ELEMENTS OF LOCAL PUBLIC HEALTH INFRASTRUCTURE THAT CORRELATE WITH BEST PRACTICE ACTIVITIES: A PRELIMINARY ANALYSIS

by

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To God be the glory, the honor, and the fame

To my parents, advising committee, friends, and colleagues

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ABSTRACT

Public health infrastructure (PHI) serves as the core foundation for essential public health and its services. However, the U.S. PHI has been weakened by understaffing, underfunding, limited resources and partnerships, and outdated data and information systems over the past few decades. The recent COVID-19 pandemic exacerbated its vulnerability and weakened nature, resulting in increased health disparities and worse health outcomes in general for the nation. The goal of this study was to identify elements of local PHI that are associated with the completion of 20 key public health activities while adjusting for state differences. Cross-sectional secondary data were acquired and linked from two national surveys of local health departments, the National Profile of Local Health Departments survey and the National Longitudinal Survey of Public Health Systems. In total, 20 multivariable logistic regression models were created to analyze the relationships between variables. State fixed effects were used in multivariable models to control for state differences. It was found that state differences affected the correlations of infrastructure variables. Several staffing elements, abilities to provide certain services, and participation in certain types of actions were strongly correlated with the completion of best practice activities. These findings will add to the discussion of what the minimum necessary elements of PHI may be.

1. INTRODUCTION

1.1 Background

The essential foundation of public health and its services are supported by public health infrastructure (Healthy People 2030, 2020). The National Association of County and City Health Officials (a.k.a. NACCHO) defines that the "local public health infrastructure includes the systems, competencies, frameworks, relationships, and resources that enable public health agencies to perform their core functions and essential services" (NACCHO, n.d.). A resilient and tenable public health infrastructure should have several key components, such as a competent and diverse workforce, adequate and flexible funding and investment, and cross-sector community partnerships (Baker et al., 2005; DeSalvo et al., 2017; Farberman et al., 2020; Healthy People 2030, 2020; The Public Health Alliance, 2022; U.S. Census Bureau, 2023). However, over the last few decades, research has revealed the United States lacks a strong and sustainable public health infrastructure.

First, the public health workforce in the United States has been understaffed, underpaid, and overworked (Farberman et al., 2020). An 80% increase in the nation's public health workforce is what is needed to provide basic services every community needs, while almost a third of the current public health professionals indicated they might resign from their jobs in the next year (de Beaumont Foundation, 2021, 2022).

Moreover, Farberman et al. (2020), Maani & Galea (2020), and the Public Health Alliance (2022) indicated that the public health infrastructure has been chronically and significantly underfunded. The overall funding for public health in the United States has been in a downward trend for the last two decades, and the LHD budgets have reduced by 24% just within the last decade. Increasing the amount, flexibility, and sustainability of funding for LHDs are urgent at the local, regional, state, and federal levels. Owsley et al. (2020), Skoufalos et al. (2017), and the Public Health Alliance (2022) indicated that public health infrastructure has also been under-resourced, leaving the LHDs failing to meet community needs effectively and timely. Challenges and complexities exist in forging partnerships and collaboration with other organizations and sectors, but

partnerships and collaboration are particularly needed to support blending and braiding of funds to maximize the use of limited resources, and ultimately improve the nation's health outcomes.

Additionally, data and information systems in public health have also been found to be fragmented and concerning. Many information systems are unable to offer actionable data to local, regional, and state public health departments to make data-driven policy decisions (Indiana Department of Health, 2022), and many LHDs reported that their current systems are somewhat or very ineffective (Indiana Department of Health, 2022; The Public Health Alliance, 2022). All these weakened core components of the public health infrastructure have undermined the capabilities of local health departments (LHDs) and other public health organizations to provide sufficient services and programs, which have exacerbated health disparities and inequity in the nation.

It is also important that rural communities are considered in the efforts of addressing health drivers and improving health outcomes in rebuilding the public health infrastructure. Rural areas occupy 72% of the land and contain 14% of the total population in the United States (Dobis et al., 2021). The rural population is sicker, older, and poorer, while they consist of many older and vulnerable populations, who particularly need access to health care. However, the current rural areas are more deficient in access to care, resources, funding, and partnerships than their counterparts (Owsley et al., 2020; Skoufalos et al., 2017). Since the COVID-19 pandemic, the core functions of the public health infrastructure have been further threatened, and it has been a stark reminder of the urgency and importance of rebuilding and sustaining a solid public health infrastructure to prepare for the next national emergency (Farberman et al., 2020). Rural areas have especially been more vulnerable to the impact of COVID than their counterparts, with health disparities more pronounced and health outcomes significantly worse in rural areas than their counterparts (Mueller et al., 2020; National Rural Health Association, 2021).

1.2 Research Gaps & Aims

Existing research has shown the key elements of the public health infrastructure that contribute to health disparities, equity, and outcomes. Some have assessed the impact of specific aspects of the infrastructure on certain health outcomes. However, none has systematically studied the correlations between the elements of local public health infrastructure and the completion of key

public health activities. Therefore, this study aims to fill this gap and accomplish the following aims:

1. Identify elements of the LHDs' infrastructure that are correlated with the completion of key public health activities (e.g., prioritization of community health needs) defined in Turnock et al. (1998).
2. Estimate how the correlations change when elements of infrastructure are controlled by the state variable.

1.3 Research Questions

To achieve the purpose of this study, the following research questions (RQ) will be answered:

RQ 1: What is the current status of public health infrastructure?

RQ 2: What are the elements of the local public health department infrastructure that are associated with the best public health practices in the United States?

RQ 3: How do the associations between elements of the local public health department infrastructure and best public health practices change when controlling for state differences?

2. LITERATURE REVIEW

2.1 Overview

As an overview of the research topic, the following elements will be introduced to provide context for the rest of this study.

- Key components that constitute a strong and sustainable public health infrastructure
- Measures of health outcomes
- Health factors that contribute to health outcomes

First, based on existing literature, some common areas that a strong and sustainable public health infrastructure possesses include but are not limited to (Baker et al., 2005; DeSalvo et al., 2017; Farberman et al., 2020; Healthy People 2030, 2020; The Public Health Alliance, 2022):

1. A competent public health workforce with well-trained staff
2. Adequate and resilient funding and investment
3. Cross-sector and community partnerships and collaborations
4. Usable public health data and robust information systems
5. Prepared to respond to public health emergencies

Before diving into the literature synthesis on how each area of the infrastructure impact health outcomes, it is important to define how health outcomes are measured first. Adapted from the County Health Rankings Model by the County Health Rankings & Roadmaps (n.d.), Figure 2.1 indicates the factors that contribute to the healthiness of a county. There are two types of health outcomes, length of life and quality of life. Length of life measures the longevity of residents in a community and is determined by several metrics, such as premature mortality, COVID-19 age-adjusted mortality, and infant mortality. On the other hand, quality of life measures the level of healthiness individuals perceive, which portrays the overall health of a community and emphasizes how physical, mental, emotional, and social health are important to individuals throughout their lifespan. It is measured by such things as poor physical health days, low birth weights, and frequent mental distress. Within each measure of health outcomes, health disparities (e.g., socioeconomic status) exist (Kindig, n.d.). Health disparity is defined as “a particular type of health difference

that is closely linked with social, economic, and/or environmental disadvantage" (Healthy People 2030, n.d.-a).

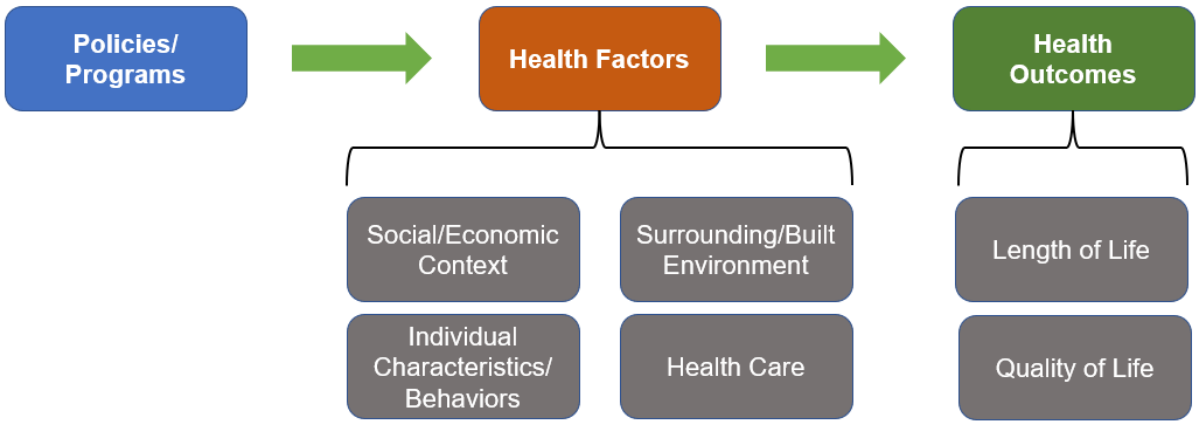

Figure 2.1 Measures of Healthiness

Several intertwined factors together impact the health of individuals and certain groups of people (County Health Rankings & Roadmaps, n.d.; World Health Organization, 2017). Health factors include the following but are not limited to:

1. Social and economic context (e.g., education, income, employment)
2. Surrounding and built environment (e.g., housing, air quality, workplace)
3. Individual characteristics and behaviors (e.g., gender, age, lifestyle)
4. Health Care (e.g., access to and quality of services and resources)

For the remainder of this chapter, major areas of the public health infrastructure that impact health outcomes are explored, including workforce, funding, resources, partnerships, data, and information systems in public health. Based on Figure 2.1, some components of the areas may directly impact health outcomes, while others may indirectly impact health outcomes when the components contribute to relevant public health policies, programs, or health factors. For each area, the recent and current state, the impacts on health outcomes, future needs, and best practices of LHDs are summarized in the subsection below. Additionally, key public health terms are defined both when they first appear and in Appendix A.

2.2 Literature Synthesis

2.2.1 Public Health Workforce

Research has shown that the public health workforce is critical in tackling health challenges of the present and future (American Public Health Association, 2021). However, constant challenges remain within the U.S. public health workforce, which has adversely impacted the public health of the nation and the delivery of health care. Consequently, the public health workforce has been underfunded, underappreciated, undertrained, and understaffed (The Public Health Alliance, 2022).

Workforce Diversity & Competencies

The U.S. has been facing growing diversity in every region of the country while disparities among racially/ethnically diverse groups persist (Jackson & Nadine Gracia, 2014; Jensen et al., 2021). A diverse public health workforce is critical to eliminating health disparities (Coronado et al., 2020). Public health professionals who have diverse experiences and perspectives are often able to suggest innovative approaches to address public health problems. Since the COVID-19 pandemic, the need for greater workforce diversity and that the LHD workforce would reflect the communities they serve have been underscored (Coronado et al., 2020; Pittman et al., 2021; The Public Health Alliance, 2022). While a diverse public health workforce plays an important role in improving health outcomes, challenges persist in developing such a workforce. LHD workforce has often been unreflective of the communities heavily burdened by health inequities and disproportionate health impact (The Public Health Alliance, 2022). As reported by many LHD executives, often limited staff is from the most influenced communities, and the persistent shortage of multicultural and multilingual staff has been a critical obstacle to rapid emergency response efforts, such as developing trust between communities and the LHDs. According to the Public Health Alliance (2022), best practices to support communities disproportionally impacted by public health emergencies include but are not limited to:

- **Establish Farmworker Resource Centers.** The Ventura County Human Services Agency established the Farmworker Resource Program in 2019 for building meaningful relationships among the agricultural community, bridging community members to resources, and handling workplace issues. This program has been instrumental in the

COVID-19 pandemic response, which has disproportionately affected Latinx and Indigenous communities and agricultural workers, through rapid translation of COVID-19-related education materials outreach to farmworkers, information sharing on resources and testing, and enhancement of community priorities during the response. Legislation has introduced this practice model across the state to require other counties in California to build farmworker resource centers.

- **Recruit Community Organizers without Educational Credentials & with Priorities to Certain Candidates.** Shasta County Community Action Agency recruited several community organizers well before COVID to support public health realignment funds. The hiring requirements did not include education credentials and they prioritized candidates who have bicultural or bilingual backgrounds and are from the disproportionately affected communities. The community organizers are trusted partners, working directly with community members, leaders, and community-based organizations (CBOs) to identify assets, needs, and priorities of the community to undertake changes in policy, systems, and the environment.

To ensure an adequately skilled workforce in addressing these challenges, training for healthcare professionals in public health is critical (Indiana Department of Health, 2022; Tilson & Gebbie, 2004). According to Jackson & Nadine Gracia (2014) and Jensen et al. (2021), with an increasingly diverse country, the U.S. Department of Health and Human Services' Office of Minority Health (HHS Office of Minority Health) has stressed promoting cultural and linguistic competencies in health and healthcare. To strengthen community-based interventions to improve health outcomes and healthcare for all individuals and serve individuals with diverse language and cultural backgrounds, it is important to prioritize developing cultural competency among healthcare providers and systems in their efforts to eliminate disparities. According to the Public Health Alliance (2022), in fact, 95% of the community organizations would indicate that it is their priority to hire multilingual staff from the communities in a community survey conducted in California statewide. However, the COVID-19 pandemic has revealed that the local public health workforce has often not been reflective of the communities most impacted, along with a shortage of staff. Leaders from the local public health departments considers shortage of multicultural and

multilingual staff as a critical obstacle to emergency response efforts, such as developing and translating materials related to the COVID-19.

Besides developing cultural competency, according to the Advisory Committee on Interdisciplinary, Community-Based Linkages (2021), training for telehealth implementation and utilization has also been revealed to be critically needed, since telehealth has become a key part of the public health infrastructure. Though existing research has demonstrated the benefits of telehealth, including promoting interprofessional collaboration, eliminating disparities associated with the underserved population (e.g., individuals with disabilities), and improving access to health care. It has become a pivotal component of health care provision within the Centers for Disease Control and Prevention framework. The COVID-19 pandemic has revealed the benefits and accessibility of telehealth to clinical care in many cases when in-person care would rather expose patients to severe health risks (Koonin et al., 2020). However, barriers to telehealth implementations exist, such as a lack of provider training in using telehealth. Many providers expressed their desire for additional training and best practices in telehealth, according to a needs assessment conducted by the Reimagine New York Commission (Wicklund, 2021). While best practices have not been provided by any studies, the Advisory Committee on Interdisciplinary Community-Based Linkages (2021) suggested that telehealth training should promote tailoring for the competencies required by each health profession.

According to the Public Health Alliance (2022), some LHDs recommended the following practices to address the above challenges:

- Work closely with recruiters to prioritize hiring multilingual and multicultural staff, who reflect the communities most burdened by inequities and disproportionate health impacts.
- Adopt standard recruitment policies and prioritize recruiting those from the communities served. For example, revise and/or remove requirements for language proficiency and minimum levels of formal education for hiring policies.
- Develop paid public health internships, mentorship programs, and professional pathways through partnerships with local schools and colleges, social services, workforce training programs, and CBOs.

- Establish cooperation with diverse stakeholders to create a Public Health Corps program and funding flow for young adults, those from the communities, and those in the communities most impacted by health inequities to be involved in LHDs.

Workforce Recruitment & Retention

The public health workforce has experienced staffing shortages and decline for decades (Baker et al., 2005; Farberman et al., 2020). Over the last decade, the public health workforce has decreased by more than 15% (Ciampa, 2023; Kumar et al., 2022). Exacerbated by the COVID-19 pandemic, the decline and shortage in public health professionals have been demonstrated in weakened capacity in the public health system (Baker et al., 2005). According to the NACCHO 2020 Forces of Change Survey Report, 76% of the LHDs indicated that they were short on staff to meet the needs that arose during the pandemic. According to an analysis by the Public Health National Center for Innovations and the de Beaumont Foundation (2021), to sufficiently provide basic public health services to the communities, over 80,00 full-time-equivalent positions are needed at the state and local health departments, which means an 80% increase in the nation's public health workforce to cover a minimal level of services every community needs.

Not only has the public health workforce been understaffed, but it has also been underpaid and overworked. Due to staffing shortages, public health workers reported that they were constantly being asked to work more while not receiving the adequate pay that they deserve, especially during the pandemic (Farberman et al., 2020). According to de Beaumont Foundation (2022), results from the 2021 Public Health Workforce Interests and Needs Survey (PH WINS) revealed the stunning fact that nearly half of the public health professionals indicated they plan to resign or retire from their jobs during the next five years. Almost a third of the public health professionals stated indicated that they have the possibility of leaving in the next year. The most common reasons for leaving their jobs include but are not limited to burnout, inadequate pay, and mental distress. To address these issues, the Public Health Alliance (2022) recommended the LHDs to 1. Establish incentive policies or programs to recruit and retain public health professionals through working with public health agencies at the state- and federal-level. 2. Conduct an LHD workforce needs assessment to learn the resources and needs of the current workforce and provide recommendations for future staffing.

According to the Public Health Alliance (2022), the COVID-19 pandemic is a stark reminder that the current public health workforce has been deficient in adaptability and flexibility to respond to changes and emergencies. Throughout the pandemic, the LHD staff constantly needed to adapt to changing and uncertain situations of COVID-19 quickly, but they often were unable to respond to the impact of a novel virus efficiently. The LHDs staff must acquire new skills and be trained in new areas of public health to respond to the next emergency. Formal graduate education and professional training have been inadequate among public health workers, which prevents professional development among public health professionals and diminishes the workforce capacity that employs these public health workers (Baker et al., 2005; Indiana Department of Health, 2022). Therefore, suggested solutions include: 1. Arrange more opportunities for public health staff to be cross-trained in various areas of public health priorities. 2. Arrange additional opportunities for public health staff to acquire knowledge and skills from new topic areas that would enhance standard public health functions and prepare for the next emergency.

Besides challenges from staffing shortage, decline, and the COVID-19 pandemic, the Indiana Department of Health (2022) noted several barriers to governmental public health recruitment from national findings, such as skills mismatch, salary discrepancy, and a general unawareness of job postings (Castrucci et al., 2015; Krasna & Fried, 2021; Sellers et al., 2019). According to the Indiana Department of Health (2022), hiring and retaining some positions in the LHDs have been a particular challenge, which prohibits timely emergency response. For instance, epidemiologists play a key role in the combat of the COVID-19 pandemic, conducting research and providing updated information such as protective behaviors and vaccine effectiveness. However, according to the 2019 profile study interactive report, though 90% of the LHDs directly provided services for communicable/infectious diseases and 84% for environmental health, only 28% of the LHDs reported that they employed an epidemiologist/statistician (NACCHO, 2019). To promote recruitment and retention in the public health workforce, the Indiana Department of Health (2022) recommend establishing and implementing the following policies:

- Provide workforce incentive programs (e.g., loan repayment programs) to relieve financial burdens from education or training expenses in return for the time of service in certain settings or areas. For example, the state-sovereign incentive program in Illinois provides nurse educators loan repayment on eligible loans that paid education expenses for

achieving formal education degrees to become a registered nurse and/or nurse educator. Selected individuals are awarded based on their balance of eligible loans, but the maximum is $5,000 per year.

- Promote experiential learning in public health by
    - Assessing the extent to which graduates from public health programs work for governmental public health organizations.
    - Ensuring applied practice experiences (e.g., practicum, internships) is one of the accreditation requirements for Master of Public Health degree programs for public health students.
    - Providing opportunities for community and professional involvement through the accredited Master's programs for public health students.
- Providing fellowships (i.e., funded opportunities to receive training in integrating and advancing skills in their fields of expertise) to develop competent public health workers in top-priority areas of needs or specialties (e.g., epidemiology). Statewide fellowships can also be integrated with other employment-based benefits to retain fellows to work in-state.

Other Workforce-related Best Practices of LHDs:

According to Public Health Alliance (2021), these are the best practices that are related to building a nimble workforce

- **Rapid hiring**: LHDs should ensure the process of recruitment and onboarding for staff to meet the critical needs of the COVID-19 response quickly, such as nurses, contact tracers, and case investigators. For instance, the Riverside Health System hired nearly 400 new staff in 7 weeks.
- **Community health workers (CHWs)**: LHDs should partner with community-based organizations to promote the expansion of networks of Community Health Workers (CHWs) and those working in Spanish-speaking communities to expand outreach and support for affected communities. Research has revealed that these workers alleviate expenses for healthcare and enhance health outcomes for individuals and communities with chronic health conditions.

2.2.2 Public Health Funding, Resources, & Partnerships

Farberman et al. (2020), Maani & Galea (2020), and the Public Health Alliance (2022) stated that funding in public health is essential to efforts of effectively addressing health inequity and disparities, lasting partnership formation and continuation, and other community-based efforts to tackle top public health needs and emergencies. However, a consistent chronic trend of underfunding has persisted in public health. The overall public health funding has been on a downward pattern for the past two decades. Just over the past decade, LHD budgets decreased by 24%. An underinvestment study by the Milbank Quarterly revealed that an additional $4.5 billion is the amount needed to provide a minimal level of public health foundation. Over the years, research has shown that a lack of consistent and sufficient funding diminishes resources and partnerships, increases utilization and spending in health care, undermines the capacities, capabilities, and operations of LHDs, weakens the core infrastructure, and exacerbates existing public health issues and crises. To address chronic underfunding and its inconsistency, the Public Health Alliance (2022) and DeSalvo et al. (2017) recommended innovative funding models for the public health systems at the state level to support LHDs to be explored and established, for which blending and braiding from various sources would be permitted or incentivized. During the COVID-19 pandemic, health disparities and inequities were exacerbated, and the pandemic disproportionately impacted certain populations and communities. Therefore, Maani & Galea (2020) suggested increasing funding for LHDs to undertake efforts in eliminating disparities and promoting community-wide health equity. In addition, the Public Health Alliance (2022) also stated the urgency to increase the flexibility and sustainability of funding for LHDs at all levels (i.e., local, regional, state, and federal). Flexible and long-term funding would allow the LHDs to recruit essential staff to perform essential services, acquire or update core equipment and facilities, purchase prioritized supplies, and explore and implement activities for tackling top public health challenges and crises in partnership with other organizations and sectors to advance health equity. The best practices mentioned in the Public Health Alliance (2022)'s report include:

1. **Guide investments through equity-focused indicators.** When funding related to COVID became available, California created several indicators of health equity to guide investments in the most affected communities. For example, the Health Equity Metric of California's Blueprint for a Safer Economy was declared in October 2020, for which the LHDs were asked to develop investment plans that provide resources to the neighborhoods

with the lowest California Healthy Places Index quartile (i.e., the least healthy communities) in each jurisdiction.

2. **Enhance LHD's capacity to support the community needs of those impacted the most by inequities through pooling resources.** For instance, the Public Health Institute executed an equity-focused COVID response program called Together Toward Health (TTH) to mitigate the expansion of the COVID-19 virus in California by bridging LHDs, CBOs, and community leaders to meet the needs of the communities through funding, coordination, and more. Their efforts are specially targeted to support the communities most affected by COVID. After all, TTH has funded over 270 CBOs across the state of California, and they were able to support the development of a linguistically and culturally equipped workforce.

As a result of the chronically underfunded public health systems, many LHDs were under-resourced, which contributed to increasingly unmet community needs and exacerbated health inequities among communities (Skoufalos et al., 2017; The Public Health Alliance, 2022). According to the Public Health Alliance (2022), their survey of CBOs revealed that 85% of CBOs agreed that general operating support would benefit them the most and make the most positive difference during the pandemic, and 77% revealed that funding, grants, and other emergency aids were their top support during the pandemic. However, over 70% of CBOs indicated that they had no contracts with any LHDs or other agencies after almost a year since COVID was reported in the U.S.. They stated that LHDs allocated resources with them in the latter part of the pandemic, but the process was slow. Due to challenges with making contracts and purchasing, almost half of the CBOs responded that having technical assistance for that would help them to be more efficient in applying for funding.

Owsley et al. (2020) and the Public Health Alliance (2022) indicated that forging stronger networks within public health is conducive to maximizing resource utilization. To increase the utilization of resources across the nation, the Public Health 3.0 framework by the federal government stresses that the public health systems need to form and strengthen partnerships with the medical and social service sectors to tackle social determinants of health (SDOH) through more efficient community resource allocation. To address varying kinds of community needs jointly,

the Public Health Alliance proposed the best practices that funders should pool resources into local rapid response funds and grant applications should be more flexible. In Biasi et al. (2019)'s work, several strategies to ease and speed grant applications, braiding, and blending of resources for maximum utilization were proposed as follows:

1. **Modify grant application processes.** This includes but is not limited to:
    a. ***Reduce grant announcements.*** When grant requirements are closely aligned, create only one announcement for that grant award. For instance, the Assistant Secretary for Preparedness and Response's Hospital Preparedness Program (ASPR's HPP) and the Centers for Disease Control and Prevention's Public Health Emergency Preparedness Cooperative Agreements (CDC's PHEPCAs) announced a joint grant together to merge their efforts to coordinate public health emergency preparedness.
    b. ***Coordinate grant timelines.*** Change the grant application process so that the start and end dates of different grants match with each other. This would ease the coordination of resources and funding between partners. For instance, ASPR's HPP and CDC's PHEPCAs ensured the start and end dates of the joint grant they proposed together were the same from FY 2012 to FY 2018.
2. **Modify grant proposal requirements or preferences.** This involves but is not limited to requiring applicants to apply for grants involved in braiding efforts, for which they need to coordinate their funding with others to undertake the same initiative in their communities.
3. **Modify planning and monitoring and reporting processes.** This includes but is not limited to requiring applicants to trace and assess the outcomes and interim metrics (e.g., education, employment, physical/mental health, and/or housing measures) for their cross-programs and award them with monetary incentives to meet the requirement.

Besides the need of increasing resource utilization and modify grant applications to allow braiding and blending, the Public Health Alliance (2022) indicated that funding for public health crises also needs to be long-term to reestablish a more maintainable public health system and infrastructure. In the pandemic response survey, nearly half of the LHDs stated that the funding they received throughout the pandemic was deficient. Many respondents indicated that the funding was temporary and offered only once to support coping with immediate needs, but that left many LHDs

unequipped to respond to the next crisis and meet other essential needs they have to operate. While the funding for the pandemic helped with short-term needs in the communities related to COVID, it did not tackle the root causes of the issues (e.g., SDOH). Maani & Galea (2020) also stated that public health funding is inclined to be reactionary and unpredictable, even before COVID. Supplemental funds were deployed to LHDs when infectious diseases appeared to be alarming threats to population health, which hinders the public health infrastructure to be sustainable and increases preventable health care utilization and expenditures.

Lack of consistent funding and resources, the public health system and LHDs have failed to form and retain trusted and robust partnerships due to their lack of capacities at the local and state levels. However, developing community partnerships is considered a core capacity that builds a strong public health system (Farberman et al., 2020). Through effective partnerships, LHDs can leverage combined resources and skills and effectively address challenging health issues (Skoufalos et al., 2017). As a part of the Public Health 3.0 initiative, public health departments are called to engage with community stakeholders to forge multi-sector partnerships (e.g., between LHDs, CBOs, and other private or public sectors) to promote collective actions in enhancing the nation's health (DeSalvo et al., 2017). To promote forming and retaining partnerships for maximizing resource utilization, the Public Health Alliance (2022) has suggested several best practices but not limited to the following:

1. **Use and arrange with fiscal intermediaries** (e.g., local community foundations) to efficiently allocate finances to smaller and less conventional partners to support the COVID-19 response. For instance, the Sierra Health Foundation was utilized by Sacramento County to make agreements with several CBOs.
2. **Intermediaries work with CBOs in joint efforts.** For instance, Prevention Institute, an intermediary to a nonprofit organization (NPO), closely worked with several high-capacity CBOs to address health inequities in the built environment for children up to 5 years old. As a result, Prevention Institute partnered with the NPO in resource allocations to meet additional needs, such as supporting resident engagement strategies during the pandemic.
3. **Continue public health crisis and relief funds.** Ensure public health crisis and relief funds are sustained for long-term use, grant applications are more flexible and easier to complete, and retain and expand networks of partnerships with existing and novel grantees.

2.2.3 Public Health Data & Information Systems

Public health data stem from a variety of data sources, such as population behavior data, environmental data, and health system data (Indiana Department of Health, 2022). A strong public health infrastructure involves having updated data and information systems (Healthy People 2030, 2020). It is important for addressing fundamental drivers of health to have timely, reliable, practical, and accurate data (DeSalvo et al., 2017). However, many information systems in public health fail to offer meaningful data to support data-driven decisions on local, regional, and state levels for making policies, as public health data has historically been isolated from reporting requirements, funding source, and so on (Indiana Department of Health, 2022). Baker et al. (2005) stated that the quality of the current information and data systems varies largely by jurisdiction - Some have exceptional systems, while systems are obsolete or unavailable in others. DeSalvo et al. (2016), the Indiana Department of Health (2022), and the Public Health Alliance (2022) indicated that the COVID-19 pandemic has exposed the broken nature of the current public health data and information systems, where the United States has been operated with inaccurate data estimates of disease spread. In a survey conducted by the Public Health Alliance before the expansion of COVID, 44% of the LHDs reported that their current data systems are somewhat or very ineffective. Race and ethnicity data has particularly been lacking, and misclassification of such data is another challenge when the data is available. These data are critical for identifying population-specific challenges amidst the global public health crisis, and not having them undermine the ability of the public health departments to trace and prepare for the impacts of COVID-19 on health equity. To strengthen public health infrastructure, workforce, and communications, improving data and information systems is a top priority to prepare for the next public health emergency (Baker et al., 2005; Farberman et al., 2020).

To address the ongoing challenges of missing, imprecise, and defective data, especially ethnicity and race data, the Public Health Alliance (2022) reported several best practices that have been successfully implemented and adopted by other organizations:

- **Improve practices of data collection.** California mandated a state-level regulation in July 2020, which requires collecting data on race/ethnicity, sexual orientation, and gender identity. However, respondents can still indicate “unknown” or “other” in their selections. To comprehensively transform the data collection practices, systematic change is needed.

- **Community outreach.** The Los Angeles Department of Public Health created an Asian & Pacific Islander Task Force, focusing on improving fractured data collection and reporting practices among the Asian American, Native Hawaiian, and Pacific Islander communities in Southern California.
- **Linking dataset.** The Urban Indian Health Institute released best practices of data collection on American Indian and Alaska Native populations in August 2020, and it involves linking data sets to address misclassification, allowing multiple selections for race/ethnicity in data collection, as well as making it possible for more precise data reporting.

The Public Health Alliance (2022) also indicated the following best practices to tackle the lack of data standards and out-of-date data systems in public health:

- Standardize and streamline the procedures for case investigation and contact tracing.
- Seek input from LHDs on data workflows, needs, and problems through interviews and focus groups with the engagement of a contractor (e.g., Deloitte).
- Routinely survey LHDs and create tools and resources to support local response. For example, create a contact tracing program readiness survey to identify immediate needs and supplement future planning.
- Develop data dashboards available to the public, which eliminate double reporting (i.e., LHDs need to report once to the state and once to the public).

2.2.4 Rural Health

According to the Office of Management and Budget, non-metro counties (i.e., rural areas) include micropolitan counties that have urban cores of 10,000 to 49,999 individuals and counties outside of metropolitan or micropolitan areas (Health Resources & Services Administration, 2022). These rural areas cover 72% of the land area of the United States. In 2020, the rural population in the United States was composed of 46 million residents, accounting for 14% of its total population (Dobis et al., 2021). According to Harrington et al. (2020), the National Rural Health Association (2021), Owsley et al. (2020), and Skoufalos et al. (2017), rural communities are very different from their urban counterparts. First, rural communities are made up of about 25% of older adults

(i.e., Americans older than age 65) in the United States, and these older adults have less access to services, resources, activities, and social cohesion than those living in urban and suburban areas. Besides older adults, migrant workers and other vulnerable populations also reside in rural areas. Second, significant health disparities are exacerbated in rural areas due to several factors, such as fewer economic opportunities, fewer resources and funding, and the opioid crisis.

Overall, the National Rural Health Association (2021) indicated that rural populations are older, poorer, and sicker than urban populations. First, health outcomes are worse in rural areas than their urban and suburban counterparts, particularly in terms of chronic disease, infant mortality, cancer outcomes, and overall life expectancy. These differences in health outcomes and health disparities have been further exacerbated by the COVID-19 pandemic. Second, rural areas have faced high vulnerability to hospital closures since 1990, and medical deserts have become more prevalent in rural areas than in urban areas, thus fracturing access to care and leading to frequent treatment delays for the rural populations (Gujral & Basu, 2020).

To address these challenges in rural areas, Haynes-Maslow et al. (2018) and Owsley et al. (2020) both indicated forging community partnerships to facilitate the implementation of public health programs and enhance the efficiency of resource allocations within communities. Cross- and multi-sector partnerships are especially needed in rural areas, where resources, services, and organizations are limited. Multisectoral partnerships have been proven to decrease the utilization of health care and preventable deaths. Through strong and expanded networks, optimizing limited resources can be achieved and several health conditions can be reduced significantly. Additionally, Haynes-Maslow et al. (2018) also recommended regular communication with communities and relevant stakeholders about the impact of behavioral change strategies and how progress on change can ensure lasting improvement.

2.3 Research Gaps

Several research gaps were revealed in the literature review. Existing literature has shown evidence and discussed components of the public health infrastructure, systems, and LHDs that are important to them or impactful to certain health outcomes. Findings based on the NACCHO's 2019 Profile Study results have been used to investigate different aspects of the public health

infrastructure on a local level. For example, Alford et al. (2021) studied how the prioritization of emergency preparedness funding within the LHDs altered before the pandemic. Shah et al. (2022) investigated how LHDs ensured food safety for Americans. Findings based on the NALSYS's results have also been used in similar means. For instance, the most recent NALSYS-related publication assessed how state Medicaid expansion affected the delivery of population health activities in cross-sector networks (Cezar Brian et al., 2023). Another recent article (Brosi & Mays, 2022) studied the relationships between variability in LHD abilities and COVID-19 deaths. However, none of the literature has systematically investigated the associations between the components of public health infrastructure and the completion of key public health activities in the United States. Therefore, this study aims to fill the gap. To systematically develop a strong public health infrastructure in the United States, it is necessary to study such associations. Because the elements of local PHI vary largely by their areal distinctions (e.g., geography, demographics, culture), particularly between rural and urban areas, it would be most appropriate to focus on studying such associations on the jurisdiction level or community level to discover what elements of the LHDs support the completion of key public health activities that are best practice activities defined in Turnock et al. (1998).

3. METHODS

3.1 Study Design and Methodology

This study was designed to be a quantitative-based, cross-sectional data analysis project, where secondary data were retrieved from the 2019 National Profile of Local Health Departments (also known as the "Profile study") and the 2018 National Longitudinal Survey of Public Health Systems (NALSYS). The 2019 Profile study provides the newest comprehensive data on the essential structure of the local health departments (LHD), whereas the 2018 NALSYS data provides the most recent comprehensive information on each local health department's participation in 20 key public health activities identified in the literature as best practices for improving population health. Responses were merged by the local health department and analysis was performed on those LHDs that responded to both surveys. The general form of the study is a series of logistic regression models where the predictor variables consist of the infrastructure variables describing the local public health departments, and the outcome variables are the 20 public health activities from the NALSYS data. Though rural PHI is distinct from urban or suburban PHI, levels of rurality are not accounted for to control the scope of this study.

3.1.1 Introduction to Data Source

The 2019 Profile study was conducted by the National Association of County and City Health Officials (NACCHO). According to Feeser (2019) and the National Association of County and City Health Officials (n.d.), the profile studies began in 1989 and have been conducted every three years, aiming to provide the most sizable and authentic source of data for each local health department. The profile studies intend to gather information about the infrastructure and practices within each LHD in an exhaustive and precise fashion. The funders of the studies are the Centers for Disease Control and Prevention (CDC) and the Robert Wood Johnson Foundation (RWJF). According to Feeser (2019), the 2019 Profile study surveyed 2,453 LHDs with the 2019 Profile questionnaire from NACCHO, which was divided into three modules – Core, Module 1, and Module 2. The topic of the questionnaire includes LHDs' staffing levels, emergency preparedness, community health assessment, and so on. The questionnaire was disseminated through e-mailing the primary contact of each LHD, resulting in an overall response rate of 61%.

According to Systems For Action (n.d.), the NALSYS data has been the only longitudinal source of data collected nationwide about the actions taken by local public health agencies in shielding and enhancing their residents' health. It sought to learn and appraise the connections between these agencies and how they collaborate in promoting health locally. According to Mays & Scutchfield (2020), the NALSYS survey was first conducted in 1998, and subsequently in 2006, 2012, 2014, 2016, and 2018. From 1998 to 2012, a stratified random sample representing the biggest local governmental public health agencies in the nation was utilized in the survey instrument, including agencies serving large-size jurisdictions of at least 100,000 residents. However, NALSYS began to enlarge the cohort of the study population in 2014, which included agencies serving small-size jurisdictions of less than 100,000 population. The most recent survey in 2018, which included 495 large-size jurisdictions and 556 small-size jurisdictions, was disseminated through mail or emails to the directors of 1,051 local governmental public health agencies (Response rate = 60%). In each NACCHO survey, a set of 20 key public health activities were used to assess the performance of local public health delivery systems. The survey sought to (1) capture the availability of public health activities in local communities, (2) ascertain the types of organizations participating in each activity, (3) discover how much overall community effort was attributed to each local public health agency, and (4) assess the effectiveness of public health activities performed.

3.1.2 Ethical Approval

The Institutional Review Board (IRB) approval was obtained before the start of the project. An exemption was granted for this secondary research under the federal human subjects research regulations 45 CFR 46.104. by the Purdue University Human Research Protection Program System (HRPP).

3.1.3 Programming Software

Coding was performed for both preparing the analytical dataset and conducting statistical analyses, for which the R version 4.2.0 (2022-04-22 ucrt) of RStudio was utilized. Refer to Appendix G for code used for data linking, cleaning, and statistical analyses.

3.1.4 Data Cleaning and Preparation

To prepare the analytic dataset, multiple steps were performed to delete, modify, or merge the data. First, a subset of the NALSYS data (n=1013) was retrieved from the complete NALSYS data (n=1916), where only the most recent NALSYS data (2018) from the prior three surveys was kept for each LHD based on its NACCHO ID. Then, the subset of NALSYS 2018 data was merged with the NACCHO 2019 data with a natural join method by the NACCHO IDs in both datasets. The merged dataset contains a total of 660 observations, which represent the LHDs that took both the 2019 NACCHO survey and the 2018 NALSYS survey.

Second, some variables were deleted from the merged dataset due to their inherent unusefulness in the study (e.g., survey weights used in developing the survey were excluded as they were not applicable to the merged data). Other variables in the merged dataset were modified based on the nature of the questions or response types. To allow for a relatively straightforward interpretation of logistic regression models, many of the predictor variables were transformed into dummy variables. For questions that treat each choice as a categorical variable, their categorical variables have binary responses (e.g., yes or no). They were directly transformed into dummy variables by using "1" to represent yes or positive responses (i.e., box was checked) and "0" to represent no or negative responses (i.e., box was not checked, but question was answered). For other questions, they often have one categorical variable representing all choices. The variables for these questions were first divided into sub-variables. Then, the original categorical variables were deleted, and the sub-variables were transformed into dummy variables. For instance, for the question that asks what the highest degree is for the top executive at the LHD, the variable for the question was divided into sub-variables that represent each degree level (i.e., Associate's, Bachelor's, Master's, or Doctorate). For continuous variables, they were left unchanged. Additionally, to avoid the dummy variable trap, at least one response to each categorical question was not coded into a dummy variable and thus served as the baseline or reference value for the other dummy variables coded from the same question. The baseline value for categorical variables was determined based on the context of the original survey question. For example, for the question that asks what the highest degree is for the top executive at an LHD, the sub-variable that represents the Associate's degree was chosen as the baseline, because it conveys the meaning of "less education" compared to the rest of the sub-variables (Bachelor's, Master's, and Doctorate).

