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## Public Health Workforce Perceived Impact of Emerging Issues in Public Health

Kristie C. Waterfield

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# PUBLIC HEALTH WORKFORCE PERCEIVED IMPACT OF EMERGING ISSUES IN PUBLIC HEALTH

by

KRISTIE CASON WATERFIELD

(Under the Direction of Gulzar H. Shah)

## ABSTRACT

*Background:* In an era where public health has been viewed as a global, multi-disciplinary field, the public health workforce has remained united to unfailingly holding fast to the mission of protecting, promoting, and improving the health of the public. However, the practice of public health is consistently evolving, and the workforce is continually facing a mirage of challenges. In order to overcome these challenges, practitioners need to be up-to-date on the necessary knowledge and skills to effectively deliver the core public health services.

*Purpose:* The purpose of this research was to explore the perceived impact of emerging trends in public health on the day-to-day work of state and local public health workforces, as well as, if the workforce environment was associated with variations in perceived individual impact. Also, this research examines the extent to which the awareness of the emerging public health trends mediated the relationship between workforce environment and the perceived individual impact levels was examined.

*Methods:* Multinomial logistic regression and mediation was performed to analyze data from the 2017 PH WINS, a cross-sectional survey utilizing a nationally representative sample of the public health workforce.

*Results:* The majority of the state and local public health workforce perceived that their day-to-day work was at least marginally impacted by the emerging public health trends. Workforce environment has significant positive association with the perception of being significantly impacted by the emerging trends during their day-to-day work; cross-jurisdictional sharing (AOR=1.020, p=0.002), QI (AOR=1.035, p=<0.001), public health and primary care integration (AOR=1.025, p=<0.001), EBPH (AOR=1.036, p=<0.001), HiAP (AOR=1.027, p=<0.001), and multi-sectoral collaboration (AOR=1.022, p=<0.001). The mediation analysis found that the knowledge of the emerging trends partially mediated (63%) the relationship between the workforce environment and overall impact of the emerging trends.

*Conclusion:* This study was consistent with prior studies that reported that organizational climate and culture have an effect upon the workplace environment, as well as, work engagement and meaningfulness. As practitioners shift into the role of chief health strategists, it may become necessary for all of them to have formal training in public health foundations and tools to efficiently deliver the essential public health services to their communities.

INDEX WORDS: Public health workforce, Emerging issues, PH WINS, Organizational Development, Workplace Environment

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EMERGING ISSUES IN PUBLIC HEALTH

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Fulfillment of the Requirements for the Degree

DOCTOR OF PUBLIC HEALTH

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## DEDICATION

I dedicate my dissertation to my children, Olivia and Maddux, which I love to the moon and back and all the stars. You are the inspiration that started me on this journey and the motivation that pushed to me to complete it. To Olivia and Max, thank you for making me want to be the best mom I can be.

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## CHAPTER I – INTRODUCTION

Public health is different things to different people. The image that public health evokes is as varied as the population that it serves. To some, public health embodies a broad social system. To others, the image is of the professional workforce whose responsibility it is to solve important health problems within the community. Another image still is that of the body of knowledge, research, interventions, and techniques that can be applied to health-related issues and problems.<sup>1</sup> However, for the majority of the general public, public health primarily involves services and activities that are provisions of medical care to indigent populations that are provided by governmental public health agencies. Thus, public health remains misunderstood by not only the general public but also the dedicated practitioners that provide its essential services.

While public health literally means the health of the public and is measured in terms of health outcomes and incidence of illness and disease<sup>1</sup>, there are many definitions of what public health is, yet no single answer will satisfy everyone. The practice of public health is also consistently evolving. The public health workforce is constantly facing a mirage of challenges and dealing with continual change, e.g. unexpected natural disasters, new approaches to health care, environmental emergencies, and an aging population. These obstacles will continue to cause strain and challenge the knowledge and skills of public health workers. Because of these obstacles and challenges, the public health workforce needs to be up-to-date on the necessary knowledge and skills to effectively deliver the essential core public health services.<sup>2,3</sup> They need to be able to answer the questions “Why does it matter?” and “Why now?” So why does it matter and why must it happen now? It matters and it must be now because as a key component of a community’s infrastructure and economic growth, public health must surpass the current trend of “diagnosis of the month” and continually ensure that the essential services are available to those who needed

them, when they are needed.<sup>3-5</sup> Unfortunately despite over a century of public health advances in reducing and eliminating injuries and diseases, while increasing life expectancy, the public health system in the United States still faces many challenges. These challenges include an aging population, the growing burden of chronic disease, deteriorating of life expectancy rates, and mediocre performance measures in terms of health quality, access to health care, efficiency of health services, and health equity.<sup>6-8</sup>

Public health workforce is the heart of the public health infrastructure. Their efforts to ensure the quality and accessibility to health services while focusing on the population's health needs, are what makes public health successful.<sup>3</sup> Their efforts in working to improve public health practice need to be fully understood and appreciated.<sup>9</sup> While their work transcends their individual skills, the current workforce may not still be fully prepared for the required work today and in the future.<sup>3,10</sup> Public health multidisciplinary in nature, with many professions and job categories.<sup>9,11</sup> The public health workforce takes pride in deriving from many different academic, experiential, and professional backgrounds, because ultimately they all share the common bonds of upholding the same ethical principles and being committed to the same common mission.<sup>9,12</sup> Recent studies of both national and state surveys have shown that the majority of the public health workforce lacks formal public health education and training. In 1980, only approximately twenty percent of the workforce had any formal public health training and even then the amount of formal training varied by job category. The lack of formal training, even among the most critical job categories, is astonishing.<sup>9,13,14</sup>

While the majority of formal training provided to many of the public health workers focuses solely on their specific aspect of public health practice, such as environmental health, nursing, administration, health education, or epidemiology,<sup>9</sup> the lack of formal training in other

aspects of public health practice, however, does not necessarily lead to the conclusion that public health workers are unprepared to provide the essential core public health services.<sup>9,15</sup> As public health has refocused and has placed more emphasis on population-based health, there also needs to be a refocus on the formal training needs of the entire workforce to include the five core public health skills: Biostatistics, Environmental Health Science, Epidemiology, Health Administration, and Social and Behavioral Health.<sup>4</sup> The Institute of Medicine (IOM) and the Charleston Charter both identified additional skills that are extraordinarily important to public health workers in order for them to effectively deliver the essential core public health services. These skills include informatics, communication, strategic planning and thinking, communication, cultural competency, ethics genomics, quality assurance, policy development and advocacy, health law, community-based research, coalition building and mobilization, team building, and organizational effectiveness.<sup>3,4</sup>

The reality is that there are many forces that affect not only the size of the public health workforce but also the limited the support for continuing education and professional development. Financial restraints, expansion of information technology, increase of public health worker productivity, and recent developments known as emerging trends in public health, impact not only the proportion of professionals needed and the type training that is required; they also shape the direction of public health practice and the effectiveness in which the workforce provides the essential core public health services.<sup>1,5,16-18</sup> The history of public health can be characterized by the trends that were prevalent to the practice of public health. Before 1850, public health practice was responsible for responding to infectious disease and battling recurring epidemics; while after 1950, public health practice had shifted to becoming the safety net for medical care and the focus became increasing the range of public health provisions.<sup>1</sup> Today, we are again beginning to

experience a shift that has been set forth by Public Health 3.0, the public health workforce are being called upon to become the chief health strategist within their communities.<sup>5</sup> Thus it is imperative that public health workers at both state and local levels are not only aware of the current emerging public health issues, such as cross-jurisdictional sharing, creating a culture of quality improvement, Health in All Policies and evidence-based public health, as identified in 2015 by Erwin and Brownson,<sup>19</sup> but that they understand and apply these issues to their everyday practice.

#### Purpose Statement

The aim of this research was to examine the perceived impact of emerging issues in public health on the day-to-day work of state and local public health agency workforces, as well as, if the workforce environment was associated with variations in perceived individual impact. The extent to which the knowledge of the emerging public health issues mediates the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce was also explored. The local and state public health agency workforces were the focus of the study due to availability of the data currently provided by the Association of State and Territorial Health Officials (ASTHO) and de Beaumont Foundation.



## Research Questions

This research pursued the following research questions and hypotheses (Appendix A):

1. What is the perceived impact of the six emerging public health issues on the day-to-day work of state and local public health workforce?
2. Is workforce environment associated with variations in perceived individual impact levels on the day-to-day work of state and local public health workforce?
3. To what extent does the knowledge of the emerging public health issues mediate the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce?

## Significance of Study

Local health departments (LHDs) operating in a post-Affordable Care Act, post-Public Health Accreditation Board accreditation era are experiencing a lack of substantial investment in the public health workforce.<sup>18,20</sup> As the public health system continues to struggle to deal with today's problems, the public health workforce seems much less prepared for tomorrow,<sup>20</sup> Examining the variations in the individual perceived impact levels of the emerging issues in public health with the individual and organizational factors that may be associated with these variations will fill important gaps in the existing research literature. This study will provide a better understanding of the investment that needs to be made in regard to workforce development, especially in terms of training and efficiency of daily workflow, and changes to the overall workforce environment, including rewarding innovation and increased levels of workers reporting that they feel that their work is related to the overall goals of the agency.<sup>16</sup>

A main priority of the workforce development model is to develop a workforce that has the right knowledge and skills necessary to meet the needs of the communities they serve.<sup>21</sup> A

crucial priority that has been highlighted by the Department of Health and Human Services is ensuring that public health workforce has adequate and appropriate training.<sup>5,12</sup> Both current and future public health workers need consistent training in order to provide continual improvement in the nation's health. The public health worker must have the knowledge and skills in order to not only do their job well but also influence others toward achieving the goals required to increase the overall health of the population.<sup>5</sup> A key goal for public health agencies should be increasing the overall performance of the agency. In order to achieve this, agency leadership needs to focus on the elements of productivity, effectiveness, efficiency, and equity.<sup>22-29</sup> Studies have consistently linked an increase in a public health agency's overall performance with administrative practices and features, including workforce development, leadership, financial processes, relationships and partnerships within the organization, and the organizational culture.<sup>23-27,29</sup>

Knowledge regarding the emerging issues in public health and the ability to incorporate them in the day-to-day activities of public health practice will be helpful to public health leadership. Especially in terms of increasing efficiency of their workforce through improved administrative practices and features, as well as, improved proficiency in delivering the essential public health services to their communities.<sup>22-29</sup>

#### Delimitations

This research is a cross-sectional study that used quantitative data from the 2017 Public Health Workforce Interests and Needs Survey (PH WINS). The study population for PH WINS is a national representative sample of public health agency workers, that utilized multiple, distinct sample frames that included participants from state health agency (SHA) central offices, members of the Big Cities Health Coalition (BCHC), and LHDs.<sup>30,31</sup>

## Definition of Terms

The following terms are used throughout this research:

*Big Cities Health Coalition (BCHC)* – a forum for the health departments in the largest metropolitan areas of the United States to exchange ideas and strategic plans in order to promote and protect the health of the people they serve. Coalition membership criteria requires that the health departments be locally governed and located within the top thirty most urban areas with a population greater than 400,000 (or if outside the top thirty, population must be greater than 800,000).<sup>32</sup>

*Cross- jurisdictional sharing* - resource sharing among public health agencies that may take place within a state (between two or more local health agencies) or across state boundaries (such as between state health agencies) to improve services and capabilities.<sup>33</sup>

*Evidence-Based Public Health Practice (EBPH)* – basis decision-making on the key components of the best available scientific evidence, systematically using informatics, application of program-planning frameworks, community engagement in decision making, ensure sound evaluation, and ultimately disseminating what is learned.<sup>34</sup>

*Health in All Policies (HiAP)* – A collaborative approach to policy making and programming that integrates community health considerations across all sectors, at all levels, in order to improve the health of entire population.<sup>35</sup>

*Local Health Departments (LHDs)* – Administrative agency of either local or state government that is concerned with and responsible for the public health of a population in a jurisdiction that is smaller than a state.<sup>35</sup>

*Multi-Sectoral Collaboration* - an effective strategy to achieve societal learning and change through collaboration between various stakeholder groups (e.g., government, civil society, and private sector) and sectors (e.g., health, environment, economy).<sup>36</sup>

*Public Health Infrastructure* – consists of the resources and relationships necessary to carry out the core functions and essential services. The resources include human, organizational, informational, and financial.<sup>9,35</sup>

*Public Health System Performance* – set of activities that are coordinated to ensure that the goals and objectives of the public health agency are being consistently met in an efficient and effective manner.<sup>35</sup>

*Public Health Workforce* – the population of employed individuals that work in governmental public health agencies, academia, hospitals, foundations, and nonprofit organizations that represents the multiple disciplines such as epidemiology, environmental health, health education, prevention medicine, administration, health law, nursing, and information technology.<sup>12,35,37</sup>

*Quality Improvement* – Methods used to formally integrate processes that link knowledge, structures, processes, and outcomes to enhance quality throughout an organization improve the delivery of service.<sup>35,38</sup>

*State Health Agencies (SHAs)* – State governmental agency that is primarily responsible for public health of entire state's population.<sup>35,39</sup>

## CHAPTER II – LITERATURE REVIEW

As the state of the healthcare system in general continues to change during the twenty-first century, the public health workforce must adapt.<sup>40</sup> Unfortunately, public health practitioners are having to adapt to these changes while also dealing with urgent health threats (such as global health security and the opioid crisis) and decreases in public health funding. Community trust in the public health system and its workforce is important now and will be increasing so in the future.<sup>41,42</sup> It is imperative that public health practitioners be made aware of the emerging public health issues and the impacts these issues will make on public health practice. The focus of public health practice needs to be on the “Forces of Change” that will either support, reinforce, impede, or negate any actions being taken in the practice setting by public health practitioners on key emerging issues.<sup>19</sup> Erwin and Brownson have identified the major forces of change as: Patient Protection and Affordable Care Act (ACA), Public Health Accreditation Board (PHAB) Accreditation, Climate Change, Health in All Policies (HiAP), Social Media and Informatics, Global Travel, and Transitions in Demographics.<sup>19,43</sup> While some of these forces have been present in the public health landscape for several years, others are relatively new, however, they all affect the context of the environment in which the public health system operate and position the focus of the emerging issues.<sup>19</sup>

This research examined the perceived impact of emerging issues in public health on the day-to-day work of state and local public health agency workforces, as well as, if the workforce environment was associated with variations in perceived impact on an individual level. This research also explored the extent to which the knowledge of the emerging public health issues mediated the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce. The intention of the study

is to answer the following research questions: 1. What is the perceived impact of the six emerging public health issues on the day-to-day work of state and local public health workforce? 2. Is workforce environment associated with variations in perceived individual impact levels on the day-to-day work of state and local public health workforce? 3. To what extent does the knowledge of the emerging public health issues mediate the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce?

The themes for the literature review search included public health workforce, public health infrastructure, emerging issues in public health, public health systems performance, and the organizational behavior and development theories. While the aim of this research was to accurately measure the perceived impact level these issues have on the on the day-to-day work of state and local public health workforce, it also sought to expand the current knowledge base for public health workforce and practice research and assist with policy, practice, and workforce development recommendations, with variations based on demographics and workforce environment.

### Public Health Workforce

The health of the population is reliant on the resources dedicated to public health agencies and the workforce that provides the essential services to their communities.<sup>5,12</sup> The public health workforce represent multiple disciplines such as epidemiology, environmental health, health education, preventative medicine, nursing, information technology, law, and business management, and work in a multitude of organizations that range from governmental public health agencies, academia, hospitals, public and private foundations, non-profit organizations, and even insurers.<sup>12,37</sup> The public health workforce is comprised of professionals from various backgrounds,

majority of whom have no formal public health training and limited training in management, leadership, and other essential organizational skills.<sup>5,12,31,37,44</sup> Many public health workers have a primary professional discipline and their own set of core competencies, in addition to their attachment to public health, such as physicians, nurses, dentists, social workers, nutritionists, health educators, anthropologists, psychologists, architects, sanitarians, engineers, epidemiologist, biostatisticians, economists, lawyers, political scientist, and dozens of other professions. This multidisciplinary workforce, with somewhat divided loyalties to multiple professions, blurs the distinctiveness of public health as a unified profession.<sup>1,9,12,44</sup>

Thus, the definition of a public health worker is unclear. In addition to the variety of disciplines that make up the workforce, public health workers that are employed outside of governmental public health agencies are difficult to identify, and not all employees of governmental public health agencies have public health responsibilities associated with their job descriptions.<sup>1,9,12,45</sup> When examining the entire health sector, the public health workforce is only a small subset of the 14 million employed persons. Public health workers comprise between 400,000 and 650,000 of those employed persons.<sup>1,9,12,37,46</sup> However for decades, the assessment of the public health workforce size and composition within the United States, on a regular basis, has been a challenge for public health officials and researchers.<sup>7,47-52</sup> This challenge exists due to the diverse employment settings, the multidisciplinary nature of public health, lack of standardized worker classifications, and a lack of a national standardized workforce monitoring system.<sup>30,49,53</sup> Unfortunately this jeopardizes public health leadership's ability to comprehend workforce capacity, predict trends, and develop policies that will be beneficial in the future.<sup>54</sup>

The estimates of the current public health workforce based on practice settings are approximately fifty-one percent are at the local level, thirty percent are at the state level, and

nineteen percent are at the federal level.<sup>54</sup> This is a consistent trend over the last few decades and it is not surprising given the necessity that the majority of public health services must be provided at the local level.<sup>55</sup> The top three occupational classifications are administrative/clerical, public health nurse, and environmental health worker.<sup>9,54,56</sup> Conversely, approximately thirty percent of all governmental public health workers are listed in the “other/uncategorized” professional category, which is an alarming number.<sup>54</sup> Despite having more than 400,000 public health workers in the United States,<sup>1,4,12</sup> the ratio of public health worker to number of persons served has decreased over the years in both governmental and voluntary public health agencies. Between 1980 and 2000, there has been a sizable decline in the ratio of public health workers to population served; from 220 workers per 100,000 population served in 1980 to 158 workers per 100,000 population served in 2000.<sup>54,55,57</sup> In 2013, the ratio was approximately 15 public health nurses to 100,000 population served, which is well below the recommended ratio of 20 public health nurses per 100,000 population served made by the Association for State and Territorial Directors of Nursing (now the Association of Public Health Nurses) in 2008.<sup>8,12,58,59</sup> This, in turn, implies that the public health workforce is overall inadequately staffed when compared to the overall population within the United States. The decrease in the ratio of public health workers to the number of persons served has caused an erosion of functional capacity at all levels within the public health system. The decline in workforce numbers is partly due to decreases in funding and provisions for direct service delivery,<sup>60</sup> high turnover rates, high vacancy percentages (between 2008 & 2009, approximately 23,000 workers were lost in LHDs), noncompetitive wages, and high number of workers that will soon be eligible for retirement.<sup>12,41,56,60-62</sup> By 2020, approximately 25 percent of public health workers will be eligible for retirement.<sup>60</sup> Other issues that affect overall workforce numbers are lack of standard competencies, weak career-path development, lack of both



formal graduate training and professional certification, and College of Public Health graduates are finding employment within non-public health agencies.<sup>8,63-65</sup>

So the question that beckons attention is “What does the future look like for the public health workforce?” New York Yankees legend, Yogi Berra, provided advice regarding the future that can be useful when discussing the future of public health practice. He stated “It’s tough to make predications, especially about the future,” “The future ain’t what it used to be,” and “If you don’t know where you are going, you’ll end up someplace else.”<sup>43,66</sup> Teutsch and Fielding, in their article “Rediscovering the Core of Public Health,” state that public health practice needs to make a return back to creating conditions that fulfill the fundamental mission of allowing people to live health lives.<sup>67</sup> When the public health workforce is not appropriately prepared to address the forces of change and deal with the key emerging issues, they run the risk of being incorporated into the healthcare system and the essential role of being the bearer of social justice will be lost.<sup>43</sup> Public health has always fundamentally focused on the shared values of life, health and security within a community. As the public health system has begun to re-emphasis on health inequalities and social determinants of health, the language used to needs to be a language that reflects the human good and describes the moral economy of the community.<sup>68</sup>

Future public health workers need to be successfully prepared to respond to the forces of change. According to Erwin and Brownson<sup>69</sup>, in order to be prepared, they will need the following critical capacities and capabilities: “systems thinking and systems methods, communication capacities, transformational ethics, entrepreneurial orientation, and policy analysis and response.” The public health worker of the future will need to acquire new skills, knowledge, abilities, and ways of conceptualizing to successfully gain the critical capacities and capabilities needed to attend to the effects of the forces of change.<sup>69</sup>

The Institute of Medicine (IOM)<sup>45,70</sup> has recommended that well-educated public health workers allow themselves to be more invested in the communities that they serve. Partnerships between academic programs of public health and public health workers will be beneficial to both the public health students and the public health organizations. These partnerships will provide the essential education for the current and future public health workforce.<sup>45,70-72</sup> With the aim of preparing for these partnerships and the future needs of the public health workforce, academic public health curriculum is also having to transform. The academic community is experiencing rapid growth in undergraduate public health programs, re-envisioned MPH programs, and a refining of doctoral-level programs, specifically the DrPH programs.<sup>69,73</sup> Unfortunately, it is difficult to explain to key decision makers that continuing education is necessary in order to keep public health workers up-to-date on skills and the latest practice information, because the return on investment is low and at times seem non-existent.<sup>3,74</sup> For current and future public health workers, the need for innovative approaches to workforce development, training, and capacity building is great. Important drivers of these innovative approaches will continue to be the accreditation standards put forth by PHAB and the Council on Education for Public Health (CEPH).<sup>69</sup> Public health workers of the future will also need to embrace their new role as “chief community health strategist” and a commitment to life-long learning.<sup>69,75</sup> As the core of the public health infrastructure, it has always been imperative for the infrastructure to be strong in order for the workforce to ensure they are providing the services needed most by their community.

