The Role of Public Health Nurses in Bioterrorism Preparedness - 13 Years Later

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Abstract

We follow up on the findings from an article published 13 years ago, highlighting the role of public health nurses in bioterrorism preparedness. That study found that public health nurses working in the field of bioterrorism preparedness, while dedicated to their responsibilities, experienced multiple barriers in conducting disease surveillance, including a vague scope of practice, truncated funding, and lack of standard education in public health and bioterrorism preparedness. We used a scoping review methodology to inform national developments and searched online information sources for the State of Washington to demonstrate the status of current public health and bioterrorism preparedness at the local level. Public Health nurses are trained at the Baccalaureate level with general competencies in community, public and population health. In addition, public health nurses have a wide scope of practice, from maternal health to health promotion, to health education and immunizations. Often, when a public health nurse position is open, there will be a focus in one sector, for example infectious disease. This diversity is well demonstrated when reviewing public health nurse job descriptions. We found that public health nurses remain the pillar in disease surveillance.

In summary, we found that the barriers to bioterrorism surveillance identified some 13 years ago remain pertinent to-date. The topic of public health and bioterrorism preparedness has remained of national interest, while little has changed during the last decade. The work of public health nurses would need to be more proactively supported by system improvements involving clear job responsibilities and further clarification of formal and informal reporting systems. Funding truncation continues to be a barrier in public health and bioterrorism preparedness. Our findings suggest that public health departments and jurisdictions should consider working with the national Public Health Accreditation Board to ensure quality training of public health nurses in emergency preparedness and disease surveillance. Including public health courses and bioterrorism options as accreditation expectations for nursing programs could directly impact the workforce development in public health. We suggest that the findings of this study about barriers to nurses working in public health and bioterrorism preparedness could inform local, state and federal decision-making for ensuring robust bioterrorism preparedness and improvement in public health nurses' workforce supply.

Key words: nurses, bioterrorism preparedness, public health, funding for public health and bioterrorism preparedness, nursing curriculum in public health

1. Background

Thirteen years ago, in 2005, an article exploring the role of public health nurses was featured in the Disaster Management and Response Journal[1]. The study found that public health nurses working in the field of bioterrorism preparedness, while dedicated to their responsibilities, experienced multiple barriers in conducting disease surveillance, including a vague scope of practice, truncated funding, and lack of standard education in public health and bioterrorism preparedness. The topic of public health and bioterrorism preparedness has remained of national interest, while little is understood whether improvements have been achieved during the last decade. In this work we explore the status of public health and bioterrorism preparedness thirteen years after the initial publication, aiming to determine developments and identify future steps to success. Akins *et al.* utilized a qualitative study on disease surveillance with populations in the State of Texas. A scoping review methodology is used here to inform national developments, and we searched online information sources for the State of Washington to demonstrate the status of current public health, bioterrorism preparedness at the local level, and the role of public health nurses in bioterrorism preparedness.

2. Methods

The intent of the scoping review was to improve our understanding of the current state of public health nurses and their roles in bioterrorism preparedness. Scoping reviews[2], by definition, are exploratory projects that map the literature on a topic, identifying key concepts, theories and sources of evidence, and aiming to address broader, more complex research questions. In a scoping review, the same systematic, rigorous methodologies used by the systematic reviews are used to identify studies and extract relevant data. We identified our lead question as, "What are the developments and improvements in identifying the scope of practice of public health nurses, available funding for public health and bioterrorism preparedness, and education requirements for public health and bioterrorism in nursing programs" in a follow up of barriers identified in a prior publication on the role of public health nurses[1].

To operationalize the research question into robust literature search strategies, we used the help of a librarian during the initial stages of the study design. This outreach librarian also supported the preliminary assessment of the size and scope of the available research literature, and the identification of the key words for database searches. In conducting the scoping review, we used an iterative team approach in selecting the studies for review and data extraction and incorporated numerical summaries and qualitative thematic analysis in the reporting of the results. We also conducted telephone interviews and reviews of online resources published by stakeholders as a knowledge triangulation component of the scoping review.

The following inclusion criteria were used for this study:

1. Articles published between 2005 and 2018, and online materials retrieved in 2018.
2. Publications discussing one or more of the following topics:
   (a) Public health nursing;
   (b) Disease surveillance;
   (c) Bioterrorism preparedness;
   (d) Communications for disease reporting;
   (e) Funding for public health and/or disease surveillance, and/or bioterrorism preparedness.

We searched PubMed, Cochrane, MEDLINE, and local, state, national, government and institutional websites for relevant articles and publications. Our search included works published in 2005 and after: reviews, case reports, observational and experimental studies, policies and guidelines, online information sources. We identified 365 records for further review. Each record's title and abstract were initially screened by one author for alignment with eligibility and content requirements. Next, teams of two authors worked on the reviews for each topic section, followed by team reviews of findings and analyses.

After screening for alignment with the inclusion criteria, the full text of 150 records was reviewed, and 118 were excluded. Reasons for exclusion were: purely ethical discussions without focus on one or more of the inclusion criteria, commentaries with or without numerical data not discussing relevance to the inclusion criteria, focus on biotechnology implementation rather than public health, and reports of programs outside the scope of our review. Forty-two (42) of the reviewed records were included in the final review and analyses. Figure 1 below presents pictorially the flow of the scoping review of materials for inclusion in this project.

