such weapons and asked the Director-General to provide technical assistance to policy makers in Member States to strengthen protection of their food supplies. WHO published *Food Safety Issues: Terrorist Threats to Food: Guidance for Establishing and Strengthening Prevention and Response Systems* in 2002 and noted it was one of their most- requested publications. This document was revised in 2008 based on changes in the International Health Regulations (WHO, 2008). The changes denoted a philosophy that protection of the food supply was an international concern requiring collaboration in surveillance, preparedness and open sharing of knowledge and technology between nations.

Terrorist Threats to Food emphasized the food industry is in the best position to prevent intentional contamination of food; governments should provide the support and guidance for industry to adopt food defense practices. Although the document was designed for government officials who guide policy decisions, it included an appendix with 118 food defense measures under 11 topics: risk awareness, general security, emergency procedures, hazardous materials, employees, access, suppliers, raw and packaging materials, storage and warehouses, processing areas, and transport of ingredients and processed products.

Key principles for schools. The first set of food defense guidelines prepared specifically for school nutrition programs entitled *A Biosecurity Checklist for School Foodservice Programs: Developing a Biosecurity Management Plan* (USDABC) was published by the USDA-FNS (2004). The publication identified the topic of bioterrorism as a threat to schools, provided checklists listing food defense practices, and offered guidance to schools in developing a foodservice biosecurity management plan. The guide included checklists related to 17 topics (listed in Table 2) with a total of 102 security measures identified. For example, Topic A,

Communication, included eight practices, such as “Compile team member information” and “Establish a relationship with local authorities in relation to biosecurity”.

The NFSMI collaborated with USDA to develop a Food Defense Teaching Resource for school child nutrition programs (Stretch, T., personal communication, October 13, 2011). The resource included a 12-minute video and a CD-ROM with the checklist in both PDF and digital formats (http://foodbiosecurity.nfsmi.org/index.php). The modifiable format permits programs to individualize the checklists to their needs. This resource was mailed in 2006 to 20,000 school districts across the nation. Components were also added to emergency preparedness training materials prepared by NFSMI. The original USDA publication is available to the public on the USDA-FNS website and the NFSMI website at www.nfsmi-web01.nfsmi.olemiss.edu/ResourceOverview.aspx?ID=69.

The FDA published *Guidance for Industry: Retail Food Stores and Food Service Establishments: Food Security Preventive Measures* in 2003 with revisions made in 2007 (FDA, 2007). This publication included 92 security measures under 22 subheadings in five general topic categories: Management, Human Element-Staff, Human Element-Public, Facility, and Operations. The more recent FDA guidelines showed greater emphasis on risks associated with people: employees, customers, and visitors providing services to the business. The guidelines included a 5-page *Food Defense Assessment Tool for Retail Food Stores and Food Service Establishments* with space to assess each of the 92 recommendations. Topics from this guide, developed for all types of retail stores and foodservices are shown in Table 2; they are compared to USDA-FNS topics targeted specifically to schools, and the WHO publication for policy makers. The guidelines for food defense put forth by WHO, USDA, and FDA are not

Table 2.

Topics related to Food Defense Actions identified in Food Defense publications

WHO	USDA-FNS	FDA
Risk awareness	Communication	Management
General security	Handling a Crisis	Preparing for the Possibility of Tampering or
Emergency procedures	Choosing Suppliers	other Malicious, Criminal or Terrorist Actions
Hazardous materials	Receiving/Inspection	Investigation of Suspicious Activity
Employees	Storage Areas	Evaluation Program
Access	Storing Food	Human Element – Staff
Suppliers	Hazardous Chemicals	Screening (pre-hiring, at hiring, post-hiring)
Raw and packaging	Foodservice Equipment	Daily Work Assignments
materials	Foodservice Personnel	Identification
Storage areas and	Foodservice/Food Preparation	Restricted Access
warehouses	Areas	Personal Items
Processing areas	Outside the School Building	Training in Food Security Procedures
Transport of ingredients	Water and Ice Supply	Unusual Behavior
and processed products	General Security	Staff Health
	Handling Mail	Human Element- Public
	Training	Customers
	Plan Maintenance	Visitors
		Facility Physical Security
		Storage and Use of Poisonous and Toxic
		Chemicals
		Operations
		Incoming products
		Storage
		Food Service and Retail Display
		Security of Water and Utilities
		Mail Packages
		Access to Computer Systems

mandatory, although each agency strongly urges one or more parts of the food chain to develop plans for implementing food defense.

Xirasagar, Kanwat, Smith et al., (2010) assessed food defense practices in restaurants and restaurant managers' awareness of risks of intentional food contamination. The survey used was based on the New York State Food Security Survey and adapted with input from focus groups of restaurant managers and owners. The resulting 3-page survey had 41 food defense items, 11 questions about restaurant characteristics, and six demographic questions. The authors noted several ways in which the survey was modified from the original New York State Food Security Survey to make it more user-friendly to restaurant managers. For example, the wording was changed from an enforcement tone to a collegial tone, and practices universally implemented by restaurants were removed from the survey. Only practices feasible for restaurant implementation were included, such as "Are customer self-service open-top ice bins monitored?" and "Is there good lighting in the parking areas and the back of the restaurant?" (Xirasagar, Kanwat, Qu, et al., 2010).

An internet search in 2011 using the phrase *food defense checklist* yielded downloadable checklists for retail and foodservice establishments published by the Massachusetts Department of Public Health (2009), the New Jersey Department of Health and Senior Service (2009), the Ohio Department of Agriculture (2005), and the Defense Logistics Agency (2011). In addition, Iowa State University Extension and the University of Nebraska-Lincoln in 2007 jointly prepared a food defense checklist for retail foodservice operations; dissemination of the information is included in food safety trainings and available upon request (Strohbehn, Sneed, Paez, & Beattie, 2007).

U.S. federal legislation. The Bioterrorism Act of 2002 was enacted to increase security of the U.S. food supply against terrorist attacks. The law had four main thrusts: registration of food businesses, prior notification of delivery of imported food, the right of FDA to hold food in administrative detention, and a requirement for record-keeping and retention of records that can be used to trace foods back to their origins. These requirements applied to businesses or individuals that manufacture, process, pack, transport, distribute, receive, hold or import food. The law required companies that process, manufacture, or hold food items to register with the FDA to facilitate tracing a contaminated product through the food system (FDA, 2003). Importers of food are required to notify FDA of the planned arrival of shipments (FDA, 2011). The law gave FDA the right to hold food in detention if there was evidence of a threat to the health of humans or animals (FDA, 2004b).

Restaurants, retail food businesses and non-profit food establishments were excluded from the above requirements, but subject to aspects of the record-keeping requirements. Under the Bioterrorism Act of 2002, all retail food businesses, including school foodservice operations, were required to retain invoices for food received. The length of time to retain invoices depended on the shelf life of food products with ranges from 6 months to 2 years (FDA, 2004a).

The Food Safety Modernization Act of 2010 included measures to improve safety of imported foods. Under the law, the FDA has authority to require food importers to verify food safety controls used by their suppliers. FDA has power to establish a third-party agency to certify that imports have been produced under standards equal to those of the United States. The agency may stop shipments from facilities or countries that refuse inspection by U.S. officials (FDA, 2011b).

Current Food Defense Status in U.S. Food Services.

Military

The U.S. military recognized the risks intentional food contamination presented to armed forces, especially overseas. Mara and McGrath (2009) made five recommendations for food defense including using mobile tracking technology on military food shipments, decontaminating fresh produce using ozonated water, using military personnel in foodservice operations rather than contracted employees, implementing rapid testing technology for microorganisms in suspicious food samples, and increasing funding for the development of contamination biosensors in foods.

Hall, Herbold, and England (2001) analyzed the flow of food at three military deployment sites with the intention of identifying critical points for preventing intentional contamination. They found contractual agreements required receiving personnel to accept orders of low quality; some supplies were from countries hostile to the United States; and during transportation, access to foodstuffs was controlled by the truck driver. Based on results of this case study, the authors recommended that food be purchased only from approved sources, foodservice sites have the authority to reject deliveries not meeting specifications, trucks be sealed when transporting food, storage areas be kept locked, and that employees be closely monitored as they prepared and served food and cleaned up. Hall, Herbold, and England (2001) also recommended persons handling foods be required to eat foods served as a means of reducing the likelihood of intentional contamination. Meals brought in from the outside could carry contaminants.

School Foodservice

Three studies of school foodservice food defense practices were found in the literature. Story, Sneed, Oakley, and Stretch (2007) conducted a survey of 200 foodservice directors in the largest U.S. school districts having central kitchens or warehouse distribution centers. The survey included questions about district procedures, facilities, and staffing. Respondents rated seven potential barriers to implementing food defense practices, and reported the history and perceived importance of training in 18 areas. Seventy-eight directors responded, for a response rate of 39%. Fewer than half of respondents had written procedures for:

- preventing intentional food tampering
- requiring vendors to do criminal background checks of delivery personnel
- including plans for communicating with food vendors in the district emergency preparedness plan
- securing the facilities with guards or video cameras during off hours
- asking delivery persons to show photo ID
- posting delivery schedules
- including emergency preparedness in employee orientation
- maintaining access to staff lockers, or
- scheduling new employees on a day shift where they could be observed.

The authors concluded that many large centralized school foodservice operations did not have written plans for preventing food defense violations. Money was rated the greatest barrier to implementing emergency preparedness policies and procedures, followed by lack of equipment. Time was ranked the third highest barrier. Staff perceptions and communication with outside departments were also identified as barriers, but had lower ratings.

School and Healthcare Foodservices

Yoon and Shanklin surveyed 782 FSDs in schools, hospitals, and long-term care facilities, all in the U.S. state of Kansas (2007a; 2007b; 2007c). They achieved a 24.7% response rate (n = 190), including 123 school FSDs. The results revealed that 10.6% of school FSDs had attended a seminar or other training about food defense (Yoon & Shanklin, 2007a). More schools had an employee in charge of monitoring food safety (71.5%) than had an employee in charge of monitoring food defense (26%). Formal crisis management plans were held by 35.8% of programs and 36.6% of schools reported presence of a food defense plan. While the characteristics of all combined FSDs in this study explained 12% of the variance in frequency of practice of food defense measures, it was training in food defense that affected practice frequency (Yoon & Shanklin, 2007c). Demographics, educational level, and foodservice career length did not affect practice frequency.

Food defense implementation. School foodservice directors rated employee management, utility security, facility security, and communication as less important than directors in healthcare. Mean practice frequency ratings for communication (3.8 vs. 4.1 on a 5-point scale, p<.01) and utility security (4.0 vs. 4.34, p=.03) practices were significantly lower for school foodservice directors than for health care foodservice directors. The difference in mean ratings for facility security was not significant (3.9 vs. 4.2, p = .06).

Yoon (2007) also conducted a national survey of a random sample of 1100 school FSDs in districts with enrollments of 7,500 students or greater. This survey also included a random sample of 1,100 healthcare foodservice directors. The response rate from the school FSDs was 23% (n = 254) and 18 % (n = 195) from the healthcare foodservice directors. More of the healthcare foodservice directors (57.4%) were Registered Dietitians, compared to 31.9% of

school FSDs. School foodservice operations served more meals per day than healthcare foodservice operations, with the smallest school serving 67.5 times the number of meals compared to the smallest healthcare facility (Yoon, 2007).

Yoon's 2007 survey (2007) showed improvements in food defense awareness and planning compared to the survey conducted by Yoon and Shanklin (2007a, 2007b, 2007c) in 2005. Yoon's survey showed that more than twice the number of foodservice directors (23.2%) had attended training related to food defense compared to a similar study conducted two years earlier. The proportion of operations with an employee responsible for food defense rose from 26.3% to 31.0%. Most (81.5%) operations had a crisis management plan; healthcare operations were more likely to have a well-documented plan than schools. Although planning was in place, 76.8% of operations did not conduct an audit of actual practices.

Yoon (2007) selected 12 food defense practices and asked FSDs to rate the degree to which they were implemented using a 7-point Likert type scale. The mean ratings for five measures were above 6 (6 = *most of the time*): purchase of food from reputable suppliers, making security checks of employees prior to hiring, storage and use of chemicals, assigning one person to verify and receive shipments, and inspecting packages for evidence of tampering. Clear identification of personnel, control of access to storage and production areas, and accounting for former employees' badges, uniforms, had mean ratings equal to a rating of *many times*. The practices with the lowest mean ratings were restriction of access to air and utility systems, controlling access to the foodservice facility with alarms, cameras, and physical barriers, and maintaining an updated contact list of local authorities. The mean rating of employing training about the food defense management plan was equivalent to *not very frequently*.

Regional differences. Responses were divided by USDA-RMA compliance regions. Only one item was significantly different between the six regions. Means for the statement "I want to reduce a food terrorism risk as much as possible" were higher for the Southern and Central regions, compared to the Western region. Food defense practices were more frequently performed in the Southern region compared to other regions for four practices: accounting for keys, uniforms and badges of former employees, controlling access to the foodservice facility, monitoring and physically securing the foodservice facility, and maintaining an up-to-date contact list.

Respondents from the Eastern region were m likely to have participated in food defense training. More respondents were Registered Dietitians in the Southern and Central regions. School FSDs were more likely to have been trained by a government agency and healthcare directors were more likely to be trained by professional associations.

Directors' attitudes about food defense. Yoon and Shanklin (2007b) analyzed the gap between perceptions of importance and frequency of actual practice of food defense measures among the directors. They used cluster analysis to divide the directors into two groups: a smaller gap group (SGG) and a larger gap group (LGG). The SGG was larger (n = 121) and had a smaller gap between importance and practice ratings compared to the group comprised of the remaining 69 respondents. The SGG was significantly more likely to have an employee responsible for food defense and to have a food defense management plan. That group had a much higher proportion of directors who had attended training about food defense compared to the larger gap group (13.2% vs. 1.4%). Higher percentages of director in hospitals (80%) and long-term care facilities (70%) placed in the SGG, with only 43% of school FSDS placing in that group.

The groups differed in their responses to the statement "Our operation is well-secured against any type of food biosecurity hazard/threat" in that the SGG disagreed significantly more strongly than the LGG (p <.001). This group also disagreed significantly more strongly than the LGG to the statements "Our operation does not need a food biosecurity management plan because the operation is not at risk for tampering or other malicious criminal or terrorist actions" (p = 0.02) and "the managers and supervisors know exactly what to do if our operation receives a food biosecurity threat" (p <.001) (Yoon & Shanklin, 2007b, p. 17).

Commercial Foodservice Operations

Managers of commercial operations were surveyed in two recent regional studies. Olds (2010) modified the survey instrument developed by Yoon and Shanklin (2007) and used it to assess food defense practices in a national sample of managers of private country clubs in Kansas, Iowa, Nebraska, and Missouri. The sample of country club managers interviewed by Olds (2010) was predominantly male. Olds also conducted onsite observations and interviews at 25 private country clubs. The most frequent practices at the country clubs were those related to chemical use and storage, food handling, and employee management. As found in the studies of food defense in schools and healthcare facilities, utility security and facility security were among the weakest areas. The majority of club managers did not consider their club at risk for acts of intentional food contamination, nor did they have written disaster management plans.

The club managers identified cost as the primary barrier to implementing food defense, as was the case in one study of school FSDs (Story et al., 2007). Apathy, staff resistance and lack of need were also cited as barriers. Olds recommended that risk perceptions be explored in future research about food defense practices. He compared the odds of any individual being a victim of a terrorist attack to the odds of being struck by lightning. He reasoned that because

country clubs with swimming pools and golf courses find it feasible to have procedures to prevent injuries from lightning strikes, they could also find it feasible to implement procedures to prevent injuries from intentional food contamination.

Xirasagar, Kanwat, Smith et al. (2010) surveyed one manager or owner from a sample of 926 restaurants in South Carolina. Half of the restaurants represented in the survey were casual dining, and 22% were fast food restaurants. Chemical storage, an area that proved to be strong in schools and healthcare, was the weakest area for restaurants, with only 27.2% of managers reporting chemicals were kept in locked storage. An equally small percentage of restaurants (27.3%) reported making criminal background checks of new hires.

South Carolina restaurant managers reported that their operations frequently engaged in most of the practices in the survey. For 21 of the 32 practices, 75% or more of restaurants reported performing them. The practices performed by fewer than 75% of the restaurants were: employees wear ID badges/uniforms (65%); hourly staff were trained to look for food tampering (66%); hourly staff were trained in food safety beyond state minimum requirements (73.7%); verification of the ID of delivery personnel (58%); self-service area monitored by security camera (71.5%); security cameras in food preparation and/or storage areas (38.9%); policies to prevent deliberate food tampering (61.2%); and guests not allowed to take photographs of the back of the house (72.4%). This survey was more recent than the surveys of schools and healthcare facilities.

The strengths with chemical storage and employee management differed from the results found with country clubs (Olds, 2010). These results may be due to the different geographical regions, differences in perceived risk of intentional food contamination in each industry, or could be influenced by the different methodologies, survey vs. onsite visit. The higher degree of food

defense practiced by restaurant operators could reflect a growing awareness of the risk of intentional food contamination, could reflect a greater perception of risk of intentional food contamination held by restaurant operators, or could be a result related to geographic location. A small percentage (3.1%, *n* = 29) of respondents either suspected or had experience with confirmed incidents of food tampering. The surveys of foodservice directors in healthcare and schools did not ask that question. Most of the restaurant managers surveyed were male and the majority of school and healthcare foodservice directors were female; it's possible that men and women perceive the risk of intentional food contamination differently.

Attitudes Toward Bioterrorism

Threat Appraisal

Yoon (2007) used Protection Motivation Theory to assess the threat appraisal, coping appraisal, and motivation and intention of foodservice directors regarding food defense. Threat appraisal was measured using statements to assess perception of severity, vulnerability, and fear that foodservice directors perceived related to intentional food contamination. Mean scores for measures of fear were higher than those for severity, but both were above six on a 7-point Likert scale (7 = *strongly agree*). Mean scores for vulnerability were lower, ranging between 3.31 and 5.57. The lowest value was in response to the statement "It is likely that someone will attack my operation". Healthcare and school FSDs responded similarly to all items, but differed significantly in their agreement to the statement "If someone intentionally contaminates food in my operation it will take years for my operation to recover from the attack", with schools perceiving higher severity.

Coping appraisal involved statements regarding response efficacy, response cost, self-efficacy, and operational efficacy. Both healthcare and school foodservice directors somewhat

agreed (M = 5.7 on a 7-point scale) that a food defense management plan would improve effectiveness in handling an event of intentional food contamination. School FSDs were more likely to perceive that implementing a food defense plan would be expensive and disruptive. Scores for self-efficacy showed that FSDs were somewhat in agreement that they would be able to implement a food defense plan, and somewhat disagreed that such a plan would be difficult and expensive.

Motivation and intention is the third aspect of the protection motivation theory. FSDs agreed that they wanted to protect their operations, employees, and customers from harmful events and also agreed that they wanted to avoid food terrorism in their operations. They agreed they would like to know more about food defense management plans, somewhat agreed that they were willing to participate in food defense training, and somewhat agreed that they intended to implement a food defense management plan in their operations. The means for these statements were significantly higher for healthcare directors than for school directors.

Risk Perception

Risk assessors define "risk" as the probability of exposure to a hazard times the probability that harm will occur as a result of exposure to the hazard. The discipline of risk assessment uses scientific data fit into mathematical models to predict harm that may come from different exposures to the hazard. Models can be made to predict the probability that a hazardous event will occur. Mohtadi and Murshid (2009) and Radosavljevic and Belojevic (2009) used risk assessment methods to model the probability of future terrorist events. The probability of a terrorist attack on the food supply is low, but the consequences include illness and/or death to large numbers of people should it occur. Such events engender emotional responses and visceral feelings of risk named "dread risk" (Fischhoff et al., 1978). Risk

perception is a psychological construct that seeks to explain how individuals view the risk associated with hazards. To perceive risk one must recognize a hazard and then feel likelihood that they will be exposed to the hazard and that it will cause harm. Individuals' risk perceptions often do not match risk assessors' results. For example, risk assessors have determined that flying is a safer mode of travel than driving. Yet many people fear flying because they perceive a high risk that the plane might crash. They perceive that driving is safer. After the terrorist attacks on the World Trade Center in 2001, many people increased their perception that flying was risky and chose to drive long trips instead. As a result the number of traffic deaths increased and people died who might have lived had they chosen their mode of transport based on science and not perception (Gigerenzer, 2004).

To better understand why risk perception of a hazard held by laypeople differs from the risk predicted by experts, psychologists initiated the study of risk perception. One purpose for this research was to develop a theory of risk perception that would predict the way that lay people would respond to new hazards and suggest strategies to manage the risk (Slovic et al., 1982). Initially, nine factors were hypothesized to influence risk: voluntariness of risk, immediacy of effect, individual's knowledge about risk, control over risk, newness, number of people killed at one time, whether the risk was common or dreaded, and the severity of the consequences (Fischhoff et al., 1978). Factor analysis showed that many of these were correlated and could be reduced to a two-factor model with dread risk on the horizontal axis and unknown risk on the vertical axis. A high rating on the dread risk axis incorporates lack of control, visceral feelings of dread, catastrophic potential and fatal consequence. High ratings on the unknown risk axis represent new risks that have delayed results and about which little is known. The dread risk score is more influential than the unknown score; as dread risk increases

people demand more actions to reduce the risk (Slovic, 1987). Slovic, Fischhoff, and Lichtenstein (1982) concluded that the psychometric paradigm is a reliable and quantitative method for measuring risk perception and appropriate to use for comparing risk perceptions among different groups.

The psychometric paradigm has been used to describe consumers' perceptions of food hazards (Siegrist, Keller, & Kiers, 2006). Bacterial contamination, botulism, BSE, and *salmonella* placed highest among 24 food hazards for dread risk, but did not have high scores for unknown risk. Genetically modified animals and plants showed the highest scores for unknown risk, but did not have high scores for dread risk. Given that botulinum toxin has been identified as a potential biological agent, and that *salmonella* has already been used in an attack on food, one may predict that acts of intentional contamination of food will create perceptions of dread risk. Bioterrorism has many characteristics associated with the psychometric paradigm: the hazard is relatively new and unknown, the consequences for many of the possible agents are delayed, and an event would be catastrophic for large numbers of people.

Several studies have used the psychometric paradigm to describe the perceived risk of terrorism in general. Lee, LeMyre and Krewksi (2010) surveyed 1502 Canadians in a national telephone survey about risk perceptions. Perceptions about terrorism risk were compared to those held for motor vehicle, climate change, recreational physical activity, and cell phones. Four questions derived from the psychometric paradigm of risk perception were used to assess perceived threat, perceived uncertainty, perceived control, and worry. Relative to cell phones, climate change, and motor vehicles, the respondents perceived the threat of terrorism as significantly lower. Women had higher scores than men for worry for all hazards. Perceived uncertainty was higher and perceived control was lower for terrorism compared to the other

threats. High scores for perception of control were associated with lower levels of worry, except for terrorism. Respondents who reported the highest perceived control were likely to have higher scores for worry. The authors reported surprise that personal feelings of control over the risk of terrorism were not protective, but unfavorable.

Perception of the risk of terrorism was assessed in two studies by asking "what is the probability/percent chance of being hurt in a terrorist attack?" (Blum, 2011; Fischhoff, Gonzalez, Small & Lerner, 2003). Blum (2011) compared measures of risk perception of future terrorism and their association with negative or violent prior life experiences. He found that individuals who had been victims of violent events in the past had perceptions of higher risk of terrorism compared to those with no violent life experience. Blum also found that, as the memory of the September 11, 2001 attacks became more distant, that perceptions of risk of future terrorism events decreased over a three year period.

Location has been related to the perception of risk from terrorism. Woods, Ten Eyck, Kaplowitz, and Shlapentokh (2008) discovered that respondents who lived within 5 miles of a potential terrorist targets in Michigan (major city, nuclear power plant, the state capital building, and a major chemical company) perceived a higher likelihood of a terrorist attack in their community in the next 12 months than those living more than 5 miles away. The relationship was stronger for women than for men and stronger for those at lower incomes. Estimates of the likelihood of a terrorist attack in the state or in the nation were not influenced by location. In November 2001 a national survey revealed that Americans living within 100 miles of the World Trade Center reported a higher probability they would be hurt in a terror attack than those who lived in other parts of the country (Fischhoff et al., 2003).

The studies reported above have described the risk perception of terrorism in heterogeneous populations, but have not attempted to use risk perception theory to predict the actions that individuals or groups will take to mitigate the risk. One exception is a study by Turvey, Onyango, Cuite, and Hallman (2010) that predicted consumer's response, and the economic impact, to the perceived risk of contamination of a food that was very important to them. A national sample of more than 1000 subjects was asked 16 questions that assessed elements of the psychometric paradigm (dread, lack of control, amount of knowledge of the hazard, newness, severity, immediacy of harmful effects, number of people affected). Respondents were grouped into three categories based on cluster analysis of their responses. Respondents in the three categories ("optimist", "cautious" and 'fearful") differed in their responses about their anticipated consumption of a favorite food product should there be deliberate contamination of the food by a terrorist group. The optimist group showed the least anticipated reduction in consumption and the fearful group the most reduction. Fearfulness decreased as income and level of education increased. Women were more fearful of a terrorist attack than men, which fit a consistent pattern in risk perception studies.

In summary, the psychometric paradigm has been a useful tool for assessing risk perception toward terrorism in general and food terrorism in particular. The paradigm presents a way to quantify risk perception in a reliable manner. Most studies using the paradigm were designed to describe risk perception or to compare perceived risk among various hazards. Although seminal works about the psychometric paradigm suggest its use to predict the response of lay people to a hazard, and to suggest strategies for risk management, little research having those goals has been published.

CHAPTER THREE. METHODOLOGY

This study used a mixed methods approach with two phases of data collection. Phase One used a multisite case study design with the school district as the unit of analysis. An embedded approach was used, where data from interviews, observations, and document reviews were included within each unit of analysis. In Phase Two, the link to an internet administered survey was emailed to the school food authority (SFA) or the FSD in all public school districts in seven states: Montana, Wyoming, North Dakota, South Dakota, Minnesota, Iowa, and Wisconsin. The Institutional Review Board of the Office of Responsible Research at Iowa State University approved both phases of the study. Phase One underwent a full review; Phase Two was granted exemption from full review (Appendix A).

Phase One: Multisite Case Study

Sample

A convenience sample of five school districts from the USDA-RMA Northern Compliance Region was included in the study. School districts were recruited for maximum variation of student enrollment (small, with fewer than 2,500 students; medium-sized (MS) districts with 2,500 to 7,500 students; large districts with more than 7,500 students; and a very large (VL) district from one of the top 200 in the United States having a district enrollment greater than 28,000); type of production system (onsite, centralized, or commissary); location (urban, suburban, or rural location); and credentials of the foodservice director. Selection included school districts from four of seven states in the Northern Region: South Dakota, Minnesota (two districts), Iowa, and Wisconsin. These states were chosen because states in the Northern region include metro, suburban and rural centers, United States border states, and could

be reached by the primary investigator within a one-day drive. The sampling frame to assure maximum variation is found in Appendix B.

A one-day site visit to each district was made to conduct a comprehensive assessment of food defense readiness. The schedule for each visit included observations of breakfast and lunch production and service. Five individuals holding four different positions within the district were interviewed at each site. Interviews were scheduled with the Food Service Director (FSD) and two foodservice production workers, a school administrator, and an individual representing an agency that would be called in the event of a crisis. In all cases, the administrator was a principal. In schools where more than two production workers were employed, an attempt was made to interview both the newest and most long-term employee. Four school districts were recruited from professional contacts of the author (Appendix C). One director was recruited by emailing a request to Major City Director members of the School Nutrition Association (SNA) listed in the association's directory for that state. The first contact was made to FSDs in four of the districts and the remaining site was recruited through the district superintendent, who arranged all remaining interviews for that site. In the remaining districts, after the director agreed to participate in the study, then the name of the appropriate school administrator was requested. Emergency response officials were recruited by the FSD or the administrator; position titles varied by district and included a city fire chief, a county coroner/EMT, two security management officials and a School Resource (police) Officer

Data Collection

Data collection was guided by three principles outlined by Yin in his book about case study research methods (2008). Creswell (2007) recommended this book as a reference for case

study research; the book is also referenced in Merriam (2009). These are: use multiple sources of evidence, create a case study database, and maintain a chain of evidence.

Multiple sources of evidence. The data collected included observations of implementation of the food defense checklist items, interviews with key stakeholders, and documents as made available by the site. A standardized, written case study protocol guided the investigation at each site with the purpose of answering these research questions (Appendix D).

- Which aspects of the *Biosecurity Checklist for School Food Service* items in sections A (Communication), B (Handling a Crisis), J (Foodservice/Food Preparation Areas), and L (Water and Ice Supply) are implemented?
- Who in the school district has the responsibility and authority to implement these?
- What are perceptions of school nutrition program stakeholders (district administrators, district FSDs, production workers, and emergency responders) as to the importance of implementing food defense practices?