#### Public Health Infrastructure

The public health infrastructure has been an essential part of the community infrastructure and has provided the interconnected set of elements, such as government, education, workforce and communication, needed to support the protection and promotion of the community's health.<sup>76</sup>

While there have been advances in establishing collaborative partnerships and strong leadership at all levels (local, states, and federal), the essential public health services, which include monitoring health status to identify and solve community health problems; diagnosing and investigating health problems and health hazards in the community; informing, educating, and empowering people about health issues; and mobilizing community partnerships and action to identify and solve health problems, continue to be the framework used across most public health initiatives in all public health organizations.<sup>52</sup> The current public health workforce has to not only protect its communities but now also has to provide an evidence-based linkage between clinical services and other activities, offer interventions that can be scaled to the targeted population, and provide support for clinical services that will impact the population at large.<sup>52</sup> The current lack of sufficient investment in the public health workforce, population-focused prevention, health protection, and health promotion, is causing many of the issues within the public health system and what is allowing for the public health workforce to be much less prepared for what tomorrow brings. However, by providing the proper investment in a strong public health infrastructure is a sound investment into the future of the public health system.<sup>20</sup>

The public health infrastructure is essential for carrying out the core functions and the essential services within the public health system.<sup>9</sup> The public health workforce is the most crucial part of the infrastructure because without their efforts in ensuring accessibility to quality services, the public health system would fail.<sup>3</sup> Infrastructure is viewed in both static and dynamic terms. Statically, the infrastructure is the building blocks within the foundation of the public health system. Dynamically, the infrastructure is capability of the building blocks to support the main functions to be cared out by the public health system. The public health infrastructure consists of

resources (organizational, financial, informational, and human) that are necessary to provide the core functions and essential services to the populations they served.<sup>9</sup>

The organizational resources vary based on level of government, type of organization, and populations that they serve. The organizational resources are a complex web of federal public health agencies, state departments of public health, local health departments, private-sector organizations, and voluntary organizations. The greatest difference is between all of these organizations are how their bottom line is measured, public-sector organizations are measured by health outcomes; while private-sector organizations are measured by profits and customer satisfaction. The financial resources are defined in terms of inputs and outputs. The inputs include the economic measures associated with the organizational, informational, and human resources, but also includes the items such as equipment and facilities. The outputs represent the worthiness of the public health activities performed by the public agencies in comparison to their public health policy goal and objectives.<sup>9</sup>

The informational resources are the elements of the public health infrastructure that not only support public health practice activities but also include the network of data and information needed to conduct surveillance, interventions, health prevention, and health promotion. The speed at which the public health practitioners can access and communicate information significantly impacts how well the public health agency can achieve its mission. The human resources within the public health infrastructure includes the knowledge, skills, and abilities of the public health workforce.<sup>9</sup> When the public health infrastructure is strong, the core functions and essential services are carried out by the public health system with uniformed efficiency. However, when the infrastructure is weak, the public health system is vulnerable and at times may be unable to withstand existing and potential threats.<sup>76,77</sup>

Ensuring that the public health infrastructure is strong should be a goal of the all medical and healthcare communities. Public health is the core component in protecting the American people and should remain a focused priority for the next 10 years, at least.<sup>2,4</sup> The public health infrastructure represents only a small portion of the national economy and the amount spent on health-related expenditures (approximately five percent); however, the contribution to improved health outcomes and the overall health of the population is priceless.<sup>9</sup>

### Emerging Issues in Public Health

The history of public health has been defined by broad trends and emerging issues. As the trends and issues changed over time, the public health workforce and infrastructure have had to adapt by learning new skills and acquiring the necessary knowledge to effectively protect and promote the health of the communities they were serving. Before the 1850s, public health workers were responsible for responding to infectious diseases and battling recurring epidemics. During the next one hundred years (1850-1950), public health began using science-based control measures and building state and local public health infrastructure. After 1950, public health once again shifted its focus toward filling the gaps in medical care and increasing the range of public provision for health services. This continued until 2000, when the trends in public health again shifted the focus towards preparing for and responding to community health threats and providing population health services.<sup>1</sup> In 2016, another shift began with the advancement of Public Health 3.0 and the movement to have the public health workforce become the chief health strategists within their communities.<sup>75</sup>

Beyond workforce size, composition, and distribution are the emerging issues in public health that are related to the core competencies and skills that will be the most important to the future of public health practice.<sup>9</sup> The current emerging issues that are affecting the public health

workforce, as identified by Erwin and Brownson<sup>19,43</sup> and adopted by the Association of State and Territorial Health Officials (ASTHO) and de Beaumont Foundation for the Public Health Workforce Interests and Needs Survey,<sup>30,78,79</sup> are: Cross-jurisdictional sharing of public health services, Fostering a culture of quality improvement (QI), Public health and primary care integration, Evidence-based Public Health Practice (EBPH), Health in All Policies (HiAP), and Multi-sectoral collaboration.

#### *Cross-jurisdictional sharing of public health services*

Cross-jurisdictional sharing is a resource-sharing strategy that provide a foundation for public health services to be transfer or shared for a certain period of time and has the ability to exist across all program areas and governmental structures within the public health system.<sup>33,80-82</sup> Cross-jurisdictional sharing is a strategy that ensures that public health agencies have the capacity to deliver a range of services and the capabilities to protect and improve the overall health of the communities they serve.<sup>80,83</sup> Cross-jurisdictional sharing is an important emerging issue for public health practice. The momentum of cross-jurisdictional sharing being used as an efficient alternative model for service delivery and a tool for cost control has been increasing due to the bleak economic outlook for state and local public health budgets coupled with the attention on performance improvement, cost saving,<sup>80,84-87</sup> and public health agencies in small jurisdictions being unlikely to sustain the delivery of all or most of the Ten Essential Public Health Services without some form of resource sharing.<sup>26,88-91</sup> Varying infrastructural capacities compounded with a shrinking workforce and decreasing budgets, decreases the ability of the public health system to efficiently fulfill the core functions, meet community needs, and pool necessary resources to build economies of scale.<sup>92-95</sup> Cross-jurisdictional sharing will be useful for strengthening the public

health infrastructure. Since PHAB decided to allow accreditation to “multijurisdictional entities”, the role of jurisdictional sharing has become more critical than ever before.<sup>90,96</sup>

Cross-jurisdictional sharing is intended to increase access to necessary resources while also increasing service quality and resource use efficiency. It enhances the use of certain quality measures, creates depth in core public health service staff, and the ability to provide a greater breadth of services with fewer staff.<sup>83,88,90,97,98</sup> In 2012, Vest and Shah found that public health agencies are more likely to share services in programmatic areas than operational areas.<sup>99</sup> The most common programmatic areas that engage in collaborative sharing are emergency preparedness, environmental health, and epidemiology and surveillance.<sup>33</sup>

There are several strengths, benefits, weaknesses, and challenges to cross-jurisdictional sharing. The strengths and benefits of collaborative sharing includes an increase in the capacity to hire well trained staff from diverse backgrounds, ability to offer a larger variety of community health and preventative programs, increase in the number of opportunities for diversified funding, a consistency in meeting regulatory practices and code enforcement<sup>88</sup> and an optimal strategic decision within today’s complex and dynamic landscape of public health.<sup>100</sup> It also allows for an increased level of effectiveness for emergency preparedness services, in terms of mitigation, response and recovery,<sup>101,102</sup> especially for tribal governments and public health agencies serving American Indian and Alaskan Native populations.<sup>103,104</sup> Also due to funding restrictions, specific program funding does not allow for monies to be reallocated for other programs within a LHD but creates the opportunity to share the program’s resources with other LHDs.<sup>6,105</sup> The weaknesses and challenges of collaborative sharing includes balancing responsiveness to local needs due to the geographical spread between municipalities, the feeling of being an “outsider” when it comes to local policies and decisions, differing political views, conflicting values that cause a lesser

ability to work quickly on complex issue,<sup>88</sup> competition among resource partners can be destructive if not managed properly<sup>90</sup>, and legal constraints when sharing resources across state lines or when sharing patient information.<sup>106</sup>

Shah et al found that a majority of LHDs were engaged in cross-jurisdictional sharing of resources such as funding, equipment, and/or staffing with at least one other LHD through both formal and informal agreements.<sup>33</sup> Cross-jurisdictional sharing is managed and governed in several ways that range from informal to formal arrangements and includes customary arrangements, service-specific arrangements, shared functions with joint oversight and regionalization.<sup>106,107</sup> Cross-jurisdictional sharing arrangements are legal documents and the authority to enter a more than likely resides with policy makers and not with public health officials, which means that the policy makers must be able to understand the value of the cross-jurisdictional sharing arrangement.<sup>83,108</sup> The majority of LHDs using formal written cross-jurisdictional agreements were those located in metropolitan jurisdictions.<sup>33</sup> Unfortunately, many of the cross-jurisdictional agreements are considered to be incomplete based on legal perspective based on the fact that some do not address consequences of nonpayment, financial commitment upon termination, or provisions related to payment changes or financial audits.<sup>109</sup>

Collaborative sharing is a common thread that binds many of the other emerging public health issues and influences such as PHAB voluntary accreditation,<sup>110,111</sup> focus on quality improvement,<sup>112-114</sup> evidence-based public health,<sup>34,115</sup> Health in All Policies,<sup>116,117</sup> and usage of informatics.<sup>118,119</sup> There are several interrelated approaches to cross-jurisdictional sharing and those include regionalization, standardization, centralization, coordination, and networking.<sup>82</sup> Cross-jurisdictional sharing has been successfully implemented in Georgia,<sup>90</sup> Connecticut, Massachusetts,<sup>88</sup> Colorado<sup>83</sup> and the tribal communities in Wisconsin<sup>80</sup> and California.<sup>120</sup> Overall



there has been an increase nationally in the implementation of cross-jurisdictional sharing as a resource-sharing strategy.<sup>6,81,82</sup>

### *Fostering a culture of quality improvement (QI)*

Quality improvement (QI) has been introduced into the US public health system as a way to strengthen the public health infrastructure by improving the local public health systems.<sup>121</sup> QI approaches have been incorporated into the performance measurement at the agency level for the Ten Essential Services,<sup>122,123</sup> as well as, part of the PHAB accreditation process.<sup>124</sup> While there is not a formal definition of QI within the public health sector, the most commonly used one was developed by Riley et al.

It [QI] refers to a continuous and ongoing effort to achieve measurable improvements in the efficiency, effectiveness, performance, accountability, outcomes, and other indicators of quality in services or processes which achieve equity and improve the health of the community.<sup>125</sup>

While the implementation of QI has been institutionalized for many years in other sectors, such as manufacturing, law enforcement, transportation, and clinical healthcare,<sup>126-128</sup> it is still relatively new to the public health sector and the diffusion of its principles are not widely known, but the momentum toward embracing QI is very positive<sup>112,129-133</sup> and many LHDs are embarking upon implementation of QI initiatives that expand the utilization of the performance standardization tools.<sup>114</sup> Beitsch et al. found that approximately seventy percent of all LHDs were involved in QI activities before 2010, the majority of those LHDs that reported using formal QI efforts also reported not using a QI framework to guide those efforts. While most are not using one of the basic tools for QI (process map or plan-do-study-act cycle), they are engaging in QI

trainings and activities that are contributing to an increase in the quality of the services being provided to their communities.<sup>114</sup>

The benefits of QI implementation and creating a culture of quality include improvements in overall efficiency and effectiveness for the public health agency and its workforce,<sup>134,135</sup> such as the ability for the agency to build and develop workforce capacity<sup>136,137</sup> and increase efficiencies in relation to cost savings<sup>138</sup> and streamlining processes.<sup>125</sup> Other benefits of QI implementation throughout the entire organization include increase satisfaction of patients, clients, and workforce, improved data quality,<sup>139</sup> increased usage of the programs and services provided,<sup>125</sup> and a supportive environment, both internally and externally, of QI programs activities and projects.<sup>140-</sup>

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Adopting and implementing quality improvement does come with a set of challenges that every agency has to overcome. The challenges for QI implementation and adoption can be structural, functional, or both. The structural challenges may include an economies of scales that are inadequate to support the delivery of the essential services,<sup>144</sup> lack of relevance and time, insufficient training,<sup>127,128,142,145,146</sup> insufficient funding resources,<sup>127,128,142,145-147</sup> lack of support from other sectors to secure the local infrastructure, and the inability to maintain resources to would allow the QI activities to be sustainable.<sup>147</sup> The functional challenges may include lack of leadership commitment, inappropriate measure for the project, traditional hierarchical decision making process, emphasis on following “the rules” instead of the health outcomes, siloed work responsibilities for programs and public health professionals, and the one-and-done problem solving technique instead of continuous improvement approach.<sup>90,143</sup> Studies have also shown that public health agencies serve smaller populations view QI projects and activities as “add-ons” to

their current activities if the resources are available, while larger populations are more likely to commit to full implementation of QI activities and projects.

In order for public health agencies to overcome these challenges, the agencies need to create an organizational culture that reflects ongoing and pervasive application of QI practices throughout all programs and departments. One QI project or sporadic projects does not create a culture and changing the culture throughout the organization will not only benefit the agency and its public health workforce, it will also impact the community the agency serves.<sup>148,149</sup> Creating a culture of quality will require the agency to gain support from senior leadership and the leadership will need to not only support QI principles but to play the role of QI champion. The agency will also need to seek the support of the administration with the county government and local healthcare community.<sup>141</sup>

The Collaborative Improvement and Innovation Network (CoIIN) used QI and collaborative learning to reduce infant mortality in thirteen southern states. The researchers wanted to bolster already existing policies, increase efforts on both clinical and system-levels while developing innovative approaches to improve birth outcomes on five shared priority areas. What the researchers found after twenty-four months was that the transition from development to implementation was the most challenging issue, the model needed to be clear and engaging so that everyone understood what was expected of them, training and support are critical aspects in order to achieve success, the CoIIN QI model and principles cannot be a one-size fits all approach, and the early formation of a data measurement strategy is an essential component to the success of the CoIIN QI model and approach.<sup>150</sup>

There are important drivers for the implementation of QI methods, practices, and the overall creating a culture within the public health agencies. One very important driver that places

a lot of pressure on public health agencies to do more with less is governmental fiscal austerity.<sup>151</sup> Due to tight budgets and a reduction in resources, public health agencies are having to rely on methods such as Lean Thinking, in order to increase efficiency and reduce waste.<sup>151,152</sup> Another important driver is the PHAB voluntary accreditation process.<sup>141,153</sup> Beitsch and colleagues have made a case for accreditation as a driver for the adoption of QI practices among LHDs. They found that accredited LHDs have a higher level of overall QI implementation, higher levels of formal QI processes in programmatic areas, conduct 4 or more QI projects simultaneously, and report substantial growth in data and informatics usage, than non-accredited LHDs.<sup>154</sup> Several national level initiatives that promote the use of QI, such as National Public Health Performance Standards, Turning Point Performance Management Collaborative, Robert Wood Johnson Foundation funded Multi-State Learning Collaborative and Communities of Practice for Public Health Improvement, and the CDC's National Public Health Improvement Initiative, have also been drivers to the implementation of QI.<sup>138,155-158</sup> In 2010, during the Public Health Forum, the Institute of Healthcare Improvement stated in order to achieve the national health outcome goals, public health QI needed to be driven by the following six priority areas: Population Health Metrics and Information Technology, Evidence-Based Practices, Research, and Evaluation, Systems Thinking, Sustainability and Stewardship, Policy, and Workforce and Education.<sup>12</sup>

#### *Public health and primary care integration*

Due to the passing of the Affordable Care Act (ACA) in 2010 and the increase of individuals with health insurance coverage, more and more LHDs are having to make the decision of whether they will continue to provide clinical services such as maternal and child health, oral health, and HIV/AIDS treatment.<sup>159</sup> The IOM released a report in 2012 that stated:

As clinical care provision in a community no longer requires financing by public health departments, public health departments should work with other public and private providers to develop adequate alternative capacity in a community's clinical care delivery.<sup>7</sup>

LHDs are having to make the decision to continue providing clinical services based on the local context and if the need is there within their jurisdiction.<sup>160</sup> However, a hallmark of the ACA is the promotion and increased access to clinical preventative services.<sup>161</sup> The ultimate goal of public health is to protect, promote, and maintain the health of the population, while reducing the burden of disease, death, and disability and can be achieved by providing life-saving, evidence-based care via clinical preventative services.<sup>161-163</sup> Currently, public health clinical service provision falls into one of two categories: 1) no longer needed due to the expansion of Medicaid coverage and those patients that were seeking care at public health agencies are now seeking care with private providers, or 2) still needed as substitutes for the private providers due to supply and demand issues.<sup>164</sup> Integration between the two is being made a prominent issue on the national agenda due to the influence of funding agencies, such as the CDC and the Health Resources and Services Administration (HRSA),<sup>165</sup> the new era of enhanced public health practice being ushered in by Public Health 3.0,<sup>166</sup> and the fact that despite the passage of the ACA, there are still many individuals that do not have insurance coverage or live in an area dearth of primary care providers, which leads these individuals to seek care at alternatives, such as LHDs. <sup>167-170</sup>

Historically, public health and primary care have existed and operated independently of each other despite the shared common goals of addressing the issues of disease prevention and promoting the health and well-being of all people.<sup>165,171,172</sup> The main difference between public health and primary care is their focus. Public health focuses on population health by offering

services that are for the collective good of the entire populations. Primary care focuses on the health of individuals by providing services that are beneficial to the immediate health needs.<sup>165,173,174</sup> Public health is becoming under an increasing demand to find ways to collaborate with primary care. In the instances of emergency preparedness and immunizations, public health and primary care have a long history of collaboration, other areas are in need of work in order to broaden and deepen the relationship.<sup>165,171</sup>

While integration has been defined several different ways among the various healthcare sectors,<sup>175</sup> the literature has been relatively consistent with the definition. The literature consistently includes coordination of funding and infrastructure; alignment of mission, vision, and values; shared goals and objectives; alliance between leadership; evaluation; sustainability; community engagement; shared data; and innovation.<sup>160,176-184</sup> Kodner and Kyriacou defined it in terms of “a discrete set of techniques and organizational models designed to create connectivity, alignment and collaboration within and between the cure and care sectors at the funding, administrative and/or provider levels.”<sup>185</sup> At the suggestion of the CDC and HRSA, the IOM convened a committee to examine the integration of public health and primary care. The committee suggested that the integration should occur on a continuum with varying degrees of integration based on the need of the community. The thought process being that public health and primary care would move away from their operational silos but would not include a merger between them. The varying degrees of integration would range from mutual awareness (being informed of each other’s activities) to partnership (programmatic level with no separation) and would include cooperation (sharing resources such as personnel, facilities, and data) and collaboration (joint planning and execution of services). For any level of integration between public health and primary care to be successful, the following foundational aspects must exist:

well-aligned, multi-level leadership, communication, mutual awareness, formal processes, relationship history, and shared values.<sup>171,186</sup>

Public health and primary care integration has both benefits and challenges, however, the growing consensus is that the impact that public health and primary care would make together on the overall health of the population is so much greater than what the impact they would make independently.<sup>165</sup> Primary care providers could better care for patients by addressing the underlying causes of the disease and certain behaviors using population-based information from public health agencies. In turn, public health practitioners could improve dissemination of health promotion messages and community health strategies using individual-level data from primary care.<sup>165</sup> Other benefits to public health and primary care integration are an increase in data sharing that would positively impact the advances being made in information technology and informatics,<sup>165</sup> support for geriatric providers,<sup>187</sup> and a reduction in health disparities and an increase in health equity.<sup>175</sup>

The challenges of integration include entrenched silos, lack of financial incentive, and an inflexible regulatory system.<sup>70,76,165,188</sup> Additionally, both public health and primary care practitioner have to be overcome are that neither is accountable to the other and thus they must be willing to integrate, they usually lack interoperable information systems making the ability to share data difficult, and lastly a lack of infrastructural support that would allow for integration at any point on the continuum to occur.<sup>165</sup>

#### *Evidence-based Public Health Practice (EBPH)*

Jenicek defined evidence-based public health practice (EBPH) in 1997 as the "... conscientious, explicit, and judicious use of current best evidence in making decisions about the care of communities and populations in the domain of health protection, disease prevention, health

maintenance and improvement (health promotion)."<sup>189</sup> EBPH is an essential component for those public health professionals that are responsible for developing, implementing, and evaluating disease prevention programs and policies.<sup>190</sup> EBPH basically allows LHDs to effectually use their limited resources to improve the health of those they serve within the jurisdiction.<sup>191</sup> When applying the evidence-based framework to program and policy planning, EBPH has the potential to increase current population health outcomes.<sup>34,192</sup> In order to effectively employ the evidence-based public health approach, practitioners need to utilize the best evidence available, systematically use information sources and data, appropriately apply the framework to programs and policies, engage community leaders in the decision making process, evaluate appropriately, and ensure that the results are disseminated to all stakeholders.<sup>115,193,194</sup>

Evidence-based decision making (EBDM) is the process of integrating the best available evidence, the practitioner's expertise, and the community's health needs and characteristics.<sup>189,193-</sup><sup>200</sup> EBDM is the central notion of EBPH<sup>201</sup> and is needed when making programmatic and policy decisions based on the best available research. EBDM is also required in order to assist in decreasing the burden of disease and protecting the overall health of the local community.<sup>34,115,194,198</sup> Public health workers face an ever changing set of challenges and are required to obtain and update a solid mix of knowledge, skills, and competencies in order to successfully engage in EBPH and EBDM. Some of the expected competencies include action planning, prioritizing program and policy options, dissemination of research to policy makers, and economic evaluation.<sup>44,193</sup> These competencies are consistent with those found in Domain 10 of the PHAB standards, specifically standard 10.1 that states "Identify and Use the Best Available Evidence for Making Informed Public Health Practice Decisions" and stand 10.2 that states "Promote Understanding and Use of the Current Body of Research Results, Evaluations, and



Evidence-based Practices with Appropriate Audiences”<sup>155</sup> However, due to certain job responsibilities certain public health professions (epidemiologist, preparedness coordinator, and health educator) are more likely to be involved in EBPH and EBDM than others.<sup>202-204</sup>

EBDM is also very different from political decision-making, which causes a tension public health workers and policy makers. Governmental councils, especially local, do not like to be told what to do. Their main drive tends to be toward what meets their political agenda instead of what is actually best for the overall health of the community. Public health believes that evidence needs to be presented before decisions are made, however in some cases, this is not very prominent with local policy makers. There are times in which council members will listen to the public health workers and will in turn use their political clout to ensure that the decisions are made accordingly and the goals are achieved.<sup>205</sup>

