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Relationship Between Modality and the Degree of Knowledge Retention in Bioterrorism Training

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Abstract

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MS, Boston University, 2001

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of the Requirements for the Degree of

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Abstract

A public health workforce must be trained to react quickly, especially in the case of terrorist attack. Political leaders and emergency management experts have often cited inadequate emergency training as a contributing factor in the public health system's failed preparations for a bioterrorist event. As a result of these failures, billions of dollars have been allocated towards correcting infrastructure deficiencies including training for public health nurses (PHNs), who are critical to a communitywide medical response. This quantitative study used Pearson's correlation and a multivariate regression analysis to evaluate the most effective modality of bioterrorism training (BTT) for PHNs working in rural communities in North Carolina. Using a conceptual framework created by Handler, Issel, and Turnock, this study compared 3 modalities of instruction (MOI) to seek the best predictor of success in retaining learned bioterrorism skills. The research question focused on whether MOI for BTT/all-hazards training courses significantly predicted the degree of retention of emergency knowledge/skills for PHNs working in public health agencies in North Carolina. A multiple choice survey was used to test 103 PHNs' level of knowledge retention on a bioterrorism quiz. The results of this study were ultimately inconclusive in that no MOI was found to be a statistically significant predictor of retention. Factors such as age were found to be successful predictors of knowledge retention. The readiness issues identified in this study have a potential for positive social change if community decision makers use this information to prioritize future funding for public health professionals or enhance communitywide emergency preparedness education programs.

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Dedication

This work is dedicated to the spirit of my grandmother, Gertrude Crawford, a humble woman of quiet dignity who suffered through the “Jim Crow” South to complete her high school diploma in a segregated Negro high school. Her inspiration towards education compelled me to strive to be the first bachelor’s, master’s, and now doctorate holder in our family. I hope that everything I’ve done has honored and represented you well. Thank you Grandma, I promise to do the same with my Granddaughter.

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I would like to thank my wife, Peggy, for standing by me during this process of achieving a doctoral degree. She served as my guide, my professional peer, and more often a stricter critic of my work than I was. I would also like to thank my family for their continued patience, love, and support throughout this arduous process. They have always been my reason for striving to be the best and my commitment towards achieving those results. Finally, I would like to thank Dr. David Milen, Dr. Lori Demeter, and Dr. Anne Fetter for their guidance, patience, and professional insights in achieving this level in my life. I am truly thankful for everyone support at Walden University.

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Chapter 1: Introduction to the Study

The tragic events revolving around the terrorist attack of September 11, 2001 (9/11) and the subsequent anthrax attacks in October 2001, in which the U.S. Postal Service facilitated the delivery of spore-laden letters to individuals in five states, brought to light significant national and institutional deficiencies in the United States public health system's (PHS's) ability to respond to acts of terrorism. Former Department of Health and Human Services (HHS) Secretary Thompson quickly identified deficiencies in organizational capability and public health care workers' (PHCW's) lack of training as contributing factors in the delayed responses and identification of biological agents (Strongin, 2001). The public fear brought on by the unpredictability of these attacks (which was often exacerbated by overly sensationalistic reporting by the media) placed strains on the national intelligence, law enforcement, and medical communities to "do something" before the next attack (Galamas, 2011). The Gilmore Commission was directed by Congress in October 2001 to investigate the domestic impact of the 9/11 and anthrax attacks and to make recommendations for domestic infrastructure preparedness. The committee released its report in December 2001, titled: *Third Annual Report to the President and the Congress of the Advisory Panel to Assess Domestic Response Capabilities for Terrorism Involving Weapons of Mass Destruction (2001)*. The report revealed that many of the critical public health infrastructure failures identified (in particular advanced emergency training for biohazards) had been common knowledge throughout the public health community for decades. The panel's findings noted that the nation's public health infrastructure was insufficiently funded and unprepared to meet the

challenges of the new terrorism threat (Gursky & Bice, 2012; Keck & Erme, 2012, p. 337).

Between December 2001 and January 2002 the National Association of County and City Health Officials (NACCHO, as cited in Keck & Erme, 2012, p. 323) conducted a random stratified survey sampling of over 2,700 local health agencies to assess the status of each agency's bioterrorism (BT) preparedness plan and its degree of completion. Of the 1,024 respondents, only 12% of the agencies reported having a written plan for BT preparedness or response, and at least 30% stated that they had a plan that was within 80% of completion. The majority of the agencies reported that they lacked the capability to respond to a BT threat due to chronic underfunding from the parent state. Much of this was the result of decades of cost shifting between public health programs (Berger & Moreno, 2010). According to Morse (2002), every state saw a 1% to 2% decrease in personnel and public health funding for its core programs throughout the 1980s (over $14.4 billion of the $903 billion or a decrease of 1.6%). Despite the billions of dollars allocated by Congress to the HHS to shore up a crumbling public health infrastructure against BT threats (Franco, 2009), many state and rural local health departments often had to continue to cost shift to ensure routine services were funded. This left BT preparedness and training programs historically underfunded (Hupert, 2012, p. 243). Prior to the events of 9/11 there had been limited research on the potential impact of this funding shortfall on emergency preparedness for local health departments. This changed as state and federal officials began to access potential threats by terrorist groups (Keck & Erme, 2012, p. 321).

PHCWs, with public health nurses (PHNs) in particular, often lack the requisite knowledge or experience to diagnose biologically contaminated patients (Berger & Moreno, 2010). PHNs represent the largest component of person power (at 35%) within the PHS and they provide the majority of community-based health care services including tuberculosis surveillance, immunization programs, and follow-up screenings after identified disease outbreaks (Potter, Gebbie, & Tilson, 2008, p. 240). The core curriculum for these nurses includes epidemiology, clinical investigation, and statistical analysis courses that are not routinely required in standard registered nurse programs (Tilson and Gebbie, 2004).

This quantitative study evaluated the relevant factors that supported the retention of key emergency skills of PHNs to help to ensure the effectiveness of the medical response to rural communities impacted by acts of biological terrorism. Seminal events of domestic and international terrorism (I discuss this in detail in Chapter 2) since the 1990s have served as catalysts for the growth of emergency preparedness programs. While the field of education and adult learning is vast and well documented, the focus towards linking PHCWs' competencies and skills to specific performance requirements/criteria remains a challenge. Limited studies have been conducted on linking core PHN competencies to specific performance requirements that will ensure retention of emergency skills and knowledge (Grener & Knebel, 2003; Potter et al. 2008; Williams, 2008). This represents a gap in the body of knowledge for PHN professionals working in rural communities who are instrumental in providing support services to communitywide disaster scenarios. By evaluating the relevancy of training modalities, their effectiveness,

and the core competencies that could be enhanced or retained, in this study I sought to develop a predictive statistical model by which public health leaders (PHL) could measure successful outcomes for bioterrorism training (BTT) for nurses. I targeted rural health departments in this study because of the potential for terrorists to use biological agents, which Galamas (2011) described as “silent bioterrorist attacks” (p. 81), against small populations as targets of opportunity. Historically those populations have had a lower potential for detection due to its perceived lower threat posture than the more “protected” major metropolitan areas (Fielding & Plough, 2012, p. 232). By understanding the potential vulnerability of the rural public health infrastructures and the nurses working within these systems, I believe that state governments who have the constitutional power to declare emergencies (Berger & Moreno, 2010; Hodge et al., 2008) will be better prepared to support the process so that can these rural facilities will be able to provide enhanced medical response and support in a time of crisis.

Background

Bioterrorism can be defined as the intentional release of potentially deadly bacteria and/or viruses into the air, food, or water supply to be used by a terrorist group or faction with the intent of causing death, disruption of services, or in making a political statement (Sidel & Levy, 2012, p. 203). Unlike nuclear weapons, which are produced, stored, and strictly regulated under close supervision by governments, biological pathogens exist freely in the open environment and can appear as naturally occurring diseases (i.e. anthrax, smallpox, etc.). As the nation’s national health institute for disease prevention, the Centers for Disease Control and Prevention (CDC, n.d.) groups biological

agents/pathogens into three categories based on degree of lethality, accessibility, and potential as a national threat. Category A consists of high-priority agents and includes organisms or toxins that pose the highest risk to the public because (a) they can be easily transmitted from person to person, (b) have a high death rate, (c) could cause a public health panic, and (d) will require special action for public health preparedness and response. Category B consists of agents that are the second highest priority because (a) they are moderately easy to spread, (b) can result in moderate illness rates and low death rates, and (c) require enhanced disease monitoring. Category C consists of the third highest priority agents and includes emerging pathogens that could be engineered for mass spread in the future because (a) they are easily available, (b) are easily produced and spread, and (c) have potential for high morbidity and mortality rates and major health impact. Samples of these pathogens are maintained under strict control at CDC laboratories in Georgia and at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) in Maryland (CDC, n.d.).

Many of the more lethal pathogens can be altered into weaponized forms that have the ability to be dispersed by aerosols or other modes of dissemination into populated areas (Galamas, 2011). These agents or pathogens can be developed with or without national sanction more cheaply than conventional weapons of mass destruction (WMD) and can be easily transported across porous national borders without detection or impunity (Sidel & Levy, 2012, pp. 203-204). A central attribute for the use of biological weapons is the ability to disseminate disease-producing microorganisms or toxins purposefully through a variety of vectors (modes of disease transmission) that could

cause widespread sickness or death. The scope and impact of a biological attack is dependent on the characteristics of the pathogen, design of its delivery system, type of environment in which it could be introduced, and the effectiveness and timeliness of the public health response (Sidel & Levy, 2012, p. 207). There is little dispute that biological weapons have the capacity to initiate potential epidemics on a grand scale and to a degree of lethality unparalleled in modern history. According to Robinson (as cited in West, Lillibridge, Howard, Grabenstein, Dembek, & Dombrowski, 2010) the World Health Organization (WHO) estimated that a 50-kilogram sample of aerosoled anthrax spores delivered to a city of 500,000 people could kill up to 95,000 people and cause illness in as many as an additional 125,000. The impact of BT in the first decade of the 21st century was less defined in the realm of designing medical educational and emergency preparedness programs than that of conventional terrorism as an intelligence or law enforcement phenomena that has been heavily cited in literature reviews or studies (Sidel & Levy, 2012, p. 221).

One of the most commonly predicted scenarios constructed by emergency planners following a BT event was that victims requiring immediate medical attention would likely overburden both the hospital and public health care services at the local level and rapidly exhaust available resources in a matter of days (Dembek, 2005, p. 30). Other scenarios include multiple attacks, attacks disguised as natural occurring events, attacks with a combination of pathogens, and a large-scale direct attack (pp. 25-26). Much of this would be attributed to a lack of specialized knowledge by the PHCWs on disease identification and treatment protocols and the lack of public health information

available to community on disaster management (Aung & Whittaker, 2010). While the majority of the national emergency response scenarios were formed around naturally occurring events (fire, earthquake, and weather), the new dynamic of BT created unknown or unprepared variables for emergency professionals, PHCWs, and the public to adapt to. The additional complication of nonexistent funding among rural public health agencies to augment their training beyond the requirements of maintaining nurse's professional licensure is a critical gap. These PHNs are often the first contact for local health support (Jakeway, LaRose, Cary, & Schumacher, 2008). It is therefore important to provide the advanced training for nurses who will be on the front line of a potential biological incident as members of the of the initial assessment team (Polivka et al., 2008). Identifying gaps in this training will be valuable in validating the appropriate requirements for core competencies for PHNs.

Problem Statement

Lawmakers and emergency management leaders viewed an inadequately trained PHCW work force as a contributing factor in the failure of the PHS after the 2001 anthrax attacks (Gottron & Shea, 2011; Keck & Erme, 2012, p. 322). Measuring the effectiveness of BTT towards meeting emergency core competencies for PHNs remains largely unsubstantiated despite the congressionally mandatory requirements for the states to establish BT response programs and training (Lister, 2005). Unfortunately, the level of success has not remained consistent over time. In 2010, the White House and Congress both received a failing grade in supporting BT readiness (Graham & Talent, 2010; West et al., 2010).

Many rural health organizations continue to lack the appropriate funding to upgrade their nurses' emergency preparedness skills due to a lack of federal funding that tapered off after 2008 (Franco & Sell, 2010). Local PHL are faced with the option of looking for the most cost-effective methods to train their PHN staff. In this quantitative study, I evaluated the effectiveness of the different BTT modalities (independent variables) and attempted to predict (via regression analysis) the most successful MOI to assist in the retention of learned skills (dependent variable) by PHNs. Based on my findings I believe the results of this study could help smaller facilities with limited budgets opt for more cost-effective BTT via nontraditional modes (web based, asynchronous, simulation, etc.) that would optimize and maintain the PHNs' emergency preparedness skills. Limited research has been conducted on linking modes of BTT to predictive models for improving core and emergency competencies of PHNs. The supposition that improvement in PHN BT skills will have a direct and positive correlation towards an improvement of community health outcomes has also been largely unsubstantiated, with less than 5% of PHCWs feeling they have the appropriate training to care for BT victims (Keck & Erme, 2012, p. 323). In this study, I evaluated the relationship between modality of training and the level of BT/all hazards knowledge/skill retention for PHNs working in rural communities.

Purpose of the Study

The growth of the emergency management profession after 9/11 has spawned an industry of training programs that include self-taught, instructor-led, in-service training; college-level courses; and Internet-based services (Alexander, Wallace, Wilfert, &

Horney, 2007; Dembek, Iton, & Hansen, 2005). These courses provide users of all specialties with a variety of resources on emergency management and all hazards response protocols. PHLs are faced with the challenge of evaluating these resources to find the most cost-effective BTT/all hazards training (AHT) for their staffs. The purpose of this quantitative study was to evaluate and understand how various training modalities or methods of instruction (MOIs)—the primary independent variable, as defined as I_1 = *traditional brick-and-mortar classroom*, I_2 = *blended training* (equally balanced between brick-and-mortar and online learning), and I_3 = *web-based online learning* —were related to the degree of retention of BT/emergency response skills for PHNs—the dependent variable, as measured as by a memory recall quiz based on previously completed training. This relationship was statistically evaluated using a Pearson correlation coefficient and a multiple linear regression analysis of the primary (MOIs) and secondary (age, level of education, and experience as a PHN) independent variables (I discuss the findings in Chapter 4).

In this study, I focused on establishing which MOI most positively correlated with the degree of retention of BT/all hazards emergency skills for PHNs working in rural health departments in North Carolina. I discuss other independent variables in Chapters 2 and 3. These PHNs are defined as PHCWs who have a first responder responsibility to identify, evaluate, and triage initial casualties during a BT incident. In this study, I attempted to determine which MOI was more likely to be statistically significant in predicting a positive degree of retention amongst PHNs based on collected data from a

targeted survey that included a memory quiz to measure knowledge acquired from completed BTT/AHT.

Conceptual Framework

The overarching issue for this study was the relationship among BTT in various MOI programs and the degree of information retention in the emergency competencies of PHNs. Central to my premise was the argument that PHNs in smaller and more rural communities need viable BTT programs (or alternatives) that could enhance their competencies in emergency response and prepare their facilities for the consequences of a BT attack. In this study I used a conceptual framework based on work conducted by Handler, Issel, and Turnock (2001), who measured the levels of PHCWs' performance in direct relation to 10 essential public health services or indicators that support improved community public health quality outcomes. I used Handler et al.'s framework throughout this study because of its adaptability to a broad spectrum of PHS settings, including emergency preparedness and training program management.

Handler et al.'s (2001) framework would suggest that ensuring the effectiveness of the services of the PHS was an iterative process that used functional feedback loops to support five key domains that assured the system was functioning towards meeting community health quality needs. These domains included

- a macro context of external environment or socio-ecological factors,
- the mission or philosophy of the health care organization,
- the capacity of the cumulative resources (the workforce and their skill levels),
- the processes essential to provide health services, and

- outcomes or indicators of effectiveness and quality.

I adopted a variation of Handler et al.'s (2001) framework that was used by Avery and Zabriskie-Timmerman in a 2009 quantitative study that applied BTT funding, community leadership, and preparedness to a hypothetical model used to predict community health outcomes. Handler et al.'s framework's functionality was based on the ability to adapt to varying organizational or structural changes down to the department level (Avery & Zabriskie-Timmerman, 2009). Avery and Zabriskie-Timmerman's adaptation of Handler et al.'s model was incorporated into this study to show BTT (via a BT quiz score) as an input variable to prove retention of emergency knowledge. I felt that understanding the institutional context of how the socioecological determinates of health (policymaking, social factors, health services, individual behavior, and biology and genetics) shape the organization would determine how successfully different training modalities could be implemented (Richmond, Hostler, Leeman, & King, 2010). Examples of this were noted throughout the review of literature (which I discuss in Chapter 2) to include advancements in technology that expanded high speed Internet services to rural communities (Grener & Knebel, 2003; Potter et al. 2008; Williams, 2008). The option of Internet-based training for staff members enabled workers to complete training when they were unable to travel to traditionally based programs or courses that were geographically unavailable. Once a training program had been developed, a system of performance standards or metrics was required to evaluate and validate the training's effectiveness and degree of information retention among PHNs. Handler et al.'s framework provided the support construct to evaluate performance based

on feedback to system users to establish community outcomes of effectiveness, efficiency, and equity of services. Once developed, a system of performance standards or metrics needs to be maintained in order to validate program effectiveness, assure quality performance, and to assess the degree of information retention among PHNs (Handler et al., 2001).

Nature of the Study

In this quantitative study, I sought to determine the predictability of three MOIs that were related to PHNs' degree of retention of information, which would implicitly inform their responses to BT events. In this study I used a quantitative cross-sectional approach using a targeted survey of PHNs (n = 103) from rural communities in North Carolina. The sample size was calculated based on an effect size of 0.25 that resulted in a power of 0.80 (I provide more details in Chapter 3). This nonexperimental approach provided a cross-sectional view of a broad selection of rural PHNs who had taken courses in emergency preparedness to meet their professional nursing requirements. Participating nurses were tested on their knowledge of BT based on previously completed training. I asked the nurses a series of questions pertaining to their understanding of emergency protocols, tested their knowledge of BT, and asked them to self assess their preferred method of learning and level of comfort in applying these retained skills to a potential emergency situation. Other independent variables such as age of participants, sex, educational attainment levels, and race were also evaluated to determine their relationships to adult learning and retention of information by PHNs (I include a detailed overview in Chapter 2).

At over 50,000 full-time equivalents strong, PHNs represent the largest percentage (35%) of medical personnel in the United States PHS (Potter et. al, 2010, p. 247). At the community level, PHNs are often represented in a 4:1 ratio to physicians (Rosenstock, Helsing, & Rimer, 2011). The sample base of this survey was limited to senior PHNs who often serve as gatekeepers into the rural PHS at the community level in North Carolina and have a responsibility to support organizational training. The data from the targeted online survey were analyzed to determine the predictability of the MOI in retaining critical emergency competencies and skill acquisition obtained through a BTT course completed within 2 years of the memory retention quiz. The findings from this analysis (I provide details in Chapter 4) were specific to PHNs who had completed a BTT/AHT course and achieved a specified score on a memory quiz (I provide details in Chapter 3) that was included as part of the target survey.

I chose a cross-sectional design to encompass the differing types of PHNs in the community based on the three-tiered model for PHN experience from the Quad Council of Public Health Nursing (to be referred as the Quad Council throughout this study; Quad Council, 2011), which is comprised of various nursing and public health professional groups. The Quad Council (2011) was founded in the early 1980s “to address priorities for public health nursing education, practice, leadership, and research and as the voice for public health nursing” (p. 1). The three tiers are based on proficiencies obtained from education sources and experience on the job. Tier 1 PHNs are basic or generalists who carry out day-to-day operations within public health departments and have basic nursing competencies but no management responsibilities (Quad Council, 2011). Tier 2 PHNs

serve in management and supervisory roles and conduct implementation and evaluation of public health programs at the local health department level (Quad Council, 2011). Tier 3 PHNs are executive-level managers who typically have staff reporting to them and may be responsible for major programs at the local and state and levels (Quad Council, 2011). At each of the three tiers, there are varying levels of education, experience, and roles and responsibilities (Quad Council, 2011). For the purpose of this study, PHNs from each tier were grouped randomly by region and assessed for BT/all hazard knowledge using Tier 1 as the baseline criteria of nursing performance for all PHNs. For this reason, there was no specific differentiation between the tier groups during the data collection and analysis phase of this study (I discuss a detailed summary of data collection and analysis in Chapter 3).

To narrow the focus of this study, I chose a state with a high percentage of rural communities based on the United States Census (USC; 2010). The state of North Carolina was chosen from among four other states on the East Coast of the United States that had a large percent of their populations living in or near rural communities (USC, 2010). With a population of a little more than 4,800 registered PHNs (North Carolina Board of Nursing, n.d.), a quantitative approach was deemed to be the most appropriate methodology in managing the anticipated survey data.

The study consisted of a targeted online survey of a sample of midlevel and senior PHNs working within the 10 designated regions that encompass the 100 counties of North Carolina. Within these counties, there are 85 public health agencies that provided community-based health care to poor and underserved populations (North Carolina Board

of Nursing, n.d.). For the purpose of this study, I sent invitation e-mails to PHLs of each county health agency with information detailing the scope of the study and a request that they forward a supplied consent form (with website link) to their nursing staff to participate in the study. The e-mail and consent form served as informed consent for the PHNs on their staff (I provide a detailed description of this process in Chapter 3). Selected midlevel and senior PHNs (n = 103) completed a four-section multiple-choice questionnaire that was used to collect data to address the research question and the null and alternative hypotheses. Section 1 consisted of a demographic section that assessed where the PHNs worked, their level of education, and other general demographic statistics. Section 2 accessed core/emergency nursing competencies using a 5-point Likert scale to establish levels of confidence in performing basic/emergency nursing skills. Section 3 included a 15-question multiple-choice memory retention quiz that evaluated the PHNs level of knowledge of BT/all hazards response protocols they received at least 2 years after completing a standardized BTT course that covered the eight categories of emergency training recognized by the CDC. The quiz provided immediate feedback by giving the participant the correct answer. Participants were then asked to indicate how they learned or acquired the knowledge/skill required to answer the quiz question via an additional set of questions. The final section questionnaire asked specific questions about the type of BT/AHT completed, when they completed BT/AHT, and their preferred learning style. Data collection was accomplished through the online service Survey Monkey over a 6-week period in the summer of 2014. The link to the website was made

available for participants to use a secure network to conduct the survey and submit their responses. By collecting online data, there was much less chance of data entry errors.

The dependent variable of this study was the degree of retention of BT/all hazards knowledge/skills North Carolina PHNs received through previously completed BTT. Retention was measured as the percentage of correct answers on a memory retention quiz. Scores above 70% represented a successful degree of memory retention for the PHN. In this study I attempted to understand the relationships between the PHNs' different training MOIs (the primary independent variable) and them meeting their desired professional competency levels and retaining perishable skills. A Pearson correlation analysis and multiple regression analysis were conducted on survey results (including memory quiz) to establish any predictive (statistically significant) trends from the MOIs that could determine the most successful training methodology based on knowledge/skill acquisition and retention. I provide a detailed summation of the data collection, analysis, and interpretation processes, as well as ethical considerations and Walden's Institutional Review Board (IRB) approval in Chapter 3, and a copy of IRB approval letter and approval number is included in Appendix (A).

Research Questions and Hypotheses

This study centered on one research question, which was used to evaluate and validate which MOI used to teach BT/AHT could best predict the degree of emergency knowledge/skill retention for PHNs working in rural health departments in North Carolina. The MOIs are defined as *x*, *y*, *z*, which are defined as (*x*) I_1 = traditional brick-and-mortar classroom, (*y*) I_2 = blended training (equally balanced between brick-and-

mortar and online learning), and (*z*) I_3 = web-based online asynchronous learning. The sample was drawn from rural communities in 10 public health regions in North Carolina and was oversampled to allow for power maintenance and a projected rate of return of at 25%. Previous studies conducted by the University of North Carolina at Chapel Hill netted similar returns from the public health community (Alexander, Horney, Murkiewitz, & MacDonald, 2010).

Research Question: Does the independent variable (MOI, *x*, *y*, or *z*) for BT/AHT courses statistically significantly predict the dependent variable (degree of retention of emergency knowledge/skills for PHNs, as measured by a memory quiz and an assessment survey in terms of percent) working in rural public health agencies in North Carolina?

$H_0$1: The independent variable (MOI) for BT/AHT courses does not statistically significantly predict the dependent variable (the degree of retention of emergency knowledge/skills for PHNs as measured by a memory quiz in terms of percent) and all beta (β) coefficient values are not significantly statistically different from zero.

H_A1: The independent variable (MOI) for BT/AHT courses statistically significantly predicts the independent variable (the degree of retention of emergency knowledge/skills for PHNs, as measured by a memory quiz in terms of percent) and at least one beta (β) coefficient value is significantly statistically different from zero.

My central premise of this question was to evaluate if one or more MOIs had a more statistically significant relationship with the degree of information retention and skill acquisition of basic and emergency preparedness knowledge/competencies for PHNs

in rural North Carolina. The findings from this study could have functional implications for PHLs requesting additional funding for training and investment in high-end purchases such as community high-speed Internet and network resources (Avery & Zebriske-Timmerman, 2009; Hartwig et al., 2009; Mayer, 2003; Olson et al., 2008). Theoretically, this should result in improved community readiness through the greater ability to rapidly identify, inform, and coordinate victims of a BT event.

Definitions of Terms

The following terms and definitions are provided as a tool and basis for understanding the concepts, ideas, and theories in reference to depicting information specific to the public PHS, public health nursing, adult learning theories, and emergency preparedness concepts.

Asynchronous learning: Used as a student-centered teaching method that uses online learning resources to facilitate information sharing to a network of people. Students and instructors do not have to be online at the same time; rather they interact through a series of threaded communication forums. It can be used to facilitate learning in traditional on-campus education, distance education, and continuing education programs (Picciano, 2009).

Blended learning: A learning methodology that recognizes that learners represent different generations, different personality types, and different learning styles and applies a merged approach to be more conductive to the individual's need. Blended learning is education that combines face-to-face classroom methods with computer-mediated activities (Picciano, 2009).

Cognitive structures: Learning pathways that describe the chosen route taken by a learner through a range of e-learning activities that allows them to build knowledge progressively. Because learners have unique knowledge structures based upon their experiences and abilities, the ways that they choose to access, interact, and interrelate messages in interactive courseware also vary (Van Merrienboer & Sweller, 2010).

Essential public health services: The CDC and a task force of public health subject matter experts created 10 essential indicators of health services quality for public health organizations. These indicators serve to validate the effectiveness of public health programs that have a direct relationship to improving community health readiness (CDC, n.d.; Handler et al., 2001; Novick & Morrow, 2008, pp. 43-50).

Evidence-based medicine: The conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. It seeks to assess the strength of the evidence of risks and benefits of treatments (including lack of treatment) and diagnostic tests. This helps clinicians predict whether a treatment will do more good than harm (Huntington, & Gavaga, 2011; Potter et al., 2010).

Gilmore Commission: This commission was empowered by Congress between 1999 and 2003 as an advisory panel on the issues of terrorism and use of WMDs. This commission helped establish many of the mandated reporting requirements for state BTT programs (Gursky & Bice, 2012).

Instructional system design: The practice of creating instructional experiences that make the acquisition of knowledge and skill more efficient, effective, and appealing to the learner. The process consists broadly of determining the current state and needs of

the learner, defining the end goal of instruction, and creating some *intervention* to assist in the transition (Stiller, Freitag, Zinnbauer, & Freitag, 2009).

Modality affect: A term used most often in the fields dealing with memory and learning, to refer to how learner performance depends on the presentation mode of studied items *(*McNeill, Doolittle, & Hicks, 2009).

Multiple modalities: Multiple modalities allow students to experience learning in ways in which they are most comfortable while also challenging them to experience and learn in other ways as well. Critical to this model is the concept that academic program and course goals and objectives to drive the pedagogical (process of teaching) and andragogical (adult learning) approaches and technologies used (Picciano, 2009).

Rural community: A city, town, or local jurisdiction supporting fewer than 75,000 people according the 2010 USC. Rural community definition was determined by per capita and economic demographics of the permanent population (USC, 2010).

Socioecological: This model considers the complex interplay between individual, relationship, community, and societal factors. It allows one to address the factors that have a determinate relationship to health care quality based on essential public health indicators (Potter et al., 2008, p. 253; Rosenstock et al., 2011)

Assumptions

The impact of 9/11 prompted a substantial growth in the emergency preparedness industry in the areas of training courses, certifications, and associations' membership dedicated to the Department of Homeland Security (DHS) and emergency response (Fielding & Plough, 2012, p. 230). Organizations such as the Federal Emergency

Management Agency (FEMA) and its training branch the Emergency Management Institute (EMI) provide a myriad of free and low-cost training course in homeland security, emergency preparedness, and incident response protocols to support the DHS's National Response Framework (NRF). The CDC headquartered in Washington, DC provides basic and advanced public health information on biological agents and BT response protocols on its website. With this growth and accessibility to BT-related information, I made a key assumption that information and courses would be available for access through open source review (i.e. professional journals, the Internet, or professional associations). Information obtained through this process was assumed to be vetted or critically reviewed for scholarly content and accuracy of source material. No college-level graduate medical education-level courses or continuing nursing education association-based courses were required for this study, and Walden's IRB permission was not needed to obtain access to course curriculum for scholarly review. The permission of the authors was obtained to use the figures or charts included in this study.

My second assumption was that there would be a continued interest by public health professionals at the state and local community levels on how to be prepared for a potential BT attack and find cost-effective methods to train their nursing staffs. Despite the infrequency of attacks in the past decade, emergency management professionals recognize that rural regions represent a prime target of opportunity for attacks by terrorist groups due to their limited resources and infrastructure, isolation from metropolitan areas, and the high potentials of casualties produced (Fielding & Plough, 2012, p. 232).

In addition, there is still the potential for a random attack that would fit into the unpredictable nature of an asymmetric attack.