Third, responses were treated as missing data and replaced with "NA" in the dataset whenever data cells were empty, contained bad data (e.g., character values for a numeric variable or values outside the possible range), or for values of "unknown", "not sure", or equivalent meaning. Some missing data were filled in with values by using other variables in the same questions that imply the values of the missing data. For instance, for the question that asks about the occupational categories (e.g., agency leadership) of public health staff and their full-time equivalent (FTE) status, we know that the number of FTE would be 0 if there are no staff hired for a specific occupational category in an LHD. After filling in missing data that was implied by responses to other questions, variables with missing data greater than 5% of total observations were excluded to minimize data loss in the final model due to listwise deletion.

Lastly, any remaining candidate predictors were filtered to include only those that fit the definition of local public health infrastructure (LPHI) from the NACCHO (NACCHO, n.d.), and the analytic dataset consisted of the remaining data.

Again, the definition of LPHI:

> "Local public health infrastructure includes the systems, competencies, frameworks, relationships, and resources that enable public health agencies to perform their core functions and essential services. Infrastructure categories encompass human, organizational, informational, legal, policy, and fiscal resources" (NACCHO, n.d.).

3.1.5 Clean Dataset

The clean dataset consists of 274 infrastructure variables (i.e., candidate predictors) and 20 key public health activities (i.e., outcome variables). The infrastructure variables are the components or activities that are potentially highly correlated with the completion of 20 key public health activities, and they describe the following aspects of the local public health infrastructure (LPHI):

1. Profile of the top executive (e.g., academic background) at the LHD
2. Organizational structure of the LHD (e.g., how different agencies operate in relation to the LHD)
3. Workforce of the LHD (e.g., types of employees hired)
4. Modality of provision for immunization services/activities

5. Modality of provision for disease/condition screening services/activities (e.g., cancer)
6. Modality of provision for communicable disease treatment services/activities (e.g., HIV/AIDS)
7. Modality of provision for maternal and child health services/activities (e.g., prenatal care)
8. Modality of provision for other health services (e.g., behavioral/mental health)
9. Modality of provision for epidemiology and surveillance activities (e.g., chronic disease)
10. Modality of provision for population-based primary prevention activities (e.g., chronic disease programs)
11. Modality of provision for inspection activities (e.g., children's camps)
12. Modality of provisions for other environmental health activities (e.g., air pollution)
13. Modality of provision for other types of essential activities, health services, and environmental activities (e.g., emergency medical services)
14. Service delivery (e.g., if blood lead screening services were delivered in 2018)
15. Areas of active participation in policy or advocacy activities at the LHD (e.g., injury and violence prevention)
16. Completion of a community health assessment for the LHD's jurisdiction
17. Participation in developing a health improvement plan for the community within the LHD's jurisdiction
18. Availability of a local nonprofit hospital serving residents of the LHD's jurisdiction
19. Development of a comprehensive, agency-wide strategic plan for the LHD
20. Change in budget and expectation of future budget of the LHD

Appendix B includes all the useful infrastructure variables in the clean dataset, where the variables originated or derived from the codebook for the NACCHO 2019 Profile study, meaningful short descriptions of the variables (i.e., aliases in column 2), and descriptions of the variables based on the original survey questions were listed. The aliases are made of acronyms and abbreviations from the corresponding descriptions of the variables. For ease of reading, the acronyms of terms in the description column are spelled out the first time when they appear. The full list of acronyms is included in Appendix C. Additionally, Appendix F contains a complete list of 20 key public health activities from the 2018 NALSYS survey conducted by Mays & Scutchfield (2020).

Table 3.1 lists the 20 key public health activities in the clean dataset, where the original variable from the NALSYS 2018 survey and the original survey questions are displayed below. These activities, ranging from identifying top community health needs to assessing damaging health events, will be used to assess the associations of the infrastructure variables in Appendix B in relation to each of the 20 public health activities.

Table 3.1 The 20 Key Public Health Activities

Variable	Survey Question
av1	In the past three years in your jurisdiction, has a community needs assessment process been conducted that systematically describes the prevailing health status in the community?
av2	In the past three years in your jurisdiction, has a survey of the population for behavioral risk factors been conducted?
av3	In your jurisdiction, are timely investigations of adverse health events conducted on an ongoing basis, including communicable disease outbreaks and environmental health hazards?
av4	Are the necessary laboratory services available to support investigations of adverse health events and meet routine diagnostic and surveillance needs for your jurisdiction?
av5	In the past 3 years in your jurisdiction, has an analysis been completed of the determinants of and contributing factors to prioritize health needs, the adequacy of existing health resources, and the population groups most effected?
av6	In the past three years in your jurisdiction, has an analysis been completed of age-specific participation in preventive and screening services?
av7	In your jurisdiction, is there a network of support and communication relationships that includes health related organizations, the media, and the general public?
av8	In the past year in your jurisdiction, have there been formal efforts to inform public officials about the potential public health impact of decisions under their consideration?
av9	In the past three years in your jurisdiction, has there been a prioritization of the community health needs that have been identified from a community needs assessment?
av10	In the past three years in your jurisdiction, have community health initiatives been implemented that are consistent with priorities established from a community health needs assessment?
av11	In the past three years in your jurisdiction, has a community health action plan been developed with community participation to address community health needs?
av12	In the past three years in your jurisdiction, have plans been developed to allocate resources in a manner consistent with community health action plans?
av13	In the past three years in your jurisdiction, have resources been deployed as necessary to address priority health needs identified in the community health needs assessment?
av14	In the past three years in your jurisdiction, has an organizational assessment of the local public health agency been conducted?
av15	In the past three years in your jurisdiction, have age-specific priority health needs been addressed effectively via the provision of or linkage to appropriate services?
av16	In the past three years in your jurisdiction, have there been regular evaluations of the effects of public health services on community health status?
av17	In the past three years in your jurisdiction, have professionally recognized process and outcome measures been used to monitor public health programs and to redirect resources as appropriate?
av18	In the past three years in your jurisdiction, has the public regularly received information about current health status, health care needs, health behaviors, and health care policy issues?
av19	Within the past year in your jurisdiction, has the media received reports on a regular basis about health issues affecting the community?
av20	In the past three years in your jurisdiction, has there been an instance in which a mandated public health program or service failed to be implemented as required by state or local law, ordinance, or regulation?

3.2 Statistical Analyses

An analysis plan was created before the start of the analyses, including both bivariate analyses and multivariable analyses. Refer to Appendix G for R codes used for statistical analyses.

3.2.1 Bivariate Analyses

The bivariate analyses were run between the public health department infrastructure variables and the 20 key public health activities to understand their potential relationships using logistic regression models. Models were fit with one of the key public health activities as the response and one of the infrastructure variables as the independent or predictor variable such that all pairs of responses and independent variables were modeled. A file of bivariate results was generated for each of the 20 response variables (i.e., public health activities), including the coefficients and P-values of the corresponding variables. Predictor variables were counted as significant if their P-values were less than or equal to 5%. After all the bivariate analyses were run, all the bivariate results were compiled, and the frequency of each variable being significant across all 20 bivariate analyses was also counted and compiled.

3.2.2 Multivariable Analyses

Using the significant infrastructure variables from the bivariate results, multivariable analyses were performed. A multivariable logistic regression model was generated for each of the 20 public health activities to address the following aims:

1. Create logistic regression models to identify infrastructure variables highly correlated with the 20 outcome variables.
2. Estimate the impact of infrastructure on public health activities when state differences are accounted for.

For each multivariable regression model, a dataset that contains infrastructure variables significant to the corresponding public health activity in the bivariate analysis was utilized. First, listwise deletion was performed for each model to delete observations that have at least one missing value for any included independent variable. The purpose of this step is to ensure a successful run for backward elimination for each multivariable model in the RStudio using an automated function

(i.e., use a constant sample size regardless of variables currently in the model). After deleting observations listwise, a backward elimination was performed for each model to find the best-fitted model for the data using the Akaike information criterion (AIC). For models 1, 3, and 10, variables that caused quasi-complete separations or nearly quasi-complete separations were dropped after the backward elimination. The backward elimination was run again to ensure that the AIC was minimized. Then, state control variables were added to each multivariable model. A summary of results was generated for each model based on the infrastructure variables that are left after the backward elimination. The new and old values of estimates (before and after inclusion of state and rurality indicators), odd's ratios, and P-Values were generated for each infrastructure variable.

4. RESULTS

4.1 Bivariate Analyses

The frequency of each useful infrastructure variable being statistically significant at 5% across the 20 bivariate analyses is compiled in Appendix D. Figure 4.1 summarizes the number of infrastructure variables that belong to each frequency of significance. All the useful infrastructure variables (n=274) are significant to at least one best practice activity, and approximately 50% of them are significant to at least 5 best practice activities. There are no variables that are significantly related to all 20 best practice activities, but the variable "Pol/Adv Other Pol Areas" has the highest frequency of being significant (n=15). This implies that whether an LHD is actively involved in policy or advocacy activities for policy areas other than those listed in the survey is correlated with accomplishing most of the best practice activities.

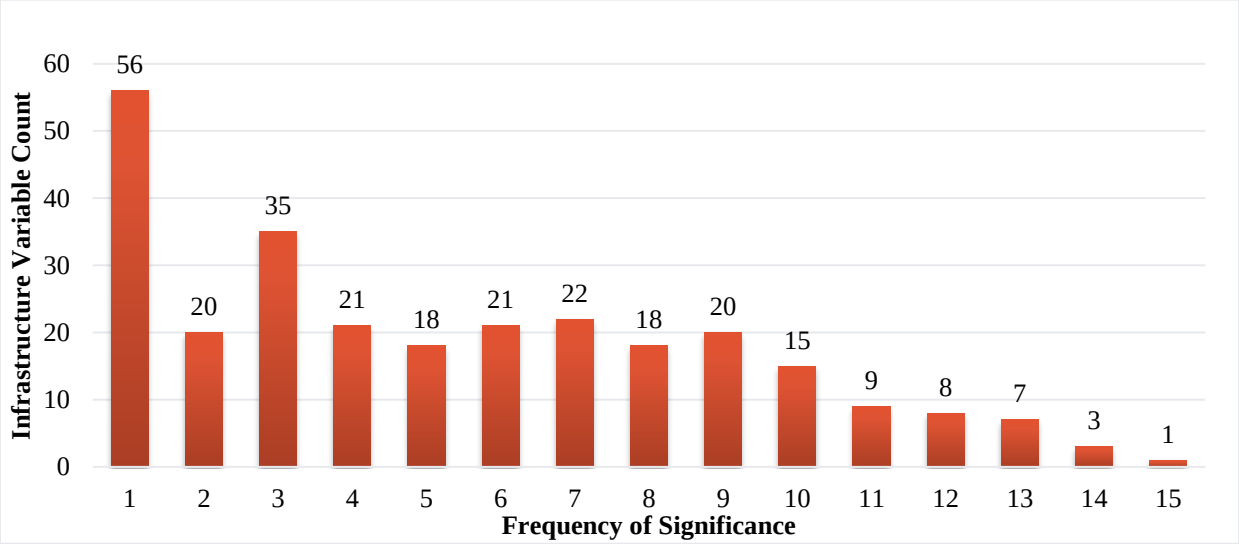

Figure 4.1 Infrastructure Variable Count vs. Frequency of Significance

In Appendix D, variables are categorized into various topics based on the nature of their questions from the NACCHO 2019 Profile study. A few highlights of each topic are summarized below based on the 274 infrastructure variables significant in bivariate analyses.

Profile of Top Executive

For the significant variables that describe the profile of the top executive at an LHD, variables "Full-Time Top Exec", "Bachelor Top Exec", and "Master Top Exec" are among the highest in terms of their frequency of being significant. This conveys that having a top executive in an LHD who is employed full-time and has a bachelor's or master's degree being the highest degree may affect the completion of 50% of the best practice activities.

Organizational Structure

For the significant variables that describe the modalities of governance of an LHD (e.g., how different agencies operate in relation to the LHD), all the variables have low frequencies of significance, where the variable "One or More LBHs" is the most frequently significant (n=3). This means that it may be important to three best practice activities that an LHD has one or more local boards of health (LBHs).

Current Staffing

For the three significant variables that describe the current staffing of LHDs, "# Vacant FTEs" (n=14) is about 50% more frequent in being significant than "# Hired" and "# Filled FTEs". This means that understaffing may affect the completion best practice more than total staffing numbers.

Types of Occupations Employed

For the significant variables that describe the type of staff LHDs hired, "Lab Worker", "Behav Health Staff", and "Off & Admin staff" are among the highest in terms of their frequency of being significant. This implies that recruiting laboratory workers, behavioral health staff, and office and administrative support staff may be essential to the LHDs' functioning.

Change in Staffing

For the two significant variables that describe changes in staffing level within the LHDs, "# Lost Employees" is twice as frequent as "# Reduced Hour Employees" in being significant. This conveys that losing an additional employee has more impact on the completion of best practice activities than an additional employee who had their working hours reduced.

Immunization

For the significant variables that describe how immunizations are provided in the communities, "Child Imm via Others" has frequencies of significance 3 times more than the rest of the significant infrastructure variables. This indicates that childhood immunizations provided via others in the community independent of LHD funding may affect the completion of up to 9 best practice activities.

Screening for Diseases or Conditions

For the significant variables that describe how screenings for diseases or conditions are provided in the communities, variables "Screening HIV/AIDS Directly", "Screening Cancer NA", "Screening CVD Directly", and "Screening Diabetes Directly" are among the highest in terms of their frequency of being significant. This means that providing screenings for HIV/AIDS, cardiovascular disease (CVD), and diabetes by the LHDs directly, as well as not having screenings for cancer available in the communities, may influence the completion of about 60% of the best practice activities.

Treatment for Communicable Diseases

For the variables that describe how treatments for communicable diseases are provided in the communities, "Treatment HIV/AIDS Contracted Out" has the highest frequency of significance. This conveys that the completion of about 75% of the best practice activities are correlated with the the indication of whether treatments for HIV/AIDS are contracted out to other organizations or not.

Maternal and Child Health

For the variables that describe how maternal and child health services or activities are provided, "PCare Directly", "WIC Health Directly", and "WIC Health via Others" are among the highest in terms of their frequency of being significant.

Other Health Services

For the variables that describe how other health services are provided, "Oral Health Directly" has the highest frequency of being significant. This indicates that providing oral health directly or not may affect up to 14 best practice activities.

Epidemiology and Surveillance Activities

For the variables that describe how epidemiology and surveillance activities are provided, a few variables are among the highest in terms of their frequency of being significant, including "Epi&Surv C/I Disease Directly", "Epi&Surv CD via Others", "Epi&Surv CD DK", "Epi&Surv Injury DK", " Epi&Surv BRFs DK", and "Epi&Surv Synd Surv DK". These variables are significant to the completion of about 50% of best practice activities, which implies that they may be major indicators of whether or not LHDs are capable of conducting best practices.

Population-based Primary Prevention Activities

For the variables that describe how population-based primary prevention activities are provided, "Pri Prev Phys Act DK", "Pri Prev Opioids DK", and "Pri Prev Sub Abuse Directly" are among the highest in terms of their frequency of being significant. This means these variables may affect the completion of about 60% of the best practice activities.

Inspection Activities

For the variables that describe how inspection activities are provided, "Insp Rec Water Directly", "Insp Tobacco Ret DK", "Insp Lead NA, Insp Milk Proc NA", are among the highest in terms of their frequency of being significant. These variables may influence the completion of about 50-60% of the best practice activities.

Other Environmental Health Activities

For the variables that describe how other environmental health activities are provided, several variables are among the highest in terms of their frequency of being significant, including "Env Health Air Qual DK", "Env Health Rad Cont DK", "Env Health Vect Cont Directly", "Env Health Land Use DK", "Env Health Haz Resp NA", and "Env Health Air Polu NA". This means that these variables may impact the completion of half of the best practice activities.

Other Activities

For the variables that describe how other activities are provided, "Ani Cont NA", "Lab Serv Directly", and "Lab Serv NA" are among the highest in terms of their frequency of being significant. This means that these variables may impact the completion of half of the best practice activities.

Service Provision

For the variables that describe whether certain services are provided at any time, "Serv Com Disease" and "Serv Drug Prev" are among the highest in terms of their frequency of being significant. This implies that providing services for communicable diseases and tobacco, alcohol, or other drug prevention may play an important role in the completion of best practice activities, as the bivariate analyses indicated that they are significant to the completion of about half of the best practice activities.

Policy or Advocacy Activities

For the variables that describe how policy or advocacy activities are provided, "Pol/Adv Other Pol Areas" has the highest frequency of being significant as the bivariate analyses conclude that actively involved in policy or advocacy activities for other policy areas (i.e., policy areas that are not indicated in the survey) are likely impactful on the overall completion of public health activities, as it is significant to 75% of the best practice activities.

Community Health Assessment and Planning

For the variables that describe how the abilities of LHDs in terms of capacities to conduct assessments and plans, a few variables are significant to about half of the public health activities, including "Health Imp Plan (≤ 3 yr)", "Health Imp Plan Future", "Nonprofit Hospital ≥ 1", and "Strategic Plan Future". These variables imply that having community health improvement plans, strategic plans, and having at least one nonprofit hospital in the jurisdictions of the LHDs likely are important to the fulfillment of most of the best practice activities.

Change in Budget

For the variables that describe the changes in budgets within the LHDs, variables "Budget Increased" and "Budget Decrease Expected" have much higher frequencies of significance than "Budget Increase Expected". The LHDs that had their budgets increased or expect their budgets to decrease next year are significant to at least 25% of the completion of the best practice activities.

4.2 Multivariable Analyses

For the following 20 multivariable models, the reduced model contains all infrastructure variables remaining after backward selection, whereas the full model uses the same variables in the reduced model but controls for differences among states using fixed effects. The state variables were retrieved from the first two digits of the NACCHO ID in the analytic dataset. The complete results for all 20 full models are included in Appendix. E.

Each result table below displays the results of its corresponding multivariable regression analysis without the results of the state variables. Appendix E contains the complete tables of the results. In each table, the columns that have names starting with "Full" represent the results of the model when state control variables were added in, while the columns that have names starting with "Reduced" represent the results of the model when control variables were not added in.

For interpreting the results, only the positive coefficients increase the chance of the response (odd's ratio > 1), and the negative coefficients decrease the chance of the response (odd's ratio < 1). When the odd's ratio of a variable is less than 1, it is a decrease in the odd's ratio by (1 - odd's ratio) %. When the odd's ratio of a variable is greater than 1, it is an increase in the odd's ratio by (odd's ratio - 1) *100%.

Additionally, color coding was utilized in the table to allow readers to easily visualize the significant variables. The significant variables in the reduced model are coded in yellow, whereas the significant variables in the full model are coded in green.

Model 1

Table 4.2 below shows the results of the multivariable logistic regression model for indicating that a community needs assessment process has been conducted in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 463 LHDs. After backward selection, the reduced model has 15 predictors significant at 5%, whereas the full model has 11 significant predictors.

The reduced model has 12 predictors positively associated and 3 predictors negatively associated with the indication that a community needs assessment process has been conducted. On the other hand, the full model has 10 predictors positively associated and one predictor negatively associated with the indication that a community needs assessment process has been conducted. Comparing the full model's P-Value with the reduced model's P-Value, 9 predictors are significant in both models. Six predictors cease to be significant and two become significant in the full model.

Based on the full model's odds ratios, the following can be concluded about its significant variables:

1. **RN**: If an LHD currently employs registered nurse(s), it increases the chance of indicating that a community needs assessment process has been conducted by more than a factor of 9.
2. **Oral HC Staff**: If an LHD currently employs oral health care staff, it *decreases* the chance of indicating that a community needs assessment process has been conducted by (1 – odd's ratio)% = (1-0.21)% = 79%
3. **Epidemiologist/Statistician**: If an LHD currently employs epidemiologist(s)/statistician(s), it *increases* the chance of indicating that a community needs assessment process has been conducted by a factor of 3.
4. **# Lost Employees**: For each additional employee an LHD has lost via attrition and not replaced because of hiring freezes or budget cuts, it *increases* the chance of indicating that a community needs assessment process has been conducted by 51%.
5. **Screening STDs via Others**: If an LHD provides screenings for other sexually transmitted diseases/infections (STDs) via others in the community that are independent of LHD

funding, it *increases* the chance of indicating that a community needs assessment process has been conducted by more than a factor of 4.

6. **Treatment TB Directly:** If treatments for tuberculosis were provided directly by an LHD, it *increases* the chance of indicating that a community needs assessment process has been conducted by a factor of 4.
7. **Epi&Surv M&C Health Directly**: If epidemiology and surveillance activities for maternal and child (M&C) health were provided directly by an LHD, it *increases* the chance of indicating that a community needs assessment process has been conducted by a factor of 3.
8. **Pri Prev Opioids Directly**: If population-based primary prevention activities for opioids were provided directly by an LHD, it *increases* the chance of indicating that a community needs assessment process has been conducted by more than a factor of 2.
9. **Pol/Adv Oral Health**: If an LHD has been actively involved in policy or advocacy activities for oral health, it *increases* the chance of indicating that a community needs assessment process has been conducted by more than a factor of 9.
10. **Strategic Plan (≤ 3 yr)**: If an LHD developed a comprehensive, agency-wide strategic plan within the last three years, it *increases* the chance of indicating that a community needs assessment process has been conducted by more than a factor of 5.
11. **Strategic Plan (3-5 yr ago)**: If an LHD developed a comprehensive, agency-wide strategic plan more than three years ago but within the past five years, it *increases* the chance of indicating that a community needs assessment process has been conducted by more than a factor of 3.

Table 4.1 Results of the Multivariable Logistic Regression Model for Indicating that A Community Needs Assessment Process Has Been Conducted

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-7.57		0.00	-6.91		0.00
Master Top Exec	0.72	2.05	0.06	0.45	1.56	0.26
RN	2.77	15.91	0.01	2.25	9.51	0.02
Oral HC Staff	-1.36	0.26	0.01	-1.54	0.21	0.01
Epidemiologist/Statistician	0.93	2.54	0.02	1.20	3.30	0.01
# Lost Employees	0.21	1.23	0.12	0.41	1.51	0.02
Screening STDs via Others	2.01	7.44	0.00	1.56	4.76	0.00
Treatment Other STDs Contracted Out	3.71	40.72	0.00	1.41	4.08	0.09
Treatment TB Directly	1.23	3.43	0.01	1.47	4.34	0.01
Home HC NA	-3.12	0.04	0.10	-1.55	0.21	0.27
B/M Health Directly	1.98	7.26	0.01	1.15	3.14	0.09
Epi&Surv M&C Health Directly	0.94	2.56	0.06	1.17	3.23	0.03
Pri Prev Opioids Directly	1.16	3.20	0.01	1.07	2.91	0.02
Pri Prev Sub Abuse Directly	-0.98	0.37	0.05	-0.41	0.66	0.38
Insp Private Water DK	-1.61	0.20	0.03	-0.48	0.62	0.46
Insp Health Fac NA	2.37	10.74	0.07	1.74	5.69	0.14
Env Health PHNA NA	1.39	4.02	0.09	1.22	3.39	0.11
Serv Epi&Surv	1.06	2.90	0.04	0.58	1.78	0.29
Serv Com Disease	0.93	2.54	0.08	0.76	2.13	0.20
Serv M&C Health	-1.10	0.33	0.06	-0.72	0.49	0.21
Pol/Adv Oral Health	2.33	10.24	0.00	2.25	9.53	0.00
Pol/Adv Alc Opi Drug	-0.92	0.40	0.05	-0.70	0.50	0.13
Pol/Adv None	-1.24	0.29	0.09	-0.75	0.47	0.32
Strategic Plan (≤ 3 yr)	2.44	11.51	0.00	1.77	5.84	0.00
Strategic Plan (3-5 yr ago)	1.80	6.06	0.00	1.30	3.68	0.04
Strategic Plan Future	1.22	3.38	0.04	0.57	1.77	0.31

RN = registered nurse, HC = health care or healthcare, STDs = sexually transmitted diseases/infections, TB = tuberculosis, B/M = behavioral/ mental, M&C = maternal and child, DK = don't know, PHNA = public health nuisance abatement, NA = not available.

Model 2

Table 4.3 below shows the results of the multivariable logistic regression model for indicating that a survey of the population for behavioral risk factors has been conducted in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 442 LHDs. After backward selection, the reduced model has 17 predictors significant at 5%, whereas the full model has 9 significant predictors.

The reduced model has 11 predictors positively associated and 6 predictors negatively associated with the indication that a survey of the population for behavioral risk factors has been conducted. On the other hand, the full model has 6 predictors positively associated and 3 predictors negatively associated with the indication that a survey of the population for behavioral risk factors has been conducted. Comparing the full model's P-Value with the reduced model's P-Value, 6 predictors are significant in both models. Eleven predictors cease to be significant and three become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Combined HHS Agency**: If an LHD is part of a combined health and human services (HHS) agency, it increases the chance of indicating that a survey of the population for behavioral risk factors has been conducted by a factor of 2.
2. **Screening TB Contracted Out**: If screenings for tuberculosis were contracted out by an LHD, it *decreases* the chance of indicating that a survey of the population for behavioral risk factors has been conducted by (1-odd's ratio)% = (1-0.14)% = 86%
3. **Pri Prev Sub Abuse via Others**: If population-based primary prevention activities for substance abuse were provided via others in the community that are independent of LHD funding, it *decreases* the chance of indicating that a survey of the population for behavioral risk factors has been conducted by (1-odd's ratio)% = (1-0.17)% = 83%.
4. **Pri Prev Mental Ill Contracted Out**: If population-based primary prevention activities for mental illness were contracted out by an LHD, it *increases* the chance of indicating that a survey of the population for behavioral risk factors has been conducted by more than a factor of 4.

5. **Insp Tobacco Ret NA**: If an LHD indicated that inspection activities for tobacco retailers were not available in community, it *decreases* the chance of indicating that a survey of the population for behavioral risk factors has been conducted by (1-odd's ratio)% = (1-0.41)% = 59%.
6. **Env Health Food Sft Edu Directly**: If environmental health activities for food safety education were provided by an LHD directly, it *increases* the chance of indicating that a survey of the population for behavioral risk factors has been conducted by more than a factor of 2.
7. **B/M Health Directly**: If an LHD indicated that behavioral/mental health services were provided by them directly, it *increases* the chance of indicating that a survey of the population for behavioral risk factors has been conducted by more than a factor of 2.
8. **Strategic Plan (≤ 3 yr)**: If an LHD developed a comprehensive, agency-wide strategic plan within the last three years, it *increases* the chance of indicating that a survey of the population for behavioral risk factors has been conducted by more than a factor of 2.
9. **Budget Increased**: If an LHD's current year' budget was greater than its previous year's budget, it *increases* the chance of indicating that a survey of the population for behavioral risk factors has been conducted by 76%.

Table 4.2 Results of the Multivariable Logistic Regression Model for Indicating that A Survey of the Population for Behavioral Risk Factors Has Been Conducted

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-5.74		0.00	-4.51		0.00
Full-Time Top Exec	0.97	2.63	0.09	0.51	1.67	0.45
Combined HHS Agency	0.63	1.87	0.08	0.88	2.42	0.02
Agency Leadership	1.06	2.88	0.04	0.78	2.19	0.15
Health Educator	-0.78	0.46	0.03	-0.40	0.67	0.27
Busn & Finc Worker	0.80	2.22	0.01	0.68	1.97	0.06
# Lost Employees	0.06	1.06	0.33	0.11	1.11	0.19
Screening Other STDs Directly	-0.69	0.50	0.04	-0.47	0.63	0.23
Screening TB Contracted Out	-1.64	0.19	0.00	-1.99	0.14	0.00
Screening Cancer Directly	0.51	1.67	0.07	0.57	1.78	0.06

Table 4.2 continued

Treatment HIV/AIDS Directly	0.45	1.56	0.11	0.41	1.51	0.16
EPSDT NA	-1.65	0.19	0.04	-1.62	0.20	0.05
Well-child Clinic DK	-17.71	0.00	0.98	-2.29	0.10	0.21
B/M Health Directly	0.80	2.23	0.07	1.03	2.79	0.02
Epi&Surv C/I Disease Directly	1.97	7.19	0.01	0.58	1.79	0.40
Pri Prev CD Directly	0.61	1.84	0.08	0.68	1.97	0.08
Pri Prev Sub Abuse via Others	-1.51	0.22	0.03	-1.75	0.17	0.01
Pri Prev Mental Ill Contracted Out	1.34	3.83	0.02	1.57	4.80	0.01
Insp Tobacco Ret NA	-0.76	0.47	0.06	-0.89	0.41	0.04
Env Health Food Sft Edu Directly	0.79	2.19	0.02	1.07	2.91	0.00
Env Health Air Polu DK	1.48	4.39	0.05	0.41	1.50	0.41
Ani Cont via Others	1.11	3.04	0.00	0.66	1.93	0.08
Schl Clinic via Others	0.66	1.94	0.01	0.42	1.53	0.11
Serv Obe Prev	0.66	1.94	0.03	0.27	1.31	0.40
Pol/Adv Land Use	-0.49	0.61	0.11	-0.45	0.64	0.18
Pol/Adv Oral Health	0.49	1.63	0.11	0.59	1.80	0.07
Pol/Adv Other Env Health	0.54	1.71	0.05	0.42	1.52	0.15
Com Health Ass (≤ 3 yr)	0.44	1.56	0.13	0.48	1.61	0.13
Com Health Ass (> 5 yr)	-1.84	0.16	0.01	-1.35	0.26	0.06
Strategic Plan (≤ 3 yr)	0.60	1.82	0.02	0.92	2.51	0.00
Budget Increased	0.55	1.74	0.04	0.57	1.76	0.05

HHS = health and human services, STDs = sexually transmitted diseases/infections, TB = tuberculosis, HIV/AIDS = human immunodeficiency virus/ acquired immunodeficiency syndrome, C/I = communicable/ infectious, CD = chronic disease, NA = not available, DK = don't know.

Model 3

Table 4.4 below shows the results of the multivariable logistic regression model for indicating that timely investigations of adverse health events are conducted on an ongoing basis. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 527 LHDs. After backward selection, the reduced and full models both have 4 significant predictors.

The reduced and full models both have 3 predictors positively associated and one predictor negatively associated with the indication of adverse health events were investigated timely and continuously. Two predictors cease to be significant and two become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Agency Leadership**: If an LHD currently employs agency leader(s), it *increases* the chance of indicating that adverse health events were investigated timely and continuously by a factor of 14.
2. **Child Imm Contracted Out**: If an LHD contracted out childhood immunization activities/services, it *decreases* the chance of indicating that adverse health events were investigated timely and continuously by (1 – odd's ratio)% = (1-0.02)% = 98%.
3. **Pri Prev Tobacco via Others**: If an LHD indicated that population-based primary prevention activities for tobacco were provided via others in community that are independent of LHD funding, it *increases* the chance of indicating that adverse health events were investigated timely and continuously by a factor of 5.
4. **Schl Clinic via Others**: If an LHD indicated that activities for school-based clinic were provided via others in the community that are independent of LHD funding, it *increases* the chance of indicating that adverse health events were investigated timely and continuously by a factor of 16.

Table 4.3 Results of the Multivariable Logistic Regression Model for Indicating that Adverse Health Events Were Investigated Timely and Continuously

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-0.80		0.35	14.60		1.00
Agency Leadership	1.68	5.37	0.03	2.67	14.40	0.02
Env Health Worker	1.34	3.83	0.04	0.12	1.13	0.91
Child Imm Contracted Out	-2.66	0.07	0.00	-3.80	0.02	0.00
Pri Prev Tobacco via Others	1.10	2.99	0.09	1.63	5.12	0.04
Schl Clinic via Others	1.22	3.39	0.06	2.79	16.28	0.01
NP Hospital ≥ 1	1.67	5.32	0.01	0.75	2.12	0.35

NP = Nonprofit.

Model 4

Table 4.5 below shows the results of the multivariable logistic regression model for indicating that necessary laboratory services are available to support investigations of adverse health events and meet routine diagnostic and surveillance needs. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 544 LHDs. After backward selection, both the reduced and full models have 3 predictors significant at 5%. Both the reduced and full models have 2 predictors positively associated and one predictor negatively associated with the indication of sufficient laboratory services. One predictor ceases to be significant, and one became significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Nutritionist**: If an LHD currently employs nutritionist(s), it *increases* the chance of indicating sufficient laboratory services by more than a factor of 3.
2. **Epi&Surv M&C Health Directly**: If epidemiology and surveillance activities for maternal and child (M&C) health were provided by an LHD directly, it *increases* the chance of indicating sufficient laboratory services by a factor of 4.

3. **Insp Lead DK**: If an LHD doesn't know how inspection activities for lead inspection were provided, it *decreases* the chance of indicating sufficient laboratory services by (1 – odd's ratio)% = (1-0.13)% = 87%.

Table 4.4 Results of the Multivariable Logistic Regression Model for Indicating Sufficient Laboratory Services

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	2.76		0.02	19.86		1.00
Rookie Top Exec	-1.87	0.15	0.09	-2.17	0.11	0.09
Nurs Top Exec	-0.90	0.41	0.06	-0.57	0.56	0.32
Epidemiologist/ Statistician	1.02	2.77	0.08	1.02	2.76	0.18
Health Educator	-0.89	0.41	0.11	-0.91	0.40	0.16
Nutritionist	0.87	2.40	0.10	1.28	3.59	0.04
Screening CVD Contracted Out	-22.58	0.00	1.00	-2.56	0.08	0.13

Table 4.5 continued

Comp Pri Care NA	-19.45	0.00	1.00	-24.93	0.00	1.00
Sub Abuse DK	37.31	> 999	0.99	21.74	> 999	1.00
Epi&Surv M&C Health Directly	1.52	4.58	0.00	1.47	4.34	0.03
Pri Prev Phys Act DK	19.02	> 999	0.99	20.16	> 999	1.00
Pri Prev Sub Abuse DK	-38.46	0.00	0.99	-23.71	0.00	1.00
Pri Prev Mental Ill Directly	1.65	5.18	0.12	1.13	3.10	0.32
Insp Rec Water Contracted Out	-2.13	0.12	0.09	-2.71	0.07	0.17
Insp Lead DK	-1.91	0.15	0.01	-2.02	0.13	0.04
Insp Food Serv DK	-20.52	0.00	1.00	-22.33	0.00	1.00
NP Hospital ≥ 1	1.49	4.42	0.00	1.08	2.94	0.05

CVD = cardiovascular disease, DK = don't know, M&C = maternal and child, NP = nonprofit.

Model 5

Table 4.6 below shows the results of the multivariable logistic regression model for indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 446 LHDs. After backward selection, the reduced model has 22 predictors significant at 5%, whereas the full model has 12 significant predictors.

The reduced model has 15 predictors positively associated and 7 predictors negatively associated with the indication of a complete analysis of health priorities, adequacy of health resources, and most impacted population groups. On the other hand, the full model has 8 predictors positively associated and 4 predictors negatively associated with the indication of a complete analysis of health priorities, adequacy of health resources, and most impacted population groups. Comparing the full model's P-Value with the reduced model's P-Value, 12 predictors are significant in both models. Ten predictors cease to be significant, and no predictor become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Epidemiologist/Statistician**: If an LHD currently employs epidemiologist/statistician, it *increases* the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by a factor of 3.
2. **Treatment HIV/AIDS Contracted Out**: If treatments for HIV/AIDS were contracted out by an LHD, it *increases* the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by more than a factor of 4.
3. **PCare via Others**: If an LHD indicated that prenatal care was provided via others in community independent of LHD funding, it *increases* the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by a factor of 3.
4. **Epi&Surv BRFs NA**: If an LHD indicated that epidemiology and surveillance activities for behavioral risk factors (BRFs) were not available in community, it *decreases* the chance of

indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by (1 – odd's ratio)% = (1-0.12)% = 88%.

5. **Epi&Surv M&C Health Directly**: If epidemiology and surveillance activities for maternal and child (M&C) health were provided by an LHD directly, it ***increases*** the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by a factor of 3.
6. **Insp Sep Sys Contracted Out**: If inspection activities for septic systems were contracted out by an LHD, it ***decreases*** the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by (1 – odd's ratio)% = (1-0.15)% = 85%.
7. **Env Health Rad Cont NA**: If environmental health activities for radiation control were not available in community, it ***increases*** the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by more than a factor of 6.
8. **Env Health Air Polu NA**: If environmental health activities for air pollution were not available in community, it ***decreases*** the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by (1 – odd's ratio)% = (1-0.13)% = 87%.
9. **Lab Serv Directly**: If activities for laboratory services were by an LHD directly, it ***decreases*** the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by (1 – odd's ratio)% = (1-0.42)% = 58%.
10. **Schl Clinic via Others**: If activities for school-based clinic were provided via others in community independent of LHD funding, it ***increases*** the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by a factor of 2.
11. **Pol/Adv Mental Health**: If an LHD has been actively involved in policy or advocacy activities for mental health, it ***increases*** the chance of indicating a complete analysis of health priorities, adequacy of health resources, and most impacted population groups by more than a factor of 2.
12. **Health Imp Plan (≤ 3 yr)**: If an LHD participated in developing a health improvement plan for community within the last three years, it ***increases*** the chance of indicating a complete

analysis of health priorities, adequacy of health resources, and most impacted population groups by a factor of 2.