Observations. Observation of two meal production and service periods was planned for each district. Food defense practices were assessed using the checklist developed jointly by Iowa State University Extension and the University of Nebraska-Lincoln (Appendix E). The checklist included 32 items divided into five categories.

Interviews. The purpose of the interviews was to obtain qualitative research data. Kvale and Brinkmann (2009) explained that qualitative data is a product of social interaction during the interview and that rigid adherence to a procedure or method may not result in optimal data. Interviewing skill and knowledge of the interview subject are needed for the interviewer to pose follow-up questions leading to a fuller understanding of the topic (Kvale & Brinkmann, 2009) .

All interviewees completed informed consent forms before being interviewed (Appendix F). An interview guide was developed for each stakeholder group based on four USDABC sections: Communication, Handling a Crisis, Foodservice/Food Preparation Areas, and Water and Ice Supply (Appendix G). Merriam (2009) recommended an interview guide be used by new researchers as a tool to provide structure until confidence is gained. A semi-structured approach, using a combination of survey questions, closed-ended questions, and open-ended questions was planned. Questions about risk perception were worded identically to items in the Phase Two survey. Each interview was audio-recorded with permission. The interview materials are found in Appendix H.

Document review. The foodservice director was asked to make available for review the food defense plan, if one was in place.

Create study data base. Yin's (2008) second identified principle for data collection is to create a case study data base. Reliability of case studies is enhanced with the use of a written protocol and development of a case study data base (Yin, 2008). The data collected for each school site was imported into NVivo® version 10.0 by QSR. Digital copies of documents, scans of completed observation checklists, interview transcripts, and receipts documenting transcription service and travel were included in the data base.

Chain of evidence. Yin (2008) proposed that the reliability of case study data is assured by a third principle: maintain a chain of evidence. All documents were coded for location and, in the case of interviews, individuals by group of stakeholder and interview item.

Data Analysis

Interview data. Digitial recordings of the interviews were transcribed by an individual with IRB training and previous experience transcribing research interviews. Open-ended

questions in the interview guides for all stakeholders were designed to get information about these themes: vulnerability of the foodservice operation, personal experiences with food tampering, barriers to food defense, importance of food defense, and communication about food defense. Reviewers were instructed to read the transcripts and identify content that reflected these themes and to identify new themes that emerged from the interview data. Two researchers with expertise in food defense identified emerging themes from the transcripts.

Transcripts from the first three site visits were reviewed in summer 2012, with each reviewer suggesting themes. Proposed themes were discussed via telephone conversation; six themes and 10 sub-themes were agreed upon. Transcripts from the final two site visits were reviewed in late fall 2012. No new themes emerged from interviews at these site visits. Wording and organization of themes and subthemes continued to be discussed by the reviewers until a list of four themes and 11 subthemes was finalized in February 2013.

Procedures outlined by Maykut and Morehouse (1994) were used to code transcript data. Maykut and Morehouse recommended that transcripts literally be cut into chunks representing "units of meaning" that could stand alone without explanation, then pasted on index cards for arrangement into larger units of meaning, or themes. NVivo® version 10.0 by QSR facilitated this process with digital technology. Interview transcripts were uploaded into the program and units of meaning highlighted. Highlighted text was coded according to subthemes and copied into individual reports for each subtheme.

Maykut and Morehouse (1994) recommended writing rules for inclusion before coding data. Rules for inclusion, i.e. statements that describe the proposed meaning represented by the theme, were developed for proposed themes and subthemes as the coding process progressed and were used to guide assignment of units of meaning to subthemes. Nvivo® reports that displayed

all units of meaning coded to each subtheme were printed and units of meaning were evaluated a second time to assure that they fit with the rules of inclusion. Rules of inclusion are shown in Appendix I.

Observation data. The *Food Defense Checklist for Retail Foodservice Operations*, developed by the extension services of Iowa State University and the University of Nebraska-Lincoln, was used to guide observation periods at each site. Because only two to three hours of observation were possible at each school, not all checklist items could be observed. For those items not actually observed, the kitchen manager or foodservice director was asked about practices. Details from the interview transcripts were also used to document checklist items. Observational data were tallied and summarized.

Phase Two: Regional Survey

Population

The survey population was all school districts in the USDA-RMA Northern Compliance Region (N = 1,531). District FSDs were the preferred representative for each school district, but due to the rural nature of several of the states in the population, not all districts had an administrator whose responsibilities were centered on the foodservice operation. The names and email addresses of districts' FSDs and/or the SFA (the person responsible within each district for administration of the Child Nutrition Program,) were requested from each of the seven state agencies which oversaw administration of the federal program. State agency directors varied in the kind and amount of information they were willing to share. When addresses for foodservice directors were not provided, the survey was sent to the SFA. In small school districts, the SFA may be a district administrator and not the individual who directs the foodservice operation. To ensure as accurate representation from school foodservice directors as possible, the survey cover

letter requested the survey be forwarded to the individual responsible for day to day direction of the district's child nutrition program. A detailed description of the process used to create the sample for each state is described in Table 3.

Table 3

Adjustments Made to Email Lists Provided by the Child Nutrition Director for each State

State	Adjustments made
IA	List of both FSDs and SFAs received. Private schools, residential facilities, and correctional facilities were removed. Only the addresses for foodservice directors were included in the sample. If no email address was available for the foodservice director, then the survey was sent to the SFA.
MN	State agency provided a list of FSDs with the SFA listed if the district did not have a foodservice director. Four directors did not have email addresses and they were omitted from the sample.
MT	The office of public instruction specified use of the directory of Montana schools published on their website. No information about SFAs or FSDs was included in guide. A search of all school websites was made for email addresses of foodservice directors, kitchen managers, head cooks and included in sample (n = 46). All others were sent to the contact email address identified for each district if it matched with the address of the superintendent or district clerk. If no contact email address was specified, then the superintendent's email address was used. Finally, the list was compared to the SNA directory of Directors. SNA member directors' email addresses were substituted for other administrators' when found.
ND	Emails for public districts' SFA were supplied by state office. This list was compared to the SNA directory of Directors. All SNA director members but one was already listed as the SFA. For this one district the SNA member was substituted for the SFA.
SD	State office supplied email addresses for foodservice directors. A small number (n = 6) of directors had no email addresses and were omitted from the sample.
WY	Survey sent to districts' FSDs or their surrogates as listed in online directory provided by the state agency.
WI	Survey sent to list of SFAs.

Survey Instrument

The survey had four sections: Risk Perception; Food Defense Planning; Current Food Defense Practices; and Demographic Information (Appendix J). The Risk Perception section of the survey assessed respondents' perceptions of the risk of food tampering and of terrorist attacks. These items were adapted with permission from surveys by Lee et al. (2010) and Turvey et al. (2010) (Appendix K). The original questions from the survey by Lee et al (2010) asked members of a general population of Canadian citizens about the threat of terrorism to their personal health, their personal control over terrorism risk, the amount of uncertainty associated with terrorism risk, and their worry about terrorism risk. These items were adapted to replace "personal health" with "your foodservice operation". The four items were then repeated with references to terrorism replacing references to food tampering. "Food tampering" is commonly used by the general public and was the term used in this study's survey and interviews rather than "intentional food contamination".

Lee et al. (2010) questioned the validity of her survey item phrased as "What level of uncertainty do you think there is, in general, about terrorism risks?" because that question had a higher percentage of *don't know* responses than other risk perception questions. For that reason, only four of five questions assessing "unknown risk" were adapted from the national survey created by Turvey, et al. (2010). That survey was used to assess risk perceptions of intentional food contamination held by a national sample of 1,000 persons in the United States.

Surveys have been developed to assess food defense implementation in schools (Story et al., 2007; Yoon, 2007; Yoon & Shanklin, 2007a, 2007b, 2007c), country clubs (Olds, 2010) , and retail establishments (Strohbehn et al., 2007; Xirasagar, Kanwat, Qu, et al., 2010). The surveys used with schools and country clubs were derived from the USDABC instrument containing 102

items. The survey used in this study included 31 items that focused on topics found to have low frequency of implementation in previous studies (Story et al., 2007; Yoon & Shanklin, 2007a, 2007b, 2007c). These topics were employee management, facility security, utility security, and communication practices and were adapted, with permission (Appendix K), from the survey used by Yoon and Shanklin (2007a). These sections of the USDABC are included in Appendix G.

The Food Defense Practices section asked respondents to rate the frequency with which 31 food defense practices were implemented in their districts. A 5- point Likert-type rating scale was used with additional options *don't know* and *not under my authority*. Questions were removed from the general food defense section if they also appeared in the facility security, utility security, or communication sections. Questions from Yoon's (2007) survey that measured more than one construct were separated into multiple items. For example "Our operation controls, monitors, and secures all access points into the foodservice facility, including all food product, food ingredient, and chemical storage areas with alarms, cameras, lock, fences, or other security hardware that meet national and local fire and safety codes" was made into three items, one that assessed control of access to the foodservice facility, one about control of access to storage areas, and one about security of chemical storage areas.

The final two sections of the survey asked about food defense planning and requested demographic information. Many of these items were adapted with permission (Appendix K) from the surveys by Yoon (2007) and Olds (2010). Response options to questions about number and types of production facilities were patterned after those used by NFSMI (2004) in a study about the prevalence of various forms of food production systems in schools.

The survey was reviewed for content validity and clarity by nine FSDs and two unit managers in Midwestern states not included in the study population. Unit managers were asked

to provide feedback because SFAs in very small districts might forward the survey to a head cook or kitchen manager. District enrollments of the reviewers were representative of the size categories specified in the sampling frame for Phase One of this study (fewer than 7,500 students, 7,500-10,000 students, 10,000-20,000 students, >20,000 students). Respondents were asked to take the survey and give feedback about the clarity and appropriateness of the survey items on a feedback form (Appendix L). Reviewers were asked to return only the feedback form; responses to the survey items were not requested. Minor modifications based on feedback were incorporated into the final survey. The survey was coded into SurveyGizmo® by the Office of Distance Education and Education Technology at Iowa State University.

Data Collection

The Institutional Review Board at Iowa State University exempted the study from full review in December, 2012. The survey was deployed January and February 2013. Personalized emails were sent out in groups by state and mailed on different days to prevent a glut of immediate responses from slowing the server and frustrating respondents. Emails were sent in the evening so that they would be available to respondents when they first opened their email in the morning. Dillman, Smythe, and Christian, (2009) reported response rates to be best when emails were received at the beginning of the work day compared to the afternoon.

An email giving prior notification of the survey was not used, as Dillman, Smyth, and Christian (2009) reported omitting this practice for internet surveys. All potential respondents, as public employees with email addresses assigned by their school districts, could be expected to have the skills needed to access the survey. The initial message explained the purpose of the survey, and included a link to the survey (Appendix M). Respondents were advised that by clicking the link to the survey they were giving their consent to participate in the study. Emails

returned as undeliverable were first checked for errors against original source, and then checked against the school district website. If no solution for the undeliverable email was found from these two checks, the school district was classified as having no data and no further messages were sent. Two mailings were sent: the initial invitation and a follow-up message one week later. After the reminder message, the directors of the child nutrition programs in each state were sent a message asking them to express support for the survey to their SFAs and FSDs. The actions of the state directors likely contributed to the high response rates of some states in this study.

A prize drawing for one $50 gift certificate per state was offered as an incentive for participation. Bosnjak and Tuten (2003) found that prize drawings increased survey completion rates for internet-administered surveys compared to pre-paid incentives. To maintain confidentiality of respondents, the prize drawing was formatted as a separate survey administered at the end of the main survey.

Statistical Analysis

Stata ®version 11.0 (StataCorp, College Station, Texas) was used to analyze the survey results. Descriptive statistics, *t* tests, chi-square tests of independence, and one way ANOVA with a Bonferroni correction, and Fisher's Exact test were used. Because of the variety of position titles reported by respondents, the 12 title options were grouped by level of authority into unit manager, district FSD, and district administrator categories. ANOVA was used to identify relationships between position title and dependent variables measuring risk perception. A *t* test was used to compare means for worry, perceived extent of risk, and personal control between terrorism and food tampering. An overall mean for the six dread risk perception measures was computed using reverse coding for two items rating perception of personal control

over terrorism and over food tampering. ANOVA was used to identify relationships between position title and reported influence over foodservice department policies and influence over school board level building security and utility security policies. Descriptive statistics were computed for demographic characteristics and categorical operational characteristics. Frequencies for food defense and crisis management activities and training were reported. Chi-square analysis was used to find relationships between categorical operational and demographic school district characteristics of school districts. School enrollments, which were grouped into 6 categories on the survey, were regrouped for the chi-square analysis into districts with enrollments ≤7,500 and 7,501 or greater.

Ratings of food defense practices were given numerical values (5= *always*, 4= *most of the time*, 3= *sometimes*, 2= *rarely*, 1= *never*). *Don't know* and *not under my authority* were coded as different missing values. Frequencies of these responses were determined but they were not included in computing means and standard deviations. The mean ratings for the 31 food defense practices were totaled and the mean determined. The overall mean ratings for each of the four categories (general food defense, utility security, facility security, communication) were determined. One negatively phrased practice, "Our district allows the foodservice production area to be used for special events by outside groups" was reverse coded when the overall mean for facility security practices was computed.

CHAPTER FOUR. RESULTS AND DISCUSSION

Phase One: Multi-site Case Study

Description of Sample

Five school districts in four states were visited between May and November 2012. Districts were recruited through the personal network of the investigator and through cold contacts with members of SNA whose contact information was included in SNA directories. The districts were chosen to match a sampling frame that assured maximum variation within the sample (Appendix A). District enrollments ranged from 2,000 to 43,000 students. One district used a central production kitchen with no onsite service and the remaining districts used combinations of conventional and commissary production systems. All foodservice operations were self-operated. Four districts had central warehouse facilities.

Five persons were interviewed at each study site: a school principal, the district FSD, two production workers, and an individual with district or community security responsibilities. These individuals (as a group referred to as "emergency responders" in this paper) included a city fire chief, a School Resource Officer, a private health /safety consultant, a security manager, and an individual who served as county coroner and EMT while also holding a full-time position as Human Resource Director in the school district. Demographics for each site are shown in Table 4.

Each site visit was conducted during a single day and included observation of breakfast and lunch production and service. Observations were made in three public middle schools, one public elementary school, one private K-12 charter school that obtained food from the central kitchen in a public school district, one central kitchen operation and one dining facility housed

Table 4

Demographics of Case Study Sites

Parameter	Site 515 small district, rural area	Site 715 MS district, suburban area	Site 315 MS district, urban area	Site 815 MS district, metropolitan area	Site 615 VL district, metropolitan area
Student enrollment[a]	2,000	5,000	7,000	9,000	43,000
Primary production system	on-site	on-site	on-site	commissary	central
Storage system	central warehouse	central warehouse	onsite	central warehouse	central warehouse
Population[b]	10,000	22,000	50,000	57,000	285,000
Credentials of FSD	Some college	Bachelor's Degree	Graduate Degree, RD	Graduate Degree, RD, SNS	Bachelor's Degree, RD
Average number of breakfasts served daily[a]	950	300	2,100	1,000	18,000
Average number of lunches served daily[a]	1,700	3,000	3,800	5,000	31,000
Approximate ADP (lunch)	77%	64.5%	56%	54%	72%
Population below poverty level	48%	6%	23%	5%	22%

Note. MS = medium size, VL = very large; RD = Registered Dietitian, SNS = School Nutrition Specialist; FSD = Foodservice Director; ADP = average daily participation. [a]Rounded to protect identity. [b]Obtained from 2010 Census; population rounded to protect district identity

in its own building on the same city block as a high school, middle school, and elementary school. This dining facility served students from K-12 and was rented during the school day from a federal agency. It was also used to serve food to 100 children who lived in a dormitory during the week so that they could attend school. Elementary and middle/high school students walked outside from their school buildings to the dining facility for their meals.

Observation Checklist Results

Current levels of implementation of food defense best practices were observed at seven production sites in five districts. Each of the five district visits began with observation of breakfast production and service. The time between breakfast and lunch service was used to observe lunch production, to conduct interviews, and to travel to other sites; these activities varied by location. Lunch service was observed at four sites. The author was given permission to independently explore four of the onsite kitchen operations. A guided tour was provided at the central production facility, a private school served by the central facility, and one onsite production facility. The *Food Defense Checklist for Retail Foodservice Operations*, developed by the extension services of Iowa State University and the University of Nebraska-Lincoln, was used to guide the observation periods at each site. The time required for interviews and travel to multiple sites to conduct interviews allowed only two to three hours of observation at each school; not all checklist items could be observed. For those items not actually observed, the kitchen manager or FSD were asked about practices. Details from the interview transcripts were also used to document checklist items.

One district had a food defense plan and a team responsible for food defense. Emergency contact information was posted in the kitchen at one site, in the custodian's work space at one site, in the binder holding the food safety plan at another site, and was not observed at three sites. One FSD explained that emergency contact information was not given to employees because they were expected to contact a unit manager in an emergency. Two sites were visited during early morning darkness and observed to be adequately lighted. Primary entrances were locked at one school, monitored at one school and unlocked at all other locations. Outside air intake equipment was fenced and locked at three locations; four others were not observed. Entrances

to receiving areas were observed unlocked and unattended at six of seven sites. Exterior entrances to production areas were observed to be unlocked in three locations. Of these, one was in the midst of a construction project; an exterior door adjacent to the kitchen was kept unlocked to allow workers access to materials stored outside.

Interior entrances to three kitchens doubled as entrances to the serving line and stood open all day while production staff were present. The unit manager for one of these (who reported receiving training about food defense) placed proofing cabinets to act as barrier to entry in passageways leading from the serving line to the production area. In one school a custodian was observed behind the serving line with his lunch tray; in two other schools delivery persons were observed to deliver milk and bread during lunch production. Other than these incidents no unauthorized persons were observed to enter any of the seven production areas.

Employees in all seven production sites had photo ID badges, but they were not worn in one of the kitchens visited. Lockers for storage of personal belongings were available to employees at three production sites; at one site production workers kept personal belongings in an office because their lockers were in a distant location; at two sites personal items were stored in the manager's office, and in one site personal items were kept in the food storage area.

All self-service bars and serving lines were monitored by foodservice employees during meal service periods. Storage areas in the central production facility and its satellite school were locked. Food storage areas in four onsite kitchens were found unlocked; the area was not observed at one site. In one school the primary researcher was challenged by a production worker when she was found exploring the food storage room. Two of the unlocked food storage areas were accessible from public areas. Chemicals used by the nutrition program were stored away from food and kept in locked cabinets or storage rooms at only one site; chemical agents

used by the foodservice program were stored away from food, but not in locked cabinets at five sites, and not observed at one site.

Qualitative Data Analysis

All but one of the 25 interviews was digitally recorded and transcribed. The digital recorder malfunctioned at the time of the interview with a production worker in the small rural school district. Notes were taken during the interview and summarized in a typed document.

Interview themes. The transcripts were reviewed to identify emerging themes, and then coded into units of data that were categorized into themes and subthemes. Four themes emerged:

- Lack of Awareness
- Lack of Concern
- Food is not Considered as a Potential Danger
- Conflicting Priorities and Expectations Influence Food Defense

A total of 247 sections were identified to be "units of meaning" as defined by Maykut and Morehouse (1994). The number of units of meaning or interview statements assigned to each subtheme is shown in Appendix N. Also shown in Appendix N is the number of units of meaning contributed by each of the stakeholder groups: principals, FSDs, emergency responders, and production workers.

Theme one: Lack of awareness. Most interviewees were not familiar with the term food defense, but when it was defined for them they acknowledged awareness of the potential for intentional contamination of food. Seven of ten production workers could identify vulnerable aspects of the foodservice operation, such as location of an unlocked storage cabinet in a public hallway or that fresh produce was more vulnerable to contamination than canned produce. Of

the 25 interviewees, six (24%) related experiences of intentional food contamination, with six of these incidents occurring in schools. The theme of Awareness was divided into three sub-themes:

- *Food defense* is an unfamiliar term, but the concept is not.
- Experience with food tampering was uncommon, but not unheard of.
- Different stakeholders perceive different areas of vulnerability.

Food defense is an unfamiliar term, but the concept is not. Principals, production workers, and emergency responders were asked if they were familiar with the concept of food defense. The question was not asked of FSDs. One principal, one responder, and five production workers indicated they had heard of the term. The five production workers represented four of the five districts that were part of Phase One. The only district where both production workers interviewed reported knowledge about food defense was the district with the smallest student enrollment. Production workers in that district had received one week of training from the state education office and food defense was included as a topic. Only the FSD with the central kitchen facility had attended training sessions on food defense issues and she had attended multiple training events.

Other administrators were not familiar with the term but expressed familiarity with the concept. One principal said, "I hadn't heard that term, I just know what you are talking about." Another said, "I'm aware of food contamination issues but I have not heard specifically 'food defense'." One principal at first indicated unfamiliarity with the term, but then remembered hearing about it through the media. Although these three principals indicated they understood the concept of food defense, as the interviews progressed, it became apparent there was

confusion with food defense and other safety issues. Two principals considered food defense as a concept related to shelter-in-place. One gave as an example,

> And we would be self-sufficient here with the food and the water that we have in the building. No one would come in and nobody would go out. So it would be important to make sure that our food supply was safe.

It was concluded that these principals interpreted food defense as a way to supply food to students in a non-food-related emergency.

One emergency responder indicated familiarity with the term food defense, and one other was aware of intentional food contamination and recognized how schools could be vulnerable. Another emergency responder who worked as a School Resource Officer and was a member of the local police force said, "I would say that I've thought about it before but not in relationship to the school and I guess to our community as a whole." A city fire chief who served as an emergency responder found intentional food contamination to be a reasonable concern for schools: "I think it's a very, very trusting society and I think it would be easy, if somebody wanted to get into a school and probably find a way to do that." Two production workers had heard of food tampering, and three were familiar with the term food defense specifically. One cook said the term "was not used in everyday language" but that she had seen or heard about it. A kitchen supervisor in the VL metropolitan district said she had heard of food defense "'Cause it's in the news. Everybody's aware of the contamination and things like that." Several food production workers confused food defense with food safety. One cook posited that food tampering could occur in the kitchen from workers with contaminated hands, "I think it could be any of us because she's got gals working with her, I've got gals working with me. Anybody could not wash their hands or whatever." Another cook associated intentional food contamination with illness caused by time and temperature abuse: "I went to a lot of classes

about poisoning, about the temperature. Not the terrorism, I don't know." When asked if she had ever received training about food defense, one worker responded, "For what to look for? Ya." Another worker responded to the question about food defense training:

> not specifically about terrorism type contamination, it's more about natural contamination. You know, cross contamination between like chicken and vegetables, you know, that kind of food tampering. But not so much about food defense if it's actually about people trying to do something to the food. I haven't had much training in that.

Food defense has been included in recent editions of the National Restaurant Association Education Foundation's ServeSafe® curriculum, expanding to one-and-a-half pages in the sixth edition (National Restaurant Association, 2012). The association of food defense with food safety could be a result of *ServeSafe*® or other food safety training.

After food defense was defined in the interviews, food production workers were able to give examples of how food tampering could occur. As one cook explained

> because basically, don't you read that if I wanted to, I could go in the freezer and sprinkle something on whatever and, I'm thinking like when you asked me the question, things that are not, you're not able to see with the eye but it would still be very toxic to you. So am I wrong in thinking . . . that we're easy?

When asked if the foodservice had one or more persons responsible for food defense one production worker offered an example of what food defense involved, "Yes. Such as dating and making sure seals are shut. Things like that, yes. We're all responsible for that and to report anything unusual."

Principals, emergency responders and FSDs were asked if they had heard of the USDA *Biosecurity Checklist for School Food Service* (USDABC). Two principals and three FSDs had knowledge of the publication. One principal had learned of the USDABC through news or professional media. Another principal had heard of the USDABC and said she was aware of the

concept, but not the term *food defense.* No emergency responders were familiar with the USDABC. Of the three FSDs familiar with the USDABC only one had a food defense plan. When asked to see the food defense plan, this FSD produced a completed USDA Biosecurity Checklist. This was the only district with a food defense plan and it was the district with the central kitchen facility.

A FSD who had previously worked in hospital administration had learned about the risk of food tampering in that setting, "I've known that it's out there. That they can access and do this through the hospitals. It became something we were concerned with." She described participating in tabletop emergency preparedness training exercises. This finding supports research by Yoon (2007) who found that foodservice operations in healthcare settings were more likely than schools to have well-documented crisis management plans.

Experience with food tampering was uncommon, but not unheard of. All participants were asked if they had experienced an incident of food tampering at work or in their personal lives. Four FSDs and two emergency responders reported experiences of food tampering, with two reporting two incidents. One emergency responder knew of an incident in her district but had not been involved. One emergency responder said that he had worked on cases involving intentional poisoning and another remembered a case where "something bad" had been added to a punch bowl at a wedding and 10 guests were sent to the hospital after consuming the punch. These incidents did not occur in schools. The incidents recalled by FSDs occurred in schools, although one of the incidents happened in a district where the director had previously worked. Four of the incidents occurring in the case schools were perpetrated by students: BB pellets were added to a batch of mashed potatoes, a used condom was placed in a container of ranch salad

dressing, urine was found on and around a salad bar, and a worm was placed on a pan of corn in the serving line.

The only incidents involving employees occurred in the VL district with the central kitchen facility. A foodservice production employee was suspected when plastic bandages were found in batches of cooked noodles on more than one occasion. The final school incident involved an "irritated" employee who knowingly performed an incomplete cleaning of a machine that had been used to process raw ground beef.

Different stakeholders are aware of different areas of vulnerability. Interviewees gave a variety of answers when asked what area of the school would be most vulnerable to attacks on the food. The nature of the responses was related to the position of the interviewee. The responses of the principals reflected their concern with protection against intruders. Three of five principals were most concerned with the security of exterior doors, one stated that the cafeteria was the most vulnerable area and one thought the food was most vulnerable in the central kitchen. FSDs saw food as most vulnerable outside of the food production areas. One FSD mentioned the serving line; two mentioned deliveries/loading dock and two of the FSDs believed the food was most vulnerable in the supply chain before it was delivered to the district.

Production workers identified vulnerabilities in their workplaces: delivery, the serving line, a large steam-jacketed kettle in the production area, and unlocked storage areas as being vulnerable. Another cook was concerned that identification badges weren't being worn by school staff. Three workers were unable to identify a vulnerable area and expressed confidence that their kitchens were safe.

These responses give insights into the concerns of the different groups of stakeholders; these could be used to develop training materials and activities addressed to specific needs of the

groups. The data suggest that training about food defense should focus on the immediate work environment when targeting production workers. Administrators may be receptive to knowledge about food defense if they are made aware of the shared goal of preventing intruders. FSDs may respond to information that helps them protect food when it is not under their direct control, such as when the food is in transit.

Theme two: Lack of concern. A strong theme that emerged from the interviewees was that food tampering or terrorism would not happen at their school or in their particular locations. Three subthemes were identified in this theme: timing of food contamination; trustworthiness of school employees; and sense that nothing bad could happen *here*. Interviewees were fairly consistent in stating any food contamination would almost certainly occur before the food arrived in the district, with some specifically identifying the vulnerability of imported food. Confidence was also expressed that coworkers and other school employees were trustworthy. This theme was grouped into three subthemes:

- Food is most vulnerable to contamination before it arrives to the site.
- Food is safe because co-workers are trustworthy.
- No one would want to attack *our* school.

Food is most vulnerable to contamination before it arrives to the site. This view was expressed by principals, FSDs and production workers. A kitchen manager stated, "It would have to be before it came to this building. Everything we have is locked." Another principal stated that there was "no risk" from foodservice or other district employees. A production worker made a similar claim,

> Attacking the food not the people? Once it's in our kitchen it would be pretty tough because you have to be authorized to be in the kitchen so it would have to be someone who is already working there. So I think [the risk] is slight.

One school administrator explained,

> We have no control from where it comes from until the time it gets to us. But for here, everybody is conscious of what goes on with the food here but before it gets to us we have no idea.

The idea that fresh produce items, especially imported produce, were most likely to be the kind of food that would be contaminated in the supply chain was repeated several times by production workers. One worker said:

> Or apples or oranges, [food tampering] could be done. If things like that really want to take out the U.S., that's how they would probably do it. Importing foods from different countries, that's how I think they would do it.

According to the psychometric paradigm, risk perception can be measured using two factors, *dread risk* and *unknown risk* (Slovic, Fischhoff, & Lichtenstein, 1982). Lack of control over a risk increases the perception of risk because uncontrollability contributes to the dread risk factor (Slovic, 1987). Principals, FSDs, and production workers expressed confidence in the protection of food once it was in their building and it was under their control. Control is perceived to be least with imported foods, making those foods seem riskiest. However, children's exposure to imported food is lower in school than in other venues because federal guidelines require that USDA-funded Child Nutrition Programs purchase domestically produced food to the "maximum extent practicable" (USDA-FNS, 2006).