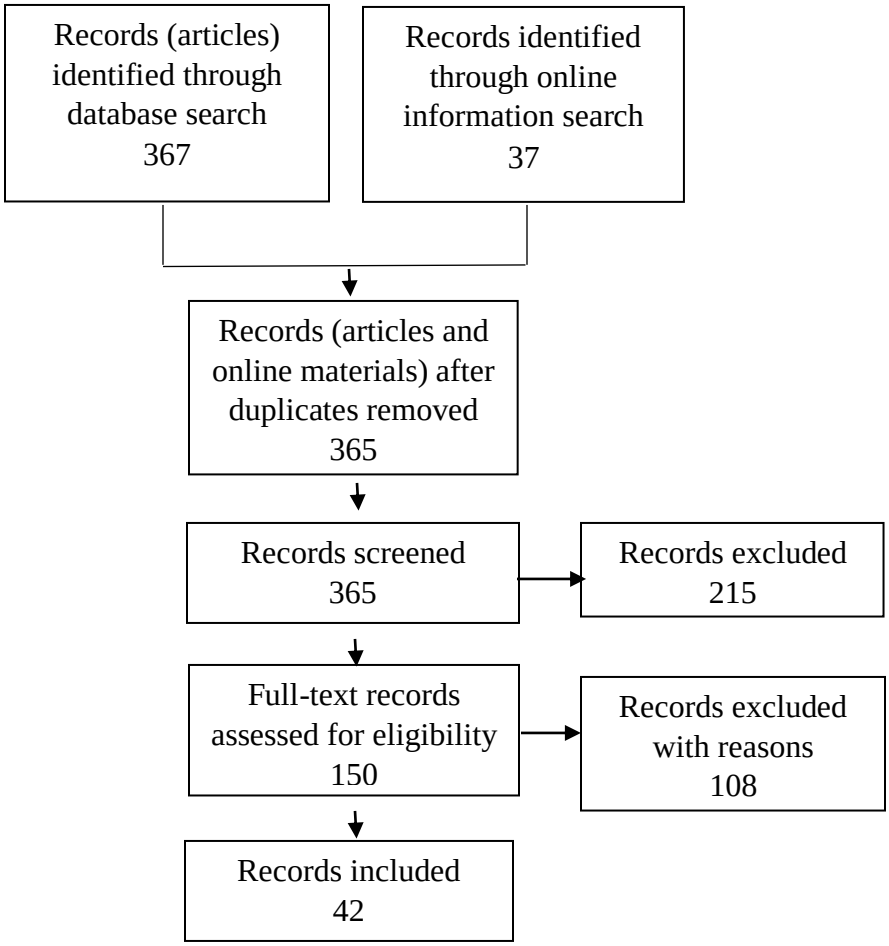

Figure 1. Scoping review flow of records selected for inclusion.

Table 1 below lists in the 42 records identified for this study, based on review and inclusion criteria.

Author, Year	Title
AACN, 2008	The Essentials of Baccalaureate Education for Professional Nursing Practice
AACN, n.d. (retrieved 2018)	AACN Essentials
Akins et al., 2005	The role of public health nurses in bioterrorism preparedness
Alexander et al., 2008	Partnering to Meet Training Needs: A Communicable-Disease Continuing Education Course for Public Health Nurses in North Carolina
APHA, n.d. (retrieved 2018)	What is Public Health
Avery & Zabriskie-Timmerman, 2009	The impact of federal bioterrorism funding programs on local health department preparedness activities
Bahk et al., 2015	Comparing timeliness, content, and disease severity of formal and informal source outbreak reporting
Buehler & Holtgrave, 2007	Who gets how much: funding formulas in federal public health programs
CDC, 2016	Global Disease Detection Operations Center: Event-Based Surveillance
CDC, 2017	Gateway to Health Communication & Social Marketing Practice
CDC, 2018	National Notifiable Diseases Surveillance System (NNDSS)
Census.gov, n.d. (retrieved 2018)	Quick Facts
CMS, 2016	National Health Expenditures 2016 Highlights
Co.Cowlitz.Wa, n.d. (retrieved 2018)	Welcome to an Engaged Community
Co.Thurston.Wa, n.d. (retrieved 2018)	Thurston Co Health Programs
Dietz et al., 2010	Medical errors and patient safety in palliative care: a review of current literature
DOH, WA, n.d. (retrieved 2018)	Local Health Jurisdictions
DOH, WA, n.d. (retrieved 2018)	Emergency Preparedness and Response
DOH, WA, n.d. (retrieved 2018)	For Public Health and Healthcare Providers (Accreditation)
DOH, WA, n.d. (retrieved 2018)	For Public Health and Healthcare Providers (Public Health Transformaiton)
Dowling & Lipton, 2005	Bioterrorism preparedness expenditures may compromise public health
Gostin, 2005	Finding a space for the public's health in bioterrorism funding: a commentary
Governmentjobs.com, n.d. (retrieved 2018)	Thurston County Classification Specifications
Governmentjobs.com, n.d. (retrieved 2018)	Class Specifications