Table 4.5 Results of the Multivariable Logistic Regression Model for Indicating that A Complete Analysis of Health Priorities, Adequacy of Health Resources, and Most Impacted Population Groups was Completed

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-6.05		0.00	-5.02		0.00
Master Top Exec	0.61	1.83	0.03	0.31	1.36	0.29
Lab Worker	0.85	2.34	0.05	0.78	2.19	0.08
Epidemiologist/ Statistician	0.75	2.12	0.01	1.20	3.33	0.00
Behav Health Staff	-0.69	0.50	0.04	-0.67	0.51	0.06
Treatment HIV/AIDS Contracted Out	2.03	7.59	0.00	1.52	4.58	0.00
Treatment TB Directly	0.72	2.05	0.07	0.61	1.84	0.13
PCare Contracted Out	2.44	11.51	0.00	1.36	3.88	0.06
PCare via Others	1.67	5.33	0.01	1.11	3.05	0.04
WIC Health Directly	-0.55	0.58	0.12	-0.14	0.87	0.71
EPSDT NA	-1.44	0.24	0.09	-1.62	0.20	0.07
Home HC DK	-14.97	0.00	0.98	-16.03	0.00	0.99
Sub Abuse NA	2.09	8.05	0.05	1.32	3.76	0.21
Epi&Surv CD Contracted Out	2.12	8.35	0.02	1.75	5.75	0.06
Epi&Surv BRFs NA	-2.30	0.10	0.03	-2.13	0.12	0.04
Epi&Surv M&C Health Directly	0.99	2.69	0.00	1.19	3.27	0.00
Pri Prev CD Contracted Out	-1.15	0.32	0.08	-0.64	0.53	0.33

Table 4.5 continued

Pri Prev Sub Abuse Contracted Out	1.18	3.26	0.07	0.66	1.93	0.33
Insp Sep Sys Contracted Out	-2.23	0.11	0.02	-1.90	0.15	0.03
Insp Bd Art NA	-0.65	0.52	0.14	-0.79	0.45	0.09
Insp Lead DK	1.23	3.44	0.10	1.24	3.46	0.08
Insp Food Proc NA	-2.35	0.10	0.00	-1.37	0.25	0.06
Env Health Air Qual DK	-1.19	0.30	0.06	-0.20	0.82	0.69
Env Health Rad Cont NA	1.91	6.72	0.00	1.88	6.54	0.00
Env Health Air Polu NA	-1.70	0.18	0.00	-2.01	0.13	0.00
Lab Serv Directly	-0.81	0.45	0.04	-0.86	0.42	0.02
Schl Clinic via Others	0.87	2.39	0.00	0.85	2.35	0.00
Serv Com Disease	1.12	3.06	0.02	0.41	1.50	0.40
Serv Diabetes Screen	0.44	1.55	0.13	0.57	1.77	0.08
Serv Obe Prev	0.81	2.26	0.01	0.53	1.71	0.10
Pol/Adv Mental Health	1.08	2.94	0.00	1.07	2.91	0.00
Health Imp Plan (≤ 3 yr)	1.21	3.37	0.00	0.86	2.37	0.00
Strategic Plan (3-5 yr ago)	0.89	2.44	0.03	0.55	1.74	0.16
Strategic Plan (> 5 yr)	-1.18	0.31	0.04	-0.88	0.41	0.14

HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome, TB = tuberculosis, WIC = women, infants, and children, CD = chronic disease, BRFs = behavioral risk factors, NA = not available, M&C = maternal and child, DK = don't know.

Model 6

Table 4.7 below shows the results of the multivariable logistic regression model for indicating an analysis of age-specific participation in preventive and screening services has been completed in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 509 LHDs. After backward selection, the reduced model has 12 predictors significant at 5%, whereas the full model has 8 significant predictors.

The reduced model has 8 predictors positively associated and 4 predictors negatively associated with the indication of an analysis of age-specific participation in preventive and screening services has been completed. On the other hand, the full model has 6 predictors positively associated and 2 predictors negatively associated with the indication of an analysis of age-specific participation in preventive and screening services has been completed. Comparing the full model's P-Value with the reduced model's P-Value, 7 predictors are significant in both models. Five predictors cease to be significant, and one become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Pub Info Professional**: If an LHD currently employs public information professional(s), it *increases* the chance of indicating an analysis of age-specific participation in preventive and screening services has been completed by a factor of 2.
2. **Screening CVD Directly**: If screenings for cardiovascular disease (CVD) were by an LHD directly, it *increases* the chance of indicating an analysis of age-specific participation in preventive and screening services has been completed by 87%.
3. **Epi&Surv CD Directly**: If epidemiology and surveillance activities for chronic disease were provided by LHD directly, it *decreases* the chance of indicating an analysis of age-specific participation in preventive and screening services has been completed by (1 – odd's ratio)% = (1-0.44)% = 56%.
4. **Epi&Surv M&C Health Directly**: If epidemiology and surveillance activities for maternal and child (M&C) health were provided by LHD directly, it *increases* the chance of indicating an analysis of age-specific participation in preventive and screening services has been completed by more than a factor of 2.

5. **Pri Prev CD Contracted Out**: If population-based primary prevention activities for chronic disease (CD) programs were contracted out by an LHD, it ***increases*** the chance of indicating an analysis of age-specific participation in preventive and screening services has been completed by more than a factor of 2.
6. **Pol/Adv Em Prp&Resp**: If an LHD has been actively involved in policy or advocacy activities for emergency preparedness and response, it ***increases*** the chance of indicating an analysis of age-specific participation in preventive and screening services has been completed by 68%.
7. **Pol/Adv Housing**: If an LHD has been actively involved in policy or advocacy activities for safe and healthy housing, it ***decreases*** the chance of indicating an analysis of age-specific participation in preventive and screening services has been completed by (1 – odd's ratio)% = (1-0.58)% = 42%.
8. **Major Revision PH Ord/Reg**: If an LHD indicated a substantive revision to an existing public health ordinance/regulation, it ***increases*** the chance of indicating an analysis of age-specific participation in preventive and screening services has been completed by more than a factor of 2.

Table 4.6 Results of the Multivariable Logistic Regression Model for Indicating an analysis of age-specific participation in preventive and screening services has been completed

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-6.48		0.00	-24.62		1.00
# Hired	0.01	1.01	0.03	0.01	1.01	0.06
# Filled FTEs	-0.01	0.99	0.04	-0.01	0.99	0.10
Pub Info Professional	0.66	1.93	0.01	0.90	2.47	0.00
Screening CVD Directly	0.68	1.98	0.01	0.63	1.87	0.02
Treatment HIV/AIDS via Others	0.77	2.17	0.10	0.72	2.05	0.11
Epi&Surv C/I Disease Directly	2.95	19.15	0.01	2.74	15.43	0.02
Epi&Surv CD Directly	-0.85	0.43	0.00	-0.83	0.44	0.00
Epi&Surv BRFs DK	-15.75	0.00	0.98	-17.88	0.00	0.99
Epi&Surv M&C Health Directly	0.83	2.28	0.01	1.08	2.95	0.00
Epi&Surv M&C Health via Others	-0.37	0.69	0.15	-0.51	0.60	0.06
Pri Prev CD Contracted Out	1.39	4.03	0.00	1.02	2.78	0.03
Pri Prev Opioids Directly	0.36	1.43	0.13	0.23	1.26	0.38
Insp Tobacco Ret DK	-0.74	0.48	0.14	-0.82	0.44	0.09
Env Health Vect Cont NA	-1.56	0.21	0.05	-0.50	0.61	0.39
Serv Obe Prev	0.91	2.48	0.00	0.60	1.82	0.06
Pol/Adv Em Prp&Resp	0.43	1.53	0.09	0.52	1.68	0.04
Pol/Adv Fund HC	-0.42	0.65	0.10	-0.40	0.67	0.15
Pol/Adv Housing	-0.53	0.59	0.04	-0.55	0.58	0.04
Pol/Adv Other Pol Areas	0.47	1.59	0.08	0.42	1.52	0.13
Major Revision PH Ord/Reg	0.55	1.73	0.02	0.74	2.10	0.00
Health Imp Plan (≤ 3 yr)	0.42	1.52	0.09	0.45	1.58	0.08

CVD = cardiovascular disease, HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome, C/I = communicable/ infectious, CD = chronic disease, DK = don’t know, M&C = maternal and child, HC = health care or healthcare, PH = public health.

Model 7

Table 4.8 below shows the results of the multivariable logistic regression model for indicating the presence of a network of support and communication relationships that includes health related organizations, the media, and the general public. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 521 LHDs. After backward selection, the reduced model has 3 predictors significant at 5%, whereas the full model has 5 significant predictors.

The reduced model has 2 predictors positively associated and one predictor negatively associated with the indication of the presence of a network of support and communication relationships. On the other hand, the full model has 3 predictors positively associated and 2 predictors negatively associated with the indication of the presence of a network of support and communication relationships. Comparing the full model's P-Value with the reduced model's P-Value, 2 predictors are significant in both models. One predictor ceases to be significant, and two become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Full-Time Top Exec**: If an LHD's top executive works full-time, it *increases* the chance of indicating the presence of a network of support and communication relationships by more than a factor of 3.
2. **Epi&Surv CD Directly**: If epidemiology and surveillance activities for chronic disease were provided by an LHD directly, it *increases* the chance of indicating the presence of a network of support and communication relationships by a factor of 2.
3. **Pri Prev Mental Ill NA**: If population-based primary prevention activities for mental illness were not available in the community, it *decreases* the chance of indicating the presence of a network of support and communication relationships by (1 – odd's ratio)% = (1-0.03)% = 97%.
4. **Env Health Air Qual NA**: If environmental health activities for indoor air quality were not available in the community, it *decreases* the chance of indicating the presence of a network of support and communication relationships by (1 – odd's ratio)% = (1-0.38)% = 62%.

5. **Serv Obe Prev**: If an LHD provided services for obesity prevention at any time, it *increases* the chance of indicating the presence of a network of support and communication relationships by a factor of 2.

Table 4.7 Results of the Multivariable Logistic Regression Model for Indicating the Presence of a Network of Support and Communication Relationships

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-0.27		0.55	1.26		0.36
Full-Time Top Exec	1.23	3.43	0.00	1.26	3.52	0.01
Nutritionist	-0.54	0.58	0.10	-0.19	0.83	0.58
Screening HIV/AIDS Contracted Out	0.80	2.22	0.11	0.69	2.00	0.16
Epi&Surv CD Directly	0.57	1.76	0.06	0.72	2.06	0.02
Pri Prev CD Directly	-0.61	0.54	0.09	-0.47	0.63	0.19
Pri Prev CD Directly	0.59	1.81	0.15	0.29	1.33	0.48
Pri Prev Opioids NA	-1.86	0.16	0.04	0.07	1.08	0.94
Pri Prev Mental Ill Contracted Out	1.35	3.86	0.07	1.55	4.70	0.05
Pri Prev Mental Ill NA	-2.17	0.11	0.08	-3.67	0.03	0.01
Env Health Air Qual NA	-0.62	0.54	0.06	-0.98	0.38	0.01
Ani Cont NA	-1.05	0.35	0.12	-0.86	0.42	0.28
Serv Diabetes Screen	0.45	1.56	0.11	0.19	1.21	0.53
Serv Obe Prev	0.74	2.10	0.01	0.89	2.43	0.00

HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome, CD = chronic disease, NA = not available.

Model 8

Table 4.9 below shows the results of the multivariable logistic regression model for indicating that public officials were formally informed of the potential public health impact of decisions under their consideration in the past year. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 445 LHDs. After backward selection, the reduced model has 22 predictors significant at 5%, whereas the full model has 16 significant predictors.

The reduced model has 13 predictors positively associated and 9 predictors negatively associated with the indication that public officials were formally informed of potential public health impact. On the other hand, the full model has 9 predictors positively associated and 7 predictors negatively associated with the indication of public officials were formally informed of potential public health impact. Comparing the full model's P-Value with the reduced model's P-Value, 11 predictors are significant in both models. Eleven predictors cease to be significant, and 5 become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Master Top Exec**: If an LHD's top executive's highest degree is Masters, it *increases* the chance of indicating public officials were formally informed of potential public health impact by more than a factor of 2.
2. **# Hired**: For each additional employee an LHD hired, it *increases* the chance of indicating that public officials were formally informed of potential public health impact by 1%.
3. **# Vacant FTEs**: For each additional full-time equivalent (FTE) vacancy, it *decreases* the chance of indicating that public officials were formally informed of potential public health impact by (1 – odd's ratio)% = (1-0.97)% = 3%.
4. **Env Health Worker**: If an LHD currently employs environmental health worker(s), it *increases* the chance of indicating public officials were formally informed of potential public health impact by more than a factor of 4.
5. **Prep Staff**: If an LHD currently employs preparedness staff, it *decreases* the chance of indicating public officials were formally informed of potential public health impact by (1 – odd's ratio)% = (1-0.34)% = 66%.

6. **Screening Diabetes Directly**: If screenings for diabetes were performed by LHD directly, it *increases* the chance of indicating public officials were formally informed of potential public health impact by more than a factor of 2.
7. **Pri Prev CD via Others**: If population-based primary prevention activities for chronic disease (CD) programs were provided via others in community independent of LHD funding, it *decreases* the chance of indicating public officials were formally informed of potential public health impact by (1 – odd's ratio)% = (1-0.19)% = 81%.
8. **Insp Schl/DC Directly**: If inspection activities for schools/daycare were provided by an LHD directly, it *decreases* the chance of indicating public officials were formally informed of potential public health impact by (1 – odd's ratio)% = (1-0.35)% = 65%.
9. **Env Health Food Sft Edu Directly**: If environmental health activities for food safety education were provided by LHD directly, it *decreases* the chance of indicating public officials were formally informed of potential public health impact by (1 – odd's ratio)% = (1-0.30)% = 70%.
10. **Env Health Haz Resp NA**: If environmental health activities for hazmat response were not available in the community, it *decreases* the chance of indicating public officials were formally informed of potential public health impact by (1 – odd's ratio)% = (1-0.06)% = 94%.
11. **Env Health Noise Polu DK**: If an LHD doesn't know how environmental health activities for noise pollution were provided, it *decreases* the chance of indicating public officials were formally informed of potential public health impact by (1 – odd's ratio)% = (1-0.38)% = 62%.
12. **Lab Serv Contracted Out**: If activities for laboratory services were contracted out by the LHD, it *increases* the chance of indicating public officials were formally informed of potential public health impact by more than a factor of 5.
13. **Pol/Adv Housing**: If an LHD has been actively involved in policy or advocacy activities for safe and healthy housing, it *increases* the chance of indicating public officials were formally informed of potential public health impact by more than a factor of 3.
14. **Pol/Adv Clim Change**: If an LHD has been actively involved in policy or advocacy activities for climate change, it *increases* the chance of indicating public officials were formally informed of potential public health impact by a factor of 8.

15. **Pol/Adv Fund Local PH**: If an LHD has been actively involved in policy or advocacy activities for funding for local public health, it *increases* the chance of indicating public officials were formally informed of potential public health impact by a factor of 2.
16. **Pol/Adv Other Env Health**: If an LHD has been actively involved in policy or advocacy activities for other environment health areas, it *increases* the chance of indicating public officials were formally informed of potential public health impact by a factor of 2.

Table 4.8 Results of the Multivariable Logistic Regression Model for Indicating Public Officials were Formally Informed of Potential Public Health Impact

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-0.59		0.46	0.58		0.65
Master Top Exec	0.77	2.16	0.03	0.91	2.50	0.01
PH Top Exec	0.58	1.79	0.10	0.69	2.00	0.08
Combined HHS Agency	0.68	1.97	0.15	0.51	1.67	0.29
# Hired	0.01	1.01	0.00	0.01	1.01	0.01
# Vacant FTEs	-0.03	0.97	0.02	-0.03	0.97	0.04
PH Physician	0.54	1.72	0.11	0.72	2.06	0.07
Env Health Worker	0.90	2.46	0.14	1.51	4.52	0.03
Behav Health Staff	-1.24	0.29	0.01	-0.67	0.51	0.20
Prep Staff	-0.69	0.50	0.11	-1.08	0.34	0.04
Screening Diabetes Directly	0.62	1.85	0.07	0.76	2.13	0.03
Treatment HIV/AIDS Contracted Out	-0.91	0.40	0.11	-1.10	0.33	0.08
Treatment TB Contracted Out	3.60	36.66	0.01	1.44	4.23	0.13
B/M Health Directly	1.30	3.67	0.04	0.78	2.18	0.23
Epi&Surv CD via Others	0.98	2.67	0.04	0.69	1.99	0.19
Epi&Surv BRFs DK	-3.00	0.05	0.02	-1.22	0.29	0.26
Pri Prev CD via Others	-1.73	0.18	0.00	-1.65	0.19	0.00

Table 4.8 continued

Pri Prev CD Directly	0.92	2.50	0.02	0.33	1.39	0.47
Pri Prev Opioids Directly	0.74	2.09	0.02	0.49	1.64	0.19
Insp H/Motels DK	-1.25	0.29	0.07	-1.10	0.33	0.12
Insp Schl/DC Directly	-0.70	0.50	0.11	-1.04	0.35	0.03
Insp Rec Water Directly	-0.82	0.44	0.07	-0.66	0.52	0.16
Insp Lead DK	1.76	5.79	0.03	0.44	1.55	0.56
Insp Food Serv Directly	1.33	3.77	0.06	0.84	2.31	0.30
Env Health Food Sft Edu Directly	-1.21	0.30	0.03	-1.19	0.30	0.04
Env Health Food Sft Edu via Others	-0.70	0.50	0.05	-0.56	0.57	0.13
Env Health Haz Resp NA	-4.02	0.02	0.01	-2.74	0.06	0.01
Env Health Noise Polu DK	-1.15	0.32	0.01	-0.96	0.38	0.03
Lab Serv Contracted Out	2.68	14.63	0.00	1.76	5.79	0.02
Pol/Adv Land Use	-0.87	0.42	0.03	-0.58	0.56	0.18
Pol/Adv Mental Health	-0.66	0.51	0.07	-0.46	0.63	0.24
Pol/Adv Housing	1.43	4.16	0.00	1.27	3.55	0.00
Pol/Adv Clim Change	2.07	7.89	0.01	2.08	8.02	0.01
Pol/Adv Fund Local PH	1.06	2.89	0.00	0.86	2.35	0.02
Pol/Adv Other Env Health	0.69	1.99	0.06	0.75	2.11	0.04
Adopted New PH Ord/Reg	1.23	3.43	0.00	0.70	2.01	0.07
Major Revision PH Ord/Reg	-0.63	0.53	0.10	-0.08	0.92	0.85

HHS = health and human services, FTEs = full-time equivalents, PH = public health, HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome.

Model 9

Table 4.10 below shows the results of the multivariable logistic regression model for indicating community health needs have been prioritized in the past three years as identified from a community needs assessment. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 467 LHDs. After backward selection, the reduced model has 16 predictors significant at 5%, whereas the full model has 12 significant predictors.

The reduced model has 10 predictors positively associated and 6 predictors negatively associated with the indication that community health needs have been prioritized. On the other hand, the full model has 8 predictors positively associated and 4 predictors negatively associated with the indication that community health needs have been prioritized. Comparing the full model's P-Value with the reduced model's P-Value, 10 predictors are significant in both models. Six predictors cease to be significant, and 2 become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Epidemiologist/Statistician**: If an LHD currently employs epidemiologist(s)/statistician(s), it *increases* the chance of indicating community health needs have been prioritized by more than a factor of 2.
2. **Com Health Worker**: If an LHD currently employs community health worker(s), it *decreases* the chance of indicating community health needs have been prioritized by (1 – odd's ratio)% = (1-0.44)% = 56%.
3. **Behav Health Staff**: If an LHD currently employs behavioral health staff, it *decreases* the chance of indicating community health needs have been prioritized by (1 – odd's ratio)% = (1-0.26)% = 74%.
4. **Well-child Clinic Directly**: If well-child clinic was provided by an LHD directly, it *increases* the chance of indicating community health needs have been prioritized by more than a factor of 2.
5. **Epi&Surv C/I Disease Directly**: If epidemiology and surveillance activities for communicable/infectious (C/I) disease were provided by an LHD directly, it *increases* the chance of indicating community health needs have been prioritized by a factor of 4.

6. **Serv Obe Prev**: If an LHD provided services for obesity prevention at any time, it *increases* the chance of indicating community health needs have been prioritized by more than a factor of 2.
7. **Pol/Adv Oral Health**: If an LHD has been actively involved in policy or advocacy activities for oral health, it *increases* the chance of indicating community health needs have been prioritized by more than a factor of 2.
8. **Pol/Adv Alc Opi Drug**: If an LHD has been actively involved in policy or advocacy activities for tobacco, alcohol, opioids, or other drugs, it *decreases* the chance of indicating community health needs have been prioritized by (1 – odd's ratio)% = (1-0.38)% = 62%.
9. **Health Imp Plan (≤ 3 yr)**: If an LHD participated in developing a health improvement plan for the community within the last three years, it *increases* the chance of indicating community health needs have been prioritized by a factor of 3.
10. **Health Imp Plan Future**: If an LHD hasn't participated in developing a health improvement plan for the community but plans to participate/develop within the next year, it decreases the chance of indicating community health needs have been prioritized by (1 – odd's ratio)% = (1-0.24)% = 76%.
11. **Strategic Plan (≤ 3 yr)**: If an LHD developed a comprehensive, agency-wide strategic plan within the last three years, it *increases* the chance of indicating community health needs have been prioritized by more than a factor of 3.
12. **Strategic Plan (3-5 yr ago)**: If an LHD developed a comprehensive, agency-wide strategic plan more than three years ago but within the past five years, it *increases* the chance of indicating community health needs have been prioritized by a factor of 4.

Table 4.9 Results of the Multivariable Logistic Regression Model for Indicating that Community Health Needs Have Been Prioritized

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-5.75		0.00	-4.14		0.00
Full-Time Top Exec	1.34	3.83	0.03	1.05	2.85	0.12
One or More LBHs	0.94	2.57	0.01	0.31	1.36	0.47
# Filled FTEs	0.00	1.00	0.11	0.00	1.00	0.09
Env Health Worker	1.26	3.53	0.00	0.21	1.23	0.63
Epidemiologist/Statistician	0.67	1.95	0.08	0.96	2.61	0.02
Com Health Worker	-0.99	0.37	0.01	-0.82	0.44	0.02
Behav Health Staff	-1.57	0.21	0.00	-1.37	0.26	0.00
# Reduced Hour Employees	1.36	3.90	0.07	1.19	3.30	0.20
Adult Imm DK	-16.39	0.00	0.99	-18.67	0.00	1.00
Screening CVD Directly	-1.15	0.32	0.03	-0.65	0.52	0.20
Screening Diabetes Directly	0.83	2.30	0.08	0.29	1.34	0.51
Treatment Other STDs Contracted Out	2.48	11.88	0.00	0.80	2.22	0.25
Well-child Clinic Directly	1.15	3.16	0.01	0.91	2.49	0.03
B/M Health Directly	1.00	2.73	0.10	0.49	1.64	0.42
Epi&Surv C/I Disease Directly	1.31	3.72	0.09	1.44	4.20	0.03
Epi&Surv CD Directly	0.56	1.75	0.15	0.04	1.04	0.91
Epi&Surv BRFs DK	2.57	13.13	0.10	-0.17	0.84	0.83
Epi&Surv Synd Surv DK	-1.99	0.14	0.00	-0.51	0.60	0.31
Serv Obe Prev	0.81	2.26	0.04	0.91	2.49	0.01
Pol/Adv Oral Health	0.95	2.57	0.02	0.92	2.51	0.02

Table 4.10 continued

Pol/Adv Alc Opi Drug	-1.00	0.37	0.03	-0.96	0.38	0.02
Pol/Adv Fund Local PH	0.64	1.89	0.08	0.40	1.50	0.24
Health Imp Plan (≤ 3 yr)	1.44	4.21	0.00	1.22	3.38	0.00
Health Imp Plan Future	-1.24	0.29	0.02	-1.44	0.24	0.01
Strategic Plan (≤ 3 yr)	1.83	6.23	0.00	1.37	3.94	0.00
Strategic Plan (3-5 yr ago)	1.63	5.08	0.00	1.43	4.18	0.01
Strategic Plan Future	1.04	2.83	0.07	0.74	2.09	0.16

LBHs = local boards of health
FTEs = full-time equivalents
DK = don't know
CVD = cardiovascular disease
STDs = sexually transmitted diseases/infections
B/M = behavioral/ mental
C/I = communicable/ infectious
CD = chronic disease

Model 10

Table 4.11 below shows the results of the multivariable logistic regression model for indicating that community health initiatives established from a community health needs assessment have been implemented in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 483 LHDs. After backward selection, the reduced model has 20 predictors significant at 5%, whereas the full model has 16 significant predictors.

The reduced model has 9 predictors positively associated and 11 predictors negatively associated with the indication that community health initiatives have been implemented. On the other hand, the full model has 7 predictors positively associated and 9 predictors negatively associated with the indication that community health initiatives have been implemented. Comparing the full model's P-Value with the reduced model's P-Value, 12 predictors are significant in both models. Eight predictors cease to be significant, and 4 become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Info Sys Specialist**: If an LHD currently employs information systems specialist(s), it *decreases* the chance of indicating that community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.27)% = 73%.
2. **Pub Info Professional**: If an LHD currently employs public information professional(s), it *increases* the chance of indicating that community health initiatives have been implemented by more than a factor of 3.
3. **Prep Staff**: If an LHD currently employs preparedness staff, it *decreases* the chance of indicating that community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.35)% = 65%.
4. **Screening Other STDs Directly**: If screenings for other sexually transmitted diseases/infections (STDs) were performed by the LHD directly, it *increases* the chance of indicating that community health initiatives have been implemented by more than a factor of 3.
5. **Screening Cancer NA**: If an LHD indicated that screenings for cancer were not available in the community, it *decreases* the chance of indicating that community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.05)% = 95%.
6. **Treatment HIV/AIDS NA**: If treatments for HIV/AIDS were not available in community, it *decreases* the chance of indicating that community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.07)% = 93%.
7. **Epi&Surv M&C Health Directly**: If epidemiology and surveillance activities for maternal and child (M&C) health were provided by the LHD directly, it *increases* the chance of indicating that community health initiatives have been implemented by a factor of 3.
8. **Pri Prev CD Directly**: If population-based primary prevention activities for chronic disease (CD) programs were provided by the LHD directly, it *increases* the chance of indicating that community health initiatives have been implemented by a factor of 4.
9. **Pri Prev CD via Others**: If population-based primary prevention activities for chronic disease (CD) programs were provided via others in the community independent of LHD funding, it decreases the chance of indicating that community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.21)% = 79%.

10. **Env Health Rad Cont NA**: If environmental health activities for radiation control were not available in the community, it *increases* the chance of indicating that community health initiatives have been implemented by a factor of 3.
11. **Ani Cont NA**: If activities for animal control were not available in the community, it *decreases* the chance of indicating that the community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.08)% = 92%.
12. **Schl Clinic DK**: If an LHD doesn't know how activities for school-based clinic were provided, it *decreases* the chance of indicating that community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.04)% = 96%.
13. **Pol/Adv Alc Opi Drug**: If an LHD has been actively involved in policy or advocacy activities for tobacco, alcohol, opioids, or other drugs, it *decreases* the chance of indicating that community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.39)% = 61%.
14. **Pol/Adv None**: If an LHD has not been involved in any policy or advocacy activities at all, it *decreases* the chance of indicating that community health initiatives have been implemented by (1 – odd's ratio)% = (1-0.11)% = 89%.
15. **Strategic Plan (≤ 3 yr)**: If an LHD developed a comprehensive, agency-wide strategic plan within the last three years, it *increases* the chance of indicating that community health initiatives have been implemented by a factor of 3.
16. **Strategic Plan (3-5 yr ago)**: If an LHD developed a comprehensive, agency-wide strategic plan more than three years ago but within the past five years, it *increases* the chance of indicating that community health initiatives have been implemented by a factor of 6.

Table 4.10 Results of the Multivariable Logistic Regression Model for Indicating that Community Health Initiatives Have Been Implemented

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	0.29		0.84	-0.92		0.61
# Vacant FTEs	0.00	1.00	0.35	0.00	1.00	0.93
RN	-2.18	0.11	0.04	-0.80	0.45	0.31
Epidemiologist/Statistician	0.06	1.07	0.87	0.28	1.32	0.57
Com Health Worker	0.42	1.52	0.26	0.62	1.86	0.08
Nutritionist	-0.11	0.90	0.78	0.31	1.36	0.48
Info Sys Specialist	-1.41	0.24	0.00	-1.32	0.27	0.01
Pub Info Professional	1.25	3.50	0.01	1.37	3.92	0.00
Prep Staff	-0.26	0.77	0.58	-1.06	0.35	0.04
Screening Other STDs Directly	1.08	2.96	0.02	1.37	3.95	0.01
Screening Other STDs Contracted Out	1.54	4.66	0.07	0.23	1.26	0.78
Screening Cancer Directly	-0.25	0.78	0.52	-0.07	0.93	0.87
Screening Cancer NA	-5.42	0.00	0.00	-3.07	0.05	0.04
Screening Diabetes Directly	0.32	1.38	0.44	-0.59	0.55	0.19
Treatment HIV/AIDS Directly	0.90	2.46	0.02	0.37	1.45	0.34
Treatment HIV/AIDS NA	-3.76	0.02	0.00	-2.60	0.07	0.04
Treatment Other STDs Contracted Out	1.15	3.16	0.24	0.85	2.35	0.37
PCare NA	-0.36	0.70	0.74	-0.15	0.86	0.87
Epi&Surv C/I Disease Directly	2.13	8.45	0.01	0.73	2.08	0.33
Epi&Surv CD Directly	-0.26	0.77	0.54	-0.38	0.69	0.42
Epi&Surv M&C Health Directly	0.64	1.90	0.23	1.19	3.28	0.03
Pri Prev CD Directly	1.08	2.95	0.01	1.40	4.07	0.00
Pri Prev CD via Others	-1.78	0.17	0.01	-1.57	0.21	0.00

Table 4.10 continued

Insp Sep Sys Contracted Out	-2.59	0.07	0.01	-1.46	0.23	0.15
Insp Schl/DC Directly	-0.27	0.77	0.51	-0.09	0.92	0.85
Insp Tobacco Ret DK	0.64	1.89	0.34	0.18	1.20	0.75
Insp Lead NA	-1.93	0.14	0.01	-0.79	0.46	0.26
Insp Milk Proc NA	-0.46	0.63	0.37	-0.33	0.72	0.51
Env Health Rad Cont NA	1.22	3.38	0.06	1.12	3.07	0.05
Env Health Air Polu NA	0.79	2.21	0.18	0.19	1.20	0.74
Ani Cont NA	-3.79	0.02	0.00	-2.53	0.08	0.03
Schl Clinic DK	-3.14	0.04	0.00	-3.17	0.04	0.02
Schl Health Directly	-0.63	0.53	0.08	-0.49	0.61	0.16
Serv Blood Lead Screen	0.00	1.00	0.99	0.33	1.40	0.42
Serv M&C Health	-0.90	0.41	0.13	-0.38	0.68	0.56
Pol/Adv Fund HC	0.57	1.77	0.19	0.70	2.02	0.10
Pol/Adv Inf Disease	-0.91	0.40	0.04	-0.40	0.67	0.32
Pol/Adv Obe/Phys Act	0.86	2.37	0.03	0.47	1.60	0.23
Pol/Adv Alc Opi Drug	-0.70	0.50	0.12	-0.95	0.39	0.05
Pol/Adv None	-1.97	0.14	0.01	-2.20	0.11	0.01
Pol/Adv Fund Local PH	0.59	1.81	0.16	0.30	1.35	0.47
NP Hospital ≥ 1	1.03	2.80	0.02	0.20	1.22	0.67
Strategic Plan (≤ 3 yr)	1.84	6.28	0.00	1.20	3.33	0.01
Strategic Plan (3-5 yr ago)	2.87	17.69	0.00	1.86	6.44	0.01
Strategic Plan Future	0.79	2.21	0.17	-0.21	0.81	0.71

FTEs = full-time equivalents, RN = registered nurse, STDs = sexually transmitted diseases/infections, NA = not available, HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome, NA = not available, C/I = communicable/infectious, CD = chronic disease, DK = don't know, NP = nonprofit.

Model 11

Table 4.12 below shows the results of the multivariable logistic regression model for indicating that a community health action plan has been developed with community participation to address community health needs in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 465 LHDs. After backward selection, the reduced model has 17 predictors significant at 5%, whereas the full model has 9 significant predictors.

The reduced model has 12 predictors positively associated and 5 predictors negatively associated with the indication that a community health action plan has been developed. On the other hand, the full model has 6 predictors positively associated and 3 predictors negatively associated with the indication that a community health action plan has been developed. Comparing the full model's P-Value with the reduced model's P-Value, 9 predictors are significant in both models. Eight predictors cease to be significant, while no variable become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Lab Worker**: If an LHD currently employs laboratory worker(s), it *increases* the chance of indicating a community health action plan has been developed by more than a factor of 4.
2. **Epi&Surv M&C Health Directly**: If epidemiology and surveillance activities for maternal and child (M&C) health were provided by the LHD directly, it *increases* the chance of indicating a community health action plan has been developed by more than a factor of 3.
3. **Pri Prev Sub Abuse Directly**: If population-based primary prevention activities for substance abuse were provided by the LHD directly, it *increases* the chance of indicating a community health action plan has been developed by a factor of 2.
4. **Insp Campg & RVs NA**: If inspection activities for campgrounds & RVs were not available in the community, it *decreases* the chance of indicating a community health action plan by (1 – odd's ratio)% = (1-0.40)% = 60%.
5. **Env Health Air Polu NA**: If environmental health activities for air pollution were not available in the community, it *decreases* the chance of indicating a community health action plan by (1 – odd's ratio)% = (1-0.28)% = 72%.

6. **Lab Serv Directly**: If activities for laboratory services were provided by the LHD directly, it *decreases* the chance of indicating a community health action plan by (1 – odd's ratio)% = (1-0.47)% = 53%.
7. **Pol/Adv Obe/Phys Act**: If an LHD has been actively involved in policy or advocacy activities for obesity/physical activity, it *increases* the chance of indicating a community health action plan has been developed by a factor of 2.
8. **Health Imp Plan (≤ 3 yr)**: If an LHD participated in developing a health improvement plan for the community within the last three years, it *increases* the chance of indicating a community health action plan has been developed by a factor of 5.
9. **Strategic Plan (3-5 yr ago)**: If an LHD developed a comprehensive, agency-wide strategic plan more than three years ago but within the past five years, it *increases* the chance of indicating a community health action plan has been developed by a factor of 3.

Table 4.11 Results of the Multivariable Logistic Regression Model for Indicating that A Community Health Action Plan Has Been Developed

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-5.66		0.00	-22.33		1.00
Master Top Exec	0.63	1.88	0.03	0.24	1.27	0.40
Lab Worker	1.61	4.98	0.00	1.55	4.72	0.00
Info Sys Specialist	-0.65	0.52	0.05	-0.37	0.69	0.28
Prep Staff	-0.65	0.52	0.13	-0.82	0.44	0.07
Busn & Finc Worker	0.58	1.78	0.09	0.41	1.51	0.25
Screening Other STDs Contracted Out	1.39	4.01	0.04	1.02	2.78	0.12
Screening TB via Others	-0.54	0.58	0.07	-0.31	0.73	0.30
Screening Cancer NA	-14.87	0.00	0.98	0.51	1.66	0.63
Treatment Other STDs Contracted Out	1.86	6.41	0.05	1.35	3.87	0.09
Home HC via Others	2.65	14.13	0.01	0.92	2.52	0.23

Table 4.11 continued

Epi&Surv CD Directly	0.45	1.57	0.14	0.09	1.10	0.75
Epi&Surv M&C Health Directly	0.82	2.26	0.02	1.31	3.72	0.00
Pri Prev Opioids Directly	-0.66	0.52	0.05	-0.64	0.53	0.07
Pri Prev Sub Abuse Directly	0.74	2.09	0.03	0.80	2.24	0.02
Insp Campg & RVs NA	-1.72	0.18	0.00	-0.92	0.40	0.04
Env Health Rad Cont NA	0.91	2.49	0.06	0.79	2.20	0.08
Env Health Air Polu NA	-1.01	0.37	0.03	-1.26	0.28	0.01
Lab Serv Directly	-0.87	0.42	0.02	-0.75	0.47	0.03
Lab Serv NA	-3.11	0.04	0.02	-1.68	0.19	0.08
Serv Epi&Surv	0.86	2.36	0.11	0.78	2.19	0.13
Pol/Adv Fund HC	0.53	1.70	0.10	0.46	1.59	0.14
Pol/Adv Obe/Phys Act	0.79	2.21	0.01	0.89	2.44	0.00
Pol/Adv Occp Hea&Saf	1.49	4.43	0.02	0.74	2.10	0.18
Com Health Ass (> 5 yr)	1.45	4.28	0.09	1.37	3.95	0.06
Health Imp Plan (≤ 3 yr)	1.63	5.11	0.00	1.68	5.38	0.00
Health Imp Plan (> 5 yr)	-2.51	0.08	0.04	-1.95	0.14	0.05
Strategic Plan (≤ 3 yr)	0.90	2.46	0.04	0.45	1.56	0.31
Strategic Plan (3-5 yr ago)	1.74	5.71	0.00	1.24	3.46	0.02
Strategic Plan Future	-0.88	0.42	0.15	-0.97	0.38	0.10

STDs = sexually transmitted diseases/infections, TB = tuberculosis, NA = not available, CD = chronic disease, M&C = maternal and child, NA = not available, HC = health care or healthcare.

Model 12

Table 4.13 below shows the results of the multivariable logistic regression model for indicating that plans have been developed to allocate resources that align with community health plans in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 497 LHDs. After backward selection, the reduced model has 9 predictors significant at 5%, whereas the full model has 8 significant predictors.

The reduced model has 4 predictors positively associated and 5 predictors negatively associated with the indication that plans have been developed to allocate resources that align with community health plans. On the other hand, the full model has 5 predictors positively associated and 3 predictors negatively associated with the indication that plans have been developed to allocate resources that align with community health plans. Comparing the full model's P-Value with the reduced model's P-Value, 6 predictors are significant in both models. Three predictors cease to be significant, and 2 become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Screening Diabetes Directly**: If screenings for diabetes were performed by the LHD directly, it *increases* the chance of indicating that plans have been developed to allocate resources that align with community health plans by 93%.
2. **Epi&Surv C/I Disease Directly**: If epidemiology and surveillance activities for communicable/ infectious (C/I) disease were provided by the LHD directly, it *increases* the chance of indicating thate plans have been developed to allocate resources that align with community health plans by more than a factor of 6.
3. **Epi&Surv C/I Disease via Others**: If epidemiology and surveillance activities for C/I disease were provided via others in the community independent of LHD funding, it *decreases* the chance of indicating that plans have been developed to allocate resources that align with community health plans by (1 – odd's ratio)% = (1-0.54)% = 46%.
4. **Epi&Surv Injury DK**: If an LHD doesn't know how epidemiology and surveillance activities for injury were provided, it *decreases* the chance of indicating that plans have been

developed to allocate resources that align with community health plan by (1 – odd's ratio)% = (1-0.22)% = 78%.

5. **Pri Prev Opioids Directly**: If population-based primary prevention activities for opioids were provided by the LHD directly, it *increases* the chance of indicating that plans have been developed to allocate resources that align with community health plans by 88%.
6. **Ani Cont Contracted Out**: If activities for animal control were contracted out by the LHD, it *increases* the chance of indicating that plans have been developed to allocate resources that align with community health plans by a factor of 6.
7. **Pol/Adv Obe/Phys Act**: If an LHD has been actively involved in policy or advocacy activities for obesity/physical activity, it *increases* the chance of indicating that plans have been developed to allocate resources that align with community health plans by 82%.
8. **Pol/Adv Alc Opi Drug**: If an LHD has been actively involved in policy or advocacy activities for tobacco, alcohol, opioids, or other drugs, it *decreases* the chance of indicating plans have been developed to allocate resources that align with community health plan by (1 – odd's ratio)% = (1-0.38)% = 62%.