While EBPH and EBDM are crucial to the public health workforce and a well-functioning public health agency, the processes are met with various barriers with the public health agencies. There are individual-level barriers that include knowledge of process, lack of experience, skills needed to conduct EBPH, and the ability to adapt to changes in interventions or settings. Organizational barriers also exist and include non-supportive leadership, a cultural that is not conducive to EBDM, dissemination of research, and access to resources.<sup>23,115,193,206-208</sup> System-level barriers, such as funding, lack of relevant research, competing priorities, and political environment, have also been known to be difficult barriers to overcome.<sup>23,115,207,208</sup> Public health agencies that are located in rural areas,<sup>209</sup> experience high turnover rates, and/or have a workforce that has little to no formal public health training<sup>39,210-212</sup> tend to experience higher numbers of barriers and find it more difficult to overcome. Fortunately, the barriers can be overcome, the individual-level barriers are easier to eliminate with frequent workforce development and training

sessions. The system-level and organizational are more difficult to address, however, with a skilled workforce and an increase in capacity, the agency will be able find the support that it needs to properly implement EBPH and EBDM.<sup>213-215</sup>

Despite the many challenges and barriers of EBPH adoption, there are also numerous direct and indirect benefits. These benefits include increased access to high-quality information, higher success rate for program and policy implementation, workforce productivity increases, and more efficient use of resources.<sup>23,34,195,216,217</sup> Public health agencies that adopt EBPH and EBDM are more likely to meet the accreditation standards set for by PHAB for the national voluntary accreditation process.<sup>23,195,214</sup> Timely implementation of evidence-based intervention programs and policies is paramount to the bridging the gap between new research findings and applying them in the most appropriate setting in order to improve population health.<sup>218-220</sup> Putting EBPH into place requires sufficient capacity, because capacity is a determinant of performance and the greater the capacity of the public health agency, the greater the impact on the population.<sup>214</sup>

#### *Health in All Policies (HiAP)*

The fact that many believe that public health is defined as health care for the poor<sup>221</sup> is very unfortunate because public health has the responsibility of health promotion and protection of the entire population. The public health practitioners have to not only ensure that the ten essential services are being provided the most vulnerable and underserved of our population, but they also have to serve as the support net for health care services and in many cases become the “last resort” provider. As the voice for health promotion and the role of health in all public and private sectors, public health agencies need to fully embrace the Health in All Policies (HiAP) approach. By embracing HiAP, public health workers will become strong advocates of the relevance of public health during the decision-making process for all sectors. Currently there is a lack of

understanding in many sectors (i.e. agriculture, education, housing, and transport) about their adverse effects their policies and programs have on the health of their community.<sup>67,222</sup> While there have been efforts to improve education and living conditions, other considerations such as employment opportunities, transportation, and neighborhood safety are being ignored.<sup>223-226</sup>

The movements for a policy framework that highlights the importance of intersectional collaboration and a broader understanding of the role that behavioral, environmental, and other lifestyle factors on health outcome began in the 1970s.<sup>227</sup> These movements lead for the formation of HiAP and since then several countries (Australia, Netherlands, New Zealand, Norway, and U. S.)<sup>228</sup> have begun implementing various adaptations of the HiAP approach. Health in All Policies is defined as “a change in the systems that determine how decisions are made and implemented by local, state, and federal government to ensure that policy decisions have neutral or beneficial impacts on the determinants of health.”<sup>229</sup> Institutionally the HiAP framework is not a fixed framework, it is more about the organization’s culture, thus flexible and allows for local variations.<sup>225,230</sup> The key elements of HiAP include health equity, benefits for all sectors, environmental sustainability, intersectoral collaboration, community and stakeholder engagement, funding and investment coordination, integration of research and data into decision making, and the implementation of accountability measures.<sup>116,231,232</sup> The core aim of HiAP is achieving health equity and in order to accomplish this the social determinants of health need to be addressed by across all governmental levels.<sup>233-237</sup>

Since 2010, U.S. jurisdictions have gradually passed HiAP or HiAP-like laws and integrating these laws at all levels of government with the hopes of achieving better population health outcomes through increased collaboration between public and private sectors.<sup>238</sup> A commitment to HiAP requires analysis on governmental spending, a shift in what decisions effect

the cost of living within a community, and an examination of a government's ability to increase taxes on items that undermine SDoH and decreases taxes on what promotes them.<sup>239</sup> Governments that implement HiAP are finding that as they move toward strengthening health equity via intersectoral collaborations, they also have to implement integrated governance that is guided by long-term strategies and goals.<sup>240,241</sup>

While there are many benefits to HiAP approach, there are also many challenges and barriers. Several of these challenges include policy-makers that are not experienced with intersectoral collaboration, lack of evidence regarding implementation, and the difficulty of quantifying social systems.<sup>242,243</sup> Another challenge to the HiAP approach involves working with other sectors to improve population health while also still being able to address the core needs of those sectors.<sup>244</sup> The South Australian government implemented a HiAP approach in 2007 with the primary goal of improving health equity via intersectoral collaboration. However, they experienced a shift in focus and while they were successfully in implementing policies that address social determinants of health, they did so lacking an explicit focus on the health inequities.<sup>245</sup>

The variation in the implementation and evaluation of HiAP approach has proven to be a daunting barrier to overcome. Due to the lack of standardization, practitioners have found it difficult to determine the appropriate goals and objectives to assist in the guidance of their initiatives. Evaluation is an important key factors that drive success, however, it is difficult in many instances to attribute the work of the HiAP initiative to the observed outcomes.<sup>228</sup> Evaluation of how HiAP contributes to improving the observed outcomes is crucial because the process of policy making is "messy," rarely takes place in a single movement, and takes place in a complex dynamic systems.<sup>246-249</sup> This has to a call for additional research to better understand HiAP implementation and evaluation.<sup>117,250,251</sup>

### *Multi-sectoral collaboration*

Multi-sectoral collaborations, such as partnerships, alliances, and networks, have been a part of the public health system for many years.<sup>252-254</sup> They allow for the broad distribution of risks and responsibilities, an ease in exchanging knowledge and expertise, and increase the impact of the public health programs.<sup>255-258</sup> Multi-sectoral collaborations provide the ability to be socially innovative and leverage complementary resources in an overall effort to equitably, efficiently, and effectively address the social determinants of health and overall health issues of the community.<sup>259-265</sup> Thus, any efforts to improve population health outcomes will require sustained investment from many stakeholders and the inclusion of multi-sectoral partnerships with both governmental and nongovernmental entities, such as health care insurers and providers, public safety, schools, environmental, transportation, recreation departments, and community nonprofits, is a must.<sup>70,266-273</sup>

Collaborations between multiple sectors can exist in a variety of forms. The type of collaboration depends on the purpose of the partnership between the various entities. The partnerships can be either informal or formal. Informal partnerships are usually based on information exchange and viewed as a networking opportunity. More formal partnerships can take on the roles of modifying activities (coordination), sharing of resources (cooperation), or joint planning (alliance).<sup>274</sup> Barnes and colleagues<sup>274</sup> found that LHDs reported being more likely to have partnerships with hospitals, state departments of health, and physician groups and less likely to have partnerships with transportation and recreation departments.

Multi-sectoral collaborations are built on the premise that no one sector is solely responsible for the capacity for improving population health outcomes, it has been stated that “it takes a village” to improve a population’s health.<sup>258,275-279</sup> While lack of cooperation between

public health and other sectors and the often-resulting communication silos exists, collaboration is inherently better than continuing to work independently.<sup>175,280,281</sup> These joint ventures need to utilize the best available resources and skills to develop and implement prevention programs.<sup>258,275-278</sup> However, the formation of these collaborative partnerships is not always smooth. Fortunately for the LHDs that have a local board of health (LBoH), they may be able to rely on the board members to provide connections and leverage to begin the process.<sup>110</sup> The LBoH members embody the diversity of the community, provide the resources needed to fortify the partnerships between the governmental and non-governmental sectors, and in most communities are highly underutilized.<sup>282</sup>

Major drivers for the formation of multi-sectoral collaborations are community health needs assessments (CHNAs), community health assessments (CHAs), and community health improvement plans (CHIPs). CHNA is defined as “an effort to identify and prioritize a community’s health needs, accomplished by collecting and analyzing data, including input from the community.”<sup>283</sup> CHA is defined as “a systematic examination of the health status indicators for a given population that is used to identify key problems and assets in a community.”<sup>155</sup> CHIP is defined as “a long-term, systematic effort to address public health problems on the basis of the results of CHA activities and community health improvement process.”<sup>155</sup> Two national initiatives influence how and why organizations are conducting CHNAs, CHAs, and CHIPs. The first initiative is the Patient Protection and Affordable Care Act (ACA) section 9007. This section of the ACA mandates that every three years nonprofit hospitals must conduct a CHNA and in turn implement the recommended strategies. During the process, the hospitals are required engage with public health and other community organizations.<sup>284</sup> The second initiative is the PHAB voluntary national accreditation process. The accreditation standards and pre-requisites require that LHDs

conduct both a CHA and CHIP within the last five years.<sup>155</sup> During the assessment processes, hospitals and LHDs must take into account all of the available knowledge, information, and expertise that is relevant to their community.<sup>285</sup> The collaborative partnerships during the assessment process allows for the pooling of resources and the potential for higher quality assessments.<sup>286</sup> Unfortunately, these collaborations are more likely to occur in jurisdictions with larger populations, high total expenditures, a locally governed LHD, and a LBoH. LHDs in smaller jurisdictions may not have the financial or staffing resources necessary to engage in the assessment: they also may not have a LBoH or a local hospital needed to form collaborative partnerships.<sup>287</sup>

In 2012, the IOM reported several benefits of collaborative community health efforts such as fulfilling governmental mandates, cost savings, and better coordination of care.<sup>165</sup> Evidence shows that communities that incorporate multisector partnerships and networks into their public health system are experiencing improved population health outcomes, such as decline in preventable death rates.<sup>271,288</sup> Partnerships assist with raising awareness of pressing health concerns, strengthen community engagement, mobilize new funding commitments, share expenses, improve the use of EBPH, and advance policies that include institutional reforms and public health system strengthening.<sup>289-291</sup> The process of building and sustaining multi-sectoral collaborations includes the development of a shared vision, necessary financial resources, and implementation strategies for monitoring, accountability, and improvement, while fostering trust among all members.<sup>256,262,292</sup>

Partnerships can also create issues such as creating emerging disease silos, being narrowly focused and issue-specific while ignoring broader implications, and using vertical programs to address horizontal health needs. The partnerships need to ensure that they do not increase the

burden on a weakened public health system by decreasing services for non-focal health issues.<sup>293</sup> Partnerships also need to ensure that they are governed in such a way that private interests do not influence public health policy decision making process.<sup>294</sup> In order to deal with these issues, the collaborative partners need to define their partnership; manage the risks and responsibilities for each partner; assess their structure, processes, and outcomes; and provide continual performance improvement.<sup>295</sup>

### Performance Management

At a time when both the impact of the emerging issues and the threats against the public health system seem to be increasing, the need to reform and strengthen the public health system and infrastructure becomes imperative.<sup>296</sup> Public health systems reform has many goals, one of those being improving performance of the system. Performance is a multifaceted concept that includes the elements of efficiency, effectiveness, productivity, and equity.<sup>22-24,26,28,29,95,297-301</sup> Efficiency focuses on the link between structures and outcomes; effectiveness focuses on the link between processes and outcomes; productivity is the correlation between the structure and the processes; and equity within the outcomes is the way that public health services are delivered so that health disparities are reduced.<sup>302</sup>

The performance within the public health system is positively associated with financial resources, staffing per capita, and with the productivity of the public health workforce especially in areas of workforce development, partnerships, interorganizational relationships, leadership, and organizational culture.<sup>23,26,301</sup> The best way to improve performance within the public health system is through performance management. The future of public health agencies and their ability to effectively and efficiently utilize their resources depends on the use of performance management



systems. In order to develop high-performing public health agencies, performance management is essential.<sup>296</sup>

Performance management was best defined by the Public Health Foundations as the practice of linking performance standards and measures to performance data, which in turn strategically informs leadership about any needed adjustments or changes in policy, program directions, agency priorities, and/or resource allocation. Performance management frames reports in a way that allows agencies to successfully improve the quality of public health practice.<sup>303</sup>

A performance management system is ultimately the tool that organizes and monitors QI processes, performance goals, and the overall improvement of the agency via dashboards or scorecards.<sup>296</sup> It is important to note that performance management does not evaluate individual public health workers and their performance; it is a monitoring system that evaluates the priorities of the agency. The use of performance management has been shown to increase accountability and transparency within both the agency and the overall public health system.<sup>296</sup> While public health practitioners are experts in surveillance and tracking data, performance management allows the public health practitioners to combine their data expertise with the business practice of tracking key management and agency priority outcomes to ensure that they are making the most appropriate decisions regarding resource allocation and the public health services they provide.<sup>296</sup>

According to the National Association of County and City Health Officials' 2016 National Profile of Local Health Departments (2016 Profile Study), PHAB accreditation is a major driver in the utilization of performance management.<sup>304</sup> Domain nine of the PHAB Standards and Measures version 1.5 directly addresses performance management. The domain focuses on "the use and integration of performance management and quality improvement practices and processes for the continuous improvement of the public health department's practices, programs, and

interventions.”<sup>155</sup> Beitsch and colleagues<sup>154</sup> found that while actively engaging in the accreditation process is in fact a driver for the uptake of performance management. They found that the number of LHDs pursuing accreditation remained relatively the same from 2013 to 2016, the number of LHDs that had implemented formal performance management and QI activities and projects had increased.<sup>154</sup>

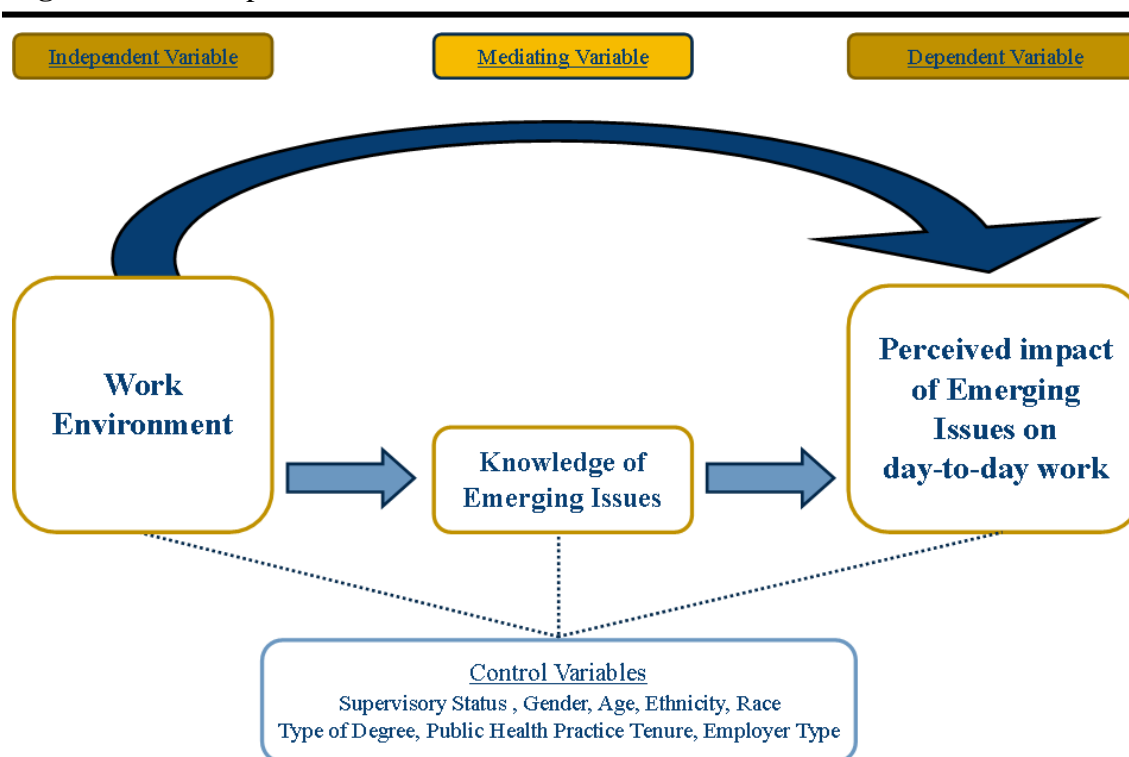
The future of performance management within public health depends on a variety of factors. The emphasis on the utilization of performance management dashboards and the creation of a standard national dashboard needs to be increased.<sup>296</sup> The support of the agency leadership is crucial and public health needs to learn from the lesson set forth by other industries. As the public health performance management system matures, the focus needs to be not only on the health outcomes of the community, but also on the agency’s consumers’ needs.<sup>296</sup> Also, as the system matures collaboration between the public health agencies and public health academia needs to occur so that more courses focusing on performance management are accessible to public health students at all levels. Lastly, performance management workforce development needs to emphasize on training, integration, collaboration with community partners, and using public health agencies that have successfully integrated performance management systems as models for future coordination and development.<sup>296</sup>

#### Framework

The conceptual framework that will be used for this study was based on principles set forth in both the Job Characteristics Theory by Richard Hackman and Edward Lawler<sup>305</sup> and Kurt Lewin’s Organizational Development Theory.<sup>306,307</sup> This conceptual framework model focuses the association between workforce environment and the perceived individual impact of the emerging issues in public health on the day-to-day work of state and local public health workforce. The

framework also focuses on the impact that the overall knowledge of the emerging issues in public health have on the relationship between the workforce environment and the perceived impact of the emerging issues. This framework model can also be applied to measure the relationship between organizational factors and individual practitioner characteristics at any level of public health system, such as national, state, or local system.

**Figure 2.1.** Conceptual Framework



The Job Characteristics Theory was developed by Richard Hackman and Edward Lawler in 1976 and then adapted by Richard Hackman and Greg Oldham in 1980.<sup>305</sup> The theory was originally based on principles from Maslow's need hierarchy theory and from expectancy theory that focus on personal characteristics or task attributes that are essential to the job and constructed in a way that motivate workers to engage higher-order needs.<sup>305</sup> The theory consists of five characteristics and attributes: autonomy - individuals feel personal responsibility for their work;

task identity – use of personally valued skills and abilities; variety – use of different skills and abilities; feedback – level of accomplishment that comes from the task or external source; and task significance – meaningfulness of the work. All five of the theory characteristics and attributes were relevant to this study; PH WINS used seventeen variables to assess the public health workplace environment and all seventeen variables could be connected to at least one of the theory's characteristics and attributes. Job Characteristics Theory focuses on core job characteristics, critical psychological states, moderators, and outcomes. It states that the job design has an effect on motivation, work performance, and job satisfaction; thus certain job characteristics affect the outcomes of the jobs themselves.<sup>305</sup>

Kurt Lewin developed the Organizational Development Theory during the 1930s. Lewin was an industrial social psychologist that focused his research on groups more than individuals and he theorized that behavior was a functional interaction of person and environment.<sup>305</sup> Organizational development utilizes strategies that lead to organizational learning such as knowledge attainment, gaining of insight, and skill learning.<sup>305,306</sup> Organizational learning utilizes organizational climate and culture to facilitate the learning by individuals, by groups within the organization, and by the organization itself. Measures of the theory focus on Expanding the knowledge and effectiveness of people to accomplish more successful organizational change and performance.<sup>306</sup>

The Job Characteristics Theory and the Organizational Development Theory help guide the development of strategies and tools for research in order to monitor public health performance and focus system improvements and reform. This framework allows public health researchers to effectively examine the association between workforce environment and individual-level

perceived individual impact of the emerging issues in public health on the day-to-day work of state and local public health workforce.

#### Gaps in Knowledge and Justification for the Study

The extent to which the public health workforce perceives an impact of the emerging issues on their day-to-day public health practice is scarce. Also, the extent of which the workforce environment was associated with variations in perceived individual impact, as well as, the impact that the knowledge of the emerging issues have on the association between the workforce environment and the perceived impact of the emerging issues. This study hopes to fill in some of those gaps in the current knowledge.

In 2015, Shah and Madamala<sup>16</sup> conducted an initial study regarding the level of awareness of national public health trends using 2014 PH WINS data. They found that more than sixty percent of the public health workforce had knowledge about some of the emerging trends (such as implementation of ACA, EBPH and QI) and less than thirty percent of the workforce had knowledge about some of the other emerging trends (Public Health Systems and Services Research and HiAP). They found that the factors of supervisory status, education, governance, academic collaboration, and workforce environment were all significantly associated with awareness regarding emerging trends in public health. This study used the 2017 PH WINS data and explored the perceived impact of emerging public health issues on the day-to-day work of state and local public health agency workforces, as well as, if the workforce environment was associated with individual variations in perceived impact. This study also examined the extent to which the knowledge of the emerging public health issues mediated the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce. By using focusing on some of the

identified issues related to contemporary issues and by using more recent data, this study was an appropriate follow-up to the initial study by Shah and Madamala.<sup>16</sup>

## CHAPTER III – METHODOLOGY

In this chapter, the study methodology, including the study design, data sources, the population, data collection procedures, data analysis, outcome measures, and proposed statistical techniques are discussed.

### Study Design

This study used a cross-sectional study design, which is a type of observational study design. A quantitative approach that utilized secondary data from the only nationally-representative survey of the United States public health workforce was used. Operationally, the intention of the study was to answer the four research questions, that each had their own hypotheses and measures. (Appendix A)

The research aims for this study were to accurately measure the perceived impact level that the emerging issues in public health have on the day-to-day work of state and local public health workforce, as well as, if the workforce environment was associated with variations in perceived individual impact. The research also explored the extent to which the knowledge of the emerging public health issues mediates the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce. From the research questions (Appendix A), one will also be able to make a judgment regarding the influence that workforce environment has on the perceived impact that the emerging issues have on public health practice. This study sought to expand the public health workforce and practice research, while examining which factors, such as workforce environment, awareness of the emerging issues, and education affect the individual variations in the perceived impact of the six emerging issues in public health.