Governmentjobs.com, n.d. (retrieved 2018)	Job Classifications
Hebert et al., 2007	Building preparedness by improving fiscal accountability
Himmelstein & Woolhandler, 2016	Public Health's Falling Share of US Health Spending
Hyde et al., 2006	Better prepared but spread too thin: the impact of emergency preparedness funding on local public health
IOM, 2012	For the public's health. Investing in a healthier future
Kman & Bachmann, 2012	Biosurveillance: A Review and Update
Lang et al., 2018	A Funding Crisis for Public Health And Safety
Meit et al., 2013	An Examination of Public Health Financing in the United States
Okanogancounty.org, n.d. (retrieved 2018)	Administrative Staff
Persell & Robinson, 2008	Detection and early identification in bioterrorism events
PHABoard.org, 2013	Public Health Accreditation Board (PHAB) Standards and Measures
Seattle University, n.d. (retrieved 2018)	Typical Junior Transfer Program of Study
Sell, 2010	Understanding Infectious Disease Surveillance: Its Uses, Sources, and Limitations
UW, n.d. (retrieved 2018)	University of Washington BSN Program Curriculum Grid
Watson & Watson, 2017	Public Health Preparedness Funding: Key Programs and Trends From 2001 to 2017
Watson & Watson, 2017	Funding and Organization of US Federal Health Security Programs
WSU, n.d. (retrieved 2018)	Washington State University Course Work BSN
Yoon et al., 2017	Using Syndromic Surveillance for All-Hazards Public Health Surveillance: Successes, Challenges, and the Future

Table 1. Included records.

The study findings, presented in Section 3 below, are based on analysis of these 42 included records.

3. Study Findings

3.1. Public Health and Bioterrorism Preparedness Funding

Availability of funds for public health is a critical determining factor in bioterrorism preparedness, and shapes the availability and roles of public health nurses in bioterrorism preparedness. Healthcare spending in the US is up to $3.3 trillion, an increase of 4.3 percent in 2016, bringing the gross domestic product share of healthcare to 17.9 percent[3]. It has been estimated that only three (3) percent of current U.S. national health expenditure supports public health, with the majority of public funding attributed to clinical care and clinical care research[4]. When accounting for private sector expenditures, the estimate of public health share drops to 0.5 percent[5]. In 2016, Himmelstein and Woodlandler published findings from an analysis of National Health Expenditure Accounts (NHEA) data, an annual compilation of total health expenditures produced by the US Department of Health and Human Services.

They found that while in 1960 public health accounted for only 1.36 percent of total health expenditure,[6] spending rose to 3.18 percent in 2002 after the events of the 9/11 attacks. Between 2002 and 2014, public health expenditure declined by 17 percent[6]. Even with the growing acknowledgement of the value of public health initiatives and ongoing concern for disease outbreaks and/or bioterrorism, increases in healthcare spending do not include public health. The Centers for Disease Control and Prevention (CDC), the leading authority on public health, has seen essentially no increase in budget over the last ten years (after adjusting for inflation), other than the addition of the Prevention and Public Health Fund created by the Affordable Care Act (ACA).[7] The Prevention and Public Health Fund was established to place more emphasis on public health, beginning by supporting the primary care workforce.[4] However, beginning in 2013, this earmarked federal spending became a target for further funding cuts, with an estimated $11.85 billion loss from the funding schedule as originally enacted by fiscal year 2028[7]. In addition to the CDC, local health departments also receive federal funding from the US Department of Agriculture (USDA), the Health Resources and Services Administration (HRSA) the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA) and sometimes the Department of Homeland Security (DHS)[5]. Federal funding allocation between jurisdictions is determined by a mixture of strategies, including the use of funding formulas. For example, the CDC Bioterrorism and Health Emergency Preparedness Program budgeted $810 million in base funds in 2005, with each state receiving a minimum $3.91 million and the remainder distributed by population size[8]. An additional 5% are earmarked for urban areas and less than 1% are specifically flowing to border states[8].

The large majority of public health funding (80 to 90 percent) is provided by state and local governments rather than federal programs[5,6]. Overall, tracking local public health expenditures is difficult due to varying definitions and programs between states[5]. However, in a report analyzing seven states (Alabama, Arkansas, California, Georgia, Massachusetts, North Dakota and Oregon), researchers from the University of Chicago found that the combined state and federal funding trends have resulted in up to a 17% reduction in the non-clinical workforce between 2008 and 2011[5]. The Trust for America's Health estimated that since 2008 local health departments have lost 55,590 staff members, either to layoffs or attrition[7]. The combination of lack of new positions and concerns over inconsistent revenue makes it difficult for health care workers, including public health nurses, to enter and stay in the public health field, and bioterrorism preparedness specifically. Whereas most federal funding for public health has been allocated for reactive situations such as natural disaster or bioterrorism response (e.g., Post-911 anthrax), state funding has been traditionally most flexible and could be used to support ongoing non-categorical initiatives[5]. State funding, however, continues to decline at a faster rate that federal funding, and thus federal funding has become over time a larger proportion of the health departments' revenue[5]. This is problematic in the context of emergency preparedness, as national attention and thus revenue streams are not focused on major issues of health safety and emergency preparedness until a disaster has already struck.