Table 4.12 Results of the Multivariable Logistic Regression Model for Indicating that Plans Have Been Developed to Allocate Resources that Align with Community Health Plans

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-3.72		0.00	-4.09		0.00
Full-Time Top Exec	1.07	2.93	0.09	0.99	2.69	0.15
Health Educator	-0.54	0.58	0.07	-0.20	0.82	0.53
Child Imm via Others	0.94	2.55	0.05	0.52	1.69	0.28
Screening Cancer Contracted Out	0.73	2.08	0.06	0.53	1.70	0.18
Screening CVD Directly	-0.45	0.64	0.14	-0.41	0.66	0.19
Screening Diabetes Directly	0.74	2.09	0.01	0.66	1.93	0.02
WIC Health via Others	-0.56	0.57	0.03	-0.39	0.68	0.19

Table 4.12 continued

B/M Health Contracted Out	0.51	1.67	0.16	0.55	1.74	0.16
Epi&Surv C/I Disease Directly	1.43	4.18	0.09	1.92	6.81	0.02
Epi&Surv C/I Disease via Others	-0.57	0.57	0.01	-0.62	0.54	0.01
Epi&Surv CD Contracted Out	1.20	3.30	0.07	1.01	2.73	0.11
Epi&Surv Injury DK	-1.34	0.26	0.04	-1.53	0.22	0.02
Pri Prev CD Directly	0.63	1.88	0.09	0.74	2.10	0.06
Pri Prev Opioids Directly	0.68	1.97	0.00	0.63	1.88	0.01
Insp Campg & RVs NA	-0.78	0.46	0.07	-0.75	0.47	0.09
Insp H/Motels NA	-1.04	0.35	0.06	-0.84	0.43	0.12
Ani Cont Contracted Out	1.85	6.36	0.01	1.85	6.35	0.01
Serv Obe Prev	0.55	1.73	0.07	0.51	1.66	0.10
Pol/Adv Obe/Phys Act	0.38	1.46	0.13	0.60	1.82	0.02
Pol/Adv Housing	0.50	1.66	0.03	0.38	1.47	0.12
Pol/Adv Alc Opi Drug	-0.94	0.39	0.00	-0.97	0.38	0.00
Pol/Adv None	-1.76	0.17	0.02	-0.96	0.38	0.15
Health Imp Plan (> 5 yr)	-1.36	0.26	0.11	-0.83	0.44	0.28
Strategic Plan Future	-0.78	0.46	0.06	-0.74	0.48	0.07

CVD = cardiovascular disease, WIC = women, infants, and children, B/M = behavioral/mental, C/I = communicable/infectious, CD = chronic disease, DK = don't know, NA = not available.

Model 13

Table 4.14 below shows the results of the multivariable logistic regression model for indicating that resources have been deployed as necessary to address priority health needs in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 465 LHDs. After backward selection, the reduced model has 15 predictors significant at 5%, whereas the full model has 12 significant predictors.

The reduced model has 10 predictors positively associated and 5 predictors negatively associated with the indication that resources have been deployed as necessary to address priority health needs. On the other hand, the full model has 8 predictors positively associated and 4 predictors negatively associated with the indication that resources have been deployed as necessary to address priority health needs. Comparing the full model's P-Value with the reduced model's P-Value, 9 predictors are significant in both models. Six predictors cease to be significant, and 3 become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Master Top Exec**: If an LHD's top executive's highest degree is Masters, it *increases* the chance of indicating public officials were formally informed of potential public health impact by 91%.
2. **# Vacant FTEs**: For each additional full-time equivalent (FTE) vacancy, it *increases* the chance of indicating resources have been deployed as necessary to address priority health needs by a factor of 3%.
3. **Treatment Other STDs Contracted Out**: If treatments for other STDs were contracted out by the LHD, it *increases* the chance of indicating resources have been deployed as necessary to address priority health needs by a factor of 5.
4. **WIC Health via Others**: If women, infants, and children (WIC) health were provided via others in community independent of LHD funding, it *decreases* the chance of indicating resources been deployed as necessary to address priority health needs by (1 – odd's ratio)% = (1-0.37)% = 63%.

5. **Epi&Surv C/I Disease Directly**: If epidemiology and surveillance activities for communicable/ infectious (C/I) disease were provided by the LHD directly, it *increases* the chance of indicating resources have been deployed as necessary to address priority health needs by a factor of 12.
6. **Pri Prev Phys Act Contracted Out**: If population-based primary prevention activities for physical activities were contracted out by the LHD, it *increases* the chance of indicating resources have been deployed as necessary to address priority health needs by a factor of 7.
7. **Pri Prev Opioids NA**: If population-based primary prevention activities for opioids were not available in the community, it *decreases* the chance of indicating resources have been deployed as necessary to address priority health needs by (1 – odd's ratio)% = (1-0.03)% = 97%.
8. **Pri Prev Mental Ill Contracted Out**: If population-based primary prevention activities for mental illness were contracted out by the LHD, it *increases* the chance of indicating resources have been deployed as necessary to address priority health needs by more than a factor of 4.
9. **Lab Serv NA**: If activities for laboratory services were not available in the community, it *decreases* the chance of indicating resources have been deployed as necessary to address priority health needs by (1 – odd's ratio)% = (1-0.06)% = 94%.
10. **Schl Clinic NA**: If activities for school-based clinic were not available in the community, it *decreases* the chance of indicating resources have been deployed as necessary to address priority health needs by (1 – odd's ratio)% = (1-0.48)% = 52%.
11. **Pol/Adv Obe/Phys Act**: If an LHD has been actively involved in policy or advocacy activities for obesity/physical activity, it *increases* the chance of indicating resources have been deployed as necessary to address priority health needs by 88%.
12. **Pol/Adv Fund Local PH**: If an LHD has been actively involved in policy or advocacy activities for funding for local public health, it *increases* the chance of indicating resources have been deployed as necessary to address priority health needs by a factor of 2.

Table 4.13 Results of the Multivariable Logistic Regression Model for Indicating that Resources Have Been Deployed as Necessary to Address Priority Health Needs

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-5.00		0.00	-6.62		0.00
Master Top Exec	0.56	1.75	0.02	0.65	1.91	0.02
# Filled FTEs	0.00	1.00	0.11	0.00	1.00	0.61
# Vacant FTEs	0.02	1.02	0.04	0.03	1.03	0.03
RN	1.30	3.68	0.11	1.75	5.75	0.06
Com Health Worker	0.55	1.73	0.03	0.37	1.45	0.19
# Reduced Hour Employees	0.50	1.64	0.05	0.50	1.66	0.05
Screening Cancer NA	-15.36	0.00	0.98	-16.36	0.00	0.99
Treatment Other STDs Contracted Out	2.03	7.64	0.00	1.70	5.47	0.01
WIC Health via Others	-0.75	0.47	0.01	-0.99	0.37	0.01
Epi&Surv C/I Disease Directly	2.04	7.66	0.01	2.51	12.35	0.01
Epi&Surv M&C Health Directly	-0.48	0.62	0.13	-0.42	0.66	0.25
Pri Prev CD Directly	0.55	1.73	0.15	0.65	1.91	0.13
Pri Prev Phys Act Contracted Out	2.11	8.28	0.02	2.00	7.39	0.04
Pri Prev Tobacco Directly	0.51	1.67	0.12	0.44	1.56	0.24
Pri Prev Opioids NA	-2.13	0.12	0.10	-3.50	0.03	0.03
Pri Prev Mental Ill Contracted Out	1.47	4.37	0.01	1.58	4.83	0.01
Insp Food Proc DK	-1.31	0.27	0.06	-0.92	0.40	0.10
Insp Milk Proc NA	-0.68	0.51	0.09	-0.07	0.94	0.88

Table 4.13 continued

Env Health Rad Cont NA	0.70	2.01	0.11	0.86	2.37	0.08
Lab Serv NA	-1.91	0.15	0.04	-2.81	0.06	0.01
Schl Clinic NA	-0.72	0.49	0.02	-0.74	0.48	0.03
Pol/Adv Land Use	-0.70	0.50	0.02	-0.66	0.52	0.07
Pol/Adv Obe/Phys Act	0.49	1.64	0.06	0.63	1.88	0.03
Pol/Adv Housing	0.61	1.84	0.03	0.26	1.29	0.43
Pol/Adv Fund Local PH	0.55	1.73	0.06	0.71	2.03	0.03
Com Health Ass (≤ 3 yr)	0.53	1.70	0.05	0.24	1.27	0.42
Health Imp Plan Future	-1.25	0.29	0.02	-1.16	0.31	0.06
Budget Increased	0.61	1.84	0.02	0.55	1.74	0.06

FTEs = full-time equivalents, RN = nurse practitioner, NA = not available, STDs = sexually transmitted diseases/infections, WIC = women, infants, and children, C/I = communicable/infectious, M&C = maternal and child, CD = chronic disease.

Model 14

Table 4.15 below shows the results of the multivariable logistic regression model for indicating that an organizational assessment of the local public health agency has been conducted in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 476 LHDs. After backward selection, the reduced model has 11 predictors significant at 5%, whereas the full model has 7 significant predictors.

The reduced model has 9 predictors positively associated and 2 predictors negatively associated with the indication that an organizational assessment of the local public health agency has been conducted. On the other hand, the full model has 5 predictors positively associated and 2 predictors negatively associated with the indication that an organizational assessment of the local public health agency has been conducted. Comparing the full model's P-Value with the reduced model's

P-Value, 6 predictors are significant in both models. Five predictors cease to be significant, and one becomes significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **PH Physician**: If an LHD currently employs public health physician(s), it *increases* the chance of indicating an organizational assessment of the local public health agency has been conducted by 80%.
2. **Env Health Worker**: If an LHD currently employs environmental health worker(s), it *increases* the chance of indicating an organizational assessment of the local public health agency has been conducted by a factor of 2.
3. **Epi&Surv M&C Health via Others**: If epidemiology and surveillance activities for maternal and child (M&C) health were provided via others in the community independent of LHD funding, it *decreases* the chance of indicating an organizational assessment of the local public health agency has been conducted by (1 – odd's ratio)% = (1-0.57)% = 43%.
4. **Pri Prev CD via Others**: If population-based primary prevention activities for chronic disease (CD) programs were provided via others in the community independent of LHD funding, it *decreases* the chance of indicating an organizational assessment of the local public health agency has been conducted by (1 – odd's ratio)% = (1-0.43)% = 57%.
5. **Env Health Food Sft Edu via Others**: If environmental health activities for food safety education were provided via others in the community independent of LHD funding, it *increases* the chance of indicating an organizational assessment of the local public health agency has been conducted by 92%.
6. **Pol/Adv Housing**: If an LHD has been actively involved in policy or advocacy activities for safe and healthy housing, it *increases* the chance of indicating an organizational assessment of the local public health agency has been conducted by a factor of 2.
7. **Strategic Plan (≤ 3 yr)**: If an LHD developed a comprehensive, agency-wide strategic plan within the last three years, it *increases* the chance of indicating an organizational assessment of the local public health agency has been conducted by 71%.

Table 4.14 Results of the Multivariable Logistic Regression Model for Indicating that an Organizational Assessment of the Local Public Health Agency Has Been Conducted

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-3.82		0.00	-2.69		0.01
One or More LBHs	0.41	1.50	0.10	0.46	1.58	0.18
# Filled FTEs	0.00	1.00	0.02	0.00	1.00	0.16
PH Physician	0.69	1.99	0.00	0.59	1.80	0.02
Env Health Worker	1.25	3.47	0.00	0.76	2.14	0.04
# Lost Employees	0.10	1.10	0.04	0.11	1.11	0.09
Screening Cancer via Others	1.25	3.50	0.03	0.55	1.73	0.27
Treatment HIV/AIDS Directly	0.41	1.50	0.07	0.39	1.47	0.10
Treatment HIV/AIDS Contracted Out	0.92	2.51	0.01	0.51	1.67	0.15
WIC Health via Others	-0.43	0.65	0.06	-0.29	0.75	0.31
Epi&Surv CD Directly	0.50	1.64	0.02	0.16	1.17	0.50
Epi&Surv M&C Health via Others	-0.62	0.54	0.02	-0.56	0.57	0.04
Pri Prev CD via Others	-0.50	0.61	0.10	-0.84	0.43	0.01
Pri Prev Mental Ill Contracted Out	0.76	2.14	0.07	0.87	2.39	0.05
Env Health Food Sft Edu via Others	0.87	2.38	0.00	0.65	1.92	0.01
Pol/Adv Em Prp&Resp	0.38	1.46	0.10	0.34	1.40	0.15
Pol/Adv Housing	0.83	2.28	0.00	0.81	2.25	0.00
Strategic Plan (≤ 3 yr)	0.53	1.69	0.02	0.53	1.71	0.02

PH = public health, WIC = women, infants, and children, CD = chronic disease, M&C = maternal and child.

Model 15

Table 4.16 below shows the results of the multivariable logistic regression model for indicating that age-specific priority health needs have been addressed effectively in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 506 LHDs. After backward selection, the reduced model has 5 predictors significant at 5%, whereas the full model has 4 significant predictors.

The reduced model has 4 predictors positively associated and 1 predictor negatively associated with the indication of age-specific priority health needs have been addressed effectively. On the other hand, the full model has 4 predictors positively associated and no predictor negatively associated with the indication of age-specific priority health needs have been addressed effectively. Comparing the full model's P-Value with the reduced model's P-Value, 2 predictors are significant in both models. Three predictors cease to be significant, and 2 become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Comp Pri Care Contracted Out**: If comprehensive primary care were contracted out by the LHD, it *increases* the chance of indicating age-specific priority health needs have been addressed effectively by a factor of 7.
2. **Epi&Surv M&C Health Directly**: If epidemiology and surveillance activities for maternal and child (M&C) health were provided by the LHD directly, it *increases* the chance of indicating age-specific priority health needs have been addressed effectively by 85%.
3. **Serv Obe Prev**: If an LHD provided services for obesity prevention at any time, it *increases* the chance of indicating age-specific priority health needs have been addressed effectively by 73%.
4. **Budget Decrease Expected**: If an LHD's next year's budget is expected to be less than its current year's budget, it *increases* the chance of indicating age-specific priority health needs have been addressed effectively by more than a factor of 2.

Table 4.15 Results of the Multivariable Logistic Regression Model for Indicating that Age-Specific Priority Health Needs Have Been Addressed Effectively

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-1.45		0.00	-17.56		0.99
# Hired	0.01	1.01	0.04	0.01	1.01	0.09
# Filled FTEs	-0.01	0.99	0.05	-0.01	0.99	0.13
Behav Health Staff	0.40	1.49	0.11	0.27	1.31	0.34
Child Imm Contracted Out	0.71	2.04	0.14	0.41	1.51	0.42
Comp Pri Care Contracted Out	1.45	4.26	0.08	1.96	7.06	0.03
Epi&Surv M&C Health Directly	0.43	1.54	0.08	0.62	1.85	0.03
Pri Prev CD Contracted Out	0.67	1.96	0.13	0.44	1.55	0.34
Pri Prev Opioids Contracted Out	0.61	1.83	0.15	0.58	1.78	0.20
Insp Tobacco Ret DK	-0.56	0.57	0.15	-0.39	0.68	0.30
Env Health Land Use DK	-0.74	0.47	0.13	-0.66	0.52	0.17
Serv Obe Prev	0.62	1.85	0.01	0.55	1.73	0.03
Pol/Adv Clim Change	0.72	2.06	0.02	0.65	1.91	0.05
Budget Decrease Expected	0.70	2.02	0.02	0.81	2.24	0.01
Budget Increase Expected	0.35	1.42	0.11	0.45	1.56	0.06

FTEs = full-time equivalents, CD = chronic disease, DK = don’t know.

Model 16

Table 4.17 below shows the results of the multivariable logistic regression model for indicating that the effects of public health services on community health status have been evaluated regularly in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 483 LHDs. After backward selection, the reduced model has 11 predictors significant at 5%, whereas the full model has 8 significant predictors.

The reduced model has 9 predictors positively associated and 2 predictors negatively associated with the indication that the effects of public health services have been evaluated regularly. On the other hand, the full model has 6 predictors positively associated and 2 predictors negatively associated with the indication that the effects of public health services have been evaluated regularly. Comparing the full model's P-Value with the reduced model's P-Value, 6 predictors are significant in both models. Five predictors cease to be significant, and 2 become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **# Lost Employees**: For each additional employee an LHD has lost via attrition and not replaced because of hiring freezes or budget cuts, it *increases* the chance of indicating that the effects of public health services have been evaluated regularly by 6%.
2. **Sub Abuse NA**: If an LHD indicated that substance abuse services were not available in the community, it *increases* the chance of indicating that the effects of public health services have been evaluated regularly by a factor of 11.
3. **Pri Prev Mental Ill Contracted Out**: If population-based primary prevention activities for mental illness were contracted out by the LHD, it *increases* the chance of indicating that the effects of public health services have been evaluated regularly by more than a factor of 3.
4. **Insp Food Serv via Others**: If inspection activities for food service establishments were provided via others in the community independent of LHD funding, it *decreases* the chance of indicating that the effects of public health services have been evaluated regularly by (1 – odd's ratio)% = (1-0.34)% = 66%.

5. **Pol/Adv Inf Disease**: If an LHD has been actively involved in policy or advocacy activities for infectious disease, it ***increases*** the chance of indicating that the effects of public health services have been evaluated regularly by a factor of 2.
6. **Major Revision PH Ord/Reg**: If an LHD indicated a substantive revision to an existing public health ordinance/regulation, it ***increases*** the chance of indicating that the effects of public health services have been evaluated regularly by 67%.
7. **Health Imp Plan Future**: If an LHD hasn't participated in developing a health improvement plan for the community but plan to participate/develop one within the next year, it ***decreases*** the chance of indicating that the effects of public health services have been evaluated regularly by (1 – odd's ratio)% = (1-0.34)% = 66%.
8. **Strategic Plan (≤ 3 yr)**: If an LHD developed a comprehensive, agency-wide strategic plan within the last three years, it ***increases*** the chance of indicating that the effects of public health services have been evaluated regularly by 63%.

Table 4.16 Results of the Multivariable Logistic Regression Model for Indicating that the Effects of Public Health Services Have Been Evaluated Regularly

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-4.94		0.00	-4.22		0.01
Health Educator	-0.45	0.63	0.13	0.10	1.10	0.76
# Lost Employees	0.04	1.04	0.09	0.06	1.06	0.04
Treatment HIV/AIDS Contracted Out	0.61	1.85	0.04	0.52	1.67	0.13
Sub Abuse NA	2.08	8.03	0.02	2.42	11.21	0.01
Epi&Surv C/I Disease Directly	2.00	7.42	0.06	2.30	9.99	0.05
Pri Prev Phys Act Directly	0.72	2.06	0.01	0.57	1.78	0.05
Pri Prev Mental Ill Contracted Out	0.97	2.63	0.02	1.37	3.93	0.00
Insp Rec Water via Others	-0.52	0.60	0.04	-0.45	0.64	0.12
Insp Milk Proc NA	-0.65	0.52	0.06	-0.21	0.81	0.56
Insp Food Serv via Others	-0.48	0.62	0.09	-1.08	0.34	0.01
Env Health Vect Cont via Others	0.42	1.52	0.07	0.24	1.28	0.33
Serv Com Disease	0.93	2.54	0.03	0.80	2.22	0.09
Serv Obe Prev	0.63	1.88	0.03	0.33	1.39	0.29
Pol/Adv Inf Disease	0.61	1.84	0.01	0.71	2.03	0.01
Major Revision PH Ord/Reg	0.47	1.60	0.03	0.51	1.67	0.04
Health Imp Plan Future	-1.27	0.28	0.01	-1.07	0.34	0.03
Strategic Plan (≤ 3 yr)	0.53	1.69	0.02	0.49	1.63	0.05

HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome, NA = don't know, C/I = communicable/infectious, PH = public health.

Model 17

Table 4.18 below shows the results of the multivariable logistic regression model for indicating that process and outcome measures have been used to monitor public health programs and to redirect resources in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 461 LHDs. After backward selection, the reduced model has 24 predictors significant at 5%, whereas the full model has 19 significant predictors.

The reduced model has 11 predictors positively associated and 13 predictors negatively associated with the indication that process and outcome measures have been used to monitor public health programs and to redirect resources. On the other hand, the full model has 9 predictors positively associated and 10 predictors negatively associated with the indication that process and outcome measures have been used to monitor public health programs and to redirect resources. Comparing the full model's P-Value with the reduced model's P-Value, 18 predictors are significant in both models. Six predictors cease to be significant, and one become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Rookie Top Exec**: If an LHD indicated that it's their top executive's first time being a top executive, it *decreases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.38)% = 62%.
2. **# Hired**: For each additional employee an LHD hired, it *increases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by 2%.
3. **# Filled FTEs**: For each additional full-time equivalent (FTE) filled, it decreases the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.98)% = 2%.
4. **B/M Health Directly**: If an LHD indicated that behavioral/mental health services were provided by them directly, it *increases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by a factor of 5.

5. **Epi&Surv C/I Disease via Others**: If an LHD indicated that epidemiology and surveillance activities for C/I disease were provided via others in the community independent of LHD funding, it ***decreases*** the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.30)% = 70%.
6. **Epi&Surv CD Directly**: If an LHD indicated that epidemiology and surveillance activities for chronic disease were provided by them directly, it ***increases*** the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by a factor of 2.
7. **Insp Food Proc DK**: If an LHD indicated that they don't know how inspection activities for food processing were provided, it ***decreases*** the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.21)% = 79%.
8. **Insp Milk Proc NA**: If an LHD indicated that inspection activities for milk processing were not available in the community, it ***decreases*** the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.45)% = 55%.
9. **Insp Food Serv via Others**: If an LHD indicated that inspection activities for food service establishments were provided via others in the community independent of LHD funding, it ***decreases*** the chance of indicating process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.41)% = 59%.
10. **Serv HBP Screen**: If an LHD indicated that they provided services for high blood pressure (HBP) screening at any time, it ***decreases*** the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.42)% = 58%
11. **Serv Obe Prev**: If an LHD indicated that they have provided services for obesity prevention at any time, it ***increases*** the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by a factor of 2.
12. **Pol/Adv Mental Health**: If an LHD indicated that they have been actively involved in policy or advocacy activities for mental health, it ***decreases*** the chance of indicating that process

and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.54)% = 46%.

13. **Pol/Adv Occp Hea&Saf**: If an LHD indicated that they have been actively involved in policy or advocacy activities for occupational health and safety, it *increases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by more than a factor of 4.
14. **Adopted New PH Ord/Reg**: If an LHD indicated that a new local public health ordinance/regulation has been adopted, it *increases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by more than a factor of 2.
15. **Health Imp Plan (≤ 3 yr)**: If an LHD indicated that they participated in developing a health improvement plan for the community within the last three years, it *decreases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.40)% = 60%.
16. **Health Imp Plan Future**: If an LHD indicated that they haven't participated in developing a health improvement plan for the community but plan to participate/develop one within the next year, it *decreases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by (1 – odd's ratio)% = (1-0.19)% = 81%.
17. **NP Hospital ≥ 1**: If an LHD indicated that there's at least one nonprofit hospital serving residents of their jurisdiction, it *increases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by more than a factor of 2.
18. **Strategic Plan (≤ 3 yr)**: If an LHD indicated that they developed a comprehensive, agency-wide strategic plan within the last three years, it *increases* the chance of indicating that process and outcome measures have been used to monitor public health programs and to redirect resources by more than a factor of 2.
19. **Budget Increased**: If an LHD indicated that their current year' budget is greater than its previous year's budget, it *increases* the chance of indicating that process and outcome

measures have been used to monitor public health programs and to redirect resources by 72%.

Table 4.17 Results of the Multivariable Logistic Regression Model for Indicating that Process and Outcome Measures Have Been Used to Monitor Public Health Programs and to Redirect Resources

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-1.77		0.045	-1.79		0.12
Rookie Top Exec	-0.82	0.44	0.006	-0.97	0.38	0.00
# Hired	0.01	1.01	0.026	0.02	1.02	0.03
# Filled FTEs	-0.02	0.98	0.023	-0.02	0.98	0.02
Pub Info Professional	-0.74	0.48	0.008	-0.47	0.62	0.12
Behav Health Staff	-0.62	0.54	0.076	-0.49	0.61	0.17
Busn & Finc Worker	0.60	1.83	0.054	0.54	1.72	0.12
Child Imm via Others	1.00	2.71	0.080	0.73	2.08	0.19
Screening HIV/AIDS Directly	0.82	2.27	0.007	0.68	1.97	0.06
Screening Cancer NA	-16.68	0.00	0.991	-1.10	0.33	0.43
Screening Diabetes Directly	0.43	1.54	0.138	0.41	1.50	0.19
B/M Health Directly	1.63	5.10	0.000	1.64	5.15	0.00
Epi&Surv C/I Disease via Others	-1.07	0.34	0.000	-1.20	0.30	0.00
Epi&Surv CD Directly	0.67	1.95	0.021	0.91	2.48	0.00
Epi&Surv CD Contracted Out	1.49	4.45	0.026	1.06	2.90	0.10
Epi&Surv CD via Others	0.62	1.86	0.104	0.58	1.79	0.14
Epi&Surv Injury DK	-1.16	0.31	0.153	-0.06	0.94	0.93
Pri Prev Mental Ill Directly	0.60	1.82	0.060	0.27	1.31	0.43

Table 4.17 continued

Insp Tobacco Ret DK	-1.31	0.27	0.019	-0.79	0.45	0.13
Insp Food Proc DK	-2.31	0.10	0.012	-1.57	0.21	0.04
Insp Milk Proc NA	-0.79	0.46	0.035	-0.80	0.45	0.05
Insp Food Serv via Others	-0.68	0.51	0.024	-0.89	0.41	0.02
Env Health Haz Resp NA	-16.75	0.00	0.987	-16.96	0.00	0.99
Env Health Haz Resp DK	-1.74	0.18	0.151	-0.73	0.48	0.39
EMS Directly	0.83	2.30	0.134	1.06	2.88	0.09
Serv Epi&Surv	-0.78	0.46	0.100	-0.52	0.59	0.29
Serv HBP Screen	-1.00	0.37	0.000	-0.87	0.42	0.00
Serv Obe Prev	0.85	2.33	0.008	0.90	2.47	0.01
Pol/Adv Fund HC	-0.59	0.56	0.039	-0.34	0.71	0.25
Pol/Adv Mental Health	-0.76	0.47	0.006	-0.61	0.54	0.04
Pol/Adv Occp Hea&Saf	1.79	5.97	0.000	1.54	4.65	0.00
Pol/Adv Housing	0.56	1.74	0.042	0.43	1.54	0.14
Pol/Adv Clim Change	-0.54	0.58	0.158	-0.29	0.74	0.46
Adopted New PH Ord/Reg	0.79	2.20	0.002	0.98	2.66	0.00
Health Imp Plan (≤ 3 yr)	-0.78	0.46	0.011	-0.91	0.40	0.01
Health Imp Plan (> 5 yr)	-1.73	0.18	0.074	-1.80	0.17	0.13
Health Imp Plan Future	-1.89	0.15	0.001	-1.67	0.19	0.00
NP Hospital ≥ 1	0.70	2.01	0.077	0.99	2.70	0.01
Strategic Plan (≤ 3 yr)	1.00	2.73	0.000	1.09	2.96	0.00
Budget Increased	0.55	1.73	0.032	0.54	1.72	0.05

FTEs = full-time equivalents, HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome, NA = not available, B/M = behavioral/mental, C/I = communicable/infectious, CD = chronic disease, DK = don't know, EMS = emergency medical services, HC = health care or healthcare, PH = public health, NP = nonprofit.

Model 18

Table 4.19 below shows the results of the multivariable logistic regression model for indicating that the public has regularly received information about current health status, health care needs, health behaviors, and health care policy issues in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 509 LHDs. After backward selection, the reduced model has 12 predictors significant at 5%, whereas the full model has 9 significant predictors.

The reduced model has 6 predictors positively associated and 6 predictors negatively associated with the indication that the public has regularly received current health information. On the other hand, the full model has 5 predictors positively associated and 4 predictors negatively associated with the indication that the public has regularly received current health information. Comparing the full model's P-Value with the reduced model's P-Value, 7 predictors are significant in both models. Five predictors cease to be significant, and two become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Epidemiologist/Statistician**: If an LHD indicated that they currently employ an epidemiologist/statistician, it *decreases* the chance of indicating the public has regularly received current health information by (1 – odd's ratio)% = (1-0.44)% = 56%.
2. **Pub Info Professional**: If an LHD indicated that they currently employ a public information professional, it *increases* the chance of indicating that the public has regularly received current health information by a factor of 2.
3. **Epi&Surv C/I Disease Directly**: If an LHD indicated that epidemiology and surveillance activities for communicable/ infectious (C/I) disease were provided by them directly, it *increases* the chance of indicating that the public has regularly received current health information by a factor of 5.
4. **Pri Prev CD Directly**: If an LHD indicated that population-based primary prevention activities for chronic disease (CD) programs were provided by them directly, it *increases* the chance of indicating that the public has regularly received current health information by a factor of 2.

5. **Insp Sep Sys Contracted Out**: If an LHD indicated that inspection activities for septic systems were contracted out, it ***decreases*** the chance of indicating that the public has regularly received current health information by (1 – odd's ratio)% = (1-0.20)% = 80%.
6. **Env Health Haz Resp NA**: If an LHD indicated that environmental health activities for hazmat response were not available in the community, it ***decreases*** the chance of indicating that the public has regularly received current health information by (1 – odd's ratio)% = (1-0.13)% = 87%.
7. **EMS Contracted Out**: If an LHD indicated that activities for EMS were contracted out, it ***decreases*** the chance of indicating that the public has regularly received current health information by (1 – odd's ratio)% = (1-0.08)% = 92%.
8. **Pol/Adv Fund HC**: If an LHD indicated that they have been actively involved in policy or advocacy activities for funding for access to healthcare, it ***increases*** the chance of indicating that the public has regularly received current health information by a factor of 3.
9. **Pol/Adv Obe/Phys Act**: If an LHD indicated that they have been actively involved in policy or advocacy activities for obesity/physical activity, it ***increases*** the chance of indicating that the public has regularly received current health information by 84%.

Table 4.18 Results of the Multivariable Logistic Regression Model for Indicating that the Public Has Regularly Received Current Health Information

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-1.29	0.28	0.045	-0.45	0.64	0.663
Lab Worker	0.60	1.82	0.073	0.58	1.79	0.125
Epidemiologist/ Statistician	-0.67	0.51	0.026	-0.82	0.44	0.021
Pub Info Professional	0.87	2.38	0.005	0.87	2.39	0.010
Screening HIV/AIDS Directly	-0.57	0.57	0.090	-0.63	0.53	0.108
Treatment HIV/AIDS Directly	0.86	2.37	0.004	0.49	1.63	0.110
Epi&Surv C/I Disease Directly	1.80	6.07	0.004	1.62	5.08	0.007
Pri Prev CD Directly	0.69	1.99	0.013	0.90	2.47	0.003
Pri Prev CD NA	-1.56	0.21	0.077	-2.04	0.13	0.022
Pri Prev Sub Abuse Directly	0.51	1.67	0.077	0.42	1.52	0.164
Insp Sep Sys Contracted Out	-1.20	0.30	0.070	-1.59	0.20	0.033
Insp Housing DK	-1.10	0.33	0.011	-0.67	0.51	0.133
Env Health Haz Resp NA	-2.99	0.05	0.001	-2.06	0.13	0.003
EMS Contracted Out	-1.50	0.22	0.049	-2.48	0.08	0.005
Pol/Adv Fund HC	0.93	2.53	0.006	1.23	3.41	0.000
Pol/Adv Obe/Phys Act	0.49	1.63	0.079	0.61	1.84	0.036
Health Imp Plan Future	-1.07	0.34	0.008	-0.84	0.43	0.050
Strategic Plan (3-5 yr ago)	0.91	2.48	0.040	0.75	2.12	0.066

HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome, C/I = communicable/infectious, CD = chronic disease, NA = not available, DK = don't know, EMS = emergency medical services, HC = health care or healthcare.

Model 19

Table 4.20 below shows the results of the multivariable logistic regression model for indicating that the media has regularly received reports about health issues affecting the community in the past year. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 509 LHDs. After backward selection, both the reduced and full models have 8 predictors significant at 5%, 6 predictors positively associated, and 2 predictors negatively associated with the indication that the media has regularly received reports about health issues affecting the community. Comparing the full model's P-Value with the reduced model's P-Value, 7 predictors are significant in both models. One predictor ceased to be significant, and one became significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Oral HC Staff**: If an LHD indicated that they currently employ oral health care staff, it *increases* the chance of indicating the media has regularly received reports about health issues affecting the community by a factor of 7.
2. **PCare Directly**: If an LHD indicated that prenatal care was provided by them directly, it *increases* the chance of indicating that the media has regularly received reports about health issues affecting the community by a factor of 3.
3. **Oral Health Directly**: If an LHD indicated oral health was provided by them directly, it *decreases* the chance of indicating that the media has regularly received reports about health issues affecting the community by (1 – odd's ratio)% = (1-0.30)% = 70%.
4. **Insp Sep Sys Directly**: If an LHD indicated inspection activities for septic systems were provided by them directly, it *increases* the chance of indicating the media has regularly received reports about health issues affecting the community by a factor of 2.
5. **Ani Cont NA**: If an LHD indicated activities for animal control were not available in the community, it *decreases* the chance of indicating that the media has regularly received reports about health issues affecting the community by (1 – odd's ratio)% = (1-0.08)% = 92%.
6. **Serv Epi&Surv**: If an LHD indicated that they provided services for epidemiology and surveillance at any time, it *increases* the chance of indicating that the media has regularly received reports about health issues affecting the community by a factor of 2.

7. **Serv Obe Prev**: If an LHD indicated that they provided services for obesity prevention at any time, it *increases* the chance of indicating that the media has regularly received reports about health issues affecting the community by a factor of 2.
8. **Health Imp Plan (3-5 yr ago)**: If an LHD indicated that they participated in developing a health improvement plan for the community more than three years ago but within the past five years, it *increases* the chance of indicating that the media has regularly received reports about health issues affecting the community by more than a factor of 2.

Table 4.19 Results of the Multivariable Logistic Regression Model for Indicating that the Media Has Regularly Received Reports about Health Issues Affecting the Community

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-1.38		0.00	0.02	1.02	0.99
Master Top Exec	0.39	1.47	0.11	0.37	1.44	0.18
Oral HC Staff	1.43	4.19	0.00	1.98	7.21	0.00
Screening HIV/AIDS Directly	0.57	1.76	0.03	0.21	1.23	0.50
PCare Directly	0.59	1.80	0.06	1.21	3.34	0.00
Oral Health Directly	-1.01	0.36	0.01	-1.21	0.30	0.00
Pri Prev Phys Act Contracted Out	1.61	4.98	0.13	2.04	7.69	0.06
Insp Sep Sys Directly	0.73	2.08	0.01	0.79	2.21	0.02
Ani Cont NA	-2.57	0.08	0.00	-2.57	0.08	0.00
Serv Epi&Surv	0.79	2.21	0.04	0.89	2.42	0.04
Serv Obe Prev	0.94	2.56	0.00	0.89	2.43	0.00
Health Imp Plan (3-5 yr ago)	0.81	2.25	0.03	0.99	2.69	0.01

HC = health care or healthcare, HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome, NA = not available.

Model 20

Table 4.21 below shows the results of the multivariable logistic regression model for indicating that there has been a failed instance of mandated public health program or service in the past three years. After removing rows with missing data for variables that were significant in the bivariate analyses, the remaining dataset contains data from 517 LHDs. After backward selection, the reduced model has 13 predictors significant at 5%, whereas the full model has 9 significant predictors.

The reduced model has 2 predictors positively associated and 11 predictors negatively associated with the indication that there has been a failed instance of a mandated public health program or service. On the other hand, the full model has one predictor positively associated and 8 predictors negatively associated with the indication that there has been a failed instance of a mandated public health program or service. Comparing the full model's P-Value with the reduced model's P-Value, 9 predictors are significant in both models. Four predictors cease to be significant, and none become significant in the full model.

Based on the full model's odds ratios, the following can be concluded for its significant variables:

1. **Pri Prev Opioids Directly**: If an LHD indicated that population-based primary prevention activities for opioids were provided by them directly, it *decreases* the chance of indicating there has been a failed instance of a mandated public health program or service by (1 – odd's ratio)% = (1-0.09)% = 91%.
2. **Insp Private Water DK**: If an LHD indicated that they don't know how inspection activities for private drinking water were provided, it *decreases* the chance of indicating there has been a failed instance of a mandated public health program or service by (1 – odd's ratio)% = (1-0.04)% = 96%.
3. **Env Health Food Sft Edu NA**: If an LHD indicated that environmental health activities for food safety education were not available in the community, it *decreases* the chance of indicating there has been a failed instance of mandated public health program or service by (1 – odd's ratio)% = (1-0.02)% = 98%.
4. **Env Health Vect Cont Contracted Out**: If an LHD indicated that environmental health activities for vector control were contracted out, it *decreases* the chance of indicating there

has been a failed instance of a mandated public health program or service by (1 – odd's ratio)% = (1-0.01)% = 99%.

5. **Env Health Noise Polu NA**: If an LHD indicated that environmental health activities for noise pollution were not available in the community, it *decreases* the chance of indicating there has been a failed instance of a mandated public health program or service by (1 – odd's ratio)% = (1-0.10)% = 90%.
6. **Serv Obe Prev**: If an LHD indicated that they provided services for obesity prevention at any time, it *increases* the chance of indicating there has been a failed instance of a mandated public health program or service by more than a factor of 5.
7. **Pol/Adv Other Pol Areas**: If an LHD indicated that they have been actively involved in policy or advocacy activities for other policy areas, it *decreases* the chance of indicating there has been a failed instance of a mandated public health program or service by (1 – odd's ratio)% = (1-0.10)% = 90%.
8. **Com Health Ass Future**: If a community health assessment hasn't been completed but the LHD plans to complete one within the next year, it *decreases* the chance of indicating there has been a failed instance of a mandated public health program or service by (1 – odd's ratio)% = (1-0.05)% = 95%.
9. **Budget Increased**: If an LHD indicated that their current year' budget is greater than its previous year's budget, it *decreases* the chance of indicating there has been a failed instance of a mandated public health program or service by (1 – odd's ratio)% = (1-0.22)% = 78%.

Table 4.20 Results of the Multivariable Logistic Regression Model for Indicating that There Has Been a Failed Instance of Mandated Public Health Program or Service

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	4.28		0.000	19.74		1.00
Screening Cancer Directly	0.94	2.56	0.140	1.05	2.86	0.24
EPSDT DK	-1.10	0.33	0.047	-1.26	0.28	0.07
Well-child Clinic via Others	1.81	6.11	0.021	1.59	4.91	0.12
Comp Pri Care Contracted Out	-1.66	0.19	0.077	-1.69	0.18	0.14
Sub Abuse Contracted Out	-2.27	0.10	0.000	-1.57	0.21	0.05
Pri Prev Opioids Directly	-1.90	0.15	0.006	-2.37	0.09	0.01
Insp H/Motels NA	-1.59	0.20	0.032	-1.99	0.14	0.07
Insp Private Water DK	-2.92	0.05	0.000	-3.23	0.04	0.00
Env Health Food Sft Edu NA	-3.30	0.04	0.043	-3.83	0.02	0.03
Env Health Vect Cont Contracted Out	-2.64	0.07	0.003	-4.84	0.01	0.00
Env Health Noise Polu NA	-1.81	0.16	0.003	-2.34	0.10	0.01
Serv Obe Prev	1.07	2.92	0.049	1.75	5.73	0.02
Pol/Adv Other Pol Areas	-1.18	0.31	0.026	-2.33	0.10	0.00
Com Health Ass Future	-2.65	0.07	0.035	-2.91	0.05	0.03
Health Imp Plan (> 5 yr)	-1.51	0.22	0.118	-0.22	0.80	0.85
Strategic Plan (≤ 3 yr)	0.74	2.10	0.152	0.72	2.06	0.24
Budget Increased	-1.19	0.30	0.021	-1.51	0.22	0.04

EPSDT = early and periodic screening, diagnostic and treatment, DK = don’t know, NA = not available.