My final assumption was that PHNs recognize that their precarious position within the community may place them in the role of first responders in the event of a communitywide BT disaster. With this in mind, it was assumed that the participants of the study would wish to have a higher degree of training, insight, and working knowledge to recognize and identify biological agents, their signs and symptoms, and what resulting therapies could be adapted for community use prior to the patient receiving definitive care in the hospital. PHNs also have an innate duty and responsibility to educate the community. A survey of this magnitude may serve as a value added tool in convincing PHLs on the validity of funding BT/all hazards emergency preparedness training.

Delimitations

For the purpose of this study, my sample base for selecting participants included PHNs who work in rural communities in the state of North Carolina. These nurses were primarily working in community-based health agencies. The sampling included nurses of various educational and practice experience. The large percentage of women in the nursing profession should have reflected a higher ratio of women to men as part of the sample base. Maintaining control at all key transaction points and providing clear survey questionnaire instructions was invaluable in limiting incomplete survey results.

Limitations

This study attempted to conduct a statewide evaluation of a sample of Tier 1, 2, and 3 PHNs in rural communities in North Carolina and assess their degree of retention

of BT/all hazards knowledge received through previous training. The study also evaluated the MOI used to complete this training and its relationship towards enhancing the retention of emergency skills/knowledge. A limiting factor to this study was the level of cooperation and interest received from PHLs from local health agencies. I discussed and clearly defined what the study entailed or what I hoped to accomplish in the invitation e-mail, which included an information brief of the study's scope and goals for each community health director. A potential concern of how the collected data would be used was addressed in the invitation e-mail in order to reduce rejection. An example could be the fear that study data could negatively impact future funding. This could have had the potential for political ramifications for appointed PHLs. Several PHLs consulted their legal counsel for recommendations on whether to participate in the study.

The threat to validity and reliability of the data came in the forms of internal and external validity issues. The key threat to external validity was that any mistakes or misinterpretation of my intent for the survey could cause a backlash against the study. The public health community is tight knit and that would quickly discredit any study it deemed as potentially threatening to their funding, violating patient privacy, or painting their organization in a negative light. As a result, the face validity had to be strong. To reduce this threat to validity, an information brief was sent as an attachment to the invitation e-mail to PHLs including informed consent and a link to the survey that would explain the process and anticipated goals, biases, historical incidences, and distribution and prevention of mishandling of surveys. The challenge was to establish a similar base

for comparison between similar PHS and widely disparate organizations. Several agencies PHLs had overlapping authority that covered by geographical areas.

A final limitation to this study could be the oversaturation of BT- and terrorism-related studies conducted after the events of 9/11. My focus in this study was a niche subject regarding the retention of BT/AHT skills for nurses. My goal for this study was to show why it would be a valuable expenditure of time and what expected end goals would be achieved through its evaluation.

Scope of the Study

The scope of this quantitative study was to evaluate the relationship between the degree of retention of emergency information/training received by PHNs working in rural communities in the state of North Carolina and the MOI used to conduct this training. Key to this study was an analysis of the effectiveness of BT/AHT in meeting the emergency competencies for PHNs based on the MOI, the PHNs' preferred style of learning, and their comprehension of the subject matter. Using a tailored survey to collect data from community PHNs, my original premise for this study was to analyze the collected data using a regression analysis to develop a predictive model based on the most prescribed MOI. This would enable rural public health organizations to choose the most cost-effective BT/AHT program that would meet the organization’s missions based on retention of essential emergency skills. I conducted a Pearson correlation coefficient analysis on the primary (three prescribed MOIs) and secondary (age, years of education, and years in the PH profession) independent variables to establish that their relationships were statistically significant to move forward with a regression analysis. None of the

primary variables rejected the null hypothesis for this study and only the participants' age was found to reject the null hypothesis in favor of having a predictable relationship towards success in retention of emergency skills based on a memory quiz completed by the participant.

Despite an initial concern for the validity of the study based on the findings of the Pearson correlation analysis I ran a multiple regression analysis on the primary and secondary independent variables using the bioterrorism quiz score as the dependent variable to test the relationship between the prescribed MOI used by the participants to receive BTT. As confirmed by the Pearson coefficient analysis, only age of the participant was found to be statistically significant in predicting a level of retention of skill or knowledge in PHNs surveyed. While the original premise of this study failed to establish a predictive model based on MOI, it is important to note that many of the empirical findings of this study on the emergency training needs of the public health nursing community remain unmet. I outline the implications of my findings from this study in Chapter 5.

Significance of the Study

The social significance of this study was in making PHLs aware of the gaps in their emergency preparedness training programs that could be exploited by terrorist groups and in helping agencies enhance their ability to prepare their communities for a biological attack. I believe this study could be important for PHLs who may need to leverage limited resources and training dollars to prepare their organizations for the worse types of scenarios. In the over fourteen years since the 2001 anthrax attacks, the

United States' attention on BTT has waned and continues to leave rural communities vulnerable. Without some degree of situational awareness, the first signs of an attack could be several contaminated people showing up to the emergency rooms with similar unusual symptoms that may not be immediately indicative of a biological agent (Galamas, 2011). It will take a trained and observant nursing staff to recognize the early symptoms of a BT epidemic and provide the appropriate notification.

I believe this study has the potential for real-world implications for use. One of the more insidious scenarios depicted by emergency preparedness professionals is the release of a biological agent into a small community that lacks the coordinated resources and response capabilities of a metropolitan area. Most disease producing agents take days to incubate and show significant symptoms and most rural PHSs are ill prepared to deal with the scope and reality of such an event (Galamas, 2011). The findings from this study could be important for professional emergency planners who may be able to assess and identify intelligence indication and warnings based on compiled data and identified trends. This would allow planners and PHL to better leverage limited rural resources into resource sharing agreements or memorandums of understanding for mutual support (Fielding & Plough, 2012, p. 235). Ultimately rural communities may be in a better position as they wait for the federal government to respond. While this study may not change the world, it may make PHLs aware of their surroundings and communities. Complacency is the terrorists' greatest asset in achieving their objectives of using minimal effort to achieve great results. After over 30 years in the field of emergency management, I am convinced that a level of situational awareness gives a person the

options to determine the best avenues to turn during an emergency. Our public health organizations should be one place to turn.

Summary

The impact of terrorism and its by product BT is a form of nontraditional warfare that is often the product of non nation state actors who wish to enact social change through deliberate acts of violence. The goal of the PHS is to leverage medical skills, community health awareness, and coordination to provide for disease surveillance and mitigation. The PHS has struggled with a deteriorative infrastructure, poor cost saving ratios, and an understaffed work force that is over worked, under compensated, and often ill trained to handle the myriad of new and evolving public health threats.

In this study I attempted to evaluate the educational aspects of providing PHNs with adequate BTT to help mitigate potential future attacks on rural communities. Despite the billions of dollars allocated to the medical and public health communities in the aftermath of 9/11, it is still considered insufficient in addressing the needs of a system plagued by decades of economic cost shifting. In Chapter 1 I provided a justification for the need for this proposed study and the anticipated outcomes of the research. In Chapter 2 I provide an overview of the literature review conducted with areas concentrating on BT as an emerging community threat, understanding the core competencies that PHNs require, and understanding the different training modalities used to deliver educational content. In Chapter 3, I focus on the quantitative methodologies used to construct my conceptual framework for my research.

In Chapter 4 I describe the results of the six week study conducted with PHNs in North Carolina who completed the Internet survey. Chapter 4 is arranged around the breakout of survey results by the four sections of the questionnaire. The results of Pearson's correlation coefficient and multiple regression analyses are provided. The statistical tests reject or fail to reject the null hypotheses. In Chapter 5 I provide an interpretation of the research findings, offers recommendations for action, and explains the implications for social change.

Chapter 2: Literature Review

I conducted this literature review in an attempt to identify a gap in the literature so that I could create a research question to address this gap. My research question was designed to quantify the data collected for this study, in order to address the identified gap in the literature. The need to prepare PHNs to treat patients impacted by terrorism and its subcomponent of BT initially broadened after the events of 9/11 and has since waned as funding and interest has decreased (Gursky & Bice, 2012). The concern towards ensuring that community public health organizations are prepared to meet the challenge has grown while initial federal funding rose and then receded. The Walden University Library's services were extensively used as the primary source for scientifically based scholarly information used to conduct this review of relevant literature. Peer-reviewed journals, articles, and data on the subject matter areas of health sciences and nursing, public administration, adult learning and instructional modalities, and BT programs were reviewed and evaluated for content. I also reviewed previous Walden dissertations pertaining to areas of BT, community public health, and educational and curriculum analysis for relevant content and supporting references.

Specific databases such as ProQuest, SocINDEX, Google Scholar, Academic Search Premier, Business Sage, Cumulative Index to Nursing & Allied Health Literature, Nursing & Allied Health Source database, Medline, PubMed, and the International Security and Counterterrorism System sites were all invaluable in the areas of the history of BT, PHN, and other areas of the technical and sociological aspects of terrorism. More general databases on nursing, medical systems and the United States PHS were found

throughout Walden's online library. I focused on specific keywords such as *bioterrorism, public health, training modalities, core competencies; public health nursing; skill acquisition, knowledge retention, community health, public health care workforce, ten essential public health services, community readiness,* and *the impact of bioterrorism* to further narrow my search parameters along specific objectives. This allowed me to collect over 100 relevant and recent articles in peer-reviewed journals or sources that helped me to identify a gap in the existing nomothetic network and further narrow the focus of my study from the entire PHS to a more specific topic of PHNs and their degree of retention of BTT information. This allowed me to break this literature review into three key areas or subtopics: (a) understanding BT as an emerging public health and community threat, (b) core competencies in educating PHNs, and finally (c) an evaluation of BTT. Several older references were considered seminal or landmark works that exceeded Walden University policy for references less than 5 years old; however, their content value was critical to this study and I have used them sparingly throughout this literature review.

Existing Gap in the Literature

The topic of educating the PHCWs in emergency protocols has seen a significant rise since the 1990s (Gursky & Bice, 2012). Seminal events such as the Oklahoma City bombings in 1995, the 2000 Centennial Olympic Park bombing in Atlanta, the attack on the U.S.S. *Cole* in the of Yemen in 2000, and 9/11emphasized the growth of terrorism by domestic and non-nation state actors. These events served as a catalyst for the growth of emergency preparedness programs. The events of 9/11 and the adoption of the homeland

security concept have made emergency preparedness, continuity of government, and all hazards awareness programs a necessity for all aspects of the federal government emergency response posture (Gursky & Bice, 2012; Kahn, 2011).

For this literature review, I reviewed emergency preparedness and BTT from a broad national perspective and narrowed the focus down to specific topics at the state and local levels that often lacked the specificity within the body of knowledge. While the field of education and adult learning is vast and well-documented, the focus towards linking PHCWs' competencies and skills to specific performance requirements/criteria remains a challenge. Historically, the government has grouped PHCWs together with other health care workers as a homogeneous group because public health was seen as a subspecialty because many of the skills at the basic level were generically similar (Potter et al., 2008, p. 226). In past generations, this has often led to non-public health trained professionals working in underserved areas based on provider need rather than clinical competence (Tilson & Gebbie, 2004). Today, with fewer PHCWs entering into the market, there is a need for a more specialized professional who not only understands disease surveillance but can apply evidence-based medicine and standards to community based programs to improve clinical outcomes (Potter et al., 2008, p. 247).

In this literature review, I address the degree of the retention of information from emergency training for PHNs in BT/all hazards awareness. While there have been significant studies conducted for physicians and medical residents who work in larger metropolitan health care systems, there are only limited studies conducted with PHNs in more rural communities (Rebmann & Mohl, 2010; Sidel & Levy, 2012; West et al.,

2010). Limited studies have been conducted on linking core PHN competencies to specific performance requirements that would ensure retention of emergency skills and knowledge. This study attempted to add to the body of knowledge for PHNs working in rural communities to close the gap that currently exists.

Relevance of the Literature to the Research Question

9/11 and the subsequent anthrax attacks hit the United States at its most critical and weakest link: its civilian population. Modern terrorism in all its manifestations is a form of nontraditional warfare that has flourished over the past 35 years amongst non-nation-state actors who have not been subject to national or political hegemony that guides established nation-states (Galamas, 2011). The scope of this quantitative study was not to explore the complicated nature of terrorism or BT tactics in detail, but rather to evaluate BTT in relation to the degree of retention of emergency competencies for rural PHN based on their mode of instruction. This may prove critical to public health professionals who will be charged with protecting an unsuspecting civilian population during a BT event.

Former speaker of the Iranian parliament (and future president), Rafsanjani coined the phrase “poor man's atomic bomb,” in 1988 when he spoke of his country being able to easily produce chemical and biological weapons (Croddy, 2002, p. 9). That phrase, its implications, and its ability to instill fear amongst potential victims can have a long-lasting effect on a population (Galamas, 2011). Unlike traditional terrorist methodologies such as car bombings or even chemical weapons, biological pathogens can cause delayed illness and/or death that may not occur until weeks after the attack.

Biological agents can contaminate food stocks that can indirectly affect more people than a bomb or other direct attack. A 2004 study conducted by WHO estimated that casualties in excess of 95,000 could result from a moderate sample of aerosolized anthrax spores (West et al., 2010). The anthrax attack in 2001 identified significant gaps in the protection protocols of U.S. metropolitan and community readiness systems related to a lack of training of U.S. medical providers (Gursky & Bice, 2012). In 2010, the U.S. Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism gave the Obama Administration and Congress a failing grade for BT readiness (Graham & Talent, 2010; West et al., 2010). In this study, I addressed the degree of retention of information on BTT for rural PHNs in relation to MOI.

BT as an Emerging Public Health Threat

BT from an Abbreviated Historical Context

From a historical retrospective, the use of biological agents to produce diseases in humans has been documented as a tactic of warfare since the early 14th century (Sidel & Levy, 2012, p. 207). The ancient Tartars (primarily ethnic Turks who lived in present-day Ukraine) catapulted bubonic plague-ridden bodies of their enemies over the walled city of Kaffa (CDC, n.d.; Kostadinov & Galabova, 2010; Sidel & Levy, 2012, p. 207). This tactic of “poisoning the well” or sickening an enemy has been used throughout human history to spread fear and wide-scale death, which could be used to destabilize governments and invoke sociopolitical change (Kostadinov & Galabova, 2010). While the mechanism of disease transmission was unknown to the early users of these tactics,

the causal effect and impact made by this form of warfare was evident to terrified users and victims alike (Kostadinov & Galabova, 2010).

The evolution of BT as a nontraditional weapon of war has been limited and not clearly understood or used as a deliberate weapon of warfare until the 20th century. The limited application of biological weapons during World Wars I and II by the Japanese, Germans, Russians, and the United States seemed to be guided by a sense of fear or perhaps inspired wisdom. The potential for an uncontrolled release of an agent into the surrounding communities was a consequence many nations were unable or unwilling to support (Sidel & Levy, 2012, pp. 207-208). In 1969, President Nixon banned the continued development of biological weapons by the United States and ordered the destruction of strategic stockpiles of existing weapons (Sidel & Levy, 2012, p. 208; Tucker & Mahan, 2009). Unfortunately, other countries and non nation state actors did not follow the United States' lead and have often taken advantage of this treaty. The former Soviet Union continued developing biological agents as weapons up until the end of the Cold War and employed over 42,000 scientists at the height of its production efforts (Sidel & Levy, 2012, p. 209). The loss of the post Soviet Union hegemony amongst its former protectorate states saw many of the former government biotoxin laboratories abandoned and ransacked. This era opened the door for biological weapons to leave the strict control of the government (Tucker & Mahan, 2009). By the end of the Cold War, most Western nations had established treaties that limited the development or deployment of biological weapons against population centers (Bučka, Žák, & Nečas, 2010; Sidel & Levy, 2012, p. 207).

The growth of non nation state actors in the late 1970s precipitated the expansion of a form of nontraditional warfare doctrine that did not require large armies, strategic nuclear arsenals, or overall power over the parent country. What did evolve was the potential for creating wide scale panic amongst the populations placed at risk by potential unsuspected man-made plagues produced and released by a small number of terrorist factions (Galamas, 2011). This growth saw the potential of using biological weapons as an inexpensive way of entering the international field as a recognized actor. Galamas (2011) discussed this adaptation by terrorist groups (the Palestine Liberation Organization for example) as a means to establish limited legitimacy that could not be obtained by use of other methods of terror. By the mid-1990s, the growth of terrorist groups in the United States, the Middle East, and the Far East began to adopt alternative terrorist methodologies to achieve their goals. The 1995 attacks on the Tokyo subway (by the Japanese extremist cult *Aum Shinrikyo*) and on the Murrow building in Oklahoma City (by domestic terrorist McVey) helped to galvanize the United States' decision to enhance its terrorism posture. President Clinton signed Presidential Decision Directive (PDD-39) in 1996 to increase federal funding towards terrorism training, infrastructure improvement, and overall recognition that the BT and other forms of terrorism would be a part of the national discussion for the foreseeable future (Keck & Erme, 2012, p. 321). In 2000, Congress passed the Public Health Threats and Emergencies Act (P.L. 106-505) which allocated funding to public health organizations to improve hospital infrastructure, the creation of a dedicated emergency preparedness programs, and BTT (Berger & Moreno, 2010; Franco, 2009; Franco & Sell, 2010; Lister, 2011).

The impact and scope of the 9/11 attacks placed the United States in the inevitable position as a world leader of defending its sovereignty and legitimacy against an unknown terrorist quantity. The subsequent fears driven by the media, public officials, and the saber rattling of terrorist groups such as Al Qaeda, helped to pass many of the legislative initiatives that typically would have stalled in Congress after the heated and highly partisan elections of 2000 (Galamas, 2011). The concurrent fear and the desire by politicians to show the world that the United States was taking the lead in the "war on terrorism" helped to push their legislation to create the DHS in early 2002 to consolidate many of the conflicting intelligence, emergency management, and support agencies that did not communicate with each other. The outcome of this creation helped to increase funding toward existing organizations such as HHS and FEMA which subsequently invigorated a whole industry of emergency preparedness professionals.

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (P.L. 107-188), also known as the *Bioterrorism Act*, became the impetus for increasing congressional funding for BTT programs. Title II of the Bioterrorism Act covered funding for infrastructure upgrades for hospitals at the state level. BT response was funded at the state level under grants of $75,000 and $150,000 established by HHS and the CDC based on a fiscal formula that granted equal coverage for each state (Niska & Shimizu, 2011). Lister's (2005) congressional study noted unequal funding access for rural communities who often lacked the physicians, PHNs, or laboratory resources to fully support these new initiatives. The law also covered areas such as food protection, water safety and purity, and the new DHS which consolidated many of the disparate

federal agencies and policies that managed emergency preparedness and BT readiness and response, and training support (Gottron & Shea, 2011; Lister, 2005).

The first level of post 9/11 emergency preparedness funding came in 2002 as an infusion of $135 million in federal funding for the Health Resources and Service Administration (HRSA) (a management support office reporting to the HHS Secretary) to distribute to the states as grants to establish or enhance their BTT programs (Franco, 2009). Funding towards BTT averaged $28 million annually from 2003 to 2005 as the program was initiated at the state level. Mandated annual reports validated state program readiness and levels of completeness (Franco, 2009) and funding allocation from HRSA came with the guidance to prioritize mass casualty and surge capability, BT response, and continued training of staff in decontamination procedures (Franco & Sell, 2010). Funding for HRSA grants for BTT was discontinued after 2005. These grants were reallocated under the Hospital Preparedness Program managed by the Assistant Secretary for Preparedness and Response (ASPR) from 2006 and 2007. As Franco and Sell (2010) noted the reallocations of funds towards the BioWatch and BioShields programs (at $5.6 billion over fiscal year [FY] 2006-2013), the Strategic National Stockpile (SNS), and changes in national priorities shifted the focus of federal funding away from BTT programs.

Events such as Hurricanes Katrina and Rita in the summer of 2005 prompted the Bush Administration to reprioritize spending on emergency preparedness to respond to victims of the Gulf Coast. The Pandemic and All-Hazard Preparedness Act of (PAHPA) 2006 was signed into law to coordinate all national level emergency events under a

unified framework using an all hazards approach that could be adapted to the national response framework. The law became a supplement to the Bioterrorism Act to include the surveillance programs BioWatch and BioShield to protect federal institutions (Franco & Sell, 2010; Walsh et al., 2012). The desire for an all hazards approach to emergency preparedness has become the standard best business practice model. Incidents such as the British Petroleum Oil spill in 2009 and a series of other domestic epidemics and regional disasters during the Obama Administration has also shifted the priority towards an all hazards national response. Subsequent congressional reports by Lister (2011) have outlined each of these key focus areas (medical surge capacity, workforce surge capacity, and medical monitoring after a disaster) in regards to public health emergency preparedness and response at the state and federal levels. An evaluation conducted by Lister (2011) for HHS and reported to 112th Congress identified major gaps in hospital facility capability and a general lack of training for emergency and public health responders (Gottron & Shea, 2011). Lister's report only reemphasized many of the organizational and fiscal constraints that the U.S. health care system was already under. Maintaining appropriate continuing medical education and emergency preparedness training was also observed as an organizational challenge that impacted readiness.

PHS Response and Post 9/11 Actions

The transition of the PHS to a war on terrorism footing after 9/11 did not come easily and was not appreciated by local organizations that continued to struggle to meet their community's needs. The supplemental funding that flowed into the states became a hot bed of contention as priorities of needs had to be balanced against the fiscal realities

that there would never be enough money to overcome the decades of neglect that affected the PHS (Madamala, Seller, Beitsch, Pearsol, & Jarris, 2011). Federal restrictions on how these grants would be prioritized and allocated (Franco & Sell, 2010); new guidelines on how programs could be evaluated for cost-effectiveness, and how to best educate the PHCWs in a timely fashion became issues that PHLs had to overcome.

The United States PHS is a multi-functional system of integrated health care programs and funding processes that work together to support community health by establishing assessments of diseases through programs of surveillance, creation of policies to promote public health and wellness awareness, and establishment of systems of quality assurance (Lister, 2005). The PHS supports a wide diversity of services that include supplemental support to the Veterans Administration (VA) for homeless veterans, free standing public health agencies and community health centers, and public school nurses (Ablah, Konda, Melbourne, Ingoglia, & Gebbie, 2010). The PHS approaches health care from a community-based model that attempts to achieve community health care parity through cost containment strategies.

The increase in disaster response and recovery awareness after 9/11 also introduced a new dynamic of fighting a national war on terrorism that often conflicted with public health's national mission of serving the public at the state and local levels. The increase in funding for BT program establishment, training, and hiring often took away state funds from other public health programs (i.e. influenza outbreaks, tuberculosis screenings, and maternal/prenatal health care) that often lacked routine funding (Franco & Sell, 2010). Salinsky (2002) noted that despite the initial increase in federal funding for

BTT programs based on the HHS and the Government Accountability Office's (GAO) analysis, there were still considerable gaps in the PHS. These gaps in services included epidemiology/laboratory readiness, communication and data transfer, and collaboration between state and local jurisdictions on joint response. The funding for hospitals initiated by the state grants attempted to close these gaps by providing directed funds towards BTT (often at the detriment of other public health programs; Levy & Sidel, 2012, p. 14). This detriment was especially notable in rural programs where jurisdictions and scope of services often straddled population centers in those affected states (Hodge, 2012). The GAO reports requested by Congress between 2001 and 2004 substantiated the reports and complaints that grant funds were not reaching many rural communities (GAO, 2013). Central to Salinsky's (2002) analysis of the situation included the PHS's need to sustain health initiatives through the targeting of improvements in education, optimization of existing funding strategies at the state and local levels, and ensuring that the PHCWs were adequately trained to meet the challenge of a post 9/11 world (Gottron & Shea, 2011). The adoption of performance metrics and the movement towards community based practice under the ten essential public health services prescribed by the CDC has helped to alleviate many of the infrastructure inadequacies discussed.

Educating the Public Health Workforce in a Post 9/11 Environment

According to NACCHO (n.d.) in 2014 the PHS consists of over 59 State and territorial health departments, over 2,700 county and city health departments and a myriad of governmental and nongovernmental support systems that include the Red Cross. The concern for noncompliance with the Bioterrorism Act prompted the

government to sponsor a series of surveys to measure BT plan/program completion. In the early phases of this law several GAO reports indicated that state and local compliance to the Bioterrorism Act had been sketchy at best (GAO, 2003, 2013; Heinrich, 2001, 2004). A 2002 survey conducted by the GAO of 1,482 urban hospitals indicated that 51% maintained a BT plan. A survey conducted by Beitsch (2005) identified that only 89% of the 42 states' public health agencies reported that they had a role in planning for BT preparedness based on the level federal funding. By 2007 this had risen to 98% with all 50 states reporting various levels compliance (Madamala et al., 2011). A survey conducted of over 395 hospitals under the National Hospital Ambulatory Medical Corps Survey (NHAMCS; 2008) revealed that over 99% of hospitals had an emergency response plan and of those 93% were prepared for a biological attack (Nicki & Shimizu, 2011). Areas of concern from the government continued to be infrastructure readiness, mass casualty management, PHCWs' training, communication resources, and state/region laboratories (Gursky & Bice, 2012).

The Bioterrorism Act (which replaced the Public Health Threats and Emergencies Act of 2000) provided an initial infusion of almost $4 billion dollars towards establishing an emergency preparedness capability at the state and local health department levels to include a BTT (Franco & Sell, 2010). Many of the issues focused on the PHCWs and the need to attract and retain qualified staff in rural areas which has been one of the more hampering aspects toward reaching compliance with the Bioterrorism Act. Emergency preparedness and training of PHCWs was another significant gap identified in the overall preparedness of local health departments. This was particularly noted in the case of PHN

staffs (Carbon & Soravanc, 2010). Despite the over $65 billion allocated towards infrastructure improvement and training from fiscal years 2002 - 2013, anecdotal evidence has not been sufficient to show that an improvement has been achieved (Watson & Sell, 2013). While the GAO (2013) noted that every state has achieved some degree of success in initiating a disaster preparedness/all hazards plan, the levels of completeness varied and specific questions on how the federal government would validate metrics at the local health department level remained unanswered (Franco & Sell, 2010).

As the United States moved away from 9/11, it needed to establish a solid infrastructure of emergency preparedness and response capacity that included adequate BT response training of the PHCWs at the local health department level. While much of those components were included in state level grants as a onetime supplement, the majority of the literature reviewed established that a sustained level of funding and commitment at the federal and state levels will be necessary to improve service performance in order to fulfill the ten essential indicators for positive public health outcomes (CDC, n.d.; Gottron & Shea, 2011). The ten essential public health services include:

1. Monitor health status to identify community health problems.
2. Diagnose and investigate health problems and health hazards in the community.
3. Inform, educate, and empower people about health issues.
4. Mobilize community partnerships to identify and solve health problems.

5. Develop policies and plans that support individual and community health efforts.
6. Enforce laws and regulations that protect health and ensure safety.
7. Link people to needed personal health services and assure the provision of health care when otherwise unavailable.
8. Assure a competent public health and personal health care workforce.
9. Evaluate effectiveness, accessibility, and quality of personal and population-based health services.
10. Research for new insights and innovative solutions to health problems.

The application of these essential indicators was seen as a method to establish a measurable framework of performance by which federal, state, local organizations could establish guidance on incorporating BT response into medical and nursing curriculums (Carney et al., 2011). The application of the indicators also helped to support federal funding guidelines for long-range planning and an all hazards based approach on organizational needs and community response. These indicators formed a standardized core framework for public health functions that was envisioned by the Institute of Medicine (IOM) in 1988. These core functions included (a) assessment of PHS, (b) policy development, and (c) assurance of quality of services (Education Committee of the Association of Community Health Nursing Educators, 2010; IOM, 1988, p. 43).

Limited resources and bureaucracy continued to plague the states in coordinating emergency response at the local and rural levels. State health officials attempted to establish collaborative partnerships across federal and state jurisdictions. National level

events such as Hurricane Katrina in 2005 and the influenza pandemic of 2009 served as wake-up calls for public interest on the federal government's responses to large-scale emergency situations in the role of public health and safeguarding the public's interest (Madamala et al., 2011). After action reports and lessons learned recommendations prompted a demand for national performance standard or metrics for state and local health agencies. The development of the National Public Health Performance Standards Program (NPHPSP) by the CDC in 1998 was established to link core competencies for PHCWs to measurable training requirements and socio-ecological outcomes (Landrum, Beitsch, Turnock, & Handler, 2008, p. 475). As a management and measurement tool, the NPHPSP is composed of three performance assessment tools (state, local public health, and local public health governance) and 31 performance indicators which are used by the state and local public health departments to evaluate their performance based on the ten essential public health services. Officially adopted in 2002, the model has been tested for face, content, and criterion validity in studies throughout the United States and is currently viewed as the "gold standard" for performance-based and an evidence-based evaluation of public health service programs and viewed as an essential component of a future public health accreditation system (Landrum et al., 2008, p. 475). The creation of the Public Health Accreditation Board (PHAB) in 2007 and the adoption of the Mobilizing for Action through Planning and Partnerships (MAPP) as a strategic community health quality improvement tool are several of the outcomes of NPHPSP's success as a model (Landrum et al., 2008, p. 475-476). While federal officials view performance metrics as a necessary requirement to standardize and quantify performance,

this desire for increased performance has come with a price of over working an already overburdened PHCWs who are aging and there are fewer college graduates entering the fields of public health, epidemiology, or PHN (Keck & Erme, 2012, p. 334; Madamala et al., 2011).