Funding for public health and bioterrorism preparedness is truncated and involves multiple independent streams, therefore not

well aligned. In addition to the already mentioned Federal agencies involved in public health funding, programs related to health security and subsequently bioterrorism are also sponsored by the US Department of Defense (DoD), Department of Justice (DoJ), Department of Energy (DoE), Department of Commerce (DoC), and the National Science Foundation (NSF)[9]. In particular, the Public Health Emergency Preparedness (PHEP) cooperative agreement program and the Hospital Preparedness Program were initially funded at a high of $940 million and $515 million in fiscal years 2002 and 2003 respectively[10]. These programs were designed to improve surveillance and response, coordinating public health and health care entities, and have seen success in helping quickly responding to evacuation for hurricanes or pandemic such as influenza and Ebola[10]. However, both the PHEP and Hospital Preparedness Program have seen decreased budgets of 31% and 50% since their original installations in the early 2000s[10]. Overall, in fiscal year 2017 it is estimated that federal funding for health security totals only $12.9 billion, with greater than 50 percent allocated for general national preparedness and response to any number of threats. In addition, 20 percent are allocated directly to threats of radiological or nuclear attack, 13 percent for bioterrorism, 10 percent for infectious diseases, and 3 percent for chemical security[9]. This funding pales in comparison to the rest of healthcare funding and is spread amongst multiple agencies and local health departments. Part of the difficulty in securing funding for public health and bioterrorism preparedness is the need to demonstrate accountability and results at times of no active attacks. It is estimated that the federal government has spent $13 billion on biodefense during the period 2001-2007, yet the distribution is unclear because of the wide variety of public health practices in the individual states[11]. The justification of such funding would be difficult to defend and expand in the absence of tabulated results. Subsequently, bioterrorism preparedness, just like the rest of public health, is also subjected to budget cuts, with an estimated reduction of $800 million in fiscal year 2017 as compared to 2016[9]. The diminishing resources available to support emergency preparedness, both financially and administratively, are of major concern for national security.

In 2009, Avery and Zabriskie-Timmerman reported that federal funding for bioterrorism preparedness enhanced local health departments' preparedness activities but did so indirectly by enabling the hiring of specialized leadership[12]. The most valuable aspect that determined the preparedness activities of a local health department was the presence of dedicated emergency preparedness staff and ultimately, the availability of public health nurses. With bioterrorism funding waning, the ability to open dedicated positions for emergency preparedness has diminished, in competition with funding and staffing needs in other essential public health services[1]. Within the public health community, there has been a discussion about how possible over-emphasis of funding needed for bioterrorism preparedness could place other public health initiatives at risk[13-15]. Such thinking could explain why most of the biodefense dollars (88 percent in fiscal year 2014) have been allocated to programs that are not solely dedicated to bioterrorism, but also generalized disaster preparedness[10].

3.2. Current Status of Disease Surveillance

Disease surveillance is defined as an ongoing process of data collection, analysis, investigation, and action[16] and public health nurses play a central role in it. Disease surveillance is essential to identify possible

bioterrorism events. U.S. surveillance systems including the National Notifiable Diseases Surveillance System (NNDSS) relies on local and state-based surveillance of infectious diseases[16]. Cases of notifiable diseases are reported from healthcare providers to local and state health departments which are then sent to the U.S. Centers for Disease Control and Prevention (CDC). Consequently, public health officials analyze and interpret data at the national level, thereby monitoring, controlling and preventing the occurrence and spread of certain agents[17]. Different mechanisms can play a significant role in helping to identify a bioterrorist event; passive surveillance involving the regular reporting of disease data by health institutions to public health authorities or alternatively active surveillance practices such as designated public health members regularly contacting health care providers to obtain information about health conditions[18]. Another type of surveillance, syndromic surveillance, occurs by monitoring symptoms before a diagnosis has been made to detect unusual activity that would require public health action[19]. An example of such a program is BioSense, a syndromic surveillance system collecting real-time health-related data from a large selection of hospitals, private labs, and pharmacies to determine if a particular disease event is happening[16]. Public health practitioners use syndromic surveillance daily and it is currently an essential component of many U.S. health departments' surveillance activities[20]. The United States uses the Laboratory Response Network (LRN) to detect, confirm and report bioterrorism agents. Suspicious specimens are sent for additional testing in higher-tier labs[21]. Environmental surveillance involves the continued sampling of ambient air for the presence of biological agents[21]. The Biowatch program is a federal monitoring system that consists of sampling devices that typically sample the air daily for signs of biological agents. Sampling devices are deployed in 31 major U.S. cities and are intended to speed detection of a bioterrorism event. Samples are transported to LRN laboratories daily for analysis[21].

The integration of different surveillance systems such as syndromic, laboratory and environmental surveillance serves as an important mechanism to defend against a bioterrorist attack and can help officials determine if there is a need for mass prophylaxis, vaccination, or another intervention[16]. Channels for disease surveillance reporting fall under two categories: informal and formal. Informal notification systems such as the Global Public Health Intelligence Network (GPHIN), ProMED Mail and HealthMap proactively collect and disseminate event-based surveillance information that can detect outbreaks[22]. Formal reporting, on the other hand, offers data from indicator-based surveillance that involves reports of specific diseases from health care providers to public health officials[16,23]. Both channels most often report the same information, but formal reporting is given greater value as the gold standard than informal reporting[22]. Formal channels are prone to a time lag, however. Considering the timeliness as well as the source of reports for formal and informal surveillance, it is important to utilize not just one type of source but all possible sources for rapid and accurate outbreak reporting[22].