5. DISCUSSION

5.1 Conclusions

Out of the 274 infrastructure variables tested, there are 115 variables (or about 42% variables) significant for at least one key public health activity based on the multivariable analyses. In total, these 115 variables are significant 189 times to the completion of certain best practice activities. The full list of significant infrastructure variables with their corresponding frequency of significance is in Appendix H. Table 5.1 below shows the major themes that were identified out of the significant infrastructure variables and their meanings, as well as the total number of significant variables per each theme.

Table 5.1 Major Themes of the Significant Infrastructure Variables

Theme	Count
1. Direct Provision	36
2. Staffing	32
3. Policy/Advocacy Activities	24
4. Provision Not Available	22
5. Epidemiology & Surveillance Activities	20
6. Health Improvement/Strategic Plans	19
7. Provision via Others in the Community	16
8. Contract Out	16
9. Inspection Activities	12
10. Don't Know Provision	6
11. Change in Budget	4

For the remainder of this chapter, multivariable results of each theme will be summarized with overall patterns and takeaways.

5.1.1 Theme 1: Direct Provision

Table 5.2 contains the full list of variables that are categorized as direct provision and were statistically significant in at least one model, where the number of times they are significant is indicated in the second column. It was found that providing several public health services or activities directly by LHDs is strongly correlated with increased chances of completing the

following best public health practices. The following are the activities that have three significant variables that increase the chance of completing them:

1. A community needs assessment process has been conducted that systematically describes the prevailing health status in the community. (Activity 1)
2. Community health initiatives have been implemented that are consistent with priorities established from community health needs assessment. (Activity 10)
3. Plans have been developed to allocate resources in a manner consistent with community health action plans. (Activity 12)

Table 5.2 Significant Infrastructure Variables for Direct Provision

Variable Alias	Count
Pri Prev Sub Abuse Directly	1
PCare Directly	1
Screening Other STDs Directly	1
Insp Sep Sys Directly	1
Well-child Clinic Directly	1
Insp Schl/DC Directly	1
Screening CVD Directly	1
Treatment TB Directly	1
Oral Health Directly	1
B/M Health Directly	2
Lab Serv Directly	2
Env Health Food Sft Edu Directly	2
Screening Diabetes Directly	2
Pri Prev CD Directly	2
Epi&Surv CD Directly	3
Pri Prev Opioids Directly	3
Epi&Surv C/I Disease Directly	4
Epi&Surv M&C Health Directly	7
Total	**36**

It is also worth noting that "Epi&Surv M&C Health Directly" are strongly associated with increased chances of completing 7 best practice activities. LHDs performing these best practice activities seem to be prioritizing direct provision of epidemiology and surveillance activities for maternal and child (M&C) health.

Out of the 36 times variables are significant, there are 7 times that providing epidemiology and surveillance activities directly decreases the chance of completing certain best practice activities, which may be unintuitive at first glance. For example, it was found that providing oral health services directly by the LHDs is strongly associated with decreasing the chance that the public has regularly received information about current health status, health care needs, health behaviors, and health care policy issues. The reason why such a result was found may be because there exists a hierarchy of needs for communities. The necessity to focus on lower-level needs (e.g., oral health) means that it is more difficult to focus on higher-level needs (e.g. providing the public with current health information).

5.1.2 Theme 2: Staffing

Table 5.3 contains the full list of variables that are categorized as staffing, where the number of times they are significant is indicated in the second column. Three variables are positively associated with activity 8, which means that recruiting environmental health workers, top executives that have a Master's degree as the highest degree, and more employees all increase the chance that public officials have been formally informed about the potential public health impact of decisions under their consideration.

Table 5.3 Significant Infrastructure Variables for Staffing

Variable Alias	Count
Lab Worker	1
Info Sys Specialist	1
# Filled FTEs	1
Com Health Worker	1
Behav Health Staff	1
Full-Time Top Exec	1
Rookie Top Exec	1
PH Physician	1
Nutritionist	1
Agency Leadership	1
RN	1
# Vacant FTEs	2
# Lost Employees	2
Master Top Exec	2
Env Health Worker	2
Oral HC Staff	2
Prep Staff	2
# Hired	2
Pub Info Professional	3
Epidemiologist/Statistician	4
Total	**32**

It is also worth noting that "Epidemiologist/Statistician" and "Pub Info Professional" are both strongly associated with increasing the chance of completing at least 3 best practice activities, which indicates that LHDs that are able to staff these positions may be better equipped to perform these practices. The one activity for which hiring epidemiologists or statisticians is negatively associated with is that the public has regularly received information about current health status, health care needs, health behaviors, and health care policy issues. This is most likely because the job responsibilities of epidemiologists or statisticians are irrelevant to the completion of this best practice. Rather, this is most related to the job responsibilities of public information professionals, who are the representatives in the LHDs to publicize public health information to the media and public.

Out of the 32 times variables are significant, there are 10 times that hiring certain types of workers or increasing amount of FTEs decreases the chance of completing certain best practice activities. For example, it was found that hiring oral health care staff is strongly associated with decreasing

the chance that a community needs assessment process has been conducted. This may be because recruiting this type of staff indicates a focus on more obvious community needs such that the necessity to complete a community needs assessment is not apparent.

5.1.3 Theme 3: Policy/Advocacy Activities

Table 5.4 contains the full list of variables that are categorized as policy or advocacy activities, where the number of times they are significant is indicated in the second column. Four variables are positively associated with activity 8, which means that engaging in policy or advocacy activities for safe and healthy housing, climate change, funding for local public health, and other environmental health areas (i.e., areas not indicated in the survey) all increase the chance that public officials have been formally informed about the potential public health impact of decisions under their consideration.

It is also worth noting that engaging in policy or advocacy activities for obesity/physical activity is associated with increased chances of completing 4 best practice activities. LHDs performing these best practice activities seem to be prioritizing policy or advocacy activities for obesity/physical activity.

Table 5.4 Significant Infrastructure Variables for Policy/Advocacy Activities

Variable Alias	Count
Pol/Adv Other Pol Areas	1
Pol/Adv Fund HC	1
Pol/Adv None	1
Pol/Adv Occp Hea&Saf	1
Pol/Adv Inf Disease	1
Pol/Adv Clim Change	1
Pol/Adv Other Env Health	1
Pol/Adv Em Prp&Resp	1
Pol/Adv Fund Local PH	2
Pol/Adv Oral Health	2
Pol/Adv Mental Health	2
Pol/Adv Housing	3
Pol/Adv Alc Opi Drug	3
Pol/Adv Obe/Phys Act	4
Total	**24**

Out of the 24 times variables are significant, there are 7 times that participating in policy or advocacy activities decreases the chance of completing certain best practice activities. For example, it was found that participating in policy/advocacy activities specifically for tobacco, alcohol, opioids, or other drugs is associated with decreasing the chance that community health initiatives have been implemented, community health needs have been prioritized, and resource allocation plans have been developed in the past three years. The reason why such results occur may be because the communities most likely to engage in policy/advocacy around these issues have been harder hit by substance use trends such as the opioid crisis which has drawn the focus of the LHD away from other longer term plans.

5.1.4 Theme 4: Provision Not Available

Table 5.5 contains the full list of variables that are categorized as the provision of services or activities is not available, where the number of times they are significant is indicated in the second column. It is worth noting that “no provision” for certain services or activities negatively affects the implementation of community health initiatives (Activity 10) and deployment of necessary resources to address priority health needs (Activity 13) the most, as three significant variables in this theme are strongly associated with decreased chances for completing these two activities.

Table 5.5 Significant Infrastructure Variables for Provision Not Available

Variable Alias	Count
Insp Campg & RVs NA	1
Screening Cancer NA	1
Treatment HIV/AIDS NA	1
Insp Milk Proc NA	1
Lab Serv NA	1
Pri Prev Mental Ill NA	1
Env Health Food Sft Edu NA	1
Env Health Air Qual NA	1
Sub Abuse NA	1
Epi&Surv BRFs NA	1
Schl Clinic NA	1
Env Health Noise Polu NA	1
Pri Prev Opioids NA	1
Insp Tobacco Ret NA	1
Env Health Haz Resp NA	2
Env Health Rad Cont NA	2
Ani Cont NA	2
Env Health Air Polu NA	2
Total	**22**

Out of the 22 times variables are significant, there are 3 times that "not having" certain services or activities increases the chance of completing certain best practice activities, which can be unintuitive. For example, it was found that not having environmental health activities for radiation control increases the chance that community health initiatives have been implemented (Activity 10). This is most likely because the LHDs have more capacities to do other things (e.g., implement initiatives) when they are not required to commit resources to providing these activities (e.g., radiation control).

5.1.5 Theme 5: Epidemiology & Surveillance Activities

Table 5.6 contains the full list of variables that are categorized as epidemiology and surveillance activities, where the number of times they are significant is indicated in the second column. Providing epidemiology and surveillance activities for maternal and child (M&C) health directly by the LHDs is strongly associated with increased chances of completing 7 best practice activities. In addition, proving epidemiology and surveillance activities for communicable/ infectious (C/I)

disease directly by the LHDs is also strongly correlated with increased chances of completing 4 best practice activities. Being able to provide these two types of services appear to reflect the level of capacity needed to perform many best practices.

Table 5.6 Significant Infrastructure Variables for Epidemiology & Surveillance Activities

Variable Alias	Count
Epi&Surv M&C Health via Others	1
Epi&Surv Injury DK	1
Serv Epi&Surv	1
Epi&Surv BRFs NA	1
Epi&Surv C/I Disease via Others	2
Epi&Surv CD Directly	3
Epi&Surv C/I Disease Directly	4
Epi&Surv M&C Health Directly	7
Total	20

Out of the 20 times variables are significant, there are 6 times one of the variables decreases the chance of completing certain best practice activities. For example, it was found that providing epidemiology & surveillance activities for chronic disease directly is associated with decreasing the chance of indicating that an analysis of age-specific participation in preventive and screening services has been completed. This is likely due to the limited capacities of some LHDs. When LHDs provided epidemiology & surveillance activities directly, they're more likely to have fewer capacities to do other things, such as completing an analysis.

5.1.6 Theme 6: Health Improvement/Strategic Plans

Table 5.7 contains the full list of variables that are categorized as health improvement or strategic plans of the LHDs, where the number of times they are significant is indicated in the second column.

Table 5.7 Significant Infrastructure Variables for Health Improvement and Strategic Plans

Variable Alias	Count
Health Imp Plan (3-5 yr ago)	1
Health Imp Plan Future	3
Strategic Plan (3-5 yr ago)	4
Health Imp Plan (≤ 3 yr)	4
Strategic Plan (≤ 3 yr)	7
Total	**19**

Health Improvement Plan

Out of the 8 times where variables are significant for participation in developing health improvement plans, there are 4 times variables are associated with increased chances of participation, while the other 4 times variables are associated with decreased chances of participation. Among the 4 variables that are associated with increased chances of participation, participation in developing a health improvement plan within the last 3 years is strongly associated with increased chances that an analysis has been completed of the determinants of and contributing factors (Activity 5), community health needs have been prioritized (Activity 9), and a community health action plan has been developed (Activity 11) within the last three years. Among the 4 variables that are associated with increased chances of participation, participation in developing a health improvement plan within the last 3 to 5 years is strongly associated with increased chances that the media has received reports regularly about health issues affecting the community (Activity 19).

Among the 4 variables that are associated with decreased chances of participation, it was found that it decreases the chance of completing 3 best practice activities when LHD hasn't participated in developing a health improvement plan. This implies that participation in developing health improvement plans is very critical to the LHDs' completion of the best practice activities. It was odd to find that participation in developing a health improvement plan within the last 3 years is associated with decreased chances that professionally recognized process and outcome measures have been used to monitor public health programs and to redirect resources as appropriate (Activity 17). It may be that participation in developing a health improvement plan is a leading indicator of using professionally recognized process and outcome measures, which don't take effect on a large scale until after the 3 year horizon (i.e., first the plan is made of what changes to make, what goals

to reach, and how to monitor progress and as that plan is executed those measures are put into place).

Strategic Plan

Out of the 11 times where variables are significant for developing a comprehensive, agency-wide strategic plan, having a more recent strategic plan (i.e., not older than 3 years) and one that is older (i.e., 3 to 5 years old) both are highly associated with increased chances of having conducted a community needs assessment (Activity 1), having prioritized community health needs (Activity 9), and having implemented community health initiatives (Activity 10). There are two other findings worth noting. First, while having an older strategic plan increases the chance of indicating that 4 key public health activities were completed, having a more recent strategic plan increases the chance of indicating that 3 additional public health activities were completed. Second, having a more recent strategic plan increases the chances even more of having conducted a community health needs assessment (Activity 1) when compared to having an older strategic plan.

However, it was odd to find that having an older strategic plan has a slightly higher magnitude of increase with its correlation with prioritizing community health needs (Activity 9) and implementing community health initiatives (Activity 10) than having a more recent strategic plan. It may be that the additional time lag increases the chances that the strategic plan is bearing fruit in the form of priorities and implementation.

5.1.7 Theme 7: Provision via Others in the Community

Table 5.8 contains the full list of variables that are categorized as the provision via others in the community, where the number of times they are significant is indicated in the second column. Out of the 16 times where variables are significant, 6 times variables are associated with increased chances of completing certain best practice activities. There are two times where variables are strongly associated with increased chances of conducting timely investigations of adverse health events continuously (Activity 3) or completing an analysis of health priorities, adequacy of health resources, and most impacted population groups (Activity 5).

Out of the 16 times where variables are significant, 10 times variables are associated with decreased chances of completing certain best practice activities. This implies that the LHDs are less likely to indicate completion of the 20 best practice activities overall when activities or services are provided through others in the community that are independent of the LHDs' funding.

Table 5.8 Significant Infrastructure Variables for Provision via Others in the Community

Variable Alias	Count
Epi&Surv M&C Health via Others	1
PCare via Others	1
WIC Health via Others	1
Pri Prev Tobacco via Others	1
Env Health Food Sft Edu via Others	1
Pri Prev Sub Abuse via Others	1
Screening STDs via Others	1
Epi&Surv C/I Disease via Others	2
Insp Food Serv via Others	2
Schl Clinic via Others	2
Pri Prev CD via Others	3
Total	**16**

5.1.8 Theme 8: Contract Out

Table 5.9 contains the full list of variables that are categorized as contracted out, where the number of times they are significant is indicated in the second column. Out of the 16 times where variables are significant, three times variables are associated with increased chances of indicating that necessary resources have been deployed to address priority health needs (Activity 13). This implies that contracting services or activities out to other organizations are particularly helpful for accomplishing activity 13.

It is worth noting that contracting out primary prevention activities for mental illnesses to other organizations is strongly associated with increased chances of having surveyed behavioral risk factors (Activity 2), having deployed necessary resources to address priority health needs (Activity 13), and having had regular evaluations of the effects of public health services (Activity 16). This may mean that LHDs that have found pervasive mental health issues in their communities and

have contracted out services for prevention tend to consider the organizations contracted to help with prevention as meeting the need.

Table 5.9 Significant Infrastructure Variables for Contract Out

Variable Alias	Count
Ani Cont Contracted Out	1
Env Health Vect Cont Contracted Out	1
Lab Serv Contracted Out	1
Treatment Other STDs Contracted Out	1
Pri Prev Phys Act Contracted Out	1
Pri Prev CD Contracted Out	1
Treatment HIV/AIDS Contracted Out	1
EMS Contracted Out	1
Child Imm Contracted Out	1
Screening TB Contracted Out	1
Comp Pri Care Contracted Out	1
Insp Sep Sys Contracted Out	2
Pri Prev Mental Ill Contracted Out	3
Total	**16**

5.1.9 Theme 9: Inspection Activities

Table 5.10 contains the full list of variables that are categorized as inspection activities, where the number of times they are significant is indicated in the second column. Out of the 12 times where variables are significant, three variables are associated with decreased chances of indicating that Activity 17 is performed. This indicates that not having inspection activities for milk processing, providing inspection activities for food service establishments via others in the community, and not knowing how inspection activities for food processing were provided decrease the chances of indicating that professionally recognized process and outcome measures have been used to monitor public health programs and to redirect resources as appropriate (Activity 17).

It is worth noting that both “Insp Food Serv via Others” and “Insp Sep Sys Contracted Out” are significant twice, respectively. This means that providing inspection activities for food services via others decreases the chances of indicating that there have been regular evaluations of the effects of public health services (Activity 16) and process and outcome measures have been used to monitor public health programs (Activity 17). In addition, this also means that contracting out

inspection activities for septic systems decreases the chances of indicating that the public has regularly received current health information (Activity 18) and that the media has regularly received reports about community health issues (Activity 19).

Table 5.10 Significant Infrastructure Variables for Inspection Activities

Variable Alias	Count
Insp Private Water DK	1
Insp Campg & RVs NA	1
Insp Sep Sys Directly	1
Insp Milk Proc NA	1
Insp Schl/DC Directly	1
Insp Lead DK	1
Insp Food Proc DK	1
Insp Tobacco Ret NA	1
Insp Food Serv via Others	2
Insp Sep Sys Contracted Out	2
Total	**12**

5.1.10 Theme 10: Don't Know Provision

Table 5.11 contains the full list of variables that are categorized as don't know how services are provided, where the number of times they are significant is indicated in the second column. Out of the 6 times where variables are significant, each variable is associated with a decreased chance of indicating that a different best practice activity has been completed. These associations may indicate a general lack of information available to the survey respondent about both the infrastructure and activity variables, which may mean that both sets of items are subject to some level of under reporting.

Table 5.11 Significant Infrastructure Variables for Don't Know Provision

Variable Alias	Count
Insp Private Water DK	1
Schl Clinic DK	1
Env Health Noise Polu DK	1
Epi&Surv Injury DK	1
Insp Lead DK	1
Insp Food Proc DK	1
Total	**12**

5.1.11 Theme 11: Change in Budget

Table 5.12 contains the full list of variables that are categorized as changes in the budget, where the number of times they are significant is indicated in the second column. Out of the 4 times where variables are significant, LHD's annual budget being higher than that of the last year was significant 3 times, while LHD's future annual budget being less than the current year was significant once.

It is worth noting that LHD's annual budget higher than that of the last year is associated with increased chances of having conducted a behavioral risk factors survey (Activity 2) and having used process and outcome measures to monitor public health programs as well as reallocating resources (Activity 17). It is also associated with a decreased chance of having an instance of a failed mandated public health program or service (Activity 20). The increase in budgets may be a positive cycle which began with a budget increase to perform Activity 2 and 17 which then resulted in good data which lead to the ability to advocate for increased funding for specific needs. Current observations may be at any part of the cycle as the relationship would still be positive in the cross-sectional model.

It was odd to find that a future decreasing annual budget would be strongly associated with an increasing possibility of having addressed age-specific priority health needs effectively through appropriate services provided. Perhaps this indicates that some temporary previous funding had come to an end now that the needs had been met.

Table 5.12 Significant Infrastructure Variables for Change in Budget

Variable Alias	Count
Budget Decrease Expected	1
Budget Increased	3
Total	**12**

5.1.12 Summary

In conclusion, different types of activities and modalities of provisions seem to have different impacts on the overall accomplishment of the 20 best practices. First, directly providing public

health activities or services by the LHDs, hiring a diverse range of public health professionals, actively engaging in policy and advocacy activities, providing epidemiology and surveillance activities, and not having activities or services available overall seem to have significant impacts on the accomplishment of the best practices. Second, developing community health improvement plans and strategic plans, providing activities or services through other organizations in the communities, contracting activities or services out, and providing inspection activities overall seem to have relatively significant impacts on the accomplishment of the best practices. Lastly, not knowing or being unaware of how activities or services are provided and having expected changes in budgets for the LHDs overall seem to have little impact on the accomplishment of the best practices.

Moreover, different types of activities and modalities of provisions seem to create varying positive impacts on the accomplishment of the 20 best practices. First, directly providing public health activities or services by the LHDs, actively engaging in policy and advocacy activities, developing community health improvement plans and strategic plans, and having expected changes in budgets for the LHDs seem to create significant positive impacts on the accomplishment of the best practices. Not having activities or services available seems to create significant negative impacts on the accomplishment of the best practices. Second, hiring a diverse range of public health professionals, providing epidemiology and surveillance activities, and contracting activities or services out seem to create relatively significant positive impacts on the accomplishment of the best practices. Lastly, providing activities or services through other organizations in the communities and providing inspection activities seem to create small positive impacts on the accomplishment of the best practices. Not knowing or being unaware of how activities or services are provided seems to create small negative impacts on the accomplishment of the best practices.

When it comes to the types of staff LHDs employ, hiring a diverse range of staff overall seems to have a large impact on the completion of the best practices. This agrees with the existing findings mentioned in Chapter 2, where Coronado et al. (2020), Pittman et al. (2021), and the Public Health Alliance (2022) concluded that a diverse public health workforce is essential to improving population health outcomes and that the need for diversity within the workforce has been particularly highlighted since the pandemic.

In addition, there seem to be varying levels of priorities for activities conducted by LHDs. First, LHDs seemed to be prioritizing the development of strategic plans for LHDs and direct provisions for epidemiology and surveillance activities for maternal and child health. There are also several activities LHDs relatively prioritized compared to other activities. For example, having epidemiologists or statisticians on staff for the LHDs and directly providing epidemiology and surveillance activities for communicable or infectious diseases were relatively prioritized compared to other activities by the LHDs. The conclusions on these two activities specifically agree with the existing findings mentioned in Chapter 2. NACCHO (2019) found that public health researchers and experts have stressed the importance of having epidemiologists on staff, particularly in the fight against the COVID-19 virus, as they are indispensable in responding to public health crises promptly by providing the most updated information on the status of the infections, protective behaviors, and vaccine effectiveness. Therefore, this confirms the finding that having epidemiologists on staff was relatively prioritized within the LHDs. Also, it has been known that LHDs have been the chief strategies and front-line organizations in combating COVID-19 in their respective communities. This confirms the finding that directly providing epidemiology and surveillance activities for communicable or infectious diseases was relatively prioritized within the LHDs.

5.2 Limitations & Future Work

This study has several limitations. First, the causal relationships between the infrastructure variables and the 20 key public health activities are potentially distorted due to the survey data from NACCHO and NALSYS being collected at different times. The NACCHO profile study was conducted in 2019, which provided the infrastructure variables for this study. On the other hand, the NALSYS survey was conducted in 2018, which provided the outcome variables for this study. In addition, many questions in the NACCHO profile study (i.e., infrastructure variables) measure elements of the local public health infrastructure (PHI) at different points of time or ranges of time. Some questions ask if the LHDs have had something in the past three years, while others ask if the LHDs had something just over the past year.

Second, because the surveys relied on self-reports and were most likely completed by one person from each LHD, individual biases and differences in perception may have affected the survey

responses. This means that the surveys were answered based on the personal knowledge and understandings of the LHDs from the survey respondents, and they may contain inaccurate or biased information because the answers from the respondents can be subjective in nature.

Third, as mentioned earlier in Chapters 1 and 2, it is important to account for differences in levels of rurality due to significant distinctions between rural areas and their urban counterparts. This study has not included a rurality measure. Therefore, the recommendations for the LHDs are likely not suitable for all LHDs in the U.S.. However, the future plan of this study includes incorporating the Index of Relative Rurality (IRR) as the rurality measure to account for differences in levels of rurality among the LHDs. After accounting for differences in levels of rurality in our models, impacts of elements of PHI on the completion of 20 key public health activities when controlled by both state and rurality measures will be assessed, and recommendations will be updated based on the new findings.

Last but not least, this study assessed the impacts of the elements of the infrastructure on the completion of the key public health activities, but not the quality of completion. Therefore, future research may include assessing the impacts of the elements of the infrastructure on the quality of completion of key public health activities.

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APPENDIX A. DEFINITIONS

The following key terms appeared throughout the thesis and are listed in alphabetic order.

Health Equity

"The attainment of the highest level of health for all people." (Healthy People 2030, n.d.-a).

Health Disparity

"A particular type of health difference that is closely linked with social, economic, and/or environmental disadvantage." (Healthy People 2030, n.d.-a).

Local Health Department (LHD)

"An administrative or service unit of local or state government, concerned with health, and carrying some responsibility for the health of a jurisdiction smaller than the state." (Feeser, 2019).

Local Public Health Infrastructure (LPHI)

"Local public health infrastructure includes the systems, competencies, frameworks, relationships, and resources that enable public health agencies to perform their core functions and essential services. Infrastructure categories encompass human, organizational, informational, legal, policy, and fiscal resources." (NACCHO, n.d.).

Population Health

"The health outcomes of a group of individuals, including the distribution of such outcomes within the group." (Kindig & Stoddart, 2003).

Public Health

"The science and art of preventing disease, prolonging life, and promoting health through the organized efforts and informed choices of society, organizations, public and private communities, and individuals." (Winslow, 1920).

Public Health 3.0

"Public Health 3.0 refers to a new era of enhanced and broadened public health practice that goes beyond traditional public department functions and programs. Cross-sectoral collaboration is inherent to the Public Health 3.0 vision, and the Chief Health Strategist role requires high-achieving health organizations with the skills and capabilities to drive such collective action. Pioneering US communities are already testing this approach to public health, with support from several national efforts. (DeSalvo et al., 2017)"

Rural Areas

The Office of Management and Budget indicates that non-metro counties (i.e., rural areas) include micropolitan counties that have urban cores of 10,000 to 49,999 individuals and counties outside of metropolitan or micropolitan areas (Health Resources & Services Administration, 2022).

Social Determinants of Health (SDOH)

"Social determinants of health (SDOH) are the conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks. SDOH can be grouped into 5 domains, including economic stability, education access and quality, health care access and quality, neighborhood and built environment, social and community context." (Healthy People 2030, n.d.-b).

APPENDIX B. USEFUL INFRASTRUCTURE VARIABLES

Variable	Variable Alias	Description
c4q26	Full-Time Top Exec	Top executive works full-time
c4q25	Rookie Top Exec	This is top executive's first position as a top executive of the LHD.
c4q34_Bachelors	Bachelor Top Exec	Top Executive's Highest Degree is Bachelors
c4q34_Masters	Master Top Exec	Top Executive's Highest Degree is Masters
c4q34_Doctorate	Doctorate Top Exec	Top Executive's Highest Degree is Doctorate
c4q502b	Nurs Top Exec	Top executive holds a degree in nursing.
c4q502c	PH Top Exec	Top executive holds a degree in public health
c2q501	Combined HHS Agency	LHD is part of a combined health and human services (HHS) agency.
c2q506	EHD in Separate Agency	Environmental health department (EHD) operates in a separate agency from the LHD.
c2q301	One or More LBHs	LHD has one or more local boards of health (LBHs).
c5q36	# Hired	Total employees currently hired
c5q37	# Filled FTEs	Total full-time equivalent (FTE) currently filled
c5q70	# Vacant FTEs	Total FTE vacancies
c5q63a	Agency Leadership	Currently employs agency leader
c5q43a	RN	Currently employs registered nurse
c5q57a	LPN & LVN	Currently employs licensed practical or vocational nurse
c5q58a	Nurs & Home Health Aide	Currently employs nursing aide and home health aide
c5q44a	PH Physician	Currently employs public health physician
c5q59a	Oral HC Staff	Currently employs oral health care staff
c5q55a	Env Health Worker	Currently employs environmental health worker
c5q60a	Lab Worker	Currently employs laboratory worker
c5q47a	Epidemiologist/Statistician	Currently employs epidemiologist/statistician
c5q48a	Health Educator	Currently employs health educator
c5q61a	Com Health Worker	Currently employs community health worker
c5q49a	Nutritionist	Currently employs nutritionist
c5q50a	Info Sys Specialist	Currently employs information systems specialist
c5q51a	Pub Info Professional	Currently employs public information professional
c5q52a	Behav Health Staff	Currently employs behavioral health staff
c5q56a	Prep Staff	Currently employs preparedness staff
c5q62a	Ani Conl Worker	Currently employs animal control worker

c5q64a	Busn & Finc Worker	Currently employs business and financial operations worker
c5q65a	Off & Admin staff	Currently employs office and administrative support staff
c10q307	# Lost Employees	Number of employees lost via attrition and not replaced because of hiring freezes or budget cuts
c10q308	# Reduced Hour Employees	Number of employees with reduced working hours for budgetary reasons (excluding employees placed on mandatory furlough)
c6q55i	Adult Imm via Others	Adult immunizations provided via others in community independent of LHD funding
c6q55g	Adult Imm DK	Don't know how adult immunizations were provided
c6q56b	Child Imm Contracted Out	Childhood immunizations were contracted out by LHD
c6q56i	Child Imm via Others	Childhood immunizations provided via others in community independent of LHD funding
c6q57a	Screening HIV/AIDS Directly	Screening for human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) performed by LHD directly
c6q57b	Screening HIV/AIDS Contracted Out	Screening for HIV/AIDS were contracted out by LHD
c6q57i	Screening HIV/AIDS via Others	Screening for HIV/AIDS provided via others in community independent of LHD funding
c6q57g	Screening HIV/AIDS DK	Don't know how screening for HIV/AIDS were provided
c6q58a	Screening Other STDs Directly	Screening for other sexually transmitted diseases/infections (STDs) performed by LHD directly
c6q58b	Screening Other STDs Contracted Out	Screening for other STDs were contracted out by LHD
c6q58i	Screening STDs via Others	Screening for other STDs provided via others in community independent of LHD funding
c6q59a	Screening TB Directly	Screening for Tuberculosis (TB) performed by LHD directly
c6q59b	Screening TB Contracted Out	Screening for TB were contracted out by LHD
c6q59i	Screening TB via Others	Screening for TB via others in community independent of LHD funding
c6q60a	Screening Cancer Directly	Screening for cancer performed by LHD directly
c6q60b	Screening Cancer Contracted Out	Screening for cancer were contracted out by LHD

c6q60i	Screening Cancer via Others	Screening for cancer provided via others in community independent of LHD funding
c6q60f	Screening Cancer NA	Screening for cancer not available in community
c6q61a	Screening CVD Directly	Screening for cardiovascular disease (CVD) by LHD directly
c6q61g	Screening CVD Contracted Out	Screening for CVD were contracted out by LHD
c6q62a	Screening Diabetes Directly	Screening for diabetes performed by LHD directly
c6q62g	Screening Diabetes DK	Don't know how screening for diabetes were provided
c6q63a	Screening HBP Directly	Screening for high blood pressure (HBP) by LHD directly
c6q63i	Screening HBP via Others	Screening for HBP provided via others in community independent of LHD funding
c6q63g	Screening HBP DK	Don't know how screening for HBP were provided
c6q142i	Screening BMI via Others	Screening for Body Mass Index (BMI) via others in community independent of LHD funding
c6q65a	Treatment HIV/AIDS Directly	Treatment for HIV/AIDS performed by LHD directly
c6q65b	Treatment HIV/AIDS Contracted Out	Treatment for HIV/AIDS were contracted out by LHD
c6q65i	Treatment HIV/AIDS via Others	Treatment for HIV/AIDS provided via others in community independent of LHD funding
c6q65f	Treatment HIV/AIDS NA	Treatment for HIV/AIDS not available in community
c6q65g	Treatment HIV/AIDS DK	Don't know how treatment for HIV/AIDS were provided
c6q66a	Treatment Other STDs Directly	Treatment for other STDs performed by LHD directly
c6q66b	Treatment Other STDs Contracted Out	Treatment for other STDs were contracted out by LHD
c6q66f	Treatment Other STDs NA	Treatment for other STDs not available in community
c6q66g	Treatment Other STDs DK	Don't know how Treatment for other STDs were provided
c6q67a	Treatment TB Directly	Treatment for TB performed by LHD directly
c6q67b	Treatment TB Contracted Out	Treatment for TB were contracted out by LHD
c6q69a	PCare Directly	Prenatal care provided by LHD directly

c6q69b	PCare Contracted Out	Prenatal care were contracted out by LHD
c6q69i	PCare via Others	Prenatal care provided via others in community independent of LHD funding
c6q69f	PCare NA	Prenatal care not available in community
c6q69g	PCare DK	Don't know how prenatal care were provided
c6q71a	WIC Health Directly	Women, infants, and children (WIC) health provided by LHD directly
c6q71i	WIC Health via Others	WIC health provided via others in community independent of LHD funding
c6q71f	WIC Health NA	WIC health not available in community
c6q73f	EPSDT NA	Early and periodic screening, diagnostic and treatment (EPSD) not available in community
c6q73g	EPSDT DK	Don't know how EPSD were provided
c6q74a	Well-child Clinic Directly	Well-child clinic provided by LHD directly
c6q74i	Well-child Clinic via Others	Well-child clinic via others in community independent of LHD funding
c6q74g	Well-child Clinic DK	Don't know how well-child clinic were provided
c6q75a	Comp Pri Care Directly	Comprehensive primary care provided by LHD directly
c6q75b	Comp Pri Care Contracted Out	Comprehensive primary care were contracted out by LHD
c6q75f	Comp Pri Care NA	Comprehensive primary care not available in community
c6q75g	Comp Pri Care DK	Don't know how comprehensive primary care were provided
c6q76i	Home HC via Others	Home health care provided via others in community independent of LHD funding
c6q76f	Home HC NA	Home health care not available in community
c6q76g	Home HC DK	Don't know how home health care were provided
c6q77a	Oral Health Directly	Oral health provided by LHD directly
c6q77b	Oral Health Contracted Out	Oral health were contracted out by LHD
c6q77i	Oral Health via Others	Oral health provided via others in community independent of LHD funding
c6q77f	Oral Health NA	Oral health not available in community
c6q77g	Oral Health DK	Don't know how oral health were provided
c6q78a	B/M Health Directly	Behavioral/mental health services provided by LHD directly
c6q78b	B/M Health Contracted Out	Behavioral/mental health services were contracted out by LHD
c6q78f	B/M Health NA	Behavioral/mental health services not available in community

c6q78g	B/M Health DK	Don't know how behavioral/mental health services were provided
c6q79a	Sub Abuse Directly	Substance abuse services provided by LHD directly
c6q79b	Sub Abuse Contracted Out	Substance abuse services were contracted out by LHD
c6q79f	Sub Abuse NA	Substance abuse services not available in community
c6q79g	Sub Abuse DK	Don't know how Substance abuse services were provided
c6q80a	Epi&Surv C/I Disease Directly	Epidemiology and surveillance activities for communicable/ infectious (C/I) disease provided by LHD directly
c6q80i	Epi&Surv C/I Disease via Others	Epidemiology and surveillance activities for C/I disease provided via others in community independent of LHD funding
c6q80g	Epi&Surv C/I Disease DK	Don't know how epidemiology and surveillance activities for C/I disease were provided
c6q81a	Epi&Surv CD Directly	Epidemiology and surveillance activities for chronic disease provided by LHD directly
c6q81b	Epi&Surv CD Contracted Out	Epidemiology and surveillance activities for chronic disease were contracted out by LHD
c6q81i	Epi&Surv CD via Others	Epidemiology and surveillance activities for chronic disease provided via others in community independent of LHD funding
c6q81g	Epi&Surv CD DK	Don't know how epidemiology and surveillance activities for chronic disease were provided
c6q82g	Epi&Surv Injury DK	Don't know how epidemiology and surveillance activities for injury were provided
c6q83f	Epi&Surv BRFs NA	Epidemiology and surveillance activities for behavioral risk factors (BRFs) not available in community
c6q83g	Epi&Surv BRFs DK	Don't know how epidemiology and surveillance activities for BRFs were provided
c6q84a	Epi&Surv Env Health Directly	Epidemiology and surveillance activities for environmental health provided by LHD directly
c6q84b	Epi&Surv Env Health Contracted Out	Epidemiology and surveillance activities for environmental health were contracted out by LHD
c6q84f	Epi&Surv Env Health NA	Epidemiology and surveillance activities for environmental health not available in community
c6q84g	Epi&Surv Env Health DK	Don't know how epidemiology and surveillance activities for environmental health were provided
c6q85f	Epi&Surv Synd Surv NA	Epidemiology and surveillance activities for syndromic surveillance not available in community

c6q85g	Epi&Surv Synd Surv DK	Don't know how epidemiology and surveillance activities for syndromic surveillance were provided
c6q86a	Epi&Surv M&C Health Directly	Epidemiology and surveillance activities for maternal and child (M&C) health provided by LHD directly
c6q86i	Epi&Surv M&C Health via Others	Epidemiology and surveillance activities for M&C health provided via others in community independent of LHD funding
c6q86g	Epi&Surv M&C Health DK	Don't know how epidemiology and surveillance activities for M&C health were provided
c6q87g	Pri Prev Injury DK	Don't know how population-based primary prevention activities for injury were provided
c6q89a	Pri Prev CD Directly	population-based primary prevention activities for chronic disease (CD) programs provided by LHD directly
c6q89b	Pri Prev CD Contracted Out	population-based primary prevention activities for chronic disease (CD) programs were contracted out by LHD
c6q89i	Pri Prev CD via Others	population-based primary prevention activities for chronic disease (CD) programs provided via others in community independent of LHD funding
c6q89f	Pri Prev CD NA	population-based primary prevention activities for chronic disease (CD) programs not available in community
c6q89g	Pri Prev CD DK	Don't know how population-based primary prevention activities for chronic disease (CD) programs were provided
c6q90a	Pri Prev CD Directly	population-based primary prevention activities for chronic disease (CD) programs provided by LHD directly
c6q90f	Pri Prev CD NA	population-based primary prevention activities for chronic disease (CD) programs not available in community
c6q90g	Pri Prev CD DK	Don't know how population-based primary prevention activities for chronic disease (CD) programs were provided
c6q91a	Pri Prev Phys Act Directly	population-based primary prevention activities for physical activities provided by LHD directly
c6q91b	Pri Prev Phys Act Contracted Out	population-based primary prevention activities for physical activities were contracted out by LHD
c6q91f	Pri Prev Phys Act NA	population-based primary prevention activities for physical activities not available in community
c6q91g	Pri Prev Phys Act DK	Don't know how population-based primary prevention activities for physical activities were provided

c6q93a	Pri Prev Tobacco Directly	population-based primary prevention activities for tobacco provided by LHD directly
c6q93b	Pri Prev Tobacco Contracted Out	population-based primary prevention activities for tobacco were contracted out by LHD
c6q93i	Pri Prev Tobacco via Others	population-based primary prevention activities for tobacco provided via others in community independent of LHD funding
c6q93g	Pri Prev Tobacco DK	Don't know how population-based primary prevention activities for tobacco were provided
c6q145a	Pri Prev Opioids Directly	population-based primary prevention activities for opioids provided by LHD directly
c6q145b	Pri Prev Opioids Contracted Out	population-based primary prevention activities for opioids were contracted out by LHD
c6q145f	Pri Prev Opioids NA	population-based primary prevention activities for opioids not available in community
c6q145g	Pri Prev Opioids DK	Don't know how population-based primary prevention activities for opioids were provided
c6q146a	Pri Prev Sub Abuse Directly	population-based primary prevention activities for substance abuse provided by LHD directly
c6q146b	Pri Prev Sub Abuse Contracted Out	population-based primary prevention activities for substance abuse were contracted out by LHD
c6q146i	Pri Prev Sub Abuse via Others	population-based primary prevention activities for substance abuse provided via others in community independent of LHD funding
c6q146g	Pri Prev Sub Abuse DK	Don't know how population-based primary prevention activities for substance abuse were provided
c6q95a	Pri Prev Mental Ill Directly	population-based primary prevention activities for mental illness provided by LHD directly
c6q95b	Pri Prev Mental Ill Contracted Out	population-based primary prevention activities for mental illness were contracted out by LHD
c6q95i	Pri Prev Mental Ill via Others	population-based primary prevention activities for mental illness provided via others in community independent of LHD funding
c6q95f	Pri Prev Mental Ill NA	population-based primary prevention activities for mental illness not available in community
c6q95g	Pri Prev Mental Ill DK	Don't know how PBPP activities for mental illness were provided
c6q97f	Insp Campg & RVs NA	Inspection activities for campgrounds & RVs not available in community
c6q100a	Insp Sep Sys Directly	Inspection activities for septic systems provided by LHD directly
c6q100b	Insp Sep Sys Contracted Out	Inspection activities for septic systems were contracted out by LHD