Co-workers are trustworthy. Knowledge about a risk reduces the *unknown* factor of risk perception whereas "newness" of the risk makes it seem riskier (Slovic, 1987). Six of the ten

production workers expressed confidence that their coworkers, who were known to them, and with whom they interacted on a daily basis, could be trusted not to tamper with the food. One worker said, "I never thought of tampering before, you know. It's just kind of a family here. You just trust everyone." Another claimed, "I think it's pretty much safe. Not 100% but pretty much." This trust among production workers is evidenced by the way in which their personal items were kept in unlocked lockers while they were at work. Employee lockers were kept unlocked in all sites visited except for the central kitchen facility.

When employees prove to be untrustworthy, other employees may not feel comfortable to report the questionable actions that they observe. The FSD for the VL central kitchen had experienced a situation where production workers could not be relied on to report the misbehavior of another employee:

> I found out that there were at least four employees who were aware that this employee, on purpose, did not clean the machine and left raw meat in it. So that really made me aware of people will not report things because they're afraid of what will happen in the work place. There's a lot of peer pressure.

The sense of being "family" may not have applied to the central kitchen facility. One of the four production workers *not* heard to make some kind of statement showing trust in co-workers was the worker from the central production facility. Working in a central kitchen facility is more like working in a factory than in a school. Workers have no contact with the children who benefit from the meals, which may reduce the sense that the work involves serving children. Central kitchens tend to be located in very large school districts so that employees may not live in the community they serve and may feel a lack of connection to its children. Central kitchen operations have production characteristics that make them at risk for acts of intentional contamination, but the relationships among co-workers and between workers and

managers have not been discussed as risk factors. It is possible that workers in central kitchens feel differently towards their work compared to workers in school settings. This is an issue that should be addressed in future research.

All districts in this study sought to hire trustworthy employees by requiring criminal background checks on all new hires. Reliance on criminal background checks alone may not be sufficient for this purpose. As a police officer, the School Resource Officer had experience with criminal background checks that challenged the idea that this hiring procedure would assure trustworthy employees, "Some stuff slips through the cracks. Because I found out stuff about people that they [administration] weren't aware of after the fact." Reference checks and careful observation of new employees are needed for strong food defense.

The experiences of interviewees in this study provide evidence that attacks on food may be more likely from internal sources than from outsiders. A principal acknowledged that it was not unusual for security breaches to be made by individuals with ties to the district: "I can't think of a time we've had an intruder that wasn't either a student or a parent."

No one would want to attack* our *school. When asked about the risk of food tampering or terrorist attacks on food in their foodservice operations, four interviewees asserted that such things could happen in other places, but were unlike to happen "here". For instance one production worker from a MS district said, "The only time I really thought about terrorists was when I was in Mall of America, but I never really thought about food tampering or anything." A production worker from the small rural district said ". . . I always think it happens on the east coast because they're right there. They're more at risk than we would be." These interviewees perceive that only iconic locations or locations in the "east" where the attacks of September 11, 2001 occurred are vulnerable. This supports results by Fischhoff, Gonzalez, Small, & Lerner

(2003) that showed for men the perception of risk from terrorism was significantly lower for individuals living more than 100 miles from the site of the World Trade Center.

Those living in small towns or locations far from major urban areas may believe that their place is too insignificant to be a target. The county coroner from the rural district said the risk of terrorist acts was "almost none in our area. I think in the nation it's different. But I think in our area almost none." The coroner's impression was that terrorism was unlikely because of the perceived insignificance of their location on a national scale:

> Interviewer: So, [you believe, the risk of terrorism is low] out here. Because of your remoteness.
> Principal: Pretty much. Maybe a chance in [name of city] but we're so rural, I don't see it. It couldn't impact the whole country.

In contrast, the Fire Chief from a large metropolitan area disagreed that small towns were immune from terrorism:

> I always said, after 9 – 11, if a terrorist really wanted to hit the heart of the United States to a point that just instilled fear across the, absolutely, completely disrupt the nation, it's easy to separate ourselves from New York City, but to hit a couple of schools in the Midwest, and that would send an absolute, ripple, whether it was a bomb, or food stuff. They're incredibly vulnerable if they wanted to send a shock wave that would be the way to do it.

Torok & Tauxe (1997) reported that an attack on restaurants in The Dalles Oregon in 1984 was considered by the FB1 to be the only attack on food in the U.S. by a terrorist group. The Dalles, with a 2010 population of 13,620, was not a major, iconic landmark, and in fact is smaller than all but one of the cities in this study. Size and geographic location may not predict the occurrence of intentional food contamination.

Theme three: Food is not considered a potential danger. A third theme that emerged from the data is that food issues were viewed as being separate from school operations and that

those issues were the responsibility of the FSD. As a result, only one of five districts had a food related issue included in their crisis management plan. Three subthemes were identified:

- The foodservice operation is perceived as separate from school operations.
- The foodservice is responsible for food defense and the administration is responsible for security.
- Crisis management planning does not address food hazards.

The foodservice operation is perceived as separate from school operations. School foodservice operations that participate in the federal child nutrition programs are required to have independent budgets; these are separate from the school districts' general funds. Each child nutrition program is expected to be self- sufficient; revenues received from the sale of food must cover expenses, including labor. This independence can lead to a sense of autonomy and separation of the foodservice department not possible for other school district entities. As the health and safety consultant for one MS district described

> They have their own budget and operate out of it so [FSD] doesn't have to go through any hoops to get stuff. Now if I'm trying to get a head end vent on an air conditioner . . . I have to jump through hoops to get a budget and [have] more people to deal with. . . . [FSD] put a new freezer in this year. First she came to me to get capital money and I'm sitting there all our capital money is used. Well then she goes back to her own budget. So then she went and did it. There is a separation.

The security manager for the largest school district studied expressed the same idea, "Yes, 'cause generally food service is dealt with separately, they have their own budget."

The five emergency responders (a fire chief, health and safety consultant, School Resource Officer, a security manager and a county coroner) interacted with the FSDs in their districts in limited ways. In the VL metropolitan district, the emergency responder was a security manager who reported frequent meetings with the FSD. In the MS suburban district the

emergency responder was also a security manager and indicated conversations were held with the FSD about capital purchases and health and safety training. The School Resource Officer from the MS urban district admitted, "… we make a lot of small talk and joke around and stuff like that but we haven't had a lot of serious conversations about the security of the kitchen or food that's coming in." The fire chief had communicated with the MS metropolitan school district FSD one time when an unfamiliar white powder was found in packages of cheese. This situation illustrated a reactive rather than proactive stance. The county coroner and EMT from the small rural district was also the school district's Human Resources officer. She had interacted with the FSD regarding hiring and criminal background checks, but had no contact relating to her emergency responder roles.

Previous research by Yoon (2007), Yoon and Shanklin (2007a, 2007b), and Story, Sneed, Oakley, & Stretch (2007) showed that communication was an aspect of food defense infrequently implemented. They used the USDABC as the standard for food defense best practices. The practices listed under communication include establishing a relationship with local authorities regarding food biosecurity and determining which authority should be contacted in different types of food-related emergencies. In the present study administrators reported engaging in emergency planning with local authorities, but the two FSDs reporting contacts with authorities had done so only in response to an incident.

The foodservice is responsible for food defense. Administration is responsible for security. Principals considered issues involving food defense to be the purview of the FSDs and expressed confidence in their abilities. Although the principal has ultimate responsibility for building security, every student and employee is expected to do their part. To the contrary,

protection of food was seen as the sole responsibility of the foodservice operation, as illustrated by this interchange:

> Interviewer: Who's responsible for food defense in your school?
> Principal: It would be the district nutrition person and then directly in our building would be the kitchen manager.
> Interviewer: Who's responsible for building security?
> Principal: Everyone.

Each principal identified at least one member of the foodservice staff (head cook, FSD, foodservice employees) as being responsible for food defense. Two principals also included themselves as responsible, and one of these also included the custodial staff as having some responsibility. The principal of the private charter school contracted food services from the VL metropolitan district. He identified the public school district's central kitchen FSDs as responsible for food defense, but explained his school had responsibility for following the central kitchen's protocol for receiving the food.

Four of the five FSDs listed more than one individual as responsible for the HACCP safety plan. The FSD for the MS metropolitan school had a team of employees responsible for HACCP. Food defense was included under the HACCP plan for this district.

> Interviewer: Do you have a team that is responsible for food defense?
> FSD: No it's all under HACCP. That's where we put it.
> Interviewer: Have you ever addressed food defense on your HACCP team?
> FSD: As food defense, calling it food defense, probably not. I was trying to think. We probably talk more about it as HACCP. The topics that I think fall under food defense probably are just falling under general topics of HACCP.

The VL metropolitan district with the central kitchen had a team consisting of the FSD, assistant director, central kitchen manager, and quality control manager. This FSD combined HACCP and her food defense plan that was based on the USDABC. She said, "they go hand in hand". The FSD for the small rural district stated that she had ten employees responsible for HACCP—her ten kitchen managers. In the two remaining districts, both MS districts, the FSDs stated they

themselves were responsible. In the three districts where HACCP and food defense were not combined, the small rural district had no one responsible, and in the two remaining MS districts the FSDs said that they were responsible. In six of ten cases, production workers identified persons having position authority as responsible for HACCP. Three production workers viewed all the production workers as responsible and one didn't specify who was responsible. However, when production workers were asked if one or more foodservice employees was responsible for food defense (described as protecting food from food tampering) 70% (n = 7) said "we all are", or words to that effect:

> Interviewer: Do you have anybody here who's responsible for making sure nobody contaminates the food?
> Production worker: I think that's what we do. I think that's our job.

This sense of responsibility is limited by a lack of training and an incomplete understanding of what food defense entails. Production workers understood that it was important to check products for signs of tampering and to keep non-foodservice employees out of the kitchen but showed a misunderstanding of how food defense differs from food safety.

Crisis management planning does not address food threats.

Requirements and planning process. In this study "crisis management" was used to describe to any kind of planning for emergencies. The principal from the MS suburban school described crisis management planning at his school:

> I met with [name], the fire chief, and the police chief, and HAZMAT was also there. So we talked through every scenario involving the school and the city, we talked about issues with trains coming through. Issues, since we're next to an Interstate, semis turning over, [gas station] that has petroleum that could cause a problem. So we talked about every scenario we could think of, gas leaks and what we would do in the building, how we would evacuate, if we would evacuate.

When asked if the crisis management plan addressed crises involving food, the same principal responded, "so the notion of possibly doing one on food safety and food contamination, purposeful contamination would be intriguing. I never thought of that." Food defense planning was assumed to be the sole responsibility of the FSD by one principal, who trusted that it was being done in his district:

> Interviewer: Has this district implemented a written plan to address food defense?
> Principal: I'm sure we have but I'm not aware.
> Interviewer: Actually [FSD interview indicated] they haven't.
> Principal: It would surprise me if they haven't.

The on-line interactive version of the USDABC checklist lists the first step in food defense planning as creating a planning team (National Food Service Management Institute, 2007). The recommendation is to use the emergency response planning team already in operation at the school. It is recommended that the team include a custodian, school nurse, parent, and science expert (e.g. a science teacher), as well as experts from the wider community. The first checklist presented is the Communication checklist, an indication of its importance. This resource can be used to communicate to principals and emergency responders what is needed for food defense. Because no emergency responders had heard of the USDABC and only two of five principals were even vaguely aware of it, FSDs need to be encouraged to initiate the discussion.

Response to an incident is site-specific. The USDABC recommends keeping an updated emergency contact list, but in practice individual school districts had their own procedures for handling emergencies and most did not include directly calling emergency contacts. The chain of communication for reporting emergencies varied from district to district. The VL metropolitan school district had an emergency communications center to which all events were reported; this office then decided what the next step should be. Employees in that district's

central kitchen facility were not given emergency contact numbers because all incidents were to be reported to a manager.

The FSD in the MS urban district said that the appropriate contact would be influenced by whether the perpetrator was an external or internal person. The School Resource Office from that district said that if food tampering was suspected in his district:

> The response is to notify law enforcement and it will work its way up to the chain of command to work with the school administration at [school administrative center] to investigate where it happened to protect the children and to [inaudible] staff.

He went on to clarify that because he was a law enforcement officer, administration often called him before calling 911. The fire chief from the MS metropolitan district said that for emergencies 911 should be called, but acknowledged that such a call might be difficult to make if an emergency was only suspected.

> There's another piece to it that I respect and that is, if it's a situation where they're just not sure, nobody likes to have three fire trucks and two police cars showing up, there are calls where they're just not sure and they want more of a consultation. In those situations, it's perfectly fine to call a non-emergency number. You know, if they have a *relationship* [italics added] and somebody's cell phone number and say you know, we really don't think this is anything but there's just something about it.

When incidents involve children, law enforcement officials want to be involved. The fire chief imagined a scenario that would attract police to the scene:

> . . . if all of a sudden they started out with "we've got one sick kid". It's the middle of the afternoon and we have one kid puking. Pretty soon two more come in and that's weird. All of a sudden there's three more. There's six people puking? Then they start, this isn't right, they should be calling 911. Particularly when it's a school, no matter what the call, the police will always respond just because it's kids and they want to make sure there's nothing funky going on.

The principal of the private charter school stated he would contact authorities in an emergency, but relied on the judgment of the school nurse in determining if a food-related emergency were occurring. The principal of the elementary school in the small rural district would call tribal police in case of an emergency because almost all children were tribal members and not under the jurisdiction of the county or city authorities. It is evident that even in this small convenience sample of five districts the complexity of jurisdictions and spheres of authority make food defense planning a very district-specific matter.

When specific questions were asked, such as "who would you call when food tampering was suspected?", "how would you identify whether children had an illness due to contamination of the food?", or "when do you bring in external authorities and when can a food tampering incident remain internal?", the responses were often not definitive, because of the complexity of the systems. This is an indication of lack of knowledge about how their respective districts are "plugged into" community resources.

In the case of the charter school that contracted all food services from the VL metropolitan district, the foodservice employees were not school employees. The food production supervisor was accountable to both the school principal and her employer, begging the question, "who has the ultimate authority for food defense?" Although the central kitchen facility had an active food defense plan, it was designed to protect the food through delivery to the service kitchen, but it was unclear which agency was responsible from that point.

The situation is further complicated by the reliance of the charter school principal on the school nurse to identify occurrences of food related illnesses among students. Inclusion of training related to food safety or the consequences of intentional food tampering is not typical of health care provider preparation. The differences between a common viral illness and a bacterial

illness are typically the severity of the symptoms. The number of persons experiencing symptoms would also provide an indication of food related problems. If the nurse at the charter school had no contact with nurses in the public district it would delay identification of a widespread pattern of illness caused by food from the central kitchen. Without policy and procedural guidance on how to respond, those in the front lines may not have adequate knowledge, training or expertise on what to do.

Even when everyone working in a school is employed by the same entity, without planning and communication between school nurses, foodservice managers, and emergency responders, identification of a food-related illness could be delayed, resulting in severe consequences. As the principal of the MS urban district explained:

> I think you need awareness. You need a conversation of what could potentially happen. What level of alarm should be. That would be second. Three would be to get the right people in coordination with each other. That wouldn't be difficult because we have the people for other emergencies in place.

In one district elementary school children had to walk to a different building for their school meals. In this situation school principals were not able to provide oversight of the students, staff, or the facilities due to physical location and different employers. As the elementary school principal explained,

> . . . the high school and [our school] share this [site] over here; for every other principal food service is in their building. They have a lot more input into how things are locked up and who goes in and who doesn't and everything so I would say that other people in this district feel that they have more control than I do.

Theme four: Conflicting priorities and expectations influence security. School security was a high priority issue among participants of this study. School security is a key

concern for maintaining food defense, but school administrators in this study had not made than connection. Often food defense was compromised due to conflicting priorities. This theme of conflicting priorities and expectations was divided into two sub-themes:

- Security is designed to protect children, not food.
- Community expectations can impede food defense.

Goal of security is to protect children, not food. Four of the five administrators clearly identified that they were responsible for school security and the other stated that the Bureau of Indian Affairs held that responsibility. Three of the five included "everyone" as responsible for building security, recognizing that administrators alone cannot assure school security.

In all five districts, security practices and use of technology were targeted to locations where students could be found throughout the day. One of the six school buildings visited had video surveillance. Cameras were located in corridors, and in places where the exterior of the building could be monitored. Three cameras were placed in the cafeteria area, where students were present during the school day, but no cameras were in the food production or loading dock areas. The purposes of the cameras were deterrence or to provide evidence in the case of wrong doing. The camera data was not reviewed or monitored unless an event had already happened. As the principal explained:

> First of all, the cameras are more meant for after the fact. And it's meant for security and it's also, in the middle school, it's used for student issues so there is nobody monitoring the cameras until there is an incident, then they go back and look at the tape. So another way to do that is 24/7, monitor the cameras.

All school districts had policies that all exterior doors should be kept locked with the exception of a single entrance that was unlocked for all or part of the day. The restrictions on the

main entrances varied widely among the five districts, with five of the seven buildings having no restrictions on entry during the school day, except for signs indicating all visitors must check in at the office. The MS metropolitan district allowed the main entrance to be unlocked only at the beginning and end of the school day. Between times the entrance was locked and visitors used an intercom system to alert the main office and request to be buzzed in. Although security measures to prevent intruders were very tight at this school, areas necessary for food defense, such as the dry storeroom (including a chemical storage area), and the boiler room/ mechanical area were unlocked. These areas were along a hallway leading out of the cafeteria. They were accessible and not monitored by cameras or staff. The MS suburban district had an employee assigned to a check-in station who issued badges to visitors during the entire school day. However, at the back of the building exterior doors near the kitchen and in the central warehouse area were unlocked at the time of the visit. Both the principal and the health and safety consultant for this district acknowledged that this was a vulnerable area and plans were underway to tighten security in these areas.

Yet, the two foodservice operations in this study that were not attached to schools were in some ways less protected than the school buildings. The kitchen manager of the freestanding dining/production facility stated that the main entrance doors to the dining area of the facility were unlocked during the day and she had no authority to lock them. The principal of the elementary students who ate lunch in the dining facility expressed a need for restricted entry into the building:

> I think over here we have some kids who don't go to school but probably eat lunch. They'll cut class for the day, come back and eat lunch and then leave again. . . . . So right now anybody can enter that building during lunch hour. Now I think they lock it when there's not supposed to be anybody over there eating. But the rest of time from 11 to 1 for sure, it's unlocked and anyone can enter.

Other security measures followed this pattern of protecting the students, but not the food that was served to them, although in the charter school served by the VL district's central kitchen, a food defense measure also achieved a school security need. Food was delivered from the central kitchen for service to the 750 students in the private school in two unlocked rolling cabinets. The central kitchen had set a strict protocol for delivery of the cabinets:

> Principal: The protocol is there're supposed to unload what they're going to bring in outside of the door and then shut the truck, open the door and bring that in and it's all right within 10 feet of each other. So when you think about simplicity standpoint. This isn't the simplest say but it's the safety way. Unload what you're going to be bringing in, shut the truck, open the door and we're all right here. In a small space like this in terms of, here's the back end of the truck, the doors are right here, open the doors, bring your shipment in, shut the doors. Bring it down.
>
> Interviewer: So if there're two carts, is one cart left unattended briefly while the other…
>
> Principal: We'd have to ask [name] on that but I would imagine so but you gotta, for me that wouldn't concern me because now you've got it in the school. Unless somebody got into the school because people didn't do their job. That's the only time I'd be concerned.

A third example demonstrates how spending for security measures is allocated away from buildings that do not house children during the day. The central kitchen facility operated by the VL school district shared their building with two other departments and the central food and supply warehouse. Loading docks at the front of the building served the central warehouse. The area was fenced and the gate locked and deliveries had to be identified to be admitted. In contrast, the central kitchen had a receiving area on the opposite side of the building with no fence surrounding it. Although the need for better security in that area was identified, the funding for it was on hold because of security needs in school buildings. The central kitchen facility was a lower priority because no children were there. The FSD explained:

> School security is more important for students. So what we can do is monitor, keep an eye on, do labs [microbiological tests], and do the best that we can. Ultimately, when you think about it, the funding needs to go to the students in the individual schools.

In one case the need to protect students was in direct conflict with the need to protect food and water supplies. The school (MS district) with the greatest access control also had good control over access to the kitchen. Other critical areas were less protected. The doors to the kitchen were kept closed at all times, which allowed the production workers to monitor that entry. But the dry food storage area located across a hallway from these closed doors, was observed to be open and unlocked, most likely to allow convenient access. The hallway began at the cafeteria, went past kitchen and store room, past the boiler room, the head custodian's office and to the loading dock. This hallway had three critical areas for maintaining food defense located along it; none of these areas was behind locked doors. When asked why the doors from the cafeteria were not locked to limit access to the areas along the hallway, the principal explained that the hallway was one of five emergency exits. In the event of a threat to children in the cafeteria area, the children were instructed to run to safety through this hallway, or one of the other four.

Community expectations play a part. Because public schools are partially funded by local tax dollars, community stakeholders have influence over the use of school property. As taxpayers, community groups may expect the right to use school kitchens for auxiliary purposes when school is not in session. A FSD explained, "I think, overall, we're doing the best that we can as a school district given that's it's a public facility and that our buildings are used by outside organizations too." When outside groups use kitchen facilities, the potential exists for intentional and unintentional contamination of the food stored in the kitchen and storerooms. Even though groups bring their own food into the kitchen, group leaders unfamiliar with the risks may allow opportunities for food tampering to occur. Three of the five districts studied had board-level policies about the use of kitchen facilities by community groups, and one had a

department policy. In one of the MS districts with such a policy, the requirement to have a foodservice employee present did not apply during the summer months. The kitchen in one school district was used by the YMCA to feed children attending their summer youth programs: These programs were not under the oversight of the School Nutrition Program:

> Interviewer: So they'll have access to your kitchen in the summer.
> Production worker: Morning, noon, and night. So who's going to be aware, if this is run by the YMCA or something? So it's a very open door.

The FSD in the small, rural district reported that school kitchens were used for funeral wakes. Even the central kitchen in the largest district was used for non-food production uses: the FSD explained that student groups were allowed on tours.

Community values can complicate efforts to maintain food defense. In one medium size district, the FSD stated her belief that the community would be opposed to protecting food through the use of containers and packaging needed to wrap individual portions for service because of the waste that would be generated:

> Well the barrier is just ecology. Ecology and cost. So there's a cost to all the disposable items we would use and there's a huge concern for the community and the citizens in this area that we behave responsibility for the environment, so we try to be environmentally friendly and that means using the least disposable products.

Finally, the need for food defense may not fit with community's self-identity. Community members may resist changes that improve building security. As the security manager for a school in MS suburban district explained:

> It's actually been kind of a push to get this level of security to this point because we suggested it in the past, again there's financial things and that's not how we operate attitude. You know, small town and so just getting the outside door secured is a big step.

Risk Perception

All interviews included a series of 10 defined-answer items adapted from previous research on the psychometric paradigm of risk perception. Items were adapted from studies of terrorism risk by Lee, Lemyre, & Krewski (2010) and Turvey, Onyango, Cuite, & Hallman (2010). These studies included items that measured "dread risk" and "unknown risk", the two axes in the psychometric paradigm of risk perception presented by Slovic, Fischhoff, & Lichtenstein (1978). An eleventh item was dropped from the interview guide after the first data collection site because all interviewees expressed confusion about the question's meaning. The item, "What level of uncertainty do you think there is, in general, about terrorism risks?" was the question that the authors (Lee, LeMyre, & Krewski, 2010) had recommended be interpreted with caution because responses to the item on their previously administered survey showed a high proportion of *don't know* answers.

Table 5 shows the agreement to statements that contribute to unknown risk. The majority of interviewees (76%) agreed that scientists were knowledgeable about intentional food contamination but disagreed that they personally knew a lot (64%). The mean for the statement "when a food is deliberately contaminated safety inspectors can visibly see that it should not be consumed" was 1.5 indicating strong disagreement to the statement. This result suggests the inability to see contaminants contributes to unknown risk.

Measures of the other axis of the psychometric paradigm of risk perception, dread risk, are shown in Table 6. Feelings of personal control over a risk reduce dread risk perception. A low level of worry about a threat reduces dread risk; dread risk is also reduced if the threat or extent of risk is low.

Table 5

Level of Agreement with Statements Measuring "Unknown Risk" Perception of Food Tampering and Terrorist Acts by School Principals (n = 5), FSDs (n = 5), Emergency Responders (n = 5), and Production Workers (n = 10)

Measures of unknown risk	*n*	Strongly Disagree *n* (%)	Somewhat Disagree *n* (%)	Somewhat Agree *n* (%)	Strongly Agree *n* (%)	*M*[a] (*SD*)
Scientists know a lot about how terrorists could contaminate the food supply.	23	0 (0%)	4 (16%)	11 (44%)	8 (32%)	3.2 (0.7)
Food being contaminated is a new type of risk for me.	24	7 (28%)	-	7 (28%)	10 (44%)	2.8 (1.3)
I know a lot about how terrorists could contaminate the food supply.	24	7 (28%)	9 (36%)	6 (24%)	2 (8%)	2.1 (1.0)
When a food is deliberately contaminated, safety inspectors can visibly see that it should not be consumed.	25	18 (72%)	4 (16%)	1 (4%)	2 (8%)	1.5 (0.9)

[a]Rating scale: 1= *strongly disagree* , 2= *somewhat disagree*, 3= *somewhat agree*, 4=*strongly agree*.

The mean for personal control over food tampering (M = 2.4) was greater than the means for worry or extent of risk, falling between *slight* and *moderate*. The distribution of responses showed two modes with *none* and *moderate* each having 32% of the responses. A breakdown of responses by position showed that a number of FSDs and production workers reported high personal control over food tampering, but no principals indicated higher than slight control over food tampering (Figure 1). A breakdown by position showed that only those involved with the foodservice operation, the production workers and FSDs, perceived a "high" risk of food tampering (Figure 2). These results suggest that foodservice employees perceive a higher threat of food tampering than other respondents, but also feel more empowered to control the risk.

Table 6

Level of Perceived Risk, Worry, and Personal Control in Relation to Food Tampering and Terrorist Acts Against the Food Supply of School Principals (n = 5), FSDs (n = 5), Emergency Responders (n = 5), and Production Workers (n =10)

Measures of dread risk	*N*	Almost none *n* (%)	Slight *n* (%)	Moderate *n* (%)	High *n* (%)	*M*[a] (*SD*)
How much personal control do you feel you have over food tampering?	25	8 (32%)	4 (16%)	8 (32%)	5 (20%)	2.4 (1.5)
To what extent is food tampering a risk to your school foodservice operation?	24	9 (36%)	9 (36%)	4 (16%)	2 (8%)	2.0 (1.0)
How much do you worry about food tampering?	25	11 (44%)	7 (28%)	6 (24%)	1 (4%)	1.9 (0.9)
How much personal control do you feel you have over terrorism risks?	25	12 (48%)	8 (32%)	4 (16%)	1 (4%)	1.8 (0.9)
How much do you worry about terrorism risks?	25	11 (44%)	12 (48%)	1 (4%)	1 (4%)	1.7 (0.8)
To what extent is terrorism a risk to your school foodservice?	22	11 (44%)	8 (32%)	2 (8%)	1 (4%)	1.7 (0.8)

Note. *Don't know* responses were not included in analysis. [a] Rating scale: 1 = *almost none*, 2 = *slight*, 3 = *moderate*, 4 = *high*.