Continuing challenges for the PHCWs in the 21st century include defining the scope of public health, classifying and evaluating the workforce, understanding what competencies are required, developing these competencies amongst a diverse workforce, assuring that the training meets the appropriate accreditation requirements and guidelines, and coping with the legacy of neglect of the PHS over last 30 years. The goal or outcome of these challenges is in educating the necessary workforce, recruiting the appropriate mix, ensuring the correct competencies meet community health needs, and ultimately working with a workforce and understanding their needs. The 2012 CDC report Healthy People 2020 reemphasizes many of the issues outlined in numerous sources and that four key infrastructure issues will continue to plague the PHCWs for the foreseeable future, these included: (a) insufficient workforce based on skill sets, (b) a shortage of PHCWs due to pending retirement age and replacement, (c) insufficient education of the current public workforce, and (d) insignificant or inadequate organizational incentives to retain and keep PHCWs (Rosenstock et al., 2011). In many documented studies the work force has not kept pace with the new demands placed upon the system after 2001. Maintaining skill sets and competencies to handle emerging disease surveillance for BT is particular daunting due to limitation in training funds at rural facilities (Edwards, Kang, & Silenas, 2008). The Center for Public Health Preparedness (CPHP) program implemented by the

CDC and HRSA from 2004 - 2010 has been one attempt to turn this trend around by establishing training programs at schools of public health (Baker, Lichtveld, & MacDonald, 2010; Richmond et al., 2010).

The growth of emergency preparedness training programs, undergraduate and graduate education programs, seminars, and specialized career paths have helped to evolve the field of emergency management. Many of these programs were brought together under the auspices of CDC's CPHP program. This program was developed to establish collaborative partnerships between public health communities i.e. the front line of public health and academia to provide quality, leveraging of new technologies, and building bridges for use of practice-based training (Baker et al., 2010). By the end of the original program in 2010 over 1.3 million learners had received specialized training on public health, epidemiology, and disease surveillance techniques that were applied in train-the-trainer type seminars (Richmond et al., 2010). Over 27 of these programs were established throughout the nation and the overall goals were to increase PHCWs' competencies, design learning objectives, and recruit public health services professionals. These actions have helped to develop adaptive educational programs to meet the growing needs of a PHS which needs to be ready for the next crises. In 2010 the CPHP's were redesigned and funded as Preparedness and Emergency Response Learning Centers (PERLC) at 14 schools of public health to continue linking emergency training core public health competencies. (Rosenstock et al., 2011)

The Association of Schools of Public Health (ASPH) continues to emphasize professional certification and training of the PHCWs based on (a) population based

services, (b) infectious disease containment, (c) environmental safety, (d) injury prevention, (e) behavioral health, (f) disaster preparedness, and (g) assurance of health services. One methodology envisioned by a CDC sponsored taskforce in 2003 was to quantify workforce competencies using a logic model that evaluates population-based core competencies based on five evidence-based criteria or relationships. This task force was called the Calloway Garden Group panel and the group quantified these relationships into an analysis template called the Calloway Garden Logic Model. This model includes: (a) a predictive relationship between performance indicators and outcomes, (b) competency development for specific skill sets, (c) workforce performance to identify best indicators for better performance, (d) workforce monitoring and tracking, and (e) labor market forces such as recruitment and local economy (Potter et al., 2008, p. 253).

The CDC and the IOM, along with the Calloway Garden Groups panel, worked to establish linkages between the relationships that determined multiple outcomes that affected health and its performance. The group framed this performance criteria as an socio-ecological model that would link academia via the public health schools to the best public health practices that were often multi and trans-disciplinary in nature due to PHCWs' competencies and a diverse skill sets (Rosenstock et al., 2011). The socio-ecological model could also be broken down into an ecological view which looked at the perspectives of multiple strategies to determine the best public health outcomes and from a socio-ecological approach to establish strategies toward achieving these multiple outcomes of community-based requirements (Education Committee of the Association of Community Health Nursing Educators, 2010). While the majority of the panel’s findings

were cross disciplinary in nature, the PHN as the largest constituent of the PHCWs represented the largest target audience that had a direct role in coordinating community health care. The ultimate goal of developing competencies within the PHCW is to establish performance criteria and metrics which can be monitored, measured, and quantified for consistency of services, and the ability to meet the ten essential public health services.

Developing Competencies for PHNs

Linking Socioecological Determinants of Public Health to Competencies

The PHS in United States is composed of a myriad interconnected federal, state, and local systems that support community health needs through a population-based framework that supports a socio-ecological model of determinates that affect health outcome (Potter et al., 2008, p. 253). In order for such a structure to remain viable as the demands for services changes or evolves, it will depend on a vibrant and diverse workforce dedicated to providing dynamic community-based services. PHNs represent the largest cadre of personnel by providing over 35% of the overall PHCW (Rosenstock et al., 2011). These nurses support all levels of public health organizations, federal and states agencies, and at the local health departments levels. The diversity of their education sources, accession routes, and levels of experience is equally varied. Training for nurses can be limited to the entry level diploma nurse who must often apply on-the-job training to supplement classroom-based training to as high as nurses performing at the doctoral level teaching PHN (Education Committee of the Association of Community Health Nursing Educators, 2010). Those with advanced degrees often have

specializations in public health, environmental health, or may work as clinical nurse practitioners, or ultimately as senior nurse executives.

Similar to physicians, PHNs in all states are required to be licensed and maintain a level of continuing education in order to maintain their accreditation and licensure within that state. The challenge for PHNs over the last 30 years has been that there are fewer nurses entering the profession and even fewer staying until retirement. This has been a downward trend since the late seventies. By 2000 only 31% of nurses in public health were under the age of 40 (Potter et al., 2008, p. 247). This represented a marked change from 1980 where 52% of nurses in public health were under the age of 40 (Potter et al., 2008, p. 247). This has becomes a challenge because fewer nurses are staying to retirement age due to myriad personal and professional reasons (Rosenstock et al., 2011). This has equated to a higher rate of turnover and the inability to retain qualified and experienced PHN personnel (Potter et al., 2008, p. 247). Since the mid-1980s, and throughout the early 21st century, the continuing education of all PHCWs has been challenging due to the high retirement rate up to 24% (Rosenstock et al., 2011), the lack of schools of public health attracting the next generation of practitioners, and a general inability of local health departments to adequately pay workers at competitive rates (Rosenstock et al., 2011). With a workforce close to 50,000 full time equivalents (FTEs) the PHN field is essential to maintaining a public health infrastructure that will support the goals of providing quality levels of essential public health care services (Potter et al., 2008, p. 231).

In the past, many PHNs entered the profession without the requisite knowledge of public health, any experience in environmental and community surveillance, were often forced to learn their duties while on the job. Many were forced to supplement their own education and training without organizational or state subsidies for tuition reimbursement (Rosenstock et al., 2011). Unfortunately, little has changed for funding restricted public health agencies. Part of the conflict involves maintaining a level of proficiency in an environment where historical infrastructure deficiencies and prioritization to meet organizational needs have been reduced along with available funding needed to improve nurse training. This has made many nurses in these positions resistant to moving beyond education or training that was not job specific, required for licensure, or paid for by a third-party.

While there is no single academic degree or training requirement that can encompasses every aspect of the PHN's capability, the need to standardize core competencies across the public health spectrum has been a goal since IOM's 1988 report (p. 127-128; Polevik et al., 2008). A consortium of 19 public health organizations came together in 1998 to develop population-based competencies that crossed all segments of the public health workforce and occupation groups. This group became known as the Counsel on Linkages (COL) between Academic and Public Health Practice and the group established specific domains or skill sets within the public health community that would facilitate the best clinical outcomes based on a socio-ecological model of health determinates (Potter et al., 2008, p. 226; Rosenstock et al., 2011). These eight domains are:

1. Analytics and assessments skills
2. Policy development and program planning skills
3. Communication skills
4. Cultural competency skills
5. Community dimension of practice skills
6. Basic public health science skills
7. Financial planning and management skills
8. Leadership and systems thinking skills.

Out of these eight domains the COL identified 68 core competencies that supported population-based treatment protocols that were specific to PHCWs and their ability to evaluate community specific outcomes. The shift away from individual-based health care process to a population-based construct has been the central theme of these eight domains since the late 1990s (Olson et al., 2008). Key to these domains was the identification and strengthening of basic skills that provided an effective delivery of public health services. The challenge for expanding PHNs roles in meeting these new criteria depended on realigning these eight general public health domains into nursing specific performance competencies. In 2004, a task force of four nursing agencies established part of this goal by cross indexing the 68 cores public health competencies identified and developed nursing specific competencies. These four agencies formed the Quad Council and included the Association of Community Health Nurse Educators (ACHNE), the Association of State and Territorial Directors of Nursing (ASTDN), the American Public Health Association (Public Health Nursing Section), and the American

Nursing Association's Congress on Nursing Practice and Economics (Potter et al., 2008, p. 253). The Quad Council quantified nursing competencies into three tiers based on proficiencies and level of experience. The levels of proficiency were adapted at each level to provide advancement from generalist to specialists in a progressive pyramid hierarchy. This pyramid type model included: (a) An awareness of basic functions for all nurses (Tier 1), (b) knowledge as an intermediary level of nursing (Tier 2), and (c) finally proficiency as an advanced function of PHN (Tier 3). While evidence of how these tiers ranked by percentage of PHN at each level was not found during this literature review it can be inferred and assumed that entry level nurses comprise the largest group of PHNs and the other categories (Tiers 2 and 3) represent a natural progression of more experienced and seasoned who are closer to retirement at the top. These three tiers were ultimately integrated into the Quad Council's 2011 core competencies for PHNs.

Kalb et al. (2006) conducted a study to evaluate the standard measures for reviewing PHN competencies and their performance to ensure relevancy in linking to essential public health services as they progressed from basic level nursing to the proficiency of senior nurses. The study compared the competency linkages to the ten essential public health services and established a grid and a scoring methodology for the 68 core competencies within the eight domains (Kalb et al., 2006). The final component of Kalb et al,'s study established general workplace of goals for PHNs that included the need for better communication, reliability, appearance, and overall conduct of workers.

PHNs confidence level to perform these competencies at the expected levels of proficiency remained an overwhelming challenge based on the need to support

population-based care rather than individual care. This premise was investigated in a Williams' (2008) 2006 - 2008 study which assessed the emergency capability of the Kentucky rural PHCWs. Williams (2008) recognized that many rural nurses stated that they lack the confidence and needed additional training in the absence of a physician to adequately diagnose or treat patients in an emergency situation. This conforms with IOM's 2003 study which outlined the need for increased training to improve core and specialized competencies for PHCWs (Greiner & Knebel, 2003, p. 59). This would seem to be especially problematic during disasters or surge conditions that could stress normal systems (Chiu, Parker, & Standley, 2012).

By 2010 these 68 competencies were updated and subdivided into levels of practice based on three tiers of proficiency (Chiu et al., 2012; Quad Council 2011). Tier 1 applied to general PHNs who carried out day-to-day functions in local health departments. Tier 2 pertained to PHNs who were in managerial or supervisory positions, who provided advance clinical services, or involved program implementation at the community level. Tier 3 competencies were applied to PHNs in senior executive or senior leadership roles that provided oversight of programs often at the region, state, or federal levels. The goal of these three tiers was to allow for each level of nursing practice to be quantified against the COL eight domains for PHCWs (Quad Council, 2011). The Quad Council's deliberate breakout of core nursing skills and competencies allowed for public health specific education, training, and ultimately the best use of socio-ecological determinants to affect population-based community health services.

Adaptation of Disaster Management to PHN Competencies

Disaster management is considered a relatively recent addition to the formal curriculum of PHNs (Education Committee of the Association of Community Health Nursing Educators, 2010). While all nurses receive basic instruction on managing emergencies as part of basic/advanced life support and triage protocols, the new dynamics of supporting mass casualty site management, command and control, and surge operations requires a more in-depth knowledge of incident management and control operations. The CDC funded a study to evaluate the core competency requirements for PHCW to support a BT response capability at the state and federal level. Developed by the Columbia University School of Nursing in coordination with the CDC, these nine competency requirements were established to support BT/all hazards planning after the 2001 anthrax attack (CDC, 2002). These competencies were divided by skill sets and categorized by emergency preparedness phases to fall in line with the National Response Framework and NIMS. These phases are: (a) Phase 1- Preparedness and planning, (b) Phase 2 - Response and mitigation, and (c) Phase 3 - Recovery and evaluation. The nine core competencies for public health clinical staff which include PHNs are:

1. Describe the role of public health in emergency response in a range of emergencies that might arise.
2. Describe the chain of command in emergency response.
3. Identify and locate the agency emergency response plan (or pertinent portion of the plan).

4. Describe functional role(s) in emergency response and demonstrate role(s) in regular drills.
5. Demonstrate correct use of all equipment used for emergency communications.
6. Describe communication role(s) in emergency response: (a) within the agency, (b) using established communication systems, (c) with the media, (d) with the general public, and (e) personal (with family, neighbors).
7. Identify limits to own knowledge, skills, and authority, and identify key systems resources for referring matters that exceed these limits.
8. Recognize unusual events that might indicate an emergency and describe appropriate actions (e.g., communicate clearly within the chain of command).
9. Apply creative problem-solving and flexible thinking to unusual challenges within his/her functional responsibilities and evaluate effectiveness of all actions taken.

A continuing challenge towards ensuring that PHNs are provided a more comprehensive education in emergency management is to include it as a part of the core nursing curriculum. Common barriers have included a lack of standardize of curriculums in public health schools, the lack of adequate funding, a lack of desire by program leadership to change current curriculum, and an overall lack of subject matter expertise amongst nursing educators in the areas of mass casualty management, BTT, or AHT. A 2004 CDC survey on preparedness programs revealed that only 14% of nurses had received BTT or disaster response in the preceding year (West et al., 2010). The recent

Ebola outbreak during the summer of 2014 prompted National Nurses United (NNU), a nursing advocacy group, to conduct a survey of over 3,000 nurses in over 1,020 facilities in 46 states on their level of preparedness and training needed to be prepared to treat an Ebola infected patient. Over 84% of the survey's respondents indicated that they received no additional training on identifying or treating Ebola or other exotic infectious disease states (PR Newswire, 2014). This unfortunately is a consistent theme noted throughout this literature review in that the urgent need for additional medical professional training is directly proportional to the current crisis and public outcry based on the actual and perceived lack of preparedness of medical facilities. While Ebola as a viral hemorrhagic (bleeding) disease is considered a CDC Category A biological disease, there is no history to date of its use as a bioterrorism agent (Sidel & Levy, 2012, p. 213).

Although the number of subject matter experts in the areas of BT has remained limited, other areas such as public awareness of mass casualty management has seen a significant rise since Hurricane Katrina with the enactment of the PAHPA (Walsh et al., 2012). While the majority of nursing curriculum is still lecture-based, many colleges have introduced online courses to their programs as technology and high speed networks have evolved. The growth of emergency preparedness programs has integrated itself into components of the nursing curriculum. The addition of BT to nursing school programs has often come at the expense of other clinical studies or a reduction of clinical rotation hours (Rebmann & Mohl, 2010). There has been an increase in bachelors and graduate level programs in disaster preparedness and homeland security since 2001 and many courses have been specifically developed to enhance nursing skills to support incident

management and response. Industry standardization is a goal that is still on the horizon for many of these programs due to many of the barriers that Rebmann and Mohl (2010) described above.

Chiu et al. (2012) discussed the use of a blended methodology based on web-based technology, the use of hands-on simulations, and tabletop exercises to enhance terrorism training as a part of the core nursing curriculum. The overall goal of evaluating these blended program methodologies include developing continuing education programs, providing training for first responders, and moving beyond the tunnel vision or perceptions that have limited many nurse educators from fully integrating disaster management into nursing curriculum. The results from a focus group which was funded as part of a 19 state grant funded by HRSA which looked at the adaptation of readiness and awareness postures based on personnel, professional, and community through a series of systemic security measures designed to illicit a collaborative effort amongst professional partners (Chiu et al., 2012). Jakeway et al. (2008) evaluated the role of PHNs and emergency preparedness through the establishment of standardized competencies to support rural and public health operations during emergencies. The overall goal was to link core nursing competencies and skills with the national preparedness phases of prevention, protection, mitigation, response, and recovery under the NRF. This includes assessing, planning, implementation, and evaluating these core competencies against FEMA phases of emergency management response and emergency nursing competencies to create a framework that is supportive yet flexible for disaster

recovery scenarios. This criterion allows for the treatment of mass casualty patients by rural PHNs and local health departments.

BTT remains a critical 21st century issue which has not been strongly supported by schools of public health despite growing evidence that communities will be a future target of opportunity for attack. Despite the implementation of the CPHP programs (now PERLC) at schools of public health, the number of overall PHNs with specific BTT remains relatively low (West et al., 2010). A study by Carter and Gaskins (2010) on the evaluative assessments of BT scenarios by nursing students who used a patient simulation model to facilitate role-playing as part of patient access exercise showed promise in the use of a blended curriculum. At each stage of the study nurses swapped roles and responsibilities for diagnostic and treatments of simulated patients as part of a tabletop exercise. The goal was to provide hands-on training to supplement the didactic training. The key to Carter and Gaskin's study was the lack of (or limitation of) BT content in PHN curriculums. Despite the gains made by the CPHP program and other training funding by HRSA much of the more extensive training for nurses in disaster preparedness occurred at the Bachelor of Science in Nursing (BSN) level.

Jacobson et al. (2010) conducted a study on the self-reported status of terrorism training completed by rural PHNs. Jacobson et al.'s study recognized the plight of rural organizations which had underdeveloped training programs. These programs often served communities which could be deemed targets of opportunity for a potential BT acts due to limited funding, a lack of understanding of the risks and potential threats to the rural community, and overall perception by community leaders and local health department

leaders that the likelihood of a BT event was greatly reduced (Rebmann & Mohl, 2010). Despite the growth of national programs, there still remains a significant decrease in the availability and prioritization of terrorism training for PHNs. Those PHNs who did complete the self-reported study did not express full confidence in their abilities to diagnose and treat biological contaminated or infected patients (Chiu et al., 2012). All of the study's participants agreed that additional BTT was needed and the majority preferred an instructor led courses versus self-study. Those younger nurses also recognized web-based training as a viable option to supplement training or use as a stand-alone product. While the rural community continues to be at potential risk of a biological event, the perceptions by agency leadership and the availability of funds continues to be a key barrier towards training of nurses.

A study by Rebmann and Mohl (2010) evaluated the impact of BTT programs for PHNs. Rebmann and Mohl's study reevaluated the barriers to BTT was primarily centered on time away from work, funding, and a perceived value of BTT. Rebmann and Mohl saw a perception that the only types of nurses that required BTT were those involved as infectious disease, epidemiology, and those in training settings. The survey evaluated areas of perceived benefits, perceived barriers for BTT, and BT knowledge achieved through the training. More objective-based knowledge was seen as the best value and it did not give a false sense of achievement. The nurses surveyed sought to seek a balance between competency-based and objectively measured knowledge for programs. The results of the study concluded that 97% of PHNs agreed that there was value in receiving training and the levels of confidence in the ability to treat patients were

increased. The majority of PHNs saw time off as a barrier to most training, and in particularly areas where PHNs covering large areas with limited staff. Over 60% of the PHNs surveyed stated that they had no previous BTT in the past and those with advanced skills as a nurse practitioner or advanced PHN tended to have a higher percentage of additional BTT or disaster preparedness (Rebmann & Mohl, 2010).

Evaluation of BTT/AHT for PHNs

Maintaining a competent PHCW force is a complex process that must take a myriad of competing factors into perspective in order to meet the user's needs, establish clear guidelines for clinical care, and to meet the core competencies based on the COL guidelines for PHCWs. This becomes equally more complex in regards to PHNs who have a diverse degree of educational backgrounds, experiences, and training needs. Educating adults and meeting their specific needs encompasses an entire field of study within the education system. The goal of this study was not to explore the field of pedagogy (process of teaching) or andragogy (the modern practice of adult education) in depth, but to provide a limited or retrospective overview of specific adult learning strategies, modalities of learning, and acquisition and retention of skills. The key to this study was the understanding of different training methodologies used in conducting BTT and evaluating which MOI was preferred by evaluated PHNs. Understanding the different types of training modalities and how adults comprehend different learning methodologies was emphasized as part of this literature review. The varied educational experiences, program designs, and socioeconomic factors play a key role in how nurses learn, how they retain information, and how information is best applied.

Understanding Adult Learning Modalities

Every adult learner is unique. Demographics such as sex, age, personality, and socioeconomics determine how we learn. How we learn is also based on the history of how we learned as children. The field of pedagogy is the formal process or art of education and teaching which normally advances from child to adult. The key differences between the traditional form of education and that of adult learners (i.e. andragogy) are that adult learners tend to be more autonomous, self-directed, and use informal processes/methodologies to learn (Koo & Miner, 2010). Adults also tend to use life experiences that children have not yet mastered and can adapt to the changing methods used to instruct them. Adults learn intrinsically by applying learning to specific goals for tasks to complete rather than extrinsically for the sheer joy of learning. Adults also require feedback on the process or progress of their learning and how they can best apply lessons taught (Koo & Miner, 2010; McDaniel, 1987). This is important for PHNs who work with a level of independence or self-direction and requires training that is relevant towards their professional growth or clinical outcomes. Motivation is a function of adult learning whereby there must be an established or perceived goal towards achieving if the level of instruction is going to be retained or have long term meaning (Miner, Childers, Alperin, Cioffi, & Hunt, 2005). A pioneer of modern adult learning was Knowles (1970) which has been viewed as a seminal work that refers to the modern practice as an art form that has distinct differences from the traditional pedagogical model. Knowles' theories were based on six assumptions or characteristics of adult learners. These assumptions were that:

1. Adult learners tend to be autonomous and self-directed as they mature.
2. Over time, adults accumulate a foundation of experiences and knowledge that can be applied towards learning.
3. Most adults are goal oriented and focused towards career success.
4. Most adults want education or training that is relevancy oriented toward achieving greater personal or professional growth.
5. Adults want training that is practical to specific problems or issues to solve.
6. Adult learners have an expectation to be shown respect from instructors (Knowles, 1970)

Many factors provide motivation for adult learners as well as barriers to the educational process. Economic barriers, social dynamics, and even modes of learning can be potential barriers toward educating the modern PHCWs. Lieb (1991) developed a model that addressed six factors that motivated adult learners working in professional environments. These included:

1. Social Relationships - building and maintaining social relationships and friendships.
2. External Expectations - meeting structured competency requirements or achievement.
3. Social Welfare - using skills to serve mankind or promote needs of the community.
4. Personal Achievement - maintain professional competence or obtain higher job status.

5. Escape/Stimulation - providing a break in routine from other aspects of daily life.
6. Cognitive interest - learning for the sake of self-gratification (Abdullah, Parasuraman, Muniapan, Koren, & Jones, 2008; Lieb, 1991)

How adults learn and how they retain information is often rooted in childhood learning patterns. As human beings develop, these learning patterns change and adapt to different stimulation needs and fall into familiar patterns that the learner tends to favor as their preferred mode for learning. These cognitive structures represent pathways that adapt to the users learning needs as they grow (Van Merriënboer & Sweller, 2010). Human memory has been evaluated as a sequence of stages that moves from being able to retain information over a short term to maintaining memories over a lifetime. This model or process of short and long term memorization that has been widely studied over the past 50 years. The most popular model is the Atkinson-Shiffrin model, created by Atkinson and Shiffrin (1968): their model (Figure 1), describes memory in terms of sensory memory, short term memory, and long term memory inputs that processes information, encodes it for recognition, and stores the information for later recall.

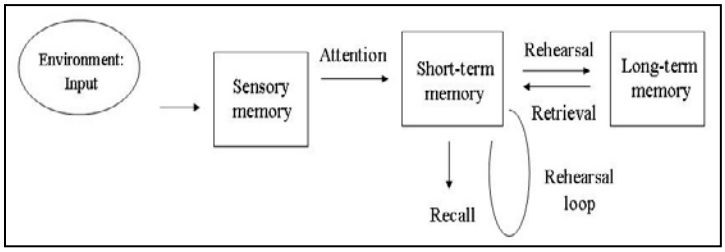

Figure 1. Atkinson-Shiffrin model of memory: "Process of Memory" as a sequence of three stages, from sensory to short-term to long-term memory. From "Human Memory: A Proposed System and its Control Processes" by R. Atkinson and R. Shiffrin, in K. Spence & J. Spence (Eds.), *The psychology of learning and motivation*, 2, p. 93, 1968, New York, Academic Press Inc.. Copyright 1968 by the Academic Press Inc. Reprinted with permission.

Sensory memory is the ability to retain impressions of sensory information after the original stimuli have ended. It acts as a buffer for stimuli received through the five senses (sight, hearing, smell, taste, and touch) and are retained accurately but very briefly (Reysen, 2008, p. 656). The new information decays or degrades very quickly, typically in 200 - 500 milliseconds (1/5 - 1/2 second) after the perception of an item (Reysen, 2008, p. 656). Sensory memory represents an essential step for storing information in short-term memory which is passed on through a cognitive process of selectively concentrating on memory and filtering out other environmental stimuli (Reysen, 2008, p. 656).

Short-term memory acts as a form temporary recall of the information which is processed at any point in time. This recall ability allows people to remember and process information at the same time while holding on to a small amount of information (typically around 7 items or even less) in a readily-available state for a short period of time (typically from 10 to 15 seconds, or sometimes up to a minute; Atkinson & Shiffrin, 1968, p. 98). This information is quickly purged unless the brain makes a conscious effort to retain it in long-term memory. The transfer of information to long-term memory for more permanent storage can be facilitated or improved by mental repetition of the information or, even more effectively, by giving it a meaning and associating it with other previously acquired knowledge (Atkinson & Shiffrin, 1968, p.103).

Long-term memory is intended for storage of information over a long period of time and involves a process of physical changes in the structure of neurons (or nerve cells) in the brain (Segar, 2005, p. 800). These neurons form networks in the brain that

can be created, altered, or strengthened as new information is acquired and applied. Long term memory is often divided into two main types: implicit (or procedural) memory and explicit (or declarative) memory (Segar, 2005, p. 801). Implicit memory is the unconscious memory of skills and how to do things, particularly the use of objects or movements of the body. These memories are typically acquired through repetition and practice, and are composed of automatic sensory motor behaviors that are so deeply embedded that we are no longer aware of them. These sensory motor behaviors allow us to carry out ordinary motor actions automatically. Previous experiences aid in the performance of a task without explicit and conscious awareness of these previous experiences. Explicit memory is the memory of facts and events, and refers to those memories that can be consciously recalled (or "declared") and consists of information that is explicitly stored and retrieved. Explicit memory can be further sub-divided into episodic memory and semantic memory. Episodic memory represents the memory of experiences as a sequence of specific events in time from which the brain can reconstruct the actual events that took place at any given point in an individual's life. As Dew and Giovanello (2010) noted episodic memory has a tendency to degrade in older adults and is reflective in test results. While the reasons and mechanism behind this age related degradation have generated mixed results in psychology and neuroscience research it should be taken into account for researchers conducting recall or recognition studies with older participants (Cerella, Onyper, & Hoyer, 2006). Semantic memory is a more structured record of facts, meanings, concepts and knowledge about the external world that we have acquired. Semantic memory refers to general factual knowledge, shared

with others and independent of personal experience and of the spatial/temporal context in which it was acquired. Semantic memories stand alone as simple knowledge which is described as a measure of cognitive retention and load theory (Van Merrienboer & Sweller, 2010). This form of memory is often tested through standardized and multiple choice tests through cued recall testing (when a person is given a list of items to remember and is then tested with cues to remember material).

Most adult learners pick one of three standard methodologies for learning -- auditory, visual, or kinesthetic learners. Auditory learners receive input through verbal means and their brains picks out specific messages that resonate in long and short-term memories. Voice tone, pitch, and speed of presentation will have impacts toward effectiveness of lessons presented. Visual learners interpret signals the colors, movement, and other stimuli that allows the user to place or pull ideas together to formulate structure. Body language plays a key role in teaching students who are visually motivated. Kinesthetic learners use a combination of auditory and visual methods that are also enhanced by movement. This combination provides a level of stimulation that provides a balance between the other two methodologies. These normally work for people who enjoy hands-on instruction through case study or role-play as a part of tabletop exercises. Children and adult learners select, organize, and integrate information into our sensory memory, working memory, and ultimately into their long-term memory. This function of cognitive load theory that can often become overloaded when too much information is inputted or not clearly organized (Stiller et al., 2009). Studies based on Dale’s Cone of Experience model have shown that people retain 10% of what they see;

30 to 40% of what they see and hear; and up to 90% of what they see, hear, and do (Dale, 1969). Understanding these types of methodologies of adult learning is important in the 21st century due to the growth of the Millennial learner who is accustomed to a level of technology, ability to multitask, and able to comprehend the technological complexities that previous generations did not have available to apply (Kesselheim, 2010). Keeping course content relevant through instructional system design will help to enhance the learning strategies of the next generation of PHNs (Stiller et al., 2009).

Educating the adult learner in the 21st-century has been enhanced through the technological uses of distance learning via the Internet, satellite training, and other training methodologies that did not require a certified instructor or classroom. Traditional didactic training via a brick and mortar institution and an onsite educator will continue to the primary setting of most universities and schools of public health. With the cost of training escalating and the reduction of training dollars to support non-licensure training, the growth and use of distance learning short courses and college based courses have become in greater demand for continued medical/nurse education. Many of these options have established a blended methodology which combines the mixture of web-based learning, asynchronous e-learning, and other hybrid training programs that mixes face-to-face class-based training with technology-based support and project based learning. This blended method has been found to meet many of the requirements of traditional instructor led based learners and still supports the needs of Millennials and organizations that faced fiscal restrictions on providing additional support training for nursing staff (Picciano, 2009). Unfortunately this same ease of use for younger generations could be a source of

frustration to older PHNs who are not technology savvy or in many cases resistant or more comfortable with a traditional educational format. Those older students who do actively participate in the blended course tend to enhance the level instruction by applying practical experience to the classroom environment (Picciano, 2009). The same is true for career changers and men who have become more prominent in schools/programs of nursing in the last 25 years as the gender bias and perception has become less distinctive.

The expansion of high speed Internet networks and the greater acceptance of web-based programs as a part of core curriculum designed over the last two decades has made the use of non-instructor led training and more viable option for individuals with different learning aptitudes. This “multimodal model” takes the generational differences of learners into account as part of the instructional system design process and makes adjustments as needed (Picciano, 2009). PHNs 40 years and older are not staying in the profession until retirement and this represents the loss of knowledge and experience that can’t be replaced by next generation nurses (Potter et al., 2008, p. 247). Adapting this model to learning styles may provide an impetus for ensuring that older nurses retain relevant information and be available to mentor junior nurses. The field of knowledge management and knowledge retention has been used in other industries with varying degrees of success for the past two decades.