c6q100i	Insp Sep Sys via Others	Inspection activities for septic systems provided via others in community independent of LHD funding
c6q101f	Insp H/Motels NA	Inspection activities for hotels/motels not available in community
c6q101g	Insp H/Motels DK	Don't know how inspection activities for hotels/motels were provided
c6q102a	Insp Schl/DC Directly	Inspection activities for schools/daycare provided by LHD directly
c6q103f	Insp Child Camp NA	Inspection activities for children's camps not available in community
c6q103g	Insp Child Camp DK	Don't know how inspection activities for children's camps were provided
c6q105f	Insp Bd Art NA	Inspection activities for body art not available in community
c6q105g	Insp Bd Art DK	Don't know how inspection activities for body art were provided
c6q143a	Insp Rec Water Directly	Inspection activities for recreational water provided by LHD directly
c6q143b	Insp Rec Water Contracted Out	Inspection activities for recreational water were contracted out by LHD
c6q143i	Insp Rec Water via Others	Inspection activities for recreational water provided via others in community independent of LHD funding
c6q143f	Insp Rec Water NA	Inspection activities for recreational water not available in community
c6q143g	Insp Rec Water DK	Don't know how inspection activities for recreational water were provided
c6q107f	Insp Tobacco Ret NA	Inspection activities for tobacco retailers not available in community
c6q107g	Insp Tobacco Ret DK	Don't know how inspection activities for tobacco retailers were provided
c6q109f	Insp Lead NA	Inspection activities for lead inspection not available in community
c6q109g	Insp Lead DK	Don't know how inspection activities for lead inspection were provided
c6q110f	Insp Food Proc NA	Inspection activities for food processing not available in community
c6q110g	Insp Food Proc DK	Don't know how inspection activities for food processing were provided
c6q111f	Insp Milk Proc NA	Inspection activities for milk processing not available in community
c6q111g	Insp Milk Proc DK	Don't know how inspection activities for milk processing were provided
c6q112a	Insp Public Water Directly	Inspection activities for public drinking water provided by LHD directly

c6q112i	Insp Public Water via Others	Inspection activities for public drinking water provided via others in community independent of LHD funding
c6q112g	Insp Public Water DK	Don't know how inspection activities for public drinking water were provided
c6q113g	Insp Private Water DK	Don't know how inspection activities for private drinking water were provided
c6q114a	Insp Food Serv Directly	Inspection activities for food service establishments provided by LHD directly
c6q114i	Insp Food Serv via Others	Inspection activities for food service establishments provided via others in community independent of LHD funding
c6q114f	Insp Food Serv NA	Inspection activities for food service establishments not available in community
c6q114g	Insp Food Serv DK	Don't know how inspection activities for food service establishments were provided
c6q115f	Insp Health Fac NA	Inspection activities for health-related facilities not available in community
c6q115g	Insp Health Fac DK	Don't know how inspection activities for health-related facilities were provided
c6q116f	Insp Housing NA	Inspection activities for housing not available in community
c6q116g	Insp Housing DK	Don't know how inspection activities for housing were provided
c6q117f	Env Health Air Qual NA	Environmental health activities for indoor air quality not available in community
c6q117g	Env Health Air Qual DK	Don't know how environmental health activities for indoor air quality were provided
c6q118a	Env Health Food Sft Edu Directly	Environmental health activities for food safety education provided by LHD directly
c6q118b	Env Health Food Sft Edu Contracted Out	Environmental health activities for food safety education were contracted out by LHD
c6q118i	Env Health Food Sft Edu via Others	Environmental health activities for food safety education provided via others in community independent of LHD funding
c6q118f	Env Health Food Sft Edu NA	Environmental health activities for food safety education not available in community
c6q118g	Env Health Food Sft Edu DK	Don't know how environmental health activities for food safety education were provided
c6q119f	Env Health Rad Cont NA	Environmental health activities for radiation control not available in community
c6q119g	Env Health Rad Cont DK	Don't know how environmental health activities for radiation control were provided
c6q120a	Env Health Vect Cont Directly	Environmental health activities for vector control provided by LHD directly

c6q120b	Env Health Vect Cont Contracted Out	Environmental health activities for vector control were contracted out by LHD
c6q120i	Env Health Vect Cont via Others	Environmental health activities for vector control provided via others in community independent of LHD funding
c6q120f	Env Health Vect Cont NA	Environmental health activities for vector control not available in community
c6q120g	Env Health Vect Cont DK	Don't know how environmental health activities for vector control were provided
c6q121g	Env Health Land Use DK	Don't know how environmental health activities for land use planning were provided
c6q124a	Env Health Haz Resp Directly	Environmental health activities for hazmat response provided by LHD directly
c6q124f	Env Health Haz Resp NA	Environmental health activities for hazmat response not available in community
c6q124g	Env Health Haz Resp DK	Don't know how environmental health activities for hazmat response were provided
c6q127f	Env Health Air Polu NA	Environmental health activities for air pollution not available in community
c6q127g	Env Health Air Polu DK	Don't know how environmental health activities for air pollution were provided
c6q128f	Env Health Noise Polu NA	Environmental health activities for noise pollution not available in community
c6q128g	Env Health Noise Polu DK	Don't know how environmental health activities for noise pollution were provided
c6q144f	Env Health PHNA NA	Environmental health activities for public health nuisance abatement (PHNA) not available in community
c6q144g	Env Health PHNA DK	Don't know how environmental health activities for PHNA were provided
c6q130a	EMS Directly	Activities for emergency medical services (EMS) by LHD directly
c6q130b	EMS Contracted Out	Activities for EMS were contracted out by LHD
c6q130i	EMS via Others	Activities for EMS provided via others in community independent of LHD funding
c6q131b	Ani Cont Contracted Out	Activities for animal control were contracted out by LHD
c6q131i	Ani Cont via Others	Activities for animal control provided via others in community independent of LHD funding
c6q131f	Ani Cont NA	Activities for animal control not available in community
c6q131g	Ani Cont DK	Don't know how activities for animal control were provided
c6q134a	Lab Serv Directly	Activities for laboratory services by LHD directly

c6q134b	Lab Serv Contracted Out	Activities for laboratory services were contracted out by LHD
c6q134i	Lab Serv via Others	Activities for laboratory services provided via others in community independent of LHD funding
c6q134f	Lab Serv NA	Activities for laboratory services not available in community
c6q136i	Schl Clinic via Others	Activities for school-based clinic provided via others in community independent of LHD funding
c6q136f	Schl Clinic NA	Activities for school-based clinic not available in community
c6q136g	Schl Clinic DK	Don't know how activities for school-based clinic were provided
c6q137a	Schl Health Directly	Activities for school health by LHD directly
c6q137f	Schl Health NA	Activities for school health not available in community
c10q404a	Serv Imm	LHD provided services for immunization at any time
c10q405a	Serv Epi&Surv	LHD provided services for epidemiology and surveillance at any time
c10q406a	Serv Com Disease	LHD provided services for communicable disease screening or treatment at any time
c10q415a	Serv Blood Lead Screen	LHD provided services for blood lead screening at any time
c10q416a	Serv HBP Screen	LHD provided services for HBP screening at any time
c10q417a	Serv Diabetes Screen	LHD provided services for diabetes screening at any time
c10q408a	Serv M&C Health	LHD provided services for maternal and child health at any time
c10q418a	Serv Obe Prev	LHD provided services for obesity prevention at any time
c10q419a	Serv Drug Prev	LHD provided services for tobacco, alcohol, or other drug prevention at any time
c10q420a	Serv Env Health	LHD provided services for environmental health (including food safety) at any time
c12q260n	Pol/Adv Em Prp&Resp	LHD has been actively involved in policy or advocacy activities for emergency preparedness and response
c12q260o	Pol/Adv Food Safety	LHD has been actively involved in policy or advocacy activities for food safety
c12q260e	Pol/Adv Fund HC	LHD has been actively involved in policy or advocacy activities for funding for access to healthcare
c12q260w	Pol/Adv Inf Disease	LHD has been actively involved in policy or advocacy activities for infectious disease

c12q260p	Pol/Adv Inj&Vio Prev	LHD has been actively involved in policy or advocacy activities for injury and violence prevention
c12q260f	Pol/Adv Land Use	LHD has been actively involved in policy or advocacy activities for land use planning
c12q260q	Pol/Adv Mental Health	LHD has been actively involved in policy or advocacy activities for mental health
c12q260r	Pol/Adv Obe/Phys Act	LHD has been actively involved in policy or advocacy activities for obesity/physical activity
c12q260h	Pol/Adv Occp Hea&Saf	LHD has been actively involved in policy or advocacy activities for occupational health and safety
c12q260s	Pol/Adv Oral Health	LHD has been actively involved in policy or advocacy activities for oral health
c12q260t	Pol/Adv Housing	LHD has been actively involved in policy or advocacy activities for safe and healthy housing
c12q260u	Pol/Adv Alc Opi Drug	LHD has been actively involved in policy or advocacy activities for tobacco, alcohol, opioids, or other drugs
c12q260v	Pol/Adv Wast Watr Sanit	LHD has been actively involved in policy or advocacy activities for waste, water, or sanitation
c12q260j	Pol/Adv Other Pol Areas	LHD has been actively involved in policy or advocacy activities for other policy areas
c12q260k	Pol/Adv None	LHD has not been involved in any policy or advocacy activities at all
c12q260x	Pol/Adv Clim Change	LHD has been actively involved in policy or advocacy activities for climate change
c12q260y	Pol/Adv Fund Local PH	LHD has been actively involved in policy or advocacy activities for funding for local public health
c12q260z	Pol/Adv Other Env Health	LHD has been actively involved in policy or advocacy activities for other environmental health areas
c12q261	Adopted New PH Ord/Reg	A new local public health ordinance/regulation has been adopted
c12q501	Major Revision PH Ord/Reg	A substantive revision to an existing public health ordinance/regulation
c7q147_Yes1	Com Health Ass (≤ 3 yr)	A community health assessment has been completed within the last three years
c7q147_Yes3	Com Health Ass (> 5 yr)	A community health assessment has been completed more than five years ago
c7q147_No4	Com Health Ass Future	A community health assessment hasn't been completed but plan to complete within the next year

c7q149_Yes	Health Imp Plan (≤ 3 yr)	LHD participated in developing a health improvement plan for community within the last three years
c7q149_Yes2	Health Imp Plan (3-5 yr ago)	LHD participated in developing a health improvement plan for community more than three years ago but within the past five years
c7q149_Yes3	Health Imp Plan (> 5 yr)	LHD participated in developing a health improvement plan for community more than five years ago
c7q149_No4	Health Imp Plan Future	LHD hasn't participated in developing a health improvement plan for community but plan to participate/develop within the next year
c7q501	NP Hospital ≥ 1	At least one nonprofit hospital serving residents of LHD jurisdiction
c7q217_Yes1	Strategic Plan (≤ 3 yr)	LHD developed a comprehensive, agency-wide strategic plan within the last three years
c7q217_Yes2	Strategic Plan (3-5 yr ago)	LHD developed a comprehensive, agency-wide strategic plan more than three years ago but within the past five years
c7q217_Yes3	Strategic Plan (> 5 yr)	LHD developed a comprehensive, agency-wide strategic plan more than five years ago
c7q217_No4	Strategic Plan Future	LHD hasn't developed a comprehensive, agency-wide strategic plan but plan to develop within the next year
c10q301_greater	Budget Increased	LHD's current year' budget is greater than its previous year's budget
c10q303_less	Budget Decrease Expected	LHD's next year's budget is expected to be less than its current year's budget
c10q303_greater	Budget Increase Expected	LHD's next year's budget is expected to be greater than its current year's budget

APPENDIX C. GLOSSARY OF ACRONYMS

Below is the full list of acronyms appeared in Table 3.1 in alphabetic order.

AIDS = acquired immunodeficiency syndrome

B/M = behavioral/ mental

BMI = body mass index

BRFs = behavioral risk factors

CD = chronic disease

CVD = cardiovascular disease

C/I = communicable/ infectious

DK = don't know

EHD = environmental health department

EMS = emergency medical services

EPSDT = early and periodic screening, diagnostic and treatment

FTE = full-time equivalent

HBP = high blood pressure

HC = health care or healthcare

HHS = health and human services

HIV = human immunodeficiency virus

LBHs = local boards of health

M&C = maternal and child

NA = not available

NP = nonprofit

PH = public health

RN = registered nurse

PHNA = public health nuisance abatement

SA = substance abuse

STDs = sexually transmitted diseases/infections

TB = tuberculosis

WIC = women, infants, and children

APPENDIX D. FREQUENCY OF SIGNIFICANCE: BIVARIATE ANALYSES

The following table is summarized from counting the frequency of significance for each 274 useful infrastructure variables from the bivariate analyses.

Topic	Variable Alias	Sig. Count
Profile of Top Executive	Full-Time Top Exec	10
	Rookie Top Exec	2
	Bachelor Top Exec	10
	Master Top Exec	9
	Doctorate Top Exec	1
	Nurs Top Exec	4
	PH Top Exec	5
Organizational Structure	Combined HHS Agency	2
	EHD in Separate Agency	1
	One or More LBHs	3
Current Staffing	# Hired	6
	# Filled FTEs	7
	# Vacant FTEs	14
Types of Occupations Employed	Agency Leadership	9
	RN	7
	LPN & LVN	1
Population-based Primary Prevention Activities (cont.)	Pri Prev Tobacco Contracted Out	1
	Pri Prev Tobacco via Others	2
	Pri Prev Tobacco DK	10
	Pri Prev Opioids Directly	9
	Pri Prev Opioids Contracted Out	5
	Pri Prev Opioids NA	7
	Pri Prev Opioids DK	13
	Pri Prev Sub Abuse Directly	13
	Pri Prev Sub Abuse Contracted Out	6
	Pri Prev Sub Abuse via Others	1
	Pri Prev Sub Abuse DK	13
	Pri Prev Mental Ill Directly	13
	Pri Prev Mental Ill Contracted Out	8
	Pri Prev Mental Ill via Others	3
	Pri Prev Mental Ill NA	6
	Pri Prev Mental Ill DK	7

Types of Occupations Employed (cont.)	Nurs & Home Health Aide	1	Inspection Activities	Insp Campg & RVs NA	7
	PH Physician	10		Insp Sep Sys Directly	2
	Oral HC Staff	10		Insp Sep Sys Contracted Out	4
	Env Health Worker	8		Insp Sep Sys via Others	1
	Lab Worker	13		Insp H/Motels NA	4
	Epidemiologist/Statistician	3		Insp H/Motels DK	2
	Health Educator	6		Insp Schl/DC Directly	8
	Com Health Worker	7		Insp Child Camp NA	8
	Nutritionist	9		Insp Child Camp DK	1
	Info Sys Specialist	7		Insp Bd Art NA	8
	Pub Info Professional	2		Insp Bd Art DK	4
	Behav Health Staff	13		Insp Rec Water Directly	11
	Prep Staff	8		Insp Rec Water Contracted Out	3
	Ani Conl Worker	3		Insp Rec Water via Others	1
	Busn & Finc Worker	8		Insp Rec Water NA	7
	Off & Admin staff	12		Insp Rec Water DK	1
Change in Staffing	# Lost Employees	6		Insp Tobacco Ret NA	3
	# Reduced Hour Employees	3		Insp Tobacco Ret DK	10
Immunization	Adult Imm via Others	2		Insp Lead NA	10
	Adult Imm DK	2		Insp Lead DK	3
	Child Imm Contracted Out	3		Insp Food Proc NA	5
	Child Imm via Others	9		Insp Food Proc DK	8
	Screening HIV/AIDS Directly	11		Insp Milk Proc NA	12

Screening for Diseases or Conditions	Screening HIV/AIDS Contracted Out	7	Inspection Activities (cont.)	Insp Milk Proc DK	3
	Screening HIV/AIDS via Others	2		Insp Public Water Directly	7
	Screening HIV/AIDS DK	1		Insp Public Water via Others	1
	Screening Other STDs Directly	7		Insp Public Water DK	1
	Screening Other STDs Contracted Out	6		Insp Private Water DK	7
	Screening STDs via Others	1		Insp Food Serv Directly	4
	Screening TB Directly	5		Insp Food Serv via Others	3
	Screening TB Contracted Out	2		Insp Food Serv NA	1
	Screening TB via Others	1		Insp Food Serv DK	1
	Screening Cancer Directly	8		Insp Health Fac NA	2
	Screening Cancer Contracted Out	6		Insp Health Fac DK	1
	Screening Cancer via Others	5		Insp Housing NA	3
	Screening Cancer NA	12		Insp Housing DK	5
Screening for Diseases or	Screening CVD Directly	12	Other Environmental Health Activities	Env Health Air Qual NA	5
	Screening CVD Contracted Out	1		Env Health Air Qual DK	10
	Screening Diabetes Directly	12		Env Health Food Sft Edu Directly	6
	Screening Diabetes DK	1		Env Health Food Sft Edu Contracted Out	1
	Screening HBP Directly	1		Env Health Food Sft Edu via Others	3
	Screening HBP via Others	1		Env Health Food Sft Edu NA	3
	Screening HBP DK	1		Env Health Food Sft Edu DK	1

Conditions (cont.)	Screening BMI via Others	1	Other Environmental Health Activities (cont.)	Env Health Rad Cont NA	5
Treatment for Communicable Diseases	Treatment HIV/AIDS Directly	7		Env Health Rad Cont DK	9
	Treatment HIV/AIDS Contracted Out	14		Env Health Vect Cont Directly	11
	Treatment HIV/AIDS via Others	3		Env Health Vect Cont Contracted Out	1
	Treatment HIV/AIDS NA	7		Env Health Vect Cont via Others	3
	Treatment HIV/AIDS DK	1		Env Health Vect Cont NA	6
	Treatment Other STDs Directly	7		Env Health Vect Cont DK	1
	Treatment Other STDs Contracted Out	9		Env Health Land Use DK	9
	Treatment Other STDs NA	1		Env Health Haz Resp Directly	4
	Treatment Other STDs DK	5		Env Health Haz Resp NA	9
	Treatment TB Directly	4		Env Health Haz Resp DK	4
	Treatment TB Contracted Out	2		Env Health Air Polu NA	10
Maternal and Child Health	PCare Directly	9		Env Health Air Polu DK	5
	PCare Contracted Out	1		Env Health Noise Polu NA	3
	PCare via Others	6		Env Health Noise Polu DK	1
	PCare NA	7		Env Health PHNA NA	6
	PCare DK	3		Env Health PHNA DK	3
	WIC Health Directly	9	Other Activities	EMS Directly	1
	WIC Health via Others	8		EMS Contracted Out	1
	WIC Health NA	1		EMS via Others	3
	EPSDT NA	4		Ani Cont Contracted Out	1

Maternal and Child Health (cont.)	EPSDT DK	1	Other Activities (cont.)	Ani Cont via Others	1
	Well-child Clinic Directly	6		Ani Cont NA	9
	Well-child Clinic via Others	1		Ani Cont DK	3
	Well-child Clinic DK	3		Lab Serv Directly	9
Other Health Services	Comp Pri Care Directly	1		Lab Serv Contracted Out	4
	Comp Pri Care Contracted Out	3		Lab Serv via Others	2
	Comp Pri Care NA	1		Lab Serv NA	12
	Comp Pri Care DK	6		Schl Clinic via Others	4
	Home HC via Others	3		Schl Clinic NA	4
	Home HC NA	1		Schl Clinic DK	4
	Home HC DK	4		Schl Health Directly	7
	Oral Health Directly	14		Schl Health NA	1
	Oral Health Contracted Out	1	Service Provision	Serv Imm	1
	Oral Health via Others	1		Serv Epi&Surv	8
	Oral Health NA	1		Serv Com Disease	11
	Oral Health DK	1		Serv Blood Lead Screen	5
	B/M Health Directly	11		Serv HBP Screen	1
	B/M Health Contracted Out	7		Serv Diabetes Screen	8
	B/M Health NA	1		Serv M&C Health	7
	B/M Health DK	3		Serv Obe Prev	1
	Sub Abuse Directly	10		Serv Drug Prev	10
	Sub Abuse Contracted Out	1		Serv Env Health	2
Other Health Services (cont.)	Sub Abuse NA	4	Policy or Advocacy Activities	Pol/Adv Em Prp&Resp	3
	Sub Abuse DK	5		Pol/Adv Food Safety	2

Epidemiology and Surveillance Activities	Epi&Surv C/I Disease Directly	9		Pol/Adv Fund HC	10
	Epi&Surv C/I Disease via Others	2		Pol/Adv Inf Disease	12
	Epi&Surv C/I Disease DK	1		Pol/Adv Inj&Vio Prev	3
	Epi&Surv CD Directly	2		Pol/Adv Land Use	11
	Epi&Surv CD Contracted Out	4		Pol/Adv Mental Health	11
	Epi&Surv CD via Others	9		Pol/Adv Obe/Phys Act	3
	Epi&Surv CD DK	8		Pol/Adv Occp Hea&Saf	6
	Epi&Surv Injury DK	9		Pol/Adv Oral Health	13
	Epi&Surv BRFs NA	4		Pol/Adv Housing	9
	Epi&Surv BRFs DK	11		Pol/Adv Alc Opi Drug	6
	Epi&Surv Env Health Directly	5		Pol/Adv Wast Watr Sanit	5
	Epi&Surv Env Health Contracted Out	1		Pol/Adv Other Pol Areas	15
	Epi&Surv Env Health NA	1		Pol/Adv None	11
	Epi&Surv Env Health DK	3		Pol/Adv Clim Change	10
	Epi&Surv Synd Surv NA	3		Pol/Adv Fund Local PH	10
	Epi&Surv Synd Surv DK	8		Pol/Adv Other Env Health	6
	Epi&Surv M&C Health Directly	4		Adopted New PH Ord/Reg	8
	Epi&Surv M&C Health via Others	3		Major Revision PH Ord/Reg	5
	Epi&Surv M&C Health DK	3	Community Health Assessment and Planning	Com Health Ass (≤ 3 yr)	6
	Pri Prev Injury DK	6		Com Health Ass (> 5 yr)	6
	Pri Prev CD Directly	5		Com Health Ass Future	5

Population-based Primary Prevention Activities	Pri Prev CD Contracted Out	3		Health Imp Plan (≤ 3 yr)	9
	Pri Prev CD via Others	4		Health Imp Plan (3-5 yr ago)	2
	Pri Prev CD NA	5		Health Imp Plan (> 5 yr)	8
	Pri Prev CD DK	7		Health Imp Plan Future	9
	Pri Prev CD Directly	7		Nonprofit Hospital ≥ 1	10
	Pri Prev CD NA	1		Strategic Plan (≤ 3 yr)	8
	Pri Prev CD DK	3		Strategic Plan (3-5 yr ago)	6
	Pri Prev Phys Act Directly	4		Strategic Plan (> 5 yr)	3
	Pri Prev Phys Act Contracted Out	4		Strategic Plan Future	9
	Pri Prev Phys Act NA	2	Change in Budget	Budget Increased	6
	Pri Prev Phys Act DK	12		Budget Decrease Expected	7
	Pri Prev Tobacco Directly	8		Budget Increase Expected	2

APPENDIX E. FULL RESULTS OF MULTIVARIABLE ANALYSES

Model 1

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-7.57		0.00	-6.91		0.00
Master Top Exec	0.72	2.05	0.06	0.45	1.56	0.26
RN	2.77	15.91	0.01	2.25	9.51	0.02
Oral HC Staff	-1.36	0.26	0.01	-1.54	0.21	0.01
Epidemiologist/Statistician	0.93	2.54	0.02	1.20	3.30	0.01
# Lost Employees	0.21	1.23	0.12	0.41	1.51	0.02
Screening STDs via Others	2.01	7.44	0.00	1.56	4.76	0.00
Treatment Other STDs Contracted Out	3.71	40.72	0.00	1.41	4.08	0.09
Treatment TB Directly	1.23	3.43	0.01	1.47	4.34	0.01
Home HC NA	-3.12	0.04	0.10	-1.55	0.21	0.27
B/M Health Directly	1.98	7.26	0.01	1.15	3.14	0.09
Epi&Surv M&C Health Directly	0.94	2.56	0.06	1.17	3.23	0.03
Pri Prev Opioids Directly	1.16	3.20	0.01	1.07	2.91	0.02
Pri Prev Sub Abuse Directly	-0.98	0.37	0.05	-0.41	0.66	0.38
Insp Private Water DK	-1.61	0.20	0.03	-0.48	0.62	0.46
Insp Health Fac NA	2.37	10.74	0.07	1.74	5.69	0.14
Env Health PHNA NA	1.39	4.02	0.09	1.22	3.39	0.11
Serv Epi&Surv	1.06	2.90	0.04	0.58	1.78	0.29
Serv Com Disease	0.93	2.54	0.08	0.76	2.13	0.20
Serv M&C Health	-1.10	0.33	0.06	-0.72	0.49	0.21
Pol/Adv Oral Health	2.33	10.24	0.00	2.25	9.53	0.00

Pol/Adv Alc Opi Drug	-0.92	0.40	0.05	-0.70	0.50	0.13
Pol/Adv None	-1.24	0.29	0.09	-0.75	0.47	0.32
Strategic Plan (≤ 3 yr)	2.44	11.51	0.00	1.77	5.84	0.00
Strategic Plan (3-5 yr ago)	1.80	6.06	0.00	1.30	3.68	0.04
Strategic Plan Future	1.22	3.38	0.04	0.57	1.77	0.31
Arkansas				-1.73	0.18	0.13
Arizona				-0.15	0.86	0.92
California				0.79	2.20	0.57
Colorado				2.26	9.58	0.15
Connecticut				-0.12	0.89	0.93
District of Columbia				16.62	> 999	1.00
Delaware				16.15	> 999	1.00
Florida				16.73	> 999	0.99
Georgia				13.16	> 999	1.00
Iowa				19.41	> 999	0.99
Idaho				-2.71	0.07	0.07
Illinois				0.79	2.19	0.52
Indiana				-0.25	0.78	0.82
Kansas				0.35	1.42	0.78
Kentucky				0.21	1.24	0.84
Louisiana				18.72	> 999	1.00
Massachusetts				0.87	2.38	0.55
Maryland				16.54	> 999	1.00
Maine				18.35	> 999	1.00
Michigan				-0.17	0.84	0.89
Minnesota				-0.80	0.45	0.49
Missouri				0.01	1.01	0.99
Montana				19.59	> 999	1.00
North Carolina				18.03	> 999	0.99
North Dakota				17.83	> 999	1.00
Nebraska				18.61	> 999	1.00
New Hampshire				17.09	> 999	1.00
New Jersey				2.55	12.82	0.13
New Mexico				-23.09	0.00	1.00
Nevada				16.68	> 999	1.00

New York				1.26	3.52	0.40
Ohio				1.80	6.07	0.20
Oklahoma				-1.39	0.25	0.34
Oregon				0.71	2.04	0.62
Pennsylvania				-2.01	0.13	0.20
South Carolina				12.02	> 999	1.00
Tennessee				-0.53	0.59	0.66
Texas				-0.26	0.77	0.81
Utah				-1.95	0.14	0.24
Virginia				0.21	1.24	0.89
Vermont				22.29	> 999	1.00
Washington				-1.13	0.32	0.38
Wisconsin				0.71	2.03	0.59
West Virginia				1.68	5.37	0.26
Wyoming				-0.70	0.50	0.66

Model 2

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-5.74		0.00	-4.51		0.00
Full-Time Top Exec	0.97	2.63	0.09	0.51	1.67	0.45
Combined HHS Agency	0.63	1.87	0.08	0.88	2.42	0.02
Agency Leadership	1.06	2.88	0.04	0.78	2.19	0.15
Health Educator	-0.78	0.46	0.03	-0.40	0.67	0.27
Busn & Finc Worker	0.80	2.22	0.01	0.68	1.97	0.06
# Lost Employees	0.06	1.06	0.33	0.11	1.11	0.19
Screening Other STDs Directly	-0.69	0.50	0.04	-0.47	0.63	0.23

Screening TB Contracted Out	-1.64	0.19	0.00	-1.99	0.14	0.00
Screening Cancer Directly	0.51	1.67	0.07	0.57	1.78	0.06
Treatment HIV/AIDS Directly	0.45	1.56	0.11	0.41	1.51	0.16
EPSDT NA	-1.65	0.19	0.04	-1.62	0.20	0.05
Well-child Clinic DK	-17.71	0.00	0.98	-2.29	0.10	0.21
B/M Health Directly	0.80	2.23	0.07	1.03	2.79	0.02
Epi&Surv C/I Disease Directly	1.97	7.19	0.01	0.58	1.79	0.40
Pri Prev CD Directly	0.61	1.84	0.08	0.68	1.97	0.08
Pri Prev Sub Abuse via Others	-1.51	0.22	0.03	-1.75	0.17	0.01
Pri Prev Mental Ill Contracted Out	1.34	3.83	0.02	1.57	4.80	0.01
Insp Tobacco Ret NA	-0.76	0.47	0.06	-0.89	0.41	0.04
Env Health Food Sft Edu Directly	0.79	2.19	0.02	1.07	2.91	0.00
Env Health Air Polu DK	1.48	4.39	0.05	0.41	1.50	0.41
Ani Cont via Others	1.11	3.04	0.00	0.66	1.93	0.08
Schl Clinic via Others	0.66	1.94	0.01	0.42	1.53	0.11
Serv Obe Prev	0.66	1.94	0.03	0.27	1.31	0.40

Pol/Adv Land Use	-0.49	0.61	0.11	-0.45	0.64	0.18
Pol/Adv Oral Health	0.49	1.63	0.11	0.59	1.80	0.07
Pol/Adv Other Env Health	0.54	1.71	0.05	0.42	1.52	0.15
Com Health Ass (≤ 3 yr)	0.44	1.56	0.13	0.48	1.61	0.13
Com Health Ass (> 5 yr)	-1.84	0.16	0.01	-1.35	0.26	0.06
Strategic Plan (≤ 3 yr)	0.60	1.82	0.02	0.92	2.51	0.00
Budget Increased	0.55	1.74	0.04	0.57	1.76	0.05
Arkansas				-0.24	0.79	0.85
Arizona				1.15	3.14	0.40
California				-0.11	0.90	0.93
Colorado				2.32	10.15	0.08
Connecticut				0.45	1.57	0.73
District of Columbia				16.63	> 999	1.00
Delaware				17.09	> 999	1.00
Florida				0.85	2.35	0.44
Georgia				-18.49	0.00	1.00
Iowa				1.77	5.87	0.22
Idaho				1.76	5.80	0.33
Illinois				0.58	1.79	0.60
Indiana				0.03	1.03	0.98
Kansas				1.98	7.24	0.11
Kentucky				0.81	2.24	0.45
Louisiana				18.12	> 999	0.99
Massachusetts				0.73	2.08	0.59
Maryland				-0.65	0.52	0.67
Maine				15.84	> 999	1.00
Michigan				1.21	3.35	0.30
Minnesota				1.07	2.91	0.40
Missouri				1.36	3.90	0.30
Montana				1.51	4.52	0.31

North Carolina				-0.71	0.49	0.52
North Dakota				-2.39	0.09	0.15
Nebraska				1.68	5.37	0.32
New Hampshire				18.97	> 999	1.00
New Jersey				1.00	2.73	0.41
New Mexico				-17.41	0.00	1.00
Nevada				0.09	1.09	0.96
New York				2.27	9.71	0.06
Ohio				1.39	4.01	0.19
Oklahoma				15.36	> 999	1.00
Oregon				0.90	2.46	0.45
Pennsylvania				0.89	2.42	0.57
South Carolina				14.85	> 999	0.99
Tennessee				0.30	1.34	0.79
Texas				2.02	7.53	0.07
Utah				1.00	2.73	0.50
Virginia				0.41	1.50	0.74
Washington				0.21	1.23	0.87
Wisconsin				0.52	1.69	0.65
West Virginia				2.09		0.13
Wyoming				-14.83		0.99

Model 3

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-0.80		0.35	14.60		1.00
Agency Leadership	1.68	5.37	0.03	2.67	14.40	0.02
Env Health Worker	1.34	3.83	0.04	0.12	1.13	0.91
Child Imm Contracted Out	-2.66	0.07	0.00	-3.80	0.02	0.00
Pri Prev Tobacco via Others	1.10	2.99	0.09	1.63	5.12	0.04

Schl Clinic via Others	1.22	3.39	0.06	2.79	16.28	0.01
NP Hospital ≥ 1	1.67	5.32	0.01	0.75	2.12	0.35
Alabama				4.51	91.01	1.00
Arkansas				-16.28	0.00	1.00
Arizona				2.74	15.52	1.00
California				3.04	20.86	1.00
Colorado				-17.04	0.00	1.00
Connecticut				4.57	96.45	1.00
District of Columbia				3.80	44.57	1.00
Delaware				3.92	50.35	1.00
Florida				-16.68	0.00	1.00
Georgia				2.77	15.96	1.00
Hawaii				8.22	3718.22	1.00
Iowa				-15.12	0.00	1.00
Idaho				3.22	25.00	1.00
Illinois				2.27	9.71	1.00
Indiana				4.66	105.95	1.00
Kansas				3.62	37.45	1.00
Kentucky				-16.79	0.00	1.00
Louisiana				5.62	275.34	1.00
Massachusetts				-16.91	0.00	1.00
Maryland				2.67	14.38	1.00
Maine				3.54	34.50	1.00
Michigan				2.37	10.67	1.00
Minnesota				-17.37	0.00	1.00
Missouri				2.77	15.89	1.00
Montana				3.01	20.35	1.00
North Carolina				3.54	34.43	1.00
North Dakota				-17.20	0.00	1.00
Nebraska				1.82	6.18	1.00
New Hampshire				0.00	1.00	1.00
New Jersey				3.91	49.85	1.00
New Mexico				0.87	2.40	1.00
Nevada				0.81	2.24	1.00
New York				3.48	32.56	1.00
Ohio				2.33	10.28	1.00
Oklahoma				5.57	263.49	1.00

Oregon				5.96	387.22	1.00
Pennsylvania				1.01	2.73	1.00
South Carolina				-18.21	0.00	1.00
Tennessee				-16.86	0.00	1.00
Texas				2.59	13.30	1.00
Utah				2.86	17.39	1.00
Virginia				3.07	21.52	1.00
Vermont				0.12	1.13	1.00
Washington				2.63	13.82	1.00
Wisconsin				2.48	11.91	1.00
West Virginia				1.54	4.68	1.00
Wyoming				-17.11	0.00	1.00

Model 4

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	2.76		0.02	19.86		1.00
Rookie Top Exec	-1.87	0.15	0.09	-2.17	0.11	0.09
Nurs Top Exec	-0.90	0.41	0.06	-0.57	0.56	0.32
Epidemiologist/ Statistician	1.02	2.77	0.08	1.02	2.76	0.18
Health Educator	-0.89	0.41	0.11	-0.91	0.40	0.16
Nutritionist	0.87	2.40	0.10	1.28	3.59	0.04
Screening CVD Contracted Out	-22.58	0.00	1.00	-2.56	0.08	0.13
Comp Pri Care NA	-19.45	0.00	1.00	-24.93	0.00	1.00
Sub Abuse DK	37.31	> 999	0.99	21.74	> 999	1.00
Epi&Surv M&C Health Directly	1.52	4.58	0.00	1.47	4.34	0.03
Pri Prev Phys Act DK	19.02	> 999	0.99	20.16	> 999	1.00
Pri Prev Sub Abuse DK	-38.46	0.00	0.99	-23.71	0.00	1.00

Pri Prev Mental Ill Directly	1.65	5.18	0.12	1.13	3.10	0.32
Insp Rec Water Contracted Out	-2.13	0.12	0.09	-2.71	0.07	0.17
Insp Lead DK	-1.91	0.15	0.01	-2.02	0.13	0.04
Insp Food Serv DK	-20.52	0.00	1.00	-22.33	0.00	1.00
NP Hospital ≥ 1	1.49	4.42	0.00	1.08	2.94	0.05
Arkansas				-14.32	> 999	1.00
Arizona				1.02	> 999	1.00
California				1.12	3.06	1.00
Colorado				-18.74	0.00	1.00
Connecticut				2.25	9.49	1.00
District of Columbia				-3.36	0.03	1.00
Delaware				0.96	2.62	1.00
Florida				-17.71	0.00	1.00
Georgia				-0.84	0.43	1.00
Hawaii				3.34	28.30	1.00
Iowa				-16.24	0.00	1.00
Idaho				0.26	1.30	1.00
Illinois				1.10	3.00	1.00
Indiana				-16.45	0.00	1.00
Kansas				-18.15	0.00	1.00
Kentucky				-17.64	0.00	1.00
Louisiana				-0.26	0.77	1.00
Massachusetts				-15.69	0.00	1.00
Maryland				0.77	2.15	1.00
Maine				0.14	1.15	1.00
Michigan				0.69	2.00	1.00
Minnesota				1.39	4.00	1.00
Missouri				2.34	10.40	1.00
Montana				2.46	11.65	1.00
North Carolina				0.87	2.38	1.00
North Dakota				0.93	2.53	1.00
Nebraska				2.71	15.03	1.00
New Hampshire				1.80	6.05	1.00
New Jersey				1.69	5.41	1.00
New Mexico				-1.15	0.32	1.00

Nevada				2.02	7.55	1.00
New York				-16.74	0.00	1.00
Ohio				-16.69	0.00	1.00
Oklahoma				4.51	90.74	1.00
Oregon				2.24	9.38	1.00
Pennsylvania				0.02	1.02	1.00
South Carolina				-0.46	0.63	1.00
Tennessee				-18.54	0.00	1.00
Texas				-16.65	0.00	1.00
Utah				-18.64	0.00	1.00
Virginia				-0.65	0.52	1.00
Vermont				2.43	11.37	1.00
Washington				0.64	1.89	1.00
Wisconsin				-17.19	0.00	1.00
West Virginia				2.76	15.86	1.00
Wyoming				2.87	17.67	1.00

Model 5

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-6.05		0.00	-5.02		0.00
Master Top Exec	0.61	1.83	0.03	0.31	1.36	0.29
Lab Worker	0.85	2.34	0.05	0.78	2.19	0.08
Epidemiologist /Statistician	0.75	2.12	0.01	1.20	3.33	0.00
Behav Health Staff	-0.69	0.50	0.04	-0.67	0.51	0.06
Treatment HIV/AIDS Contracted Out	2.03	7.59	0.00	1.52	4.58	0.00
Treatment TB Directly	0.72	2.05	0.07	0.61	1.84	0.13
PCare Contracted Out	2.44	11.51	0.00	1.36	3.88	0.06