Our findings suggest that there has been no additional systematic development to ease the responsibilities of public health nurses in disease surveillance. Although the National Notifiable Disease Surveillance System (NNDSS) allows for the sharing of notifiable disease related health information nationwide, there is not a complete

integration of disease surveillance systems at a federal level[16,17]. There are over 300 disease surveillance efforts with many of them having different system designs that make it difficult to be integrated together[16]. The roles, joint strategies, policies, and procedures for operating across different agencies remain unclear[21].

Another barrier to conducting disease surveillance involves public health funding reductions that have resulted in drastic cuts in public health employment. In 2009, there were cutbacks in epidemiology staff in nine percent of all local health departments. There was a 15 percent loss of the local health department workforce from 2008 to 2009 due to staffing reductions[16]. Without the personnel with the necessary skills to compile and interpret disease data, the efficacy of disease surveillance could be undermined. Additionally, bioterrorism effects are not always immediately recognized as other methods of terrorism. Consequently, a bioterrorism attack may not be easily distinguishable from a naturally occurring infectious disease outbreak[22]. False-positive activation is another challenge in disease surveillance and can be due to technical malfunctions. Taking action in response to a false-positive activation would be a great expense and could also cause substantial public distress[21].

3.3. Organization of the Washington State Public Health System

Public health systems across the United States include plans for potential threats that could affect the population health. One possible threat is through bioterrorism, where disease surveillance is essential in order to recognize an attack early on. Washington State has a network of resources that are tasked with emergency preparedness. The focus from state, local and health officials is earthquake response due to the state's unique geography and concerns about the "Cascadia Subduction Zone". Each year there is a joint effort of local, state and military personnel who conduct simulated earthquake disaster response exercises. These exercises consume time, personnel and resources to address the policy makers' directives of public safety and preparedness. Mock or simulated exercises like these are carried out by other states to address their distinctive and common risks. Training for "rare" events would be difficult to defend to the public who may not perceive bioterrorism as an imminent threat when they are aware of seasonal disasters such as hurricanes, tornados, flooding, wind or ice storms. States such as Alabama and Mississippi have a collaborative relationship with their Public Health Training Center to address public health preparedness through technical, scientific, managerial and leadership competencies for their public health workforce. This alliance is supported through the University of Alabama (Region IV Public Health Training Center) which offers webinars for professionals on a variety of disaster preparedness topics for the past 15 years or more. Columbia University offers trainings and certificates through their National Center for Disaster Preparedness, Mailman School of Public Health. Oftentimes, these disaster, surveillance and bioterrorism trainings are funded through grants with limited sustainability.

Washington State's public health system is a framework for public health leaders to guide health care in disease surveillance and bioterrorism preparedness. Figure 2 presents the Washington State counties, on which the state public health system is based.

Figure 2. Washington State counties[24]

Washington State has 30 county health departments, two (2) city-county health departments, and 3 multi-county health districts. These are the 35 local health jurisdictions (LHJ). The LHJ are primarily based on the counties of Washington State, with city-county health departments including Seattle/King County and Tacoma/Pierce County. The Multi-county health districts include Benton-Franklin County, Chelan-Douglas County, and Northeast Tri County Health District (Ferry, Pend Orielle, and Stevens Counties). Each LHJ operates independently, under the guidance of Washington State's Department of Health[24].

Washington State has a population of 7,288,000 and is spread over 66,455 square miles. The population and square mileage of LHJs vary greatly, especially comparing the urban and rural areas. The two largest LHJs in population are the city-county health departments: Seattle/King with 2,149,970 people and Tacoma/Pierce with 861,312 people. The next populated LHJ is Snohomish County with 787,620 people, and the least populated LHJ is Garfield County with 2,247 people. The land area of the LHJs ranges from Northeast Tri County Health District at 6,081 square miles to San Juan County at 174 square miles[25].

Washington's public health LHJs are grouped into 9 emergency preparedness regions in order to "encourage coordination and resource sharing"[26]. The 9 regions, shown in color in Figure 3, each have a lead LHJ that employs staff to "create local emergency preparedness plans and to collaborate on a regional plan that will tie local plans together"[26]. Examples of emergency preparedness region tasks include planning point of dispensing (POD) operations with an antidote in the case of a bioterrorism attack and patient movement plans in the case of a natural disaster[27]. Continuous tasks, such as disease surveillance, food inspection, and maternal child health services are carried out through LHJs, with support from respective emergency preparedness regions[27].

Figure 3. Washington State Public Health Emergency Preparedness Regions[26]

An important distinction in Washington State's emergency preparedness and response plan is the differentiation between public health and healthcare efforts. The emergency preparedness regions coordinate public health issues, while eight (8) healthcare preparedness coalitions coordinate healthcare aspects, such as caring for many patients during an infectious disease outbreak, including appropriate transportation and facilities. Communication and coordination are essential in preparing for and responding to public health emergencies, and these coalitions include hospitals, local public health agencies (mainly LHJs), emergency management teams, and emergency medical services to plan for and coordinate the best care for a large-scale emergency. These coalitions are represented in Figure 3, as "EMS planning regions," with the recent consolidation of regions 5, 6 and Kitsap County. Additionally, the counties in region 2 on the map operate independently, and the counties in region 4 operate through Oregon, as they are in the Portland metro area. The coalition regions mostly align with Washington's emergency preparedness regions to streamline regional coordination[27]. The healthcare coalitions in the state of Washington are largely funded by the Hospital Preparedness Program (HPP), while public health preparedness is largely funded by the CDC[27].