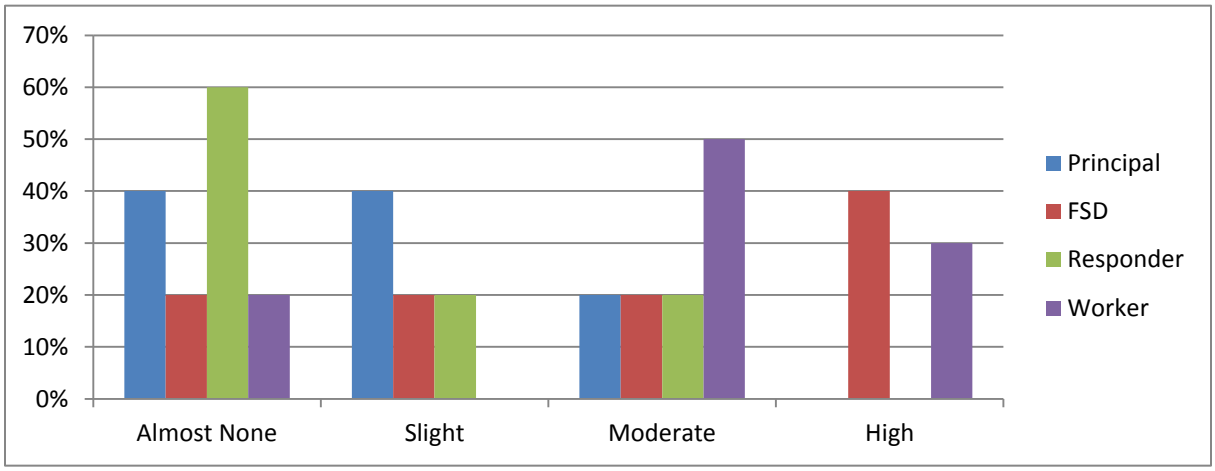

Figure 1. Level of Personal Control Over Food Tampering Perceived by School District Personnel

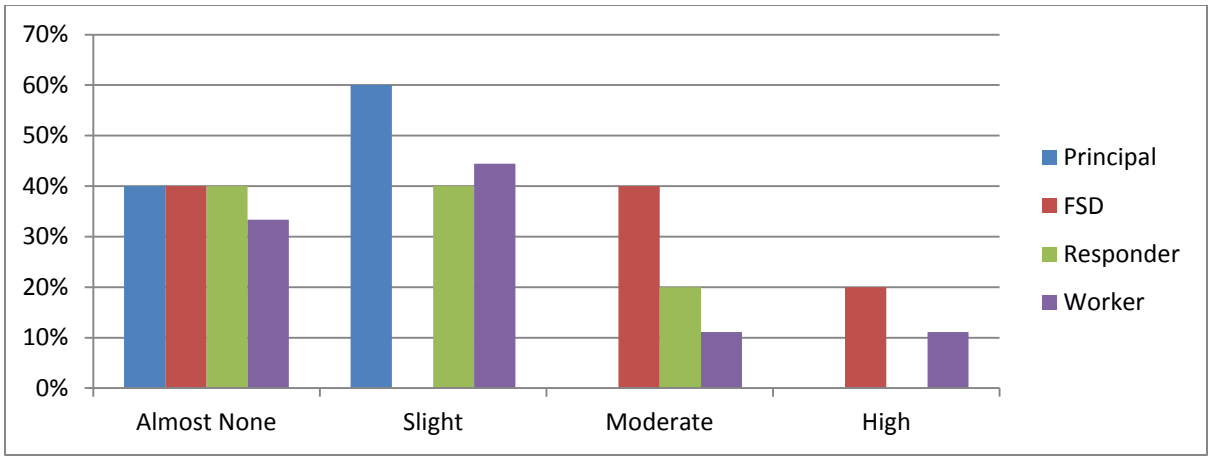

Figure 2. Level of Risk of Food Tampering Perceived by School District Personnel and Emergency Responders

Phase Two: Regional Survey

Description of Sample

An email message with a link to the survey was sent to the population of 1,531 school districts that participate in the federal Child Nutrition Program located in the seven states of the USDA Risk Management Agency's Northern Compliance Region: Montana, Wyoming, North Dakota, South Dakota, Minnesota, Iowa, and Wisconsin. Thirty messages were undeliverable and correct addresses could not be found, leaving a sample of 1,501 potential districts. A total of 556 responses was received, for a return rate of 37.0%. Surveys were excluded from the sample if they included responses to one or zero items (n = 13), resulting in 543 usable surveys (36%). Table 7 shows numbers of surveys sent, returned surveys and response rates for each state in the region.

Of the 543 usable responses, 59 (10.9%) did not indicate a state. Although state was not provided, responses were made to other survey items and included in reports and analyses of those data. All of the 59 reported their title and data from this group were included in all analyses using position as a variable. Almost all responded to the first (n = 53) and last (n = 58)

Table 7

Number and Percentage Response Rates of Survey Responses by States in USDA-RMA Northern Compliance Region

State	Sent	Rejected by district mail server	Potential responses	Responses received	Response rate
				n	%
Iowa	278	1	277	137	49.4
Wisconsin	413	19	394	116	29.4
Minnesota	324	6	318	86	27.0
South Dakota	139	0	139	81	58.3
Montana	160	2	158	29	18.4
Wyoming	46	1	45	18	40.0
North Dakota	171	1	170	17	10.0
No state reported				59	
Unusable surveys				13	
Total	1,531	30	1,501	556	37

Note. USDA-RMA = United States Department of Agriculture Risk Management Agency

in the series of risk perception questions and the data were included in results for these items. Almost all (*n* = 51, 86%) in the no-state group responded to the statement about implementing a food defense plan; of these eight (15.7%) indicated they had implemented a plan, a percentage slightly higher than the 14.5% reported by those also reporting a state. Responses from the no-state group fell in frequency for the 31 food defense practices, with 25 responses for the first of the series falling to eight responses for the last practice in the series. Only one response from the no-state group was received for all operational and demographic items, suggesting that those

who did not indicate a state were reluctant to share other district characteristics. Therefore, respondents who chose not to reveal their state were underrepresented in data about food defense practice implementation and analyses involving operational or demographic characteristics.

The majority of surveys came from the three most populous states in this seven-state sample: Iowa, Minnesota, and Wisconsin. While the greatest number of surveys received was from Iowa, the response rate from South Dakota was highest at 58.3%. The overall response rate and individual state response rates for this survey were greater than those from previous surveys of FSDs researching food defense (Yoon & Shanklin, 2007; Yoon, 2007). As part of a national study, Yoon (2007) mailed paper surveys to a sample of 50 FSDs from the population in the current study and received 16 responses; no responses were received from North Dakota, South Dakota, or Montana. Therefore findings from this study will begin to fill a gap in knowledge about food defense practices in U.S. schools, particularly in rural districts and from states that border other countries. Because almost 90% of responses (n = 481) were from individuals in the district FSD or unit manager categories, there is confidence that results of this study represent actual practices in public school districts' school meals programs.

Demographics of the survey respondents are shown in Table 8. Position title was one of the first items on the survey. Because of the diversity of sizes of the school districts in this population, respondents were given a choice of eleven titles: district foodservice director, district foodservice manager, head cook, cook manager/kitchen manager, business manager, superintendent, principal, health coordinator, curriculum coordinator, administrative assistant, foodservice supervisor, and other. Survey invitations requested that SFAs forward the survey to the individual in the district with day-to-day oversight of the school meals program. Smaller districts might use a management model in which the SFA is the superintendent or another

Table 8

Demographics of Survey Respondents (N = 543)

Demographic	*n*	%
State		
Iowa	137	25.2
Wisconsin	116	21.4
Minnesota	86	15.8
South Dakota	81	14.9
Montana	29	5.3
Wyoming	18	3.3
North Dakota	17	3.1
Not reported	59	10.9
Reported title		
District foodservice director	382	70.4
District administrator	46	8.5
Unit manager	99	18.2
Other/missing	16	3.0
Reported Certified district enrollment, 2012 academic year		
<2,500	368	67.8
2,501-5,000	50	9.2
5,001-7,500	21	3.9
7,501-10,000	10	1.8
10,001-20,000	12	2.2
>20,000	12	2.2
Not reported	70	13.4
Child Nutrition Program administration		
Self-operated	439	80.8
Outside contractor	38	7.0
Not reported	66	12.2
Type of production system		
Onsite kitchen	295	54.3
Centralized/commissary	8	1.5
Combination	179	33.0
Not reported	61	11.2
Operated central warehouse facility		
Yes	206	37.9
No	266	49.0
Not reported	71	13.1

administrator, with actual day to day operational supervisory responsibilities delegated to a production staff member. It appears this model of child nutrition program administration is prevalent because 88.6% (n = 481) of respondents selected district foodservice director, district foodservice manager, head cook, or cook manager/kitchen manager.

To streamline presentation of the data, titles were grouped into three categories based on scope of authority. District foodservice director and district foodservice manager were grouped together and labeled "district FSDs" (n = 382). Superintendent, business manager, and principal were combined and termed "district administrator" (n = 46). Cook manager/kitchen manager and head cook were combined and called "unit manager with production responsibilities" (n = 99). "Other" included 14 titles in small quantities that did not fit these categories (e.g. Principal, Adminstrative Assistant, or Curriculum Coordinator; they were included with missing values (n = 2) for position title. Only two respondents indicated title as Foodservice Supervisor. Because it was unclear whether they were district-level or unit-level managers and the number was very small, they were included in the Other category. Data from the Other category was included in all analyses except those that differentiated responses by title.

The majority (n = 368, 67.8%) of respondents were from school districts with enrollments of less than 2,500 students (Table 8). Previous studies of food defense practices conducted with multi-state populations had sampled larger school districts: the 200 largest school districts in the U.S. with central kitchen operations (Story, Sneed, Oakley, & Stretch, 2007) and districts with enrollments over 7,500 (Yoon, 2007). The current study included 34 responses (6.3%) from districts with enrollments greater than 7,500 students. Thus, the results of this study give an indication of food defense attitudes and practices from school districts of all sizes, including some with enrollments among the lowest in the nation, and allow for comparisons

between smaller and larger districts' food defense planning. In addition, the sample in this study included districts in three states with national borders: North Dakota, Montana, and Minnesota.

The majority of responses were from self-operated child nutrition programs (80.8%, *n* = 439). Eight districts reported using only a centralized production system, while the majority of respondents indicated onsite kitchens were used (54.3%, *n* = 295). Use of a central warehouse was reported by 206 districts (37.9% of all districts). As with data regarding location by state, many respondents chose not to report district enrollment (13.4%, *n* = 70), program administration (12.2%, *n* = 66), type of operation (11.2%, *n* = 61), or use of a central warehouse (13.1%, *n* = 71). It may be that respondents were fatigued by the time they reached the demographic items at the end of the survey. The item requesting the demographic of title was one of the first items in the survey and was reported on all but 16 (3%) of the usable responses. Another possible reason for missing information related to school characteristics was a reluctance to share demographic information because of the sensitivity of the topic.

The median reported daily average number of reimbursable lunches was 600, with a median of 150 breakfast meals served; indicating that the sample included many programs in small districts. The range of district sizes in this sample is illustrated in Table 9, with the smallest breakfast program serving an average of four students for breakfast and five students for lunch. Although the minimum breakfast and lunch counts seem very small, it should be noted state agency offices confirmed these low numbers did exist in some districts. Indeed, 10% of programs profiled in this study served an average of 30 or fewer breakfasts and there were five districts that reported serving an average of 25 students or less in the lunch program.

Table 9

Descriptive Statistics for Average Daily Reimbursable Meal Counts for Districts Reporting Participation

State	Lunch				Breakfast			
	n	Median	Min	Max	*n*	Median	Min	Max
Iowa	125	550	18	7,500	128	150	0	3,000
Minnesota	82	850	110	30,000	82	250	0	20,000
Montana	29	270	22	3,400	28	86	0	1,000
North Dakota	15	200	5	6,500	15	60	0	1,700
South Dakota	72	250	47	15,000	68	70	0	2,500
Wisconsin	108	813	98	13,000	103	200	0	5,500
Wyoming	18	575	155	7,000	18	125	0	2,000
Meal counts not reported	35				42			
State not reported	59				59			
Total	543				543			

By contrast, the largest program served 20,000 students for breakfast and 30,000 students for lunch. Of the 449 districts that reported daily average lunch meals, there were only five districts that reported serving more than 10,000 reimbursable lunches per day; the 95th percentile for average daily lunches served was 5,000 lunches.

The majority (54.3%, $n = 295$) of districts reported an onsite kitchen production system, defined in the survey as "all meals prepared and served in the same location". The next most frequently reported system was a combination onsite/central /commissary system, defined for

respondents as “both centralized and onsite production systems are in place in the district where food is prepared and served in one location and meals or food items in bulk are sent to other locations for service”. Eight districts reported a central production facility, defined as “a production facility that prepares food for service only at other sites; no meals or food is served onsite”. Of these, five were districts with certified enrollments below 7,500 students, two were in large districts (7,500-20,000 students) and one was in a very large district with more than 20,000 enrolled students.

Of the districts using onsite production (n = 295), 161 (55.3%) had one production kitchen, whereas 90% of districts had four or fewer kitchens (Table 10). Eight districts had more than eight onsite kitchens; the greatest number of kitchens was 27. Seven districts had more than eight combination production sites; the greatest number of production sites was 20. A comparison of mean numbers of kitchens (excluding numbers >8) showed a significantly higher mean number of kitchen sites in combination districts compared to those with onsite systems; 2.51 versus 2.13 respectively, t (467) = 2.00, p = .0458). These findings illustrate potential threat to protection of food when food is prepared at one site and transported to another as an additional food chain link, delivery of prepared food, is introduced.

A small number of responding districts (n = 8) used a central/commissary system. This group was 1.5% of the sample but provided 5.2% (30,332) of the average total 583,308 lunches reported as served by all respondents each day. These central/commissary districts had a range of service sites from one to between 12 and 48 (Table 11). Service sites include those as part of districts’ school nutrition programs and sites not part of the district programs, such as day care centers. Interestingly, the greatest number of in-district service sites (n = 65) was reported by a

district using a combination production system. Central/commissary production was used in both the smallest and the largest districts responding to the survey.

Table 10

Reported Number of Production Kitchens by Districts with Onsite and Combination Production Systems

Number of kitchens	Onsite Districts		Combination Districts	
	n	%	*n*	%
1	161	54.6	74	41.8
2	55	18.6	45	25.4
3	31	10.5	24	13.6
4	17	5.8	8	4.5
5	7	2.4	8	4.5
6	6	2.0	5	2.8
7	3	1.0	4	2.3
8	3	1.0	2	1.1
>8	8	2.7	7	4.0
Not reported	4	1.4	2	1.1
Total	295	100.0	179	100.0
M (*SD*)	2.13 (1.85)		2.51* (2.06)	

*p = .0458

Vulnerability to intentional contamination of food increases when food is transported to sites away from the place of production, which occurs with a central or commissary production system. The impact of an act of food tampering is greatest when food is prepared in bulk and then divided or portioned and sent to district or community sites for service. Of those districts using a combination production system, 25.2% sent food out for service to six or more sites within the school district (Table 11). In addition, districts of all production types (onsite, combination, and central/commissary) made use of production capacity to provide meals to clients of community agencies such as children at day care or senior citizens at congregate meal dining sites, expanding the potential impact of food contamination (Table 12).

Table 11

Enrollment Levels of School Districts According to Type of Production System Employed and Type of Service Sites Reported

	Production system					
	Onsite		Central/commissary		Combination	
	n	%[a]	*n*	%[a]	*n*	%[a]
Enrollment						
<2,500	256	86.8	3	37.5	106	59.2
2,501-5,000	15	5.1	1	12.5	34	19.0
5,001-7,500	4	1.4	1	12.5	16	8.9
7,501-10,000	3	1.0	2	25.0	5	2.8
10,001-20,000	3	1.0	0	-	9	5.0
>20,000	7	2.4	1	12.5	4	2.2
Not reported	7	2.4	0	-	5	2.8
Total	295	100.0	8	100.0	179	100.0
Number of service sites						
In-district						
1			2	25.0	30	16.8
2			1	12.5	43	24.0
3			0	-	25	14.0
4			0	-	18	10.1
5			0	-	13	7.3
6-8			1	12.5	27	15.1
9-12			2	25.0	8	4.5
12-48			2	25.0	10	5.6
65			0	-	1	<1.0
Not reported			0	-	4	10.1
Total			8	100.0	170	100.0
Non-district			*n*	%	*n*	%
1			2	25.0	45	25.1
2			0		14	7.8
3			0		6	3.4
4			1	12.5	2	1.1
5			0		3	1.7
>8			2	25.0	19	10.7
Not reported			3	37.5	90	50.3
Total			8	100.0	179	100.0

Note. Type of production system was not reported by 61 respondents.
[a] Percent shown is percent of respondents reporting type of production system

Table 12

Number of Respondents Reporting Types of Non-District Sites Served by Child Nutrition Programs Using Different Production Systems (n= 156)

	Onsite	Central	Combination
Day care centers	20	2	33
Special schools	15	2	25
Community centers	2	1	1
Preschools	9	0	11
Senior citizen dining sites	3	0	1
Private schools	3	0	5
Other public schools	4	1	1
Total	56	6	77

Table 13 presents data from three survey items pertaining to crisis management planning. Within the past decade, crisis management planning by school districts has increased in importance. Homeland Security Presidential Directive 5 published on February 28, 2003, mandated implementation of a National Incident Management System (NIMS) to establish a "single, comprehensive approach" for responding to all manner of emergencies and disasters (U.S. Department of Homeland Security, 2003). All K-12 districts that received federal grants to improve emergency preparedness were required to implement NIMS, with all others encouraged to do so. Preparing an all-hazard emergency operations plan is a key activity in implementing NIMS (U.S. Department of Homeland Security, n.d.). Planning for NIMS has increased in scope and detail since 2003. In 2010 the Department of Homeland Security and the Department of Education published the *Annex to the Government Facilities Sector-Specific Plan* defining expectations for K-12 and higher education schools in emergency management (U.S. Department

of Homeland Security & U.S. Department of Education, 2010). This report identified an all-hazards comprehensive emergency management plan as the most important risk mitigation activity for these sectors. All survey respondents in the current study were asked whether their districts had a crisis management plan. Many of the respondents, such as head cooks and kitchen managers, may have limited authority within their districts and thus are not involved in developing crisis management plans; responses were indicative of how well the plans have been communicated throughout districts, particularly to child nutrition program staff.

Table 13 shows that more than half (59.2%, $n = 226$) of all district FSDs and 78.3% ($n = 36$) of district administrators believed their districts had crisis management plans. Few district FSDs (4.2%, $n = 16$) responded their districts did not have plans; many more didn't know or chose not to answer the question (36.6%, $n = 140$). A small percentage of district FSDs (10.2%, $n = 39$) reported inclusion of a food tampering incident in their district's crisis management plan, but curiously, only one (2.2%) district administrator did so. Half (50.5%) of district FSDs did not know if food tampering was included in the plan, compared to 8.7% ($n = 4$) of district administrators. District FSDs most frequently reported they were not included in crisis management planning (41.4%, $n = 158$). Results from this regional survey support findings from a key theme identified in Phase One of this study (the qualitative phase), that the foodservice department is considered separate from other district operational units and frequently not included in emergency response planning.

Table 13

District FSDs' and Administrators' Reported Involvement in District Crisis Management Planning and Security Policy Development

	District FSDs				District Administrators[a]			
Survey item	Yes	No	Don't know	Not reported	Yes	No	Don't know	Not reported
Does your district have a crisis management plan?	226 (59.2)	16 (4.2)	104 (27.2)	36 (9.4)	36 (78.3)	2 (4.4)	0 -	8 (17.4)
Is a food tampering scenario included in the crisis management plan?	39 (10.2)	107 (28.0)	193 (50.5)	43 (11.3)	1 (2.2)	33 (71.7)	4 (8.7)	8 (17.4)
Were any school foodservice managers included in district crisis management planning?	60 (15.7)	158 (41.4)	112 (29.3)	52 (13.6)	10 (21.7)	18 (39.1)	9 (19.6)	9 (19.6)

Note. Percentages shown in parentheses. [a] Includes 32 superintendents and 14 business managers.

Table 14 shows that most, but not all, district FSDs (those with titles of District Foodservice Director [n = 322] or District Foodservice Manager [n = 60]) reported ability to influence foodservice department policies regarding building (75.1%, n = 287) and utility security (61.8%, n = 236). Influence over board level policies was significantly lower than for foodservice department policies ($p < .001$ for both utility and security policies). More district FSDs reported influence regarding changes in district (board level) building security policy than district utility security policies (44.8% compared to 34.2%; $p = .003$).

District administrators (superintendents and business managers) reported a greater frequency of influence over board level building and utility security policies. Surprisingly, they also reported a greater frequency of influence over foodservice department utility policies than reported by the district FSDs (73.9% compared to 61.8%, $p = .006$). These findings supported the span of control by district FSDs as limited to food production activities. These findings suggest that both district FSDs and district administrators may perceive that responsibility

Table 14

Reported Influence of District-Level Administrators on Policies Related to Building and Utility Security

In your position can you influence changes in:	District FSDs (N = 382)			District administrators (N = 46)		
	Yes	No	Not reported	Yes	No	Not reported
Foodservice department policy regarding building security?	287 (75.1)	53 (13.9)	42 (11.0)	33 (71.7)	4 (8.7)	9 (20.0)
District policy (board level) regarding building security?	171 (44.8)	162 (42.4)	49 (12.8)	35 (76.1)	2 (4.4)	9 (20.0)
Foodservice department policy regarding utility security?	236 (61.8)	97 (25.4)	49 (12.8)	34 (73.9)	3 (6.5)	9 (20.0)
District policy (board level) regarding utility security?	131 (34.2)	197 (51.6)	54 (14.1)	34 (74.0)	4 (8.7)	8 (17.4)

Note. Percentages shown in parentheses.

for utility security is not related to the foodservice operation. Authority over utility security policies in the foodservice operation in some school districts may be poorly defined. While district security policies may have been implemented to protect students from harm when in attendance at school, many of the measures will also protect from intentional food contamination if they are enforced at times when students are not present.

Findings from this study reflect a need for district administrators and district foodservice administrators to discuss and clarify security steps and responsibilities to protect students from physical harm from direct and indirect threats. The vision statement for the *Education Facilities Sector-Specific Plan of 2010* (U.S. Department of Homeland Security & U.S. Department of Education, 2010) included developing, practicing, and updating plans in collaboration with first responders, community members, and pertinent state and local partners. Although foodservice administrators were not specified in this list of stakeholders the vision statement specified the need for a food defense plan that includes prevention-mitigation, preparedness, response, and

recovery for all food preparation, storage, and delivery facilities. It is important that district FSDs be aware of this vision and request to be involved in planning as a means to ensure student protection. The segregation of child nutrition programs from district security planning is a concern. An integrative approach to prevention controls for all threats presented to students is needed, regardless of whether programs within the district have local, state, or federal oversight.

In this study, food defense plans were reported to be implemented in 79 (14.5%) of 543 responding districts. Of these, 26.5% (n = 21) had implemented the plan more than 5 years ago, 60.8% (n = 48) within the past 2-5 years, and 13% (n = 10) within the last year. Laws passed shortly after the terrorist acts of 9-11-01 led to new requirements and a new awareness of the need to protect the food supply. The Public Health Security and Bioterrorism Preparedness and Response Act (2002) made resources available for food defense, although most were directed toward imported foods and domestic producers, packers, and processors. Child Nutrition Program procurement rules (Child Nutrition and WIC Reauthorization Act, 2004)) require the use of domestic foods to the extent possible; exceptions are allowed for foods not produced in the United States, such as bananas. Thus, there are some controls inherent in the program as part of food procurement.

The Child Nutrition and WIC Reauthorization Act (2004) required school nutrition programs to adopt a hazard analysis and critical control point (HACCP) approach to food safety. Although food defense is not explicitly included as part of HACCP, the fundamental step of identification of physical, biological, and chemical hazards to food does invite inclusion of action steps to thwart intentional food sabotage. Existing food defense plans were reported to have been updated within the last year in 40.5% (n = 32) of the 79 districts. The small percent of districts acknowledging the presence of a food defense plan, even one embedded within a district

food safety HACCP plan or a district crisis management plan, is a concern. However, while it is possible food defense controls are woven into the district's HACCP plan, findings from this study suggest further training is needed within districts to allow for full integration of action steps to mitigate all types of threats.

A test of independence using Fisher's Exact Test showed that frequency of implementation of a food defense plan did not differ between states ($n = 477$, $p = .804$). Location, in a state that shared a border with Canada, also showed no relation to reported implementation of a food defense plan X^2 (1, $n = 477$) = .586, $p = .444$). School districts in border states were not more likely to have food defense plans than those in states in the interior United States (Table 15).

Chi-squared test of independence were performed to examine where relationships existed between operational and demographic variables and implementation of a food defense plan (Table 15). Although large enrollments mean larger numbers of students might be affected by a food tampering incident, districts with enrollment >7,500 students were not more likely to implement a food defense plan ($p = .887$). Transportation of food between production and service sites may potentially introduce opportunities for food tampering, but districts using a central kitchen or a combination onsite/commissary production system had no difference in frequency of implementation of a food defense plan compared to districts using an onsite production system ($p = .135$). Use of a central warehouse system where large quantitites of food are held also introduces opportunities for food tampering, but school districts having a central warehouse were not more likely to have a food defense plan ($p = .897$). Finally, FSDs who reported influence on district-level building security or utility policies were not more likely to

Table 15

Reported percentage of districts implementing a Food Defense Plan by Reported Characteristics of School District Foodservice Operations

Variable	food defense plan, %	no food defense plan, %	*N*	*df*	X^2	*p*
District located in a border state (Minnesota, North Dakota, or Montana)	16.9	83.1	477	1	.5861	.444
District enrollment >7,500 students	15.5	84.9	468	1	.0202	.887
Use of central or commissary production system	18.0	82.0	475	1	2.2291	.135
Operation of a central warehouse facility	14.8	85.2	466	1	.0167	.897
District FSD involved in district crisis management planning	36.7	63.3	298	1	18.1334	<.001
District crisis management plan reported to include a food tampering scenario	45.1	54.9	213	1	28.825	<.001
District FSD received training about food defense	31.3	68.7	335	1	20.347	<.001
District FSD reported influence on district building security policies	17.3	82.7	328	1	.3095	.578
District FSD reported influence on district utility policies	17.2	82.8	451	1	.1064	.744

Note. A total of 79 respondents reported having a food defense plan. *Don't know* responses were not included in analysis. $p < .05$ denotes a statistically significant relationship between variables

implement a food defense plan ($p = .578$ and $p = .744$, respectively). These results suggest that districts in which food tampering would affect the largest number of children do not have a greater frequency of implementing a food defense plan compared to counterpart districts.

Reports of food defense plan implementation were more likely when the FSD reported involvement in district crisis management planning ($p <.001$), and when the crisis management

plan included a food tampering scenario (p <.001). The communication between FSD, administrators, and emergency responders required during the planning processes may reduce barriers to food defense planning. Alternately, FSDs concerned about food defense may ask to be involved in broader risk management activities.

Finally, food defense plan implementation was more likely if the district FSD reported having received training about food defense (p <.001). This result suggests that an increase in food defense training may lead to implementation of food defense plans by more districts. Characteristics of successful training programs are a topic for future research.

Each respondent was asked to rate level of agreement to the statement "I plan to develop and implement a food defense plan in my foodservice operation." The results, by reported title, are shown in Table 16. District FSDs reported a mean of 3.0 (*somewhat agree*) on a 4-point Likert scale with 4 = *strongly agree*, compared to district administrators' reported mean of 2.6 (between *disagree* and *somewhat agree*), suggesting greater awareness for foodservice administration about the need for such a plan. Unit managers, who are likely to have less responsibility for policy planning, had a lower mean than that of FSDs, but greater than levels of agreement by district administrators.

This survey was implemented in the middle of the 2012-2013 school year, during a time when SFAs were adjusting to major changes in regulations resulting from the Healthy Hunger-free Kids Act of 2010. Enthusiasm for a new initiative may have been low, contributing to the results. These results suggest that district administrators are less likely to initiate food defense planning than are FSDs, supporting a theme found in Phase One that foodservice operations appear to be a "silo" entity within district operations and anything pertaining to foodservice is directly handled by FSDs. Yoon (2007) included this item in her survey of FSDs from districts

with >7,500 students and found a mean between *somewhat agree* and *agree* (*M* = 5.44 on a 7-point scale). Her study did not report the number of respondents who already had a food defense plan and it is unclear whether those who had a plan responded to the statement.

Table 16

Levels of Agreement to the Statement "I will develop and implement a food defense management plan in my operation." by Reported Title of Survey Respondents (n =527)

Title	Strongly agree	Agree	Agree somewhat	Disagree	Strongly disagree	Not reported[a]	*M*[b] (*SD*)
District FSDs (*n* = 382)	3 (<1.0)	50 (13.1)	156 (40.8)	42 (11.0)	3 (<1.0)	128 (33.5)	3.03 (0.68)
District administrators (*n*= 46)	0 (-)	4 (8.7)	17 (37.0)	12 (26.1)	3 (6.5)	10 (21.7)	2.61 (0.80)
Unit managers (*n*= 99)	2 (2.0)	11 (11.1)	30 (30.3)	21 (21.1)	1 (1.0)	34 (34.4)	2.87 (0.82)

Note: Two respondents did not report a title and 14 respondents reported a title not corresponding to these catergories; their responses are not included. Percentages shown in parentheses. [a] Not included in computing the mean. [b]Rating scale: 1 = *strongly disagree*, 2 = *disagree*, 3 = *agree somewhat*, 4 = *agree*, 5 = *strongly agree*.

Risk Perception

Slovic's (1987) psychometric paradigm for risk perception consisted of four quadrants centered on two factors: *unknown risk* and *dread risk*. Table 17 shows responses to four items measuring unknown risk. The internal consistency of these items, as measured by Cronbach's alpha, was low (α=.1806), indicating these items may not be an effective measure of this construct (Table 17). Alpha values were not reported in the study from which the items were adapted (Lee, Lemyre, & Krewski, 2010).

Table 17

Frequencies of Level of Agreement to Statements Measuring "Unknown Risk" Perception of Food Tampering and Terrorist Acts by Survey Respondents (N=543)

Measures of unknown risk	Strongly disagree	Some-what disagree	Some-what agree	Strongly agree	Don't know[a]	Not Reported	*M*[a] (*SD*)
Scientists know a lot about how terrorists could contaminate the food supply	16 (2.95)	56 (10.31)	258 (47.51)	129 (23.76)	75 (13.8)	9 (1.66)	3.08 (0.73)
Food being contaminated is a new type of risk for me[b]	60 (11.05)	90 (16.57)	197 (36.28)	166 (30.57)	25 (4.6)	5 (<1.0)	2.91 (0.98)
I know a lot about how terrorists could contaminate the food supply	217 (39.96)	131 (24.13)	98 (18.05)	12 (2.21)	78 (14.4)	7 (1.29)	1.79 (0.91)
When a food is deliberately contaminated, safety inspectors can visibly see that it should not be consumed	366 (67.40)	70 (12.89)	30 (5.52)	39 (7.18)	31 (5.7)	7 (1.29)	1.49 (0.91)

Note. *Don't know* responses were not included when computing means and standard deviations. Percentages shown in parentheses. [a]Rating scale: 1 = *strongly disagree*, 2 = *somewhat disagree*, 3 = *somewhat agree*, 4 = *strongly agree*.