The accreditation of these hybrid methodologies has been an ongoing process of evaluation of instructional system design to ensure core curriculum relevance and performance outcomes that meet academic institution requirements. The growth of

simulation-based training has shown a greater degree of acceptance in the medical community than in other educational outlets (Guimond, Sole, & Salas, 2011). While the number of studies conducted in regards to public health use a blended methodologies remains limited, the level of satisfaction of students and academic institutions has shown promise in meeting basic and advanced competencies for PHCWs as outlined in the IOM's guidelines (Chandler, Qureshi, Gebbie, & Morse, 2008).

Linking Program Requirements to Nursing Core Competencies

The establishment of BTT was nationally mandated by the Bioterrorism Act in 2002 in an effort to improve the national response capability of health organizations. Models for workforce performance were evaluated using CPHP funds to investigate public health performance enhancement. In 2003, the Rollins School of Public Health at Emory University tested a competency-based workforce development process created by Miner, Alperin, Cioffi, and Hunt (2005) called the MACH model (aptly named for its four authors). The MACH Model enabled test bed public health organizations in Georgia to evaluate how workforce competencies and instructional competencies could be blended to achieve greater individual PHCWs' performance. The MACH Model operated under a set of basic assumptions of organizational and individual performance: (a) expected organizational performance is clearly defined; (b) contribution of personnel to organizational performance is defined as workforce competencies (by functional roles); (c) workforce competencies are defined, explicitly or implicitly; (d) instructional competencies are developed from workforce competencies to enable assessment of need and the development of relevant training; (e) relevant training plus individual skills/assets

influence individual performance; and (f) individual performance influences organizational performance (Miner et al., 2005).

The MACH model evaluated the curriculum process of designated training, looked at individual performance needs based on organizational requirements to determine the best recommendations for training to include which modes of training best fit the individual's needs. The MACH Model is based on eight main components that are cyclical and reinforce one another:

1. Workforce competencies - broadly defined to meet multiple work related requirements based on job descriptions and skill requirements.
2. Defining elements - understanding the context in which employees are operating (the who, what, where, and how of the PHCW) and what skills are required.
3. Instructional competencies - modeled after the six stages of learning illustrated in blooms taxonomy (knowledge, comprehension, application, analysis, synthesis, and evaluation) to establish a framework for training and evaluation.
4. Curriculum process - provides a structure for designing and conducting training programs consisting of five stages (assessment, planning, development, delivery, and evaluation).
5. Individual performance - ensuring that the learning experience meets the individual's expectations and learning needs including hands-on skills that can be applied to the job.

6. Organizational performance - a reciprocal relationship that assumes that the organization will be the beneficiary of the training completed by the individual to improve outcomes.
7. Accreditation/credentialing - the development of performance metrics or standards that evaluate the improved outcomes of the organization based on workforce improvement.
8. Intervening variables - potential barriers to learning process including financial, policy, and workforce issues (Miner et al., 2005).

The CDC created the Working Group on Competency-Based Curriculums of the Public Health Workforce Develop Collaboration to create a model for lifelong learning (levels of proficiency) that would link core competencies of PHCWs to organizational goals (Hoeppner, Olson, & Larson, 2010). The model was based on established core competencies for BTT for PHCWs based on the ten essential health services and the 68 public health competencies established by the COL. Establishment of core PHNs core competencies were cross walked against these essential health services to establish requirements for education and training by the Quad Council (2011). Over the past decade the CDC and the public health academic community have worked together to ensure that these competencies are included in the PERLC curriculums of PHNs and other professionals (Rosenstock et al., 2011). The addition of an all hazards approach to emergency preparedness planning has helped to bolster the capability of public health organizations and instilled a level of confidence in those nurses who have completed the training.

Aligning these core requirements to a standardized public health curriculum remains a challenge. The University of Minnesota School of Public Health Nursing, the Columbia University School of Nursing, and others came together to design competency-based programs which added emergency preparedness response and recovery competencies to their graduate nursing programs (Montealegre, Koers, Byson, & Murray, 2011). This partnership between academia, the CDC, and other governmental agencies has enhanced the application of the all hazards approach in meeting the needs for PHCWs. This has been marginally successful in filling many of the gaps identified in the PHS. Noted barriers continue to include fiscal challenges that plague non-metropolitan area PHSs and the validation of performance metrics. The refinement of competency-based curriculums has the potential providing of improved dividends for future PHN practitioners.

The impact of competency-based curriculums has been a challenge for the PHCWs as they strive to acquire and retain critically needed skills. The continued challenge to maintain volatile skills (skills that are not normally used in the workplace) is a concern for emergency planners and leaders in the PHCW. Establishment of core competencies for PHN in regards to BTT and all hazards preparedness is been under study since the late 1990s. The congressionally mandated requirement that HRSA monitor and evaluate performance outcomes of state and local public health readiness as a requirement for continuing federal funding has necessitated the development of various validation models that could provide quantitative data or reports. While the scope of this study did not investigate or evaluate secondary data resources for these reports,

understanding several of the more common evaluative models used for skill acquisition/retention is important in helping PHNs as they progress through the different levels of skill proficiency.

The Dreyfus Five-Stage Model of Adult Skill Acquisition was developed in 1980 by Stuart and Huber Dreyfus based on a study conducted with chess players and military officers to determine learning proficiency based on skill acquisition (Dreyfus, 2004). The model accessed progressive level of skills of individuals based on five levels of proficiency starting from novice through experts. Designed to be used for any industry, this model provided a progressive level of growth for individuals based on performance, experience, and mastery of competencies required for the particular industry (Dreyfus, 2004; Miner & Koo, 2010). The five levels include: (a) Novice, (b) Advanced Beginner, (c) Competent, (d) Proficient, and (e) Expert. At each stage of the learner becomes more confident, acquires more autonomy, and is less restricted by rules or policy as their level of knowledge and experience allow them to become more adaptable to changing and varying situations by applying practical experience to environmental or organizational requirements. As Koo and Miner (2010) noted, as individuals advance through the stages, they continue to become (a) more characteristic of a life-long learner (Olson et al., 2008), (b) more advanced in cognitive and affective competency domains, (c) more intuitive in their thinking and actions, (d) more sought out as a mentor, and (e) more acknowledged as a leader.

By the mid-1980s Benner collaborated with the Dreyfus brothers to modify the model to be more adaptable towards nursing from a practitioner’s point of view to

instruct new nurses. Benner's (2004) goal was to address nurses whose learning and experience often crossed many professional boundaries. While Benner's model categories mirrored the Dreyfus model, Benner tied competencies based on practitioner clinical performance at specific milestones during a nurse's career as a factor in determining proficiency attainment and movement to the next level (Benner, 2004; Ransburg & Childress, 2012). Benner's adaptation of Dreyfus' model was called the Benner Novice to Expert Theory which formulated a progressive pyramid that depicted the skill level based on proficiency of milestones achieved. Novice nurses were represented at the base of the pyramid and expert nurses are represented at the top of pyramid (Marble, 2009). Benner's model followed the five level proficiency scale developed by the Dreyfus brothers and used nursing performance as it's metric (Ransburg & Childress, 2012).

As competency-based medicine continued to evolve to include practice-based education the need to advance this model to include additional levels of proficiency became apparent by the early 21st-century. Koo and Miner (2010) adjusted Dreyfus' 1980 model to include public health as a practice-based model by adding the categories of "advanced expert" and "luminary" to suggest that these categories provided a greater degree of oversight in public health policy decisions needed for senior levels practitioners and policy developers. While Koo and Miner's expanded model followed the Dreyfus model's general criteria on core definitions and leadership requirements for each level, it applied the criteria of research and practice application as a public health requirement to support evolving levels of proficiency of skills acquired. These seven categories consist

of (a) Entry, (b) Capable, (c) Competent, (d) Proficient, (e) Expert, (f) Advanced expert, and (g) Luminary (Koo & Miner, 2010).

The expanded model for public health also takes into account the need for adult learners to look at alternative methodologies of training to acquire these skills and to retain these skills as proficiency levels change, degree of mastery evolve, and technology changes. All three models of skill acquisition are widely used to represent progressive growth of the individual worker from a novice or entry-level capability of following basic directions using structured guidance to become more confident and competent as they gain experience and develop the clinical skills to come subject matter experts within their fields of expertise. The COL has evaluated the best use of the Extended Dreyfus model for use in public health outcome based workforce development and applicability across the entire public health competency levels based on the ten essential public health services (Koo & Miner, 2010). The results revealed that retaining learned skills and knowledge is a challenge for professionals who are often inundated by new studies, new methodologies introduced, and often burdened with the day-to-day operations within the public health arena. Many skills become “muscle” memory whereupon the individual draws upon these experiences as something they do routinely and come to mind without afterthought. Other skills have to be continuously relearned, honed, and exercised in order to build a level of confidence that can be applied toward muscle memory. Adult learners learn best by applying skills vice passively receiving them. As previously discussed under kinesiology, skills that can be applied to workplace situations have a higher percentage of being retained by the user. Adoption of core competencies by the

Quad Council and the COL has helped to quantify many of the skills that PHN must be cognizant in to meet their levels of competencies at specific points in their career.

Effectiveness and Evaluation of Learning Strategies

My goal in this study was to evaluate and understand how the different modalities of training could impact the cognitive thought processes of adults (rural PHNs) and their preferred learning style based on MOI. Instrumental to this learning process was linking BTT/AHT effectiveness to performance outcomes by way of the ten essential health services using Handler et al.'s 2001framework as a conceptual construct. Handler et al.'s (2001) model calls for an iterative process that links external or social-ecological determinates of public health to improve outcomes for effective, efficient, and equitable community health. The macro environment phase represents external funding sources, disease occurrence, and environmental factors that has direct impact or relationship towards the identified community. The PHS and its mission to provide health care service for the community represents the legislative, regulations, and compliance requirements established by state and federal entities to ensure quality of care.

These factors are variable based on mission, organizational structure, and state requirements. These require the support of the structural capacity of the model which ties specific health care support services or resources (including the PHCWs) needed to leverage health care services throughout the organization. These structures feed into the ten essential services that drive performance and deliver quality services as an outcome to the community. The final aspect of Handler et al.'s (2001) model supports community outcomes via feedback to the organization based on perceived and quantified outcomes in

effectiveness, efficiency, and equity of services. This can be validated via satisfaction surveys and accreditation of the organization via the Joint Commission. Avery and Zabriskie-Timmerman (2010) modified Handler et al.'s model to be scalable down to the department level in regards to flexibility and functionality. Their model made preparedness and supplemental BTT funding as a central input towards improving outcomes at the local health department level (Avery & Zabriskie-Timmerman, 2010).

The growth of nontraditional training has been viewed as cost-effective for organizations, able to impact large groups of adult learners, be adaptable to a more technologically savvy workforce, and reduces the time away from organizations that are struggling to support an ever-growing community population. Much of this training has been incorporated into an all hazard format that was nationally implemented under the National Incident Management System (NIMS; DHS, 2004) after Hurricanes Katrina/Rita. NIMS was structured to provided tailored federal support and response to the states to encompass specific events such natural disasters, disease epidemics, and BT to take advantage of funding grants under the PAHPA (Walsh et al., 2012).

Distance learning, web-based, satellite base, and table top exercises lead by a facilitator have become increasingly popular means of bring training to nurses. The use of game, role-playing, and simulation based training helps to reinforce didactic course content, fine-tune core competencies, and develop a “muscle memory” of techniques and protocols to follow during an emergency that supplements traditional emergency triage skills (Morrison & Catanzaro, 2010; Olson et al., 2010; Stegeman & Zydney, 2010). The hope of a training program is that trainees will be able to retain (skill acquisition) and

take information back to the parent organization and introduce or implement changes based on new or best business practices. Alternative modes of learning may be more problematic for older learners than those Generation Xers or Millennials who integrate social media, multimedia, and other means of electronic communications into their lives on a daily basis. McNeill et al. (2009) expressed some of these concerns of multimedia overloading short-term memory in their study that compared two types of multimedia instruction and how much information could be retained over short periods of time. This dual coding theory or multi-modality is based on studies conducted in the 1990s and were reviewed for validity to determine applicability with current technologies using redundant methodologies. Their findings indicated that careful review and construction of training tools are more likely to net more effective outcomes using multimedia systems (McNeill et al., 2009).

University based courses have made the technological leap into web-based instructions that provides students the ability to learn on their own schedules, or in an asynchronous mode, or via other varieties of learning strategies. The flexibility of these blended modalities allows the instructor to facilitate rather than instruct. Several colleges became pioneers of using web-based instructions for public health courses in the early 21st century. This included the University of North Carolina Chapel Hill, Columbia University, Emory University, and others that linked the program into the CDC's CPHP/ PERLC network as test bed institutions (Miner et al., 2014). The growth of Internet networks and high speed service has enabled these colleges to push or download large content out to students and reduced the need for PHNs to leave their parent organizations

to attend training. The growth of evidence-based medicine has forced many educators to revise their core curriculums to include evidence-based practice for the public health community (Potter et al., 2010). This ensured that continuing education credits tied directly into supportable practices that would enhance the nurse's capability and could be validated through the appropriate accrediting agency for licensure. This has a particular interest for the PHN community which sees itself in a direct role for investigating outbreaks, conducting risk communications, accessing signs and symptoms of disease, dispensing medicines, and addressing the needs of a medically fragile community during an emergency (Morrison & Catanzaro, 2010).

A 2010 study conducted by the CDC's CPHP/PERLC brought together 32 evaluators from 23 schools of public health to develop a Training Selection System (TSS) that outlined evaluations steps which the group recommended as a tool to evaluate public health training in emergency preparedness. With the assistance of a collaborative group from the ASPH, the CPHP/PERLC focus group formulated three main domains for evaluating public health emergency preparedness courses. Each level or domain has a set of criteria and that must be applied in order for the TSS to be used to evaluate training needs (Hites & Altschuld, 2010)., they included:

1. Domain 1: Course design and structure – which consists of:
    a. Criterion 1: Course content is appropriate for the target audience
    b. Criterion 2: Course levels appropriate for participants
    c. Criterion 3: Course format is appropriate for the participants

   d. Criterion 4: Continuing education credit is provided to meet the needs of certain public health professionals

2. Domain 2: Training content – which consists of:
   a. Criterion 5: Training was developed and will be delivered by qualified content experts and is based on current evidence in good science
   b. Criterion 6: The design and delivery of the course will accomplish training goals and objectives
3. Domain 3: Evaluation of learning – which consists of:
   a. Criterion 7: The course evaluation includes a data collection tool to gather information about the characteristics of the participants and the course
   b. Criterion 8: The course evaluation includes instruments that gather feedback from multiple sources to demonstrate that the course was delivered as planned and in and to a form decisions about coursed improvement.
   c. Criterion 9: The course includes assessment tools to evaluate whether the program is having its desired effect -n improving participant knowledge, skills, and competencies
   d. Criterion 10: The course represents a best practice
   e. Criterion 11: The course addresses external guidelines

Evaluation of training programs for PHNs remains in flux due to the diversity of nursing educational backgrounds, organizational needs, and barriers to place limitations

based on fiscal constraints. The challenge for educators and public health planners will be to ensure that BTT is evaluated for quality, user-friendliness, and applicability towards organization and mission goals and must be balanced with enhancing the core competencies of nurses in accordance with the COL guidance.

Standards for BTT

The emergency preparedness profession has undergone substantial growth in scope, training requirements, and certifications in the aftermath of the events of 9/11 (Hupert, 2012, p. 238). As colleges and emergency management organizations have come together to update their curriculums to ensure relevance to educational and professional needs, the establishment of a standardized format for BTT and AHT continues to vary by industry, professional needs, and duration of study. The adaptation of NIMS by federal and state agencies has been harder to implement at the local public health level. The military style command and control structure of the Incident Command System (ICS) which is a key component of NIMS has presented significant challenges to the decentralized nature of most public health departments and their lack of integration at the local and state levels (Edwards, Kang & Silenas, 2008; Kohn, Barnett, Galastri, Semon & Links, 2010).

Between 2004 and 2010, the CDC worked with schools of public health to incorporate specific requirements for emergency training that could be adapted into the CPHP format as core competencies for BTT. To ensure Congressional compliance, an evidence-based group collaborative (EBGC) was created to review past experiences and determine future guidance for creating training for emergencies and disasters. Data was

collected from state/local level reports and peer-reviewed articles on organizational impacts to determine compliance with CPHP programs goals (Potter et al., 2010). This model has been adopted for all of the nation's CPHP programs, IOM/HRSA core public health training, and by FEMA for its training programs (Dembek, Iton, & Hansen, 2005; Miner, Allan, & McKenzie, 2014).

The major assumption established in this study is that there is no defined standardized model for BTT. The CPHP model, which has been evaluated and tested in graduate level courses and during tabletop/live-action exercises does serve as a reliable model in meeting the baseline requirements for providing BTT level surveillance and response by PHCWs. The core competencies for BTT programs under the CPHP ensures that PHCWs are knowledgeable about:

1. Characteristics of Biological Agent Classes A, B and C associated with BT.
2. Clinical Manifestation of Diseases associated with BT.
3. Surveillance and Epidemiology.
4. Laboratory Systems.
5. Health Risk Communication and Media Relations.
6. Psychosocial Impact of BT.
7. Worker Safety Issues.
8. Information Technology (Dembek et al., 2005).

These core competencies were addressed as assessment questions in Section 4 of the targeted survey for PHN. The purpose of inclusion in this study was to ensure that baseline requirements for BTT and the nurse's perception of the training completed

would meet public health industry requirements. Nurses were asked about their level of understanding of these competencies, the modes of educational delivery, and their levels of proficiency in being able to fulfill these core competencies during a BT event.

Summary

In this Chapter 2 literature review I have attempted to encompass an understanding of the nature of a potential BT attack on a rural population and the scope of what a PHN would be need to know in order to be effective in responding to an event. The role of the PHN is diverse and complex from the perspective of the types of communities he or she works in, the populations he or she serves and the degree upon which education and training will play a vital part in developing appropriate treatments. It is important to understand the historical context of how BT has made an impact and the steps the government and states have taken to mitigate its affect. It is also important to understand how the different modalities of training impact the adult learner, established different types of training based on core nursing competencies, and finally what evaluative system or criteria could be used to a evaluate return on investment for limited fiscal dollars by local public health agencies or departments. In Chapter 3, I introduce the methodology I used to conduct this study and many of the challenges that I had to overcome in selecting the sample population base, designing my survey tool, and collecting my data.

Chapter 3: Research Method

The purpose of my study was to assess the nature of the relationship between MOIs with the degree of retention of knowledge/skills following BTT courses in meeting the training competency needs of rural community PHNs in North Carolina. My goal in this study was to assess and understand which training MOI (the primary independent variable) could best predict the degree of retention of information among PHN emergency competencies (dependent variable) and ultimately increase readiness by ensuring that the nursing staff had the right tools to augment the public health team during a BT incident.

Research Design and Approach

This study revolved around one research question that was used to evaluate and validate which MOI used to teach BT/AHT could best predict the degree of emergency knowledge/skill retention for PHNs working in rural health departments in North Carolina. The MOIs are defined as *x*, *y*, and *z*. The sample was drawn from rural communities in North Carolina. The sample was drawn from rural communities in 10 public health regions in North Carolina and was oversampled to allow for power maintenance and a projected rate of return of at 25%. Previous studies conducted by the University of North Carolina at Chapel Hill netted similar returns from the public health community (Alexander et al., 2010).

> *Research Question*: Does the independent variable (MOI, *x*, *y*, or *z*) for BT/AHT courses statistically significantly predict the dependent variable (degree of retention of emergency knowledge/skills for PHNs, as measured by a memory

quiz and an assessment survey in terms of percent) working in rural public health agencies in North Carolina?

$H_0$1: The independent variable (MOI) for BT/AHT courses does not statistically significantly predict the dependent variable (the degree of retention of emergency knowledge/skills for PHNs as measured by a memory quiz in terms of percent) and all beta (β) coefficient values are not significantly statistically different from zero.

H_A1: The independent variable (MOI) for BT/AHT courses statistically significantly predicts the independent variable (the degree of retention of emergency knowledge/skills for PHNs, as measured by a memory quiz in terms of percent) and at least one beta (β) coefficient value is significantly statistically different from zero.

I conducted this study using a non-experimental cross-sectional design using a targeted survey of rural PHN to evaluate three MOIs used to teach BTT/AHT programs. These MOIs consisted of

1. (x) I_1 = traditional brick-and-mortar classroom,
2. (y) I_2 = blended training (equally balanced between brick-and-mortar and online learning), and
3. (z) I_3 = web-based online asynchronous learning.

The cross-sectional approach allowed for the analysis of PHNs who were selected from the 10 PH regions that encompass the 100 counties of North Carolina. Nurses assigned to the 85 public health agencies were assessed on acquired BT/all hazards knowledge/skills based on the level of experience and competencies prescribed by the Quad Council (2011). In this study I attempted to measure the degree of core knowledge and their

comfort in being able to apply these new skills during a BT incident. The compiled data from the survey were evaluated using a Pearson correlation coefficient and multiple regression analysis. My goal was to establish a predictive trend or model on which MOI was more adaptive or predictive towards success in acquisition of emergency response performance competencies and retention of core skills for PHNs.

The advantages of using a cross-sectional study allowed me to obtain information that represented a snapshot in time for PHNs working in rural communities. I contacted 85 local PHLs (representing North Carolina's 100 counties) and requested that these PHLs forward a website link to my study to PHNs on their staff. Those anonymous PHNs who completed the survey represented my sample population base. Using this stratified sample methodology allowed me to focus and evaluate PHNs at different skill and experience levels. This helped maintain a standardized structure despite the different work environments and subspecialties of PHNs (Frankfort-Nachmias & Nachmias, 2008, p. 133). Other advantages of conducting a cross-sectional study included not having a need for follow-up tasks that a longitudinal study would require (Nasca, 2009, p. 1,012). The cross-sectional study also provided better control of measurements in the stratified sampling versus a simplified random sampling, which could have provided a more stable sampling profile. Cross-sectional studies have been historically found to be valuable in supporting hypothesis generation and validation (Nasca, 2009, p. 1,014).

Throughout this study, I took steps to ensure that I only made or recognized correlations using cross-sectional data and did not infer causal relationships between the variables (Frankfort-Nachmias & Nachmias, 2008, p. 119). This was one of the

disadvantages of using the cross-sectional approach. Another key threat to validity of using the cross-sectional design was that data collected would only be represented as a "snapshot in time" and not show progressions or trends over a period of time (Frankfort-Nachmias & Nachmias, 2008, p. 133). Another potential challenge to internal validity and reliability was a lack of control of extraneous variables such as participants unwilling to truthfully answer questions or respond. I ensured that the survey questions remained unbiased by conducted a pilot study that consisted of an expert panel of seven PHNs who reviewed the survey questions and provided feedback on their content.

Methodology

In this study, I attempted to evaluate emergency nursing competencies in relation to BT/AHT courses previously taken by the survey participants. Understanding which MOI had the highest probability in helping PHNs to retain information was an important factor in understanding which MOI had the best chance of holding the participants' attention, enhancing their cognitive processes towards establishing a "muscle memory" of acquired skills, and ultimately helping PHNs retain specific skills and knowledge. I chose a quantitative methodology using a multiple regression analysis to answer the question of which MOI had the greatest likelihood of predicting the degree of retention of critical emergency information for PHNs. A quantitative analytical approach allowed me to report a summary of reports in numerical terms that could be evaluated for a level of knowledge/skill retention acquired by PHNs who had measurable standards of skill sets established as core and emergency competencies (Quad Council, 2011). For this study, Tier 1 competencies were my baseline for measuring the survey results for all

participants. I felt this would fulfill the didactic requirements of the Quad Council for basic emergency preparedness for PHNs and allow for a cross-section of rural community North Carolina PHNs who were asked to participate in the customized survey. The value of establishing a predictive model that managers could use to quantify or justify training expenses would be value added in an environment of constrained budgets for training and travel. The goal of using a quantitative analysis included determining if a common trend or statistically predictive theme could be numerically represented by the data.

In this study, I coded and separated the primary independent variables of the MOI into three categories that could be numerically represented as *x* (I_1 = traditional brick-and-mortar classroom), y (I_2 = blended training [equally balanced between brick-and-mortar and online learning]), and *z* (I_3 = web-based online asynchronous learning). These variables were evaluated against the dependent variable of the degree of retention of knowledge/skills by PHNs as represented as a percentage score on a 15-question BT quiz. Secondary independent variables such as age of participants, education level, and years working in public health were also evaluated to determine if there was any statistically significant relationship among these supplemental independent variables and the ability of PHNs to retain information. I anticipated that this study would have confidence level of at least 95%, or $p < .05$, due to my decision to limit the types of MOI to the three of the most common learning methodologies used by adult learners (Van Merriënboer & Sweller, 2010). As Frankfort-Nachmias and Nachmias (2008) noted, a key concern of using more than two independent variables (bivariate) could be the introduction of extraneous variables (covariation) that may influence both independent and dependent

variables that may not be able to be controlled (spurious; p. 93). My goal was not to draw causal conclusions without significant evidence that could control the covariation (nonspuriousness) between the independent variables.

Some of the advantages of conducting a quantitative research study included using a sample population to make estimates or inferences to a population at large, evaluating the attitudes of a group of people of similar skills and talents, being able to condense results and to use statistics to compare various groups, and providing measurable and standardized data that could be used to predict trends or occurrences amongst a population (Cresswell, 2009, p. 148). Finally, quantitative research was especially suited for testing hypotheses (Nasca, 2009, p. 1014). I used a Pearson correlation coefficient and multiple regressive analyses to provide predictive data to support my hypothesis for this study. This was fundamental in establishing which mode of learning had a higher preference of use by PHNs.

Participants/Population

I used a stratified population sample that consisted of mid-level to senior PHNs who worked in community health departments or agencies. In this study I focused primarily on registered nurses who have an expected level of training based on a specific core curriculum in public health through approved programs in public health. The Quad Council (2011) classifies PHNs' competencies into three categories or tiers of professional experience and core competency levels (as I defined in Chapters 1 and 2). The Quad Council recognized the BSN degree as the basic level of training that supports both the didactic and clinical competencies required to establish, maintain, and expand

public health services to the community. For the purpose of this study all tiers of PHNs were evaluated as part of the cross-sectional review process to ensure complete capture of all basic and emergency skill sets. As noted previously, the baseline performance criteria established for this study was based on Tier 1 competencies for core and emergency skills for PHNs established by the Quad Council (2011) and the eight domains of PHN (Council on Linkages, 2010). It is important to note that not all PHNs who worked in North Carolina had a BSN in public health nursing and many had been "grandfathered" into current positions because they had years of practical experience in the field at levels below the registered nurse. As part of the data cleaning process, I excluded license vocational nurses (LVN), licensed practical nurses (LPN), and nursing assistants (NA) from the collected survey results in order to meet these basic Quad Council (2011) requirements for didactic and clinical competency requirements. However, I did not require a bachelor's degree for all evaluated nurses since many states maintain a legacy system that does not require a bachelor's degree to maintain or hold licensure as a registered nurse. My goal was to determine which MOI would be most predictive in establishing the degree of retention of emergency information based on nurse's baseline skill sets or experience level.

A national wide survey was rejected in favor of a targeted population to ensure a more granular overview of rural community population, reduce the large population base of PHNs, and to focus on a specified state sample of rural communities as depicted in a 2010 U.S. census. This methodology was also more cost effective and still achieved the balanced population base needed to substantiate the statistical data collected for a specific

region of the country. According to NACCHO website there are over 2,700 local health departments in the United States and its territories with a PHN population averaging over 50,000 full time equivalents (NACCHO, n.d). Based on an empirical review of the available literature I identified that the majority of federal funding for BTT had gone towards metropolitan areas in high profile cities and states based on their high potential for terrorist acts. This left a target of opportunity for rural areas that received disproportionate amount of the federal funding according to GAO studies (2013). For this study I decided to look at rural communities along the eastern seaboard as potential targets of opportunity due to the availability to reach these communities via sea, air, and across state lines. According to the 2010 U.S. Census the states of North Carolina, South Carolina, Georgia, and Virginia had significantly high percentages of rural communities based on disbursement of their populations (NC 35%, SC 34%, GA 25%, and VA 25%). With an average population of almost 8 million people, North Carolina represented the highest rural population based on density and per capita rate (USC, 2010). North Carolina showed a significant distribution of its population away from major metropolitan hubs and areas, major interstates highways, and services. There were 85 local public health departments supporting the 100 counties. North Carolina had also been used in previous studies by the CDC under the CPHP program at the University of North Carolina Chapel Hill (Alexander et al., 2007, 2010) and had a significant nursing population with over of over 120,000 licensed RN and LPN/LVNs. My sample population was comprised of PHNs who account for 4,800 or 4% of the nursing workforce in North Carolina (North Carolina Board of Nursing, n.d.). I gathered information from the North Carolina

Association of Local Health Directors and the North Carolina Association of Public Health Nurse Administrators to target my sample base to mid-level and senior nurses supporting the 85 local public health departments. This establish an estimated sample population of 360 PHNs (n = 360).

From a homeland security perspective, North Carolina also had a significant military presence of ten military bases with populations in excess of 106,000 or 8% of the total active force (Military One Source, 2011). This represented a high potential for direct (military) and indirect (surrounding civilian communities) targets of opportunity for a terrorist attack. The primary advantages of selecting North Carolina was a diverse population based on socio-economics, distribution of populations between urban and rural areas, and a large dependence on federal resources to supplement housing, education, and public health. While largely conservative from a political standpoint, social welfare programs were widely used to support the infrastructure of North Carolina which maintained 16.8% of its population living below the poverty line with a median income under $46,450 per year (USC, 2010). The impact of the large distribution of land and populations included distances between primary and definitive care of hospital-based services. A study of the scope could be valuable towards informing legislators of the complications and implications of limited funding for public health organization in rural communities. Some of the limitations in early studies of rural communities included the limitation of high speed Internet networks for web-based services, the distances from rural communities to larger hubs cities such as Raleigh, Charlotte, and New Hanover County limited access to traditional based classroom led courses (Alexander et al., 2007).