## Data Source and Methods

### *Data Source*

Data for this study came from the 2017 Public Health Workforce Interests and Needs Survey (PH WINS) conducted by the Association of State and Territorial Health Officials (ASTHO) and de Beaumont Foundation. This is the only nationally-representative survey of the public health workforce, at both state and local levels.<sup>30,78,79</sup> The 2017 PH WINS was the second iteration of PH WINS. While it builds on the 2014 fielding, there have been several major changes since the first iteration. The largest change was the nationally-representative local sampling of mid-large local health departments (LHDs) employees.<sup>78</sup> The survey was web-based and its purpose was to collect state and local health department employee perspectives regarding workforce issues, validate responses regarding workforce development priorities from leadership, and to monitor the data that is collected over time. There are four main domains and three main aims within the survey. The domains were workplace environment, national trends, demographics, and training needs.<sup>30,79</sup> The aims of the survey were: to inform the public health workforce regarding future development initiatives; create a key workforce development metrics baseline; and explore the attitudes, morale, and climate of the public health workforce.<sup>30,78</sup>

### *Population and Sampling Design*

PH WINS 2017 utilized two distinctive sampling frames, state sampling frame and a local sampling frame. This allowed for major considerations regarding jurisdiction population size, governing classification, and geographic location of the jurisdiction.<sup>78,79</sup> Governing classification is the relationship between the state health agency (SHA) and the LHDs and can be defined as centralized, decentralized, shared, or mixed.<sup>308</sup> The first frame was the “state” frame and it was a nationally representative sample of permanent central office employees within an SHA. The



second frame was the “local” frame and was a nationally representative sample of medium and large size local health department employees, as well as, members of the Big City Health Coalition (BCHC).<sup>78</sup>

The “state” frame consisted of a target population that included permanent central office staff, excluded contract and temporary staff, and one member of the BCHC. Ultimately, forty-seven state health agencies participated in the 2017 PH WINS. This sample used a census approach in order to achieve a nationally representative sample. A total of 77,992 respondents were invited to participate and SHA leadership were urged to encourage their invited staff to participate. Also, all participating SHAs had to submit a complete eligible staff roster and all participating staff members had to complete an eligibility screening questionnaire. Due to the governance structure of SHAs and the different types of relationships they maintain with LHDs, the completed eligibility roster and questionnaire allowed district staff that were employees of a SHA in a decentralized state to be included in the “state” frame as eligible state health agency central office staff.<sup>78</sup>

The “local” frame consisted of two distinct populations, BCHC members and mid-large size LHDs. The BCHC consists of twenty-nine members and are a group of the largest local health departments in the United States.<sup>30</sup> The BCHC sample included twenty-five participating members, twenty-four BCHCs used a census approach that included all eligible staff and one BCHC participated via sample. A total of 16,870 BCHC respondents were invited to participate.<sup>78</sup>

The other local target population consisted of employees of mid-large size local health departments. Mid-large size LHDs were defined as those health departments that serve a jurisdiction population greater than 25,000 and employ more than twenty-five staff members. A field sample was selected via a stratified, clustered sampling of all eligible departments. The strata

were based on cross-classification of two jurisdictional populations sizes (25,000-250,000 and >250,000) and the ten Health and Human Services (HHS) Regions. In each of the invited LHDs, all staff members were encouraged to participate. In total, 7,423 respondents from 71 randomly selected mid-large size LHDs were invited to participate.<sup>78</sup>

### *Survey Administration*

The 2017 Public Health Workforce Interests and Needs Survey (PH WINS) was administered by the Association of State and Territorial Health Officials (ASTHO) with support from the de Beaumont Foundation.<sup>79</sup> The 2017 PH WINS was fielded via a concentrated effort from survey administration staff and individual agency staff, including a workforce champion and an information technology contact. Once the surveys were fielded and the responses were received, a final sample assignment was constructed. The survey fielded to 102,305 public health workers and achieved a 48% response rate.<sup>78</sup>

### *Measures/Variables*

#### *Dependent Variables*

The main variable of interest was the perceived impact level that the emerging issues in public health have on the day-to-day work of state and local public health workforce. The impact variable also had each emerging issue listed separately and was divided into four response categories: 1) Nothing at all, 2) Not too much, 3) Impact fair amount, and 4) Impact great deal. This measurement provided a base measurement into the level of impact, if any, that the emerging issues were making on current public health practice. This study focused on assessing whether workforce environment were associated with variations in the public health workers level of perceived impact the emerging issues on the day-to-day work of state and local public health workforce.

The mediating variable was the overall knowledge of the emerging issues in public health. The variable individual awareness had each emerging issue listed separately and was divided into four response categories: 1) Nothing at all, 2) Not much, 3) A little, and 4) A lot. This provided a measurement in order to establish if the public health worker's knowledge of emerging issues was consistent with previous studies.<sup>16</sup> Practitioner and organizational characteristics, such as supervisory status, ethnicity, gender, age, tenure in public health practice, employer (local, state, federal, or non-governmental), and having a public health degree, were designated as control variables.

The dependent variables for the multinomial logistic regression analysis account for the level of perceived impact that the emerging issues in public health have the day-to-day work of state and local public health workforce. Survey participants were asked "To what extent do each of the following areas impact your day-to-day work?" The areas were the emerging issues in public health and were listed as: Cross-jurisdictional sharing of public health services, Fostering a culture of quality improvement (QI), Public and primary care integration, Evidence-Based Public Health Practice (EBPH), Health in All Policies (HiAP), and Multi-sectoral collaboration (Appendix B). The responses to this question were also measured using a four-point Likert Scale, "Nothing at all", "Not too much", "Impact fair amount", and "Impact great deal". For this study these variables were recoded into new variables that indicate the level of day-to-day impact on public health activities as "Not impacted" [Nothing at all coded as 0], "Marginally impacted" [Not too much and Impact fair amount coded as 1], and "Significantly impacted" [Impact great deal coded as 2] (Appendix B).

The dependent variable for the mediation analysis accounts for the level of perceived overall impact that the emerging issues in public health have the day-to-day work of state and local

public health workforce. Survey participants were asked “To what extent do each of the following areas impact your day-to-day work?” The areas were the emerging issues in public health and were listed as: Cross-jurisdictional sharing of public health services, Fostering a culture of quality improvement (QI), Public and primary care integration, Evidence-Based Public Health Practice (EBPH), Health in All Policies (HiAP), and Multi-sectoral collaboration (Appendix B). The responses to this question were also measured using a four-point Likert Scale, “Nothing at all” [1], “Not too much” [2], “Impact fair amount” [3], and “Impact great deal” [4]. This variable was operationalized into a single continuous scale by summing the score of the six variables the participant. The range for each participant was 6-24.

#### *Independent Variable*

The independent variable considered for this Multinomial logistic regression and Mediation analyses was workplace environment (Appendix B). The variable of *workplace environment* was operationalized into a single continuous scale by summing the score of the 17 variables the participant was asked to rate their agreement on, such as “The work I do is important”, “My training needs are assessed”, “Employees learn from one another as they do their work”, “My supervisor treats me with respect”, etc. Originally, the responses to the 17 variables were measured via a five-point Likert Scale, “Strongly disagree”, “Disagree”, “Neither agree nor disagree”, “Agree”, and “Strongly agree”. The range for each participant was 17-85. As the value of the workforce environment variable increased, it was an indication of a stronger agreement for each item individually.

#### *Mediating Variable*

For evaluating the public health worker’s individual level of overall knowledge of the emerging issues in public health, study participants were asked, “How much, if anything, have you

heard about the following concepts in public health?” The concepts (emerging issues in public health) listed were: Cross-jurisdictional sharing of public health services, Fostering a culture of quality improvement (QI), Public health and primary care integration, Evidence-Based Public Health Practice (EBPH), Health in All Policies (HiAP), and Multi-sectoral collaboration. (Appendix B) The responses to the above question were measured using a four-point Likert Scale, “Nothing at all” [2], “Not much” [3], “A little” [4], and “A lot” [5]. For this study, this variable was operationalized into a single continuous scale by summing the score of the six variables the participant. The range for each participant was 12-30 (Appendix B).

#### *Control Variables*

The control variables considered for this Multinomial logistic regression and Mediation analyses included supervisory status of study participant, gender of the study participant, ethnicity of the study participant, race of study participant, age of study participant, tenure in public health practice, employer, and type of degree (Appendix B).

*Supervisory status* of the study participant was categorized by four supervisory levels, these included 1) Non-supervisor, 2) Supervisor, 3) manager, and 4) Executive. The variables were recoded as: Non-supervisor coded as 0; Supervisor coded as 1; manager coded as 2; and Executive coded as 3. The level of Non-supervisor was the reference category for logistic regression models.

*Gender* of the study participants were divided into three categories, these included 1) Male, 2) Female, and 3) Non-binary/Other. The variables were recoded as: Male coded as 0; Female coded as 1; and Non-binary/Other coded as 2. Male was the reference category when comparing the other two categories to it.

Relating to the *ethnicity* of the study participants, the respondents were asked to check either 'Yes' or 'No' to the question "Are you Hispanic or Latino?" The variables were recoded as: No coded as 0 and Yes coded as 1. No was the reference category when comparing the two categories.

The *race* of the study participants was based the racial category that the respondent identified as at the time of the fielding of the survey. This variable was broken into six variables to reflect different racial categories of public health workers have identified as in the past, these included 1) White, 2) Black or African American, 3) Native Hawaiian or other Pacific Islander, 4) Asian, 5) American Indian or Alaska Native, and 6) Two or more races. The variables were coded as: White = 0; Black or African American = 1; and Other [all other race categories] = 2. The category of White was the reference category for the logistic regression model.

The *age* of the study participant was initially measured as a continuous variable based on their age, rounded to the nearest whole year. This variable was operationalized into five variables, these included 1) less than or equal to thirty years of age ( $\leq 30$  years), 2) between thirty-one and forty years of age (31 – 40 years), 3) between forty-one and fifty years of age (41 – 50 years), 4) between fifty-one and sixty years of age (51 – 60 years), and 5) greater than or equal to sixty-one years of age ( $\geq 61$  years). The variables were coded as follows: ( $< 30$  years) = 0; (31 – 40 years) = 1; (41 – 50 years) = 2; (51 – 60 years) = 3; and ( $> 61$  years) = 4. The variable of less than or equal to thirty years of age ( $\leq 30$  years) was the reference category for the logistic regression models.

*Employer* of the study participant is broken into four categories, these include 1) Local government, 2) State government, 3) Federal government, and 4) Non-governmental. The variables were recoded as: State government = 0; Local government = 1; Federal government = 2; and

Non-government = 3. State government was the reference category when comparing the other three categories to it.

Concerning the *type of degree* variable, the respondents were asked to “Please indicate which degrees you have attained”, such as BS, BSPH, MBA, MPH, PhD, MD, etc. (Appendix B) This variable was recoded into the following dichotomous variables, “Public Health Degree” [BSPH, MPH, and public health doctorate (DrPH/PhD/ScD/other public health doctorate) were coded as 1] and “Non-Public Health Degree” [all other degrees were coded as 0]. The reference category for the logistic regression models is the Non-Public Health Degree variable.

#### Analytic Methods

All statistical analyses were performed using SAS 9.4. Descriptive statistics such was computed to assess the survey participants’ level of perceived impact that the emerging issues in public health have the day-to-day work of state and local public health workforce. The command that was used was “PROC SURVEYFREQ”. During this study, there were two different types of analyses that were conducted: multinomial logistic regression and mediation.

For the multinomial logistic regression analysis, six separate models were computed during this analysis, one for each of the six emerging issues to address perceived impact. Multinomial logistic regression is a powerful analysis that is preferred by researchers since it does not assume linearity, normality, or homoscedasticity. The assumption of independence among the dependent variable choices, which states that the membership in one particular category is not related to the membership of another category.<sup>55</sup> The data analysis command that will be used is “PROC SURVEYLOGISTIC”, which will allow for weighted multinomial logistic regression.

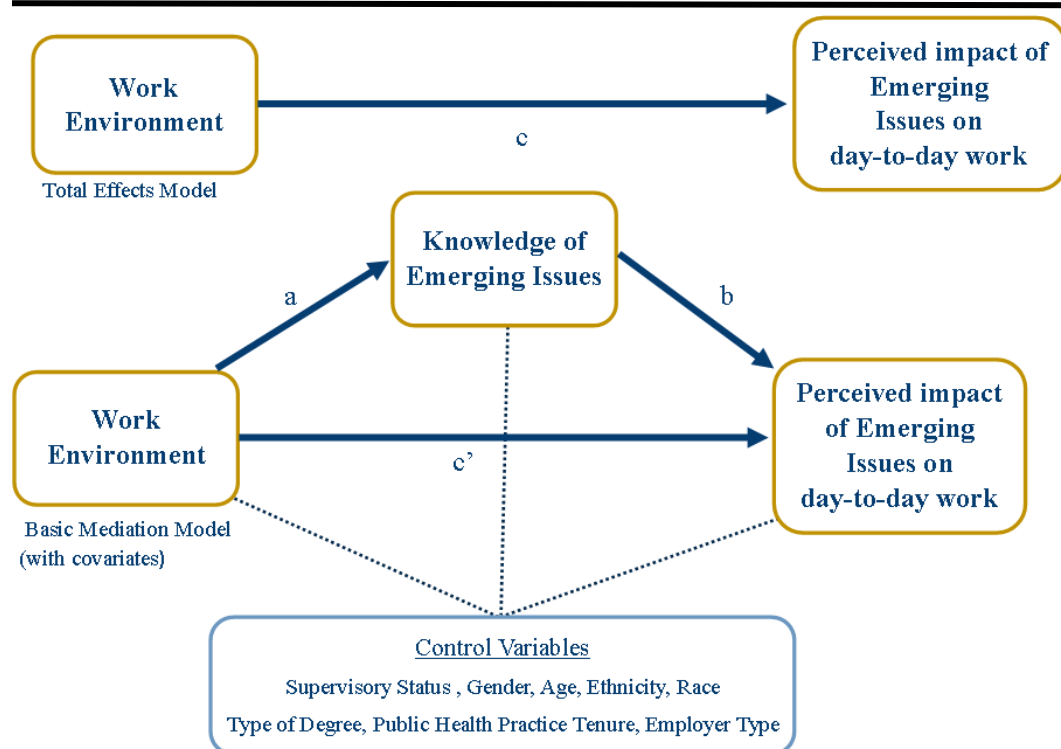
Mediation analysis was conducted using the Baron and Kenny method.<sup>309</sup> The Baron and Kenny method has four steps that need to be utilized in order to establish mediation (Figure 3.1):

1. Show that the independent variable is correlated with the dependent variable (Total effects model);
2. Show that the independent variable is correlated with the mediator (Path a);
3. Show that the mediator affects the dependent variable (Path b); and
4. Establish that the mediator completely mediates the independent variable-dependent variable relationship.

This model also assumes multivariate normal distributions and normally distributed error terms throughout the data. Pearson correlation and regression analysis were completed to during all steps of this analysis. In order for the mediator to completely mediate the relationship between the independent and dependent variables, all four of the about steps must be met. If steps one through three are met but step four is not met, then the mediator only partially mediated the relationship between the independent and dependent variables. The commands used during this analysis were “PROC CORR” and “PROC SURVEYREG”.



**Figure 3.1.** Mediation Analysis Model



Bootstrapping was the final process conducted during the mediation analysis. Bootstrapping was utilized to compute the point estimate of the indirect effect over a large number of random samples. In order to do this, bootstrapping generated an observed representation of the sampling distribution of the indirect effect by treating the obtained sample of size  $n$  ( $n=5000$  for this study) as a depiction of the population in miniature, one that was repeatedly resampled during analysis as a means of mimicking the original sampling process. The command used for this analysis was “PROC CAUSALMED”.

### *Statistical weights*

The statistical weights developed by ASTHO were applied both to account for complex sample design, reflecting probabilities of selection, and to account for nonresponse. Sampling weights were constructed for both the state health agency national sample, as well as, the local

national sample.<sup>78</sup> The SHA sample weight was a multistep construct accounting for any subsampling of staff, nonresponse adjustment, and post-stratification adjustment to align weighted count to equal the region-level staff totals in each of the HHS regions. The local sample weight was applied to those that participated as either a BCHC member, LHD in a decentralized state, or local employees from the SHA from that were located in non-decentralized states. The multistep construct accounted for probability of selection from each participation BCHC member and LHD, nonresponse adjustment, and post-stratification adjustment based on the total staff count in each of the twenty strata (ten HHS regions times the two jurisdiction population sizes).<sup>78</sup>

This chapter described the methodology and design of the research study. The chapter began by a description of the research design and restating the research purpose. The study took the form of a cross-sectional study design. As such, the research used a quantitative approach that utilized secondary data from the only nationally-representative survey of the United States public health workforce. The chapter further presented a summary of how the data would be presented and analyzed.

## CHAPTER IV – RESULTS

This chapter presents the information collected from the analysis of the six logistic regression models, as well as mediation analysis, using the Association of State and Territorial Health Officials (ASTHO) and de Beaumont Foundation 2017 Public Health Workforce Interests and Needs Survey (PH WINS). The purpose of this research was to examine the perceived impact of emerging issues in public health on the day-to-day work of state and local public health agency workforces, if the workforce environment is associated with variations in perceived individual impact, and the extent to which the knowledge of the emerging public health issues mediates the relationship between workforce environment and the perceived individual impact levels. Data from 2017 was used because it was the most current data available to evaluate public health workers perspectives on topics such as workforce engagement, workforce environment, training needs, and emerging issues in public health. PH WINS data was the only comprehensive and nationally representative data source of the United States public workforce.

### Descriptive Statistics

The descriptive statistics for all dependent and independent variables are listed in Tables 4.1 and 4.2. The number of respondents to PH WINS was 47,756 (Table 4.1). Participants that held the status of supervisor (72.26%) were a large proportion of the study participants from state and local health departments and other agencies. Those that were managers (16.39%) and executives (8.92%) made up a smaller portion of the participants, while those that were considered non-supervisors were only 2.44% of the participants. In regard to gender of the workforce, 78.36% identified as female, 21.06% identified as male and 0.58% identified as non-binary/Other. Only 12.89% of the public health workers identified as Hispanic or Latino. The largest percentage of public health workers (67.37%) were white, followed by black (16.98%) and other races (15.66%).

The age of the study participants was relatively evenly distributed with those between 51 and 60 years of age (28.83%) comprising the largest percentage, closely followed by those between 41 and 50 years of age (24.32%), those between thirty-one and forty years of age (22.44%), participants sixty-one or older (13.37%), and those thirty years old and under (11.04%).

Sixty-two percent of the participants were state government employees, while 33.72% were local government employees, 2.10% were non-governmental employees, and 2.09% were federal government employees. Those with five years or less of public health practice tenure comprised 30.45% of the participants, 21.33% had more than twenty-one years of tenure, 18.41% had six to ten years of tenure, 15.59% had eleven to fifteen years of tenure, and 14.22% had sixteen to twenty years of tenure in public health practice. Only 13.81% of the public health workers had a public health degree, while 86.19% had a non-public health degree. The workplace environment score was a continuous variable that was calculated by summing the responses of seventeen workplace environment variables (as described in Appendix B) and the score for each participant ranged from seventeen to eighty-five. The higher the sum of the workplace environment variables, the more positive the participant perceived their overall workplace environment. The mean workplace environment score was 66.02 (standard error 0.17). The overall knowledge of the emerging issues score was also a continuous variable. It was calculated by summing the responses to *How much, if anything, have you heard about the following concepts in public health?* for each of the six emerging issues in public health (as described in Appendix B). The range of the score for each participant was twelve to thirty and the mean for the overall knowledge of the emerging issues was 20.65 (standard error 0.09). Thus, the higher the sum of the overall knowledge variables, the more knowledge of the emerging issues in public health the participant had.

**Table 4.1.** Percent distribution of the independent variables, 2017 Public Health Workforce Interests and Needs Survey (PH WINS)

	<b>N (un-Weighted)</b>	<b>Percent (Weighted)</b>
Total Number of Respondents	47756	
Supervisory Status:		
Supervisor	31750	72.26
Manager	7017	16.39
Executive	3721	8.92
Non-supervisor	1055	2.44
Gender:		
Male	9270	21.06
Female	33547	78.36
Non-binary/Other	301	0.58
Hispanic or Latino:		
No	36616	87.11
Yes	6345	12.89
Race:		
White	28410	67.37
Black or African American	6930	16.98
Other	6663	15.66
Age:		
(<= 30 years)	4575	11.04
(31 – 40 years)	8899	22.44
(41 – 50 years)	10495	24.32
(51 – 60 years)	12450	28.83
(=> 61 years)	5785	13.37
Employer:		
Local government	10886	33.72
State government	31388	62.10
Federal government	515	2.09
Non-governmental	490	2.10
Tenure in Public Health Practice:		
0-5 years	13315	30.45
6-10 years	7458	18.41
11-15 years	6217	15.59
16-20 years	5258	14.22
21 years or above	9341	21.33
Educational Status:		
Non-Public Health degree	37370	86.19
Public Health degree	6329	13.81
	<b>N</b>	<b>Mean (variance)</b>
Work Environment	43575	66.02 (0.17)
Overall Knowledge of emerging Public Health issues	43269	20.65 (0.09)

Abbreviations: N, number of observations.

Table 4.2 presents descriptive statistics for the perceived impact of the emerging public health issues on the day-to-day work of state and local public health workforce, as well as, as the perceived overall impact score of the emerging issues. Concerning the perceived impact of cross-jurisdictional sharing of public health services, a large proportion of the employees perceived that they were marginally impacted on a day-to-day basis (68.54%) with the other employees perceiving that they were significantly impacted (18.18%) or not impacted (13.28%). The proportion of public health workers that perceived no impact of fostering a culture of quality improvement (QI) on a day-to-day basis was as low as 6.98%, with the remaining perceiving that they were either marginally impacted (63.53%) or significantly impacted (29.50%). Public health workers that perceived that they were significantly impacted on a day-to-day basis by public health and primary care integration is 21.02% while respectively 15.47% and 63.51% perceived no impact or that they were marginally impacted. Evidence-based public health practice (EBPH) was perceived to marginally impact 58.56% of the workforce and significantly impact 29.63% of the workforce on a day-to-day basis; while 11.50% of the workforce perceived no impact.

Public health workers that perceived no impact by Health in All Policies (HiAP) on their daily work were outnumbered (13.92%) compared to the other workers who perceived otherwise, respectively 66.88% and 22.61%, that they had either been marginally impacted or significantly impacted by HiAP. In turn, 10.51% and 22.61% perceived that they were not impacted or were significantly impacted on a day-to-day basis by multi-sectoral collaboration; however, 66.88% perceived that they were marginally impacted. The perceived overall impact of the emerging issues score was calculated by summing the responses to *To what extent do each of the following areas impact your day-to-day work?* for each of the six emerging issues in public health. It was a

continuous variable with a range for each participant of six to twenty-four and the mean for the perceived overall impact of the emerging issues was 12.90 (standard error 0.08).