PCare via Others	1.67	5.33	0.01	1.11	3.05	0.04
WIC Health Directly	-0.55	0.58	0.12	-0.14	0.87	0.71
EPSDT NA	-1.44	0.24	0.09	-1.62	0.20	0.07
Home HC DK	-14.97	0.00	0.98	-16.03	0.00	0.99
Sub Abuse NA	2.09	8.05	0.05	1.32	3.76	0.21
Epi&Surv CD Contracted Out	2.12	8.35	0.02	1.75	5.75	0.06
Epi&Surv BRFs NA	-2.30	0.10	0.03	-2.13	0.12	0.04
Epi&Surv M&C Health Directly	0.99	2.69	0.00	1.19	3.27	0.00
Pri Prev CD Contracted Out	-1.15	0.32	0.08	-0.64	0.53	0.33
Pri Prev Sub Abuse Contracted Out	1.18	3.26	0.07	0.66	1.93	0.33
Insp Sep Sys Contracted Out	-2.23	0.11	0.02	-1.90	0.15	0.03
Insp Bd Art NA	-0.65	0.52	0.14	-0.79	0.45	0.09
Insp Lead DK	1.23	3.44	0.10	1.24	3.46	0.08
Insp Food Proc NA	-2.35	0.10	0.00	-1.37	0.25	0.06
Env Health Air Qual DK	-1.19	0.30	0.06	-0.20	0.82	0.69
Env Health Rad Cont NA	1.91	6.72	0.00	1.88	6.54	0.00
Env Health Air Polu NA	-1.70	0.18	0.00	-2.01	0.13	0.00
Lab Serv Directly	-0.81	0.45	0.04	-0.86	0.42	0.02
Schl Clinic via Others	0.87	2.39	0.00	0.85	2.35	0.00

Serv Com Disease	1.12	3.06	0.02	0.41	1.50	0.40
Serv Diabetes Screen	0.44	1.55	0.13	0.57	1.77	0.08
Serv Obe Prev	0.81	2.26	0.01	0.53	1.71	0.10
Pol/Adv Mental Health	1.08	2.94	0.00	1.07	2.91	0.00
Health Imp Plan (≤ 3 yr)	1.21	3.37	0.00	0.86	2.37	0.00
Strategic Plan (3-5 yr ago)	0.89	2.44	0.03	0.55	1.74	0.16
Strategic Plan (> 5 yr)	-1.18	0.31	0.04	-0.88	0.41	0.14
Arkansas				-0.08	0.92	0.94
Arizona				-1.38	0.25	0.37
California				-0.35	0.71	0.77
Colorado				0.77	2.16	0.54
Connecticut				0.52	1.69	0.70
District of Columbia				11.53	> 999	1.00
Delaware				15.62	> 999	0.99
Florida				-0.19	0.83	0.87
Georgia				-0.03	0.97	0.99
Iowa				0.74	2.11	0.58
Idaho				-0.81	0.44	0.57
Illinois				1.02	2.78	0.39
Indiana				-0.34	0.71	0.78
Kansas				-0.33	0.72	0.82
Kentucky				0.44	1.55	0.70
Louisiana				1.63	5.09	0.36
Massachusetts				0.83	2.29	0.53
Maryland				1.60	4.96	0.32
Maine				14.58	> 999	0.99
Michigan				0.89	2.43	0.44
Minnesota				-0.43	0.65	0.72
Missouri				0.24	1.27	0.86
Montana				1.46	4.33	0.36
North Carolina				2.38	10.82	0.08
North Dakota				-0.03	0.97	0.98

Nebraska				0.39	1.48	0.83
New Hampshire				16.13	> 999	0.99
New Jersey				1.03	2.80	0.42
New Mexico				-17.53	0.00	0.99
Nevada				14.59	> 999	0.99
New York				0.84	2.31	0.49
Ohio				0.33	1.39	0.77
Oklahoma				1.66	5.25	0.25
Oregon				0.85	2.34	0.49
Pennsylvania				-0.26	0.77	0.85
South Carolina				15.27	> 999	0.99
Tennessee				0.45	1.56	0.73
Texas				-0.45	0.64	0.70
Utah				-1.32	0.27	0.36
Virginia				0.54	1.72	0.68
Vermont				17.90	> 999	0.99
Washington				-0.42	0.66	0.73
Wisconsin				0.09	1.10	0.94
West Virginia				1.15	3.17	0.40
Wyoming				4.44	84.67	0.30

Model 6

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-6.48		0.00	-24.62		1.00
# Hired	0.01	1.01	0.03	0.01	1.01	0.06
# Filled FTEs	-0.01	0.99	0.04	-0.01	0.99	0.10
Pub Info Professional	0.66	1.93	0.01	0.90	2.47	0.00
Screening CVD Directly	0.68	1.98	0.01	0.63	1.87	0.02
Treatment HIV/AIDS via Others	0.77	2.17	0.10	0.72	2.05	0.11
Epi&Surv C/I Disease Directly	2.95	19.15	0.01	2.74	15.43	0.02

Epi&Surv CD Directly	-0.85	0.43	0.00	-0.83	0.44	0.00
Epi&Surv BRFs DK	-15.75	0.00	0.98	-17.88	0.00	0.99
Epi&Surv M&C Health Directly	0.83	2.28	0.01	1.08	2.95	0.00
Epi&Surv M&C Health via Others	-0.37	0.69	0.15	-0.51	0.60	0.06
Pri Prev CD Contracted Out	1.39	4.03	0.00	1.02	2.78	0.03
Pri Prev Opioids Directly	0.36	1.43	0.13	0.23	1.26	0.38
Insp Tobacco Ret DK	-0.74	0.48	0.14	-0.82	0.44	0.09
Env Health Vect Cont NA	-1.56	0.21	0.05	-0.50	0.61	0.39
Serv Obe Prev	0.91	2.48	0.00	0.60	1.82	0.06
Pol/Adv Em Prp&Resp	0.43	1.53	0.09	0.52	1.68	0.04
Pol/Adv Fund HC	-0.42	0.65	0.10	-0.40	0.67	0.15
Pol/Adv Housing	-0.53	0.59	0.04	-0.55	0.58	0.04
Pol/Adv Other Pol Areas	0.47	1.59	0.08	0.42	1.52	0.13
Major Revision PH Ord/Reg	0.55	1.73	0.02	0.74	2.10	0.00
Health Imp Plan (≤ 3 yr)	0.42	1.52	0.09	0.45	1.58	0.08
Alabama				19.76	> 999	1.00
Arkansas				18.60	> 999	1.00
Arizona				0.39	1.47	1.00
California				17.68	> 999	1.00
Colorado				18.56	> 999	1.00
Connecticut				18.65	> 999	1.00
District of Columbia				34.05	> 999	1.00
Delaware				38.96	> 999	1.00
Florida				17.64	> 999	1.00
Georgia				16.54	> 999	1.00

Iowa				19.70	> 999	1.00
Idaho				18.23	> 999	1.00
Illinois				18.21	> 999	1.00
Indiana				1.98	7.26	1.00
Kansas				17.64	> 999	1.00
Kentucky				18.38	> 999	1.00
Louisiana				19.10	> 999	1.00
Massachusetts				17.83	> 999	1.00
Maryland				17.83	> 999	1.00
Maine				37.41	> 999	1.00
Michigan				18.27	> 999	1.00
Minnesota				17.99	> 999	1.00
Missouri				17.49	> 999	1.00
Montana				18.52	> 999	1.00
North Carolina				18.05	> 999	1.00
North Dakota				18.97	> 999	1.00
Nebraska				21.12	> 999	1.00
New Hampshire				37.39	> 999	1.00
New Jersey				19.12	> 999	1.00
New Mexico				0.10	1.11	1.00
Nevada				19.29	> 999	1.00
New York				19.05	> 999	1.00
Ohio				18.57	> 999	1.00
Oklahoma				18.41	> 999	1.00
Oregon				18.77	> 999	1.00
Pennsylvania				19.01	> 999	1.00
South Carolina				0.95	2.58	1.00
Tennessee				18.27	> 999	1.00
Texas				18.80	> 999	1.00
Utah				16.69	> 999	1.00
Virginia				18.46	> 999	1.00
Vermont				4.98	145.91	1.00
Washington				17.53	> 999	1.00
Wisconsin				18.05	> 999	1.00
West Virginia				19.02	> 999	1.00
Wyoming				2.32	10.14	1.00

Model 7

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-0.27		0.55	1.26		0.36
Full-Time Top Exec	1.23	3.43	0.00	1.26	3.52	0.01
Nutritionist	-0.54	0.58	0.10	-0.19	0.83	0.58
Screening HIV/AIDS Contracted Out	0.80	2.22	0.11	0.69	2.00	0.16
Epi&Surv CD Directly	0.57	1.76	0.06	0.72	2.06	0.02
Pri Prev CD Directly	-0.61	0.54	0.09	-0.47	0.63	0.19
Pri Prev CD Directly	0.59	1.81	0.15	0.29	1.33	0.48
Pri Prev Opioids NA	-1.86	0.16	0.04	0.07	1.08	0.94
Pri Prev Mental Ill Contracted Out	1.35	3.86	0.07	1.55	4.70	0.05
Pri Prev Mental Ill NA	-2.17	0.11	0.08	-3.67	0.03	0.01
Env Health Air Qual NA	-0.62	0.54	0.06	-0.98	0.38	0.01
Ani Cont NA	-1.05	0.35	0.12	-0.86	0.42	0.28
Serv Diabetes Screen	0.45	1.56	0.11	0.19	1.21	0.53
Serv Obe Prev	0.74	2.10	0.01	0.89	2.43	0.00
Arkansas				-1.78	0.17	0.19
Arizona				-2.54	0.08	0.09
California				-2.00	0.14	0.15
Colorado				-1.82	0.16	0.21
Connecticut				-2.09	0.12	0.15
District of Columbia				12.56	> 999	1.00
Delaware				15.41	> 999	1.00

Florida				-2.21	0.11	0.09
Georgia				-2.56	0.08	0.13
Hawaii				-21.35	0.00	1.00
Iowa				-1.59	0.20	0.28
Idaho				15.42	> 999	0.99
Illinois				-1.03	0.36	0.48
Indiana				-1.59	0.20	0.24
Kansas				-3.14	0.04	0.02
Kentucky				-1.23	0.29	0.36
Louisiana				-2.40	0.09	0.16
Massachusetts				-2.20	0.11	0.12
Maryland				-1.80	0.17	0.28
Maine				14.87	> 999	1.00
Michigan				-1.96	0.14	0.15
Minnesota				-2.67	0.07	0.05
Missouri				-1.59	0.20	0.27
Montana				-1.21	0.30	0.47
North Carolina				-1.92	0.15	0.15
North Dakota				15.13	> 999	1.00
Nebraska				-2.61	0.07	0.13
New Hampshire				14.44	> 999	1.00
New Jersey				14.77	> 999	0.99
New Mexico				14.62	> 999	1.00
Nevada				16.11	> 999	1.00
New York				-1.73	0.18	0.21
Ohio				-0.54	0.58	0.69
Oklahoma				17.42	> 999	0.99
Oregon				-0.89	0.41	0.54
Pennsylvania				-2.71	0.07	0.07
South Carolina				-4.58	0.01	0.01
Tennessee				-1.61	0.20	0.26
Texas				-1.56	0.21	0.24
Utah				14.86	> 999	1.00
Virginia				-1.96	0.14	0.15
Vermont				-21.60	0.00	1.00
Washington				-1.60	0.20	0.23
Wisconsin				-3.35	0.04	0.01
West Virginia				-0.42	0.65	0.79
Wyoming				18.97	> 999	0.99

North Carolina				0.08	1.09	0.95
North Dakota				-1.48	0.23	0.33
Nebraska				-0.75	0.47	0.68
New Hampshire				16.19	> 999	1.00
New Jersey				-0.29	0.75	0.85
New Mexico				-19.76	0.00	1.00
Nevada				-3.35	0.03	0.11
New York				0.57	1.77	0.69
Ohio				-0.20	0.81	0.85
Oklahoma				18.09	> 999	0.99
Oregon				0.27	1.31	0.86
Pennsylvania				16.13	> 999	0.99
South Carolina				-2.47	0.08	0.23
Tennessee				-2.50	0.08	0.05
Texas				-0.55	0.58	0.66
Utah				15.33	> 999	0.99
Virginia				-0.88	0.42	0.50
Vermont				-19.04	0.00	1.00
Washington				0.26	1.29	0.87
Wisconsin				0.27	1.31	0.83
West Virginia				0.84	2.31	0.60
Wyoming				-0.79	0.45	0.64

Model 8

Variable Alias	**Reduced Estimate**	**Reduced Odd's Ratio**	**Reduced P-Value**	**Full Estimate**	**Full Odd's Ratio**	**Full P-Value**
(Intercept)	-0.59		0.46	0.58		0.65
Master Top Exec	0.77	2.16	0.03	0.91	2.50	0.01
PH Top Exec	0.58	1.79	0.10	0.69	2.00	0.08
Combined HHS Agency	0.68	1.97	0.15	0.51	1.67	0.29
# Hired	0.01	1.01	0.00	0.01	1.01	0.01
# Vacant FTEs	-0.03	0.97	0.02	-0.03	0.97	0.04

PH Physician	0.54	1.72	0.11	0.72	2.06	0.07
Env Health Worker	0.90	2.46	0.14	1.51	4.52	0.03
Behav Health Staff	-1.24	0.29	0.01	-0.67	0.51	0.20
Prep Staff	-0.69	0.50	0.11	-1.08	0.34	0.04
Screening Diabetes Directly	0.62	1.85	0.07	0.76	2.13	0.03
Treatment HIV/AIDS Contracted Out	-0.91	0.40	0.11	-1.10	0.33	0.08
Treatment TB Contracted Out	3.60	36.66	0.01	1.44	4.23	0.13
B/M Health Directly	1.30	3.67	0.04	0.78	2.18	0.23
Epi&Surv CD via Others	0.98	2.67	0.04	0.69	1.99	0.19
Epi&Surv BRFs DK	-3.00	0.05	0.02	-1.22	0.29	0.26
Pri Prev CD via Others	-1.73	0.18	0.00	-1.65	0.19	0.00
Pri Prev CD Directly	0.92	2.50	0.02	0.33	1.39	0.47
Pri Prev Opioids Directly	0.74	2.09	0.02	0.49	1.64	0.19
Insp H/Motels DK	-1.25	0.29	0.07	-1.10	0.33	0.12
Insp Schl/DC Directly	-0.70	0.50	0.11	-1.04	0.35	0.03
Insp Rec Water Directly	-0.82	0.44	0.07	-0.66	0.52	0.16
Insp Lead DK	1.76	5.79	0.03	0.44	1.55	0.56

Insp Food Serv Directly	1.33	3.77	0.06	0.84	2.31	0.30
Env Health Food Sft Edu Directly	-1.21	0.30	0.03	-1.19	0.30	0.04
Env Health Food Sft Edu via Others	-0.70	0.50	0.05	-0.56	0.57	0.13
Env Health Haz Resp NA	-4.02	0.02	0.01	-2.74	0.06	0.01
Env Health Noise Polu DK	-1.15	0.32	0.01	-0.96	0.38	0.03
Lab Serv Contracted Out	2.68	14.63	0.00	1.76	5.79	0.02
Pol/Adv Land Use	-0.87	0.42	0.03	-0.58	0.56	0.18
Pol/Adv Mental Health	-0.66	0.51	0.07	-0.46	0.63	0.24
Pol/Adv Housing	1.43	4.16	0.00	1.27	3.55	0.00
Pol/Adv Clim Change	2.07	7.89	0.01	2.08	8.02	0.01
Pol/Adv Fund Local PH	1.06	2.89	0.00	0.86	2.35	0.02
Pol/Adv Other Env Health	0.69	1.99	0.06	0.75	2.11	0.04
Adopted New PH Ord/Reg	1.23	3.43	0.00	0.70	2.01	0.07
Major Revision PH Ord/Reg	-0.63	0.53	0.10	-0.08	0.92	0.85
Arkansas				0.91	2.48	0.43
Arizona				-0.63	0.53	0.72
California				18.09	> 999	0.99
Colorado				0.50	1.65	0.71

Connecticut				-2.57	0.08	0.08
District of Columbia				13.90	> 999	1.00
Delaware				15.81	> 999	1.00
Florida				-0.94	0.39	0.44
Georgia				-1.89	0.15	0.27
Iowa				0.79	2.20	0.61
Idaho				-0.35	0.71	0.83
Illinois				-1.88	0.15	0.14
Indiana				-0.42	0.66	0.73
Kansas				-3.08	0.05	0.14
Kentucky				0.00	1.00	1.00
Louisiana				0.57	1.77	0.77
Massachusetts				-1.70	0.18	0.24
Maryland				-0.60	0.55	0.70
Maine				-4.32	0.01	0.23
Michigan				0.51	1.67	0.70
Minnesota				1.23	3.41	0.49
Missouri				17.28	> 999	0.99
Montana				-0.73	0.48	0.67
North Carolina				0.08	1.09	0.95
North Dakota				-1.48	0.23	0.33
Nebraska				-0.75	0.47	0.68
New Hampshire				16.19	> 999	1.00
New Jersey				-0.29	0.75	0.85
New Mexico				-19.76	0.00	1.00
Nevada				-3.35	0.03	0.11
New York				0.57	1.77	0.69
Ohio				-0.20	0.81	0.85
Oklahoma				18.09	> 999	0.99

Oregon				0.27	1.31	0.86
Pennsylvania				16.13	> 999	0.99
South Carolina				-2.47	0.08	0.23
Tennessee				-2.50	0.08	0.05
Texas				-0.55	0.58	0.66
Utah				15.33	> 999	0.99
Virginia				-0.88	0.42	0.50
Vermont				-19.04	0.00	1.00
Washington				0.26	1.29	0.87
Wisconsin				0.27	1.31	0.83
West Virginia				0.84	2.31	0.60
Wyoming				-0.79	0.45	0.64

Model 9

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-5.75		0.00	-4.14		0.00
Full-Time Top Exec	1.34	3.83	0.03	1.05	2.85	0.12
One or More LBHs	0.94	2.57	0.01	0.31	1.36	0.47
# Filled FTEs	0.00	1.00	0.11	0.00	1.00	0.09
Env Health Worker	1.26	3.53	0.00	0.21	1.23	0.63
Epidemiologist/Statistician	0.67	1.95	0.08	0.96	2.61	0.02
Com Health Worker	-0.99	0.37	0.01	-0.82	0.44	0.02
Behav Health Staff	-1.57	0.21	0.00	-1.37	0.26	0.00
# Reduced Hour Employees	1.36	3.90	0.07	1.19	3.30	0.20
Adult Imm DK	-16.39	0.00	0.99	-18.67	0.00	1.00

Screening CVD Directly	-1.15	0.32	0.03	-0.65	0.52	0.20
Screening Diabetes Directly	0.83	2.30	0.08	0.29	1.34	0.51
Treatment Other STDs Contracted Out	2.48	11.88	0.00	0.80	2.22	0.25
Well-child Clinic Directly	1.15	3.16	0.01	0.91	2.49	0.03
B/M Health Directly	1.00	2.73	0.10	0.49	1.64	0.42
Epi&Surv C/I Disease Directly	1.31	3.72	0.09	1.44	4.20	0.03
Epi&Surv CD Directly	0.56	1.75	0.15	0.04	1.04	0.91
Epi&Surv BRFs DK	2.57	13.13	0.10	-0.17	0.84	0.83
Epi&Surv Synd Surv DK	-1.99	0.14	0.00	-0.51	0.60	0.31
Serv Obe Prev	0.81	2.26	0.04	0.91	2.49	0.01
Pol/Adv Oral Health	0.95	2.57	0.02	0.92	2.51	0.02
Pol/Adv Alc Opi Drug	-1.00	0.37	0.03	-0.96	0.38	0.02
Pol/Adv Fund Local PH	0.64	1.89	0.08	0.40	1.50	0.24
Health Imp Plan (≤ 3 yr)	1.44	4.21	0.00	1.22	3.38	0.00
Health Imp Plan Future	-1.24	0.29	0.02	-1.44	0.24	0.01
Strategic Plan (≤ 3 yr)	1.83	6.23	0.00	1.37	3.94	0.00
Strategic Plan (3-5 yr ago)	1.63	5.08	0.00	1.43	4.18	0.01
Strategic Plan Future	1.04	2.83	0.07	0.74	2.09	0.16
Arkansas				-0.98	0.37	0.33
Arizona				1.31	3.70	0.35
California				-0.20	0.82	0.85
Colorado				-0.33	0.72	0.76
Connecticut				-0.42	0.66	0.73

District of Columbia				14.41	> 999	1.00
Delaware				17.80	> 999	1.00
Florida				0.63	1.88	0.59
Georgia				13.85	> 999	1.00
Iowa				0.43	1.54	0.71
Idaho				-0.12	0.89	0.93
Illinois				1.29	3.64	0.24
Indiana				0.04	1.04	0.97
Kansas				-0.02	0.98	0.99
Kentucky				0.67	1.96	0.49
Louisiana				1.28	3.60	0.41
Massachusetts				0.75	2.11	0.51
Maryland				17.40	> 999	0.99
Maine				-1.62	0.20	0.38
Michigan				1.23	3.43	0.27
Minnesota				-0.05	0.95	0.96
Missouri				0.72	2.05	0.52
Montana				-1.18	0.31	0.39
North Carolina				17.32	> 999	0.99
North Dakota				17.57	> 999	0.99
Nebraska				17.52	> 999	0.99
New Hampshire				19.21	> 999	1.00
New Jersey				1.75	5.73	0.22
New Mexico				-19.25	0.00	1.00
Nevada				16.36	> 999	1.00
New York				2.22	9.23	0.10
Ohio				0.94	2.56	0.35
Oklahoma				0.61	1.84	0.62
Oregon				1.27	3.55	0.26
Pennsylvania				16.46	> 999	0.99
South Carolina				-2.12	0.12	0.22
Tennessee				-1.03	0.36	0.35
Texas				-0.01	0.99	0.99
Utah				15.58	> 999	0.99
Virginia				0.59	1.81	0.64
Vermont				-15.52	0.00	1.00
Washington				0.92	2.51	0.38
Wisconsin				1.65	5.22	0.21

West Virginia				0.42	1.52	0.72
Wyoming				2.42	11.21	0.12

Model 10

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	0.29		0.84	-0.92		0.61
# Vacant FTEs	0.00	1.00	0.35	0.00	1.00	0.93
RN	-2.18	0.11	0.04	-0.80	0.45	0.31
Epidemiologist/Statistician	0.06	1.07	0.87	0.28	1.32	0.57
Com Health Worker	0.42	1.52	0.26	0.62	1.86	0.08
Nutritionist	-0.11	0.90	0.78	0.31	1.36	0.48
Info Sys Specialist	-1.41	0.24	0.00	-1.32	0.27	0.01
Pub Info Professional	1.25	3.50	0.01	1.37	3.92	0.00
Prep Staff	-0.26	0.77	0.58	-1.06	0.35	0.04
Screening Other STDs Directly	1.08	2.96	0.02	1.37	3.95	0.01
Screening Other STDs Contracted Out	1.54	4.66	0.07	0.23	1.26	0.78
Screening Cancer Directly	-0.25	0.78	0.52	-0.07	0.93	0.87
Screening Cancer NA	-5.42	0.00	0.00	-3.07	0.05	0.04
Screening Diabetes Directly	0.32	1.38	0.44	-0.59	0.55	0.19
Treatment HIV/AIDS Directly	0.90	2.46	0.02	0.37	1.45	0.34

Treatment HIV/AIDS NA	-3.76	0.02	0.00	-2.60	0.07	0.04
Treatment Other STDs Contracted Out	1.15	3.16	0.24	0.85	2.35	0.37
PCare NA	-0.36	0.70	0.74	-0.15	0.86	0.87
Epi&Surv C/I Disease Directly	2.13	8.45	0.01	0.73	2.08	0.33
Epi&Surv CD Directly	-0.26	0.77	0.54	-0.38	0.69	0.42
Epi&Surv M&C Health Directly	0.64	1.90	0.23	1.19	3.28	0.03
Pri Prev CD Directly	1.08	2.95	0.01	1.40	4.07	0.00
Pri Prev CD via Others	-1.78	0.17	0.01	-1.57	0.21	0.00
Insp Sep Sys Contracted Out	-2.59	0.07	0.01	-1.46	0.23	0.15
Insp Schl/DC Directly	-0.27	0.77	0.51	-0.09	0.92	0.85
Insp Tobacco Ret DK	0.64	1.89	0.34	0.18	1.20	0.75
Insp Lead NA	-1.93	0.14	0.01	-0.79	0.46	0.26
Insp Milk Proc NA	-0.46	0.63	0.37	-0.33	0.72	0.51
Env Health Rad Cont NA	1.22	3.38	0.06	1.12	3.07	0.05
Env Health Air Polu NA	0.79	2.21	0.18	0.19	1.20	0.74
Ani Cont NA	-3.79	0.02	0.00	-2.53	0.08	0.03
Schl Clinic DK	-3.14	0.04	0.00	-3.17	0.04	0.02
Schl Health Directly	-0.63	0.53	0.08	-0.49	0.61	0.16
Serv Blood Lead Screen	0.00	1.00	0.99	0.33	1.40	0.42

Serv M&C Health	-0.90	0.41	0.13	-0.38	0.68	0.56
Pol/Adv Fund HC	0.57	1.77	0.19	0.70	2.02	0.10
Pol/Adv Inf Disease	-0.91	0.40	0.04	-0.40	0.67	0.32
Pol/Adv Obe/Phys Act	0.86	2.37	0.03	0.47	1.60	0.23
Pol/Adv Alc Opi Drug	-0.70	0.50	0.12	-0.95	0.39	0.05
Pol/Adv None	-1.97	0.14	0.01	-2.20	0.11	0.01
Pol/Adv Fund Local PH	0.59	1.81	0.16	0.30	1.35	0.47
NP Hospital ≥ 1	1.03	2.80	0.02	0.20	1.22	0.67
Strategic Plan (≤ 3 yr)	1.84	6.28	0.00	1.20	3.33	0.01
Strategic Plan (3-5 yr ago)	2.87	17.69	0.00	1.86	6.44	0.01
Strategic Plan Future	0.79	2.21	0.17	-0.21	0.81	0.71
Arkansas				0.16	1.18	0.90
Arizona				-0.36	0.70	0.82
California				-0.80	0.45	0.55
Colorado				2.53	12.52	0.09
Connecticut				1.26	3.54	0.42
District of Columbia				17.56	> 999	1.00
Delaware				18.33	> 999	1.00
Florida				18.83	> 999	0.99
Georgia				-1.33	0.26	0.39
Iowa				3.51	33.31	0.05
Idaho				0.26	1.30	0.88
Illinois				19.18	> 999	0.99
Indiana				0.76	2.15	0.60
Kansas				-0.58	0.56	0.70
Kentucky				1.34	3.81	0.31
Louisiana				0.82	2.26	0.65
Massachusetts				2.52	12.44	0.11

Maryland				1.46	4.31	0.38
Maine				20.14	> 999	1.00
Michigan				0.67	1.95	0.65
Minnesota				2.24	9.35	0.14
Missouri				1.86	6.40	0.21
Montana				-0.06	0.94	0.97
North Carolina				3.22	25.03	0.08
North Dakota				0.84	2.31	0.60
Nebraska				20.48	> 999	1.00
New Hampshire				19.23	> 999	1.00
New Jersey				2.78	16.09	0.09
New Mexico				18.24	> 999	1.00
Nevada				17.86	> 999	1.00
New York				20.14	> 999	0.99
Ohio				1.99	7.34	0.13
Oklahoma				-0.29	0.75	0.86
Oregon				1.24	3.46	0.36
Pennsylvania				-0.74	0.48	0.67
South Carolina				-1.54	0.21	0.41
Tennessee				-1.55	0.21	0.23
Texas				2.40	11.03	0.09
Utah				19.00	> 999	1.00
Virginia				0.67	1.95	0.62
Vermont				-16.14	0.00	1.00
Washington				0.33	1.40	0.81
Wisconsin				18.61	> 999	0.99
West Virginia				3.67	39.17	0.04
Wyoming				-0.04	0.96	0.98
Utah				> 999	> 999	<2e-16
Virginia				< -999	0.00	<2e-16
Washington				< -999	0.00	<2e-16
Wisconsin				< -999	0.00	<2e-16
West Virginia				> 999	> 999	<2e-16
Wyoming				> 999	> 999	<2e-16

Model 11

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-5.66		0.00	-22.33		1.00
Master Top Exec	0.63	1.88	0.03	0.24	1.27	0.40
Lab Worker	1.61	4.98	0.00	1.55	4.72	0.00
Info Sys Specialist	-0.65	0.52	0.05	-0.37	0.69	0.28
Prep Staff	-0.65	0.52	0.13	-0.82	0.44	0.07
Busn & Finc Worker	0.58	1.78	0.09	0.41	1.51	0.25
Screening Other STDs Contracted Out	1.39	4.01	0.04	1.02	2.78	0.12
Screening TB via Others	-0.54	0.58	0.07	-0.31	0.73	0.30
Screening Cancer NA	-14.87	0.00	0.98	0.51	1.66	0.63
Treatment Other STDs Contracted Out	1.86	6.41	0.05	1.35	3.87	0.09
Home HC via Others	2.65	14.13	0.01	0.92	2.52	0.23
Epi&Surv CD Directly	0.45	1.57	0.14	0.09	1.10	0.75
Epi&Surv M&C Health Directly	0.82	2.26	0.02	1.31	3.72	0.00
Pri Prev Opioids Directly	-0.66	0.52	0.05	-0.64	0.53	0.07
Pri Prev Sub Abuse Directly	0.74	2.09	0.03	0.80	2.24	0.02
Insp Campg & RVs NA	-1.72	0.18	0.00	-0.92	0.40	0.04
Env Health Rad Cont NA	0.91	2.49	0.06	0.79	2.20	0.08

Env Health Air Polu NA	-1.01	0.37	0.03	-1.26	0.28	0.01
Lab Serv Directly	-0.87	0.42	0.02	-0.75	0.47	0.03
Lab Serv NA	-3.11	0.04	0.02	-1.68	0.19	0.08
Serv Epi&Surv	0.86	2.36	0.11	0.78	2.19	0.13
Pol/Adv Fund HC	0.53	1.70	0.10	0.46	1.59	0.14
Pol/Adv Obe/Phys Act	0.79	2.21	0.01	0.89	2.44	0.00
Pol/Adv Occp Hea&Saf	1.49	4.43	0.02	0.74	2.10	0.18
Com Health Ass (> 5 yr)	1.45	4.28	0.09	1.37	3.95	0.06
Health Imp Plan (≤ 3 yr)	1.63	5.11	0.00	1.68	5.38	0.00
Health Imp Plan (> 5 yr)	-2.51	0.08	0.04	-1.95	0.14	0.05
Strategic Plan (≤ 3 yr)	0.90	2.46	0.04	0.45	1.56	0.31
Strategic Plan (3-5 yr ago)	1.74	5.71	0.00	1.24	3.46	0.02
Strategic Plan Future	-0.88	0.42	0.15	-0.97	0.38	0.10
Alabama				17.31	> 999	1.00
Arkansas				18.26	> 999	1.00
Arizona				19.62	> 999	1.00
California				18.01	> 999	1.00
Colorado				18.01	> 999	1.00
Connecticut				16.90	> 999	1.00
District of Columbia				33.21	> 999	1.00
Delaware				37.26	> 999	0.99
Florida				19.21	> 999	1.00
Georgia				17.04	> 999	1.00
Iowa				18.83	> 999	1.00
Idaho				18.58	> 999	1.00
Illinois				19.68	> 999	1.00
Indiana				18.17	> 999	1.00
Kansas				18.33	> 999	1.00

Kentucky				18.83	> 999	1.00
Louisiana				18.26	> 999	1.00
Massachusetts				17.84	> 999	1.00
Maryland				20.64	> 999	1.00
Maine				34.79	> 999	0.99
Michigan				17.98	> 999	1.00
Minnesota				18.44	> 999	1.00
Missouri				16.78	> 999	1.00
Montana				19.68	> 999	1.00
North Carolina				34.75	> 999	0.99
North Dakota				18.64	> 999	1.00
Nebraska				19.12	> 999	1.00
New Hampshire				34.56	> 999	1.00
New Jersey				18.89	> 999	1.00
New Mexico				-0.77	0.46	1.00
Nevada				35.02	> 999	0.99
New York				19.99	> 999	1.00
Ohio				19.79	> 999	1.00
Oklahoma				19.77	> 999	1.00
Oregon				18.68	> 999	1.00
Pennsylvania				18.84	> 999	1.00
South Carolina				33.12	> 999	0.99
Tennessee				19.06	> 999	1.00
Texas				18.83	> 999	1.00
Utah				18.57	> 999	1.00
Virginia				18.74	> 999	1.00
Vermont				39.70	> 999	0.99
Washington				18.04	> 999	1.00
Wisconsin				19.69	> 999	1.00
West Virginia				21.00	> 999	1.00
Wyoming				18.20	> 999	1.00

Model 12

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-3.72		0.00	-4.09		0.00
Full-Time Top Exec	1.07	2.93	0.09	0.99	2.69	0.15
Health Educator	-0.54	0.58	0.07	-0.20	0.82	0.53
Child Imm via Others	0.94	2.55	0.05	0.52	1.69	0.28
Screening Cancer Contracted Out	0.73	2.08	0.06	0.53	1.70	0.18
Screening CVD Directly	-0.45	0.64	0.14	-0.41	0.66	0.19
Screening Diabetes Directly	0.74	2.09	0.01	0.66	1.93	0.02
WIC Health via Others	-0.56	0.57	0.03	-0.39	0.68	0.19
B/M Health Contracted Out	0.51	1.67	0.16	0.55	1.74	0.16
Epi&Surv C/I Disease Directly	1.43	4.18	0.09	1.92	6.81	0.02
Epi&Surv C/I Disease via Others	-0.57	0.57	0.01	-0.62	0.54	0.01
Epi&Surv CD Contracted Out	1.20	3.30	0.07	1.01	2.73	0.11
Epi&Surv Injury DK	-1.34	0.26	0.04	-1.53	0.22	0.02
Pri Prev CD Directly	0.63	1.88	0.09	0.74	2.10	0.06

Pri Prev Opioids Directly	0.68	1.97	0.00	0.63	1.88	0.01
Insp Campg & RVs NA	-0.78	0.46	0.07	-0.75	0.47	0.09
Insp H/Motels NA	-1.04	0.35	0.06	-0.84	0.43	0.12
Ani Cont Contracted Out	1.85	6.36	0.01	1.85	6.35	0.01
Serv Obe Prev	0.55	1.73	0.07	0.51	1.66	0.10
Pol/Adv Obe/Phys Act	0.38	1.46	0.13	0.60	1.82	0.02
Pol/Adv Housing	0.50	1.66	0.03	0.38	1.47	0.12
Pol/Adv Alc Opi Drug	-0.94	0.39	0.00	-0.97	0.38	0.00
Pol/Adv None	-1.76	0.17	0.02	-0.96	0.38	0.15
Health Imp Plan (> 5 yr)	-1.36	0.26	0.11	-0.83	0.44	0.28
Strategic Plan Future	-0.78	0.46	0.06	-0.74	0.48	0.07
Arkansas				-0.39	0.68	0.69
Arizona				0.12	1.13	0.91
California				-0.90	0.41	0.35
Colorado				0.15	1.17	0.88
Connecticut				0.08	1.08	0.95
District of Columbia				14.43	> 999	1.00
Delaware				17.72	> 999	0.99
Florida				-0.36	0.69	0.68
Georgia				-0.60	0.55	0.66
Iowa				-0.48	0.62	0.66
Idaho				-0.60	0.55	0.65
Illinois				0.46	1.58	0.63
Indiana				-0.71	0.49	0.54
Kansas				-1.38	0.25	0.31
Kentucky				-0.06	0.94	0.95
Louisiana				-0.26	0.77	0.87
Massachusetts				-1.24	0.29	0.40

Maryland				-0.88	0.42	0.50
Maine				17.05	> 999	0.99
Michigan				0.10	1.11	0.92
Minnesota				1.34	3.80	0.18
Missouri				0.66	1.94	0.53
Montana				0.83	2.29	0.55
North Carolina				0.79	2.21	0.40
North Dakota				-0.90	0.41	0.54
Nebraska				16.07	> 999	0.99
New Hampshire				18.27	> 999	0.99
New Jersey				-0.25	0.78	0.81
New Mexico				-17.48	0.00	0.99
Nevada				-0.13	0.87	0.93
New York				0.55	1.74	0.56
Ohio				0.35	1.42	0.69
Oklahoma				-0.35	0.70	0.75
Oregon				0.34	1.40	0.73
Pennsylvania				-1.06	0.35	0.38
South Carolina				-1.03	0.36	0.50
Tennessee				-0.72	0.49	0.50
Texas				-0.21	0.81	0.82
Utah				-0.62	0.54	0.61
Virginia				-0.08	0.92	0.93
Vermont				19.06	> 999	0.99
Washington				-0.77	0.46	0.46
Wisconsin				-0.83	0.43	0.40
West Virginia				0.43	1.54	0.72
Wyoming				-13.66	0.00	0.99

Model 13

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-5.00		0.00	-6.62		0.00
Master Top Exec	0.56	1.75	0.02	0.65	1.91	0.02

# Filled FTEs	0.00	1.00	0.11	0.00	1.00	0.61
# Vacant FTEs	0.02	1.02	0.04	0.03	1.03	0.03
RN	1.30	3.68	0.11	1.75	5.75	0.06
Com Health Worker	0.55	1.73	0.03	0.37	1.45	0.19
# Reduced Hour Employees	0.50	1.64	0.05	0.50	1.66	0.05
Screening Cancer NA	-15.36	0.00	0.98	-16.36	0.00	0.99
Treatment Other STDs Contracted Out	2.03	7.64	0.00	1.70	5.47	0.01
WIC Health via Others	-0.75	0.47	0.01	-0.99	0.37	0.01
Epi&Surv C/I Disease Directly	2.04	7.66	0.01	2.51	12.35	0.01
Epi&Surv M&C Health Directly	-0.48	0.62	0.13	-0.42	0.66	0.25
Pri Prev CD Directly	0.55	1.73	0.15	0.65	1.91	0.13
Pri Prev Phys Act Contracted Out	2.11	8.28	0.02	2.00	7.39	0.04
Pri Prev Tobacco Directly	0.51	1.67	0.12	0.44	1.56	0.24
Pri Prev Opioids NA	-2.13	0.12	0.10	-3.50	0.03	0.03
Pri Prev Mental Ill Contracted Out	1.47	4.37	0.01	1.58	4.83	0.01
Insp Food Proc DK	-1.31	0.27	0.06	-0.92	0.40	0.10
Insp Milk Proc NA	-0.68	0.51	0.09	-0.07	0.94	0.88
Env Health Rad Cont NA	0.70	2.01	0.11	0.86	2.37	0.08
Lab Serv NA	-1.91	0.15	0.04	-2.81	0.06	0.01
Schl Clinic NA	-0.72	0.49	0.02	-0.74	0.48	0.03
Pol/Adv Land Use	-0.70	0.50	0.02	-0.66	0.52	0.07
Pol/Adv Obe/Phys Act	0.49	1.64	0.06	0.63	1.88	0.03