Data Collection and Recording Instruments

Data collection for this study consisted of a targeted survey of a sample of 360 PHNs using a four section questionnaire (Appendix B). The primary target audience were nurses who had completed some level of BTT/AHT. The goal was to assess their level of retention, comfort, and confidence in being able to use the skills and/or knowledge acquired from the course of instruction. The survey assessed which of the three types of MOIs (primary independent variable) were used and what were the nurses' preferred method of learning and the success in retaining the information obtained (dependent variable). This “snapshot in time” of the training experience would represent a non-experimental assessment (there was a pretesting of the survey to adjust tool) that is based on the nurse’s professional opinion and experience in applying newly obtained skills towards positive health outcomes.

After reviewing a variety of studies based on nurses and other PHCWs, I decided to design my own questionnaire based on (a) the core/emergency nursing competencies for PHCWs established by the Quad Council, (b) a BT/all hazards memory quiz based on CDC courses, and (c) assessment questions I designed to gather information on completed courses by PHNs. I felt that a survey that asked for specific questions on proficiency of skill sets related to BT had a more valuable contribution to the body of knowledge than many of the generic studies that I reviewed which focused a specific nursing competency or general emergency management with no specific requirements for the PHCW. The questions for this survey were developed using Handler et al.'s 2001 framework as a conceptual construct for workforce performance outcomes of public

health and each section consisted of specific questions pertaining to a specific area of concentration for recipients to answer. The questionnaire were designed and then implemented through the web-based service Survey Monkey as the primary tool to send the survey to PHNs. The website included a secured server that would hold the data of completed surveys and compilation tools that could be used with IBM's Statistical Package for the Social Sciences (SPSS) version 20.0.

The survey consisted of a four section questionnaire that asked PHNs to assess their satisfaction with BTT/AHT received, the source, and the MOI used. The first section the questionnaire consisted of demographic data consisting of age, education, and years in public health profession as a registered nurse (secondary independent variables). This information was compiled into groups or clusters using Microsoft Excel to show comparisons between categories. I was able to determine that a large percent of older nurses had completed the survey and that many of those same PHNs held leadership positions within their organizations. This finding was consistent with information outlined in the literature review that noted that PHNs as a group tended to be over the age of 40 and had worked for over 15 years in public health. The demographic section also showed that PHNs surveyed were representative of all ten public health regions in North Carolina.

Section 2 consisted of questions that focus on the Quad Council's 2011 eight domains of public health competencies for nurses (see Chapter 2 for details). Out of the 68 core competencies identified within these eight domains, questions were designed to identify if survey recipients were knowledgeable and/or met the of the basic core

competencies for PHNs. Since the survey's perimeter established Tier 1 competencies as the baseline for this study, questions were derived from the Tier 1 category of the Quad Council's (2011) competencies which have been cross-walked against the ten essential health care services for validity. The survey questions for Section 2 were measured using a 5 point Likert scale to categorize the data according to levels of confidence in meeting the core PHN competencies. The ranking scale for the survey results indicated: *Not at all confident* = 1, *somewhat confident* = 2, *undecided* = 3, *confident* = 4 and *very confident* = 5.

Section 3 consisted of a 15 question multiple-choice memory quiz that evaluated the PHNs' level of knowledge of BT/all hazards response protocols they received from previous training. This tested the participant's explicit memory (long term memory) as a measure of cogitative retention of skills/knowledge (semantic memory) acquired in the past. The participants took the test without prior preparation and answered each multiple-choice questions. Upon completion of each question, the answer to the question was displayed (providing immediate feedback) and a series of questions were provided to assess how the information for the correct answer was obtained. The choices were

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?
B. Were the knowledge/skills to answer this question learned on the job?
C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B?
D. I have no knowledge/skill in this topic.

The final section of the questionnaire asked specific questions about the type of BTT/AHT completed, when the participant completed the BTT/AHT, and what was his or her preferred method of receiving information. Questions assessed the participants' date of completion, the type of course taken based on MOI, the level of comfort with the curriculum, how much of the information they were able to retain after completion of the course, and the ability to apply skills to emergency situations. The MOIs of traditional classroom (*x*), web-based/online (*y*), or blended methodology (*z*) represented the ordinal variable in the study as it related to the independent variables. The regression analysis conducted on the MOIs displayed varying degrees of statistical significance in establishing a trend of the nurses' preferred MOI (I present the findings in Chapter 4). The questions for Section 4 consisted of multiple-choice questions that outlined specifically requested information and observations on success or failures of BTT/AHT ability to measure the skills retained by the PHNs.

Initiation of the survey process began by contacting PHLs from each of the 85 local public health agencies in North Carolina and e-mailing an invitation to participate in the study (Appendix C) that outlined the scope of the survey, and the target audience (senior department PHNs). In addition to the invitation to participate in the study, PHL's received an information brief of the study and a letter of consent which contained a URL link to the survey questionnaire on the Survey Monkey website. PHLs were asked to forward the consent letter to their nursing staffs. These documents served as the informed consent for PHNs to participate in the study. The letter of consent also provided assurances of privacy and confidentiality of nurse's identity and institution privacy. I sent

a follow-up e-mail 2 weeks after initial transmittal of information and an additional follow-up e-mail was sent 2 weeks after this. I sent a total of three separate e-mails to recipients over a 6-week period to request completion of survey using Survey Monkey is a primary data collection tool. At the conclusion of this survey, I sent a thank-you e-mail to each local health department for their participation in this study. I received several calls from PHL**s** requesting additional information about the study and its long-term impact on emergency readiness. Many felt that the findings would be valuable towards their accreditation process and requested a copy of my findings. I offered to provide a tailored report that would be specific to their public health region.

Prior to submitting the formal request to local health agencies to participate in this study, I pilot tested the survey questionnaire using an expert panel of PHNs from a local health department in Northern Virginia. Once I received IRB permission (08-08-14-0090199) to proceed, I made contact with several local public health Department directors and requested to conduct this pilot study/expert panel with 6 to 8 PHNs who would evaluate the survey questions, the anticipated time needed to complete survey, any unexpected survey results. I added an evaluation form to the online survey to collect the expert panel's feedback and evaluation of each section in their recommendations for changes (if required). This pretest data did not become a part of the final data collection process for this study. The pilot study allowed me to make specific changes and adaptations to the survey prior to sending official letters and survey links to nurses in North Carolina. The only limitation of the pilot study was that Northern Virginia does not necessarily represent a rural population; however, the proximity to regions of previous

terrorist acts could be valuable in obtaining information on the level of BTT that nurses have completed and their preferred methods of learning.

Informed Consent

In accordance with Walden University's IRB process training for conducting research with human subjects, the online course "Protecting Human Research Participants" offered by the National Institute of Health was completed. All participants involved in this study were provided a privacy statement contained in the consent form that outlined the scope of maintaining the confidentiality of the participants in any study results. All requests for anonymity were granted without exception. This included the public health organization that supported the expert panel but who requested anonymity in all published documents. The goal was to get an honest evaluation by rural PHNs on their levels of comfort with using BTT/AHT and applying core lessons to use in an emergency. Those PHNs, institutions or organizations that wished to receive a final copy of this study will be granted upon approval by Walden University, ProQuest, and myself. All participants were given the option of opting out of this study if there was a belief that personal, patient, or organizational sensitive information will be misused or misrepresented.

Sampling Strategy

The sampling strategy for this study was based on a stratified sample of 360 mid-level to senior PHNs who worked in rural communities identified by their local PHLs and information listed on the North Carolina Association of Local Health Directors and the North Carolina Association of Public Health Nurse Administrators websites. All of the

participants were contacted via their local health director after receipt of an e-mail invitation to participate in the study (Appendix C). Those PHLs who refused to provide access to their staffs were excluded from this study unless their individual nurse's information could be obtained via other sources. PHNs that completed the online survey were assured via a consent form that their identities would be protected.

The stratified sample was drawn from registered PHNs who completed the survey. A total of 113 participants responded to the survey. A total of 10 respondents were excluded for not being a nurse or not having licensure as registered nurse. All participants had an equal opportunity of being selected based on the criteria established in the letter of consent and an information briefing provided to each region PHL. Stratified sampling was determined to be the best methodology to capture a reliable sample base that would provide anonymity to the participant. Determining the number and distribution of PHNs throughout the counties was established using data from the North Carolina Public Health Department website. Oversampling was considered to account for non responses for some regions to ensure a reliable sample base. Obtaining a level of trust from the local health department directors was important in conducting the study, establishing and maintaining the follow-up schedule, and providing a willingness to share final data upon completion of this study.

Power Analysis

For this study I conducted a power analysis to calculate the minimum sample size to produce a statistically significant effect based on the strength of power. While this did not represent the "true" value or power of the actual sample, it did provide a statistical

estimate based on best judgment and sample population to decide if this study is feasible to conduct. The goal was to determine the appropriate number of replications to keep Type I error α and Type II error ß under the desired limits (e.g. $\alpha < 0.05$ and ß < 0.20). With a PHN population of over 4,800 spread amongst the 100 counties of North Carolina, I decided to use a stratified sample option of 360 mid-level to senior PHNs working community health centers in the ten geographical regions recognized by North Carolina. This would exclude nurses from other subspecialties. The power analysis required for a statistical test was the probability that it will correctly lead to the rejection of a false null hypothesis or Type II error (1 – ß; Frankfort-Nachmias & Nachmias, 2007, p. 440).

Prior to using GPower 3.1, I manually calculated the PHN population for all 100 counties to establish an estimate of PHN distribution. The initial results for a state population (N) of 360 mid to senior level PHNs with a 95% level of confidence (*e*) produced an estimate sample population (*n*) of 187 PHNs needed.

$$n = \frac{N}{1 + N * (e)^2} \quad \frac{360}{1 + N * (0.05)^2} = 187$$

To ensure that this did not represent an over sampling or under sampling that could undermine the study I conducted a GPower 3.1 analysis to establish the minimal sample with enough power to be statistically significant. Since the parameters for this study called for a Pearson correlation coefficient and a multiple regression analysis to validate or disprove the null hypothesis an *F*-test using a multiple linear regression model was chosen. The predicators for this analysis were my three primary independent variables (*x*, *y*, and *z*) and three secondary independent variables (age, education, and experience). I selected a priori power analysis and established a medium effect size of

0.25. While Cohen (1988, p. 412) defined the convention values for a multiple regression effect size as: small = 0.02, medium = 0.15, and large = 0.35, I decided that 0.25 would provide a sizeable enough sample of PHNs based on a power level of .80 (or ß ≤ .20).

Based on the power analysis calculation, the estimated sample size needed to achieve adequate power for this study was 73 total PHNs at a 95% confidence level to meet the statistical significance of this study. This number is significantly lower than the stratified sample estimate of the PHN population; however, this number met the number of participants to account for the attrition number of non-responders. Based on a power analysis run at 80% I needed a minimum of 48 total PHNs in order for the study to remain statistically significant in the event that my rate of return or turnaround of my survey slowed or stopped. Fortunately, the 103 participants that responded to my survey met the minimum power requirements needed to conduct for this study.

Data Analysis Plan

The scope of this study was to assess the degree of variance amongst the independent variables in relation to the dependent variable to establish a statistically reliable significance to reject the null hypothesis that choice of training modality did not have a discernible significance or impact on the rate level or rate of retention of emergency competencies for PHNs. My data analysis plan was designed to indicate statistical evidence to accept or reject the alternate hypothesis that one MOI of teaching BTT/AHT was more predictive towards maintaining the retention of emergency nursing competencies than the other two methods. Data collected from survey results was evaluated based on the categories of training, MOI satisfaction with the curriculum and

retention of material, and levels of comfort in applying these new skills during a BT event. The application of a cross sectional design format was used to compare the relationships between the primary independent variables (MOI) and secondary independent variables (age, education, and years in public health) and used to help eliminate or mitigate any competency bias. This prevented the inference of causal relationships between the independent variables and PHNs rate of skill retention (dependent variable) based on the Tier 1 baseline of PHN experience (Frankfort-Nachmias & Nachmias, 2008, p. 119).

The regression analysis was valuable in establishing a relationship between the MOI that Tier 1 PHNs will use for BTT. Unlike a *t*-test which could have been used to evaluate each modality for statistical significance as independent tests, running a multiple regression had a less likelihood (statistical probability) of creating a Type I error (false rejection of the null hypothesis) by adjusting for the number of groups being compared (Urdan, 2010, p. 105). As previously stated, all registered PHNs have a responsibility under the Quad Council (2011) to meet the core competency level of a Tier 1 nurses. For this study, Tier 1 nurses performance criteria was the baseline of core competencies for PHNs to meet based on the eight domains of PHN. This reduced any bias of inequality between the three tiers of PHN experience and scope of responsibilities that could have also produced unanticipated variances in the survey data results. The ratio between the within-groups variance estimate (also known as Mean Square Within, MS_W) was represented in the study as the variance between the sample group of nurses using a particular MOI and the between-groups variance estimate (also known as Mean Square

Between, MS_B) which represented the average amount of variation between the three modalities that resulted in a *F* value or ratio that determined the level of statistical significance between the groups (Urdan, 2010, p. 107). If the null hypothesis of this study is accepted, the ratio of *F* should be equal to 1. This would validate that there was no significant effect or impact to nurse rate of skill retention based on training modality. The level of comfort with each MOI was evaluated against questions in Section 4 of the survey questionnaire pertaining to retention of core skills, key skills from BTT, and competence in using the skills in an emergency situation.

The survey results were uploaded into IBM SPSS 20.0 to conduct a Pearson correlation coefficient and multiple regression analysis of the data. The goal was to establish a predictable trend that can be statistically supported that would indicate which MOI had shown the highest level of success in helping PHNs retaining skills and knowledge. Using the multiple regression would allowed me to model the actions of an independent variable based on the actions of the dependent variable. Using a multiple regression analysis I tested theories (or models) that determined which set of independent variables influenced the dependent variable. A multiple regression typically uses a single dependent variable and several explanatory (independent) variables to assess the statistical data pertinent of competing theories that are being examined.

The Pearson correlation coefficient and multiple regression analysis was found to be useful (a) in determining whether or not a particular effect is present, (b) in measuring the magnitude of a particular effect, and (c) in forecasting what a particular effect would be. In interpreting the results of a multiple regression analysis, it was important to

distinguish between correlation and causality. The correlation between the three tiers of PHNs was mitigated by reducing the competency level to represent baseline nurses at Tier 1 levels only. This adaptation ensured the correlation between the variables did not imply that one event causes the second to occur. The result was that any causal inferences were discouraged because of spurious (two variables were closely related but bore no causal relationship to a third variable) correlation (Frankfort-Nachmias & Nachmias, 2008, p. 93). Causality could not be inferred by data analysis alone and could only be established on the basis of an underlying causal theory followed up with empirical evidence that there was a causal relationship.

For this study, the level of statistical significance (α) required to reject the null hypothesis was set conventionally at .05, or 5%. The significance level measured the probability that the null hypothesis would be rejected incorrectly, assuming that the null hypothesis is true. The *p*-value associated with the null hypothesis that a regression coefficient (β) was 0 and the probability that a coefficient of this magnitude or larger had occurred by chance if the null hypothesis were true. If the *p*-value were less than or equal to 5%, the null hypothesis would be rejected. If the *p*-value were greater than 5%, the null hypothesis would be accepted and the alternate hypothesis rejected (Urdan, 2010, p. 77).

For the propose of this study, I made accommodations to manage missing data and data cleansing from the collected survey information. Questions that represent "Others" were coded with 66. Questions that represent "Don't Know" were be coded with 77. Questions that represent "Blank" were coded with 88. Questions that represent "Missing" were coded with 99 and a decision to either exclude the data or not. The size

of the collected sample was a determining factor in deciding whether to discard information. A check for errors in exporting data from Survey Monkey was conducted during the pilot study phase to reduce the incidence of operator error. Backups of all data were conducted prior to transfer of data files and analysis using SPSS. PHNs who did not meet the requirements for this study (i.e. those registered nurses not designating themselves as PHNs or LPN/LVN nurses) were excluded during screening. A frequency analysis of the variables was conducted using SPSS to determine if recoding was in required to bring data into alignment or whether to discard information.

Interpretation Plan

For this study data was extracted from Survey Monkey and exported into the Microsoft Excel and the IBM SPSS programs. Information was broken out by the four sections which include demographics, the core/emergency nursing competencies, results from the memory quiz, and PHNs opinions of recent BTT received. The first analysis was a comparison of the demographic data from each completed survey to establish a profile of nursing education, and years in practice. Information on completed BTT/AHT was also collected. Survey data from each question will be complied and charted for comparison. The goal of this study was to establish a predictive MOI that could help public health officials in determining the most cost-effective training program for PHNs. The Pearson correlation coefficient and regression analysis results was collected and displayed as a series of charts representing the trending or concentration by modality of BTT taken.

Threats to Data Quality

For the survey portion of this study, threats to data quality included the verification that nurses participating in the study who were actual public health qualified nurses. This entailed a level of trust that PHLs would ensure that the survey was forwarded onto the correct audience. The potential solution for this issue was a detailed summation of the survey's goal in the invitation to participant letter and the desired audience needed to complete the survey. The potential problem was the loss of the randomness of the target population. Another threat to quality was the perception by the public health community that the survey may present rural public health organizations in a negative light. It must be recognized that the public health community is a tight knit entity which is protective of its image. Any survey or study conducted with these individuals or groups had to be done with the utmost level of professional respect and the understanding of the value of their limited time. PHNs often serve as the gatekeepers to PHS and there is an inherent concern or fear that any study for official publication could have the potential of opening an organization up to liabilities for potential misuse of private health information (PHI) or violation of Health Insurance Portability and Accountability Act (HIPAA) laws which could levy fines of up to $10,000 for each violation of patient privacy. This was taken into consideration during the data collection process.

Ethical Considerations

The issue of BT and its impact is a sensitive issue that can cause concern if not handled correctly or placed in the proper context of other strategic level weapons with

which the United States could be attacked. This concern is somewhat mitigated due to the target population of this study being medical professionals. The primary concern was that of third party participants such as secretaries, janitorial staff, or family members who may see drafts of BT response plans or an increase in disaster training could raise community concerns that the current emergency response plans are inadequate to meet the needs of the community. They may see the study results as a precursor to something that the government has not discussing publicly and it could induce a level of anxiety that is not always appropriate. This also has the potential of having political ramifications if the hint of misappropriation of funds is alleged or if the issue of privacy is breached within a health care organization and potential fines associated with HIPAA laws are violated.

The need to remain sensitive of these issues were paramount in establishing a survey questionnaire deployment plans, obtaining informed consent from recipients, and/or pretesting the survey questionnaire using PHN professionals. The invitation to participate in the study letter that was sent to PHLs provided survey recipients with a clear understanding of the goals of the survey and study. Participants were also given the option to opt out without prejudice to the study or results presented. Maintaining the privacy of any agency or organization that wishes unanimity was respected. This study followed all of the ethical guidelines established by Walden University's IRB on conducting experiments with human subjects and allowed participants the opportunity to provide feedback on their responses.

Summary

In this study I evaluated PHNs who had used BTT/AHT programs at least 2 years ago to determine if there was a predictive correlation between the primary independent variable MOI and the dependent variable degree of retention for PHNs. This study was conducted as a quantitative cross-sectional study that surveyed 360 PHNs serving rurally in the state of North Carolina. Out of the 113 participants that completed the survey, 103 were used to conduct my analysis. My goal in this study was to determine which preferred MOI had a more predictive trend in helping nurses retain critical emergency knowledge of BT and all hazards protocols. Throughout this process all ethical and institutional guidelines have been maintained to protect the privacy of organizations, individuals, and potential patients during my data collection process. The overall goal of this study was to provide supportive evidence on which modality of BTT/AHT has a greater likelihood of producing a higher degree of emergency knowledge/skills retention by PHNs. The data and results produced can be interpreted by PHLs and applied to enhance public health organizations ability to coordinate emergency training for its PHNs and ultimately improve the level of community readiness through enhancing local public health department capabilities. In Chapter 3 I stated my research question and hypotheses, clarified my research methodology, and established my population sample base needed to statistically support my study. In Chapter 4 I provide a detailed overview of my study, the statistical methodology I used to analyze my collected data, and present the results of my analysis. In Chapter 5 I provide a summation of the results of my study

and make recommendations towards use of the findings and their potential impact on society.

Chapter 4: Results

Chapter 4 represents the culmination of the results of a cross-sectional study I conducted to assess the learning styles of PHNs who worked in rural communities in North Carolina that had taken BTT/AHT courses at least 2 years ago. This study evaluated the relationship between three modalities of training commonly used in teaching BTT/AHT courses and the degree of knowledge acquisition/retention of emergency preparedness skills required by PHNs to maintain a specific level of nursing performance.

The purpose of this study was to assess if there was a predictable MOI that had the greatest likelihood of success in helping rural community PHNs retain critical emergency nursing skills that would be required during a biological incident. Determining the best MOI for receiving BTT/AHT could prove beneficial for PHLs who may need to leverage limited resources and training dollars towards ensuring that the PHCW have sufficient tools to be prepared for a future bioterrorism event.

Research Question and Hypotheses

The research question for this study was the following: Does the independent variable (MOI, *x*, *y*, or *z*) for BT/AHT courses statistically significantly predict the dependent variable (degree of retention of emergency knowledge/skills for PHNs, as measured by a memory quiz and an assessment survey in terms of percent) working in rural public health agencies in North Carolina?

$H_0$1: The independent variable (MOI) for BT/AHT courses does not statistically significantly predict the dependent variable (the degree of retention of emergency

knowledge/skills for PHNs as measured by a memory quiz in terms of percent) and all beta (β) coefficient values are not significantly statistically different from zero.

H_A1: The independent variable (MOI) for BT/AHT courses statistically significantly predicts the independent variable (the degree of retention of emergency knowledge/skills for PHNs, as measured by a memory quiz in terms of percent) and at least one beta (β) coefficient value is significantly statistically different from zero.

Study Synopsis

Upon approval by Walden University's IRB (Number: 08-08-14-0090199), this study was initiated with a modified pilot study to evaluate the face and content validity of the survey tool, which consisted of a four-part questionnaire designed to survey and collect data from PHNs. The questionnaire consisted of (a) a demographic section, (b) a PHN's core competencies section to assess the participant's level of confidence in the ability to fulfill Tier 1 PHN skills, (c) a memory retention quiz section that assessed the PHN's basic knowledge of bioterrorism treatment protocols, and (d) a BTT/AHT assessment section that obtained the survey participant's opinions on completed training. The questionnaire was designed using survey development tools on the Survey Monkey website. A link to the survey was made available for each participant.

I conducted a pilot study utilizing PHNs from one of six public health departments located in the Northern Virginia area. Invitation e-mails to participate in a pilot study were sent to health directors of six Northern Virginia counties on August 8, 2014. Each invitation requested permission to conduct the pilot study over a 10-day period starting on August 13, 2014 and to use five to seven PHNs from each health

department who had a background or expertise in emergency training to serve as an expert panel. Each panel would take the survey and provide feedback on ways to improve the survey. A letter of consent was forwarded to each panel member by the County Health Director via an e-mail attachment. The consent letter provided an overview of the study, its potential benefit to the nursing profession, and a link to the survey and evaluation form. Only one county health department agreed to participate in the pilot study/expert panel and requested that the identity of the health department be kept confidential for the purpose of this study and any published papers derived from this study.

The pilot study/expert panel was concluded early on August 20, 2014 with a total number of seven participants completing the survey and evaluation form. With the exception of minor adjustments to the survey tool to ensure that the quiz in Section 3 did not skip from Question 33 to 35, the tool performed satisfactorily and all participants gave it a positive rating and recommended no structural changes be made. The ability to export data from the Survey Monkey secure website into Microsoft Excel and IBM SPSS 20.0 formats was also evaluated and the functionality was found sufficient for data collection and analysis purposes. I removed the evaluation form from the survey questionnaire and all pilot study data were retained. The Survey Monkey tool was cleared of information and prepared for the final study.

The formal survey officially started on August 25, 2014 with an e-mail to all North Carolina Heath Directors for requesting permission to conduct a study with their organizations. A total of 360 PHNs were contacted. The e-mail contained an attachment

with a PowerPoint brief providing an overview of the study and an attachment with a letter of consent for their staff PHNs. Directors or their designated proxy (in many cases this was delegated to the Director of Nursing Services or other senior nurse executive) were asked to forward the letter of consent to PHNs who had attended or completed BTT/AHT. This served as informed consent approved by the organization. Each consent letter contained a link to the survey questionnaire via the secure Survey Monkey website. The results of this survey are noted in the following sections.

Descriptive Statistics of Results

The Survey Monkey website was officially closed on September 30, 2014. This allowed requested participants to have access to the site for 6 weeks during the months of August and September. The electronic register within the Survey Monkey application identified 113 participants who accessed the site during the scheduled survey period. Ultimately, 10 respondents were removed because they did not meet the criteria for analysis. The data from the application was exported into an Excel spreadsheet and broken out by section and questions for each section. I collected the raw data and exported it into IBM SPSS 20.0 format and recoded the data according to the codebook in Appendix E. Based on the parameters established with the participants, their public health leadership, and the IRB, there were no identifying questions or criteria that would identify individual nurses within their respective organizations or agencies. Nurses identifying themselves as LVN/LPN (n = 2) were excluded from the final survey tally because they did not meet the professional requirements for a Tier 1 PHN as required by the Quad Council (2011). Eight additional participants who were identified as non nurses

were also removed using the data cleansing process discussed in Chapter 3. The adjusted tally for PHN was 103 (n = 103). The level of privacy was maintained throughout the survey with the exception of the permission to conduct the study e-mails, which used information from public domain sources. A breakout of PHNs represented all 10 regions of North Carolina. The 103 PHNs surveyed for this study met the statistical power level of 80% established for this study.

Section 1: Survey Demographics

The first section of the survey consisted of a demographic layout of the participants based on their input. Of the 103 PHNs completing the survey, 102 indicated that they were female (99 %) and only 1 indicated that he was male (1%). The high female-to-male ratio was consistent with the historical trends for the nursing profession with 91% female and 9% male (USC, 2010). The average age of participant nurses was 48.6 years old; this was consistent with documented discussion of an aging public health workforce (Rosenstock et al., 2011). European American nurses represented the largest percentage of nurses at n = 90 or 87.4% of nurses surveyed. African American nurses represented the next largest representation of PHNs at n = 9 or 8.7%. The remaining racial breakout of PHNs in North Carolina remained under 5% and was distributed amongst Hispanic American and Native American nurses. The limited distribution of the survey to local PHNs for the 6-week period could be a justifiable condition for the lower number of minority participants surveyed.

In regards to educational attainment, the survey indicated that an equal number of PHNs held either an associate's degree (n = 41 or 39.8%) or a bachelor's degree (n = 41

or 39.8%). Only *n* = 17 or 16.5% indicated that they held an advanced degree beyond the bachelor's degree level. The high percentage of associate's degree nurses surveyed was consistent with many traditional nursing programs that only required this level of education for registered nurses (Rosenstock et al., 2011). The Quad Council's (2011) Tier 1 requirement that establishes the BSN degree as the entry-level education requirement for PHNs is still viewed as the industry standard for the profession. As noted throughout this study, nurses holding less than a BSN would be evaluated equally because they were often "grandfathered" due to their level of experience in public health (Education Committee of the Association of Community Health Nursing Educators, 2010). A secondary requirement that PHNs holds a licensure as a registered nurse was represented by *n* = 99 or 96.1% of the survey participants. Nurses with advanced skills beyond the RN level included nurse practitioners (NP) represented a small percentage of participants at *n* = 4 or 3.9%. These nurses traditionally hold the position of physician extenders and become part of emergency management team during a crisis.

PHN participants in the study worked an average of 13 years in public health and greater than a 40-hour work week. PHNs throughout North Carolina worked in a wide variety of organizational settings, with the majority working in local health departments funded by the state. The average PHN worked for at least 6.7 years in their current positions and their job titles ranged from nurse educator through director of nursing. A cross-sectional breakout of nurses by license type and region is represented in Table 1. Table 2 represents the breakout of local health departments by the 10 recognized public health regions.

Table 1

Cross-Sectional Breakout of Nursing Profession by North Carolina Pubic Health Region

Public Health Region	State Licensure: RN/NP (Registered Nurse/Nurse Practitioner)	
	(*n*)	**(%)**
Region 1	6	5.3%
Region 2	12	12.5%
Region 3	11	10.7%
Region 4	14	13.4%
Region 5	7	7.1%
Region 6	9	10.7%
Region 7	13	11.6%
Region 8	10	8.9%
Region 9	7	6.3%
Region 10	15	13.4%

Table 2

North Carolina Public Health Regions)

Region	County
Region 1	Cherokee, Clay, Graham, Haywood, Jackson, Macon, Swain, Transylvania
Region 2	Avery, Buncombe, Burke, Caldwell, Cleveland, Henderson, Madison, McDowell, Mitchell, Polk, Rutherford, Yancey
Region 3	Alleghany, Ashe, Davidson, Davie, Forsyth, Stokes, Surry, Watauga, Wilkes, Yadkin
Region 4	Alexander, Cabarrus, Catawba, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, Union
Region 5	Alamance, Caswell, Chatham, Durham, Guilford, Orange, Person, Randolph, Rockingham
Region 6	Anson, Cumberland, Harnett, Hoke, Lee, Montgomery, Moore, Richmond, Scotland
Region 7	Edgecombe, Franklin, Granville, Halifax, Johnston, Nash, Vance, Wake, Warren, Wilson
Region 8	Bladen, Brunswick, Columbus, Duplin, New Hanover, Onslow, Pender, Robeson, Sampson
Region 9	Bertie, Camden, Chowan, Currituck, Dare, Gates, Hertford, Hyde, Martin, Northampton, Pasquotank, Perquimans, Tyrell, Washington
Region 10	Beaufort, Carteret, Craven, Greene, Jones, Lenoir, Pamlico, Pitt, Wayne

Section 2: Core Nursing Competencies

This section of the survey consisted of a series of questions that attempted to link the core competencies of PHNs to the ten essential indicators of public health quality that were established as part of the theoretical framework of this study based on the work of Handler et al. (2001) discussed in Chapter 2 and 3. These indicators followed the eight prescribed domains of public health quality used by the COL and the Quad Council to establish Tier 1 core competencies for PHNs. As noted in Chapters 2 and 3, Tier 1 competencies for basic professional nursing at the BSN level were established as the baseline for this study despite the fact that many of the PHNs conducting the survey were not required to hold a bachelor's degree in nursing to fulfill the roles in the community as PHNs. Table 3 provides an overview of the results of (n = 103) survey participants who completed Section 2 and their levels of confidence in being able to fulfill those Tier 1 core competencies.