**Table 4.2.** Percent distribution of the perceived impact of the emerging public health issues on the day-to-day work of state and local public health workforce, 2017 Public Health Workforce Interests and Needs Survey (PH WINS)

	<b>N (un-Weighted)</b>	<b>Percent (Weighted)</b>
Cross-jurisdictional sharing of public health services		
Not impacted	4115	13.28
Marginally impacted	20445	68.54
Significantly impacted	5351	18.18
Fostering a culture of quality improvement (QI)		
Not impacted	2753	6.98
Marginally impacted	21709	63.53
Significantly impacted	10290	29.50
Public health and primary care integration		
Not impacted	5261	15.47
Marginally impacted	20238	63.51
Significantly impacted	6806	21.02
Evidence-Based Public Health Practice (EBPH)		
Not impacted	4032	11.50
Marginally impacted	19329	58.86
Significantly impacted	10050	29.63
Health in All Policies (HiAP)		
Not impacted	3515	13.92
Marginally impacted	17246	68.85
Significantly impacted	4213	17.23
Multi-sectoral collaboration		
Not impacted	3026	10.51
Marginally impacted	18846	66.88
Significantly impacted	6327	22.61
	<b>N</b>	<b>Mean (variance)</b>
Perceived Overall Impact	38513	12.90 (0.08)

Abbreviations: N, number of observations.

### Multinomial Logistic Regression Models

The first model assessed the association between the variations in perceived individual impact levels of cross-jurisdictional sharing of public health services and the workforce environment after controlling for the following public health practitioner characteristics: supervisory status, gender, ethnicity, race, age, employer, tenure in public health practice, and

educational status (Table 4.3). Workforce environment of the public health worker has a significant positive association with the individual perceived impact levels of cross-jurisdictional sharing. The odds of the perception of their day-to-day work being marginally impacted vs being not impacted (adjusted odds ratio [AOR]=1.012,  $p$ -value [ $p$ ]=<0.001) by cross-jurisdictional sharing increased as the workforce environment score increased. The odds of the perception of their day-to-day work being significantly impacted vs being not impacted (AOR=1.020,  $p$ =0.002) by cross-jurisdictional sharing also increased as the workforce environment score increased.

Public health practitioners that were either a manager or an executive had significantly increased odds (AOR=1.468,  $p$ =0.039; AOR=1.968,  $p$ =0.030) of having the perception of being significantly impacted by cross-jurisdictional sharing vs not impacted as compared to those that were Non-supervisors. While compared to non-Hispanic or Latino public health workers, Hispanic or Latino workers have significantly increased odds (AOR=1.805,  $p$ =<0.001) of having the perception of being significantly impacted by cross-jurisdictional sharing as opposed to not being impacted. Black public health workers when compared to white public health workers had significantly increased odds of having the perception of being both significantly (AOR=3.168,  $p$ =<0.001) and marginally (AOR=1.375,  $p$ =0.013) impacted by cross-jurisdictional sharing; while public workers of other races when compared to white workers had significantly increased odds (AOR=1.663,  $p$ =<0.001) of having the perception of being significantly impacting by cross-jurisdictional sharing. When likened to public health workers 30 years of age or younger, a worker that is between the ages of 51 and 60 has significantly decreased odds (AOR=0.674,  $p$ =0.003) of having the perception of being marginally impacted and a worker that is 61 years of age or older has significantly decreased odds (AOR=0.467,  $p$ =0.025) of having the perception of being significantly impacted by cross-jurisdictional sharing. Public health workers that are employees



**Table 4.3.** Multinomial logistic regression for the perceived impact of cross-jurisdictional sharing of public health services on the day-to-day work of state and local public health workforce

Public Health Practitioner Characteristics	Significantly impacted vs. Not impacted				Marginally impacted vs. Not impacted			
	AOR	p-value	95% CI for AOR		AOR	p-value	95% CI for AOR	
			Lower	Upper			Lower	Upper
Work Environment	<b>1.02</b>	0.002	1.01	1.03	<b>1.01</b>	<0.001	1.01	1.02
Supervisory Status:								
Supervisor	0.70	0.206	0.40	1.23	0.75	0.417	0.38	1.51
Manager	<b>1.47</b>	0.039	1.02	2.13	1.09	0.528	0.84	1.41
Executive	<b>1.97</b>	0.030	1.07	3.62	1.58	0.062	0.98	2.55
Non-supervisor	--		--	--	--		--	--
Gender:								
Female	0.70	0.974	0.25	1.39	0.91	0.555	0.66	1.25
Non-binary/Other	0.70	0.477	0.25	1.93	0.59	0.215	0.26	1.37
Male	--		--	--	--		--	--
Hispanic or Latino:								
Yes	<b>1.81</b>	<0.001	1.45	2.25	1.21	0.079	0.98	1.49
No	--		--	--	--		--	--
Race:								
Black or African American	<b>3.17</b>	<0.001	2.22	4.52	<b>1.38</b>	0.013	1.07	1.76
Other	<b>1.66</b>	<0.001	1.32	2.10	1.20	0.181	0.92	1.57
White	--		--	--	--		--	--
Age:								
(31 – 40 years)	1.22	0.127	0.94	1.58	0.96	0.664	0.79	1.16
(41 – 50 years)	1.02	0.908	0.70	1.49	0.77	0.090	0.58	1.04
(51 – 60 years)	0.88	0.392	0.66	1.18	<b>0.67</b>	0.003	0.53	0.87
(> 61 years)	<b>0.47</b>	0.025	0.24	0.90	0.43	0.086	0.16	1.14
(< 30 years)	--		--	--	--		--	--
Employer:								
Local government	1.14	0.297	0.89	1.45	1.08	0.374	0.91	1.28
Federal government	<b>3.00</b>	0.008	1.36	6.62	<b>3.50</b>	0.036	1.09	11.26
Non-governmental	2.90	0.396	0.24	35.63	0.73	0.175	0.46	1.16
State government	--		--	--	--		--	--
Tenure in Public Health Practice:								
6-10 years	1.27	0.070	0.98	1.66	1.31	0.093	0.96	1.79
11-15 years	<b>1.53</b>	0.006	1.14	2.04	<b>1.46</b>	0.020	1.07	1.99
16-20 years	0.87	0.629	0.48	1.57	0.99	0.841	0.85	1.14
21 years or above	<b>1.73</b>	0.011	1.14	2.61	<b>1.71</b>	0.018	1.10	2.65
0-5 years	--		--	--	--		--	--
Educational Status:								
Public Health degree	<b>1.83</b>	<0.001	1.39	2.40	<b>1.23</b>	0.041	1.01	1.50
Non-Public Health degree	--		--	--	--		--	--

Abbreviations: AOR, adjusted odds ratio; CI, confidence intervals.

Note: Bold AORs indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

of the federal government (vs. state government) have significantly increased odds of having the perception of cross-jurisdictional sharing marginally impacting and significantly impacting their day-to-day work, respectively (AOR=3.499,  $p=0.036$ ; AOR=2.995,  $p=0.008$ ).

Practitioners with tenure in public health practice of 11 to 15 years and 21 years or above have significantly increased odds of having the perception of being both marginally impacted (AOR=1.457,  $p=0.020$ ; AOR=1.710,  $p=0.018$ ) and significantly impacted (AOR=1.525,  $p=0.006$ ; AOR=1.729,  $p=0.011$ ) by cross-jurisdictional sharing than those practitioners with 5 or less years of tenure. When workers that have a public health degree were equated to those workers that did not have a public health degree, those with a public health degree had significantly increased odds of having the perception of being marginally impacted (AOR=1.231,  $p=0.041$ ), as well as having the perception of being significantly impacted (AOR=1.826,  $p<0.001$ ) as opposed to not being impacted by cross-jurisdictional sharing. All other control variables in Table 4.3 had no significant association with the dependent variable perceived individual impact levels of cross-jurisdictional sharing of public health services.

The second model assessed the association between the variations in perceived individual impact levels of fostering a culture of quality improvement (QI) and the workforce environment after controlling for public health practitioner characteristics (Table 4.4). Workforce environment of the public health worker has a significant positive association with the individual perceived impact levels of QI. The odds of the perception of their day-to-day work being marginally impacted vs being not impacted (AOR=1.022,  $p<0.001$ ) by QI increased as the workforce environment score increased. The odds the perception of their day-to-day work being significantly impacted vs being not impacted (AOR=1.035,  $p<0.001$ ) by QI increased as the workforce environment score increased.

Public health practitioners that have a supervisory role have significantly increased odds of having the perception of being marginally impacted, as well as, significantly impacted (vs not impacted) by QI than those practitioners that are non-supervisors, thus including supervisors (AOR=1.498,  $p<0.001$ ; AOR=1.679,  $p<0.001$ ), managers (AOR=2.529,  $p<0.001$ ; AOR=4.984,  $p<0.001$ ), and executives (AOR=5.495,  $p=0.001$ ; AOR=14.658,  $p<0.001$ ). Female public health workers (vs male) have significantly increased odds of having the perception of being impacted by QI both marginally (AOR=1.227,  $p=0.002$ ) and significantly (AOR=1.441,  $p<0.001$ ) when compared to not being impacted. Black public health practitioners as opposed to white practitioners had significantly increased odds (AOR=1.845,  $p<0.001$ ) of having the perception of being significantly impacted by QI. Workers with a tenure in public health practice of 6 to 10 years (vs. 5 or less years) have significantly increased odds (AOR=1.221,  $p=0.013$ ) of having the perception of being significantly impacted and those with 20 years or more (vs 5 or less years) of tenure have significantly increased odds (AOR=1.341,  $p=0.010$ ) of having the perception of being marginally impacted by QI. While the odds of public health workers with 16 to 20 years of tenure (vs. 5 or less years) are significantly increased regarding the perception of being both marginally (AOR=1.548,  $p=0.008$ ) and significantly impacted (AOR=1.404,  $p=0.003$ ) by QI. Public health practitioners that have a public health degree were compared to those workers that did not have a public health degree, those with a public health degree had significantly increased odds of having the perception of being marginally impacted (AOR=1.374,  $p=0.014$ ), as well as having the perception of being significantly impacted (AOR=1.690,  $p<0.001$ ) as opposed to not being impacted by QI. All other control variables in Table 4.4 had no significant association with the dependent variable perceived individual impact levels of fostering a culture of quality improvement.

**Table 4.4.** Multinomial logistic regression for the perceived impact of fostering a culture of quality improvement (QI) on the day-to-day work of state and local public health workforce

Public Health Practitioner Characteristics	Significantly impacted vs. Not impacted				Marginally impacted vs. Not impacted			
	AOR	<i>p</i> -value	95% CI for AOR		AOR	<i>p</i> -value	95% CI for AOR	
			Lower	Upper			Lower	Upper
Work Environment	<b>1.04</b>	<0.001	1.03	1.04	<b>1.02</b>	<0.001	1.02	1.03
Supervisory Status								
Supervisor	<b>1.68</b>	<0.001	1.39	2.03	<b>1.50</b>	<0.001	1.30	1.72
Manager	<b>4.98</b>	<0.001	3.34	7.44	<b>2.53</b>	<0.001	1.70	3.77
Executive	<b>14.66</b>	<0.001	6.13	35.08	<b>5.50</b>	0.001	2.17	13.89
Non-supervisor	--		--	--	--		--	--
Gender:								
Female	<b>1.44</b>	<0.001	1.24	1.67	<b>1.23</b>	0.002	1.08	1.39
Non-binary/Other	1.69	0.249	0.68	4.21	1.83	0.076	0.94	3.59
Male	--		--	--	--		--	--
Hispanic or Latino:								
Yes	1.06	0.667	0.81	1.38	0.85	0.282	0.64	1.14
No	--		--	--	--		--	--
Race:								
Black or African American	<b>1.85</b>	<0.001	1.46	2.34	0.97	0.765	0.77	1.21
Other	1.12	0.256	0.92	1.37	0.97	0.738	0.79	1.19
White	--		--	--	--		--	--
Age:								
(31 – 40 years)	1.13	0.396	0.85	1.51	0.93	0.701	0.62	1.39
(41 – 50 years)	1.26	0.082	0.97	1.63	0.79	0.213	0.55	1.15
(51 – 60 years)	1.11	0.370	0.88	1.39	0.73	0.122	0.48	1.09
(> 61 years)	1.06	0.727	0.75	1.50	0.78	0.196	0.52	1.15
(< 30 years)	--		--	--	--		--	--
Employer:								
Local government	0.99	0.884	0.80	1.21	1.08	0.353	0.92	1.27
Federal government	1.38	0.573	0.44	4.26	2.25	0.339	0.41	12.17
Non-governmental	1.09	0.930	0.14	8.55	0.52	0.084	0.25	1.10
State government	--		--	--	--		--	--
Tenure in Public Health Practice:								
6-10 years	<b>1.22</b>	0.013	1.05	1.43	1.23	0.154	0.92	1.64
11-15 years	1.07	0.531	0.86	1.35	1.15	0.281	0.89	1.48
16-20 years	<b>1.40</b>	0.003	1.13	1.74	<b>1.55</b>	0.008	1.13	2.13
21 years or above	1.23	0.057	0.99	1.53	<b>1.34</b>	0.010	1.08	1.67
0-5 years	--		--	--	--		--	--
Educational Status:								
Public Health degree	<b>1.69</b>	<0.001	1.36	2.10	<b>1.37</b>	0.014	1.07	1.76
Non-Public Health degree	--		--	--	--		--	--

Abbreviations: AOR, adjusted odds ratio; CI, confidence intervals.

Note: Bold AORs indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

The third model assessed the association between the variations in perceived individual impact levels of public health and primary care integration and the workforce environment after controlling for public health practitioner characteristics (Table 4.5). Workforce environment of the public health worker has a significant positive association with the individual perceived impact levels of public health and primary care integration. The odds of the perception of their day-to-day work being marginally impacted vs being not impacted (AOR=1.015,  $p<0.001$ ) by public health and primary care integration increased as the workforce environment score increased. The odds for the perception of their day-to-day work being significantly impacted vs being not impacted (AOR=1.025,  $p<0.001$ ) by public health and primary care integration increased as the workforce environment score increased.

In regard to public health and primary care integration, public health agency executives (vs. non-Supervisors) have significantly increased odds of having the perception of being significantly impacted (AOR=1.729,  $p=0.001$ ) and marginally impacted (AOR=1.601,  $p=0.007$ ) contrasted with not impacted. The odds of female public health practitioners, as opposed to male health practitioners, having the perception of being both marginally and significantly impacted (vs. not impacted) by public health and primary care integration was significantly increased (AOR=1.196,  $p=0.049$ ; AOR=1.583,  $p=0.001$ ). Public health workers that identified as Hispanic or Latino, as compared to those that did not identify as Hispanic or Latino, had significantly increased odds (AOR=1.766,  $p<0.001$ ) of having the perception of being significantly impacted by public health and primary health integration. Practitioners that are black have significantly increased odds of having the perception of being significantly impacted (AOR=2.801,  $p<0.001$ ) and marginally impacted (AOR=1.468,  $p=0.006$ ) by public health and primary care integration when compared to white practitioners. Practitioners that are of other races also have significantly

**Table 4.5.** Multinomial logistic regression for the perceived impact of public health and primary care integration on the day-to-day work of state and local public health workforce

Public Health Practitioner Characteristics	Significantly impacted vs. Not impacted				Marginally impacted vs. Not impacted			
	AOR	p-value	95% CI for AOR		AOR	p-value	95% CI for AOR	
			Lower	Upper			Lower	Upper
Work Environment	<b>1.03</b>	<0.001	1.02	1.03	<b>1.02</b>	<0.001	1.01	1.02
Supervisory Status								
Supervisor	0.72	0.142	0.46	1.12	0.76	0.378	0.42	1.41
Manager	1.36	0.164	0.88	2.11	1.17	0.146	0.95	1.44
Executive	<b>1.60</b>	0.007	1.14	2.24	<b>1.73</b>	0.001	1.29	2.32
Non-supervisor	--		--	--	--		--	--
Gender:								
Female	<b>1.58</b>	0.001	1.21	2.07	<b>1.20</b>	0.049	1.00	1.43
Non-binary/Other	1.26	0.610	0.51	3.07	1.01	0.978	0.42	2.44
Male	--		--	--	--		--	--
Hispanic or Latino:								
Yes	<b>1.77</b>	<0.001	1.43	2.18	1.21	0.066	0.99	1.49
No	--		--	--	--		--	--
Race:								
Black or African American	<b>2.80</b>	<0.001	1.92	4.09	<b>1.47</b>	0.006	1.12	1.92
Other	<b>1.69</b>	<0.001	1.43	2.00	<b>1.35</b>	0.016	1.06	1.71
White	--		--	--	--		--	--
Age:								
(31 – 40 years)	0.97	0.769	0.81	1.17	1.02	0.848	0.84	1.23
(41 – 50 years)	1.01	0.947	0.69	1.48	0.85	0.133	0.68	1.05
(51 – 60 years)	0.88	0.381	0.66	1.18	0.94	0.415	0.81	1.10
(> 61 years)	<b>0.53</b>	0.004	0.35	0.80	0.60	0.193	0.28	1.31
(< 30 years)	--		--	--	--		--	--
Employer:								
Local government	1.17	0.252	0.89	1.55	1.13	0.106	0.97	1.31
Federal government	2.66	0.113	0.79	8.97	3.88	0.110	0.73	20.71
Non-governmental	4.04	0.178	0.52	31.58	1.04	0.916	0.54	1.98
State government	--		--	--	--		--	--
Tenure in Public Health Practice:								
6-10 years	1.26	0.055	1.00	1.60	<b>1.26</b>	0.044	1.01	1.57
11-15 years	1.29	0.061	0.99	1.69	1.31	0.066	0.98	1.76
16-20 years	1.08	0.841	0.52	2.24	1.06	0.730	0.77	1.46
21 years or above	<b>1.57</b>	0.001	1.21	2.05	<b>1.46</b>	0.039	1.02	2.08
0-5 years	--		--	--	--		--	--
Educational Status:								
Public Health degree	0.99	0.961	0.72	1.37	0.95	0.579	0.78	1.15
Non-Public Health degree	--		--	--	--		--	--

Abbreviations: AOR, adjusted odds ratio; CI, confidence intervals.

Note: Bold AORs indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

increased odds of having the perception of being significantly impacted (AOR=1.691,  $p<0.001$ ) and marginally impacted (AOR=1.349,  $p=0.016$ ) by public health and primary care integration when compared to white practitioners.

When public health workers that are 61 years of age or older are compared to workers that are 30 years of age or younger, those workers had significantly decreased odds (AOR=0.529,  $p=0.004$ ) of having the perception of being significantly impacted (vs. not impacted) by the integration of public health primary care. Practitioners had significantly increased odds of having the perception of being marginally impacted and significantly impacted by public health and primary care integration, if they had a tenure in public health practice of 21 or more years (AOR=1.457,  $p=0.039$ ; AOR=1.572,  $p=0.001$ ) versus a tenure of 5 years or less. Practitioners with of 6 to 10 years of tenure in practice also had significantly increased odds (AOR=1.256,  $p=0.044$ ) of having the perception of being marginally impacted by public health and primary care integration when compared to those with 5 or less years of tenure. All other control variables in Table 4.5 had no significant association with the dependent variable perceived individual impact levels of public health and primary care integration.

The fourth logistic regression model assessed the association between the variations in perceived individual impact levels of evidence-based public health (EBPH) practice and the workforce environment after controlling for public health practitioner characteristics (Table 4.6). Workforce environment of the public health worker has a significant positive association with the individual perceived impact levels of EBPH. The odds of the perception of their day-to-day work being marginally impacted vs being not impacted (AOR=1.020,  $p=0.001$ ) by EBPH increased as the workforce environment score increased. The odds for the perception of their day-to-day work

being significantly impacted vs being not impacted (AOR=1.036,  $p<0.001$ ) by EBPH increased as the workforce environment score increased.

Regarding EBPH, public health agency executives (vs. non-Supervisors) have significantly increased odds of having the perception of being significantly impacted (AOR=1.609,  $p=0.025$ ) and marginally impacted (AOR=1.895,  $p=0.038$ ) contrasted with not impacted. Public health workers of other races when compared to white workers had significantly increased odds (AOR=1.343,  $p=0.005$ ) of having the perception of being significantly impacted by EBPH; while black workers when compared to white workers had significantly increased odds of having the perception of being marginally and significantly impacted by EBPH (AOR=1.348,  $p=0.008$ ; AOR=2.148,  $p=0.002$ ). Workers that were between the ages of 41 and 50 years (vs. those ages 30 years or younger) had significantly decreased odds of having the perception of being both significantly (AOR=0.729,  $p=0.028$ ) and marginally (AOR=0.661,  $p=0.012$ ) impacted when compared to not being impacted. Also, workers that are 51 to 60 years of age (vs. 30 years or younger) had significantly decreased odds (AOR=0.628,  $p=0.013$ ) of having the perception of being marginally impacted and those that were 61 years of age or older had significantly decreased odds (AOR=0.399,  $p=0.009$ ) of having the perception of being significantly impacted by EBPH.