The small number of items also may have contributed to the low alpha value. Given these limitations, mean ratings of agreement (Table 17) for the items show strong disagreement (*M* = 1.49 on a 4-point scale) that food contaminants can be visibly detected, but some agreement that intentional food contamination is a new risk to the respondent (*M* = 2.91). There was some agreement (*M* = 3.08) that scientists know a lot about intentional contamination, but some disagreement that the respondents themselves knew a lot about the topic (*M* = 1.79). These results suggest that the inability to see that food is contaminated is the greatest contributor to unknown risk.

When results for unknown risk items were analyzed by position title, there were no significant differences between responses of district FSDs, district administrators, or unit

managers for three of the four items (Table 18). The mean for district FSDs' level of agreement to the statement "I know a lot about how terrorists could contaminate the food supply" was significantly different from that of district administrators, $F(2, 442) = 5.99$, $p = .003$).

Table 18

Comparisons of Measures of Unknown Risk of Terrorism and Food Tampering Among District Administrators, District FSDs, and Unit Managers.

Measure of unknown risk	District FSDs ($N = 382$)			District administrators ($N = 46$)			Unit managers ($N = 99$)		
	n	*M*[b]	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*
Scientists know a lot about how terrorists could contaminate the food supply	332	3.07	0.75	34	3.21	0.73	80	3.08	0.71
Food being contaminated is a new type of risk for me[a]	363	2.93	0.95	33	2.66	1.17	93	2.88	1.01
I know a lot about how terrorists could contaminate the food supply	329	1.88_a	0.89	33	1.42_a	0.75	83	1.63	0.76
When a food is deliberately contaminated, safety inspectors can visibly see that it should not be consumed	361	1.43	0.86	38	1.45	0.89	92	1.68	1.06

Note: *Don't know* responses were not used when computing mean and standard deviation.
[a] Statistically different at $p<.05$. [b]Rating scale: 1 = *strongly disagree*, 2 = *somewhat disagree*, 3 = *somewhat agree*, 4 = *strongly agree*.

Measures of the second risk perception factor, dread risk, are shown in Table 19. Nunnally recommended a minimum alpha of 0.70 for early stages of research (cited in Streiner, 2003). The six items measuring dread risk exceeded this level (α=.7508), suggesting an acceptable degree of reliability for these items for initial research. The six dread risk items were adapted from a study about risk perception by Lee, LeMyre, and Krewski (2010) with "food tampering" and "terrorism" replacing the risks of climate change, cell phones, and recreational activity specified in their study. Reverse coding was used to compute means for two items measuring perception of personal control over terrorism and food tampering because a high

value for personal control would decrease risk perception whereas a high value for worry or risk(threat) would increase overall risk perception.

Table 19

Respondents' Reported Level of Perceived Risk, Worry, and Personal Control in Relation to Food Tampering and Terrorism

Measures of dread risk	Almost none[a]	Slight	Moderate	High	Don't know[a]	No response	*M*[a] (*SD*)
To what extent is terrorism a risk to your school foodservice?	218 (40.15)	187 (34.44)	43 (7.92)	14 (2.58)	78 (14.36)	3 (<1.0)	1.68 (0.77)
To what extent is food tampering a risk to your school foodservice operation?	245 (45.12)	198 (36.46)	54 (9.94)	16 (2.95)	28 (5.16)	2 (<1.0)	1.69 (0.78)
How much do you worry about terrorism risks?	277 (51.01)	179 (32.97)	56 (10.31)	12 (2.21)	16 (2.95)	3 (<1.0)	1.62 (0.77)
How much do you worry about food tampering?	249 (45.86)	183 (33.70)	84 (15.47)	9 (1.66)	9 (1.66)	9 (1.66)	1.72 (0.79)
How much personal control do you feel you have over terrorism risks?	134 (24.68)	128 (23.68)	173 (31.86)	54 (9.94)	50 (9.21)	4 (<1.0)	2.30 (1.00)
How much personal control do you feel you have over food tampering?	53 (9.76)	109 (20.07)	240 (44.20)	122 (22.47)	18 (3.31)	1 (<1.0)	2.82 (0.90)
Overall							1.93 (0.58)

Note. Percentages are shown in parentheses. *Don't know* responses were not used when computing mean and standard deviation. [b] Reverse coding used to compute the overall mean. [a] Rating scale: 1 = *almost none*, 2 = *slight*, 3 = *moderate*, 4 = *high.*

An overall mean of 1.93 was found for the six items related to dread risk with items negatively expressed reverse coded (Table 19). Level of worry about food tampering was significantly higher than worry about terrorism (p = .046), but means for both were between

almost none and *slight*, ratings of 1 and 2 on the 4-point scale with 4 = *high*. The items assessing feelings of personal control over terrorism ($M = 2.30$) and feelings of personal control over food tampering ($M = 2.82$ had the highest mean values among the dread risk items, between *slight* and *moderate*. Because these items were worded negatively compared to the others, the higher means contribute to lower levels of dread risk.

Respondents perceived significantly more personal control over food tampering than over terrorism ($p < .001$). The means for risk of terrorism ($M = 1.68$) or food tampering ($M = 1.69$) to the operation were not significantly different ($p = .286$) and represented ratings between *almost none* and *slight*, ratings of 1 and 2 on the 4-point scale.

An analysis of variance showed that position title had significant effects on measures of dread risk (Table 20). District FSDs reported greater worry about food tampering than unit managers, $F(2, 506) = 23.58$, $p < .001$. Perceived extent of threat of food tampering was higher for district FSDs than for unit managers, $F(2, 495) = 17.98$, $p < .001$). Means for worry about terrorism and perceived extent of risk about terrorism followed the same pattern $F(2, 445) = 17.09$, $p < .001$) and $F(2, 445) = 15.93$, $p < .001$), respectively. District FSDs also had significantly higher means for worry and perceived extent of risk of both food tampering and terrorism than district administrators, $F(2, 506) = 23.58$, $p < .001$) and $F(2, 506) = 23.58$, $p < .001$, respectively. District FSDs reported greater personal control over food tampering compared to district administrators, $F(2,523) = 12.43$, $p < .001$. District FSDs had a higher mean for personal control over terrorism than district administrators, but it was not different from the mean for unit managers $F(2,520) = 3.54$, $p = .030$. These results indicate that district FSDs perceive more dread risk associated with food tampering and terrorism compared to district

administrators and unit managers, suggesting that they are in the best position to promote the cause of food defense in their districts.

Table 20

Comparisons of Measures of Dread Risk of Terrorism and Food Tampering Among District Administrators, District FSDs, and Unit Managers.

	District FSDs (n = 382)			District administrators (n= 46)			Unit managers (n = 99)		
Measure of dread risk	*n*	M^{ab}	*SD*	*n*	M^{ab}	*SD*	*n*	M^{ab}	*SD*
To what extent is terrorism a risk to your school foodservice?	330	1.81_{d}	0.80	32	1.50	0.72	86	1.31_{d}	0.56
To what extent is food tampering a risk to your school foodservice operation?	365	1.82_{d}	0.80	38	1.61	0.75	95	1.29_{d}	0.58
How much do you worry about terrorism risks?	370	1.75_{d}	0.80	43	1.23_{d}	0.48	95	1.36_{d}	0.65
How much do you worry about food tampering?	371	1.87_{d}	0.81	42	1.33_{d}	0.61	96	1.35_{d}	0.63
How much personal control do you feel you have over terrorism risks?[c]	353	2.30	0.97	39	1.97	0.96	83	2.48	1.34
How much personal control do you feel you have over food tampering?[c]	374	2.86_{d}	0.82	42	2.26_{de}	1.06	94	3.0_{e}	0.99

Note. Titles for 16 respondents did not fit these categories. [a]Rating scale: 1 = *almost none*, 2 = slight, 3 = *moderate*, 4 = *high;* [b] *Don't know* responses were not used when computing mean and standard deviation; [c] Reverse coding used to compute the overall mean for each title group. [d] Statistically different at $p < .05$. [e] Statistically different at $p < .05$.

The means for worry and risk (perceived threat) were similar to those found in a national survey of 1,502 Canadians and reported in LeMyre, Turner, Lee, and Krewski (2006) and Lee, LeMyre, and Krewski (2010). The 2006 study reported responses to three questions about the threat of terrorism. The greatest mean of the three, for responses to "to what extent do you think that terrorism is a threat to Canadians in general?" was 2.56 on a 5-point scale, representing a value between *a little* and *moderately*. Responses to "to what extent do you think terrorism is a

threat to you and your family?" and "to what extent do you currently worry about terrorism in Canada?" were lower, having means of 1.80 and 1.87, respectively, indicating a response between *not at all* and *a little*. The 2010 study reported responses about perceived threat, perceived control, and worry having respective means of 1.77 (threat), 1.43 (control), and 1.92 (worry) using the same 4-point scale presented in the current study. All represent values between *slight* and *none at all*. They compared these means with those of ratings for threat, personal control, and worry about motor vehicle use, climate change, recreational physical activity, and cell phones. Compared to these results, the means for the perceived threat of terrorism and food tampering in the current study were lower than Canadians' perceptions of threats posed by motor vehicles and climate change, and the same as the threat from recreational physical activity. The extent of worry about terrorism in the Lee et al. study was the same as worry about recreational physical activity and lower than worry about climate change or use of motor vehicles. In Lee et al. (2010), Canadians perceived greater personal control over motor vehicles, and surprisingly, over climate change compared to terrorism. Strangely, perceived control over recreational physical activity was not significantly different from perceived control over terrorism. Generalizing Lee's results to the present study suggests that measures of dread risk for terrorism and food tampering are similar to those for recreational physical activity, and motor vehicle use, which are common and accepted activities. This finding suggests there is a need for increased awareness among those with responsibility for ensuring the safety of food in child nutrition programs.

The timing of data collection in relation to violent events may have influenced risk perceptions of respondents in both the current study and Lee et al (2010). The data for the study by Lee et al. (2010) was collected in 2004, when the effects of the 9-11-01 attacks and the

bombing of the London Underground in March 2004 were recent, but before the terrorist attack on trains in Madrid in 2005. At the time of that survey, terrorist attacks in developed nations may have been perceived as novel and unlikely to happen again. The data for the current study were collected at a time when no attacks on the U.S. or Europe had occurred for many years (the Boston City Marathon bombings of 2013 occurred just after the survey data was collected). Respondents' concerns may have turned toward other risks, especially considering that the 2012 shooting of 26 elementary school teachers and children in Newtown, Connecticut occurred just weeks before this survey was deployed. District administrators turned their attention to restricting intruders from their schools and reviewed school crisis management plans with their staff. Although the Newtown event heightened the security awareness of school staff, the horror of it may have caused food tampering risk to be perceived as less of a concern.

Lee et al. (2010) had a nationally representative sample that was 75% urban as defined by LeMyre et al. (2006) compared to the regional and rural population of the current study. Canada's major urban centers are located farther east than the central U.S. population in the current study and geographic location may have influenced risk perceptions. Fischoff, Gonzalez, Small, and Lerner (2003) found that the perceived risk of terrorism was decreased as distance from New York City increased; the results of the present study could be viewed as supporting those results.

Implementation of Food Defense Best Practices

Food defense practices were grouped into four categories on the survey instrument (Table 21). The categories' overall means were general food defense (3.97), utility security (2.76), facility security (3.87, with one negatively phrased item reverse coded), and communication (3.30). The overall means for general food defense, facility security, and communication

represented responses between *sometimes* = 3 and *most of the time* = 4 on the 5-point scale with 5= *always*, whereas the overall mean for utility security represented a frequency between *rarely* and *sometimes*. Cronbach's alpha for three of the four categories (general food defense, $\alpha = .72$; facility security, $\alpha = .76$; and communication, $\alpha=.87$ indicated acceptable reliability. The facility security category had one reverse-coded item; reverse coding was used to compute alpha. The alpha for utility security was .60 suggesting less reliability for this category.

Of particular interest are those items with the highest and lowest mean levels for frequency of practice. More than half of the 31 listed food defense practices (n = 16, 52%) had reported means greater than 4.0, indicating the practice was implemented at least *most of the time*. These results suggest that many food defense practices have become "mainstream" or routine, such as restricting access to the kitchen or keeping exterior doors locked. Only six practices (19.4%) were reported as implemented less than *some of the time.* Two of these practice statements began "our district . . ." and could be considered the responsibility of the school district: "our district follows a policy that all delivery trucks on the premises be locked when not being loaded or unloaded" and "our district performs criminal background checks on current employees at specified intervals" whereas the remaining four would typically be considered responsibility of the foodservice operation. These findings again illustrate the theme of separateness of the child nutrition program within the district.

Of the total 31 practices, seven had a mean rating greater than 4.5 on the 5-point scale (5 = *always)*, indicating that the practice was very widespread in districts. Two of these practices were reported as under district authority, including the practice with the highest mean frequency of implementation (M = 4.82): performing criminal background checks on all newly hired foodservice employees.

Table 21

Frequency of Implementation of Food Defense Practices Reported by School Districts

General food defense practices (α = .72)	*n*	*M*[a]	*SD*
Our employees inspect food packages prior to use for evidence of tampering. (Examples of evidence are a broken seal or discoloration of food inside a package).	503	4.70	0.62
A foodservice employee receives all food deliveries.	506	4.57	0.75
Our district performs criminal background checks on all newly hired foodservice employees.	464	4.82	0.75
Our district performs criminal background checks on current employees at specified intervals.	317	2.30	1.56
Our foodservice employees have been trained about detecting food tampering.	457	3.53	1.40
Our foodservice employees wear photo ID badges while at work.	488	2.56	1.73
Foodservice employees wear aprons or uniforms that are unique and not easily duplicated.	496	3.30	1.67
Our district keeps track of keys provided to employees.	476	4.63	0.79
Our district keeps track of identification badges provided to employees.	400	3.39	1.73
Our foodservice operation restricts visitor access to the food storage areas.	501	4.23	1.11
Our foodservice operation restricts visitor access to the food production areas.	502	4.19	1.07
Our foodservice employees are trained to use chemicals properly to prevent food contamination.	499	4.73	0.72
Overall category	510	3.97[a]	0.62

Table 21, continued.

Utility security (α = .60)	*n*	*M*[a]	*SD*
Our district restricts access to the central controls for utilities.	346	4.38	1.00
Our district has procedures to follow if they suspect utility sources have been compromised.	230	4.13	1.23
Our foodservice operation periodically monitors drains and water lines in food production areas for possible tampering	337	2.54	1.50
Overall category	407	2.76	1.42
Facility Security Practices (α = .76)	*n*	*M*[a]	*SD*
Our district follows a policy that all delivery trucks on the premises be locked when not being loaded or unloaded.	295	2.39	1.65
Our district controls access points into the foodservice facility with security hardware (e.g. cameras).	460	3.52	1.65
Our operation controls access to food products by unauthorized individuals.	484	4.09	1.20
Our foodservice operation controls access to all chemical storage by unauthorized individuals.	449	4.02	1.24
Our foodservice employees monitor food production areas to prevent someone from intentionally contaminating food during preparation.	489	4.63	0.71
Outside entrances to the foodservice operation are kept secure.	483	4.34	.98
Outside refrigeration/storage units are kept secure.	377	4.65	0.83
Our district allows the foodservice production area to be used for special events by outside groups.[c]	489	3.14[c]	1.20
Our district requires a foodservice staff member be present when the foodservice production area is used by outside groups.	416	3.62	1.46
Overall category	498	3.87	0.66

Table 21, cont.

Communication practices (α = .87)	*n*	*M* [a]	*SD*
Foodservice staff knows what to do in the event of a food tampering incident.	445	4.06	1.09
A list of suppliers' contact information is readily available to foodservice staff.	475	4.22	1.18
Expectations about food defense are included when negotiating contracts with vendors.	342	3.28	1.53
The FSD (or person in charge of daily foodservice operations) communicates with district administrators about food safety issues.	478	3.53	1.40
The FSD (or person in charge of daily foodservice operations) communicates with district administrators about food defense issues.	471	3.14	1.51
The FSD (or person in charge of daily foodservice operations) communicates with community resource officers (including emergency responders) about food safety issues.	438	2.38	1.48
The FSD (or person in charge of daily foodservice operations) communicates with community resource officers (including emergency responders) about food defense issues.	430	2.24	1.45
Overall category	491	3.30	1.08

[a] Rating scale: 1= *never*, 2 = *rarely*, 3 = *sometimes*, 4= *most of the time*, 5= *always*.
[b] *Don't know* and *not under my authority* responses were not used when computing mean and standard deviation. [c]Reverse coding used to compute the overall mean.

The other district-controlled practice with a high frequency rating was "accounting for keys provided to employees" ($M = 4.63$). The five other practices with means greater than 4.5 but reported as under authority of the foodservice department were: assigning foodservice personnel to receive deliveries ($M = 4.57$), training employees to use chemicals properly to prevent food contamination ($M = 4.73$), monitoring food production areas ($M = 4.6$), securing outside

refrigeration/storage units (M = 4.65), and inspecting packages for evidence of tampering (M = 4.70).

These results support the findings by Yoon (2007) who reported mean ratings greater than 6.1 on a 7-point scale (indicating an average response between *most of the time* and *always*) for four items: inspection of packages for evidence of tampering, chemical storage and safe handling, background security checks for new hires, and requiring an authorized person to receive all foodservice orders. The first phase of the current study found that school foodservice production workers associated *food defense* with checking packages for signs of tampering. Food safety training lessons have traditionally included inspection of food packaging as part of the content related to receiving practices, which is likely reflected in these results.

The high frequency of implementation of district policies requiring criminal background checks of newly hired employees and accountability for keys issued suggested a strong commitment to security practices that safeguard students and resources; district administrators may not understand that the practices serve the dual purpose of keeping food safe from intentional contamination. Interestingly, district policy to perform criminal background checks on current employees at specified intervals had the next-to-lowest rating of all 31 practices (M = 2.30) between *rarely* and *sometimes*. The Department of Education for most states requires that criminal background checks be made of all new employees, but state policies do not require criminal background checks after point of hire. Given that most of the districts in this study are small and rural, with all policing activity published in the local newspaper, administrators may perceive that criminal background checks on known employees are unnecessary. This may also explain why the requirement to wear ID badges had among the lowest frequency of practice (M = 2.56).

Food defense practices related to chemical use and storage were also the most frequently implemented practices in Yoon and Shanklin's (2007a) study of school FSDs in the state of Kansas. Secure storage of chemicals and employee training about chemical use (combined) was ranked second in frequency of 12 defensive practices in Yoon's (2007) national survey of FSDs in large districts (>7,500 students). Storage and handling of chemicals is included in food safety training programs commonly used in school foodservice operations, but the focus has traditionally been to prevent accidental addition of chemicals to food. Instruction about safe handling of chemicals should be expanded to include the importance of monitoring inventory of chemical supplies and reconciling departmental use with product on hand. A recent food defense planning guide published by USDA (2012) elaborated on safe chemical use and storage for food defense, recommending that access to chemical storage areas be restricted, and monthly inventories be conducted and reviewed for unusual usage or loss of the chemicals.

At the other end of the frequency of practice scale were six items with mean scores below 3.0 on the 5-point scale, placing them between *sometimes* and *rarely* implemented. These items showed a greater distribution of answers than those having higher means, with a range of standard deviations from 1.45 to 1.74. Unlike the items with reported highest frequency of practice, that were concentrated in the general food defense and facility security categories, one or two of the measures practiced least frequently was found in each of the four categories. The mean for "our district follows a policy that all delivery trucks on the premises be locked when not being loaded or unloaded" was 2.39 and had a low number of responses (n = 295, 54%). The low number of responses, the low mean, and the large standard deviation (SD = 1.65) are three indicators that few districts recognize the potential for intentional contamination of food occurring even before it enters the building. Vendors "own" the food until the delivery invoice

is signed, and it is the responsibility of the driver to maintain safe chain of custody from the warehouse to entry into the school building. It is impossible to see the chain of custody, but one sign of diligence in food defense is a delivery truck that is kept locked when unattended.

The utility security category of practices had the lowest overall mean (M = 2.76) of the four categories. The practice of "our foodservice operation periodically monitors drains and water lines in food production areas for possible tampering" had a similar mean of 2.54 (337 respondents). Of the three practices in this group, two were worded as district-level practices (restricting access to central controls and having procedures to follow if compromise of utilities is suspected). Of those who responded (n = 346 and 230, respectively), there was confidence that the district-level practices were implemented most of the time (M = 4.38, 4.13, respectively) in contrast to the low frequency rating for the foodservice department action of monitoring drains (M = 2.54). This suggests the sample of school food authorities and FSDs in the current study are unsure of their authority or responsibility regarding maintaining safety of the water supply. It is a district controlled utility, but is used by all departments, including foodservice, each day.

The communication category of practices had a mean of 3.30. The two items with the highest implementation frequency in this category were "foodservice staff knows what to do in the event of a food tampering incident" (M= 4.06) and "a list of suppliers' contact information is readily available to foodservice staff" (M = 4.22). These items are examples of communication within the department, a sharing of information among the foodservice staff. Discussions with suppliers about food defense expectations were reported as less frequent (M = 3.28). The remaining four items in this category are indicators of communication that occurs between the department and school administrators, and between the department and emergency responders. These items were not included in previous research, but were added to the current study because

results from Phase One of this study suggested the foodservice operation was viewed as separate from other school district operations, which might imply a lack of communication about food safety and food defense with key stakeholders.

One role of the foodservice department leader is to communicate with district stakeholders about the child nutrition program on topics related to nutrition education, safe food production, and operations. The National Food Service Management Institute (NFSMI) addresses communication roles in its publication of competencies, knowledge, and skills expected of district-level school nutrition professionals (NFSMI, n.d.). Expectations for communication with emergency responders and community officials are focused on the potential need for schools to shelter-in-place students and employees, or to provide emergency food and shelter to the community. "Networking with community disaster agencies" and having updated contact information are listed as advanced skills.

The means of reported frequency of practice in this study suggest that foodservice authorities are more likely to communicate about food safety ($M = 3.53$) than food defense ($M = 3.14$). The mean for foodservice authorities' communications with school administrators about food defense represents a frequency between *sometimes* and *most of the time*; the mean for communication with emergency responders about food defense lies between *rarely* and *sometimes*, with 10.5% of respondents indicating that they never communicate with emergency responders about food safety and 36.5% reporting they never communicate with emergency responders about food defense. This low reported frequency of communication with emergency responders may be a function of the school size or lack of the regular presence of an emergency responder. Implementation of the communication category activities described in the USDABC in school foodservice operations has consistently been an area with low frequency of

implementation in previous research (Story, Sneed, Oakley, & Stretch, 2007; Yoon & Shanklin, 2007a; Yoon, 2007). However these studies looked at larger districts with more formal communication channels and FSDs with greater education, training, and experience.

Olds (2010) adapted Yoon and Shanklin's (2007a) list of food defense practices to survey a national sample of 261 country club managers and found a group of five items pertaining to chemical use and storage had the highest mean reported frequency of practice (M = 4.35 on a 5-point scale with 5 = *all the time*). Within this group the highest mean was reported for "training employees to use chemicals properly to prevent accidental contamination of food and human exposure" (M = 4.7). Another similarity with findings from this study was the low mean reported frequency for having a policy that trucks be locked when not being loaded or unloaded (M = 2.2). These findings show that among sectors of retail foodservices (specifically schools and country clubs), there are common best practices.

Participation in Food Defense Training

Table 22 displays the percent of respondents from each state who reported some training on food defense. A total of 117 (21.5%) respondents reported attending at least one training event that included content about food defense; 354 (65.2%) reported no food defense training and 72 (13.3%) did not respond. One of the group of 117 who had been trained about food defense was trained before 2001, 11(9.4% of the 117) reported training during 2001-2004, but the majority (n = 52, 44.4% of the 117) of respondents received training between 2005 and 2009. From 2010 to the date of this survey in 2012, only 17 additional respondents were trained about food defense, indicating possible decline in interest in this topic, perhaps due to other identified needs as a result of new regulations.

Table 22

Frequency of Training about Food Defense Reported by State

	Minnesota	Wyoming	Iowa	South Dakota	Wisconsin	Montana	North Dakota	State Not Reported	Total
Training reported	28 (32.6)	5 (27.8)	37 (27.0)	18 (22.2)	22 (18.9)	5 (17.2)	1 (5.9)	1 (1.7)	117 (21.5)
Training not reported	56 (65.1)	11 (61.1)	96 (70.1)	61 (75.3)	90 (77.6)	24 (82.8)	16 (94.1)	-	354 (65.2)
No response	2 (2.3)	2 (11.1)	4 (2.9)	2 (2.5)	4 (3.5)	-	-	58 (98.3)	72 (13.3)
Total	86	18	137	81	116	29	17	59	543

Note: Percentages shown in parentheses.

Of the 117 who received training 87.2% (n = 102) were district FSDs and 12.0% (n = 14) were unit managers (Table 23). One district administrator reported food defense training and reported training on more than one occasion. A chi-square test of independence showed that those from districts with enrollments >7,500 were more likely to report food defense training $(2, 471) = 6.93$, $p = .031$. Respondents from districts with enrollments greater than or equal to 7,500 had a higher frequency of receiving food defense training.

Yoon (2007) reported that 26.4 percent of school FSDs participating in her national survey had attended training about food defense. Yoon's results showed that the USDA-RMA Northern Compliance Region had the lowest percentage (7.3%, n = 31) of FSDs trained in food defense. The present study found that 21.5% (n = 117) of respondents had been trained at least once about food defense while 5.7% (n = 31) had received training on more than one occasion, but these statistics included districts of all sizes. Yoon's study included only FSDs from districts with enrollments greater than 7,500, an audience more likely to have the resources to participate in professional development opportunities, whereas the present study included

Table 23

Frequency of Food Defense Training by Position Title

	Once		More than once		No training		Not reported	
Position title	*n*	%	*n*	%	*n*	%	*n*	%
District FSD	77	20.2	25	6.5	238	62.3	42	11.0
District Administrator	0	-	1	2.2	37	80.4	8	17.4
Unit Manager	9	9.1	5	5.1	65	65.7	20	20.2
All respondents	86	15.8	31	5.7	354	65.2	72	13.3

individuals with a variety of titles and from predominantly rural and very small school districts (enrollment less than 2,500 students). Among districts in this study reporting enrollments >7,500 students, the prevalence of food defense training was 15.4% (n = 16). These findings suggest that, despite increased training opportunities from Homeland Security and NFSMI, among others, there continued to be slight interest in the topic. Major legislation in the last decade had a strong focus on preventing childhood obesity and associated new regulations may have taken the focus away from food safety and food defense concerns. The Child Nutrition and WIC Authorization Act (2004) mandated new food safety requirements, but also required schools to implement comprehensive wellness policies. The Healthy Hunger-Free Kids Act of 2010, the most recent reauthorization legislation, mandated significant changes in the menu-planning requirements for reimbursable meals. The new regulations for the lunch program under this act, implemented in 2012, created new demands on school nutrition programs and resulted in a need for training, leaving few resources for food defense planning.

Wyoming, Iowa, and South Dakota were states with response rates above 40% that also showed a relatively high frequency of training. These results could reflect a bias that respondents with prior food defense training would be more likely to complete the survey. It is interesting to note that the prevalence of food defense training is not directly correlated with population, because less-populated states such as Wyoming and South Dakota had higher rates than the more populous states of Iowa and Wisconsin.

Wyoming and South Dakota have unique characteristics that may attract federal support for training, including food defense training. Both states have higher percentages of Native Americans (5.5% for Wyoming, 8.9% for South Dakota) than the national average of 1.2% (U.S Department of Commerce, U.S. Census Bureau, n.d.) and are the locations for five of the 20 most populous Indian reservations in the United States. (Norris, Vines, & Hoeffel, 2012). Poverty and crime rates on reservations are higher than U.S. averages in general, and are among the worst on three reservations in South Dakota and Wyoming (United States Department of the Interior, Bureau of Indian Affairs, n.d). In view of these facts, the state agencies administering child nutrition programs in Wyoming and South Dakota may emphasize food defense in the training programs they offer.

Three states in the population, Minnesota, North Dakota, and Montana, share a land border with Canada comprising 1,402 miles or 35.1% of the Canada-United States border (U.S. Department of Commerce, U.S. Census Bureau, 2012). Recently, the Department of Homeland Security reemphasized in *Northern Border Strategy,* the potential for terrorists to enter the United States as the greatest security threat associated with the northern border (U.S. Department of Homeland Security, 2012). A manual count of the grants awarded by the U.S. Department of Education for emergency planning showed that between the years of 2003 to 2010, Iowa

received the most grants (n = 12), but the border states of Montana and Minnesota were awarded the next two highest number of grants to school districts among the states in the current study's population, 11 and 8, respectively. The remaining border state from this population, North Dakota was not awarded any grants for emergency planning. The fewest number of respondents was from North Dakota (n = 17), as well as the fewest reporting food defense training (n = 1).