Table 3

Summary of PHN Core Competencies Results by Degree of Confidence in Nursing Skills (n = 103)

Section 2 Questions	Not at all Confident		Somewhat Confident		Undecided		Confident		Very Confident	
	n	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Domain 1: Analytics and Assessments Skills										
Q1. Knowledge of epidemiologic data to identify health risks for a population…	0	0	25	25	11	10.5	54	53.9	9	10.6
Q2. Experience to identify determinants of health/ illness and use evidence-based public health nursing practices …	2	1.9	19	18.3	6	6.7	58	57.7	14	15.4
Domains 2: Policy Development/Program Planning Skills										
Q3. Knowledge to identify policy issues relevant to the health of individuals, families, and groups	2	2.9	16	15.5	17	16.5	47	46.6	16	18.5
Q4. Knowledge/experience to improve public health processes and use quality indicators for improvement in care …	5	4.8	12	11.5	12	11.5	54	55.8	16	16.4
Domain 3: Communication Skills										
Q5. Ability to communicate effectively and in a culturally responsive manner…	0	0	7	6.9	2	1.9	56	55.9	32	35.3
Q6. Knowledge to communicate effectively with groups/inter-professional teams and disseminate information…	0	0	4	4	4	4	60	60.6	27	31.3
Domain 4: Cultural Competency Skills										
Q7. Training/experience to use social and ecological determinants of health to work effectively with diverse groups…	1	0.9	9	8.7	7	6.8	62	62.1	19	21.4
Q8. Ability to demonstrate culturally appropriate PHN practices with groups/ community members …	0	0	8	7.8	7	8.7	59	59.2	24	24.3
Domain 5: Community Dimensions of Practice Skills										
Q9. Experience to partner effectively with key stakeholders/groups in providing care delivery using health assessments …	3	2.9	14	13.6	11	10.7	48	49.5	22	23.3
Q10. Knowledge/experience to support public health policies/programs/resources for population focused advocacy …	0	0	11	10.7	10	9.7	57	58.3	20	21.4

(table continues)

Section 2 Questions	Not at all Confident		Somewhat Confident		Undecided		Confident		Very Confident	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Domain 6: Public Health Science Skills										
Q11. Training/knowledge/experience to use descriptive epidemiological methods when conducting a health assessment …	2	1.9	13	12.5	15	14.4	57	57.7	12	13.5
Q12. Complies with all requirements of patient confidentiality/human subject protection...	1	0.9	3	2.9	3	2.9	27	27.2	65	66
Domain 7: Financial Management and Planning Skills										
Q13. Knowledge/experience to describe the impact of budget constraints on the delivery of PHN care …	4	3.9	15	14.7	16	15.7	41	43.1	21	22.5
Q14. Provide data for inclusion in budgets/help to establish budget priorities, and provide reports on program…	12	13.9	12	11.9	22	21.8	31	32.7	20	19.8
Domain 8: Leadership and Systems Thinking Skills										
Q15. Ability to incorporate ethical standards of practice in all aspects of PHN practice…	1	1	9	8.9	3	4.9	43	44.6	40	40.6
Q16. Experience working with stakeholders to identify internal/external factors affecting PHN practice …	8	8.7	18	17.5	12	13.6	42	41.6	18	18.5

Based on the survey's results, it can be inferred that North Carolina PHNs with a specific level of training as identified by licensure, years in the PH profession, and work experience would have a higher degree of confidence in their ability to meet these eight core performance categories. While the percentage of PHNs stated that they have no confidence in their ability to fulfill these requirements was exceedingly low it is unclear (based on the inability to identify specific organizations) whether these nurses represent staff members who have not been exposed to all aspects of public health categories. Areas such as budgeting priorities (question 14) and those PHNs working with internal and external stakeholders (question 16) often fall to nurses who have more experience or who hold leadership positions. The same could also hold true for those senior nurses who

are very confident in their ability to fulfill diverse roles within the public health organization such as managing programs which would require the confidentiality of patient information in the protection of human subjects in research (question 12). The overall results of this section represent a consistency that that supports the supposition that Tier 1 PHNs in North Carolina meet the requisite performance quality requirements established by the Quad Council and the COL and supports the ten essential performance indicators established in this study under by Handler et al. conceptual framework.

Section 3: Bioterrorism/All Hazards Quiz

This section of the survey evaluated and tested the participants general knowledge of bioterrorism response and all hazard preparedness protocols in regards to previously completed training. The questions were based on standardized course content of BTT/AHT programs (Table 4). The participants were given 15 multiple-choice questions and asked to provide an answer for the best choice. After each question and the respective response by the participant, Survey Monkey displayed the correct answer to the question along with a reference to where this information was obtained. A separate series of questions was then presented to the participant to assess how they obtained the information and what type of methodology was used to obtain this information. This information is provided as an overview in Table 4.

Table 4

Summary of Bioterrorism Knowledge Quiz and Answers

Quiz Questions	Quiz Answers
Q1. The most common early presenting syndrome associated with the majority of high risk ("Category A") bioterrorism-associated diseases (i.e., anthrax, botulism, plague, smallpox, tularemia, and viral hemorrhagic fevers) is:	Answer: B. Influenza-like illness
Q2. Persistence of spores in the environment is of concern after a bioterrorism event involving:	Answer: A. Anthrax
Q3. The deadliest form of anthrax is:	Answer: B. Inhalational
Q4. Smallpox has all of the following clinical features **EXCEPT**:	Answer: D. The virus can only be spread through direct or indirect contact with open lesions (e.g., by touching an infected lesion or by contact with infected clothing or bedding).
Q5 Of the following diseases, which one has the highest potential for person-to-person transmission?	Answer: D. Pneumonic plague
Q6. Which of the following are good biological terrorism threats because of substantial morbidity and mortality ease of production, efficient dissemination, stability in aerosol, or high infectivity?	Answer: C. Anthrax, smallpox, botulism, and plague
Q7. What infection control measures are recommended for a person with suspected or confirmed smallpox?	Answer: E. All of the above infection control measures are recommended for a person with suspected or confirmed smallpox.
Q8. The "integrated network of state and local public health, federal, military, and international laboratories that can respond to bioterrorism, chemical terrorism and other public health emergencies" is known as the:	Answer: B. Laboratory Response Network (LRN)
Q9. At present, the first-line laboratory response to biological terrorism involves:	Answer: C. A network of local, State, and Federal public health laboratories
Q10. According to State Laws, a physician who sees a patient he/she suspects of having anthrax or smallpox must notify the State Department of Health or the CDC:	Answer: B. By phone as soon as the provisional diagnosis is established
Q11. The local television news has just reported receiving a call from an activist group who claims that they have dispersed anthrax at a local high school basketball game earlier in the evening. Panic-stricken attendees from the game are flooding into the emergency room of the local hospital at an alarming rate with wide-ranging complaints. The patients and the television reporters should be told all the following to avoid further panic, EXCEPT:	Answer: D. Potentially exposed persons are not contagious
Q12. "Psychological first aid (PFA)":	Answer: A. Is a key component of early intervention in a mass casualty event
Q13. As a form of Psychological first aid (PFA) what is not appropriate to discuss with victims?	Answer: E. All the above
Q14. _____ sets safety standards that apply for any workers in the United States who may have been exposed to a safety or health hazard.	Answer: B. OSHA (Occupational Safety and Health Administration)
Q15. The Health Alert Network (HAN) is _____ primary method of sharing cleared information about urgent public health incidents with public information officers; federal, state, territorial, and local public health practitioners; clinicians; and public health laboratories.	Answer: B. CDC (Centers for Disease Control and Prevention)

I derived standard score for each participant based on the number of correct answers they achieved on the 15 question multiple choice test. The score was based on the percentage of the overall completed test questions (6.67% per question) and the number of correct answers. Test results were coded as 1.0 (or 6.67%) for pass/correct answer and 0.0 (or 0%) for fail/incorrect answer and then manually compiled into an Excel spreadsheet and calculated for a raw score. The final adjusted scores which ranged from 0.0 to 0.9338 were then inputted into the SPSS program. The score represented the retention of information or knowledge of the PHN as a "snapshot in time" based on prior learning and were incorporated into a Pearson correlation coefficient analysis and multiple regression models (discussed in detail below) as the dependent variable representing North Carolina PHNs who have completed a BTT/AHT course. Participant scores above 70% were considered to have a significant level of retention of basic BTT/AHT skills.

As noted in Table 5, the number of participants answering questions 1 through 15 had a significantly higher rate of correct answers that were learned from a combination of professional training and on the job experience where the skills for either honed as a function of "muscle memory" or as a consequence of work related experience requiring a greater degree of knowledge of BTT/AHT. While the empirical evidence represented in a Pearson correlation coefficient analysis (shown below) did not show conclusive evidence of statistically significantly direct correlation between these presumptions, the higher percentage of participants indicating a correct response and those preferring or using a blended methodology of learning styles could prove or support the supposition a that a

kinesiology type of learning process provides a greater degree of retention for PHNs over time. These practitioners tend to not only learn the didactics of emergency skills but must also apply and reapply these skills in a practical clinical situation or scenarios or drills to remain proficient.

Table 5

Summary of Bioterrorism Quiz and Method of Knowledge/Skill Acquisition (n = 104)

	Question Answered Correctly (Pass)		**Question Answered Incorrectly (Fail)**		**(A) Were the knowledge /skills to answer this question acquired through a course of instruction/ training?**		**(B) Were the knowledge /skills to answer this question learned on the job?**		**(C) Were the knowledge /skills to answer this question learned/ acquired as a combination of A and B**		**(D) I have no knowledge/skill in this topic.**	
	n	**(%)**	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**
Quiz Q1.	73	76.8%	23	27.2%	19	20.4%	14	15.1%	55	59.1%	5	5.4%
Quiz Q2.	53	57%	40	43.1%	25	26.9%	12	12.9%	31	33.3%	25	26.9%
Quiz Q3.	90	96.8%	3	3.3%	25	27.2%	10	10.9%	48	52.2%	9	8.7%
Quiz Q4.	44	47.8%	48	52.1%	19	21.1%	7	7.8%	36	40%	28	31.1%
Quiz Q5.	72	79.1%	19	20.9%	17	18.9%	11	12.2%	32	35.6%	30	33.3%
Quiz Q6.	76	83.5%	15	16.5%	22	24.2%	11	12.1%	40	44%	18	19.8%
Quiz Q7.	83	91.2%	8	8.8%	21	23.1%	12	13.2%	45	49.5%	13	14.3%
Quiz Q8.	42	46.7%	48	53.3%	13	14.3%	13	14.3%	16	17.6%	49	53.8%
Quiz Q9.	67	74.4%	23	25.5%	15	16.7%	13	14.4%	32	35.6%	30	33.3%
Quiz Q10.	67	73.6%	24	26.4%	15	16.5%	17	18.7%	37	40.7%	22	24.2%
Quiz Q11.	33	36.7%	57	63.3%	18	20.7%	12	13.8%	26	29.9%	31	35.6%
Quiz Q12.	70	77.8%	20	22.2%	20	22.2%	11	12.2%	29	32.2%	30	33.3%
Quiz Q13.	73	83%	15	17.1%	16	18.4%	8	9.2%	39	44.8%	24	27.6%
Quiz Q14.	80	89.9%	9	10.1%	16	18%	15	16.9%	53	59.6%	5	5.6 %
Quiz Q15.	58	65.9%	30	34.1%	10	11.2%	21	23.6%	34	38.2%	24	27%

Section 4: Assessment of Recent BTT

This final section of the survey provided an assessment of the survey participant's experience and opinions on completed BTT/AHT and their level of application of learned skills, preferred MOI, and levels of confidence in applying these newly acquired skills toward their duties as potential community first responders. Participants were first asked how long ago did they attend or complete a BTT/AHT course. This was important to access if the knowledge received remained relevant over time. The average time that the majority of the participants indicated when they completed the course was two years ago, with the shortest time being two months ago and the longest time being at least 12 years. All of the survey participants received their training in the aftermath of 9/11 and it could empirically be inferred that this was attributed to their organization's desire to have their staff complete the training to be prepared for any supplemental attacks. This time also coincides with the highest percentage of funding made of available for BTT/AHT by state and federal grants under the Bioterrorism Act. The creation and large influx of emergency training programs and short courses available to PHNs created a pool of programs with curriculums of varying length and content. The average length of the course of instruction in BTT/AHT based on participants input was four hours.

The general premise of this study was to assess which modality of training was more predictive of depicting the increased knowledge retention for PHNs. Participants were asked to identify which MOI was their preferred method and type of learning. Of the 85 participants who completed this section of the survey $n = 39$ or 45.9% indicated that they preferred an instructor led classroom or seminar format that included a

workshop or presentations. Another *n* = 9 or 10.6% of the participants indicated that they preferred online or asynchronous training with an instructor as a facilitator. The final *n* = 37 or 43.5% of the study participants indicated they preferred a blended or combined style method of training that included an instructor and self-paced course content or that they prefer a totally self-paced MOI that included Internet-based, audiovisual, CD-ROM/DVD materials that did not require the oversight of an instructor. A prevailing factor that the age of the participant may have had a decisive impact in determining the MOI was inputted as a secondary independent variable in the multiple regression models. A Pearson correlation analysis (see below) showed that a higher percentage of older PHNs in the range of 36 - 45 were more comfortable using the online for Internet-based methodologies while those participants in the 46 - 55 age range were more likely to use traditionally based services, which makes sense.

While it was noted throughout the review of literature that there was no standardized model for a bioterrorism curriculum, the CDC does recognize eight categories of core topics that should be included in the curriculum of BTT. Participants were asked to identify if their course of instruction contained any of the eight categories as part of the course layout. The eight categories were: (a) the Characteristics of Biological Agents Class A, B and C associated with bioterrorism, (b) Clinical Manifestations, (c) Surveillance and Epidemiology, (d) Laboratory Systems, (e) Health Risk Communication and Media Relations, (f) Psychosocial Impact of Bioterrorism, (g) Worker Safety Issues, and (h) Information Technology. Over 78.7% of the participants indicated that their course content contained at least 4 or more of the subject topics while

27.2% of the participants did not answer this series of questions. The sponsor or brand of the training was not requested in the survey and it is important to note that these requirements are a CDC requirement for federally supported programs and not necessarily required for those courses sponsored by for-profit organizations or as a part of fee-for-service seminars.

The next series of questions pertained to the participants views on the impact of BTT/AHT courses towards their professional development as PHNs. Participants were asked what was their your perceived or actual barriers from receiving BTT/AHT. While 29.1% of the participants did not answer these questions, 46.6% indicated that a combination of these factors served as barriers for obtaining this information. These included: (1) No administrative financial support for training by the organization (*n* = 11 or 15.1%), (2) the PHNs work schedule did not provide sufficient time for training (*n* = 11 or 15.1%), (3) the taking of BTT was not a current priority for the participant (*n* = 4 or 5.5%), (4) there were no training opportunities available for the participant (*n* = 10 or 13.7%), or (5) the PHN felt that BTT was not within the scope of their responsibilities (*n* = 3 or 4.1%). Many of the responses were consistent with empirical evidence identified in the literature review (Rebmann & Mohl, 2010; Rosenstock et al., 2011).

This led to the next question that evaluated the value of completing BTT/AHT. Over 62% of the participants indicated they valued a combination of professional and personal factors in obtaining the training. Factors included: (a) training in BTT/AHT would advances the PHNs professional knowledge, (b) preparedness for a bioterrorism attack will help the PHN reduce risk to the community through awareness education, and

(c) preparedness for a bioterrorism attack will increase the PHN's chances of detecting an attack through surveillance techniques. The *n* = 83 survey participants who completed this next section were asked about their concerns on their ability to respond or support a bioterrorism event as a PHN and did they: (a) have the ability to identify and recognize bioterrorism agents prior to a declared event (*n* = 11 or 13.3%), (b) the ability to respond effectively to a bioterrorism event with the resources available to their public health agency (*n* = 29 or 34.9%), (c) the willingness to provide assistance to response to a bioterrorism event versus providing protection for their own family (*n* = 19 or 22.9%), or (d) maintaining their current skill level (*n* = 23 or 27.7%).

The next series of questions pertained to the types of training courses the participant attended, their levels of satisfaction upon completion of their programs, and what types of supplemental training would be valuable as a part of continuing education requirements. Participants were asked what additional training they would prefer to supplement their knowledge of bioterrorism, all hazards preparedness, and emergency response in general. Participants indicated that they would prefer to attend: (a) local seminars or other in-service classroom instruction (*n* = 37 or 45.1%), (b) attend out of area conferences with lectures including interactive workshops with problem-based learning and small number of participants (*n* = 5 or 6.1%), (c) self-study through journals, or distance learning including satellite courses (*n* = 16 or 19.5) and (d) those participants who preferred a combination of methods to receive additional training (*n* = 24 or 29.3%). Survey participants were then asked their level of satisfaction or practical experience in using one of the three MOIs for completing their course. They were also asked the course

of instruction that the learning objectives that were stated in the course curriculum. Table 6 provides an overview of the level of satisfaction that participants found that there MOI.

Table 6

Experience Using MOI

	Experience with using Instructor-led (in classroom) training.		**Experience with using Internet-based training.**		**Experience with using a blended style of learning that included instructor led and Internet-based training.**		**Did course meet the learning objectives?**	
	n	**(%)**	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**
No experience	6	7.0%	1	1.2%	6	7.0%	N/A	N/A
Poor	0	0%	5	5.8%	1	1.2%	0	0%
Fair	6	7.0%	18	20.9%	8	9.3%	1	1.2%
Good	35	40.7%	35	40.7%	40	46.5%	6	7.4%
Very good	35	40.7 %	22	25.6%	27	31.4%	47	56.8%
Excellent	4	4.6 %	5	5.8%	4	4.7 %	21	25.9%

Participants were then asked to assess how they were evaluated for competency and mastery of course objectives and what methods were used to quantitatively evaluate this mastery. Participants indicated that the methods included: (a) essay exams (*n* = 1 or 1 %), (b) multiple choice/true-false exams (*n* = 40 or 38.8%), (c) term papers (*n* = 0 or 0%), (d) oral presentations (*n* = 1 or 1 %), (e) team projects (*n* = 1 or 1 %), (f) public health skill demonstration (*n* = 2 or 1.9 %), or (g) tabletop/live-action exercises (*n* = 14 or 13.6 %). The survey results indicated that 18.4% of the participants indicated they were graded by a combination of these methods. The mastery of these skill sets applied towards the next questions which assessed the level of confidence that the PHN felt in their ability to apply these new skills towards their professional duties/position and

towards an actual bioterrorism incident. Table 7 provides an overview of the PHNs level of confidence in performing job-related tasks and emergency protocols.

Table 7

Levels of Confidence in Job Performance and Implementing BTT Protocols

	Based on the training you received, how confident do you believe that learners will be able to perform their jobs better after completing similar training?		**Based on your training in bioterrorism, how confident are you in implementing your agency's protocols on reporting possible incidents of bioterrorism?**	
	n	**(%)**	***n***	**(%)**
Not confident	5	6.1%	7	8.4 %
Somewhat confident	21	25.6%	20	24.1%
Undecided	17	20.7%	23	27.7%
Confident	33	40.2%	26	31.3%
Very confident	4	4.9%	7	8.4%

While the topic of continuing education credit is not specifically significant for this study, most PHNs take these credits to maintain their current licensure and show progress towards professional growth. Participants were asked to indicate how many continuing medical/nursing education credits that they earn from the completed BTT/AHT course. The minimum credit received was 0 credits and maximum credit received for the course was 18 contact hours.

Participants were asked if it was reasonable to believe that they would be able to perform their jobs better after they completed BTT/AHT. Participants indicated their level of agreement as: (a) Strongly disagreed (n = 1 or 1.2%), (b) Disagreed (n = 3 or 3.6%), (c) Neither agreed nor disagreed (n = 18 or 21.4%), (d) Agreed (n = 49 or 58.3%), and (e) Strongly agreed (n = 13 or 15.5%).

The funding of the course was also requested as many PHNs and the literature review reflected as a significant barrier towards completion of continuing education credit. Over 83% of the participants indicated that there participating organization was responsible for funding their training.

Statistical Analysis of Survey Data

The initial process of starting the statistical analysis of this data included establishing the reliability of the survey questions to ensure that that they met the requirements for correlation analysis and clarity of data prior to conducting a multiple linear regression analysis to establish a predictive model. A Cronbach's alpha analysis was conducted on the survey questions for the core competencies section (Section 2), the bioterrorism quiz section (Section 3), and the participant's assessments section (Section 4) to establish their reliability of each category of questions. The results of the analysis in Table 8 represented a high or "tightly connected" reliability alpha greater than 0.70 (Frankfort-Nachmias & Nachmias, 2007, p. 425) for at least two of the three categories. The only exception was the assessment section which had a mixture of Likert scale questions and open answer questions and a lower than anticipated number of participants completing this section. The effect of not using a standardized format for Section IV (Sections II and III used a standard format) led to a wide range of variation of answers. Many of the returned surveys included partial or incomplete answers to the questions. The reduction of the Cronbach's alpha to 0.18 represented a low correlation between the questions and answers for this section of the survey. The data obtained from the assessment section was subjectively significant and relevant towards understanding the

personal and professional impact of BTT/AHT on PHN but the data received from Section III was used to derive the bioterrorism quiz scores for participant retention level. Those questions were proved to be statistically reliable using the Cronbach's alpha of 0.815.

Table 8

Cronbach's Alpha for Each Survey Category

Category of survey	**Questions per category**	***n***	**Cronbach's Alpha**
Section II - Core PHN Competencies	16	88	.936
Section III - Bioterrorism Quiz	30*	82	.815
Section IV - Bioterrorism Assessment	16	51	.018

* The quiz consisted of 15 initial questions and 15 assessment questions

Pearson Correlation Coefficient Analysis

I conducted a Pearson correlation coefficient analysis on the primary and secondary independent variables identified in this study. I used Pearson's analysis to evaluate the relationships between the variables to assess their statistical significance. The correlation between bioterrorism quiz score and the number of participants who preferred a traditional classroom format with an instructor (Table 9) was $r = .102$ and the significance of $p = .354$. This relationship represents a positive but weak correlation between the bioterrorism quiz and the traditional MOI that was not statistically significant $r(83) = .102$, $p > .05$. This relationship supports the null hypothesis for this MOI. In other words the survey participants who used the traditional classroom mode of instruction did not receive a high enough score on the memory retention quiz to statistically prove that they retained a significant level of bioterrorism knowledge or

skills. Of the three MOIs tested the traditional classroom method showed the strongest relationship towards memory retention. This could related to a higher than average older nursing population that tended to use traditional learning methodologies.

Table 9

Pearson Correlation of Bioterrorism Quiz Score and Traditional Classroom MOI

	Bioterrorism quiz score	
Traditional classroom (Instructor led)	Pearson correlation	.102
	Sig. (2-tailed)	.354
	n	85

The correlation relationship between the bioterrorism quiz and those participants who preferred an online or asynchronous mode of instruction (Table 10) was r = -.159 with a significance of p = .145. This relationship represents a negative and weak correlation between the bioterrorism quiz and the online MOI that was not statistically significant $r(83) = -.159$, $p > .05$. This relationship supports the null hypothesis for this MOI. In other words the survey participants who used the online or similar modes of instruction did not receive a high enough score on the memory retention quiz to statistically prove that they retained a significant level of bioterrorism knowledge or skills. Of the three MOIs tested the online method showed the weakest relationship towards memory retention. This could relate to a higher than average older nursing population who did not use online learning methodologies and a small that expected younger nurse sample base.

Table 10

Pearson Correlation of Bioterrorism Quiz Score and Online MOI

		Bioterrorism quiz score
Online (Asynchronous)	Pearson correlation	-.159
	Sig. (2-tailed)	.145
	N	85

The correlation relationship between the bioterrorism quiz and those participants who preferred a blended format that included online and instructor led course of instruction (Table 11) was r = -.003 as a significance of p = .976. This relationship represents a negative and weak correlation between the bioterrorism quiz and the blended MOI that was not statistically significant $r(83) = -.003$, $p > .05$. This relationship supports the null hypothesis for this MOI. In other words the survey participants who used the blended modes of instruction did not receive a high enough score on the memory retention quiz to statistically prove that they retained a significant level of bioterrorism knowledge or skills. Of the three MOIs tested the blended method showed a weak relationship towards memory retention. This could related to more study participants who used a combination of traditional classroom and online methodologies that widely available to PHNs.

Table 11

Pearson Correlation of Bioterrorism Quiz Score and Blended Model MOI

		Bioterrorism quiz score
Blended model of online & instructor led	Pearson correlation	-.003
	Sig. (2-tailed)	.976
	N	85

The confirmation that all of the primary independent variables (MOI) for this study were not statistically significant in relation to bioterrorism quiz score supports the null hypothesis that the MOI was not a specific predictor of PHNs knowledge or skill retention. The 15 question bioterrorism quiz that was presented as part of the data collection process to evaluate PHN levels of knowledge retention proved to be an inconclusive factor in this study. This could imply that other factors may influence the level of retention of bioterrorism/AHT knowledge.

The secondary variables of age of the participant, years of education achieved, and the number of years working in the public health profession were evaluated to assess their statistical significant relationship to the bioterrorism quiz. The correlation relationship between the bioterrorism quiz and age of participants (Table 12) was $r = .340$ and a significance of $p = .000$. This relationship represented a moderately positive correlation between the bioterrorism quiz and the age of the PHN participating in the survey as statistically significant $r(101) = .340$, $p < .001$. This relationship rejects the null hypothesis for this secondary variable. Therefore, the data supports the alternative hypothesis, suggesting that there is evidence a statistically significant relationship between the variables that older nurses tended to perform better on the bioterrorism quiz than younger nurses.

Table 12

Pearson Correlation of Bioterrorism Quiz Score and Age of Participants

		Bioterrorism quiz score
Age of participant	Pearson correlation	.340
	Sig. (2-tailed)	.000
	N	103

A positive relationship in regards to participant age allowed for a further breakdown that established a correlation between the participants in the age ranges of 36-45 who had a statistically significant correlation with those who preferred an online or asynchronous mode of instruction with $r = .260$ and significance of $p = .016$. This represented a positive relationship that was statistically significant $r(83) = .260$, $p < .05$ that rejects the null hypothesis for the online MOI. Participants in the age range of 46-55 also show a significant correlation with those who preferred a traditional or instructor led MOI with $r = .259$ and significance of $p = .017$. Again this represented a positive relationship that was statistically significance $r(83) = .259$, $p < .05$ that rejects the null hypothesis for the traditional or classroom-based MOI. In other words the age of the survey participants had a direct relationship towards achieving a high enough score on the memory retention quiz to statistically prove that they retained a significant level of bioterrorism knowledge or skills. While not one of the primary independent variables chosen to predict the level of memory retention for this study, this relationship is valuable in showing that age of the participant can affect how a PHN learns and retains knowledge or skills. This leaves this factor open for future research and study.

The correlation relationship between the bioterrorism quiz and the years of education obtained by the participants (Table 13) was $r = .167$ and a significance of $p =$

.091. This relationship represented a positive but weak correlation between the bioterrorism quiz and the years of education at each PHN participating in the survey obtained as not statistically significant $r(101) = .167$, $p > .05$. This relationship supports the null hypothesis for this secondary variable. Years of education did not help the PHN participants perform better on the bioterrorism quiz.

Table 13

Pearson Correlation of Bioterrorism Quiz Score and Years of Education

	Bioterrorism quiz score	
Years of education	Pearson correlation	.167
	Sig. (2-tailed)	.091
	N	103

The final correlation relationship that was evaluated was between the bioterrorism quiz and the number of years that the PHN worked in public health. The correlation (Table 14) was $r = .193$ and a significance of $p = .051$. This relationship represented a positive but weak correlation between the bioterrorism quiz and the years of working in public health each PHN participating in the survey served as not statistically significant $r(101) = .193$, $p = > .05$. This relationship accepts the null hypothesis for this secondary variable. Therefore, the data supports the null hypothesis, suggesting that there is evidence to suggest no statistically significant relationship exists between the variables that nurses who have worked in the public health profession longer tended to perform better on the bioterrorism quiz.

Table 14

Pearson Correlation of Bioterrorism Quiz Score and Years Working in Public Health

	Bioterrorism quiz score	
Years working in public health	Pearson correlation	.193
	Sig. (2-tailed)	.051
	N	103

Other areas that that had a statistically significant relationship included the negative correlation between traditional MOI and online MOI ($r(83) = -.317$, $p < .05$), a negative correlation between traditional MOI and blended MOI ($r(83) = -.808$, $p < .001$), a negative correlation between online MOI and blended MOI ($r(83) = -.302$, $p < .05$), a negative correlation between online MOI and years of education ($r(83) = -.246$, $p < .05$), and a positive correlation between the years of age and years in public health ($r(101) = .535$, $p < .001$). These factors while statistically significant do not have a direct relationship with the dependent variable that predisposes a relationship to PHNs retention rate based on the score of a bioterrorism quiz.