Public health workers that were employed by local government or the federal government had significantly increased odds of having the perception of being both marginally impacted (AOR=1.404,  $p=0.010$ ; AOR=4.969,  $p=0.011$ ) and significantly impacted (AOR=1.465,  $p=0.007$ ; AOR=2.599,  $p=0.051$ ) by EBPH when compared to worker that were employed by state government. However, those workers that were employed by non-governmental agencies had significantly decreased odds (AOR=0.577,  $p=0.032$ ) of having the perception of being



**Table 4.6.** Multinomial logistic regression for the perceived impact of evidence-based public health (EBPH) practice on the day-to-day work of state and local public health workforce

Public Health Practitioner Characteristics	Significantly impacted vs. Not impacted				Marginally impacted vs. Not impacted			
	AOR	<i>p</i> -value	95% CI for AOR		AOR	<i>p</i> -value	95% CI for AOR	
			Lower	Upper			Lower	Upper
Work Environment	<b>1.04</b>	<0.001	1.03	1.05	<b>1.02</b>	0.001	1.01	1.03
Supervisory Status								
Supervisor	0.72	0.338	0.36	1.44	0.77	0.453	0.38	1.55
Manager	1.34	0.085	0.96	1.88	1.19	0.259	0.88	1.61
Executive	<b>1.90</b>	0.038	1.04	3.46	<b>1.61</b>	0.025	1.07	2.43
Non-supervisor	--		--	--	--		--	--
Gender:								
Female	1.10	0.710	0.67	1.80	0.91	0.634	0.63	1.34
Non-binary/Other	0.68	0.473	0.24	1.98	0.66	0.324	0.28	1.54
Male	--		--	--	--		--	--
Hispanic or Latino:								
Yes	1.22	0.053	1.00	1.50	1.12	0.309	0.89	1.41
No	--		--	--	--		--	--
Race:								
Black or African American	<b>2.15</b>	0.002	1.34	3.44	<b>1.35</b>	0.008	1.09	1.67
Other	<b>1.34</b>	0.005	1.10	1.64	1.26	0.092	0.96	1.66
White	--		--	--	--		--	--
Age:								
(31 – 40 years)	0.93	0.541	0.72	1.19	0.85	0.176	0.68	1.08
(41 – 50 years)	<b>0.73</b>	0.028	0.55	0.97	<b>0.66</b>	0.012	0.48	0.91
(51 – 60 years)	0.75	0.083	0.55	1.04	<b>0.63</b>	0.013	0.44	0.90
(> 61 years)	<b>0.40</b>	0.009	0.20	0.79	0.39	0.074	0.14	1.10
(< 30 years)	--		--	--	--		--	--
Employer:								
Local government	<b>1.47</b>	0.007	1.12	1.92	<b>1.40</b>	0.010	1.09	1.81
Federal government	<b>2.60</b>	0.015	1.21	5.56	<b>4.97</b>	0.011	1.49	16.62
Non-governmental	<b>0.58</b>	0.032	0.35	0.95	1.38	0.607	0.39	4.87
State government	--		--	--	--		--	--
Tenure in Public Health Practice:								
6-10 years	<b>1.49</b>	0.002	1.17	1.90	<b>1.52</b>	0.006	1.14	2.05
11-15 years	<b>1.24</b>	0.016	1.04	1.48	<b>1.69</b>	0.020	1.09	2.63
16-20 years	1.15	0.374	0.84	1.57	1.10	0.536	0.81	1.51
21 years or above	<b>1.62</b>	0.010	1.13	2.33	1.61	0.090	0.93	2.80
0-5 years	--		--	--	--		--	--
Educational Status:								
Public Health degree	<b>2.83</b>	<0.001	1.96	4.11	<b>1.50</b>	0.033	1.04	2.16
Non-Public Health degree	--		--	--	--		--	--

Abbreviations: AOR, adjusted odds ratio; CI, confidence intervals.

Note: Bold AORs indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

significantly impacted by EBPH when compared to those employed by state governmental agencies. Public health practitioners had significantly increased odds of having the perception of being marginally impacted and significantly impacted by EBPH, if they had a tenure in public health practice of 6 to 10 years (AOR=1.524,  $p=0.006$ ; AOR=1.489,  $p=0.002$ ) or 11 to 15 years (AOR=1.694,  $p=0.020$ ; AOR=1.244,  $p=0.016$ ) versus a tenure of 5 years or less. Practitioners with 21 or more years of tenure in practice also had significantly increased odds (AOR=1.624,  $p=0.010$ ) of having the perception of being significantly impacted by EBPH when compared to those with 5 or less years of tenure. When public health workers had a public health degree were likened to those workers that did not have a public health degree, those with a public health degree had significantly increased odds of having the perception of being marginally impacted (AOR=1.495,  $p=0.033$ ), as well as having the perception of being significantly impacted (AOR=2.8336,  $p<0.001$ ) as opposed to not being impacted by EBPH. All other control variables in Table 4.6 had no significant association with the dependent variable perceived individual impact levels of Evidence-Based Public Health Practice.

The fifth model assessed the association between the variations in perceived individual impact levels of Health in All Policies (HiAP) and the workforce environment after controlling for public health practitioner characteristics (Table 4.7). Workforce environment of the public health worker has a significant positive association with the individual perceived impact levels of HiAP. The odds of the perception of their day-to-day work being marginally impacted vs being not impacted (AOR=1.016,  $p=0.001$ ) by HiAP increased as the workforce environment score increased. The odds for the perception of their day-to-day work being significantly impacted vs being not impacted (AOR=1.027,  $p<0.001$ ) by HiAP increased as the workforce environment score increased.

Public health workers that held the status of supervisor had significantly decreased odds (AOR=0.476,  $p=0.046$ ) of having the perception of being significantly impacted (vs not impacted) by HiAP when compared to workers that were non-supervisors. However, executives had significantly increased odd of having the perception of being marginally impacted (AOR=1.695,  $p=0.005$ ) and significantly impacted (AOR=1.027,  $p<0.001$ ) by HiAP when compared to non-supervisors. Public health workers that were female had significantly increased odds (AOR=1.668,  $p<0.001$ ) of having the perception of being significantly impacted by HiAP when compared to public health workers that were male. Odds of having the perception of being significantly impacted by HiAP were significantly increased (AOR=1.671,  $p=0.002$ ) for Hispanic or Latino public health workers as opposed to non-Hispanic or Latino public health workers. Practitioners that are black have significantly increased odds of having the perception of being significantly impacted (AOR=3.366,  $p<0.001$ ) and marginally impacted (AOR=1.663,  $p=0.006$ ) by HiAP when compared to white practitioners. Practitioners that are of other races also have significantly increased odds of having the perception of being significantly impacted (AOR=2.504,  $p=0.006$ ) and marginally impacted (AOR=1.359,  $p=0.003$ ) by HiAP when compared to white practitioners.

A worker that was between the ages of 41 and 50 years old had significantly increased odds (AOR=1.321,  $p=0.049$ ) of having the perception of being marginally impacted by HiAP when compared to their co-workers that were 30 years old or younger. Also, workers that had 21 years or more of public health practice tenure had significantly increased odds (AOR=1.401,  $p=0.025$ ) of having the perception of being marginally impacted by HiAP when assessed with co-workers with tenure in public health practice of 5 years or less. All other control variables in Table 4.7 had

**Table 4.7.** Multinomial logistic regression for the perceived impact of Health in All Policies (HiAP) on the day-to-day work of state and local public health workforce

Public Health Practitioner Characteristics	Significantly impacted vs. Not impacted				Marginally impacted vs. Not impacted			
	AOR	p-value	95% CI for AOR		AOR	p-value	95% CI for AOR	
			Lower	Upper			Lower	Upper
Work Environment	<b>1.03</b>	<0.001	1.02	1.04	<b>1.02</b>	0.001	1.01	1.03
Supervisory Status								
Supervisor	<b>0.48</b>	0.046	0.23	0.99	0.73	0.391	0.35	1.52
Manager	0.92	0.645	0.65	1.31	0.95	0.720	0.73	1.24
Executive	<b>2.01</b>	<0.001	1.48	2.75	<b>1.70</b>	0.005	1.18	2.43
Non-supervisor	--		--	--	--		--	--
Gender:								
Female	<b>1.67</b>	<0.001	1.44	1.94	1.05	0.772	0.77	1.43
Non-binary/Other	0.93	0.924	0.19	4.63	0.99	0.981	0.31	3.17
Male	--		--	--	--		--	--
Hispanic or Latino:								
Yes	<b>1.67</b>	0.002	1.23	2.27	1.07	0.572	0.84	1.36
No	--		--	--	--		--	--
Race:								
Black or African American	<b>3.37</b>	<0.001	2.56	4.43	<b>1.66</b>	0.006	1.17	2.36
Other	<b>2.50</b>	0.006	1.33	4.72	<b>1.36</b>	0.003	1.12	1.66
White	--		--	--	--		--	--
Age:								
(31 – 40 years)	0.73	0.395	0.35	1.53	1.25	0.073	0.98	1.60
(41 – 50 years)	0.74	0.409	0.26	1.54	<b>1.31</b>	0.049	1.00	1.72
(51 – 60 years)	0.57	0.202	0.24	1.37	1.16	0.341	0.85	1.58
(> 61 years)	0.32	0.132	0.07	1.43	0.62	0.105	0.34	1.11
(< 30 years)	--		--	--	--		--	--
Employer:								
Local government	1.03	0.702	0.87	1.23	1.17	0.154	0.94	1.44
Federal government	1.96	0.144	0.79	4.90	3.46	0.158	0.60	19.83
Non-governmental	0.95	0.905	0.40	2.26	1.20	0.471	0.72	2.01
State government	--		--	--	--		--	--
Tenure in Public Health Practice:								
6-10 years	1.36	0.141	0.90	2.06	1.23	0.115	0.95	1.60
11-15 years	1.95	0.129	0.82	4.65	1.09	0.311	0.92	1.29
16-20 years	1.23	0.327	0.81	1.86	0.87	0.629	0.50	1.54
21 years or above	1.93	0.059	0.98	3.82	<b>1.40</b>	0.025	1.05	1.88
0-5 years	--		--	--	--		--	--
Educational Status:								
Public Health degree	1.20	0.121	0.95	1.51	1.13	0.245	0.92	1.38
Non-Public Health degree	--		--	--	--		--	--

Abbreviations: AOR, adjusted odds ratio; CI, confidence intervals.

Note: Bold AORs indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

no significant association with the dependent variable perceived individual impact levels of Health in All Policies.

The sixth and final logistic regression model assessed the association between the variations in perceived individual impact levels of multi-sectoral collaboration and the workforce environment after controlling for public health practitioner characteristics (Table 4.8). Workforce environment of the public health worker has a significant positive association with the individual perceived impact levels of multi-sectoral collaboration. The odds of the perception of their day-to-day work being marginally impacted vs. being not impacted (AOR=1.015,  $p<0.001$ ) by Multi-sectoral collaboration increased as the workforce environment score increased. The odds for the perception of their day-to-day work being significantly impacted vs being not impacted (AOR=1.022,  $p<0.001$ ) by multi-sectoral collaboration increased as the workforce environment score increased.

Public health practitioners that were either a manager or an executive had significantly increased odds of having the perception of being either marginally impacted (AOR=1.911,  $p<0.001$ ; AOR=1.844,  $p=0.005$ ) or significantly impacted (AOR=2.898,  $p<0.001$ ; AOR=3.450,  $p<0.001$ ) by multi-sectoral collaboration vs not impacted as compared to those that were non-supervisors. When compared to non-Hispanic or Latino public health workers, Hispanic or Latino workers have significantly increased odds (AOR=1.558,  $p=0.001$ ) of having the perception of being significantly impacted by multi-sectoral collaboration as opposed to not being impacted. Black public health workers when compared to white workers had significantly increased odds of having the perception of being significantly impacted (AOR=2.409,  $p<0.001$ ), as well as, having the perception of being marginally impacted (AOR=1.243,  $p=0.032$ ) by multi-sectoral collaboration; while workers of other races when compared to white workers had significantly

**Table 4.8.** Multinomial logistic regression for the perceived impact of multi-sectoral collaboration on the day-to-day work of state and local public health workforce

Public Health Practitioner Characteristics	Significantly impacted vs. Not impacted				Marginally impacted vs. Not impacted			
	AOR	<i>p</i> -value	95% CI for AOR		AOR	<i>p</i> -value	95% CI for AOR	
			Lower	Upper			Lower	Upper
Work Environment	<b>1.02</b>	<0.001	1.01	1.03	<b>1.02</b>	<0.001	1.01	1.02
Supervisory Status								
Supervisor	0.87	0.681	0.45	1.71	0.83	0.628	0.38	1.81
Manager	<b>2.90</b>	<0.001	2.07	4.04	<b>1.91</b>	<0.001	1.48	2.46
Executive	<b>3.45</b>	<0.001	2.26	5.27	<b>1.84</b>	0.005	1.21	2.81
Non-supervisor	--		--	--	--		--	--
Gender:								
Female	1.16	0.377	0.83	1.64	1.16	0.098	0.97	1.39
Non-binary/Other	0.92	0.879	0.33	2.60	0.69	0.364	0.31	1.56
Male	--		--	--	--		--	--
Hispanic or Latino:								
Yes	<b>1.56</b>	0.001	1.23	1.97	1.12	0.306	0.90	1.41
No	--		--	--	--		--	--
Race:								
Black or African American	<b>2.41</b>	<0.001	1.70	3.41	<b>1.24</b>	0.032	1.02	1.52
Other	<b>1.53</b>	0.002	1.19	1.98	1.20	0.241	0.88	1.65
White	--		--	--	--		--	--
Age:								
(31 – 40 years)	1.07	0.684	0.76	1.53	0.99	0.974	0.70	1.41
(41 – 50 years)	1.13	0.549	0.75	1.69	1.01	0.949	0.73	1.40
(51 – 60 years)	0.81	0.186	0.58	1.11	0.80	0.081	0.62	1.03
(> 61 years)	<b>0.41</b>	0.028	0.19	0.91	0.47	0.136	0.17	1.28
(< 30 years)	--		--	--	--		--	--
Employer:								
Local government	<b>1.30</b>	0.038	1.02	1.66	1.18	0.128	0.95	1.46
Federal government	1.82	0.140	0.82	4.07	3.08	0.084	0.85	11.13
Non-governmental	2.15	0.526	0.19	24.26	<b>0.62</b>	0.032	0.40	0.96
State government	--		--	--	--		--	--
Tenure in Public Health Practice:								
6-10 years	1.26	0.058	0.99	1.59	1.22	0.197	0.90	1.64
11-15 years	1.27	0.125	0.93	1.66	1.18	0.328	0.84	1.66
16-20 years	0.71	0.381	0.32	1.56	0.68	0.205	0.37	1.25
21 years or above	1.30	0.089	0.96	1.77	1.32	0.159	0.89	1.95
0-5 years	--		--	--	--		--	--
Educational Status:								
Public Health degree	<b>3.44</b>	<0.001	2.72	4.34	<b>1.70</b>	<0.001	1.41	2.06
Non-Public Health degree	--		--	--	--		--	--

Abbreviations: AOR, adjusted odds ratio; CI, confidence intervals.

Note: Bold AORs indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

increased odds (AOR=1.531,  $p=0.002$ ) of having the perception of being significantly impacted by multi-sectoral collaboration. Practitioners that were 61 years old or older (vs. those 30 years old or younger) had significantly decreased odds (AOR=0.414,  $p=0.028$ ) of having the perception of being significantly impacted by multi-sectoral collaboration.

Public health workers employed by the local government had significantly increased odds (AOR=1.300,  $p=0.038$ ) of having the perception of being significantly impacted by multi-sectoral collaboration than those workers that were employed by the state government; in contrast, workers that were employed by non-governmental agencies had significantly decreased odds (AOR=0.621,  $p=0.032$ ) of having the perception of being marginally impacted by multi-sectoral collaboration than those workers employed by state governmental agencies. Public health practitioners that have a public health degree were compared to those workers that did not have a public health degree, those with a public health degree had significantly increased odds of having the perception of being marginally impacted (AOR=1.703,  $p<0.001$ ), as well as having the perception of being significantly impacted (AOR=3.436,  $p<0.001$ ) as opposed to not being impacted by multi-sectoral collaboration. All other control variables in Table 4.8 had no multi-sectoral collaboration

### Mediation Analysis

As noted in Chapter 3, mediation analysis involves four steps:<sup>309</sup>

1. Estimating workforce environment effects on perceived overall impact of emerging public health issues;
2. Estimating workforce environment effects on the mediator (overall knowledge of emerging public health issues);

3. Estimating the mediator (overall knowledge of emerging public health issues) effects on perceived overall impact of emerging public health issues; and
4. Estimating workforce environment and mediation effects on perceived overall impact of emerging public health issues.

The first step in the analysis is the total effect model. During this model, the direct effect of the workforce environment score on the perceived overall impact score was examined to determine whether there was a statistically significant effect of the workforce environment on the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces to ensure that mediation analysis was appropriate to conduct in this study. In Table 4.9, the model statistics for the linear regression analysis of the primary dependent variable, overall impact, were significant. There was a positive association and significant effect between the workforce environment and the perceived overall impact:  $\beta=0.086$ ,  $SE=0.007$ ,  $p<0.001$ . The  $R^2$  value for the model suggest that the model accounted for 9.3 percent of the variation in the dependent variable. The model revealed that higher supervisory status, female gender, Hispanic ethnicity, race, governmental employer, tenure in public health practice, and education status were all positively correlated with the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. Compared with non-supervisors, supervisors ( $\beta=0.327$ ,  $SE=0.144$ ,  $p=0.029$ ), managers ( $\beta=1.843$ ,  $SE=0.290$ ,  $p<0.001$ ), and executives ( $\beta=3.110$ ,  $SE=0.353$ ,  $p<0.001$ ) perceived a higher overall impact of the emerging public health issues on their day-to-day work. Female public health workers perceived a higher overall impact ( $\beta=0.750$ ,  $SE=0.179$ ,  $p<0.001$ ) to their day-to-day work than the male public health workers. When Hispanic workers were compared to non-



**Table 4.9.** Regression results for mediation analysis - Step 1

Public Health Practitioner Characteristics	Estimate ( $\beta$ )	SE	<i>p</i>	95% CI	
				Lower	Upper
Intercept	5.14	0.48	<0.001	4.17	6.12
<i>Independent Variable:</i>					
Work Environment	<b>0.09</b>	0.01	<0.001	0.07	0.10
<i>Control Variables:</i>					
Supervisory Status:					
Supervisor	<b>0.33</b>	0.14	0.029	0.04	0.62
Manager	<b>1.84</b>	0.29	<0.001	1.26	2.43
Executive	<b>3.11</b>	0.35	<0.001	2.40	3.82
Non-supervisor	--	--	--	--	--
Gender:					
Female	<b>0.75</b>	0.18	0.000	0.39	1.11
Non-binary/Other	0.22	0.42	0.602	-0.63	1.07
Male	--	--	--	--	--
Hispanic or Latino:					
Yes	<b>0.86</b>	0.16	<0.001	0.53	1.18
No	--	--	--	--	--
Race:					
Black or African American	<b>1.44</b>	0.28	<0.001	0.88	2.01
Other	<b>1.07</b>	0.15	<0.001	0.78	1.37
White	--	--	--	--	--
Age:					
(31 – 40 years)	-0.21	0.20	0.308	-0.61	0.20
(41 – 50 years)	-0.09	0.26	0.727	-0.61	0.43
(51 – 60 years)	-0.39	0.22	0.094	-0.84	0.07
(> 61 years)	<b>-0.76</b>	0.20	0.000	-1.16	-0.36
(< 30 years)	--	--	--	--	--
Employer:					
Local government	<b>0.61</b>	0.20	0.004	0.21	1.01
Federal government	3.05	1.85	0.107	-0.68	6.78
Non-governmental	1.49	1.52	0.330	-1.57	4.56
State government	--	--	--	--	--
Tenure in Public Health Practice:					
6-10 years	<b>0.68</b>	0.25	0.010	0.17	1.19
11-15 years	<b>0.51</b>	0.15	0.001	0.21	0.81
16-20 years	-0.16	0.61	0.788	-1.39	1.06
21 years or above	<b>0.62</b>	0.17	0.001	0.28	0.97
0-5 years	--	--	--	--	--
Educational Status:					
Public Health degree	<b>2.15</b>	0.16	<0.001	1.82	2.48
Non-Public Health degree	--	--	--	--	--
F Value	142.52				
Pr > F	<0.001				
R <sup>2</sup>	0.093				

Abbreviations: CI, confidence intervals.

Note: Bold  $\beta$  indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

Hispanic workers, their perceived overall impact of the emerging issues was higher ( $\beta=0.855$ ,  $SE=0.148$ ,  $p<0.001$ ). Black public health workers, when compared to white co-workers, had an increased perception of the overall impact on their daily work by the emerging public health issues ( $\beta=1.444$ ,  $SE=0.278$ ,  $p<0.001$ ).

Public health workers of other races perceived a higher overall impact issues ( $\beta=1.074$ ,  $SE=0.148$ ,  $p<0.001$ ) to their day-to-day work than the white public health workers. Local governmental employees had an increased overall impact ( $\beta=0.612$ ,  $SE=0.197$ ,  $p=0.004$ ) of the emerging issue on their day-to-day work when equated to state governmental employees. Public health practitioners with 6 to 10 years of tenure ( $\beta=0.679$ ,  $SE=0.252$ ,  $p=0.010$ ); 11 to 15 years of tenure ( $\beta=0.512$ ,  $SE=0.148$ ,  $p=0.001$ ); and 21 or more years of tenure ( $\beta=0.623$ ,  $SE=0.169$ ,  $p=0.001$ ), when compared to those with 5 or less years of tenure in public health practice, experienced a higher perceptions of overall impact on their daily work by the emerging public health issues. Public health workers that have a public health degree had a higher perceived overall impact of the emerging public health issue on their day-to-day work ( $\beta=2.149$ ,  $SE=0.162$ ,  $p<0.001$ ), then those workers that did not have a public health degree.

The model also revealed that increased age was negatively correlated with the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. Public health workers that are 61 years of age or older experienced a decrease in perceived overall impact of the emerging issues when likened to public health workers that were 30 years of age or younger ( $\beta=-0.761$ ,  $SE=0.197$ ,  $p<0.001$ ).

Before continuing to the second step, it needed to be determined if mediation had occurred. The general test for mediation was utilized to examine the relation between workforce environment, the overall impact of the emerging public health issues, and overall knowledge of

the emerging public health issues. As presented in Table 4.10, the correlations between the workforce environment and the perceived overall impact of the emerging public health issues, between the workforce environment and the overall knowledge of the emerging public health issues, and between the overall knowledge and the perceived overall impact were all significant.