Since 2013, five (5) LHJs with the Washington's Department of Health (Figure 4) have achieved voluntary national accreditation through the Public Health Accreditation Board (PHAB)[28], involving activities in performance and quality improvement within 12 domains. For example, Domain 8 requires maintaining a competent public health workforce. Therefore, through accreditation, a public health department could demonstrate staff competencies, provision of individual training and professional development, and supportive work environment[29]. Figure 4

shows the Washington State Agencies accredited by the PHAB.

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Figure 4. Washington State Agencies Accredited by the PHAB[28]

Staffing in each LHJ varies with the size of the population served. For example, Figure 5 shows the public health services staff breakdown in Thurston County, which has a population of 275,222 people[25]. Thurston County also employs public health nurses in both their community engagement and disease control and prevention sections[30]. Other counties have additional programs, for example, maternal and child health or behavioral health[31], while others only have environmental health and community health[32].

Figure 5. Thurston County's public health team[30]

Regardless of the department breakdown for each county, they must cover the 6 programs listed in Figure 6.

Figure 6. Washington State's public health system core services[33]

The staffing and program accomplishment have traditionally relied mainly or exclusively on nursing public health professionals.

3.4. Job Expectations from Public Health Nurses

Public health nurses are the pillars of the public health system, and their jobs include a wide range of duties. They are hired through LHJs, and each LHJ has a separate job description and hiring process. Analysis of three entry-level positions for public health nurses across Washington State show differences in the outlined job descriptions (Table 2). The counties of Thurston, Skagit, and Kitsap, where these job descriptions originated, require a Bachelor of Science in Nursing (BSN) to be considered for the job, prior nursing experience, particularly in public health was recommended but not required, and coursework in community health was recommended for two of the counties, Thurston and Kitsap. While the background necessary for public health nurses was similar, the duties outlined in the job descriptions had a wider range[34-36].

Job Description	Thurston County	Skagit County	Kitsap County
Nursing Qualifications	Bachelor of Science in Nursing	Bachelor of Science in Nursing	Bachelor of Science in Nursing
Recommended Specialized Coursework	Coursework in Community Health	None	Coursework with a Community Health Component
Scope/Duties related to bioterrorism	Investigations in Disease or Health Hazards	Early identifications and surveillance of disease, Emergency preparedness activities	Epidemiological Investigations for potential terrorism

Table 2. Job Requirements for Entry-Level Public Health Nurse Positions[34-36]

Public health nurses have been utilized in times of natural disasters to backfill needs at the direction of local governments or their state governors. Their roles have included managing shelters, assessing public health threats after disasters, working in teams to conduct welfare checks for those who did not evacuate, helping with transition housing, and managing day care facilities so that parents can return to work[37,38]. In addition, when state governors need trained health professionals and nurses, they have been known to mobilize school nurses to fill the same roles as public health nurses[39,40]. Many of the skills and training needed to perform these designated functions are not taught in nursing programs, but are learned from specific trainings, in-services, and mentoring from experienced public health officials and other disaster response professionals[41]. As evidenced by responses to natural and man-made disasters in the last 10-15 years, hospitals, schools, communities, and other public organizations have sought to improve their emergency or disaster preparedness plans.

Bioterrorism surveillance required for early identification is a specialized skill that requires intensive training and practice. Planning for the worst-case scenario requires resources and funding sources that are often scarce. As a result, our communities, states and nation rely on a multi-tiered system of response teams and trained professionals. With a multi-tiered system and with communication systems that have been improved through advances in technology (e.g. 911 and reverse 911), disease surveillance and bioterrorism recognition and response remain a local, state and national problem. National initiatives, national funding and grants support new trainings, sporadic training opportunities for nursing programs in general and public health districts, specifically.

3.5. Public Health and Bioterrorism Preparedness in Nursing Education

The aim of public health is defined by the American Public Health Association (APHA) as "[promoting] and [protecting] the health of people and the communities where they live, learn, work and play." APHA also states that their objectives are separate from the actions of medical professionals treating individuals who are already sick[42]. While the actions of both parties are necessary, this distinction highlights the difference in training, information and application of objectives, and would need be addressed in the

education and training of all health professionals.

Recognition of the importance of and training in public health is outlined as a requirement in nursing education. The American Association of Colleges of Nursing (AACN) publishes The Essentials of Baccalaureate Education for Professional Nursing Practice which "outline the necessary curriculum content and expected competencies of graduates" of all levels of nursing degrees[43]. As stated under Essential VII: Clinical Prevention and Population Health, "Health promotion, disease, and injury prevention across the lifespan are essential elements of baccalaureate nursing practice at the individual and population levels." This focus on individual and population health through education and preventative health measures underlies a key goal of public health. This nursing education Essential goes on to detail how this area of education can in fact help individuals through populations "prepare for and minimize health consequences of emergencies, including mass casualty disasters" and this subject is included in the curriculum "because a baccalaureate degree in nursing is the recommended minimal educational credential for population-focused care"[44]. Health sciences universities with accredited nursing programs pay due attention to student education in public health. At Washington State University (WSU), for example, the topic of public health is covered by the undergraduate required course in Community Health Nursing Theory[45], in Promoting the Health of Populations and Communities at Seattle University,[46] and in Promoting Community and Public Health at the University of Washington (UW)[47].