The lack of well-defined patterns suggests that multiple factors are involved in motivating SFAs to receive training in food defense. Those who had received training were given an open-ended question asking for details about their training. An open-ended approach was selected to elicit the widest variety of responses, but resulted in varying amounts of detail and 37 (43.0%) non-responses. The responses to this item were manually coded for the sponsor of the training session, the length of the session, and the overall topic of the session and frequencies computed from the total of 49 responses. Most responses did not include all of this information. The percentage of those not reporting a sponsor was 38.8%, with 44.9% of responses not mentioning length or topic. Those responding (n = 49) reported learning about food defense at training sessions sponsored by local (n = 6, 12.2%), state (n = 3, 6.1%), and federal agencies (n = 2, 4.1%). A variety of other sponsors was mentioned: the NFSMI (n = 3, 6.1%), colleges and universities (n = 8, 16.3%), vendors' food shows (n = 3, 6.1%), and the School Nutrition Association or its state affiliates (n = 5, 10.2%). Training about food defense was most often mentioned as part of HACCP (n = 8, 16.3%) or food safety (n = 5, 10.2%) training, but was also included as part of an emergency response planning workshops (n = 5, 10.2%) with a focus on pandemic preparedness, multi-hazard emergency planning for schools, and preparedness for natural disasters. Five (10.2%) respondents reported attending training events where food defense was the primary topic. Training was reported as one to two hours in

duration (*n* = 13, 26.5%), 4 hours or half a day (*n* = 4, 8.2%), or between one and three days (*n* = 5, 10.2%). The diversity of these results revealed that food defense training is not being directed to FSDs in an intentional way. The topic of food defense increased in each of the last three editions of the ServSafe® textbook to a length of 1-1/2 pages in the current sixth edition (National Restaurant Association, 2012); however not all school foodservice workers and administrators are required to obtain food safety training through ServSafe®. The NFSMI (2009) offers a program titled *Serving It Safe*, targeted to school employees. Group training on *Serving It Safe* must be requested through the state agency administering the school nutrition program, the USDA Regional Office, or state affiliates of the School Nutrition Association with the possibility of complete funding through NFSMI. *Serving It Safe* is also offered free of charge as an online course for individuals. The *Serving It Safe* participant manual does not include content on food defense or food tampering, however the NFSMI document library offers two streaming videos about food tampering by a disgruntled employee (NFSMI, 2012a) or intentional contamination by an intruder (NFSMI, 2012b). Although SFAs report learning about food defense at HACCP workshops, food defense is not included in the Guidance Document provided by USDA (USDA-FNS, 2005). There is a need to add food defense learning outcomes to food safety and HACCP training materials targeted to school nutrition program employees.

CHAPTER FIVE. SUMMARY AND CONCLUSIONS

This study consisted of both qualitative and quantitative phases of data collection with the purpose of describing current levels of implementation of food defense practices in school districts in one region of the United States. This chapter includes the summary of findings, conclusions, limitations of the study, and recommendations for further research.

Summary of Findings

Phase One: Multisite Case Study

A multi-site case study design included a convenience sample of five districts' Child Nutrition Programs in the states of Iowa, Minnesota, Wisconsin, and South Dakota. Sites were selected to ensure maximum variation of districts regarding: enrollment; setting (urban, rural, and suburban); production system; and FSD credentials. In each district, meal production and service were observed using a structured document based on the *Food Defense Checklist for Retail Foodservice Operations* developed by the extension services of Iowa State University and the University of Nebraska-Lincoln. Interviews were conducted with the FSD, a principal, two production workers, and an emergency responder in each district about their knowledge of food defense, practices in their district or school, and their perceptions of the risk of terrorism and food tampering. The focus of this phase was on food defense practices included in the Communication, Handling a Crisis, Foodservice/Food Preparation, and Water and Ice Supply sections of the USDABC.

Summary of observations. Seven foodservice operations were observed during the five case study visits. One central kitchen, a private school served by the central kitchen, and five onsite production facilities were observed. Food preparation was observed at five of seven facilities visited, and lunch service, but no preparation, was observed at the remaining two sites.

Breakfast service was observed in four service sites and lunch service was observed in four sites.

One district had a food defense plan and a team of employees responsible for it. Emergency contact information was posted in the kitchen at one of seven sites. The primary building entrance was locked at one site, monitored at one site, and unlocked at five sites. Unlocked exterior doors in proximity to the kitchen were observed in three sites. One custodian and two delivery persons were observed in production areas in two sites; other than that no unauthorized persons were observed in production areas.

Employees at all sites were issued photo identification badges, but they were not worn at one site. Employee lockers were observed or reported to be available at four sites, but were not being used at one site. At other sites personal belongings were kept in managers' offices or in the storeroom. All self-service bars and serving lines were monitored by foodservice employees. Storage areas were locked at two sites in the same district, were unlocked in four sites, and not observed at one site. Two of the unlocked storage areas were located in public areas. Receiving entrances were observed at all sites, with unlocked doors observed at four sites. Chemicals were stored away from food at all sites, but were in a locked cabinet in only one site.

Summary of interviews. Twenty-five interviews were conducted with district stakeholders: FSD, principal, production workers, and emergency responders. Four themes emerged from these interviews: 1) lack of awareness; 2) lack of concern; 3) food is not considered as a potential danger; and 4) conflicting priorities and expectations influence food defense.

***Awareness*.** Food defense was an unfamiliar concept among most of the stakeholder groups, but most notably among principals. Principals confused food defense with the need for food and water supplies to shelter students during an emergency, or with the need to maintain a

safe environment in the school cafeteria. Emergency responders with work-related experience involving food tampering had not transferred the threat of intentional food contamination to the school setting. Production workers often related the concept of food defense to the need to check produce and food packaging for tampering, with several production workers identifying food safety training as their introduction to the concept of food defense. Awareness of food defense was not related to size of school district or type of production system.

The four stakeholder groups each identified different areas of vulnerability to acts of intentional food contamination in their districts. Principals expressed concern for preventing entry of intruders while FSDs perceived most vulnerable areas to be outside of the production area, such as on the loading dock or at a previous point in the supply chain. Most of the production workers identified in-house operational steps outside of their control, such as serving lines, or policies and district culture regarding security measures as factors creating vulnerability to food tampering.

Lack of concern. Responses to risk perception questions indicated a general lack of concern about terrorism and food tampering, with participants expressing beliefs that attacks on the food supply would occur in large cities, at nationally recognized locations, in other geographic locations such as the "east," or at other points in the supply chain, but not in their schools. The strong "not in my back yard" belief was in contrast with actual experiences reported in the interviews. Beliefs that food is safe once under control of the foodservice operation may be unfounded given that 75% of food tampering incidents reported in Phase One interviews occurred in school foodservice operations. Four (80%)of five FSDs interviewed knew of a food tampering incident that had occurred in their districts; in spite of this only one FSD rated the level of risk of food tampering as high. In these incidents the perpetrators were

identified as students or co-workers. When students were perpetrators, incidents were handled internally and considered pranks. There is a need for training to increase the awareness of school stakeholders about vulnerability to intentional contamination of student meals with harmful substances.

Food is not considered a potential danger. Principals and FSDs interviewed had no specific procedures for dealing with food tampering; only one district had procedures for handling food in which contamination was suspected. The two emergency responders reporting work-related experiences with food tampering expressed belief that it is a reasonable concern for schools, but the other three did not, suggesting awareness of a potential danger raised only through experiences. Emergency responders did not rule out a rural location or small district as too unimportant to be the target of terrorist attacks, expressing the view that an attack in the heartland of America would achieve terrorist goals of causing nationwide fear and disruption. The success of food-related pranks initiated by students indicated districts were vulnerable to more serious attacks.

Foodservice operations were perceived by most district administrators and emergency responders as being separate from other school district operational units; with an assumption the FSD had policies to protect the food. The USDABC topics that were the focus of the current study, Communication, Handling a Crisis, and Water and Ice Supply included control steps that overlap with school district operations; thus some food defense controls extend beyond the authority of the nutrition program.

Conflicting priorities and expectations influence security. School administrators did not perceive that their goals of preventing entry of intruders, monitoring student safety in the cafeteria, or preventing theft and vandalism were helpful with food defense. The focus of school

security measures was on protecting children from harm; when children were not present, security measures were loosened. There was lack of understanding that good security practices, enforced 24 hours a day, served multiple purposes, including protection of food in the child nutrition program from intentional contamination.

Findings from this small sample size among districts in one region suggests that variation exists among school districts in organizational structure and chain of command, procedures for handling suspected food tampering, and methods for communicating information. Few districts had even a list of emergency contact names readily available. Although crisis management planning, or emergency response planning as it is called under the NIMS system, is recommended in all school districts by the U.S Department of Education and the Department of Homeland Security, food tampering was not identified as an event in existing plans of the five districts participating in Phase One.

Because public schools are partially funded by community property tax dollars, school administrators felt obligated to consider the values and desires of the community. Two districts in this phase of the study reported community groups expected to be able to use school kitchens for events not related to the child nutrition program: district policies required a foodservice employee be present, however this policy was not enforced during the summer in one of the schools where observation occurred.

Risk perception. All interviewees were asked 10 questions about their perceptions of the risks of terrorism and food tampering. Of four items measuring unknown risk, the inability to see contamination in food was the greatest contributor to risk perception. The extent of risk for food tampering and terrorism, and the extent of worry about those threats were between *almost none* and *slight*. The mean for perceived personal control over terrorism was also

between *almost none* and *slight*, but the mean for perceived control over food tampering fell between *slight* and *moderate*. Further analysis of the Phase One interview results showed that no principals or emergency responders perceived higher than *slight* personal control over food tampering and only production workers and FSDs responded with a *high* level of personal control.

Phase Two: Regional Survey

In this phase, FSDs or SFAs from 556 districts of the 1,501 contacted in northern U.S. states responded to an internet-administered survey for a response rate of 37 percent. The survey included questions about districts' operational and demographic characteristics, levels of implementation of 31 listed food defense best practices, and perceptions of risk of terrorism and food tampering.

Operational and demographic characteristics. The majority (70.4%) of respondents were district-level foodservice administrators. Most districts (67.7%) had enrollment of less than 2,500 students. An on-site production system was prevalent. A majority of districts (56.5%) reported having a crisis management plan; 9.4% of these (n = 51) included a food tampering scenario. A small percentage (15.5%) of districts reported a foodservice manager involved with crisis management planning. The majority of district foodservice administrators reported having influence over department utility and building related security policies (61.8% and 75.1%, respectively), but fewer than half reported influence over district (board-level) policy related to those topics. Few districts (14.5%) reported implementing a food defense plan. Implementation of a food defense plan was related to FSD involvement in district crisis management planning, inclusion of a food tampering scenario in the crisis management plan, and training of the FSD about food defense.

Participation in food defense training was not common; 21.6% reported training with food defense content. At least 20% of respondents from Minnesota, Wyoming, Iowa, and South Dakota reported having received training about food defense on at least one occasion. Those with training were asked to describe the training event, resulting in a very diverse array of sponsors, program lengths, and overall program topics. Most frequently, food defense was included in training about HACCP, food safety, or emergency planning. Most (n = 52 or approximately 10% of all respondents) reported training occurred between 2004 and 2009 with an additional 17 (3.3% of sample) indicated training was received after 2009.

Risk perception. Ten questions that assessed elements of risk perception, identical to those asked during interviews in Phase One, were included on the Phase Two regional survey. Survey results showed level of agreement to six statements representing dread risk was 1.97 (4-point scale; 4 = *strongly agree*). The inability to visibly see whether food had been contaminated was the predominant contributor to unknown risk. Measures of dread risk were low for both terrorism and food tampering; respondents perceived more personal control over food tampering than terrorism. District FSDs had higher scores than unit managers for worry and extent of risk and higher scores for personal control over terrorism and food tampering compared to district administrators.

Implementation of food defense practices. The overall mean for each category of food defense practices (general food defense, facility security, utility security, and communication) indicated a practice frequency between *sometimes* (3 on the 5-point scale) and *most of the time* (4 on a 5-point scale with 5 = *always)*. Of the 31 listed practices, 16 practices had mean frequencies of implementation between *most of the time* and *always* ($M > 4.0$). Of these, 13 practices were the responsibility of the foodservice operation. Those frequently practiced

general food defense practices were: inspecting packages for evidence of tampering, assigning employees to receive food deliveries, restricting access to food storage and production areas, and training employees about safe chemical use. Five facility security practices were implemented between *most of the time* and *always* including monitoring food production areas, controlling access to food production and chemical storage areas, and securing outside entrances and outside refrigeration and storage units. In the utility security category, two practices were frequently implemented with means between 4 or 5: restricting access to central utility controls, and having procedures to follow if utilities were compromised. Two communication practices were frequently implemented(M >4.0): "foodservice staff knows what to do in the event of a food tampering incident" and "a list of suppliers' contact information is readily available to foodservice staff".

Six practices (19.4%) were implemented less than *some of the time* (mean rating of < 3.0). Of these, two could be considered district responsibilities and out of the control of the foodservice operation: making criminal background checks on employees periodically after hire, and implementing a policy that all delivery trucks be locked when unattended. The practice of foodservice employees wearing photo ID badges while at work (mean of 2.6) could be considered a joint responsibility as the district must issue IDs and the FSD must enforce their use. The frequency of communication between the FSD and emergency responders for food safety and food defense matters had means of 2.4 and 2.2, respectively. Finally, the utility security item "our foodservice operation periodically monitors drains and water lines in food production areas for possible tampering" had a mean of 2.5.

Conclusions

Schools have security measures in place that could strengthen food defense, but administrators lack an understanding of the broader utility of these. The FSD is not routinely involved in discussions about school security, which prevents security resources from being used effectively to mitigate threat of intentional food contamination. Administrators and emergency responders need to be educated about the topic and encouraged to recognize their roles in maintaining food defense. Food defense must be viewed as a district-wide safety precaution, as is fire safety or building security. To keep food safe from intentional contamination, water and air supplies, chemical supplies and food storage areas throughout the school buildings must be secure during all hours of the day, even when children are not present. When school employees are empowered to challenge unauthorized visitors, their monitoring can keep areas secure; however, employees are not always present and available to monitor storage areas, loading docks, and exterior entrances.

The findings of Phase One suggest that stakeholders' beliefs about the vulnerability of their school foodservice operations to incidents of food tampering are inaccurate. Interviewees reported six incidents of food tampering in schools; five occurred in schools in the current study sample and one in a school district in which the FSD had been previously employed. Food was contaminated while it was under the control of the foodservice operation. These experiences contrasted with interview findings which indicted a belief that food was not vulnerable once it was delivered to the kitchen. Although all food tampering incidents were handled internally, food tampering by students was treated as a prank. Employees were suspected in two of the incidents. Results from the Phase Two regional survey showed that the practice of making periodic background checks of current employees was one of the least frequently implemented,

so that any criminal activity that occurred after an employee was hired would remain unknown to employers. These past food tampering incidents, although not resulting in harm, point out vulnerabilities that exist within child nutrition programs and indicate a need to for school districts to include food tampering in crisis management plans.

Results from Phase One and Phase Two of this study show current crisis management planning activities fail to identify food-related emergencies as a threat. These results suggest that an effective threat appraisal should include multiple stakeholder groups, including production workers. Because of the potential for widespread effects, there is a need for school personnel and emergency responders to agree on procedures for responding to acts of food tampering that occur in schools. Findings indicate a need to identify district level avenues of communication about food defense among stakeholders. District emergency response planning and training activities offer an opportunity to open or strengthen communication between the foodservice operation, school administration, and community emergency response teams. In situations where community expectations may conflict with food defense practices, inclusion of multiple perspectives will ensure children are protected.

Both phases of this study showed that the perception of risk of intentional food contamination was low, similar to those found in a Canadian study for cell phone use, use of a motor vehicle, and physical activity. In the current study, food tampering and terrorism were not perceived by respondents as a threat to their schools. Worry about food tampering is low and foodservice personnel reported feelings of personal control to prevent food tampering. Although the probability of food tampering causing harm to children in any one district is minute, the potential consequences could be catastrophic given that many districts prepare food for non-student populations such as child care and adult care programs; school and community

stakeholder groups must be made aware of this risk and develop action plans to reduce threat levels and respond if there is a need.

Although production workers and FSDs interviewed in Phase One identified the food supply chain and food deliveries as areas potentially vulnerable to food tampering, few controls, such as restricting access to the building via the loading dock, were observed during site visits to be in place. Survey results indicated that outside entrances were kept secure *most of the time* ($M = 4.3$ on a 5-point scale), but it was infrequent for districts to have a policy that delivery trucks be locked when unattended or for food defense expectations to be communicated with vendors ($M = 2.4$, $M = 3.3$ on a 5–point scale, respectively). Training is needed to make personnel at all points in the flow of food aware of the risk of intentional contamination of food during transit, whether arriving from a vendor or from a centralized warehouse or production kitchen.

The food tampering experiences related by six (24%) of the interviewees in Phase One suggest a need to challenge stakeholders' assertions that intentional food contamination would only happen somewhere else, that food is most vulnerable to attack before it arrives to the school district, and that co-workers are unlikely to be perpetrators of food tampering. There is a need for administrators and foodservice personnel to receive training to increase their level of awareness and concern for the threat of food tampering.

ServSafe ® and the district's HACCP-based food safety plan can prepare foodservice production workers to maintain food defense within their realms of responsibility. Inclusion of food defense practices into an existing HACCP plan will allow for integration of efforts to protect the safety of food while in district's custody and provide a communication tool with written standard operating procedures within the district. Exposure to the concept of food

defense through food safety training may explain production workers' higher awareness of the risk and their higher sense of personal control compared to district administrators and emergency responders. Districts food safety trainings (i.e. in-services) and HACCP plans should be expanded with input from all district stakeholders, to include food defense.

Food defense planning is not widespread, however at least one survey respondent from each state reported having a food defense plan. Implementation of a food defense plan was related to FSD involvement in district crisis management planning, but was not related to demographic and operational characteristics of the district. Food defense practices under the control of the foodservice operation had high rates of implementation; yet best practices that overlap with district control had low reported frequencies of implementation, thus there is a clear need to increase involvement of all district decision makers in development of food defense plans. Practices that achieved district goals of physical security and loss prevention were frequently implemented, but as noted by Phase One interviewees; these practices were not recognized as food defense measures. District administrators must be made aware of the threat of intentional food contamination and the risk of catastrophic consequences so district security measures already in place can be effectively used for food defense.

The results of this study support previous research that showed food defense practices related to use and storage of chemicals were frequently implemented and communication practices were infrequently implemented. There is a need to expand employee training about chemical use and storage to include the threat of chemicals being removed and intentionally added to food. While it is clear FSDs communicate about food safety and food defense within their departments, as demonstrated by high frequency of performance of food defense practices under department responsibility, communication about food safety and defense with stakeholders

outside of the foodservice operation appears to be less common. The ability to communicate with administrators and emergency responders about food defense issues must be recognized as an essential skill for district-level FSDs and woven into job descriptions and performance reviews. Additionally, training programs are needed to help develop these competencies.

Results from the current study suggest that food defense training is more prevalent than documented in earlier research; yet low incidence and frequency shows need for continued training for all district stakeholders. Food defense training was related to implementation of food defense plans, thus it is important to develop food defense training programs targeted to school district personnel specifically, in addition to training to others with decision making responsibility within the district. To assure that all stakeholders in school districts are informed about food defense, consistent curricula for each contingent about food defense needs to be included in trainings for superintendents, other school board policymakers, district SFAs, those in charge of school nutrition programs on a daily basis, production and transportation staff.

Limitations of the Study

Although the qualitative phase of the study was limited to five case districts, the rigor was strengthened by using methods recommended by Yin (2008), including multiple sources of evidence, creating a case study database, and maintaining a chain of evidence. The combination of written interview forms, digital recordings of interviews, and observations based on a standard food defense checklist, documenting food defense practices or lack of provided a durable body of evidence.

Case study visits were made during two 2-week periods separated by a span of 6-months, which may have led to differences in the data collected. All interviews were conducted by the primary researcher using an interview guide with structured questions, but as interviews

progressed the use of follow-up questions by the primary investigator increased. Merriam (2009) explained that it is common for interviewers to become less dependent on the interview guide as they become more comfortable with the interview process and content. Kvale and Brinkmann (2009) emphasized that "method" should not drive an interview; rather the interviewer's ability to pose questions determines the quality of interview data. Following this premise the knowledge and experience gained by the primary investigator from the first three site visits would add to the quality of the data.

Phase Two survey data were based on information reported by respondents; any self-reported data is limited by the respondents' understanding of the survey items, and the sincerity and truthfulness with which responses are made. A further limitation is that respondents represented a variety of position titles, having different degrees of knowledge, experience, and direct oversight of the foodservice operation. Survey recipients who did not hold the position of FSD were requested to forward the survey to the person responsible for day-to-day operation of the school foodservice. Even so, 58 responses were received from school district personnel not employed in the foodservice operation. In very small districts, the individual responsible for day-to-day operations may be a part-time employee with limited authority. The SFA receiving the survey may have felt more qualified than the person in charge of foodservice operations on a daily basis to answer the survey questions. Another limitation is the large number and percent of non-response or *don't know* responses for some survey items; this may be due to unit managers or others having limited knowledge about board policies or district-level procedures.

Only seven states were included in the study; thus only one region of the United States is featured. Having only 17 responses (response rate of 10%), the state of North Dakota was

underrepresented compared to the other states in the population; thus, results may not be generalizable to North Dakota school districts.

Recommendations for Further Research

This study points to a need to open avenues of communication between administrators, emergency responders, and FSDs with the purpose of achieving strong food defense within districts with the least expenditure of resources given increasing responsibilities assigned to school districts. Production workers are the main line of defense in the kitchen and storeroom settings; it is their vigilance that maintains food defense in these areas. Production workers' understanding of food defense threats and practices that mitigate these threats, as well as their level of motivation to perform food defense practices is not known. Thus, research is needed to define the knowledge, skills, and attributes needed by production workers to implement food defense practices so that qualified and reliable workers may be hired.

Central kitchen production systems use economies of scale to reduce production costs of school meals. This type of system has characteristics making it possible for an incident of food tampering to affect a large number of children during a short period of time. Production workers in central kitchens have no contact with their customers, the children, and may feel a different level of motivation to maintain food defense compared to workers in onsite kitchens who interact with children daily. Research is needed to assess employee motivations to maintain food safety and defense in this setting; particularly to assess the workplace culture and employee job satisfaction in central kitchens. A disgruntled employee working in a central kitchen has the potential to harm many students or cause widespread damage to the reputation of the child nutrition program.

The results of this study indicated that many stakeholder groups, not just child nutrition program personnel, have responsibilities in maintaining food defense or responding to a food tampering incident in a district. Principals and other administrators had limited understanding of the scope of food defense, perceiving it as a responsibility that could be assumed by the FSD alone. Food defense may be out of the control of the foodservice operation because school nurses may have responsibility to identify student illnesses resulting from intentional food contamination and custodians hold the responsibility for assuring that food production and food and chemical storage areas are monitored during cleaning procedures after foodservice personnel have left for the day. Transportation directors may coordinate distribution of prepared food to satellite units. Thus, research is needed to determine the levels of awareness and importance that district administrators, school nurses, and other noncertified staff hold regarding food defense practices, and to determine how food defense practices are included in job preparation training materials.

Emergency responders, principals, FSDs, and production workers in this study demonstrated knowledge and expertise that contributes to a safe school environment for students. Research funds could support pilot projects that develop and assess the effectiveness of various communication tools to increase awareness of food defense among broader populations of district stakeholders.

In 2012 USDA published a guidance document entitled *Creating Your School Food Defense Plan* that included four components with checklists. Research is needed to assess whether the document is being used and the frequency with which the checklist items are performed. Current levels of food defense implementation data are needed on a state by state basis with involvement of state child nutrition agencies to assure representation of schools of all

sizes, organizational structures, and geographic locations. FSDs' knowledge of and participation in school multi-hazard emergency response planning should be explored.

Finally, methods for qualitative studies should continue to be the subject of research to further define best practices for this approach. Although the recommendation is to prevent "method" from dominating interviews (Kvale & Brinkmann, 2009) it may prove valuable to analyze for differences the data obtained from interviews separated by a long time span.

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APPENDIX A
IRB Approval

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Resear
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 3/15/2012

To: Carol Klitzke
N6177 Fox St
Onalaska, WI 54650

CC: Dr. Catherine H Strohbehn
31 MacKay Hall

From: Office for Responsible Research

Title: Food Defense Practices of School Districts in Northern States: A Multiple-site Case Study

IRB ID: 11-610

Approval Date:	3/14/2012	**Date for Continuing Review:**	2/20/2013
Submission Type:	New	**Review Type:**	Full Committee

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp**.
- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.
- **Obtain IRB approval prior to implementing any changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.
- **Stop all research activity if IRB approval lapses**, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.
- Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 12/4/2012

To: Carol Klitzke
N6177 Fox St
Onalaska, WI 54650

CC: Dr. Catherine H Strohbehn
31 MacKay Hall

From: Office for Responsible Research

Title: Food Defense Practices of School Districts in Northern States: A Regional Survey

IRB ID: 12-602

Study Review Date: 12/4/2012

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
    - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
    - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**

- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

  Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

  Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

Please be aware that **approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.**

Appendix B

Sampling Frame for Case Study Sites

State	Size, total student enrollment	Production System	Central Warehouse	Location	Credentials of FS Director
Minnesota	>28,000	Centralized	yes	Urban	Bachelor degree
Wisconsin	2,500-7500	On-site Commissary	no	Suburban	RD
Iowa	>7,500<10,000	On-site	yes	Suburban	Advanced Degree , RD, SNS
South Dakota	<2,500	On-site	yes	Rural	Some college

Note: RD = Registered Dietitian, SNS = School Nutrition Specialist.

Appendix C
Recruiting Scripts:

School Foodservice Director

Hello. My name is Carol Klitzke, and I am a doctoral candidate at Iowa State University in the Hospitality Management program. Presently, I am working on a research project with the purpose of describing the implementation of food defense practices in school districts in the northern U.S. The research involves observation of meal service, a tour of building security, and interviews with key people in school districts. I would also like to review the crisis management plan and policies and procedures that relate to practices important for food defense.

I am interested in observing breakfast and lunch service in the largest school in your district. I will be observing food defense practices using a 2-page checklist developed at Iowa State University. I would like to interview an administrator responsible for building security, such as the Director of buildings and grounds, or the school principal or assistant principal. I would also like to interview you and a member of your production staff about your beliefs about food defense.

Would you be willing to participate in this project? **Your participation is voluntary.** In the interview you will be asked about your crisis management plan, your beliefs about food defense, and the barriers to implementing food defense in your district. **You may choose not to respond to any of the questions if you wish.** The visit would last no more than one school day. In addition to the interviews my activities will include review of your crisis management plan, review of policies and procedures, a tour of the foodservice operation and observation of meal service. I would also like to take photos, if permitted. It will not be necessary for you to spend all of the time with me. All information gathered through observations and interviews at your school district will be shared with you after the visit. **Information you provide and observations that I make will be kept confidential.** All gathered information will be summarized before it is published or presented. The site visit will be scheduled at your convenience.

Is this something you would be willing to help with?

During my visit I would like to interview an administrator such as the Director of buildings and grounds, or a school principal. Can you give me the name of the person in your district that I should contact?

Thank you! I will send a confirmation letter and consent form to you by email today. May I have your email address? Would you like to set a date now?

If you have questions about this study you may contact me at cjklitzke@viterbo.edu
Or, feel free to contact my major professor and faculty supervisor, Dr. Catherine Strohbehn, 515-294-3527, cstrohbe@mail.iastate.edu,

School District Administrator

Hello. My name is Carol Klitzke, and I am a doctoral student at Iowa State University in the Hospitality Management program. Presently, I am working on a research project with the purpose of describing the implementation of food defense practices in school districts in the northern U.S. I have contacted your district foodservice director and arranged to meet with him/her on _____.

While in your district, I would like to interview an administrator responsible for building security, Your district foodservice director suggested that I talk with you and ask to set up an interview.

Would you be willing to participate in this project? **Your participation is voluntary.** In the interview you will be asked about your crisis management plan, your beliefs about food defense, and the barriers to implementing food defense in your district. **You may choose not to respond to any of the questions if you wish.** The interview would

take 30 minutes. **Information you provide and observations made by the researcher will be kept confidential.** All gathered information will be summarized before it is published or presented.

Is this something you would be willing to help with?

During my visit I would like to interview an official from the agency (such as police or fire department) that you would contact if you suspected food tampering in your district. Could you give me the name of the agency or the official that I should contact?

Thank you! I will send a confirmation letter and consent form to you by email today. May I have your email address?