**Table 4.10.** Pearson Correlation to determine significance for inclusion in Mediation Analysis

Pearson Correlation Coefficients			
Prob >  r  under H0: Rho=0 Number of Observations			
	Overall Impact	Workforce Environment	Overall Knowledge
Overall Impact	1.000	0.176	0.777
		<.0001	<.0001
	38513	38460	38508
Workforce Environment	0.176	1.000	0.178
	<.0001		<.0001
	38460	43575	43207
Overall Knowledge	0.777	0.178	1.000
	<.0001	<.0001	
	38508	43207	43269

The second step in the analysis is the Path A model. During this model, the effect of the workforce environment score on the overall knowledge score was examined to determine whether there was a statistically significant effect of the workforce environment on the overall individual knowledge of the emerging public health issues among the state and local public health agency workforces. The model statistics for the linear regression analysis of the dependent variable, overall knowledge, were significant (Table 4.11). There was a positive association and significant effect between the workforce environment and the overall knowledge:  $\beta=0.068$ ,  $SE=0.007$ ,  $p<0.001$ . The  $R^2$  value for the model suggest that the model accounted for 13.4 percent of the variation in the dependent variable. The model revealed that higher supervisory status, female gender, race, governmental employer, tenure in public health practice, and education status were all positively correlated with the overall knowledge of the emerging public health issues among

**Table 4.11.** Regression Results for Mediation analysis - Step 2

Public Health Practitioner Characteristics	Estimate ( $\beta$ )	SE	<i>p</i>	95% CI	
				Lower	Upper
Intercept	14.37	0.50	<0.001	13.35	15.39
<i>Independent Variable:</i>					
Work Environment	<b>0.07</b>	0.01	<0.001	0.05	0.08
<i>Control Variables:</i>					
Supervisory Status:					
Supervisor	0.43	0.39	0.285	-0.37	1.22
Manager	<b>2.32</b>	0.14	<0.001	2.04	2.60
Executive	<b>4.41</b>	0.18	<0.001	4.04	4.78
Non-supervisor	--	--	--	--	--
Gender:					
Female	<b>0.54</b>	0.11	<0.001	0.31	0.76
Non-binary/Other	-0.44	0.37	0.237	-1.18	0.30
Male	--	--	--	--	--
Hispanic or Latino:					
Yes	0.17	0.13	0.208	-0.10	0.44
No	--	--	--	--	--
Race:					
Black or African American	0.38	0.17	0.031	0.04	0.72
Other	<b>0.54</b>	0.14	0.001	0.25	0.84
White	--	--	--	--	--
Age:					
(31 – 40 years)	-0.34	0.22	0.129	-0.77	0.10
(41 – 50 years)	-0.13	0.26	0.624	-0.65	0.40
(51 – 60 years)	-0.25	0.22	0.270	-0.70	0.20
(> 61 years)	-0.10	0.24	0.688	-0.57	0.38
(< 30 years)	--	--	--	--	--
Employer:					
Local government	<b>0.81</b>	0.21	0.001	0.37	1.24
Federal government	2.25	1.78	0.212	-1.34	5.84
Non-governmental	<b>0.98</b>	0.43	0.027	0.12	1.84
State government	--	--	--	--	--
Tenure in Public Health Practice:					
6-10 years	0.41	0.24	0.089	-0.07	0.89
11-15 years	<b>0.51</b>	0.14	0.001	0.23	0.80
16-20 years	0.26	0.41	0.529	-0.57	1.09
21 years or above	<b>0.45</b>	0.12	0.001	0.19	0.70
0-5 years	--	--	--	--	--
Educational Status:					
Public Health degree	<b>3.27</b>	0.19	<0.001	2.88	3.67
Non-Public Health degree	--	--	--	--	--
F Value	<b>515.10</b>				
Pr > F	<0.001				
R <sup>2</sup>	0.134				

Abbreviations: CI, confidence intervals.

Note: Bold  $\beta$  indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

the state and local public health agency workforces. When compared with non-supervisors, managers ( $\beta=2.318$ ,  $SE=0.137$ ,  $p<0.001$ ) and executives ( $\beta=4.409$ ,  $SE=0.185$ ,  $p<0.001$ ) reported a higher overall knowledge of the emerging public health issues. Public health workers of other races had a higher overall knowledge of the emerging issues ( $\beta=0.544$ ,  $SE=0.145$ ,  $p=0.001$ ) than white public health workers. Female public health workers had a higher overall knowledge of the emerging issues ( $\beta=0.750$ ,  $SE=0.179$ ,  $p<0.001$ ) than the male public health workers. Local governmental employees ( $\beta=0.808$ ,  $SE=0.215$ ,  $p=0.001$ ) and non-governmental employees ( $\beta=0.978$ ,  $SE=0.426$ ,  $p=0.027$ ) had an increased overall knowledge of the emerging issues as opposed to state governmental employees.

Public health practitioners with 11 to 15 years of tenure ( $\beta=0.512$ ,  $SE=0.148$ ,  $p=0.001$ ) and 21 or more years of tenure ( $\beta=0.623$ ,  $SE=0.169$ ,  $p=0.001$ ), when compared to those with 5 or less years of tenure in public health practice, conveyed a higher overall knowledge of the emerging issues in public health. Public health workers that have a public health degree also reported a higher overall knowledge of the emerging public health issues ( $\beta=3.275$ ,  $SE=0.194$ ,  $p<0.001$ ), than those workers that did not have a public health degree.

The third step in the analysis is the Path B model. During this model, the relationship between the overall knowledge score (the mediator) on the perceived overall impact score was examined to determine whether there was a statistically significant effect of the mediator (overall knowledge of the emerging public health issues) on the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. The model statistics for the linear regression analysis of the primary dependent variable, overall impact, were significant (Table 4.12). There was a positive association and significant effect between the overall knowledge and the perceived overall impact:  $\beta=1.030$ ,  $SE=0.007$ ,  $p<0.001$ . The  $R^2$  value for the

model suggest that the model accounted for 63.2 percent of the variation in the dependent variable. The model revealed that Hispanic ethnicity, race, and governmental employer were all positively correlated with higher perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. When Hispanic workers were compared to non-Hispanic workers, their perceived overall impact of the emerging issues was higher ( $\beta=0.635$ ,  $SE=0.095$ ,  $p<0.001$ ). Black public health workers, when compared to white co-workers, had an increased perception of the overall impact on their daily work by the emerging public health issues ( $\beta=1.071$ ,  $SE=0.217$ ,  $p<0.001$ ). Public health workers of other races had a higher overall perception of the overall impact of the emerging issues ( $\beta=0.526$ ,  $SE=0.108$ ,  $p<0.001$ ) than white public health workers. Federal governmental employees ( $\beta=1.190$ ,  $SE=0.390$ ,  $p=0.004$ ) had an increased overall knowledge of the emerging issues as opposed to state governmental employees.

The model also revealed that higher supervisory status, increased age, and educational status were negatively correlated with the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. When compared with non-supervisors, supervisors ( $\beta= -0.196$ ,  $SE=0.080$ ,  $p=0.018$ ) and executives ( $\beta= -0.680$ ,  $SE=0.200$ ,  $p=0.002$ ) perceived a decreased overall impact of the emerging public health issues on their day-to-day work. Also, public health workers that were 51 to 60 years of age and 61 years of age or older experienced a decrease in perceived overall impact of the emerging issues when likened to public health workers that were 30 years of age or younger ( $\beta= -0.282$ ,  $SE=0.127$ ,  $p=0.032$ ;  $\beta= -0.729$ ,  $SE=0.208$ ,  $p=0.001$ ). Public health workers that do have a public health degree also reported a lower overall impact of the emerging public health issues ( $\beta= -0.572$ ,  $SE=0.111$ ,  $p<0.001$ ), then those workers that did not have a public health degree.

**Table 4.12.** Regression Results for Mediation analysis - Step 3

Public Health Practitioner Characteristics	Estimate ( $\beta$ )	SE	<i>p</i>	95% CI	
				Lower	Upper
Intercept	-9.54	0.16	<0.001	-9.87	-9.21
<i>Independent Variable:</i>					
Overall Knowledge of emerging public health issues	<b>1.03</b>	0.01	<0.001	1.02	1.04
<i>Control Variables:</i>					
Supervisory Status:					
Supervisor	<b>-0.20</b>	0.08	0.018	-0.36	-0.04
Manager	-0.03	0.17	0.856	-0.37	0.31
Executive	<b>-0.68</b>	0.20	0.002	-1.08	-0.28
Non-supervisor	--	--	--	--	--
Gender:					
Female	0.16	0.10	0.120	-0.04	0.37
Non-binary/Other	-0.17	0.43	0.693	-1.03	0.69
Male	--	--	--	--	--
Hispanic or Latino:					
Yes	<b>0.64</b>	0.10	<0.001	0.44	0.83
No	--	--	--	--	--
Race:					
Black or African American	<b>1.07</b>	0.22	<0.001	0.63	1.51
Other	<b>0.53</b>	0.11	<0.001	0.31	0.75
White	--	--	--	--	--
Age:					
(31 – 40 years)	-0.17	0.16	0.297	-0.50	0.16
(41 – 50 years)	-0.12	0.13	0.372	-0.38	0.15
(51 – 60 years)	<b>-0.28</b>	0.13	0.032	-0.54	-0.03
(> 61 years)	<b>-0.73</b>	0.21	0.001	-1.15	-0.31
(< 30 years)	--	--	--	--	--
Employer:					
Local government	0.02	0.07	0.729	-0.12	0.17
Federal government	<b>1.19</b>	0.39	0.004	0.40	1.98
Non-governmental	0.59	1.30	0.653	-2.04	3.22
State government	--	--	--	--	--
Tenure in Public Health Practice:					
6-10 years	0.02	0.09	0.789	-0.16	0.21
11-15 years	0.10	0.15	0.497	-0.19	0.39
16-20 years	-0.09	0.09	0.330	-0.28	0.10
21 years or above	0.16	0.10	0.130	-0.05	0.37
0-5 years	--	--	--	--	--
Educational Status:					
Public Health degree	<b>-0.57</b>	0.11	<0.001	-0.80	-0.35
Non-Public Health degree	--	--	--	--	--
F Value	4191.81				
Pr > F	<0.001				
R <sup>2</sup>	0.632				

Abbreviations: CI, confidence intervals.

Note: Bold  $\beta$  indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

For the fourth step in the analysis, the mediator (overall knowledge of the emerging public health issues) was added to the model and the effect of the workforce environment score on the perceived overall impact score was examined to determine whether there was still a statistically significant effect of the workforce environment on the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. In Table 4.13, the model statistics for the linear regression analysis of the primary dependent variable, overall impact, were still significant. There was still a positive association that was statistically significant between the workforce environment and the perceived overall impact, however, due to the addition of the mediator, it was reduced:  $\beta=0.030$ ,  $SE=0.002$ ,  $p<0.001$ . The  $R^2$  value for this model suggested that the model accounted for 63.5 percent of the variation in the dependent variable. The model also shows that the association between the mediator and perceived overall impact is still positive and statistically significant ( $\beta=1.019$ ,  $SE=0.007$ ,  $p<0.001$ ).

This final model revealed that Hispanic ethnicity, race, governmental employer, and increased tenure in public health practice were all positively correlated with perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. When compared to non-Hispanic workers, Hispanic workers perceived an increase overall impact of the emerging issues ( $\beta=0.643$ ,  $SE=0.094$ ,  $p<0.001$ ). Black public health workers, when compared to white co-workers, had an increased perception of the overall impact on their daily work by the emerging public health issues ( $\beta=1.086$ ,  $SE=0.216$ ,  $p<0.001$ ). Public health workers of other races had a higher overall perception of the overall impact of the emerging issues ( $\beta=0.549$ ,  $SE=0.099$ ,  $p<0.001$ ) than white public health workers. Federal governmental employees ( $\beta=1.227$ ,  $SE=0.49$ ,  $p=0.009$ ) had an increased overall knowledge of the emerging issues as opposed to state governmental employees. Public health practitioners with twenty-one or



**Table 4.13.** Regression Results for Mediation analysis - Step 4

Public Health Practitioner Characteristics	Estimate ( $\beta$ )	SE	p	95% CI	
				Lower	Upper
Intercept	-11.34	0.22	<0.001	-11.79	-10.88
<i>Independent Variable:</i>					
Work Environment	<b>0.03</b>	0.00	<0.001	0.03	0.03
<i>Mediator:</i>					
Overall Knowledge of emerging public health issues	<b>1.02</b>	0.01	<0.001	1.00	1.03
<i>Control Variables:</i>					
Supervisory Status:					
Supervisor	<b>-0.25</b>	0.08	0.004	-0.42	-0.08
Manager	-0.08	0.17	0.659	-0.43	0.27
Executive	<b>-0.83</b>	0.21	0.000	-1.25	-0.40
Non-supervisor	--	--	--	--	--
Gender:					
Female	0.16	0.10	0.126	-0.05	0.37
Non-binary/Other	-0.04	0.41	0.914	-0.88	0.79
Male	--	--	--	--	--
Hispanic or Latino:					
Yes	<b>0.64</b>	0.09	<0.001	0.45	0.83
No	--	--	--	--	--
Race:					
Black or African American	<b>1.09</b>	0.22	<0.001	0.65	1.52
Other	<b>0.55</b>	0.10	<0.001	0.35	0.75
White	--	--	--	--	--
Age:					
(31 – 40 years)	-0.13	0.14	0.361	-0.42	0.16
(41 – 50 years)	-0.06	0.12	0.608	-0.31	0.18
(51 – 60 years)	-0.24	0.13	0.065	-0.50	0.02
(> 61 years)	<b>-0.69</b>	0.19	0.001	-1.08	-0.31
(< 30 years)	--	--	--	--	--
Employer:					
Local government	0.02	0.07	0.812	-0.12	0.15
Federal government	<b>1.23</b>	0.45	0.009	0.32	2.13
Non-governmental	0.64	1.37	0.644	-2.14	3.41
State government	--	--	--	--	--
Tenure in Public Health Practice:					
6-10 years	0.10	0.09	0.268	-0.08	0.28
11-15 years	0.17	0.14	0.241	-0.12	0.45
16-20 years	-0.01	0.10	0.886	-0.21	0.18
21 years or above	<b>0.24</b>	0.11	0.031	0.02	0.45
0-5 years	--	--	--	--	--
Educational Status:					
Public Health degree	<b>-0.53</b>	0.11	<0.001	-0.75	-0.32
Non-Public Health degree	--	--	--	--	--
F Value	<b>4503.99</b>				
Pr > F	<0.001				
R <sup>2</sup>	0.635				

Abbreviations: CI, confidence intervals.

Note: Bold  $\beta$  indicates statistically significant differences compared with the reference category at  $p < 0.05$ .

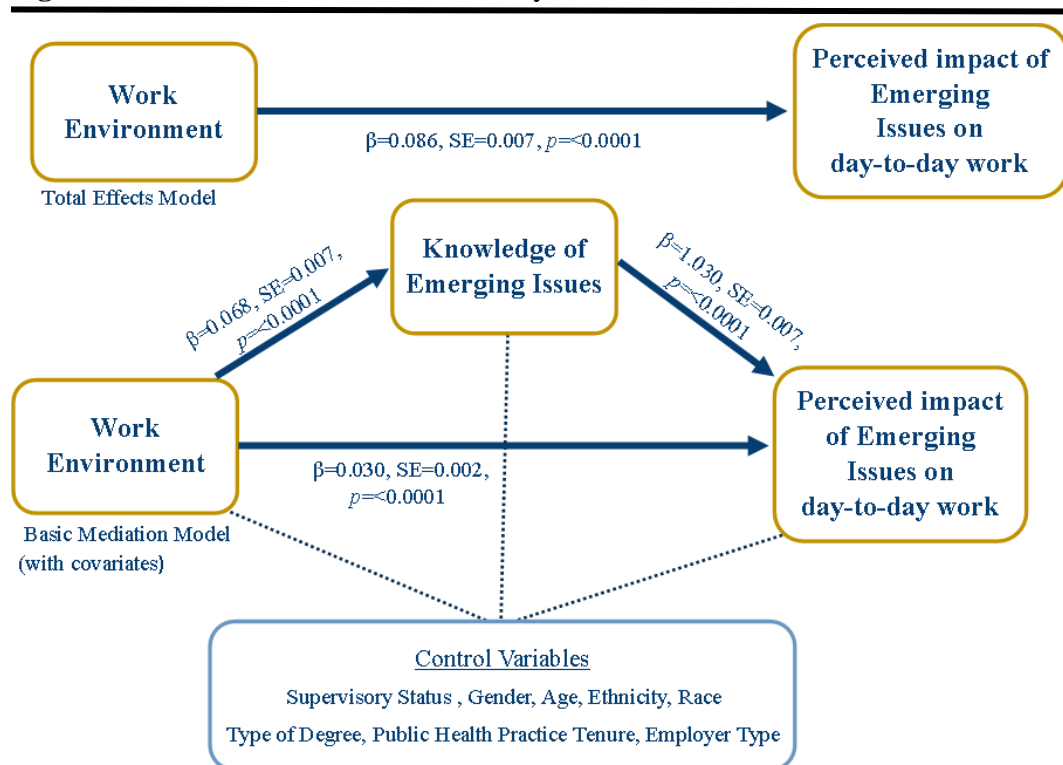
more years of tenure, when compared to those with 5 or less years of tenure in public health practice, experienced a higher perception of overall impact on their daily work by the emerging public health issues ( $\beta=0.238$ ,  $SE=0.106$ ,  $p=0.031$ ).

The model also revealed that higher supervisory status, increased age, and educational status were negatively correlated with the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. When compared with non-supervisors, supervisors ( $\beta= -0.249$ ,  $SE=0.082$ ,  $p=0.004$ ) and executives ( $\beta= -0.826$ ,  $SE=0.210$ ,  $p<0.001$ ) perceived a decreased overall impact of the emerging public health issues on their day-to-day work. Also, public health workers that were 61 years of age or older experienced a decrease in perceived overall impact of the emerging issues when likened to public health workers that were 30 years of age or younger ( $\beta= -0.695$ ,  $SE=0.191$ ,  $p=0.001$ ). Public health workers that do have a public health degree also reported a lower overall impact of the emerging public health issues ( $\beta= -0.532$ ,  $SE=0.106$ ,  $p<0.001$ ), than those workers without a public health degree.

The total effect model showed a significant positive relationship between the workforce environment and the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces (Figure 4.1). The Path A model showed that workforce environment is also positively related to the overall knowledge of the emerging public health issues. The Path B model then showed that the overall knowledge of the emerging public health issues positively predicts the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces. Finally, workforce environment does predict the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces when controlling for the overall knowledge of the

emerging public health issues. However, this method alone does not allow for a formal test of the indirect effect so it is still uncertain if the change in this relationship is truly significant.

**Figure 4.1.** Results of the mediation analysis



The final process of the mediation analysis for this study included performing the bootstrapping. The bootstrapping method was used to compute the point estimate of the indirect effect over a large number of random samples. This method needed the Path A model, which was the working environment predicting the mediator (overall knowledge). It also needed a model of the direct effect of the workforce environment on the perceived overall impact, when controlling for the overall knowledge. Bootstrapping method then used mediate to repeatedly simulate a comparison between these models and to test the significance of the indirect effect of overall knowledge emerging public health issues.

For this study, the mediation analysis was based on 5,000 bootstrapped samples using bias-corrected and accelerated 95% confidence intervals. In Table 4.14, the bootstrapping method showed that after controlling for the effect of the covariates, the workforce environment had a statistically significant total effect on the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces (TE=0.085, SE=0.003,  $p < 0.001$ ), a significant residual direct effect (DE=0.032, SE=0.002,  $p < 0.001$ ), and a significant indirect effect (IE=0.053, SE=0.002, LL=0.049, UL=0.057). As stated above, the overall mediation analysis results showed the existence of a statistically significant partial mediating effect (62.68% mediation) of the overall knowledge of the emerging public health issues in the relationship between workforce environment and the perceived overall impact of the emerging public health issues on the day-to-day state and local public health agency workforces.

**Table 4.14.** Bootstrap Analysis of Direct and Indirect Effects

	Estimate	SE	Bootstrap SE	95% CI		Bootstrap Bias Corrected 95% CI		Z	p
				Lower	Upper	Lower	Upper		
Total Effect	0.09	0.003	0.003	0.08	0.09	0.08	0.09	32.31	<.0001
Controlled Direct Effect (CDE)	0.03	0.002	0.002	0.03	0.04	0.03	0.04	18.54	<.0001
Natural Direct Effect (NDE)	0.03	0.002	0.002	0.03	0.04	0.03	0.04	18.54	<.0001
Natural Indirect Effect (NIE)	0.05	0.002	0.002	0.05	0.06	0.05	0.06	26.28	<.0001
Percentage Mediated	62.68	1.556	1.661	59.63	65.73	59.57	66.11	40.28	<.0001

Abbreviations: SE, standard error; CI, confidence intervals.