Regression Analysis

An immediate concern to the validity of the results of this study was that none of the primary predictors and only one of the secondary predictors in the data collected had a statistical significance to reject the null hypothesis based on the Pearson correlation analysis. Despite this concern, I performed a multiple linear regression analysis to test and validate the study's hypothesis that one of three MOI used to teach BTT/AHT would be able to predict the rate of retention of knowledge based on scores from a bioterrorism quiz. The dependent variable for the analysis was the bioterrorism quiz score which was

compiled and computed from the answers in Section 3 of the survey. The independent variables were the three MOIs (traditional based classroom, online or asynchronous learning, and blended methodologies), the participant's age, the years of education completed, and the number of years the participant worked in public health. Table 15 shows results of the analysis which indicated that the age of the survey participants was only one of predictor variable that was found to be statistically significant $F(1, 101) = 13.171$, $p < 0.001$. The relationship between this variable and the bioterrorism quiz does reject the null hypothesis and concludes that that the primary MOIs do not predict the retention of emergency skills in study participants. Based on empirical evidence identified in the study, it can be inferred that the significant factor of age of the participant has a more pertinent impact on the PHNs ability to learn, retain, and apply perishable emergency nursing skills rather than the MOI used by the health care professional. The R-square for the final model was .115, which means that the age of the participant explains 11.5% of the total variance in the bioterrorism quiz scores.

Table 15

Multiple Linear Regression of Bioterrorism Quiz and Factors Promoting Retention of Skills

	Unstandardized coefficients		**Standardized coefficients**		
Variables [a,b]	***B***	**Std. Error**	**Beta**	***t***	***p*- value**
(Constant)	.196	.116		1.694	.093
Age of participant [c]	.008	.002	.340	3.629	.000

[a] Dependent variable: Bioterrorism Quiz Score. [b] R-square attributed to the total model = .115; F(1, 101) = 13.17;1 p < .001. [c] R-square attributed to age of participant.

Based on the evidence of the data collected in the analysis by Pearson correlation coefficient and a multiple linear regression, no predictive memory retention model can be conclusively devised based on MOI. A functional linear regression model can be achieved using age of the participant is a single variable and the bioterrorism quiz as independent predictor or outcome. Based on the data collected in the study it is evident that a positive although weak relationship exists between the ages of the participant score achieved on the bioterrorism quiz. The interpretation of the model is that the average score of the bioterrorism quiz (BTKR) is expected to increase by .008 points for every 1-point increase in the age of the e PHN (PHN_Age).

Additionally, tolerance and variance inflation factor (VIF) values for the regression was assessed to be certain tolerance values were not approaching 0 and VIF value were not > 4. The VIF allows a quick measure of how much a variable is contributing to the standard error in the fitted regression model. With the VIF ranging from 1.00 for age, the tolerance for VIF avoided bias issues and problems with multicollinearity by staying under 10 (Field, 2009, p. 242). The values identified in the regression analysis were within the recommended parameters indicating all assumptions were met.

Summary

A total of 360 PHNs representing the 100 counties of North Carolina were invited to participate in the study. One hundred and thirteen (approximately 31%) of those invited to participate attempted to complete the survey, resulting in a final sample size of 103 (28% response rate) after all non-PHNs were excluded. The data collected from 103

respondents via an Internet survey were imported into SPSS software program for analysis.

Descriptive statistics was conducted to identify demographic characteristics of the sample. The average number of years of public health experience of nurses had been 13 years. The majority of the participants were female (99%) which represented a realistic and historic representation of the nursing industry. The average age of the study participants was 49 years old which is consistent with an aging nurse population. An equal number of nurses held at least an associate's degree or a bachelor's degree (39.8%) as a basic requirement for state licensure.

Each part of the 4 section questionnaire requested information from the nurse on their views of their professional skills as nurses, evaluated nurses emergency skills to a 15 question bioterrorism quite a quiz, and finally a an assessment of their preferences for training and many of the barriers that prevented access to training opportunities. This information was correlated and evaluated for reliability using a Cronbach's alpha analysis which found the questions of the survey to be reliable and consistent for support to the study's hypothesis.

Pearson's correlation coefficient and multiple linear regression analyses were performed to test the study's hypothesis. While several of the secondary independent variables proved to be statistically significant in disproving the null hypothesis, the primary independent variables which consisted of the three most commonly used MOI were not found be so statistically significant to support the alternative hypothesis. These factors were excluded from the adjusted regression analysis and proved to be

inconclusive to the overall findings of this study. PHNs bring a vast amount of experience, technical expertise, and compassion to their profession. The aging of PHNs has moved many of the older nurses away from traditional types of learning experiences into one that embraces the Internet and other forms of nontraditional or asynchronous learning environments. Factors such as age of the nurse and the years of experience in the public health industry were empirically proven to be statistically significant in improving retention of emergency skills and knowledge that was tested and evaluated via a bioterrorism quiz. The outcome of the regression showed that, after controlling for age and experience it could be inferred that a variety of combined factors enhances the PHNs ability to receive and retain information and apply those skills in a clinical environment.

In Chapter 5 I include an interpretation of my the research findings and their additions to the body of knowledge in regards to emergency management, limitations imposed on the study, recommendations for public health leaders, and implications for social change.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

This study was developed and conceived to address an issue related to public health workers' ability receive emergency BTT/AHT that would enable them to support their communities in the event of a bioterrorist event. Critical to this training was the ability to retain this information and apply specific skills that were often volatile and required repetition to establish a "muscle memory" for the user. The reduction of funding and availability for PHNs to complete BTT/AHT at the local public health department was identified as a continuing gap or barrier to PHNs working in North Carolina. The 6-week study that used a four-section questionnaire collected a significant number of responses that allowed for the following discussion, which will support my research hypothesis and many of the conclusions I have drawn.

Interpretation of Findings

Research Survey

The data collection process for this study was officially completed on September 30, 2014. Despite the relatively moderate return rate on the survey of 28% of the 360 PHNs contacted (or 3% higher than the projected 25%) who participated in the study, the data received provided an invaluable level of information on nurses who worked in North Carolina. Section 1 of the survey provided a demographic overview of the participants and provided insight into their work environments, their level of education, and their licensure within the state. With the exclusion of non PHNs and LPN/LVN, this study primarily focused on RNs who met the basic requirements of the Quad Council's (2011)

criteria for PHNs. One important factor to note during this study was the age of the participants, which averaged at 49 years. This represented a link to the literature review, which established that the PHN profession has had a higher-than-average percentage of nurses over the age of 40 and that fewer younger nurses are entering the profession over the preceding decades (Potter et al., 2008, p. 247; Rosenstock et al., 2011). Unfortunately, the moderate number of participants prevented a good cross mixture of age ranges amongst the population base. In particular, it was noted that a larger percentage of the participants tended to be senior managers or held leadership positions that did not allow a larger representation of entry-level or younger nurses in the study. This could have been valuable in linking nontraditional courses such as online or blended methodologies to a core group of younger nurses who were more adaptable to the use of technology in their courses of learning versus older nurses who may have been more restricted to traditional class-based courses as part of that their didactic work during nursing schools.

The next section of the survey provided a valuable assessment of the level of confidence in PHN performance standards based on to the conceptual framework established by Handler et al. (2001). This section of the survey contrasted the eight core competencies of PHN established by the Quad Council (2011) against the 10 essential public health care indicators established by the CDC (n.d.). PHNs scored higher in levels of confidence in the areas related to providing quality care, epidemiology or evidence-based research and surveillance of community populations, and ensuring a level of communication with community stakeholders. These relationships appeared to be

consistent with core performance standards required as part of their normal clinical duties as PHNs. Areas such as budgeting and program management scored lower levels of confidence and tended to reflect fewer PHNs with senior-level administrative experiences. While this portion of the survey did not provide a direct quantitative scoring that would facilitate the linkage between modes of instruction and the levels of knowledge retention, it is important to note that this section established the baseline of core nursing knowledge that supported the COL and the Quad Council's basic requirements for PHNs. When measured against Cronbach's alpha for measures of reliability, the 16 questions were found to be consistently reliable and supportive.

The third section of the survey was the most important component of the study because it provided the testing and evaluation of the participants' memory of BTT/AHT completed in the past. It also allowed the participant to also assess how they learned the skills and how those skills were applied. The two-pronged approach with initial questions, immediate feedback with answers to the questions, and then an assessment of how they obtained this knowledge allowed for a quantitative measurement of the final computed score to be inputted as a component of the dependent variable for correlation analysis and multiple regression analysis. Once again, a larger sample may have provided more data points for analysis; however, the information obtained clearly showed that many of the participants had obtained their knowledge through a variety of different methodologies that included didactic mastery through coursework as well as the technical application in either a clinical environment or as part of an exercise component. While no individual participant achieved 100% correct on the quiz, a substantial amount of

participants who completed this phase of the survey achieved greater than a 70% success rate, which was established as a favorable rate of memory retention. Unfortunately, a small percentage of the participants chose not to take the quiz and thus received a 0% that equated to a 0.00 computed score, which again reduced the number of potential data points that were added to the correlation analysis and the multiple linear regression analysis.

The fourth and final section of the survey consisted of 17 assessment questions that asked the participants their preferred MOI, some of the organizational barriers that prevented their completion of BTT/AHT training, how the knowledge and skills were evaluated, and their opinions on the success or failure in applying these new skills toward actual bioterrorism incidents. A significant number of participants failed to complete this section or completed only the portions they felt were relevant to their own work status or positions. The key concern I identified early in the analysis process was the length of time between training for many of the individuals. With training often only provided through organizational resources, many PHNs have not completed any type of BTT/AHT in years, and several felt that this training was not within the scope of their normal responsibilities. Again, this was disheartening in that it was consistent with some of the literature review articles that indicated that BTT/AHT was still not seen as a significant priority for staff nurses (Chiu et al., 2012; Rebmann & Mohl, 2010). Those who had completed training recently were more apt to complete this section of the survey and to have positive responses towards the curriculum of the training, mastery of subject matter based on tabletop exercises or other practical scenarios that allowed hands-on training,

and overall confidence that they would be able to perform these skills during an emergency event. This was also consistent with studies that identified that the application of BTT/AHT improved organizational readiness and ultimately supported community readiness (Chiu et al., 2012; Jakeway et al. 2008; Rebmann & Mohl, 2010).

Review of Statistical Findings

The scope and premise of this study was to quantitatively assess which MOI had the most likely or predictive outcome of enhancing the retention rate of emergency skills amongst PHNs (n = 103) in North Carolina. Based on the results of the survey questions in Section 4 of the questionnaire, out of the 85 participants who completed this section 45.9% of the nurses evaluated preferred a traditional classroom-based MOI. Another 10.6% indicated that they preferred an online or asynchronous type of training without an instructor facilitating the training. The final MOI represented 43.5% of the PHNs preferring a blended methodology that used instructor-led and web-based technologies. This breakout is important in depicting that a higher percentage of older nurses (ages 46 to 55) who completed the questionnaire were more than likely trained using a more traditional didactic style. The working presumption that nurses under the age of 35 (who represent millenials) would be more likely to use technology-based education services could not be conclusively validated statistically due to the low percentage of younger participants (n = 16).

The results of this study, as derived through a Pearson correlation coefficient and multiple regression analysis, proved to be inconsistent in that there were no statistically significant indicators or correlations that would link the MOI to knowledge or skill

retention. The analysis of results provided statistical evidence to support the rejection of the null hypothesis in favor of the alternate hypothesis that did not favor a particular MOI as a means of supporting the relationship between long-term memory and knowledge or skill retention. It can be inferred from this relationship that the type of MOI has a minimal impact on how nurses retain critical emergency skills and that a variety of factors including years of experience, level of education, and other social ecological criteria may play a role in knowledge retention for PHNs.

What was proven statistically was that the age of the participant had a statistically significant relationship ($F(1, 101) = 13.171$, $p < 0.001$) towards memory retention with positive scores above 70% on the bioterrorism quiz. Study participants had no opportunity to review or study for the quiz prior to taking the survey and participants were forced to rely on long-term memory or previously acquired experience to answer the questions. Descriptive analysis of the raw data indicated that participants who scored higher than 80% also had a corresponding higher education level (bachelor's degree or higher) and had spent the significant number of years in the public health profession (greater than 20 years).

These observations represent critical factors that may help PHNs retain knowledge and skills acquired during BTT/AHT training. These skills are often volatile in nature because they are not used in the day-to-day performance of the nurses' public health duties. While age and experience of PHNs are important factors in performance and development of skill sets, they cannot always be quantitatively used by PHLs support or justify budgets for training. The potential of having a predictive model that would

prioritize training by the MOI could have been used as a quantitative factor that would support picking and choosing training opportunities that would best fit the needs of the organization and the individual based on the available budget requirements. Unfortunately, the results of this study precluded the opportunity to develop such a predictive model for skill retention based on one of these three MOIs. While ultimately unproven by this study's results, the overall concept of improving emergency training for PHNs remains a viable product of this study. The data and results from this study may be valuable towards future studies or analysis pertaining to nursing performance, nursing retention, and developing incident response protocols based on core competencies required by PHNs.

Limitation of Study

The most serious limitation to this study was the lack of participation by local health Department leaders. While the rate of receipt of the initial letter of invitation reached about 70% based on a measurement of returned receipts, the actual participation was significantly lower for many regions of North Carolina. As noted by several requests for additional information from PHL, several expressed concerns over privacy issues in regards to forwarding e-mails to their nursing staffs and others directly expressed their desire not to participate in the study. Those requesting to be excluded from the study were removed from all follow up e-mails that were periodically scheduled throughout the six-week data collection period.

Other limitations noted was the small number of junior PHNs participating in the survey. With an average age of 49 years old, this represented the more senior nurses who

may not have experienced nontraditional training methodologies in their earlier careers. While this does correspond to the premise that the PHN community is aging, a young PHN perspective would have been valuable in solidifying the need for more nontraditional training as a viable means for decision-making by PHLs. Based on the results obtained, this issue remains non-conclusive.

Recommendations

This study was designed to evaluate the premise that PHNs in North Carolina were not receiving sufficient BTT/AHT they needed to be professionally competent in supporting a bioterrorism incident. Maintaining a level of knowledge and professional skills was evaluated via a bioterrorism quiz and through an assessment questionnaire that asked the participant what was their preferred MOI and how successful that method was in imparting acquired knowledge. Nurses were also asked what additional training they would want or need to become more technically proficient in providing emergency response care. While the findings for this study, that were based on the premise of identifying a specific MOI model that correlated to greater degree of knowledge retention, proved to be inconclusive, the recommendations for community readiness needs remain viable. The information and circumstances pertaining to barriers to professional training of nurses and other public health professionals outlined in the literature review remain an issue for PHLs to overcome. The majority of the study's participants agreed that they lacked the available training to be prepared for a bioterrorism event and that training remained inconsistent due to barriers at that included

a lack of funding, the availability of training, and the lack of awareness that this type of training was part of the core competency requirements as PHNs.

Educating the PHN beyond those core competencies required for their professional licensure would not only enable these nurses to competently fulfill their community level roles in disease surveillance, mass casualty preparedness, and surge support, but it would also provide a pool of trained professionals who could enact specific containment protocols recognized by the CDC to support the NRF. The recent Ebola virus crisis during the summer of 2014 provided undeniable evidence of the public's need for more disaster preparedness awareness education in regards to a potential biological epidemic. It once again also raised the concern that America's PHS was not initially prepared to meet large-scale infectious disease events despite the lessons learned from the 2002/2003 severe acute respiratory syndrome (SARS) epidemic and the 2009 H1N1 influenza pandemic. This lack of education included ill-defined or inconsistent protection protocols and national standards for hospital-based professionals (Goslin, Lucey, & Phelan, 2014).

This study provided a snapshot in time of North Carolina's public health status on BTT/AHT and preparedness during a six week period. The focus on PHNs represents a population of health care professionals who often provide a link in the chain of definitive care between physicians and nonmedical first responders. From an academic perspective, this study could be valuable as an awareness primer on which to design more detailed analysis into specific roles of public health providers (i.e. medical planning personnel or physician extenders) or towards academic professionals who develop public health

curriculums. Other states could use this format to assess their own PHNs training status and to determine the best methods to fund or sustain existing programs that would improve their own community's readiness to support a bioterrorism response plan. Finally, this study could be valuable to public health organizations who wish to provide communication, and continuing education and training to their staff and communities as part of their annual national preparedness month events. Making public health professionals aware of where training can be found either through traditional based courses, web-based or asynchronous type, or hands-on tabletop exercises could prove invaluable in helping professionals maintain and retain perishable emergency skills and keep emergency preparedness in the forefront of their professional practice.

Implications for Social Change

The events of the bioterrorism attack on America occurred over 13 years ago and unfortunately the American public has a short attention span when it comes the comes to devising lessons learned from previous events. The most recent national impact of the Ebola crisis has reopened the issue of providing expanded biological training for public health officials. While the Ebola virus has not been deliberately used as a weapon of terror to date, it's swift moving actions and devastating impact on population centers in Western Africa has now found its place in the United States. Public health officials are now recognizing a need to revise their current training protocols to re-enforce many of the biological protocols that were originally initiated after the anthrax attacks in 2001. While this study did not measure a specific biological toxin or agent, or discussed a specific training program to be enacted, the need to remain acutely aware and prepared

for a biological outbreak was discussed as part of the literature review and as a part of the survey conducted with PHNs throughout North Carolina. The implications for social change for this study is to maintain a level of awareness that the release of a biological agent could quickly inundate the medical capabilities of a community and that without adequate engagement, training, and a mindset of the community leadership to be ready for such an event, the potential for an epidemic could become reality.

PHNs are the core of any community response plan and their level of training is important in maintaining community readiness. While the results of this study and the MOI for PHNs were deemed to be inconclusive based on analysis of the collected data, many of the organizations that were contacted to participate in the study have requested a copy of the final study's results to evaluate their own communities need for BTT. As discussed with one public health preparedness expert, the need to show evidence would be critical in grant proposals for funding requirements and for accreditation needs by the Joint Commission to ensure that future funding requirements remain consistent despite competing needs of other pressing public health community requirements. From a public policy perspective, emergency preparedness training and awareness often takes a backseat to the everyday funding responsibilities for public health organizations. As noted throughout this study the historical issue of cost shifting to meet organizational needs based on limited funding opportunities for public health organizations continues to remain a challenge as funding priorities change. Public health policy and decision makers must remain cognizant that despite competing priorities, the public will ultimately attach responsibility to political leaders for any level of unpreparedness at the state and

community level. These same leaders will be quick to elevate these issues to the federal government and the issue will become lost in the static of partisan politics. The immediate fix will be limited specific funding as a sort of “Band-Aid” instead of initiating a comprehensive overhaul of a convoluted system that is been in crisis for decades. Keeping the public aware of these long-standing issues is a challenge when national level events such as the 2001 anthrax attack have thankfully been few. This awareness is critical in educating and informing the community on what to look for and what are the impacts of a potential biological release, whether it be a natural occurring disease outbreak or a man-made incident using recognized biological vectors. This study was not designated to change the minds or direct the participants toward specific policy decisions, however having the knowledge of the potential impacts that a lack of preparedness and training would provide could help PHL health leaders redirect or leverage limited funding towards improving public health organization’s goals and being ready for a potential epidemic. The critical implications for social change that I have addressed and outlined in this study include maintaining public health professionals training in a current state of awareness and readiness that will allow the community to be prepared for the unexpected potential for an act of terrorism.

Conclusion

In this study I attempted to focus on an issue that has a great importance in a world that has been plagued by international crisis and the potential threats by non-nation state actors who would attempt to use terrorism as a means of destabilizing the United States and its international partners. The focus of this study addressed the concerns of

bioterrorism and its impact on communities throughout the United States that were not readily protected by a local bioterrorism or all hazards plan. PHNs stand as gatekeepers for the community into a national public health system that is still ill prepared to meet the challenge of a widespread epidemic or pandemic event. PHNs in North Carolina were evaluated over a six week period to determine if previously completed training in BTT/AHT had been retained. Using a 4 part questionnaire, these nurses were evaluated for core nursing competencies required for all PHNs, completed a bioterrorism retention quiz, and took an assessment inventory that asked for their opinions on potential barriers to present or future training and how they perceive their competence and mastery of these volatile skills.

This study did not make an attempt to evaluate individual programs or training courses due to the diversity and variety of training courses that were created after the events of 9/11. I focused on the manpower and training needs of the PHS and how making PHL aware that there were continued deficiencies within the PHS that had not been resolved. The limited response that I received from PHNs was disheartening on some levels but some of the individual phone calls I received to request additional information provided me with hope that the information contained in this dissertation would be value added to the body of knowledge of awareness. After over 30 years of working in the field of health care and emergency management I am convinced that situational awareness, leveraging of limited resources towards obtaining organizational objectives remains a positive requirement for management to support their emergency preparedness capability and their ability to meet the requirements of their communities.

This study has opened my eyes to new opportunities and horizons to enlighten those public health communities and officials who choose to be reactive instead of proactive in safeguarding this nation’s population.

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Appendix A: IRB Authorization to Conduct Study

IRB <IRB@waldenu.edu> Fri, Aug 8, 2014 at 5:24 PM
To: Gaylon Crawford
Cc: David Milen , Walden University Research <research@waldenu.edu>, IRB <IRB@waldenu.edu>

Dear Mr. Crawford,

This email is to notify you that the Institutional Review Board (IRB) has approved your application for the study entitled, "Evaluating the Relationship between Modality and the Degree of Knowledge Retention in Bioterrorism Training."

Your approval # is 08-08-14-0090199. You will need to reference this number in your dissertation and in any future funding or publication submissions. Also attached to this e-mail are the IRB approved consent forms. Please note, if these are already in an on-line format, you will need to update those consent documents to include the IRB approval number and expiration date.

Your IRB approval expires on August 7, 2015. One month before this expiration date, you will be sent a Continuing Review Form, which must be submitted if you wish to collect data beyond the approval expiration date.

Your IRB approval is contingent upon your adherence to the exact procedures described in the final version of the IRB application document that has been submitted as of this date. This includes maintaining your current status with the university. Your IRB approval is only valid while you are an actively enrolled student at Walden University. If you need to take a leave of absence or are otherwise unable to remain actively enrolled, your IRB approval is suspended. Absolutely NO participant recruitment or data collection may occur while a student is not actively enrolled.

If you need to make any changes to your research staff or procedures, you must obtain IRB approval by submitting the IRB Request for Change in Procedures Form. You will receive confirmation with a status update of the request within 1 week of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research.

When you submitted your IRB application, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher.

Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the IRB section of the Walden web site or by emailing irb@waldenu.edu:

http://researchcenter.waldenu.edu/Application-and-General-Materials.htm

Researchers are expected to keep detailed records of their research activities (i.e., participant log sheets, completed consent forms, etc.) for the same period of time they retain the original data. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.

Please note that this letter indicates that the IRB has approved your research. You may not begin the research phase of your dissertation, however, until you have received the **Notification of Approval to Conduct Research** e-mail. Once you have received this notification by email, you may begin your data collection.

Both students and faculty are invited to provide feedback on this IRB experience at the link below:

http://www.surveymonkey.com/s.aspx?sm=qHBJzkJMUx43pZegKlmdiQ_3d_3d

Sincerely,

Libby Munson
Research Ethics Support Specialist

Information about the Walden University Institutional Review Board, including instructions for application, may be found at this link: http://researchcenter.waldenu.edu/Office-of-Research-Ethics-and-Compliance-IRB.htm

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IRB <IRB@waldenu.edu> Fri, Aug 8, 2014 at 5:24 PM
To: Gaylon Crawford
Cc: David Milen , Walden University Research <research@waldenu.edu>, IRB <IRB@waldenu.edu>

Dear Mr. Crawford,

This email is to serve as your notification that Walden University has approved BOTH your dissertation proposal and your application to the Institutional Review Board. As such, you are approved by Walden University to conduct research.

Please contact the Office of Student Research Administration at research@waldenu.edu if you have any questions.

Congratulations!

Libby Munson
Research Ethics Support Specialist, Office of Research Ethics and Compliance

Leilani Endicott
IRB Chair, Walden University

Information about the Walden University Institutional Review Board, including instructions for application, may be found at this link: http://researchcenter.waldenu.edu/Office-of-Research-Ethics-and-Compliance-IRB.htm

Appendix B: Survey Questionnaire

Study: Evaluating the Relationship between Modality and the Degree of Knowledge Retention in Bioterrorism Training

Researcher: Gaylon R. Crawford, Sr., PhD Candidate, Walden University

Section I: Participant Demographics

Gender o Female o Male	**Current age (in years)** o _____
Race/ethnicity (Part 1) Is person of Hispanic, Latino, or Spanish origin? o No, not of Hispanic, Latino, or Spanish origin o Yes, Mexican, Mexican American, Chicano o Yes, Puerto Rican o Yes, Cuban o Yes, another Hispanic, Latino or Spanish origin – *example, Argentinian, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard, and so on.* _____	
Race/ethnicity (Part 2) o White o Black, African-American, or Negro o American Indian or Alaska native o Asian Indian o Chinese o Filipino o Japanese o Korean o Vietnamese o Native Hawaiian o Guamanian or Chamorro o Samoan o Other Asian – for example Hmong, Laotian, Thai, Pakistani, Cambodian, and so on. o Other Pacific Islander – for example Fijian, Tongan, and so on. o Other Race _____	
Educational background (degree) o No High school diploma or GED o GED o High school diploma o Professional Certificate o Some college o Associate's degree o Bachelor's degree o Master's degree	

o Doctoral degree

Other

Regions

o **Region 1** Cherokee, Clay, Graham, Haywood, Jackson, Macon, Swain, Transylvania	o **Region 2** Avery, Buncombe, Burke, Caldwell, Cleveland, Henderson, Madison, McDowell, Mitchell, Polk, Rutherford, Yancey	o **Region 3** Alleghany, Ashe, Davidson, Davie, Forsyth, Stokes, Surry, Watauga, Wilkes, Yadkin
o **Region 4** Alexander, Cabarrus, Catawba, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, Union	o **Region 5** Alamance, Caswell, Chatham, Durham, Guilford, Orange, Person, Randolph, Rockingham	o **Region 6** Anson, Cumberland, Harnett, Hoke, Lee, Montgomery, Moore, Richmond, Scotland
o **Region 7** Edgecombe, Franklin, Granville, Halifax, Johnston, Nash, Vance, Wake, Warren, Wilson	o **Region 8** Bladen, Brunswick, Columbus, Duplin, New Hanover, Onslow, Pender, Robeson, Sampson	o **Region 9** Bertie, Camden, Chowan, Currituck, Dare, Gates, Hertford, Hyde, Martin, Northampton, Pasquotank, Perquimans, Tyrell, Washington
o **Region 10** Beaufort, Carteret, Craven, Greene, Jones, Lenior, Pamlico, Pitt, Wayne		

Current state license?

o RN (Registered Nurse)
o LPN/LVN (Licensed Practical/Vocational Nurse)
o NAII (Nurse Aide II)
o NP (Nurse Practitioner)
o CNM (Certified Nurse Midwife)
o CRNA (Certified Registered Nurse Anesthetist)
o CNS (Clinical Nurse Specialist)
o Other

Years working in public health? o _____	**Working status (hours per week)** o _____

Primary work setting o _____	**Years working for your current agency?** o _____
Current position o Director of nursing/administrator o Health Commissioner o Public health nurse o Nurse educator o Other (specify): _____	**Years working your current job position?** o _____

Section 2: Public Health Nursing Competencies

In the summer of 2011 the Quad Council of Public Health Nursing Organizations published the "Core Competencies for Public Health Nurses" (CCPHN) which divided core competencies into 8 domains of public health services. These domains fall in line with the ten indicators of public health quality which the Centers for Disease Control and Prevention (CDC) have defined as the Essential Public Health Services as outlined below.

Essential Public Health Services
1. Monitor health status to identify community health problems.
2. Diagnose and investigate health problems and health hazards in the community.
3. Inform, educate, and empower people about health issues.
4. Mobilize community partnerships to identify and solve health problems.
5. Develop policies and plans that support individual and community health efforts.
6. Enforce laws and regulations that protect health and ensure safety.
7. Link people to needed health services and assure the provision of health care when otherwise unavailable.
8. Assure a competent public health and personal health care workforce.
9. Evaluate the effectiveness, accessibility, and quality of personal and population-based health services.
10. Research for new insights and innovative solutions to health problems.

The following of series of questions pertain to the basic competencies that all public health nurses should maintain in carrying out their day-to-day functions in state and local health organizations. Responsibilities of public health nurses may include working directly with at risk populations carrying out health promotions programs at all levels of prevention, basic data collection and analysis, fieldwork, program planning, outreach activities, programmatic support, and other organizational tasks that supports the essential public health services.

Participants are asked to indicate the following for each question (unless a different response is required):

Not at all Confident=1	**Somewhat Confident=2**	**Undecided=3**	**Confident=4**	**Very Confident=5**
o	o	o	o	o

Domain 1: Analytics and Assessments Skills

1. I have knowledge of epidemiologic data and other ecological perspectives to identify health risks for a population and can identify individuals and family assets and needs, values and beliefs, resources and relevant environmental factors.
2. I have the training and experience to identify determinants of health and illness and use evidence-based public health nursing practices to promote the health of individuals, families and groups using multiple sources of data.

Domains 2: Policy Development/Program Planning Skills

3. I have the knowledge to identify policy issues relevant to the health of individuals, families, and groups and can describe the structure of the public health system and its impact on individuals, families, and groups within a population.
4. I understand that quality improvement is important to the practice of public health nursing and I have you participated in quality improvement teams. I have the knowledge and experience to describe the various approaches used to improve public health processes and systems and use quality indicators and core measures to identify and address opportunities for improvement in the care of individuals, family, and groups.

Domain 3: Communication Skills

5. I have the ability to communicate effectively in writing, orally, and electronically and can communicate in a culturally responsive and relevant manner using critical thinking.
6. I have the knowledge to communicate effectively with individuals, families, and groups and as a member of inter-professional team and use a variety of methods to disseminate public health information.