Meanwhile, if you have questions about this study you may contact me at cjklitzke@viterbo.edu
Or, feel free to contact my major professor and faculty supervisor, Dr. Catherine Strohbehn, 515-294-3527, cstrohbe@mail.iastate.edu.

Emergency Response Official

Hello. My name is Carol Klitzke, and I am a doctoral student at Iowa State University in the Hospitality Management program. Presently, I am working on a research project with the purpose of describing the implementation of food defense practices in school districts in the northern U.S. I have arranged to meet with school district officials on _____. While I am in your community I would like to interview an emergency response official about your agency's involvement in crisis management planning. _____ of the school district suggested that I call you and request

Would you be willing to participate in this project? **Your participation is voluntary.** In the interview you will be asked about your knowledge of the school district's crisis management plan, your beliefs about food defense, and the barriers to implementing food defense in the school district. **You may choose not to respond to any of the questions if you wish.** The interview would take 30 minutes. **Information you provide and observations made by the researcher will be kept confidential.** All gathered information will be summarized before it is published or presented.

Is this something you would be willing to help with?

Thank you! I will send a confirmation letter and consent form to you by email today. May I have your email address?

Meanwhile, if you have questions about this study you may contact me at cjklitzke@viterbo.edu
Or, feel free to contact my major professor and faculty supervisor, Dr. Catherine Strohbehn, 515-294-3527, cstrohbe@mail.iastate.edu.

Appendix D
Case Study Protocol

A. Introduction to the case study and purpose of protocol

Food defense is the protection of food from intentional contamination by those who want to harm consumers. Schools are vulnerable because they are locations where large batches of food are prepared and served to many of the children in the community. The purpose of this study is to conduct a 360^{o} assessment of food defense readiness in four public school districts in the northern United States. This document is the standardized agenda for this study.

1. Case study research questions

- To what degree are the USDABC items in sections A (Communication), B (Handling a Crisis), J (Foodservice/Food Preparation Areas), and L (Water and Ice Supply) being implemented?
- Who in the school district has the authority to implement them?
- Why has communication been reported as the weakest area of food defense in schools?
- What are methods used to communicate internally within the school district and externally with members of the community?
- What type of information is disseminated?
- What are perceptions of school nutrition program stakeholders (administrators, line employees,) as to the importance of implementing food defense practices
- How do kitchen line employees view the importance of school food defense practices?

2. Unit of Analysis

This case study uses multiple cases selected for maximum variation with an embedded approach. The unit of analysis for each case is a public school district. Data from employee interviews, an interview with an emergency response official, document review, and observation are included in each case.

B. Data Collection Procedures

1. Four Participating School Districts
a. name and contact person
b. name and contact person
c. name and contact person
d. name and contact person
2. Preparation prior to visit
a. Recruit foodservice director
1) obtain name of administrator
2) send informed consent form for two employees
3) send list of documents to be reviewed
b. Recruit administrator
1) obtain name of emergency response agency or official

2) send informed consent form
3) obtain permission to take photographs
c. Recruit emergency response official
1) send informed consent form

3. Data Collection Plan
a. Interviews
1) school foodservice director
2) school foodservice workers
3) district administrator
4) community emergency response official
b. Observation
1) observation of one day's breakfast and lunch meal services (estimated 3 hours of observation)
2) Researcher completion of food defense checklist
c. Document Review: district's or foodservice department's food defense plan

Appendix E

Food Defense Checklist for Retail Foodservice Operations

Food Defense in foodservice operations refers to the process of guarding the operation against intentional acts of contamination or tampering. This checklist will help you assess the security of your operation. Check YES, NO, or N/A (not applicable) for each practice in your operation. Develop a plan for addressing practices that were marked NO.

Facility Security	Yes	No	N/A
Facility has a written food defense plan.			
A designated person or team plans and implements food defense policies.			
Food defense practices are evaluated and documented at least annually.			
Emergency contact list is available to all employees.			
Managers conduct a daily walk-through inspection of the operation.			
The outside of facility is adequately lighted.			
Facility is locked and secured when closed.			
Exterior doors are locked at all times (except customers' entrance).			
Keys to access kitchen and food and chemical storage areas are restricted to foodservice management staff.			
Access to food preparation areas is controlled for all visitors and non-foodservice employees, including cleaning crews, delivery vendors, and contractors.			
Visitors are required to sign in at the main office, show picture ID, and explain the purpose of their visit. A visitor badge is worn.			

Personnel	Yes	No	N/A
References for new employees are verified and backgrounds are checked.			
Managers are alert for unusual employee and customer behavior (i.e. workers staying after shift, arriving early, etc.).			
Personnel have been trained in food defense policies and procedures.			
Customers are restricted from entering storage and preparation areas.			
Visitors are supervised while in food production areas.			
Terminated employees lose all means of access to facility (keys, passwords); this may mean locks are re-keyed and passwords are changed.			
Storage is provided for employees' personal items so that these are not allowed in food preparation areas.			

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University Extension

University of Nebraska Lincoln

N 3506 July 2007

Receiving	Yes	No	N/A
Food is purchased only from approved vendors.			
A delivery schedule is maintained.			
Deliveries are verified against purchase orders.			
Delivery personnel are monitored while at the facility.			
Packaging integrity of received products is verified.			
Food and supplies are placed immediately in appropriate storage upon receipt.			

Food Preparation Areas	Yes	No	N/A
Self-service stations (such as food bars and buffets) are monitored at all times by foodservice employees.			
Employees are trained to check ingredients before use to note unusual smells, defective products, and expiration dates, and to know appropriate actions to take if there is a problem.			
Records are maintained to ensure traceability of raw ingredients back to suppliers.			
Procedures are in place for safely handling and disposing of contaminated products.			

Storage Areas	Yes	No	N/A
Access to all food product and chemical storage areas is secured and controlled.			
Chemicals are stored in a locked area, outside of food preparation areas.			
Chemical use is monitored to prevent deliberate food contamination.			
Employees are trained to properly use chemicals to prevent food contamination and protect human safety.			

This publication was developed as part of a project funded by the USDA Cooperative States Research, Education and Extension Service, Project No. 2005-51110-03282. The mention of trade or company names does not mean endorsement. The contents are solely the responsibility of the authors and do not necessarily represent the views of USDA.

Prepared by Catherine Strohbehn, Ph.D., Iowa State University (ISU) Extension specialist; Jeannie Sneed, Ph.D., former ISU HRIM professor; Paola Paez, M.S., ISU HRIM graduate student; Sam Beattie, Ph.D., ISU Extension specialist; and Janelle Meyer, ISU HRIM Food Safety Project Coordinator. Reviewed by Julie Albrecht, extension specialist, University of Nebraska-Lincoln.

References: USDA-FSIS Industry Self-Assessment Checklist for Food Security
FDA Food Security Preventive Measures Guidance

Appendix F
INFORMED CONSENT DOCUMENTS

Foodservice Director

Title of Study: Food Defense Practices of School Districts in Northern States
Investigator: Carol J. Klitzke
This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION
The purpose of this study is to describe in detail the implementation of food defense practices in school districts in the northern U.S. You are being invited to participate in this study because your school district is located in USDA's northern compliance district and it is the size of district that I want to include in my study.

DESCRIPTION OF PROCEDURES

If you agree to participate, you will be asked to

- Allow me to observe breakfast and lunch meal production and service at your largest school building or at your central kitchen, if applicable

- Allow me to take photographs of physical aspects of your facility that demonstrate degree of implementation of food defense.

- Allow me to review the documents associated with your crisis management plan, policies and procedures, and food defense plan.
- Participate in a 30-minute interview. You will be asked questions about your awareness of food defense practices, the district's policies and procedures, and barriers to implementing food defense. If you allow it, your interview will be audio-taped.
- Allow me to complete a 2-page checklist about the district's food defense practices.
- Allow two of your production workers to be interviewed by me in a 30-minute interview session.

You will receive a summary of all data collected during the visit.

While I am in your district I would also like to interview an administrator or principal and a local emergency response official about their involvements in food defense planning. I will arrange these appointments.
Your participation will last for one school day, but you will not need to be with me all of the time. I estimate the time required for each activity will be

- Your interview -30 minutes
- Staff member interviews-60 minutes
- Review documents- 1.5 hours
- Observe meal service at breakfast and lunch- 3 hours
- Complete food defense checklist – 1.5 hours
- Interview with administrator- 30 minutes
- Interview with emergency response official -30 minutes.

RISKS

There are no known foreseeable risks other than inconvenience.

BENEFITS

If you decide to participate in this study there will be no direct benefit to you. It is hoped that the information gained in this study will benefit the district with a third party assessment of current practices and society by helping schools protect meals from intentional food contamination.

COSTS AND COMPENSATION

You will not have any costs from participating in this study. You will not be compensated for participating in this study.

PARTICIPANT RIGHTS

Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. You can skip any interview questions or checklist items that you do not wish to answer.

CONFIDENTIALITY

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies, such as the National Institute of Health, auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: All information from your school district will be coded to assure confidentiality. The code sheet will be kept in a locked file cabinet. Copies of any documents made will have district identifiers removed before they leave the school district. No photos will be taken that include identifying information. All computer files including references to the data will be password protected. The information collected will be retained for one year and then destroyed. During that time only my major professor and academic committee members will see the data. If the results are published, your identity will remain confidential.

QUESTIONS OR PROBLEMS

You are encouraged to ask questions at any time during this study.

For further information about the study contact Carol Klitzke, 608-796-3661 or 608-780-6037; cklitzke@iastate.edu

If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

****

PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document, and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

Participant's Name (printed)

(Participant's Signature) (Date)

Administrator

Title of Study: Food Defense Practices of School Districts in Northern States
Investigator: Carol J. Klitzke
This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION

The purpose of this study is to describe in detail the implementation of food defense practices in school districts in the northern U.S. You are being invited to participate in this study because your school district is located in USDA's northern compliance district and it is the size of district that I want to include in my study.

DESCRIPTION OF PROCEDURES

If you agree to participate, you will be asked to participate in a 30-minute interview. You will be asked questions about your awareness of food defense practices, the district's policies and procedures, and barriers to implementing food defense. If you allow it, your interview will be audio-taped.

RISKS

There are no known foreseeable risks other than inconvenience.
BENEFITS

If you decide to participate in this study there will be no direct benefit to you. It is hoped that the information gained in this study will benefit the district with a third party assessment of current practices and society by helping schools protect meals from intentional food contamination.

COSTS AND COMPENSATION

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PARTICIPANT SIGNATURE

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Participant's Name (printed)

(Signature) (date)

Emergency Response Official

Title of Study: Food Defense Practices of School Districts in Northern States
Investigator: Carol J. Klitzke
This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION

The purpose of this study is to describe in detail the implementation of food defense practices in school districts in the northern U.S. You are being invited to participate in this study because your school district is located in USDA's northern compliance district and it is the size of district that I want to include in my study.

DESCRIPTION OF PROCEDURES

If you agree to participate, you will be asked to participate in a 30-minute interview. You will be asked questions about your awareness of food defense, your agency's involvement in crisis management and food defense planning, and the security needs of the district's foodservice operations. If you allow it, your interview will be audio-taped.

RISKS

There are no known foreseeable risks other than inconvenience.

BENEFITS

If you decide to participate in this study there will be no direct benefit to you. It is hoped that the information gained in this study will benefit the district with a third party assessment of current practices and society by helping schools protect meals from intentional food contamination.

COSTS AND COMPENSATION

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You are encouraged to ask questions at any time during this study.

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**********PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document, and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

Participant's Name (printed)
(Participant's Signature)
(Date)

Employee

Title of Study: Food Defense Practices of School Districts in Northern States
Investigator: Carol J. Klitzke
This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION

The purpose of this study is to describe in detail the implementation of food defense practices in school districts in the northern U.S. You are being invited to participate in this study because your school district is located in USDA's northern compliance district and it is the size of district that I want to include in my study.

DESCRIPTION OF PROCEDURES

If you agree to participate, you will be asked to participate in a 30-minute interview. You will be asked questions about your awareness of food defense practices, the district's policies and procedures, and barriers to implementing food defense. If you allow it, your interview will be audio-taped.

RISKS

There are no known foreseeable risks other than inconvenience.

BENEFITS

If you decide to participate in this study there will be no direct benefit to you. It is hoped that the information gained in this study will benefit the district with a third party assessment of current practices and society by helping schools protect meals from intentional food contamination.

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Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. You can skip any interview questions or checklist items that you do not wish to answer.

CONFIDENTIALITY

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies, such as the National Institute of Health, auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: All information from your school district will be coded to assure confidentiality. The code sheet will be kept in a locked file cabinet. Copies of any documents made will have district identifiers removed before they leave the school district. No photos will be taken that include identifying information. All computer files including references to the data will be password protected. The information collected will be retained for one year and then destroyed. During that time only my major professor and academic committee members will see the data. If the results are published, your identity will remain confidential.

QUESTIONS OR PROBLEMS

You are encouraged to ask questions at any time during this study.

For further information about the study contact Carol Klitzke, 608-796-3661 or 608-780-6037; cklitzke@iastate.edu

If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

****

PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document, and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.
Participant's Name (printed) .
(Participant's Signature) (Date)

Appendix G
Selected sections from *Biosecurity Checklist School Foodservice Programs*
USDA and NFSMI
2004

Level of Priority (High, Medium, Low, or N/A)	A. Communication	Schedule	Implemented
_____	**A1. Compile team member information.** List the contact information for each team member and their responsibilities. Verify the information regularly and update when needed. (See page 34 for sample information form).	Assigned to: Deadline: Comments:	❑
_____	**A2. Establish a relationship with local authorities in relation to biosecurity.** Local authorities that could be contacted include law enforcement officials, hazardous material (HAZMAT) representatives, environmental health specialists/sanitarians, health officials, fire and rescue department representatives, or Federal food safety regulatory agency representatives (FDA or FSIS) and Homeland Security officials. The school food biosecurity management team should meet with representatives of these groups to discuss a partnership and how they can assist in the development of your plan, and under what types of crisis situations they would be involved.	Assigned to: Deadline: Comments:	❑
_____	**A3. Determine which agency or authority would serve as a first responder(s) based on different crisis situations.** A first responder represents the most important authority that needs to be involved with a certain type of emergency situation. There may be different first responders for different types of emergency situations. By completing suggestion A2, you will have a better understanding of what authority to list as a first responder for different situations.	Assigned to: Deadline: Comments:	❑
_____	**A4. Compile an emergency contact list of authorities.** This list should include the names and phone numbers for specific personnel from each agency or authority. (See pages 35 and 36 for emergency contact form).	Assigned to: Deadline: Comments:	❑
_____	**A5. Have on file the address and driving directions for getting to the local police and fire departments and other local first responders.** In case other forms of communication are not working, you may need someone to drive, run, or bicycle to the nearest first responder to report an emergency.	Assigned to: Deadline: Comments:	❑

Level of Priority (High, Medium, Low, or N/A)	A. Communication (continued)	Schedule	Implemented
_____	**A6. Distribute the emergency contact list to appropriate school staff.** If possible, distribute this information in several formats: post it in a secure yet prominent place, make it available in hard copies, wallet cards, and on an intranet system. Ask internal team members to program the numbers into their telephones. Use of cellular phones or other forms of communication may be necessary.	Assigned to: Deadline: Comments:	❑
_____	**A7. Verify and update emergency contact information often.** Determine how often the contact information will be verified. It is suggested to do this a minimum of one time per month. Make sure dates of revisions are noted to prevent confusion.	Assigned to: Deadline: Comments:	❑
_____	**A8. Have procedures for communicating with students, parents, and with the media when necessary (for example, notices of incidents or a press release).** Follow an established plan as designated by your school board. While already established, it is important to know the requirements and allowances of communicating with the media etc. prior to an emergency.	Assigned to: Deadline: Comments:	❑

Level of Priority (High, Medium, Low, or N/A)	B. Handling a Crisis	Schedule	Implemented
_____	**B1. Evaluate the evacuation plan for your school.** Review existing evacuation plans and make changes if necessary. Establish measures to prevent security breaches during an evacuation.	Assigned to: Deadline: Comments:	❑
_____	**B2. Create a diagram showing entry points for emergency personnel.** These entry points should be clearly marked on the building. Also, make blueprints of the building available to first responders.	Assigned to: Deadline: Comments:	❑
_____	**B3. Develop procedures for tracking all food and ingredients from manufacturer to table.** Keep detailed purchase and food production records. You can find guidance for keeping production records in the *Menu Planner for Healthy School Meals* and the *HACCP for Child Nutrition Programs Building on the Basics* manuals. (See Resources)	Assigned to: Deadline: Comments:	❑
_____	**B4. Develop procedures for recalling your products and for quickly identifying and isolating recalled products.** In the event food is found to be unfit for consumption, all of that product must be located and removed from service. Designate an area for holding recalled food items. (This should be consistent with suggestion J10). *Responding to a Food Recall* manual can provide additional guidance. (See Resources)	Assigned to: Deadline: Comments:	❑
_____	**B5. Develop procedures for safely handling and disposing of contaminated products.** Consult with knowledgeable local and State agencies. Do not dispose of products contaminated with chemical or biological agents without approval from health and law-enforcement officials. Authorities may require samples for evidence or further investigation. Use only approved solid waste haulers.	Assigned to: Deadline: Comments:	❑
_____	**B6. Develop procedures for suspending the use of contaminated water.** In addition to developing these procedures, see pages 25 and 26 for possible security measures for protecting your water and ice supply.	Assigned to: Deadline: Comments:	❑

Level of Priority (High, Medium, Low, or N/A)	B. Handling a Crisis (continued)	Schedule	Implemented
_____	**B7. Develop procedures for providing safe and secure substitute meals, including procedures for feeding students at an alternate site(s).** Consult with local health or food safety department, since these officials may have to approve changes in alternate site(s) for compliance with food safety regulations.	Assigned to: Deadline: Comments:	❑
_____	**B8. Develop procedures for notifying appropriate law enforcement and public health officials when your school receives a food biosecurity threat, as well as when a member of the school community observes or suspects product tampering.** Developing a standard form will be useful to document the who, what, when, and where of the reported situation.	Assigned to: Deadline: Comments:	❑
_____	**B9. Develop procedures to follow if you suspect the airflow to be contaminated with biological or other contaminants.** Contact your HAZMAT unit (or first responder) to determine what you should and should not do if you suspect contamination.	Assigned to: Deadline: Comments:	❑

Level of Priority (High, Medium, Low, or N/A)	J. Foodservice/ Food Preparation Areas	Schedule	Implemented
_____	**J1. Create a diagram or map that defines the boundaries of all foodservice areas as well as locations of specific activities within the foodservice area.** This should include self-service bars and school stores if applicable. This diagram will be useful in several ways: to visualize the entire setup and flow of the foodservice operation, and as a visual aid for training purposes. You might begin your diagram with a blueprint of the school.	Assigned to: Deadline: Comments:	❑
_____	**J2. Determine which foodservice areas should be restricted.** Particular attention should be paid to critical production areas where products are uniformly mixed (e.g., mixers/blenders) or produced in large batches (e.g., bulk storage containers for fluid products). Restricted areas should also include food storage areas and chemical storage rooms. Define who is allowed within restricted areas and when.	Assigned to: Deadline: Comments:	❑
_____	**J3. Mark the restricted foodservice areas and develop procedures for controlling entry by non-foodservice employees.** This policy should address the access of all non-foodservice staff such as school administrators, principals, teachers, maintenance staff, parents, students, and visitors. (This should be consistent with suggestion M6).	Assigned to: Deadline: Comments:	❑
_____	**J4. Restrict and control access to central controls for airflow, HVAC, water systems, electricity, and gas within foodservice areas.**	Assigned to: Deadline: Comments:	❑
_____	**J5. Alarm emergency exits and self-locking doors that can be opened only from the inside per local and state fire and building codes.**	Assigned to: Deadline: Comments:	❑
_____	**J6. Secure (lock, seal, equip with a sensor device) all doors, windows, roof openings, vent openings, and outside refrigeration/storage units at all times.**	Assigned to: Deadline: Comments:	❑

Level of Priority (High, Medium, Low, or N/A)	J. Foodservice/ Food Preparation Areas (continued)	Schedule	Implemented
_____	**J7. Make sure at least one authorized employee is present in the foodservice area at all times when the area is not secure.** With new employees, it may be advisable to have more than one person on duty at the same time.	Assigned to: Deadline: Comments:	❑
_____	**J8. Inspect ingredient packages prior to use for evidence of tampering. Examples of evidence are a broken seal (for unopened packages) or discoloration of food inside package (for leftover and resealed packages).**	Assigned to: Deadline: Comments:	❑
_____	**J9. Prohibit outside foods and medications in foodservice areas (for example, "personal" foods or food brought in for storage or reheating by students or employees).** For safety reasons, provide an alternate storage place to secure personal foods and medications outside of foodservice areas. (This should be consistent with suggestion I7).	Assigned to: Deadline: Comments:	❑
_____	**J10. Identify how and where to isolate suspected contaminated food or foodservice products.** Designate an area for holding distressed food and food items held for testing. *Be careful: do not disturb a possible "crime scene"—evidence may be destroyed.* (This should be consistent with suggestion B4).	Assigned to: Deadline: Comments:	❑
_____	**J11. Document where ingredients and foods are stored and prepared in the foodservice operation. If an ingredient or food is determined to be contaminated, you need to be able to trace where that item is, where that item was, and where it came from.** Trace foods by keeping thorough production and inventory records that include the lot and/or code numbers from ingredient packaging that are used and where the finished product was stored or served. This may be accomplished with flow charts or logs and a HACCP plan. (See resources)	Assigned to: Deadline: Comments:	❑

Level of Priority (High, Medium, Low, or N/A)	J. Foodservice/ Food Preparation Areas (continued)	Schedule	Implemented
_____	**J12. Do not allow the foodservice areas to be used for "special events" such as parent/teachers dinners or public events unless operated by the regular foodservice staff.** Allowing the foodservice facility to be used by unknown and untrained people decreases the security of your foodservice operation.	Assigned to: Deadline: Comments:	❑
_____	**J13. Monitor all foodservice areas for signs of suspicious activity or unauthorized entry.** This includes self-service areas such as buffets and salad bars, receiving, outside storage, and solid waste disposal.	Assigned to: Deadline: Comments:	❑

Level of Priority: High, Medium, Low, or N/A	L. Water and Ice Supply	Schedule	Implemented
_____	**L1. Secure (fence or lock) outside accesses to all water supply and ice-making equipment to prevent unauthorized access.**	Assigned to: Deadline: Comments:	❑
_____	**L2. Monitor and inspect outside accesses to all water supply and ice-making equipment to prevent unauthorized access.**	Assigned to: Deadline: Comments:	❑
_____	**L3. Develop policy and procedures for actions to take if a breach in the water supply security occurs.** Identify alternate source(s) of potable water e.g., bottled water. Also, consider the availability of bottled water.	Assigned to: Deadline: Comments:	❑
_____	**L4. Monitor the drains and water lines in food production areas periodically for possible tampering.**	Assigned to: Deadline: Comments:	❑
_____	**L5. Control access to in-house ice-making equipment and ice storage facilities.**	Assigned to: Deadline: Comments:	❑
_____	**L6. Install and use backflow devices on all water supply equipment and beverage dispensers.** Use only backflow devices that meet American Society of Sanitary Engineers (ASSE) standards - these may be stamped with the letters ASSE.	Assigned to: Deadline: Comments:	❑

Level of Priority (High, Medium, Low, or N/A)	L. Water and Ice Supply (continued)	Schedule	Implemented
_____	**L7. Test water and ice regularly to make sure it is safe to drink.** Check with local department responsible for your drinking water, municipal water company, and/or local water authority for methods and assistance.	Assigned to: Deadline: Comments:	❑
_____	**L8. Establish policy and procedures for notifying local officials responsible for drinking water and the Environmental Protection Agency (EPA) immediately if the public water supply might be unsafe to drink or use.**	Assigned to: Deadline: Comments:	❑

Appendix H
Interview Guides

Foodservice Director Interview Form

District Code: ____
Site Code:

Code		Yes	No
1	How many students are enrolled in your school district? _____		
2	On average, how many meals are served daily? Breakfast:_____ Lunch:_____		
3	How is the foodservice department operated? A. Self-operated B. Outside contract management (please provide the name of the contractor_____) 1. How many school nutrition employees are a. employed by the management company? Hourly_____ Managers/supervisors_____ FTEs_____ b. employed by the school district? Hourly_____ Managers/supervisors_____ FTEs_____		
4	Do you have a centralized warehousing operation?		
5	How many onsite kitchens does your district have?		
6	How many central kitchens do you have that include onsite service?		
7	How many central kitchens do you have with no onsite service?		
8	How many satellite kitchens do you have?		
9	Does your operation have one or more employee(s) dedicated to implementing and monitoring the HACCP food safety plan?		
10	Does your operation have one or more employee(s) dedicated to implementing and monitoring food defense, or for protection of food from food tampering?		
11	(show a copy) Are you aware of the USDA Publication "A biosecurity checklist for school foodservice programs"?		
12	If so, then how did you first become aware of this resource? Have you used this resource? Have you found it helpful?		
13	Are you aware of any other resources on food defense applicable to foodservice operations?		

	Do you want to know about other resources?		
14A	Food being intentionally contaminated or tampered with is a new type of risk for me. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14B	Scientists know a lot about how people could contaminate the food supply. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14C	When food tampering occurs, safety inspectors can visibly see that it should not be consumed 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14D	I know a lot about how people could contaminate the food supply in my foodservice operation. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14E	To what extent is food tampering a risk to your school foodservice operation? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
14F	What level of uncertainty do you think there is, in general, about the risk of food tampering in your foodservice operation? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
14G	How much personal control do you feel you have over food tampering in your foodservice operation? 1=almost none 2=slight 3=moderate 4= high		

	0=don't know/no opinion		
14H	How much do you worry about food tampering occurring in your foodservice operation? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
15	Have you ever attended a seminar or training related to food defense? Please describe it.		
16A	Has this district implemented a written plan to address food defense? If yes, what documents exist?		
16B	How frequently is the food defense management plan reviewed and updated? Who reviews the plan? What is the date of the most recent review?		
16C	If you do not have a food defense plan, what is your timeline for developing one?		
17	What areas of your school(s) do you think are the most vulnerable to an intentional attack from persons not employed by the school district?		
18	Have you ever experienced or suspected any incident of food tampering (intentional food contamination) in this district? Tell me about it		
19	Have you ever spoken with emergency response personnel about food defense measures for the child nutrition program? If so, which agency? Homeland Security Food safety task force Health inspectors Police First responders Fire Department Other		
20	When was the last time that emergency contact information for the foodservice department was updated?		
21	Does the district have board-level policies to cover these topics?		
21A	restricting use of foodservice areas by outside groups		
21B	Giving administrators access to employee lockers		
21C	Outside foods and personal medications are prohibited in foodservice areas		
21D	Items that employees are allowed to bring to work?		
22	Is storage provided for employees' personal items so that these are not allowed in food preparation areas?		
23	Are confidential records stored in locked cabinets with access only by cleared individuals		
24	Are any doors in the foodservice operation kept locked When no one is working? During the work day?		
25	Are there any parts of the foodservice operation off limits to non-foodservice school employees? students?		

	delivery people? sales representatives? How is access by visitors and non-school foodservice employees to food storage, production and service areas controlled?		
26	Are computer systems protected with		
	passwords		
	Firewalls		
	Virus detection software		
27	Please explain some perceived barriers to implementing a Food Defense Plan in your operation		

Demographic Information
Site code:
Interviewee code:

A. What is the title of your position?
District foodservice director
District foodservice manager
Business manager
Cook/supervisor
Head cook
Superintendent
Principal
Health Coordinator
Curriculum Coordinator
Other

B. In your position, can you influence changes in
a. foodservice department policy?
Yes
No
b. district policy regarding building and utility security?
Yes
No

C. Are you a Registered Dietitian (R.D)?
Yes
No

D. Are you a School Nutrition Specialist (SNS)?
Yes
No

E. What is your gender?
Female
Male

F. What is the highest level of education completed?
Less than high school
High school
Technical or vocational school
Some college
Bachelor Degree
Graduate degre

Administrator Interview Guide
Position Title:_____
District Code: ____
Site Code:

Code		Yes	No
1	How many employees work in your school (district)? _____		
30	Does your district have a crisis management plan?		
31	What types of crises are covered in your plan?		
32	Does the plan address food-related emergencies, such as outbreaks foodborne illness or recalls of products?		
33	Were foodservice managers or employees involved in development and review of the crisis management plan?		
34	Were emergency response officials involved in development or review of the plan?		
35	Are you familiar with the concept of "food defense"?		
11	(show a copy) Are you aware of the USDA Publication "A biosecurity checklist for school foodservice programs"?		
12	If so, then how did you first become aware of this resource?		
13	Are you aware of any other resources on food defense applicable to foodservice operations?		
14A	Food being intentionally contaminated or tampered with is a new type of risk for me. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14B	Scientists know a lot about how people could contaminate the food supply. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14C	When food tampering occurs, safety inspectors can visibly see that it should not be consumed. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14D	I know a lot about how people could contaminate the food supply in our school district.		