Note: Number of Bootstrap Samples = 5000

## CHAPTER V – DISCUSSION

In an era where public health has been viewed as a global, multi-disciplinary field, defined in a variety of different ways, and misunderstood by many, the public health workforce has remained united to consistently hold fast to the mission of protecting, promoting, and improving the health of the public.<sup>1,59,70,310</sup> In the twenty-first century, the state of the public health system and the role of the public health worker has continued to change and that change has unfortunately been accompanied with the challenges and obstacles associated with workers that have diverse backgrounds and many that lack formal public health training.<sup>10,34,115</sup> In order to overcome these challenges and obstacles, public health workforce have needed to adapt their day-to-day practice in order to include the emerging public health issues.<sup>10</sup> The purpose of this research was to examine the perceived impact of emerging issues in public health on the day-to-day work of state and local public health agency workforces, as well as, if the workforce environment was associated with variations in perceived individual impact. The extent to which the knowledge of the emerging public health issues mediated the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce was also explored. This study sought to expand on previous public health workforce research that examined the individual overall awareness of the emerging public health issues and the extent to which the workforce environment was associated with the individual-level variation in awareness.<sup>16</sup>

### Discussion

Overall, this study found that on an individual-level the workforce environment was significantly associated with the perceived overall impact of the emerging public health issues, as well as, with the perceived impact of each individual emerging issue, on the day-to-day work of

state and local public health workforce. Examples of the aspects of the workforce environment included the workers feeling as if their work had meaning, that their work aligned with their agency's goals, supported by leadership to pursue professional development, open communication throughout the agency, and ability to appropriately utilize the available technology. The association was positive, meaning that the more positive the workforce environment, the greater the perceived impact of the emerging issues. This finding was consistent with previous studies that have found that organizational climate, culture and leadership have an effect upon not only the workplace environment but also work engagement and meaningfulness.<sup>311-313</sup> The association between an emerging issue significantly impacting an individual's day-to-day practice and the workforce environment was highest for Evidence-based public health (EBPH) practice and fostering a culture of quality improvement (QI). This was not a surprise, since the impact of EBPH and QI on health outcomes, workforce training, and agency culture have been at forefront of research for many years.<sup>143,150,314,315</sup>

The current study also found that a positive workforce environment was associated with an increased overall knowledge of the emerging issues in public health, supported the findings of Shah and Madamala (2015).<sup>16</sup> The Job Characteristics Theory and the Organizational Development Theory were both useful in guiding the decision to utilize the overall knowledge of the emerging issues as mediating variable in the relationship between workforce environment and overall impact of the emerging issues; as well as, to evaluate and interpret the findings and implications for practice and future research. This study showed that the overall knowledge of the emerging public health issues partially mediated the effect of the workforce environment on the perceived overall impact of the emerging issues. This reinforced the principles of the Job Characteristics Theory which states that job design influences motivation, work performance, and

job satisfaction, thus certain job characteristics affect the outcomes of the jobs.<sup>305</sup> It also reinforced the principles of the Kurt Lewin's Organizational Development Theory that explain the need to expand the knowledge and effectiveness of people in order to accomplish more successful organizational change and performance.<sup>306,307</sup> This was consistent with previous studies that supported the idea that those workers that experience a positive workforce environment have an increased motivation to continually gain knowledge of a job-related issues, topics, or skills, which in turn, leads a perception that their overall job performance was the impacted by those newly acquired knowledge about the job-related issue, topic, or skill.<sup>316,317</sup>

Black public health practitioners perceived either being marginally and/or significantly impacted by all of the emerging public health issues when compared to white practitioners. Public health practitioners of other races also perceived either being marginally or significantly impacted by five out of six of the emerging health issues. Black and workers of other races were positively correlated with an increased perception of the overall impact on their daily work by the emerging public health issues when they have increased overall knowledge of the emerging issues and a perceived positive workforce environment when compared to white public health workers. Hispanic public health practitioners perceived being significantly impacted by four of the six emerging public health issues when compared to non-Hispanic practitioners. Hispanic public health workers were also positively correlated with an increased perception of the overall impact on their daily work by the emerging public health issues when they have increased overall knowledge of the emerging issues and a perceived positive workforce environment when compared to non-Hispanic public health workers. These findings show that when exposed to the emerging issues in public health via formal and informal training, black and practitioners of other races seem to be retaining and applying the knowledge in their day-to-day practice more than their

white co-workers. These findings are also true for Hispanic public health practitioners when compared to those that are non-Hispanic.

Other findings of this study showed that overwhelmingly the public health workforce is comprised of non-Hispanic white females that are in a supervisor role and do not have a public health degree. This finding was very consistent with previous studies regarding public health workforce composition.<sup>94</sup> Having an executive role were significantly positively associated with having perceived either being marginally or significantly impacted by all of the emerging public health issues. Having 21 or more years of tenure in public health practice was important in the perception of impact in three of the six emerging issues in public health. Finally, having a public health degree was positively associated with an individual perception of impact of four of the six emerging issues. These results may suggest that mastery of the skills and knowledge associated with the emerging public health issues seem to influence their perceived impact. Mastery of these emerging issues not only come from formal public health training but also appear to have been learned on the job by those in senior-level supervisory roles and/or those with a long tenure in public health practice. The mean score for overall knowledge of the emerging public health issues was 20.65, which may suggest a gap in awareness of the emerging issues by the public health workforce.

The awareness gap could be attributable to underlying reasons such as a disconnect between the workforce and leadership, a lack of shared understanding of the issues, or a lack of incentives for the workforce to adopt these modalities into their day-to-day practice. One recommendation to strategically increase awareness about the significance that the emerging issues have on public health practice would be the use of target training. The targeting training should include coursework in public health foundations, emerging issues, and the use of public health



tools. Another recommendation to increase the perceived impact of the emerging issues and also possibly address the awareness gap may be the need for public health agencies, at all levels, to incorporate the targeting training, and other awareness raising activities, into their strategic plan, their agency goals and objectives, and included in their planning for accreditation, if applicable. One final recommendation would be for public health agencies to require that the targeted training be for all public health workers entering positions at any public health agency, as well as, part of their continuing educational requirements.

### Strengths and Limitations

The main strength of this study was that it utilized a quantitative study design that used reliable data from survey administrators that has been shown to have consistent and reliable data. The Association of State and Territorial Health Officials (ASTHO) and de Beaumont Foundation continually conduct studies concerning public health practice and workforce, and they have reliable instruments. The Public Health Workforce Interests and Needs Survey the only nationally-representative survey of the public health workforce, at both state and local levels.<sup>30,78,79</sup> By applying the state and local sample weights, modifications were made to account for subsampling of staff, while also making nonresponse and post-stratification adjustments.

Some limitations of this study included the self-reported nature of the data and the fact that the data is secondary. ASTHO and de Beaumont Foundation attest that smaller health departments were not included in the local sampling frame, the frame only included medium and large local health departments; which meant that only local health departments with a jurisdiction population greater than 25,000 and employ more than 25 staff members were included. Because smaller health department were not included in the sampling frame, this could create challenges for broader generalization. An additional limitation would be that more than 95% of those that participated in

the survey were in supervisory roles and could suggest that the online only administration of the survey could have hindered its availability to field staff and other public health workers in non-supervisory roles. Also, this cross-sectional study design allowed only for correlation to be assessed, rather than causal factors.

### Public Health Implications

Organizational behavior and development theories emphasize that motivation, work performance, and job satisfaction affect an individual's job outcome and that there should always be a need within the organization to increase the knowledge and professional development of their workforce in order to accomplish more effective organizational change and performance.<sup>305-307</sup> The study finding that a positive workforce environment was associated the greater the perceived impact of the emerging issues may imply that a positive workforce environment allows for an increased motivation to continually gain knowledge that could lead to the perception that job performance was the impacted by newly acquired knowledge.<sup>316,317</sup> This study finding should be encouraging to public health agencies and their leadership in regards to providing more opportunities for professional development and continuing education, as well as, lead them to inspire their workforce to attend more off-site trainings and conferences. Also public health agency leadership should not only ensure that the organizational culture of their agency is conducive to providing a positive workforce environment but also allowing their workforce to provide feedback on a regular basis regarding their perception of their workforce environment.

The public health workforce has faced many challenges that include aging workers, low investment in the workforce, and training resources restraints.<sup>5,20,74</sup> They also have continued to contend with the issues within the health sector, such as funding and regulation changes, affecting their ability to improve population health outcomes.<sup>9</sup> The public health system has to emphasize

the need regarding investment into the public health workforce in order to not only have the manpower but also so that the practitioners have the appropriate skills and abilities to provide the populations-health focused prevention, protection, and promotion.

Public health agencies and leaders, along with schools of public health, need to model training curriculum that would not only be interdisciplinary but also adaptable to changes in the future of the public health system and workforce. As the public health workers shift into the role of chief health strategist, it may become necessary for all practitioners to have formal training in public health foundations, emerging issues, and the use of public health tools in order to effectively deliver the essential public health services to their communities. The future public health workforce will need consistent training and professional development in order to be necessarily prepared to meet the needs of their communities.

#### Recommendations for Future Research

Future studies could help address several aspects of the research. Further investigation of linkage between awareness and impact of emerging public health issues and the manner and extent to which they affect public health workforce performance and efficiency could be useful. Notably, a study that examines the impact that increased investment into the workforce has on the overall workplace environment, worker retention, professional development, and efficiency of the agency to provide services and meet the needs of the community. A qualitative study on the practitioner's perspective on the benefits, barriers, and facilitators of increasing their awareness of the emerging issues, as well as, the implementation of the emerging issues into their day-to-day practice.

Another crucial next step for research could be identification of the associations between individual public health practitioner characteristics and organizational capacity that could aide public health organizations in strengthening their capability to deliver the essential public health

services and improve population health outcomes. Future research could examine public health and primary care integration or the implementation of HiAP based on the needs within the community and the impact the integration would have on the overall effectiveness of the public health practitioners' ability to provide essential core public health services to their communities. Finally, research that explores the association between increased opportunities for formal public health education and professional development and building public health workforce capacity at the individual and organizational levels.

## Conclusion

Individual level research on the public health workforce has been a for challenge researchers, policymakers, and practitioners for many years; however, in the last several years the amount of individual level data on the workforce has begun to increase which is allowing for the engagement in more regular and active collaboration to address these challenges. The future public health practitioner will remain constrained by change brought forth via healthcare reform, information technology, accreditation, and demographic transitions. Thus, the reality that exists for the public health practitioner is that as the environment in which they practice will continue to require them to gain new skills, knowledge, and abilities. The emerging public health issues are perceived as marginally impacting the day-to-day work of more than 58 percent of the state and local public health workforce. As the awareness and implementation of the emerging issues increases, practitioners will be required to learn new ways of conceptualizing and decision making, while increasing their level of engagement in policy analysis, communication, evaluation and quality improvement.

With the majority of the workforce perceiving a daily impact from public health and primary care integration, HiAP, and multi-sectoral collaboration, workers will have to acquire a

deeper understanding of the other sectors that influence the environment in which they practice. This will in turn will require public health agencies and their leadership to demand an increase in the investment of their workforce. Public health practitioners will also continue to demand a positive and supportive workplace environment that will assist in inspiring a commitment to continuing education and performing their day-to-day work in the most effective and efficient way possible. As the study shows, the individual's perception of the workplace environment is significantly associated with their perceived impact of the emerging issues on their daily practice of public health. However, the knowledge of the emerging issues also plays a vital role in the perceived impact of the emerging issues. As the future of the public health system and the public health workforce will remain at some level uncertain; what will not be uncertain is that public health practitioners will have to always be committed to a lifelong journey of learning.

The public health has historically been defined by broad trends and emerging issues, which will likely continue for many years to come. This study offers a sound approach for assessing the perceived impact of the current emerging public health issues on the day-to-day work of state and local public health agency workforces and that can be replicated over time monitor the change in the emerging issues and the effect on the public health workforce.

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## APPENDIX A

## RESEARCH QUESTIONS AND RESEARCH HYPOTHESES

**1. What is the perceived impact of the six emerging public health issues on the day-to-day work of state and local public health workforce?**

**2. Is workforce environment associated with variations in perceived individual impact levels on the day-to-day work of state and local public health workforce?**

H<sub>0</sub>: After controlling for other variables in the model, there will be no association between the variations in individual impact levels on the day-to-day work and the workforce environment.

H<sub>1</sub>: After controlling for other variables in the model, there will be a significant positive association between the individual impact levels of cross-jurisdictional sharing of public health services and the workforce environment.

H<sub>2</sub>: After controlling for other variables in the model, there will be a significant positive association between the individual impact levels of fostering a culture of quality improvement and the workforce environment.

H<sub>3</sub>: After controlling for other variables in the model, there will be a significant positive association between the individual impact levels of public health and primary care integration and the workforce environment.

H<sub>4</sub>: After controlling for other variables in the model, there will be a significant positive association between the individual impact levels of evidence-based public health practice and the workforce environment.

H<sub>5</sub>: After controlling for other variables in the model, there will be a significant positive association between the individual impact levels of multi-sectoral collaboration and the workforce environment.

H<sub>6</sub>: After controlling for other variables in the model, there will be a significant positive association between the individual impact levels of multi-sectoral collaboration and type of degree obtained.

**3. To what extent does knowledge of the emerging public health issues mediate the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce?**

H<sub>0</sub>: Knowledge of the emerging public health issues does not mediate the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce.

H<sub>7</sub>: Knowledge of the emerging public health issues does mediate the relationship between workforce environment and the perceived individual impact levels on the day-to-day work of state and local public health workforce.

## APPENDIX B

## CODING METHODS BASED ON RESEARCH QUESTIONS

Variable Name	Variable Code	Survey Response	Response Re-Coded	Research Question/Hypothesis
<i>Dependent Variables</i>				
To what extent do each of the following areas impact your day-to-day work?				
Overall impact of : <ul style="list-style-type: none"> <li>• Cross-jurisdictional sharing of public health services</li> <li>• Fostering a culture of quality improvement (QI)</li> <li>• Public health and primary care integration</li> <li>• Evidence-Based Public Health Practice (EBPH)</li> <li>• Health in All Policies (HiAP)</li> <li>• Multi-sectoral collaboration</li> </ul>	Q135_x9 Q135_x2 Q135_x5 Q135_x6 Q135_x7 Q135_x15	Nothing at all (1) Not too much (2) Impact fair amount (3) Impact great deal (4)	Combined to create a continuous scale by summing all of the numbers Range for each participant will be 6-24	Research Q 1 Research Q 3 – H <sub>7</sub>
Cross-jurisdictional sharing of public health services	Q135_x9	Nothing at all Not too much Impact fair amount Impact great deal	“Not impacted” [Nothing at all coded as 0] “Marginally impacted” [Not too much and Impact fair amount coded as 1] “Significantly impacted” [Impact great deal coded as 2]	Research Q 1 Research Q 2 – H <sub>1</sub>
Fostering a culture of quality improvement (QI)	Q135_x2	Nothing at all Not too much Impact fair amount Impact great deal	“Not impacted” [Nothing at all coded as 0] “Marginally impacted” [Not too much and	Research Q 1 Research Q 2 – H <sub>2</sub>

			Impact fair amount coded as 1] “Significantly impacted” [Impact great deal coded as 2]	
Public health and primary care integration	Q135_x5	Nothing at all Not too much Impact fair amount Impact great deal	“Not impacted” [Nothing at all coded as 0] “Marginally impacted” [Not too much and Impact fair amount coded as 1] “Significantly impacted” [Impact great deal coded as 2]	Research Q 1 Research Q 2 – H <sub>3</sub>
Evidence-Based Public Health Practice (EBPH)	Q135_x6	Nothing at all Not too much Impact fair amount Impact great deal	“Not impacted” [Nothing at all coded as 0] “Marginally impacted” [Not too much and Impact fair amount coded as 1] “Significantly impacted” [Impact great deal coded as 2]	Research Q 1 Research Q 2 – H <sub>4</sub>
Health in All Policies (HiAP)	Q135_x7	Nothing at all Not too much Impact fair amount Impact great deal	“Not impacted” [Nothing at all coded as 0] “Marginally impacted” [Not too much and Impact fair amount coded as 1] “Significantly impacted” [Impact great deal coded as 2]	Research Q 1 Research Q 2 – H <sub>5</sub>

Multi-sectoral collaboration	Q135_x15	Nothing at all Not too much Impact fair amount Impact great deal	“Not impacted” [Nothing at all coded as 0] “Marginally impacted” [Not too much and Impact fair amount coded as 1] “Significantly impacted” [Impact great deal coded as 2]	Research Q 1 Research Q 2 – H <sub>6</sub>
<i>Mediating Variable</i>				
How much, if anything, have you heard about the following concepts in public health?				
Overall Knowledge of <ul style="list-style-type: none"> <li>• Cross-jurisdictional sharing of public health services</li> <li>• Fostering a culture of quality improvement (QI)</li> <li>• Public health and primary care integration</li> <li>• Evidence-Based Public Health Practice (EBPH)</li> <li>• Health in All Policies (HiAP)</li> <li>• Multi-sectoral collaboration</li> </ul>	Q4_3_Q7_9 Q4_3_Q7_2 Q4_3_Q4_3_5 Q4_3_Q4_3_6 Q4_3_Q4_3_7 Q4_3_Q4_3_15	Nothing at all (2) Not much (3) A little (4) A lot (5)	Combined to create a continuous scale by summing all of the scores  Range for each participant will be 12-30	Research Q 3 – H <sub>7</sub>
<i>Independent Variable</i>				
Workplace Environment				
<ul style="list-style-type: none"> <li>• I know how my work relates to the agency's goals and priorities.</li> <li>• The work I do is important.</li> <li>• Creativity and innovation are rewarded.</li> <li>• Communication between senior leadership and employees is good in my organization.</li> <li>• Supervisors work well with employees of different backgrounds.</li> </ul>	Q2_3_44 Q2_3_45 Q2_3_46 Q2_3_47 Q2_3_48 Q2_3_49 Q2_3_50 Q2_3_51 Q2_3_52 Q2_3_53	Strongly disagree (1) Disagree (2) Neither agree nor disagree (3) Agree (4) Strongly agree (5)	Combined to create a continuous scale by summing all of the numbers  Range for each participant will be 17-85 The higher the sum, the more positive the participant perceives	Research Q 2 – H <sub>1</sub> -H <sub>6</sub> Research Q 3 – H <sub>7</sub>

<ul style="list-style-type: none"> <li>• Supervisors in my work unit support employee development.</li> <li>• My training needs are assessed.</li> <li>• Employees have sufficient training to fully utilize technology needed for their work.</li> <li>• Employees learn from one another as they do their work.</li> <li>• My supervisor provides me with opportunities to demonstrate my leadership skills.</li> <li>• I have had opportunities to learn and grow in my position over the past year.</li> <li>• I feel completely involved in my work.</li> <li>• I am determined to give my best effort at work every day.</li> <li>• I am satisfied that I have the opportunities to apply my talents and expertise.</li> <li>• My supervisor and I have a good working relationship.</li> <li>• My supervisor treats me with respect.</li> <li>• I recommend my organization as a good place to work.</li> </ul>	<p>Q2_3_67 Q2_3_68 Q2_3_54 Q2_3_55 Q2_3_56 Q2_3_58 Q2_3_57</p>		<p>their overall workforce environment.</p>	
<i>Control Variables</i>				
Supervisory Status				
<p>What is your supervisory status?</p> <p>Non-supervisor Supervisor Manager Executive</p>	<p>Q5_3</p>	<p>Only check one: Non-supervisor (1) Supervisor (3) Manager (4) Executive (5)</p>	<p>Non-supervisor = 0 Supervisor = 1 Manager = 2 Executive = 3</p>	<p>Research Q 2 – H<sub>1</sub>-H<sub>6</sub> Research Q 3 – H<sub>7</sub></p>
Gender				
<p>What is your gender?</p> <p>Male Female Non-binary/Other</p>	<p>Q5_8</p>	<p>Only check one: Male (1) Female (2) Non-binary/Other (3)</p>	<p>Male = 0 Female = 1 Non-binary/Other = 2</p>	<p>Research Q 2 – H<sub>1</sub>-H<sub>6</sub> Research Q 3 – H<sub>7</sub></p>

Ethnicity				
Are you Hispanic or Latino?	Q5_9	Only check one: No (0) Yes (1)		Research Q 2 – H <sub>1</sub> -H <sub>6</sub> Research Q 3 – H <sub>7</sub>
Race				
Please select the racial category or categories with which you most identify. White Black or African American Native Hawaiian or other Pacific Islander Asian American Indian or Alaska Native Two or more races	Q5_10_1 Q5_10_2 Q5_10_3 Q5_10_4 Q5_10_5 Q5_10_6	Select category or categories with which you most identify.  (Yes=1)	White = 0 Black or African American = 1 Other [All other categories] = 2	Research Q 2 – H <sub>1</sub> -H <sub>6</sub> Research Q 3 – H <sub>7</sub>
Age				
What is your age in years? Please round to the nearest whole year.	Q5_11X	20 or below (1) 21 to 25 (2) 26 to 30 (3) 31 to 35 (4) 36 to 40 (5) 41 to 45 (6) 46 to 50 (7) 51 to 55 (8) 56 to 60 (9) 61 to 65 (10) 66 to 70 (11) 71 to 75 (12) 76 or above (13)	(< 30 years) = 0 (31 – 40 years) = 1 (41 – 50 years) = 2 (51 – 60 years) = 3 (> 61 years) = 4	Research Q 2 – H <sub>1</sub> -H <sub>6</sub> Research Q 3 – H <sub>7</sub>
Total number of years in Public Health Practice				
Please move the sliders to indicate how long you have been in each of the following (in years). Please round to the nearest year. In public health practice in total (in any agency, in any position)	Q5_12_3X	0-5 years (1) 6-10 years (2) 11-15 years (3) 16-20 years (4) 21 or above (5)	0-5 years = 0 6-10 years = 1 11-15 years = 2 16-20 years = 3 21 or above = 4	Research Q 2 – H <sub>1</sub> -H <sub>6</sub> Research Q 3 – H <sub>7</sub>

Employer Type				
Please specify your employer. Local government State government Federal government Non-governmental	Q5_29	Only check one: Local government State government Federal government Non-governmental	State government = 0 Local government = 1 Federal government = 2 Non-government = 3	Research Q 2 – H <sub>1</sub> -H <sub>6</sub> Research Q 3 – H <sub>7</sub>
Type of Degree (Public Health vs Non-Public Health)				
Please indicate which degrees you have attained. Check all that apply. (Yes=1) High school or equivalent Associate's degree in nursing Other associate degree BS/BA BSN BSPH Other baccalaureate degree MA/MS MBA MHSA MPA MPP MPH MSN MSW Other Master's degree DDS/DMD DrPH/PhD/ScD/other public health doctorate DNP DVM/VMD JD MD/DO, or international equivalent PharmD PhD/ScD/other non-public health doctorate	Q5_30_1 Q5_30_30 Q5_30_2 Q5_30_3 Q5_30_4 Q5_30_31 Q5_30_5 Q5_30_19 Q5_30_20 Q5_30_15 Q5_30_18 Q5_30_32 Q5_30_14 Q5_30_17 Q5_30_16 Q5_30_21 Q5_30_8 Q5_30_10 Q5_30_9 Q5_30_7 Q5_30_13 Q5_30_6 Q5_30_12 Q5_30_11	Check all that apply. (Yes=1) High school or equivalent Associate's degree in nursing Other associate degree BS/BA BSN BSPH Other baccalaureate degree MA/MS MBA MHSA MPA MPP MPH MSN MSW Other Master's degree DDS/DMD DrPH/PhD/ScD/other public health doctorate DNP DVM/VMD	“Public Health Degree” [BSPH, MPH, and public health doctorate (DrPH/PhD/ScD/other public health doctorate) coded as 0]  “Non-Public Health Degree” [all other degrees coded as 1]	Research Q 2 – H <sub>1</sub> -H <sub>6</sub> Research Q 3 – H <sub>7</sub>

		JD MD/DO, or international equivalent PharmD PhD/ScD/other non- public health doctorate		
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