The standards of the AACN prepare nurses as generalists without specialized training in certain fields. There are only two years for each program to cover the necessary content for licensure success and accreditation. The significant amount of education and training leaves little room for the inclusion of added, targeted training in specialties. While the requirement of public health education (as covered under Essential VII) ensures an introduction to the topic, in being one of nineteen Essentials, it is clearly a subject and not a focus or specialty that nurses would have considerable exposure to over the course of their education. Additionally, it is important to note that Essential VII emphasizes the preventative and promotional aspect of public health. It does not significantly discuss the issue of surveillance. Under the thirteen items listed as topics that the baccalaureate program must prepare the graduate for, only two mention the concept of surveillance. The issue of bioterrorism is not raised specifically, other than conceptually being under the broad categorizations of mass casualty and disease outbreaks. There is, though, an expectation in emergency preparedness, where the graduates should be prepared to "[assess] the health, healthcare, and emergency preparedness needs of a defined population" [44]. This emphasis on proactive assessment and evaluation of real-time readiness status is important. The recognition that many possible disasters, including bioterrorism, can fall under this definition of an "emergency" brings up the issue that the responses to each emergency could have extremely varied needs. Education and training in these differences does not appear to be explicitly called out in the required nursing curriculum and the reality is that any specific training in this area, unless received in an elective course, is likely to come from on the job training, possibly even in the midst of an emergency unless the nursing professional is specifically working as a public health nurse.

For accreditation purposes, a course in public health is required for nursing programs. However, nursing students also choose from a number of elective courses either to make their resume appealing for jobs in certain areas or simply because the class fits in their schedule. Therefore, additional study into the topics of public health, surveillance and bioterrorism may be done by some nursing students but is by no means a requirement. The concepts necessary for the duties of a public health nurse would be learned as needed, and most likely on the job. It is worth noting that while some conceivable training needs can be met in the elective courses, not all possible situations could be covered, imagined or even trained for. It is important to recognize the need for teaching critical thinking in public health. There are electives, such as the Essentials of Disaster Management for Health Professions offered at WSU, specifically targeting bioterrorism preparedness, which uses the educational competencies developed by the International Nursing Coalition for Mass Casualty Education as a guide to provide an overview of disaster management, including bioterrorism. Examples of similar elective offerings also include Promoting the Health of Children and Families at Seattle University[46] and Partnerships in Community Health at UW[47].

Given that public health curriculum content in BSN programs is approached from a generalist perspective, there is a recognized need for on-going training when health departments hire any new nurses, physicians, specialists or epidemiologists. The American Association of Colleges of Nursing (AACN) provides guidelines for baccalaureate-level nursing schools to prepare students for disaster response but as generalists, there is an emphasis on mass casualty, ethics, scope of practice and consideration of how roles and responsibilities may change when situations, conditions and settings are unusual. The greater emphasis would be training nurses to use sound clinical judgment for various settings and conditions. So when BSN programs teach a specific set of skills that address public health or community health needs, the deficit in specific bioterrorism training is carried by other public or private entities such as universities or collaborations with health departments and universities. Since 2005, there has been an emphasis in the literature that focuses on core competencies, and curriculum development for health practitioners with little attention to sustainability of training for health professionals and public health nurses. Trainings utilize web-based learning, distance learning and webinar delivery methods which reduce cost, travel time and contribute to accessibility for health practitioners in rural regions and at critical access care hospitals.

4. Conclusions and Lessons Learned

Terrorism, and bioterrorism specifically, has been a priority of the U.S. government, Congress and military since September 11, 2001. The National Guard (both Army and Air National Guard, NG) is a constitutionally unique military organization that is authorized under the Department of Homeland Security's National Response Framework to respond to domestic disasters and bioterrorism events. The Air National Guard EMEDS +25 (emergency medical treatment), or 16 CERFP teams (National Guard Chemical, Biological, Radiological, Nuclear and High Yield Explosive (CBRNE) Enhanced Response Force Package) are selected to cover 10 FEMA regions. Both Army and Air National Guard are trained for identifying CBRNE agents and substances, providing triage and emergency treatment, assessing consequences, advising on response

measures and assisting with state assets[48,49]. Figure 7 presents the FEMA regions.