	4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14E	To what extent is food tampering a risk to your school district? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
14F	What level of uncertainty do you think there is, in general, about the risk of food tampering in your school district? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
14G	How much personal control do you feel you have over food tampering in your school district? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
14H	How much do you worry about food tampering occurring in your school district? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
16	Has this district implemented a written plan to address food defense? If yes, what documents exist?		
10	Who is responsible for food defense in your school district?		
41	Who is responsible for building security in your school district?		
17	What areas of your school(s) do you think are the most vulnerable to an intentional attack from persons not employed by the school district?		
18	Have you ever experienced or suspected any incident of food tampering (intentional food contamination) in this district? Tell me about it		
19	Have you ever spoken with emergency response personnel about food defense measures for the child nutrition program? If so, which agency? Homeland Security Food safety task force Health inspectors Police First responders Fire Department		

	Other		
36	Who is responsible for assuring that outside doors in the foodservice area are kept locked?		
37	Is access to outside air and water intakes restricted?		
38	Is access to the HVAC system restricted?		
39	Is access to the internal water supply restricted?		
40	What is the policy for testing emergency alert systems in the district?		
	When was the last time that the emergency alert systems were tested?		
26	Are computer systems protected with		
	passwords		
	Firewalls		
	Virus detection software		
27	Please explain some perceived barriers to implementing a Food Defense Plan in your district.		

Demographic Information

Site code: Interviewee code:

A. What is the title of your position?

District foodservice director
District foodservice manager
Business manager
Cook/supervisor
Head cook
Superintendent
Principal
Health Coordinator
Curriculum Coordinator
Other

B. In your position, can you influence changes in

1. foodservice department policy?
Yes
No
2. district policy regarding building and utility security?
Yes
No

C. What is your gender?

Female
Male

D. What is the highest level of education completed?

Technical or vocational school
Some college
Bachelor Degree
Graduate degree

Emergency Responder Interview Form
Position Title:_____
District Code: ____
Site Code:

Code		Yes	No
41	Do you have a liaison officer with the school district?		
30	Are you familiar with the school district's crisis management plan?		
34	Was your agency involved in development of the crisis management plan?		
35	Are you familiar with the concept of "food defense"?		
11	Are you aware of the USDA Publication "A biosecurity checklist for school foodservice programs"?		
12	If so, then how did you first become aware of this resource?		
13	Are you aware of any other resources on food defense applicable to foodservice operations?		
14A	Food being intentionally contaminated or tampered with is a new type of risk for me. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14B	Scientists know a lot about how people could contaminate the food supply. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14C	When food tampering occurs, safety inspectors can visibly see that it should not be consumed. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14D	I know a lot about how people could contaminate the food supply in our school district. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14E	To what extent is food tampering a risk to your school district? 1=almost none 2=slight 3=moderate 4= high		

	0=don't know/no opinion		
14F	What level of uncertainty do you think there is, in general, about the risk of food tampering in your school district? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
14G	How much personal control do you feel you have over food tampering in your school district? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
18	Have you ever experienced or suspected any incident of food tampering (intentional food contamination) in your jurisdiction? Can you tell me about it?		
48	Has your agency been in communication with the school foodservice director? In writing? Over the phone? In person?		
49	What should be done if an incident of intentional food contamination or food tampering at the school is suspected?		
27	Please explain the barriers that you see in assisting the school district with food defense planning?		

Demographic Information
Site code:
Interviewee code:
A. What is the title of your position?

B. In your position, can you influence changes in
a. school district foodservice department policy?
Yes
No

b. school district policy regarding building and utility security?
Yes
No

C. What is your gender?
Female
Male

D. What is the highest level of education completed?
Less than high school
High school
Technical or vocational school
Some college
Bachelor Degree
Graduate degree

Foodservice Line Worker Interview Form
Position Title:_____
District Code: ____
Site Code:

Code		Yes	No
9	Does your operation have one or more employee(s) who is(are) responsible for the HACCP food safety plan?		
10	Does your operation have one or more employee(s) who is(are) responsible for food defense, or protection of food from intentional contamination?		
11	Have you heard of a concept called "food defense"?		
12	If so, then how did you first hear about it?		
14A	Food being intentionally contaminated or tampered with is a new type of risk for me. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14B	Scientists know a lot about how people could contaminate the food supply. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14C	When food tampering occurs, safety inspectors can visibly see that it should not be consumed 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14D	I know a lot about how people could contaminate the food supply in my foodservice operation. 4 = strongly agree 3 = somewhat agree 2 = somewhat disagree 1 = strongly disagree 0 = don't know		
14E	To what extent is food tampering a risk to your school foodservice operation? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		

14F	What level of uncertainty do you think there is, in general, about the risk of food tampering in your foodservice operation? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
14G	How much personal control do you feel you have over food tampering in your foodservice operation? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
14H	How much do you worry about food tampering occurring in your foodservice operation? 1=almost none 2=slight 3=moderate 4= high 0=don't know/no opinion		
15	Have you ever received training about food defense?		
17	What areas of your operation do you think are the most vulnerable to an intentional attack from Persons not employed by the school district? District employees from outside the foodservice department? Foodservice employees		
18	Have you ever experienced or suspected any incident of food tampering (intentional food contamination) in this district? Tell me about it		
21A	What is your school's policy about the use of the foodservice areas by outside groups?		
21B	In the last year has a manager inspected your locker?		
21D	Are there items that you are not allowed to bring to work and/or store in your locker?		
22	Where do you store personal items while at work?		
24	Are any doors in the foodservice operation kept locked When no one is working? During the work day?		
25	Are there any parts of the foodservice operation off limits to non-foodservice school employees? students? delivery people? sales representatives? you?		

27	What issues make it difficult for you to protect food from intentional contamination in your kitchen?	

Appendix I

Table I1

Rules for Inclusion and Sample Statements for Assigning Interview Data Into Subthemes

Subthemes	Rules for Inclusion of Units of Meaning into Subthemes	Sample Statements
Food defense is an unfamiliar term, but the concept is not.	Stakeholders are unfamiliar with the term food defense, but show an awareness of the potential for food to be intentionally contaminated. Food defense is confused with unintentional cross contamination, or the need to have food and water available to shelter students in place during a lockdown.	"When people take food supplies and then poison them, is that what you are talking about?"- Principal "Food defense. I should say yes I have, but no, I can't. It's not used in our everyday language maybe. I know I've seen or heard it."- emergency responder "For what to look for? Ya." .- production worker
Experience with food tampering was uncommon but not unheard of.	Interviewees had personal knowledge of food tampering incidents.	"We assisted (city) about five years ago, they had a wedding reception and there was a batch of punch and there was something. . . poured into this and probably 10 or 12 people got hauled out of there to the hospital. I forgot about that one." –emergency responder
Different stakeholders perceive different areas of vulnerability.	Stakeholder groups have different concerns about food tampering related to the requirements of their jobs. Production workers understand their role is to keep unauthorized persons out of the kitchen.	Interviewer: "What area of your school would be most vulnerable to an attack on the food?" Principal: "It would have to be in the cafeteria."
Food is most vulnerable before it arrives to the site.	Stakeholders believe that food is safe once it is on site.	"Where is the food most vulnerable? I would say in the supply chain." – foodservice director
Food is safe because co-workers are trustworthy.	Stakeholders believe they know and can trust their coworker. An attack from an internal person would be considered less severe.	"I never thought of tampering before, you know. It's just kind of a family here." – production worker
No one would want to attack *our* school.	Attacks on food would happen somewhere else; even though a school district has had problems with intruders, stakeholders feel comfortable and safe.	"The only time I really thought about terrorism was in the Mall of America . . ."- production worker

Table I1, continued

Subthemes	Rules for Inclusion of Units of Meaning into Subthemes	Sample Statements
The foodservice operation is perceived as separate from school operations.	The foodservice operation has hiring, purchasing, and training procedures separate from the school district. Communication with the foodservice director by other administrative personnel is limited.	"There are three rooms I can't get into and never want to. One is the kitchen. . ." -Principal
The foodservice operation is responsible for food defense and the administration is responsible for security.	Food defense becomes an administrative and public concern when children are affected. Until then the foodservice is depended on to protect food. Production workers understand and enforce that no unauthorized persons come into the kitchen. FSDs see food defense as an extension of HACCP.	Interviewer: "Does your plan address any food related emergencies . . .?" Principal: ". . . nutrition would probably be the first line of defense, but if there was actually something that made it to the children then we would be involved in that."
Crisis management planning does not address food hazards.	Food defense is not planned for or discussed.	Interviewer: "What should be done if an incident of . . .food tampering is suspected at this school?" Emergency responder: "What should be done?" Interviewer: "Yes" Emergency responder: Well first of all stop the food preparation. Lock it up. Call in the medical people. Try to isolate it. Keep people in the building. I guess that's the first thought off the top of my head."
Security is designed to protect children, not food.	Funds are spent to protect children from intruders or to help catch perpetrators. When children are not present, security is a lower priority than for schools where children are present.	"When you talk about those things, the locks, the cameras. . . , little by little our district keeps buying more and more. But right now they're not used in the kitchens, they're used more in hallways and entrance ways of the school district." – foodservice director
Community expectations can impede food defense.	Schools are community facilities and must be shared. Taxpayers hold expectations for school practices.	"Actually they let people use the kitchens for wakes." – foodservice director

Appendix J

Internet Administered Food Defense Survey

Food Practices - Carol Klitzke

Section A: Risk Perception

Food defense practices protect food from intentional contamination by persons who want to cause harm by adding harmful substances to food. It's often called "food tampering." Food tampering has occurred throughout history, but recently the safety of the food supply from terrorist actions has emerged as a concern.

The following seven questions ask about your feelings about terrorist acts against the food supply in general and in your own foodservice operation. Terrorist acts have the goal of promoting a political or social cause, weakening the government, or causing fear and social disruption.

strongly agree = 4 ….. Don't know = 0

1) Food being contaminated by terrorists is a new type of risk for me.
2) Scientists know a lot about how terrorists could contaminate the food supply.
4) I know a lot about how terrorists could contaminate the food supply.

High = 4 Don't know/No opinion = 0

5) To what extent is terrorism a risk to your school foodservice operation?
6) How much personal control do you feel you have over terrorism risks in your school foodservice operation?
7) How much do you worry about terrorism risks to your school foodservice operation?

The following three questions ask about food tampering. Food tampering includes incidents such as contamination of food done as a prank, an act of revenge, or to damage reputations.

High = 4 Don't know/No opinion = 0

8) To what extent is food tampering a risk to your school foodservice operation?
9) How much personal control do you feel you have over food tampering in your school foodservice operation?
10) How much do you worry food tampering in your school foodservice operation?

Section B. Food Defense Planning

Instructions: Please reply to the following questions about the food defense planning that occurs in your foodservice operations.

11) My operation has already implemented a food defense management plan.
(1) Yes
(2) No

When was your plan implemented?
(1) Within the last year
(2) Within the last 2-5 years
(3) More than 5 years ago

When was the last time your plan was updated?
(1) Within the last year
(2) Within the last 2-5 years
(3) More than 5 years ago
(4) Our plan has not yet been updated

My operation is currently in the process of developing a food defense management plan.
(1) Yes
(2) No

I plan to develop and implement a food defense plan in my foodservice operation

(1) Strongly Disagree … (5) Strongly Agree

I will develop and implement a food defense plan in my foodservice operation within the next 3 years.

(1) Strongly Disagree … (5) Strongly Agree

At the present time, I have no intention of implementing a food defense plan in my foodservice operation.

(1) Strongly Disagree … (5) Strongly Agree

Section C: Food Defense Practices

Please indicate the frequency with which these fundamental food defense activities are practiced by your district or your foodservice operation.

12) Our employees inspect food packages prior to use for evidence of possible contamination. (Examples of evidence are a broken seal or discoloration of food inside a package).

(5) Always…..(1) Never… (-1) Don't know ….(-2) Not under my authority

Our employees inspect food packages prior to use for evidence of possible contamination. (Examples of evidence are a broken seal or discoloration of food inside a package).

A foodservice employee receives food deliveries.

Our district performs criminal background checks on newly hired foodservice employees.

Our district performs criminal background checks on current employees at specified intervals.

Our foodservice employees have been trained about detecting food tampering.

Our foodservice employees wear photo ID badges while at work.

Foodservice employees wear aprons or uniforms that are unique and not easily duplicated.

Our district keeps track of keys provided to employees.

Our district keeps track of identification badges provided to employees.

Our foodservice operation restricts visitor access to food storage areas.

Our foodservice operation restricts visitor access to the food production areas.

Access to food storage areas by school personnel other than foodservice employees is restricted.

Access to food production areas by school personnel other than foodservice employees is restricted

Our foodservice employees are trained to use chemicals properly to prevent food contamination.

Our district restricts access to the central controls for utilities.

(5) Always…..(1) Never… (-1) Don't know ….(-2) Not under my authority

Our district has procedures to follow if they suspect utility sources have been compromised.

Our foodservice operation periodically monitors drains and water lines in food production areas for possible tampering.

Our district follows a policy that delivery trucks on the premises be locked when not being loaded or unloaded.

Our district controls access points into the foodservice facility with security hardware (e.g. cameras).

Our foodservice operation controls access to food products by unauthorized individuals.

Our foodservice operation controls access to all chemical storage areas by unauthorized individuals.

Our foodservice employees monitor food production areas to prevent someone from intentionally contaminating food during preparation.

Outside entrances to the foodservice operation are kept secure.

Outside refrigeration/storage units are kept secure.

Our district allows the foodservice production area to be used for special events by outside groups.

(5) Always…..(1) Never… (-1) Don't know ….(-2) Not under my authority

Our district requires a foodservice staff member be present when the foodservice production area is used by outside groups.

(5) Always…..(1) Never… (-1) Don't know ….(-2) Not under my authority

Foodservice staff knows what to do in the event of a food tampering incident.

A list of suppliers' contact information is readily available to foodservice staff.

Expectations about food defense are included when negotiating contracts with vendors.

The foodservice director (or person in charge of daily foodservice operations) communicates with district administrators about food safety (i.e. prevention of unintentional contamination) issues.
The foodservice director (or person in charge of daily foodservice operations) communicates with district administrators about food defense issues (i.e. prevention of intentional contamination).
The foodservice director (or person in charge of daily foodservice operations) communicates with community resource officers (including emergency responders) about food safety issues.
The foodservice director (or person in charge of daily foodservice operations) communicates with community resource officers (including emergency responders) about food defense issues..

Section D: Demographic Information
Instructions: Please answer the following questions about your district, the foodservice operation, and yourself.
44) In which state is your district located?
(1) Wyoming
(2) Wisconsin
(3) South Dakota
(4) North Dakota
(5) Montana
(6) Minnesota
(7) Iowa

45) What is the certified enrollment in your school district?
(1) <2500 students
(2) 2501-5000 students
(3) 5001-7500 students
(4) 7501-10,000 students
(5) 10,001-20,000
(6) >20,000

46) On average, how many reimbursable meals are served daily to students in your district by your foodservice program?
Breakfast: _____
Lunch: _____

47) How is the foodservice department in your district administered?
(1) Self-operated
(2) Outside contractor (please provide the name of the contractor): _____
Taher = 1
Chartwell = 2
Aramark = 3
Aviands = 4
CBM Food = 5
Lunchtime solutions = 6

48) What type of production system does your school district have?
(1) Onsite kitchen (all meals prepared and served in the same location).
(2) Centralized/Commissary production (a production facility that prepares food for service only at other sites; no meals or food is served onsite).
(3) Combination production system (both centralized and onsite production systems are in place in the district where food is prepared and served in one location andmeals or food items in bulk are sent to other locations for service).

How many onsite kitchens does the school district have?
(1) 1…. (8) 8 … (9) If more than 8, how many?: _____

Does your onsite kitchen prepare food for delivery to facilities outside of the school district, such as to a day care center?
(1) Yes
(2) No

(If yes) What types of facilities do you provide delivery to? (Check all that apply)
[1] Day care center
[2] Nursing home
[3] Local college
[4] Special school
[5] Mental health facility
[6] Military base
[7] Community center
[8] Other (please list)
1= Head start
2 = Assisted Living/senior dining
3= Private school
4= other public schools

How many school district sites receive meals from the central kitchen(s)?
(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6-8
(7) 9-12
(8) 12-48
(9) If more than 48, how many?: _____

Are meals delivered to any facilities outside of the school district, such as to a day care center?
(1) Yes
(2) No

(If yes) What types of facilities are served by the central kitchen? (Check all that apply)
[1] Day care center
[2] Nursing home
[3] Local college
[4] Special school
[5] Mental health facility
[6] Military base
[7] Community center
[8] Other (please list)
1= Head start
2 = Assisted Living
3= Private school

How many non-school district sites receive meals from the central kitchen(s)?

(1) 1…. (8) 8
(9) If more than 8, how many?: _____
How many combination production sites does the school district have?
(1) 1…. (8) 8
(9) If more than 8, how many?: _____
How many schools sites receive meals from the combination production kitchen?
(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6-8
(7) 9-12
(8) 12-48
(9) If more than 48, how many?: _____

Are meals delivered to any facilities outside of the school district, such as to a day care center?
(1) Yes
(2) No

(If yes) What types of facilities receive meals from the combination production kitchen? (Check all that apply)
[1] Day care center
[2] Nursing home
[3] Local college
[4] Special school
[5] Mental health facility
[6] Military base
[7] Community center
[8] Other (please list)
1= Head start
2 = Assisted Living
3= Private school

How many non-school district sites receive meals from the combination kitchen?
(1) 1…. (8) 8
(9) If more than 8, how many?: _____
49) Do the district use a centralized warehousing operation for food?
(1) Yes
(2) No

50) Does your district have a crisis management plan?
(1) Yes, but there is no written document
(2) Yes, and it is documented
(3) No
(4) Don't know

If it is documented, who has access to the written plan?
5 = no limitations/available on the internet
4= school personnel only
3=school administrators only
2= foodservice director/employees only

1=community government/emergency responders

_____

51) Is a food tampering scenario included in the crisis management plan?
(1) Yes
(2) No
(3) Don't know
52) Were any school foodservice managers included in district crisis management planning?
(1) Yes
(2) No
(3) Don't know
53) Have you ever attended a seminar or training that included content about food defense?
(1) Yes, once.
(2) Yes, more than once.
(3) No

53-1. In what year was the training held?

	Year				Briefly describe the length, location, and content of the training.
	2010-2012	2005-2009	2001-2004	Before 2001	
In what year was the training held?	(1)	(2)	(3)	(4)	___

In what year was the training held?

	Year				Briefly describe the length, location, and content of the training.
	2010-2012	2005-2009	2001-2004	Before 2001	
In what years was the training held?	[1]	[2]	[3]	[4]	___

54) What is the title of your position?
(1) District Foodservice Director
(2) District Foodservice Manager
(3) Business Manager
(4) Cook Manager, Kitchen Manager
(5) Head cook
(6) Superintendent
(7) Principal
(8) Health Coordinator
(9) Curriculum Coordinator
(10) Other: _____
(11) Administrative Assistant
(12) Food Service Supervisor

55) In your position, can you influence changes in

	Yes	No
Foodservice department policy regarding building security?	(1)	(2)
District policy (board level) regarding building security?	(1)	(2)
Foodservice department policy regarding utility security?	(1)	(2)
District policy (board level) regarding utility security?	(1)	(2)

Thank You!

Thank you for your participation in this study. Your name will be entered into a drawing for a $50 gift certificate from the School Nutrition Association. This survey was sent to school food authorities in seven states; one gift card will be awarded per state.

Appendix K
Permission to Adapt Work from Other Studies

Carol J Klitzke

From: Jennifer E.C. Lee <jeclee@alumni.uottawa.ca>
Sent: Sunday, November 20, 2011 8:21 PM
To: Carol J. Klitzke
Subject: Re: your article in the Journal of Applied Social Psychology

Hi Carol,

Thanks very much for your interest in our work. It's always nice to know that it gets read every once in a while! The questions included in our survey were as follows:

Perceived threat: To what extent is terrorism a risk to your personal health?

Perceived uncertainty: What level of uncertainty do you think there is, in general, about terrorism risks?

Perceived control: How much personal control do you feel you have over terrorism risks?

Worry: How much do you worry about terrorism risks?

All were rated by respondents on a 4-point scale (1=almost none, 2=slight, 3=moderate, 4=high) and respondents could also indicate that they did not know or had no opinion (0=don't know/no opinion)

You are more than welcome to include these questions in your survey as long as you agree to cite our work, as you mentioned in your e-mail.

Best of luck with your research!

With best regards,
Jennifer

Carol J Klitzke

From: David Olds <daveolds@k-state.edu>
Sent: Tuesday, October 25, 2011 4:50 PM
To: Carol J. Klitzke
Subject: Re: request for permission to use or adapt your survey items

Hello Carol,

Yes you have my permission to use or adapt any survey/interview items from my dissertation for your research.

Best wishes for a successful dissertation!

Sincerely,
David Olds

----- Original Message -----
From: "Carol J. Klitzke" <cjklitzke@viterbo.edu>
To: daveolds@ksu.edu
Sent: Tuesday, October 25, 2011 2:36:44 PM
Subject: request for permission to use or adapt your survey items

Carol J Klitzke

From: Calum G. Turvey <cgt6@cornell.edu>
Sent: Saturday, November 19, 2011 11:43 AM
To: Carol J. Klitzke
Subject: RE: Risk, fear, bird flu terrorists
Attachments: national survey 1.5.doc

Dear Carol... many thanks for your note. I am attaching the latest version of the survey that I have. I see no problems in your using it.

Cheers

Calum Turvey, PhD
W.I. Myers Professor of Agricultural Finance
Director of Graduate Studies
Graduate Program: http://dyson.cornell.edu/grad/index.php
Admissions: http://dyson.cornell.edu/grad/admissions.php
Editor, Agricultural Finance Review

Charles H. Dyson School of Applied Economics and Management
237 Warren Hall
Cornell University
Ithaca, NY 14853

Phone: 607.255.5230
Mobile: 607.592.6337
Fax: 607.255.1589

Agricultural Finance Review Link

www.emeraldinsight.com/afr.htm

SSRN Working Paper Link: http://ssrn.com/author=349063

Cornell University
Charles H. Dyson School of
Applied Economics and Management

Carol J Klitzke

From: Eunju Yoon <yooneunju@gmail.com>
Sent: Sunday, October 30, 2011 7:35 AM
To: Carol J. Klitzke
Subject: Re: permission to use your food defense survey

Dear Klitzke,

Thank you for the waiting. Dr. Shanklin has no problem of me sharing the instrument that I have developed for my research with you. Therefore I am writing this email giving you a permission.

I permit you, MS Carol J. Klitzke, to use the instrument that I have developed for my dissertation research, "Food defense management plan implementation intention: an application of protection motivation theory",in 2007. Please just make sure to note that instrument was used by permission of Eunju Yoon, Ph.D.

If you need any further assistance relating to use the instrument, let me know.
Good luck on your research!!

sincerely,
Eunju Yoon

--
++++++++++++++++++++++++
Eunju Yoon, Ph. D
Department of Food Science and Nutrition
Dong-A University
840 Hadan 2-dong, # M6411
Saha-gu, Busan (Zipcode: 604-714)
South Korea
Telephone: 82-51-200-7317
Fax: 82-51-200-7535
Cell: 82-10-4134-5290

Appendix L

Survey Feedback Sheet

Thank you for agreeing to pilot-test my survey! This survey is intended for the population of School Food Authorities in seven Northern states (IA, MN, WI, ND, SD, MT, and WY). The final electronic survey will be administered via email; therefore the final format will be different from what is presented here. Your input is needed to be sure content is appropriate for the audience. Your feedback will be used to improve my survey, but your response will not be included in the study results.

Directions
Please complete the survey and keep a record of how much time is required to complete it.
You may write or type comments directly onto any part of the survey.
Please respond to the feedback questions listed below.
Please return this sheet and your completed survey to me via email, fax, or snail mail by November 1

Carol Klitzke, MS, RD, SNS
900 Viterbo Drive
La Crosse WI 54601
FAX: 608-796-3668
cjklitzke@viterbo.edu

1 . Were any of the survey items difficult to understand?
2. Was the terminology used correct and up-to-date?
3. Were there any items on the survey that would cause you to stop and leave it unfinished?
4. How long did it take you to complete the survey?
5. What is your opinion about the length of the survey?
6. What would compel you to complete this survey if it were to arrive in your email Inbox?

Thank you very much!
Carol Klitzke

Appendix M
Survey Cover Letter

Email subject line: Iowa State University food defense survey

Dear (School Foodservice Director/School Food Authority):

Recent events have underscored the fact that schools, even elementary schools, are targets for violent acts. A threat not often recognized is the harm that could result from attacks on school meals through intentional contamination with harmful substances. The protection of food from such attacks is called food defense.

I am writing to ask your help in a study about food defense in schools. This study will describe what schools are doing to protect children from food tampering. The survey will also ask you questions about your attitudes regarding the risk of terrorism. It can be completed in less than 20 minutes. As a token of appreciation for your participation, you may enter your name in a drawing for a $50 gift certificate to Target.com, amazon.com or the School Nutrition Association Emporium. One drawing will be held for respondents from each of the states included in the survey.

Only public school districts in Wyoming, Montana, South Dakota, North Dakota, Minnesota, and Iowa were chosen for this survey, making your response very important.

If you are not the person with day to day oversight of the school meals program, please forward this message to that person and ask them to respond, or reply to me with the correct contact information.

Results from this study will be used by those who plan training for school foodservice personnel. This study will help target development of training materials.

Your answers are completely confidential. I will have no way to find out who has responded and who has not, so you may receive future emails from me, even if you have already responded. Your name or school district cannot be connected to your answers in any way. Your participation is voluntary. You may refuse to answer some or all of the questions on the survey, but it will be helpful if you answer as many as you can.

If you have questions or comments about this study, please feel free to contact me at 608-796-3661 or cklitzke@iastate.edu. You may also contact my faculty advisor, Dr. Catherine Strohbehn at 515-294-3527 or cstrohbe@iastate.edu

Here is the link that will take you to the survey. By clicking this link you consent to participate: http://humansciences.fooddefense.sgizmo.com/s3/

Thank you in advance for your help with this important study. Protecting children from harm is a charge we all take seriously.

Sincerely,
Carol Klitzke, RD, SNS
Doctoral Candidate in Hospitality Management
College of Human Sciences
Iowa State University

Appendix M
Reminder Email

Recently you received a message with a link to a survey about food defense practices for those in charge of school meal programs in northern states of the U.S. If you have already responded to the survey, please accept my sincere thanks!

If you have not completed the survey, I hope that you will do so today. We will best be able to prevent food tampering if people in charge of child nutrition programs will share their opinions through the survey.

Here is the link that will take you to the survey:
Sincerely,

Carol Klitzke, SNS

Doctoral Candidate in Hospitality Management
College of Human Sciences
Iowa State University
608-796-3661

APPENDIX N

Table N1 *Units of Meaning and Their Sources as Assigned to Subthemes*

Subtheme	Units[a]	Sites[b] ($n = 5$)	Interview sources: Principals ($n = 5$)		Foodservice Directors ($n = 5$)		Emergency Responders ($n = 5$)		Production Workers ($n = 10$)	
			Units	Unique sources	Units	Unique sources	Units	Unique sources	Units	Unique sources
Food defense is an unfamiliar term, but the concept is not.	43	100	14	5	5	3	8	5	18	9
Experience with food tampering was uncommon but not unheard of.	10	100	0	0	5	4	5	4	0	0
Different stakeholders perceive different areas of vulnerability.	47	100	15	5	9	5	2	2	20	7
Food is most vulnerable before it arrives to the site.	8	80	2	2	2	2	1	1	4	1
Food is safe because co-workers are trustworthy.	15	100	2	2	3	2	3	3	8	6
No one would want to attack *our* school.	15	80	3	3	4	3	3	2	5	4
The foodservice operation is perceived as separate from school operations.	16	100	9	3	2	2	4	3	0	0
The foodservice operation is responsible for food defense and the administration is responsible for security.	34	5	17	4	13	4	2	2	5	4

[a]Number of units of meaning within each subtheme. [b] Number of sites from which units of meaning were drawn.

Table N1, cont.

Subtheme	Units[a]	Sites[b] ($n = 5$)	Principals ($n = 5$) Units,	Principals ($n = 5$) Unique sources	Foodservice directors ($n = 5$) Units	Foodservice directors ($n = 5$) Unique sources,	Emergency Responders ($n = 5$) Units,	Emergency Responders ($n = 5$) Unique sources,	Production Workers ($n = 10$) Units,	Production Workers ($n = 10$) Unique sources,
Crisis management planning does not address food hazards.	28	5	17	5	4	3	10	3	0	0
Security is designed to protect children, not food.	25	5	10	5	5	2	4	2	7	5
Community expectations can impede food defense.	6	3	1	1	2	2	1	1	2	2
Column totals (percent of total)	247		90 (36.4)		52 (21.1)		42 (17.0)		67 (27.1)	

[a]Number of units of meaning within each subtheme. [b] Number of sites from which units of meaning were drawn.