Domain 4: Cultural Competency Skills

7. I have the training and experience to use social and ecological determinants of health to work effectively with diverse individuals, families, and groups?
8. I had the ability to demonstrate culturally appropriate public health nursing practices with individuals, family, groups, and community members and I contribute to promoting a culturally responsive work environment.

Domain 5: Community Dimensions of Practice Skills

9. I have the experience to partner effectively with key stakeholders and groups in providing care delivery to individuals, families, and groups using an ecological perspective, health assessments, planning, and interventions.

10. I have the knowledge and experience to support public health policies, programs, and resources and I can identify opportunities for population focused advocacy for individuals, family, and groups.

Domain 6: Public Health Science Skills

11. I have the training, knowledge, and experience to use basic descriptive epidemiological methods when conducting a health assessment for individuals, family, and groups.
12. I comply with all requirements of patient confidentiality and human subject protection.

Domain 7: Financial Management and Planning Skills

13. I have the knowledge and experience to describe the impact of budget constraints on the delivery of public health nursing care to individuals, families, and groups.
14. I routinely provide data for inclusion in programmatic budgets, help to establish budget priorities, and provide reports on program performance.

Domain 8: Leadership and Systems Thinking Skills

15. I have the ability to incorporate ethical standards of practice as the basis of all interactions with organizations, communities, and individuals and I incorporate ethical standards and all aspects of public health nursing practice?
16. I have the experience with working with stakeholders to identify visions, values, and principles for community action and can identify internal and external factors affecting public health nursing practice and services.

Section III: Bioterrorism/All Hazards Quiz

Part A. This survey will test your general knowledge of bioterrorism response and all hazards preparedness. The questions are based on the eight categories of standardized bioterrorism/all hazards training programs recommended by the Centers for Disease Control and Prevention (CDC). These categories include:

1. Characteristics of Biological Agent Classes A, B and C associated with bioterrorism.
2. Clinical Manifestation of Diseases associated with bioterrorism.
3. Surveillance and Epidemiology
4. Laboratory Systems
5. Health Risk Communication and Media Relations
6. Psychosocial Impact of bioterrorism
7. Worker Safety Issues
8. Information Technology

Part B: This section provides a summary of the answers for the survey you took in Section 2 and assesses how you acquired the knowledge or skills you used. Even if you answered the question

incorrectly it is important to understand how and where the knowledge/skill was acquired or learned. Please check the appropriate letter of the response that best describes how you acquired the knowledge/skill in bioterrorism/all hazards response.

Please read each question carefully and answer the question by checking the appropriate letter.

1. The most common early presenting syndrome associated with the majority of high risk ("Category A") bioterrorism-associated diseases (i.e., anthrax, botulism, plague, smallpox, tularemia, and viral hemorrhagic fevers) is:

   A. Acute bloody diarrhea

   B. Influenza-like illness

   C. Acute hepatitis

   D. Fever and rash

Answer: The correct answer is: **B. Influenza-like illness** **Reference: CDC**

Please select one of the following:

   A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

   B. Were the knowledge/skills to answer this question learned on the job?

   C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

   D. I have no knowledge/skill in this topic.

2. Persistence of spores in the environment is of concern after a bioterrorism event involving:

   A. Anthrax

   B. Tularemia

   C. Plague

   D. All of the above

Answer: The correct answer is: **A. Anthrax** **Reference: CDC**

Please select one of the following:

   A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

   B. Were the knowledge/skills to answer this question learned on the job?

   C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

3. The deadliest form of anthrax is:

A. Cutaneous

B. Inhalational

C. Gastrointestinal

D. Bubonic

Answer: The correct answer is: **B. Inhalational** **Reference: CDC**

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

4. Smallpox has all of the following clinical features **EXCEPT**:

A. The incubation period ranges from 7-17 days.

B. During the incubation period, the infected person looks and feels healthy and cannot infect others.

C. Infectivity is highest after the fever has begun and during the first 7-10 days following the appearance of the rash.

D. The virus can only be spread through direct or indirect contact with open lesions (e.g., by touching an infected lesion or by contact with infected clothing or bedding).

Answer: The correct answer is: **D. The virus can only be spread through direct or indirect contact with open lesions (e.g., by touching an infected lesion or by contact with infected clothing or bedding).** **Reference: CDC**

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

5. Of the following diseases, which one has the highest potential for person-to-person transmission?

A. Anthrax

B. Botulism

C. Tularemia

D. Pneumonic plague

E. Brucellosis

Answer: The correct answer is: **D. Pneumonic plague** **Reference: CDC**

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

6. Which of the following are good biological terrorism threats because of substantial morbidity and mortality ease of production, efficient dissemination, stability in aerosol, or high infectivity?

A. Anthrax, chickenpox, botulism, and plague

B. Anthrax, smallpox, chickenpox, and plague

C. Anthrax, smallpox, botulism, and plague

D. Anthrax, smallpox, mumps, and plague

Answer: The correct answer is: **C. Anthrax, smallpox, botulism, and plague**

Reference: CDC

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

7. What infection control measures are recommended for a person with suspected or confirmed

smallpox?

A. Isolation of the person in a negative-air pressure room

B. Protective clothing for health-care workers in contact with that patient

C. Vaccination of persons involved with direct medical care of suspected cases

D. Monitoring contacts of suspected smallpox cases for febrile illness

E. All of the above infection control measures are recommended for a person with suspected or confirmed smallpox

Answer: The correct answer is: **E. All of the above infection control measures are recommended for a person with suspected or confirmed smallpox**

Reference: CDC

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

8. The "integrated network of state and local public health, federal, military, and international laboratories that can respond to bioterrorism, chemical terrorism and other public health emergencies" is known as the:

A. Integrated Laboratory Network (ILN)

B. Laboratory Response Network (LRN)

C. Epidemic Intelligence Service (EIS)

D. American Clinical Laboratory Association (ALCA)

Answer: The correct answer is: **B. Laboratory Response Network (LRN)**

Reference: CDC

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

9. At present, the first-line laboratory response to biological terrorism involves:

A. Advanced laboratory techniques in clinical labs

B. Rapid, hand-held assays done by first responders

C. A network of local, State, and Federal public health laboratories

D. Biosensors strategically placed in the environment

E. A central facility coordinated by the FBI

Answer: The correct answer is: **C. A network of local, State, and Federal public health laboratories**

Reference: CDC

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

10. According to State Laws, a physician who sees a patient he/she suspects of having anthrax or smallpox must notify the State Department of Health or the CDC:

A. By phone as soon as the suspected diagnosis has been laboratory confirmed

B. By phone as soon as the provisional diagnosis is established

C. By mail, phone, or fax within 72 hours

D. Immediately after receiving written permission from the patient (or his/her legal guardian)

Answer: The correct answer is: **B. By phone as soon as the provisional diagnosis is established**

Reference: CDC

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

11. The local television news has just reported receiving a call from an activist group who claims that they have dispersed anthrax at a local high school basketball game earlier in the evening. Panic-stricken attendees from the game are flooding into the emergency room of the local

hospital at an alarming rate with wide-ranging complaints. The patients and the television reporters should be told all the following to avoid further panic, EXCEPT:

A. Potentially exposed persons would be decontaminated with soap and water

B. Vaccine prophylaxis is available for potentially exposed persons

C. Antibiotic prophylaxis is available for potentially exposed persons

D. Potentially exposed persons are not contagious

E. Potentially exposed persons should wear a face mask to avoid aerosol transmission

Answer: The correct answer is: **D. Potentially exposed persons are not conta**gious **Reference: CDC**

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

12. "Psychological first aid (PFA)":

A. Is a key component of early intervention in a mass casualty event.

B. Describes the administration of pharmacotherapy and long-term hospitalization for victims of a mass casualty event.

C. Is a "misleading" term that "should not be used to describe psychological intervention" according to the National Institute of Mental Health.

D. None of the above.

Answer: The correct answer is: **A. Is a key component of early intervention in a mass casualty event Reference: National Institute of Mental Health**

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

13. As a form of Psychological first aid (PFA) what is not appropriate to discuss with victims?

A. DO NOT force an “event debriefing” or ask individuals to share their stories with you.

B. DO NOT say “everything will be alright” or “it could have been worse”

C. DO NOT tell individuals how to respond or why you believe they have suffered as they have based on their behaviors or beliefs.

D. DO NOT complain about response efforts or services in front of people who need these services

E. All the above

Answer: The correct answer is: **E. All the above**

Reference: National Institute of Mental Health

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

14. _____ sets safety standards that apply for any workers in the United States who may have been exposed to a safety or health hazard.

A. FEMA (Federal Emergency Management Agency)

B. OSHA (Occupational Safety and Health Administration)

C. CDC (Centers for Disease Control and Prevention)

D. SEMS (Standardized Emergency Management System)

Answer: The correct answer is: **B. OSHA (Occupational Safety and Health Administration)**

Reference: OSHA

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

15. The Health Alert Network (HAN) is _____ primary method of sharing cleared information about urgent public health incidents with public information officers; federal, state, territorial, and local public health practitioners; clinicians; and public health laboratories.

    A. FEMA (Federal Emergency Management Agency)

    B. CDC (Centers for Disease Control and Prevention)

    C. NIMS (National Incident Management System)

    D. SEMS (Standardized Emergency Management System)

Answer: The correct answer is: **B. CDC (Centers for Disease Control and Prevention)**

Reference: CDC

Please select one of the following:

A. Were the knowledge/skills to answer this question acquired through a course of instruction/training?

B. Were the knowledge/skills to answer this question learned on the job?

C. Were the knowledge/skills to answer this question learned/acquired as a combination of A and B

D. I have no knowledge/skill in this topic.

Section 4: Assessment of Recent Bioterrorism Training

1. How long ago did you attend a bioterrorism or all hazards preparedness course/training?
   - _____

2. How long was the course of instruction?
   - _____

3. What type of training method (modality) do you prefer?
   - Instructor led training including small and large workshop/presentations
   - Online training with an instructor
   - Combination training (instructor led or automated methodology)
   - Self-paced training including audiovisual, Internet-based/CD-ROM without an instructor
   - Other, Specify

4. What areas of bioterrorism training were covered or taught during your course?
   - Characteristics of Biological Agents Class A, B and C associated with bioterrorism
   - Clinical Manifestations
   - Surveillance and Epidemiology
   - Laboratory Systems

- Health Risk Communication and Media Relations
- Psychosocial Impact of Bioterrorism
- Worker Safety Issues
- Information Technology
- Other, Specify

5. What are some of your perceived or actual barriers from receiving training?
   - There is no administrative financial support for training at my work.
   - My work schedule does not provide time for training.
   - Bioterrorism preparedness is not currently a priority for me.
   - There were no training opportunities available.
   - It is not within the scope of my responsibilities.
   - Other, Specify
6. What is the value to public health for completing a bioterrorism or all hazards training program?
   - Bioterrorism preparedness will advances my professional knowledge.
   - Being prepared for a bioterrorism attack will help me reduce risk to the community through awareness education.
   - Being prepared for a bioterrorism attack will increase my chances of detecting an attack through surveillance.
   - Other, Specify
7. What concerns you most about responding or supporting a bioterrorism event as a public health nurse?
   - The ability to identify and recognize bioterrorism agents prior to a declared event.
   - The ability to respond effectively to a bioterrorism event with the resources available to my public health agency.
   - The willingness to provide assistance to response to a bioterrorism event versus providing protection for my own family.
   - Other, Specify
8. What type of additional training would you prefer to supplement your knowledge of bioterrorism, all hazards preparedness, and emergency response does in general?
   - Local seminars or other in-service classroom instruction.
   - Attend out of area conferences with lectures including interactive workshops with problem-based learning and small number of participants.
   - Self-study through journals or distance learning including satellite courses.
   - Other, Specify

9. What is your experience with using Instructor-led (in classroom) training for public health courses?
    - o No experience
    - o Poor
    - o Fair
    - o Good
    - o Very good
    - o Excellent
10. What is your experience with using Internet-based training for public health courses?
    - o No experience
    - o Poor
    - o Fair
    - o Good
    - o Very good
    - o Excellent
11. What is your experience with using a blended style of learning that included instructor led and Internet-based training for public health courses?
    - o No experience
    - o Poor
    - o Fair
    - o Good
    - o Very good
    - o Excellent
12. How well did your course meet the learning objectives?
    - o Poor
    - o Fair
    - o Good
    - o Very good
    - o Excellent
13. In your course, how was student comprehension and mastery of course objectives assessed?
    - o Essay exams
    - o Multiple choice/true-false exams

- Term papers
- Oral presentations
- Team projects
- Public health skill demonstration
- Tabletop/live-action exercises
- Other, Specify

14. Based on the training you received, how confident do you believe that learners will be able to perform their jobs better after completing similar training?
    - Not confident
    - Somewhat confident
    - Undecided
    - Confident
    - Very confident
15. Based on your training in bioterrorism, how confident are you in implementing your agency's protocols on reporting possible incidents of bioterrorism?
    - Not confident
    - Somewhat confident
    - Undecided
    - Confident
    - Very confident
16. How many continuing medical/nursing education (CME/CNE) credits did you earn from the course?
    - _____
17. Who paid for the course?
    - Organization/Agency
    - Self-Paid/Financial Aid/Student Loan
    - Tuition Assistance
    - GI Bill
    - Other, Specify

Appendix C: Invitation to Support/Participate in a Dissertation Survey

Title: The Efficacy of Varying Modalities of Bioterrorism Training Programs on the Degree of Retention of Knowledge by Public Health Nurses in Rural North Carolina

Dear Public Health Leader,

My name is Gaylon R. Crawford and I am a doctoral candidate at Walden University specializing in Health Care Policy and Homeland Security. I am currently working towards the completion of my dissertation entitled "Evaluating the Relationship between Modality and the Degree of Knowledge Retention in Bioterrorism Training". The purpose of this study is to explore the extent to which public health nurses receive and retain the appropriate level of training in bioterrorism/all hazards preparedness and the instructional methods they use to receive this training.

You were selected because of your position as the Heath Director of one of the 100 county health departments in North Carolina where this study will be conducted. You (or your designated proxy) are invited to support this study by forwarding the attached letter of consent to public health nurses working in your organization who have attended training in bioterrorism/all hazards preparedness. The consent form provides an overview of the study, its potential benefits to the nursing profession, and a link to a secured website for a four part survey questionnaire designed to solicit information from public health nurses on emergency training. This study will be beneficial because it should provide valuable insight into what methods of instruction (classroom, blended training or web-based online) would be most effective in helping nurses retain critical emergency knowledge and skills.

This e-mail includes a copy of the study brief for your review. No additional supervision will be required by you or by members of your management team and no onsite resources will be used in this study. Data will be collected from participants via an online service (Survey Monkey™) which will require about 20-30 minutes to complete. The study will be conducted from August 25 through September 30, 2014. Your support and the participation of your nursing staff in this study are strictly voluntary. All privacy and rights of the participants will be strictly adhered to. In any report of this study that might be published, the researcher will not include any information that will make it possible to identify you or your organization. Walden University's institutional review board (IRB) approval for this study is 08-08-14-0090199 and will expire on August 7, 2015.

Please feel free to ask any questions before acting on this invitation to participate in this study. . Thank you in advance to your support and participation.

Gaylon R. Crawford, MBA, MS
Ph.D Candidate (ABD)

Encl:
Bioterrorism Training Study Brief
Consent Form

Appendix D: Consent Form

Evaluating the Relationship between Modality and the Degree of Knowledge Retention in Bioterrorism Training

Subj: Invitation to Participate in a Dissertation Survey

Dear Health Care Professional,

My name is Gaylon R. Crawford and I am a doctoral candidate at Walden University specializing in Health Care Policy and Homeland Security. I am currently working towards the completion of my dissertation entitled "Evaluating the Relationship between Modality and the Degree of Knowledge Retention in Bioterrorism Training".

The purpose of this letter is to inform you of my research intent and to request your participation. You are invited to participate in this study because you are currently employed as a public health nurse working in a local health department in North Carolina and have attended or completed training in bioterrorism/all hazards preparedness. This letter is part of a process called "informed consent" to allow you to understand this study before deciding whether to participate. Walden University's institutional review board (IRB) approval for this study is 08-08-14-0090199 and expires on August 7, 2015.

Please read this letter, which provides a brief overview of the study, and follow the procedures listed below. Please feel free to ask any questions before acting on this invitation to participate in this study.

Background Information:

The purpose of this study is to explore the extent to which public health nurses receive the appropriate level of training in bioterrorism/all hazards preparedness and the instructional methods they use to receive this training. This study will be beneficial because it should provide valuable insight into what methods of instruction (classroom, blended training or web-based online) would be most effective in helping nurses retain critical emergency knowledge and skills.

Procedures:

If you agree to be in this study, you will be asked to:

a) Go to the link at the bottom of this form and access the survey via the secure Survey Monkey™ website.

b) Complete the four section survey (which may take up to 20-30 minutes to complete)

c) This survey consists of questions that will evaluate the core competencies required for public health nurses, emergency competencies required to respond to bioterrorism/all hazard events, and the participant's opinions on recently completed bioterrorism/all hazards training.

Voluntary Nature of the Study:

Your participation in this study is strictly voluntary. Your decision whether or not to participate will not affect your current or future relations with your current employer. If you initially decide to participate, you are still free to withdraw at any time later without affecting those relationships.

Risks and Benefits of Being in the Study:

Risks:

As the survey participants will be anonymous, the risks of participating in this survey are minimal, and could include that of superiors and colleagues of respondents obtaining the respondents' survey responses and being displeased with their responses if they became aware of the responses. This could occur only if the participants discussed their responses with other individuals personally. In the event you experience stress or anxiety during your participation in the study you may terminate your participation at any time. You may refuse to answer any questions you consider invasive or stressful.

Benefits:

The benefits to participation in this study are in gaining new knowledge and insight into providing more efficient emergency training for public health nurses and in enhancing community readiness for a potential bioterrorist attack.

Compensation:

There will be no monetary compensation for your participation in this study.

Confidentiality:

The records of this study will be kept private. In any report of this study that might be published, the researcher will not include any information that will make it possible to identify you. Research records will be kept in a locked file, and only the researcher will have access to the records. The results of this research project will be made available to all County Health Directors who participated in the study.

Contacts and Questions:

The researcher conducting this study is Gaylon R. Crawford, if you have questions about your participation in this study.

Statement of Consent:

To protect your privacy, no consent signature is requested, instead, your completion of the online survey at the link below will indicate your consent, if you choose to participate. Click on control and the link to access the survey and follow the screen prompts accordingly.

The link to the survey is: https://www.surveymonkey.com/s/8GQQBZJ

You may print or save a copy of this consent form for your records. Thank you in advance to your support and participation.

Gaylon R. Crawford, MBA, MS
PhD Candidate

Appendix E: NIH Course Completion

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Gaylon Crawford** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 05/28/2014

Certification Number: 1475421

Appendix F: Permission to Use Copyrighted Material

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Jun 06, 2014

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Appendix G: Crosswalk of Tier 1 Core Competencies for Public Health Professionals, Public Health Nurses, and the Essential Public Health Services

Public Health Professionals Core Competencies Tier 1 (Council on Linkages, 2010)	Public Health Professionals Core Competencies Tier 2 (Council on Linkages, 2010)	Public Health Professionals Core Competencies Tier 3 (Council on Linkages, 2010)	Section 1 Survey Questions using Public Health Nurse Core Competencies Tier 1 (Quad Council, 2011)	**ESSENTIAL PUBLIC HEALTH SERVICES (CDC, n.d.)**									
				1	2	3	4	5	6	7	8	9	10
				Monitor	Diagnose Investigate	Educate	Partner	Policies	Enforce	Link People	Competent Workforce	Evaluation	Research
Domain 1: Analytic/Assessment Skills													
1.A.1 Identifies the health status of populations and their related determinants of health and illness.	1B1. Assesses the health status of populations and their related determinants of health and illness.	1C1. Reviews the health status of populations and their related determinants of health and illness conducted by the organization.	Q1. I have knowledge of epidemiologic data and other ecological perspectives to identify health risks for a population and can identify individuals and family assets and needs, values and beliefs, resources and relevant environmental factors.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
1.A.2. Describes the characteristics of a population-based health problem.	1B2. Describes the characteristics of a population-based health problem.	1C2. Describes the characteristics of a population-based health problem.		A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C

1.A.12. Describes how data are used to address scientific, political, ethical, and social public health issues.	1B12. Uses data to address scientific, political, ethical, and social public health issues.	1C12. Incorporates data into the resolution of scientific, political, ethical, and social public health concerns.	Q2. I have the training and experience to identify determinants of health and illness and use evidence-based public health nursing practices to promote the health of individuals, families and groups using multiple sources of data.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
Domain 2: Policy Development/Program Planning Skills													
2.A.1. Gathers information relevant to specific public health policy issues.	2B1. Analyzes information relevant to specific public health policy issues.	2C1. Evaluates information relevant to specific public health policy issues.	Q3. I have the knowledge to identify policy issues relevant to the health of individuals, families, and groups and can describe the structure of the public health system and its impact on individuals, families, and groups within a population.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C

2.A.10. Applies strategies for continuous quality improvement.	2B11. Develops strategies for continuous quality improvement.	2C12. Implements organizational and system-wide strategies for continuous quality improvement.	Q4. I understand that quality improvement is important to the practice of public health nursing and I have you participated in quality improvement teams. I have the knowledge and experience to describe the various approaches used to improve public health processes and systems and use quality indicators and core measures to identify and address opportunities for improvement in the care of individuals, family, and groups.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
Domain 3: Communications Skills													

3.A.2. Communicates in writing and orally, in person, and through electronic means, with linguistic and cultural proficiency.	3B2. Communicates in writing and orally, in person, and through electronic means, with linguistic and cultural proficiency.	3C2. Communicates in writing and orally, in person, and through electronic means, with linguistic and cultural proficiency.	Q5. I have the ability to communicate effectively in writing, orally, and electronically and can communicate in a culturally responsive and relevant manner using critical thinking.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
3.A.4. Conveys public health information using a variety of approaches.	3B4. Uses a variety of approaches to disseminate public health information.	3C4. Ensures a variety of approaches are considered and used to disseminate public health information.	Q6. I have the knowledge to communicate effectively with individuals, families, and groups and as a member of inter-professional team and use a variety of methods to disseminate public health information.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
3.A.6. Applies communication and group dynamic strategies in interactions with individuals and groups.	3B6. Applies communication and group dynamic strategies in interactions with individuals and groups.	3C6. Applies communication and group dynamic strategies in interactions with individuals and groups.		A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
Domain 4: Cultural Competency Skills													

4.A.1. Incorporates strategies for interacting with persons from diverse backgrounds.	4B1. Incorporates strategies for interacting with persons from diverse backgrounds.	4C1. Ensures that there are strategies for interacting with persons from diverse backgrounds.	Q7. I have the training and experience to use social and ecological determinants of health to work effectively with diverse individuals, families, and groups?	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
4.A.6 Participates in the assessment of the cultural competence of the public health organization.	4B6. Assesses public health programs for their cultural competence.	4C6. Assesses the public health organization for its cultural competence.	Q8. I had the ability to demonstrate culturally appropriate public health nursing practices with individuals, family, groups, and community members and I contribute to promoting a culturally responsive work environment.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
Domain 5: Community Dimensions of Practice Skills													
5.A.1. Recognizes community linkages and relationships among multiple factors (or determinants) affecting health.	5B1. Assesses community linkages and relationships among multiple factors (or determinants) affecting health.	5C1. Evaluates the community linkages and relationships among multiple factors (or determinants) affecting health.	Q9. I have the experience to partner effectively with key stakeholders and groups in providing care delivery to individuals,	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C

5.A.6 Uses group processes to advance community involvement.	5B6. Uses group processes to advance community involvement.	5C6. Uses group processes to advance community involvement.	families, and groups using an ecological perspective, health assessments, planning, and interventions.	A B C	A B C	A B C	A B C	A B C	A B C	A B C			
5.A.10. Informs the public about policies, programs, and resources.	5B10. Promotes public health policies, programs, and resources.	5C10. Defends public health policies, programs, and resources.	Q10. I have the knowledge and experience to support public health policies, programs, and resources and I can identify opportunities for population focused advocacy for individuals, family, and groups.	A B C		A B C	A B C		A B C		A B C	A B C	A B C
Domain 6: Basic Public Health Sciences Skills													
6.A.4. Identifies the basic public health sciences (including, but not limited to biostatistics, epidemiology, environmental health sciences, health services administration, and social and behavioral health sciences).	6B4. Applies the basic public health sciences (including, but not limited to biostatistics, epidemiology, environmental health sciences, health services administration, and social and behavioral health sciences) to public health	6C4. Applies the basic public health sciences (including, but not limited to biostatistics, epidemiology, environmental health sciences, health services administration, and social and behavioral health sciences) to public health	Q11. I have the training, knowledge, and experience to use basic descriptive epidemiological methods when conducting a health assessment for individuals, family, and groups.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C

	policies and programs.	policies and programs.											
6.A.8. Describes the laws, regulations, policies and procedures for the ethical conduct of research.	6B8. Determines the laws, regulations, policies and procedures for the ethical conduct of research.	6C8. Advises on the laws, regulations, policies and procedures for the ethical conduct of research.	Q12. I comply with all requirements of patient confidentiality and human subject protection.					A B C	A B C			A B C	A B C
Domain 7: Financial Planning & Management Skills													
7.A.5. Operates programs within current and forecasted budget constraints.	7B5. Develops a programmatic budget.	7C5. Defends a programmatic and organizational budget.	Q13. I have the knowledge and experience to describe the impact of budget constraints on the delivery of public health nursing care to individuals, families, and groups.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
7.A.7. Reports program performance.	7B7. Develops strategies for determining	7C7. Critiques strategies for determining	Q14. I routinely provide data for inclusion in	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C

	budget priorities based on federal, state, and local financial contributions.	budget priorities.	programmatic budgets, help to establish budget priorities, and provide reports on program performance.										
Domain 8: Leadership & Systems Thinking Skills													
8.A.1. Incorporates ethical standards of practice as the basis of all interactions with organizations, communities, and individuals.	8B1. Incorporates ethical standards of practice as the basis of all interactions with organizations, communities, and individuals.	8C1. Incorporates ethical standards of practice as the basis of all interactions with organizations, communities, and individuals.	Q15. I have the ability to incorporate ethical standards of practice as the basis of all interactions with organizations, communities, and individuals and I incorporate ethical standards and all aspects of public health nursing practice?	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C
8.A.3. Participates with stakeholders in identifying key public health values and a shared public health vision as guiding principles for community action.	8B3. Participates with stakeholders in identifying key values and a shared vision as guiding principles for community action.	8C3. Partners with stakeholders to determine key values and a shared vision as guiding principles for community action.	Q16. I have the experience with working with stakeholders to identify visions, values, and principles for community action and can identify internal and	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C

8.A.4. Identifies internal and external problems that may affect the delivery of Essential Public Health Services.	8B4. Analyzes internal and external problems that may affect the delivery of Essential Public Health Services.	8C4. Resolves internal and external problems that may affect the delivery of Essential Public Health Services.	external factors affecting public health nursing practice and services.	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C

Appendix H: Adult Learning Skill Acquisition Models

	Dreyfus Adult Skill Acquisition Model	**Benner Novice to Expert Theory for Nurses**	**Extended Dreyfus Skill Acquisition Model (Public Health)**
Level 1	**Novice** Rigid adherence to taught rules or plans, little situational perception, and no discretionary judgment.	**Novice(less than six months)** Any nurse entering a new clinical situation. Refers to beginners having had no experience in similar situations. Uses rule governed behavior with heavy reliance upon theoretical principles and performing within limitations.	**Entry** Implements data collection protocols and implements programmatic activities under strict controls.
Level 2	**Advanced Beginner** Guidelines for action are based on attributes or aspects, situational perception is still limited, all attributes and aspects are treated separately and given equal importance.	**Advanced Beginner (six months to 1 year)** Demonstrates marginally acceptable performance and can cope with enough real life situations to be able to transfer aspects such as global characteristics gained from previous practice,	**Capable** Oversees data-collection processes and ensures quality of data and monitors programmatic activities and keeps them on track and consistent with timelines with limited controls.
Level 3	**Competent** Copes with crowdedness, now sees actions at least partially in terms of longer term goals, and conscious deliberate planning	**Competent (1 to 2 years)** Typified by a nurse who has been on the same job in the same or similar situation for two or three years. Sees actions in terms of long range goals or plans. Establishes perspective and plan based on considerable conscious, abstract. contemplation of the problem.	**Competent** Designs a research protocol and implements the research agenda and designs a community-based intervention and the plan for its evaluation without controls.
Level 4	**Proficient** See situations holistically rather than in terms of aspects, see what is most important in a situation, perceives deviations from the normal pattern, decision-making less labored, and uses maxims for guidance, whose meaning varies	**Proficient (2 to 4 years)** Perceives issues in wholes terms based on specific context. Recognizes when the normal picture does not materialize and requires alternative options. Learns from experience what events to expect and how plans need to be modified.	**Proficient** Designs a research agenda, ensures accuracy of the research findings, and translates the science into practice and designs and implements a multipronged program to prevent and control a given condition.

	according to the situation.		
Level 5	**Expert** No longer relies on rules, guidelines, or maxims, has intuitive grasp of situations based on tacit understanding, analytic approaches used only in novel situation or when problems occur, vision of what is possible.	**Expert (4 or more years)** No longer relies on analytic principles to connect understanding of the situation to an appropriate action. Has an intuitive grasp of each situation and zeroes in on the accurate region of the problem without wasteful consideration of a large range of unfruitful alternative diagnoses of situations.	**Expert** Develops the interdisciplinary research agenda for the agency and develops programmatic approaches that cross disease boundaries.
Level 6	**N/A**	**N/A**	**Advanced Expert** Promotes and obtains resources for a research agenda in a professional field of practice and advocates for the fiscal and strategic direction of an agency or profession with the larger political and social systems.
Level 7	**N/A**	**N/A**	**Luminary** Encourages a multidisciplinary social action (including policy) response based on research findings and collaborates with other professional leaders to take action to resolve major professional and social problems.