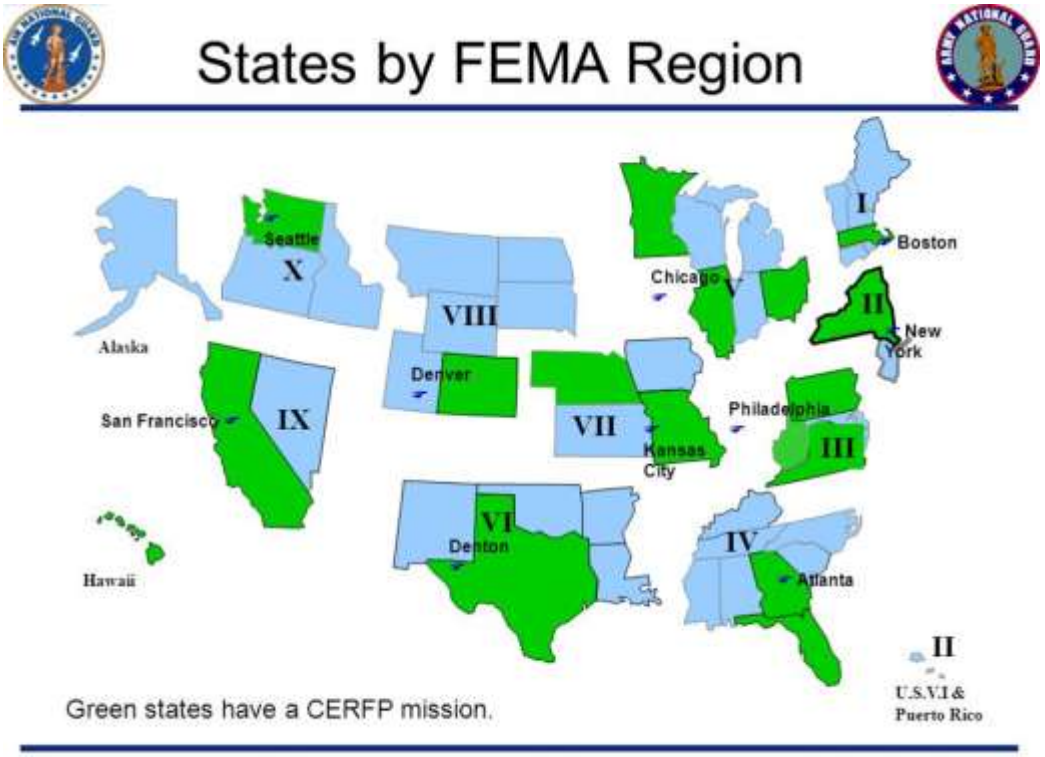

Figure 7. FEMA regions[48]

Washington State is a CERFP state with over 250 trained NG personnel dedicated to bioterrorism and natural disaster response. As citizen soldiers, NG medical personnel, comprised of medics/EMTs, nurses, physicians, public health specialists, pharmacists, dentists, physician assistants, nurse practitioners, and medical service corps leaders also serve in civilian health care settings which adds to their value as community resources. Commanders of these CERFP units organize extensive trainings 1-2 times a year with year-round training in core competencies. Throughout the United States, there are over 5000 Air National Guard medical personnel who have various levels of training in surveillance and bioterrorism recognition, in general, but more specifically to disaster response[48,49]. The NG mission in surveillance, and response to bioterrorism and natural disasters is one example of our multi-tiered system. It is also an opportunity for local and state PH nurses and disaster personnel to train and collaborate with the NG to further enhance our civilian PH nurses community-based readiness. Furthermore, trained NG medical personnel develop community-specific skills in communication, triage, local infrastructure and resource management.

Public Health nurses are trained at the Baccalaureate level with general competencies in community, public and population health. Core competencies for disaster nursing have been identified by several organizations. The International Council of Nurses' (ICN) disaster nursing framework offers three phases of disasters

for nurse competency (pre-event skills and education, disaster phase skills and knowledge, and post-disaster phase skills and competencies[50]. Yet, core competencies are not accepted universally by all entities (i.e., ICN, WHO, AACN).

In addition, public health nurses have a wide scope of practice, from maternal health to health promotion, to health education and immunizations. Often, when a public health nurse position is open, there will be a focus in one sector, for example infectious disease. This diversity is well demonstrated when reviewing public health nurse job descriptions.

As shown in Table 1, the positions from Thurston, Skagit, and Kitsap counties outline general duties, with duties in bioterrorism preparedness varying widely. Thurston County includes investigations in disease or health hazards, and Skagit includes "Participates in local Public Health Emergency Preparedness and Response activities, including disease surveillance, outbreak response, suspicious package/credible threat intakes." Kitsap County clearly outlines bioterrorism duties: "Conducts epidemiological investigations for potential biological, chemical, or radiological terrorism; coordinates the treatment of citizens exposed to bioterrorism agents and disease control and decontamination activities associated with the exposure; communicates to and educating stakeholders, partners, healthcare providers, and the public at large on exponents, degree of risk, and measures for response." It has been suggested that standardizing the job description duties for public health nurses across states could equalize their scope of practice[34-36].

Another important approach to standardizing the scope of public health positions could be through a required/standardized public health training. Some states have created continuing education courses for public health nurses, specific to communicable disease surveillance and outbreak investigations[51]. Self-perceived confidence in public health competencies improved upon completion of a specialized course[51]." Consequently, establishing a state-wide continuing education course for public health nurses, including disease surveillance and emergency preparedness with a unit on bioterrorism, could prepare public health nurses for job duties related to bioterrorism preparedness.

What we learned through the literature scoping review and the online information research leads to the following Lessons Learned:

- Public health nurses remain the pillar in disease surveillance
- The work of public health nurses would need to be more proactively supported by system improvements involving clear job responsibilities and further clarification of formal and informal reporting systems
- State NG bioterrorism and disaster simulated exercises should include interprofessional collaboration with local PH departments and local First Responders/EMS.
- Funding truncation continues to be a barrier in public health and bioterrorism preparedness
- Including public health courses and bioterrorism options as accreditation expectations for nursing programs could directly impact the workforce development in public health
- Our findings suggest that public health departments and jurisdictions should consider working with the national Public Health Accreditation Board to ensure quality training of public health nurses in emergency preparedness and disease surveillance.

In summary, we found that the barriers to bioterrorism surveillance identified some 13 years ago remain pertinent to-date. The findings of this study could inform local, state and federal decision-making authorities in ensuring robust bioterrorism preparedness and improvement in public health nurses workforce supply.

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