Pol/Adv Housing	0.61	1.84	0.03	0.26	1.29	0.43
Pol/Adv Fund Local PH	0.55	1.73	0.06	0.71	2.03	0.03
Com Health Ass (≤ 3 yr)	0.53	1.70	0.05	0.24	1.27	0.42
Health Imp Plan Future	-1.25	0.29	0.02	-1.16	0.31	0.06
Budget Increased	0.61	1.84	0.02	0.55	1.74	0.06
Arkansas				0.82	2.28	0.44
Arizona				-0.60	0.55	0.66
California				-0.41	0.67	0.71
Colorado				0.38	1.47	0.73
Connecticut				1.63	5.09	0.23
District of Columbia				11.11	> 999	1.00
Delaware				18.56	> 999	1.00
Florida				0.45	1.57	0.63
Georgia				-1.80	0.17	0.68
Hawaii				18.23	> 999	1.00
Iowa				1.81	6.10	0.14
Idaho				-0.10	0.90	0.93
Illinois				0.62	1.86	0.53
Indiana				-1.25	0.29	0.38
Kansas				-0.72	0.49	0.53
Kentucky				0.27	1.30	0.76
Louisiana				0.53	1.70	0.73
Massachusetts				-0.42	0.65	0.77
Maryland				0.15	1.16	0.92
Maine				17.43	> 999	1.00
Michigan				0.60	1.83	0.57
Minnesota				3.70	40.25	0.02
Missouri				1.00	2.72	0.39
Montana				0.80	2.23	0.58
North Carolina				0.96	2.62	0.35
North Dakota				-0.68	0.51	0.60
Nebraska				19.07	> 999	0.99
New Hampshire				19.02	> 999	1.00
New Jersey				1.09	2.98	0.32

New Mexico				-17.48	0.00	1.00
Nevada				17.88	> 999	0.99
New York				2.39	10.91	0.05
Ohio				1.23	3.41	0.19
Oklahoma				17.16	> 999	1.00
Oregon				1.61	4.99	0.15
Pennsylvania				-1.43	0.24	0.33
South Carolina				-18.51	0.00	0.99
Tennessee				0.41	1.50	0.71
Texas				-0.45	0.64	0.69
Utah				-0.38	0.69	0.76
Virginia				0.37	1.45	0.74
Washington				0.84	2.32	0.45
Wisconsin				2.70	14.94	0.02
West Virginia				1.98	7.26	0.12
Wyoming				-14.77	0.00	0.99

Model 14

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-3.82		0.00	-2.69		0.01
One or More LBHs	0.41	1.50	0.10	0.46	1.58	0.18
# Filled FTEs	0.00	1.00	0.02	0.00	1.00	0.16
PH Physician	0.69	1.99	0.00	0.59	1.80	0.02
Env Health Worker	1.25	3.47	0.00	0.76	2.14	0.04
# Lost Employees	0.10	1.10	0.04	0.11	1.11	0.09
Screening Cancer via Others	1.25	3.50	0.03	0.55	1.73	0.27
Treatment HIV/AIDS Directly	0.41	1.50	0.07	0.39	1.47	0.10
Treatment HIV/AIDS Contracted Out	0.92	2.51	0.01	0.51	1.67	0.15

WIC Health via Others	-0.43	0.65	0.06	-0.29	0.75	0.31
Epi&Surv CD Directly	0.50	1.64	0.02	0.16	1.17	0.50
Epi&Surv M&C Health via Others	-0.62	0.54	0.02	-0.56	0.57	0.04
Pri Prev CD via Others	-0.50	0.61	0.10	-0.84	0.43	0.01
Pri Prev Mental Ill Contracted Out	0.76	2.14	0.07	0.87	2.39	0.05
Env Health Food Sft Edu via Others	0.87	2.38	0.00	0.65	1.92	0.01
Pol/Adv Em Prp&Resp	0.38	1.46	0.10	0.34	1.40	0.15
Pol/Adv Housing	0.83	2.28	0.00	0.81	2.25	0.00
Strategic Plan (≤ 3 yr)	0.53	1.69	0.02	0.53	1.71	0.02
Arkansas				0.57	1.77	0.55
Arizona				0.09	1.10	0.94
California				0.72	2.05	0.45
Colorado				0.45	1.57	0.64
Connecticut				0.18	1.19	0.87
District of Columbia				16.39	> 999	0.99
Delaware				16.08	> 999	0.99
Florida				1.36	3.90	0.14
Georgia				-4.78	0.01	0.66
Iowa				1.46	4.31	0.16
Idaho				-0.08	0.92	0.94
Illinois				1.27	3.57	0.16
Indiana				-0.17	0.84	0.86
Kansas				-0.94	0.39	0.41
Kentucky				0.45	1.57	0.59
Louisiana				1.17	3.23	0.45
Massachusetts				-1.91	0.15	0.21
Maryland				0.03	1.03	0.98
Maine				0.77	2.16	0.68
Michigan				1.30	3.65	0.18

Minnesota				-0.32	0.73	0.75
Missouri				-0.97	0.38	0.46
Montana				0.86	2.36	0.51
North Carolina				0.22	1.25	0.80
North Dakota				1.24	3.47	0.30
Nebraska				16.05	> 999	0.98
New Hampshire				-13.82	0.00	0.99
New Jersey				-0.30	0.74	0.76
New Mexico				-14.86	0.00	0.99
Nevada				0.96	2.62	0.55
New York				0.90	2.45	0.32
Ohio				2.19	8.92	0.01
Oklahoma				0.55	1.73	0.63
Oregon				1.59	4.88	0.11
Pennsylvania				-1.61	0.20	0.26
South Carolina				-0.88	0.42	0.62
Tennessee				0.32	1.38	0.74
Texas				0.00	1.00	1.00
Utah				0.90	2.45	0.47
Virginia				-0.48	0.62	0.64
Vermont				-12.66	0.00	0.99
Washington				-0.46	0.63	0.64
Wisconsin				1.57	4.78	0.10
West Virginia				1.67	5.33	0.14
Wyoming				0.89	2.44	0.55

Model 15

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-1.45		0.00	-17.56		0.99
# Hired	0.01	1.01	0.04	0.01	1.01	0.09
# Filled FTEs	-0.01	0.99	0.05	-0.01	0.99	0.13
Behav Health Staff	0.40	1.49	0.11	0.27	1.31	0.34
Child Imm Contracted Out	0.71	2.04	0.14	0.41	1.51	0.42

Comp Pri Care Contracted Out	1.45	4.26	0.08	1.96	7.06	0.03
Epi&Surv M&C Health Directly	0.43	1.54	0.08	0.62	1.85	0.03
Pri Prev CD Contracted Out	0.67	1.96	0.13	0.44	1.55	0.34
Pri Prev Opioids Contracted Out	0.61	1.83	0.15	0.58	1.78	0.20
Insp Tobacco Ret DK	-0.56	0.57	0.15	-0.39	0.68	0.30
Env Health Land Use DK	-0.74	0.47	0.13	-0.66	0.52	0.17
Serv Obe Prev	0.62	1.85	0.01	0.55	1.73	0.03
Pol/Adv Clim Change	0.72	2.06	0.02	0.65	1.91	0.05
Budget Decrease Expected	0.70	2.02	0.02	0.81	2.24	0.01
Budget Increase Expected	0.35	1.42	0.11	0.45	1.56	0.06
Alabama				17.90	> 999	0.99
Arkansas				15.96	> 999	0.99
Arizona				13.94	> 999	0.99
California				15.73	> 999	0.99
Colorado				15.20	> 999	0.99
Connecticut				15.64	> 999	0.99
District of Columbia				29.79	> 999	0.99
Delaware				31.42	> 999	0.99
Florida				15.26	> 999	0.99
Georgia				14.09	> 999	0.99
Iowa				16.73	> 999	0.99
Idaho				16.85	> 999	0.99
Illinois				16.32	> 999	0.99

Indiana				14.93	> 999	0.99
Kansas				15.66	> 999	0.99
Kentucky				16.07	> 999	0.99
Louisiana				16.61	> 999	0.99
Massachusetts				16.13	> 999	0.99
Maryland				15.62	> 999	0.99
Maine				16.11	> 999	0.99
Michigan				16.98	> 999	0.99
Minnesota				16.57	> 999	0.99
Missouri				16.06	> 999	0.99
Montana				17.08	> 999	0.99
North Carolina				15.48	> 999	0.99
North Dakota				0.38	1.46	1.00
Nebraska				17.54	> 999	0.99
New Hampshire				31.03	> 999	0.99
New Jersey				17.02	> 999	0.99
New Mexico				0.49	1.63	1.00
Nevada				16.79	> 999	0.99
New York				16.37	> 999	0.99
Ohio				16.34	> 999	0.99
Oklahoma				14.92	> 999	0.99
Oregon				16.00	> 999	0.99
Pennsylvania				14.81	> 999	0.99
South Carolina				14.83	> 999	0.99
Tennessee				15.77	> 999	0.99
Texas				15.38	> 999	0.99
Utah				14.25	> 999	0.99
Virginia				16.23	> 999	0.99
Washington				16.09	> 999	0.99
Wisconsin				15.25	> 999	0.99
West Virginia				16.19	> 999	0.99
Wyoming				15.69	> 999	0.99

Model 16

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-4.94		0.00	-4.22		0.01
Health Educator	-0.45	0.63	0.13	0.10	1.10	0.76
# Lost Employees	0.04	1.04	0.09	0.06	1.06	0.04
Treatment HIV/AIDS Contracted Out	0.61	1.85	0.04	0.52	1.67	0.13
Sub Abuse NA	2.08	8.03	0.02	2.42	11.21	0.01
Epi&Surv C/I Disease Directly	2.00	7.42	0.06	2.30	9.99	0.05
Pri Prev Phys Act Directly	0.72	2.06	0.01	0.57	1.78	0.05
Pri Prev Mental Ill Contracted Out	0.97	2.63	0.02	1.37	3.93	0.00
Insp Rec Water via Others	-0.52	0.60	0.04	-0.45	0.64	0.12
Insp Milk Proc NA	-0.65	0.52	0.06	-0.21	0.81	0.56
Insp Food Serv via Others	-0.48	0.62	0.09	-1.08	0.34	0.01
Env Health Vect Cont via Others	0.42	1.52	0.07	0.24	1.28	0.33
Serv Com Disease	0.93	2.54	0.03	0.80	2.22	0.09
Serv Obe Prev	0.63	1.88	0.03	0.33	1.39	0.29
Pol/Adv Inf Disease	0.61	1.84	0.01	0.71	2.03	0.01

Major Revision PH Ord/Reg	0.47	1.60	0.03	0.51	1.67	0.04
Health Imp Plan Future	-1.27	0.28	0.01	-1.07	0.34	0.03
Strategic Plan (≤ 3 yr)	0.53	1.69	0.02	0.49	1.63	0.05
Arkansas				-1.04	0.35	0.31
Arizona				-2.78	0.06	0.07
California				-1.33	0.26	0.20
Colorado				-0.83	0.43	0.41
Connecticut				-2.81	0.06	0.04
District of Columbia				12.54	> 999	0.99
Delaware				14.87	> 999	0.99
Florida				-0.13	0.88	0.89
Georgia				-4.00	0.02	0.23
Iowa				-1.36	0.26	0.25
Idaho				-0.86	0.42	0.48
Illinois				-1.17	0.31	0.25
Indiana				-2.10	0.12	0.06
Kansas				-1.89	0.15	0.16
Kentucky				-1.03	0.36	0.24
Louisiana				-0.97	0.38	0.49
Massachusetts				-0.28	0.76	0.81
Maryland				-1.84	0.16	0.14
Maine				0.76	2.14	0.69
Michigan				-1.16	0.31	0.23
Minnesota				0.59	1.81	0.58
Missouri				-1.37	0.25	0.22
Montana				-1.53	0.22	0.29
North Carolina				-1.23	0.29	0.20
North Dakota				-1.39	0.25	0.35
Nebraska				0.28	1.32	0.86
New Hampshire				-14.11	0.00	0.99
New Jersey				-2.34	0.10	0.03
Nevada				0.05	1.05	0.98
New York				0.81	2.26	0.41

Ohio				-1.10	0.33	0.20
Oklahoma				-0.93	0.39	0.44
Oregon				-1.07	0.34	0.29
Pennsylvania				-1.32	0.27	0.29
South Carolina				-2.51	0.08	0.18
Tennessee				-1.10	0.33	0.29
Texas				-1.72	0.18	0.10
Utah				-0.01	0.99	1.00
Virginia				-1.43	0.24	0.16
Vermont				-11.87	0.00	0.99
Washington				-2.01	0.13	0.06
Wisconsin				0.77	2.16	0.44
West Virginia				-0.40	0.67	0.71
Wyoming				-14.12	0.00	0.98

Model 17

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-1.77		0.045	-1.79		0.12
Rookie Top Exec	-0.82	0.44	0.006	-0.97	0.38	0.00
# Hired	0.01	1.01	0.026	0.02	1.02	0.03
# Filled FTEs	-0.02	0.98	0.023	-0.02	0.98	0.02
Pub Info Professional	-0.74	0.48	0.008	-0.47	0.62	0.12
Behav Health Staff	-0.62	0.54	0.076	-0.49	0.61	0.17
Busn & Finc Worker	0.60	1.83	0.054	0.54	1.72	0.12
Child Imm via Others	1.00	2.71	0.080	0.73	2.08	0.19
Screening HIV/AIDS Directly	0.82	2.27	0.007	0.68	1.97	0.06
Screening Cancer NA	-16.68	0.00	0.991	-1.10	0.33	0.43

Screening Diabetes Directly	0.43	1.54	0.138	0.41	1.50	0.19
B/M Health Directly	1.63	5.10	0.000	1.64	5.15	0.00
Epi&Surv C/I Disease via Others	-1.07	0.34	0.000	-1.20	0.30	0.00
Epi&Surv CD Directly	0.67	1.95	0.021	0.91	2.48	0.00
Epi&Surv CD Contracted Out	1.49	4.45	0.026	1.06	2.90	0.10
Epi&Surv CD via Others	0.62	1.86	0.104	0.58	1.79	0.14
Epi&Surv Injury DK	-1.16	0.31	0.153	-0.06	0.94	0.93
Pri Prev Mental Ill Directly	0.60	1.82	0.060	0.27	1.31	0.43
Insp Tobacco Ret DK	-1.31	0.27	0.019	-0.79	0.45	0.13
Insp Food Proc DK	-2.31	0.10	0.012	-1.57	0.21	0.04
Insp Milk Proc NA	-0.79	0.46	0.035	-0.80	0.45	0.05
Insp Food Serv via Others	-0.68	0.51	0.024	-0.89	0.41	0.02
Env Health Haz Resp NA	-16.75	0.00	0.987	-16.96	0.00	0.99
Env Health Haz Resp DK	-1.74	0.18	0.151	-0.73	0.48	0.39
EMS Directly	0.83	2.30	0.134	1.06	2.88	0.09
Serv Epi&Surv	-0.78	0.46	0.100	-0.52	0.59	0.29
Serv HBP Screen	-1.00	0.37	0.000	-0.87	0.42	0.00
Serv Obe Prev	0.85	2.33	0.008	0.90	2.47	0.01
Pol/Adv Fund HC	-0.59	0.56	0.039	-0.34	0.71	0.25

Pol/Adv Mental Health	-0.76	0.47	0.006	-0.61	0.54	0.04
Pol/Adv Occp Hea&Saf	1.79	5.97	0.000	1.54	4.65	0.00
Pol/Adv Housing	0.56	1.74	0.042	0.43	1.54	0.14
Pol/Adv Clim Change	-0.54	0.58	0.158	-0.29	0.74	0.46
Adopted New PH Ord/Reg	0.79	2.20	0.002	0.98	2.66	0.00
Health Imp Plan (≤ 3 yr)	-0.78	0.46	0.011	-0.91	0.40	0.01
Health Imp Plan (> 5 yr)	-1.73	0.18	0.074	-1.80	0.17	0.13
Health Imp Plan Future	-1.89	0.15	0.001	-1.67	0.19	0.00
NP Hospital ≥ 1	0.70	2.01	0.077	0.99	2.70	0.01
Strategic Plan (≤ 3 yr)	1.00	2.73	0.000	1.09	2.96	0.00
Budget Increased	0.55	1.73	0.032	0.54	1.72	0.05
Arkansas				0.01	1.01	0.99
Arizona				-0.18	0.84	0.90
California				0.00	1.00	1.00
Colorado				-0.65	0.52	0.57
Connecticut				-1.74	0.18	0.20
District of Columbia				12.08	> 999	1.00
Delaware				17.04	> 999	1.00
Florida				0.22	1.25	0.83
Georgia				-19.88	0.00	0.99
Iowa				-1.24	0.29	0.42
Idaho				-1.83	0.16	0.17
Illinois				-0.39	0.68	0.72
Indiana				-0.54	0.58	0.64
Kansas				-2.64	0.07	0.11
Kentucky				-1.04	0.35	0.30
Louisiana				-1.60	0.20	0.35
Massachusetts				-1.49	0.23	0.29

Maryland				-0.51	0.60	0.74
Maine				15.97	> 999	1.00
Michigan				0.15	1.16	0.89
Minnesota				0.49	1.63	0.67
Missouri				1.05	2.85	0.41
Montana				-0.67	0.51	0.67
North Carolina				-0.17	0.84	0.87
North Dakota				-0.65	0.52	0.67
Nebraska				0.41	1.51	0.81
New Hampshire				-15.55	0.00	1.00
New Jersey				-0.54	0.58	0.63
New Mexico				-16.91	0.00	1.00
Nevada				0.78	2.17	0.71
New York				0.42	1.52	0.70
Ohio				-0.39	0.67	0.69
Oklahoma				14.76	> 999	1.00
Oregon				-1.33	0.27	0.25
Pennsylvania				-1.73	0.18	0.18
South Carolina				-0.93	0.39	0.58
Tennessee				0.22	1.24	0.85
Texas				-1.12	0.33	0.30
Utah				15.43	> 999	0.99
Virginia				-0.90	0.41	0.43
Washington				-1.41	0.24	0.20
Wisconsin				0.01	1.01	0.99
West Virginia				1.08	2.95	0.37
Wyoming				3.65	38.44	0.14

Model 18

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-1.29	0.28	0.045	-0.45	0.64	0.663
Lab Worker	0.60	1.82	0.073	0.58	1.79	0.125

Epidemiologist /Statistician	-0.67	0.51	0.026	-0.82	0.44	0.021
Pub Info Professional	0.87	2.38	0.005	0.87	2.39	0.010
Screening HIV/AIDS Directly	-0.57	0.57	0.090	-0.63	0.53	0.108
Treatment HIV/AIDS Directly	0.86	2.37	0.004	0.49	1.63	0.110
Epi&Surv C/I Disease Directly	1.80	6.07	0.004	1.62	5.08	0.007
Pri Prev CD Directly	0.69	1.99	0.013	0.90	2.47	0.003
Pri Prev CD NA	-1.56	0.21	0.077	-2.04	0.13	0.022
Pri Prev Sub Abuse Directly	0.51	1.67	0.077	0.42	1.52	0.164
Insp Sep Sys Contracted Out	-1.20	0.30	0.070	-1.59	0.20	0.033
Insp Housing DK	-1.10	0.33	0.011	-0.67	0.51	0.133
Env Health Haz Resp NA	-2.99	0.05	0.001	-2.06	0.13	0.003
EMS Contracted Out	-1.50	0.22	0.049	-2.48	0.08	0.005
Pol/Adv Fund HC	0.93	2.53	0.006	1.23	3.41	0.000
Pol/Adv Obe/Phys Act	0.49	1.63	0.079	0.61	1.84	0.036
Health Imp Plan Future	-1.07	0.34	0.008	-0.84	0.43	0.050
Strategic Plan (3-5 yr ago)	0.91	2.48	0.040	0.75	2.12	0.066
Arkansas				0.12	1.13	0.900
Arizona				-1.56	0.21	0.241
California				1.06	2.88	0.408
Colorado				-0.56	0.57	0.628
Connecticut				-0.92	0.40	0.484

District of Columbia				15.66	> 999	0.997
Delaware				15.54	> 999	0.997
Florida				-0.61	0.55	0.579
Georgia				-3.53	0.03	0.007
Iowa				-1.24	0.29	0.296
Idaho				14.35	> 999	0.992
Illinois				-0.48	0.62	0.654
Indiana				-1.35	0.26	0.151
Kansas				-0.73	0.48	0.538
Kentucky				-0.82	0.44	0.386
Louisiana				0.17	1.18	0.912
Massachusetts				-1.65	0.19	0.139
Maryland				-0.68	0.51	0.638
Maine				14.78	> 999	0.996
Michigan				-0.26	0.77	0.821
Minnesota				-0.14	0.87	0.911
Missouri				-0.60	0.55	0.592
Montana				-2.26	0.10	0.094
North Carolina				-0.30	0.74	0.796
North Dakota				-1.77	0.17	0.187
Nebraska				14.35	> 999	0.994
New Hampshire				15.13	> 999	0.997
New Jersey				-1.18	0.31	0.266
New Mexico				14.20	> 999	0.997
Nevada				-2.14	0.12	0.216
New York				-0.32	0.73	0.767
Ohio				-0.16	0.85	0.874
Oklahoma				-1.14	0.32	0.419
Oregon				0.08	1.08	0.942
Pennsylvania				-1.60	0.20	0.208
South Carolina				-3.45	0.03	0.033
Tennessee				-0.76	0.47	0.488
Texas				-0.15	0.86	0.877
Utah				14.81	> 999	0.992
Virginia				-0.94	0.39	0.374
Vermont				-18.43	0.00	0.996
Washington				-1.57	0.21	0.142

Wisconsin				0.79	2.21	0.563
West Virginia				0.34	1.40	0.791
Wyoming				-1.00	0.37	0.515

Model 19

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	-1.38		0.00	0.02	1.02	0.99
Master Top Exec	0.39	1.47	0.11	0.37	1.44	0.18
Oral HC Staff	1.43	4.19	0.00	1.98	7.21	0.00
Screening HIV/AIDS Directly	0.57	1.76	0.03	0.21	1.23	0.50
PCare Directly	0.59	1.80	0.06	1.21	3.34	0.00
Oral Health Directly	-1.01	0.36	0.01	-1.21	0.30	0.00
Pri Prev Phys Act Contracted Out	1.61	4.98	0.13	2.04	7.69	0.06
Insp Sep Sys Directly	0.73	2.08	0.01	0.79	2.21	0.02
Ani Cont NA	-2.57	0.08	0.00	-2.57	0.08	0.00
Serv Epi&Surv	0.79	2.21	0.04	0.89	2.42	0.04
Serv Obe Prev	0.94	2.56	0.00	0.89	2.43	0.00
Health Imp Plan (3-5 yr ago)	0.81	2.25	0.03	0.99	2.69	0.01
Arkansas				-0.63	0.53	0.62
Arizona				-2.26	0.10	0.12
California				-1.51	0.22	0.25
Colorado				0.24	1.27	0.88
Connecticut				-3.20	0.04	0.02
District of Columbia				11.55	> 999	1.00

Delaware				15.24	> 999	1.00
Florida				-1.62	0.20	0.22
Georgia				-4.62	0.01	0.00
Iowa				-2.26	0.10	0.10
Idaho				14.34	> 999	0.99
Illinois				-1.43	0.24	0.27
Indiana				-1.26	0.28	0.30
Kansas				-3.64	0.03	0.01
Kentucky				-0.69	0.50	0.59
Louisiana				14.83	> 999	0.99
Massachusetts				-2.40	0.09	0.07
Maryland				-2.19	0.11	0.13
Maine				14.78	> 999	1.00
Michigan				-1.44	0.24	0.27
Minnesota				-1.32	0.27	0.31
Missouri				-0.59	0.55	0.67
Montana				16.18	> 999	0.99
North Carolina				-1.72	0.18	0.20
North Dakota				-0.48	0.62	0.77
Nebraska				-0.69	0.50	0.70
New Hampshire				14.40	> 999	1.00
New Jersey				-2.23	0.11	0.08
New Mexico				15.19	> 999	1.00
Nevada				-2.08	0.13	0.25
New York				-0.78	0.46	0.55
Ohio				-0.49	0.61	0.69
Oklahoma				-0.77	0.47	0.59
Oregon				-0.87	0.42	0.51
Pennsylvania				-1.83	0.16	0.26
South Carolina				-3.65	0.03	0.03
Tennessee				-2.39	0.09	0.07
Texas				-0.88	0.42	0.48
Utah				-1.91	0.15	0.26
Virginia				-2.37	0.09	0.06
Vermont				-19.62	0.00	1.00
Washington				-2.56	0.08	0.04

Wisconsin				-1.92	0.15	0.14
West Virginia				-0.92	0.40	0.51
Wyoming				0.01	1.01	1.00

Model 20

Variable Alias	Reduced Estimate	Reduced Odd's Ratio	Reduced P-Value	Full Estimate	Full Odd's Ratio	Full P-Value
(Intercept)	4.28		0.000	19.74		1.00
Screening Cancer Directly	0.94	2.56	0.140	1.05	2.86	0.24
EPSDT DK	-1.10	0.33	0.047	-1.26	0.28	0.07
Well-child Clinic via Others	1.81	6.11	0.021	1.59	4.91	0.12
Comp Pri Care Contracted Out	-1.66	0.19	0.077	-1.69	0.18	0.14
Sub Abuse Contracted Out	-2.27	0.10	0.000	-1.57	0.21	0.05
Pri Prev Opioids Directly	-1.90	0.15	0.006	-2.37	0.09	0.01
Insp H/Motels NA	-1.59	0.20	0.032	-1.99	0.14	0.07
Insp Private Water DK	-2.92	0.05	0.000	-3.23	0.04	0.00
Env Health Food Sft Edu NA	-3.30	0.04	0.043	-3.83	0.02	0.03
Env Health Vect Cont Contracted Out	-2.64	0.07	0.003	-4.84	0.01	0.00
Env Health Noise Polu NA	-1.81	0.16	0.003	-2.34	0.10	0.01
Serv Obe Prev	1.07	2.92	0.049	1.75	5.73	0.02
Pol/Adv Other Pol Areas	-1.18	0.31	0.026	-2.33	0.10	0.00

Com Health Ass Future	-2.65	0.07	0.035	-2.91	0.05	0.03
Health Imp Plan (> 5 yr)	-1.51	0.22	0.118	-0.22	0.80	0.85
Strategic Plan (≤ 3 yr)	0.74	2.10	0.152	0.72	2.06	0.24
Budget Increased	-1.19	0.30	0.021	-1.51	0.22	0.04
Arkansas				2.21	9.13	1.00
Arizona				-17.34	0.00	1.00
California				-13.31	0.00	1.00
Colorado				2.84	17.18	1.00
Connecticut				-15.99	0.00	1.00
District of Columbia				3.97	53.00	1.00
Delaware				-0.69	0.50	1.00
Florida				0.53	1.70	1.00
Georgia				0.70	2.01	1.00
Iowa				0.45	1.57	1.00
Idaho				-14.57	0.00	1.00
Illinois				-9.90	0.00	1.00
Indiana				-13.97	0.00	1.00
Kansas				5.89	362.20	1.00
Kentucky				-14.82	0.00	1.00
Louisiana				4.78	118.70	1.00
Massachusetts				4.70	110.43	1.00
Maryland				-16.91	0.00	1.00
Maine				5.23	186.49	1.00
Michigan				-16.11	0.00	1.00
Minnesota				4.47	87.34	1.00
Missouri				-15.61	0.00	1.00
Montana				0.38	1.46	1.00
North Carolina				-14.98	0.00	1.00
North Dakota				4.40	81.67	1.00
Nebraska				1.94	6.98	1.00
New Hampshire				4.69	109.03	1.00
New Jersey				4.86	129.27	1.00
New Mexico				-0.91	0.40	1.00

Nevada				1.00	2.73	1.00
New York				-13.63	0.00	1.00
Ohio				-12.78	0.00	1.00
Oklahoma				-0.72	0.49	1.00
Oregon				-14.73	0.00	1.00
Pennsylvania				5.21	182.67	1.00
South Carolina				-0.56	0.57	1.00
Tennessee				-15.60	0.00	1.00
Texas				3.11	22.37	1.00
Utah				3.03	20.71	1.00
Virginia				2.69	14.70	1.00
Washington				-16.08	0.00	1.00
Wisconsin				-13.32	0.00	1.00
West Virginia				3.72	41.17	1.00
Wyoming				-11.32	0.00	1.00

APPENDIX F. KEY PUBLIC HEALTH ACTIVITIES

1. In the past three years in your jurisdiction, has a community needs assessment process been conducted that systematically describes the prevailing health status in the community? (Activity 1)
2. In the past three years in your jurisdiction, has a survey of the population for behavioral risk factors been conducted? (Activity 2)
3. In your jurisdiction, are timely investigations of adverse health events conducted on an ongoing basis, including communicable disease outbreaks and environmental health hazards? (Activity 3)
4. Are the necessary laboratory services available to support investigations of adverse health events and meet routine diagnostic and surveillance needs for your jurisdiction? (Activity 4)
5. In the past 3 years in your jurisdiction, has an analysis been completed of the determinants of and contributing factors to prioritize health needs, the adequacy of existing health resources, and the population groups most effected? (Activity 5)
6. In the past three years in your jurisdiction, has an analysis been completed of age-specific participation in preventive and screening services? (Activity 6)
7. In your jurisdiction, is there a network of support and communication relationships that includes health related organizations, the media, and the general public? (Activity 7)
8. In the past year in your jurisdiction, have there been formal efforts to inform public officials about the potential public health impact of decisions under their consideration? (Activity 8)
9. In the past three years in your jurisdiction, has there been a prioritization of the community health needs that have been identified from a community needs assessment? (Activity 9)
10. In the past three years in your jurisdiction, have community health initiatives been implemented that are consistent with priorities established from a community health needs assessment? (Activity 10)
11. In the past three years in your jurisdiction, has a community health action plan been developed with community participation to address community health needs? (Activity 11)
12. In the past three years in your jurisdiction, have plans been developed to allocate resources in a manner consistent with community health action plans? (Activity 12)

13. In the past three years in your jurisdiction, have resources been deployed as necessary to address priority health needs identified in the community health needs assessment? (Activity 13)
14. In the past three years in your jurisdiction, has an organizational assessment of the local public health agency been conducted? (Activity 14)
15. In the past three years in your jurisdiction, have age-specific priority health needs been addressed effectively through the provision of or linkage to appropriate services? (Activity 15)
16. In the past three years in your jurisdiction, have there been regular evaluations of the effects of public health services on community health status? (Activity 16)
17. In the past three years in your jurisdiction, have professionally recognized process and outcome measures been used to monitor public health programs and to redirect resources as appropriate? (Activity 17)
18. In the past three years in your jurisdiction, has the public regularly received information about current health status, health care needs, health behaviors, and health care policy issues? (Activity 18)
19. Within the past year in your jurisdiction, has the media received reports on a regular basis about health issues affecting the community? (Activity 19)
20. In the past three years in your jurisdiction, has there been an instance in which a mandated public health program or service failed to be implemented as required by state or local law, ordinance, or regulation? (Activity 20)

APPENDIX G. R CODE

```
#Load NALSYS_18 data
library(readxl)
NALSYS_18_read <-
read_excel("C:/Users/mengz/OneDrive/Desktop/Thesis/NALSYS_18.xlsx")

#Create a new var/column "Last" to mark the most recent LHD survey
NALSYS_18_read$Last <- 0

#Loop through and mark the last obs. of an ID as "1" for each ID
for(i in 1:(nrow(NALSYS_18_read)-1) ){
  if(!(NALSYS_18_read$nacchoid[i] ==
NALSYS_18_read$nacchoid[i+1])){NALSYS_18_read$Last[i] <- 1}
  if(i == nrow(NALSYS_18_read)-1){NALSYS_18_read$Last[i+1] <- 1}
}

#Subset the NALSYS data so only survey data that has “Last = 1” is covered
NALSYS_18 <- NALSYS_18_read[which(NALSYS_18_read$Last==1),]

#Load NACCHO_19 data
library(readxl)
NACCHO_19 <- read_excel("C:/Users/mengz/OneDrive/Desktop/Thesis/NACCHO_19.xlsx")

#Natural Join: NACCHO_NALSYS ####
NACCHO_NALSYS <- merge(x=NACCHO_19,y=NALSYS_18,by="nacchoid",all=FALSE)
write.csv(NACCHO_NALSYS,
file='C:/Users/mengz/OneDrive/Desktop/Thesis/NACCHO_NALSYS.csv')

#Load in infrastructure data frame ####
#edits: moved vars need to be excluded forward & delete Last column
```

```
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis')
dat <-read.csv('NACCHO_NALSYS_infrastructure.csv')

#Bivariate Analysis####
#1.Loop through the independent variable list
#2.Fit a bivariate logistic regression
#3.Save results for each ind-dep pair: var name, coefficient, & p-value
------------------------------------------------------------------------
##Bivariate-AV1####
#Create an empty data frame
#nrows=298-24=274
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av1 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av1) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av1~dat[,i+24],family=binomial,data=dat)
  results_av1[i,1] <- names(dat)[i+24]
  results_av1[i,2] <- coef(model)[2]
  results_av1[i,3] <- summary(model)[[13]][2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av1, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av1.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av1 <- results_av1$VarName[results_av1$Pvalue<=0.05]
write.csv(SignificantVar_av1, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av1_check.csv')
-----------------------------------------------
##Bivariate-AV2####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av2 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av2) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av2~dat[,i+24],family=binomial,data=dat)
  results_av2[i,1] <- names(dat)[i+24]
  results_av2[i,2] <- coef(model)[2]
  results_av2[i,3] <- summary(model)[[13]][2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av2, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av2.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av2 <- results_av2$VarName[results_av2$Pvalue<=0.05]
write.csv(SignificantVar_av2, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av2.csv')
-------------------------------
##Bivariate-AV3####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av3 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av3) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av3~dat[,i+24],family=binomial,data=dat)
  results_av3[i,1] <- names(dat)[i+24]
  results_av3[i,2] <- coef(model)[2]
  results_av3[i,3] <- summary(model)[[13]][2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av3, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av3.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av3 <- results_av3$VarName[results_av3$Pvalue<=0.05]
write.csv(SignificantVar_av3, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av3.csv')
---------------------------------
##Bivariate-AV4####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av4 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av4) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av4~dat[,i+24],family=binomial,data=dat)
  results_av4[i,1] <- names(dat)[i+24]
  results_av4[i,2] <- coef(model)[2]
  results_av4[i,3] <- summary(model)[[13]][2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av4, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av4.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av4 <- results_av4$VarName[results_av4$Pvalue<=0.05]
write.csv(SignificantVar_av4, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av4.csv')
---------------------------------------
##Bivariate-AV5####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av5 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av5) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av5~dat[,i+24],family=binomial,data=dat)
  results_av5[i,1] <- names(dat)[i+24]
  results_av5[i,2] <- coef(model)[2]
  results_av5[i,3] <- summary(model)[[13]][2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av5, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av5.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av5 <- results_av5$VarName[results_av5$Pvalue<=0.05]
write.csv(SignificantVar_av5, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av5.csv')
---------------------------------
##Bivariate-AV6####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av6 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av6) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av6~dat[,i+24],family=binomial,data=dat)
  results_av6[i,1] <- names(dat)[i+24]
  results_av6[i,2] <- coef(model)[2]
  results_av6[i,3] <- summary(model)[[13]][2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av6, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av6.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av6 <- results_av6$VarName[results_av6$Pvalue<=0.05]
write.csv(SignificantVar_av6, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av6.csv')
-------------------------------------
##Bivariate-AV7####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av7 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av7) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av7~dat[,i+24],family=binomial,data=dat)
  results_av7[i,1] <- names(dat)[i+24]
  results_av7[i,2] <- coef(model)[2]
  results_av7[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av7, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av7.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av7 <- results_av7$VarName[results_av7$Pvalue<=0.05]
write.csv(SignificantVar_av7, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av7.csv')
----------------------------------
##Bivariate-AV8####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av8 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av8) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av8~dat[,i+24],family=binomial,data=dat)
  results_av8[i,1] <- names(dat)[i+24]
  results_av8[i,2] <- coef(model)[2]
  results_av8[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av8, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av8.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av8 <- results_av8$VarName[results_av8$Pvalue<=0.05]
write.csv(SignificantVar_av8, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av8.csv')
-------------------------------------------------
##Bivariate-AV9####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av9 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av9) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av9~dat[,i+24],family=binomial,data=dat)
  results_av9[i,1] <- names(dat)[i+24]
  results_av9[i,2] <- coef(model)[2]
  results_av9[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av9, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av9.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av9 <- results_av9$VarName[results_av9$Pvalue<=0.05]
write.csv(SignificantVar_av9, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av9.csv')
------------------------------
##Bivariate-AV10####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av10 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av10) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av10~dat[,i+24],family=binomial,data=dat)
  results_av10[i,1] <- names(dat)[i+24]
  results_av10[i,2] <- coef(model)[2]
  results_av10[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av10, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av10.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av10 <- results_av10$VarName[results_av10$Pvalue<=0.05]
write.csv(SignificantVar_av10, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av10.csv')
---------------------------------
##Bivariate-AV11####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av11 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av11) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av11~dat[,i+24],family=binomial,data=dat)
  results_av11[i,1] <- names(dat)[i+24]
  results_av11[i,2] <- coef(model)[2]
  results_av11[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av11, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av11.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av11 <- results_av11$VarName[results_av11$Pvalue<=0.05]
write.csv(SignificantVar_av11, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av11.csv')
-------------------------------------------------
##Bivariate-AV12####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av12 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av12) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av12~dat[,i+24],family=binomial,data=dat)
  results_av12[i,1] <- names(dat)[i+24]
  results_av12[i,2] <- coef(model)[2]
  results_av12[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av12, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av12.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av12 <- results_av12$VarName[results_av12$Pvalue<=0.05]
write.csv(SignificantVar_av12, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av12.csv')
-----------------------------------------
##Bivariate-AV13####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av13 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av13) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av13~dat[,i+24],family=binomial,data=dat)
  results_av13[i,1] <- names(dat)[i+24]
  results_av13[i,2] <- coef(model)[2]
  results_av13[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av13, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av13.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av13 <- results_av13$VarName[results_av13$Pvalue<=0.05]
write.csv(SignificantVar_av13, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av13.csv')
-------------------------------------------
##Bivariate-AV14####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av14 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av14) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av14~dat[,i+24],family=binomial,data=dat)
  results_av14[i,1] <- names(dat)[i+24]
  results_av14[i,2] <- coef(model)[2]
  results_av14[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av14, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av14.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av14 <- results_av14$VarName[results_av14$Pvalue<=0.05]
write.csv(SignificantVar_av14, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av14.csv')
-----------------------------------------------
##Bivariate-AV15####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av15 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av15) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av15~dat[,i+24],family=binomial,data=dat)
  results_av15[i,1] <- names(dat)[i+24]
  results_av15[i,2] <- coef(model)[2]
  results_av15[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av15, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av15.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av15 <- results_av15$VarName[results_av15$Pvalue<=0.05]
write.csv(SignificantVar_av15, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av15.csv')
----------------------------------------
##Bivariate-AV16####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av16 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av16) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av16~dat[,i+24],family=binomial,data=dat)
  results_av16[i,1] <- names(dat)[i+24]
  results_av16[i,2] <- coef(model)[2]
  results_av16[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av16, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av16.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av16 <- results_av16$VarName[results_av16$Pvalue<=0.05]
write.csv(SignificantVar_av16, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av16.csv')
----------------------------------------
##Bivariate-AV17####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av17 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av17) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av17~dat[,i+24],family=binomial,data=dat)
  results_av17[i,1] <- names(dat)[i+24]
  results_av17[i,2] <- coef(model)[2]
  results_av17[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av17, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av17.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av17 <- results_av17$VarName[results_av17$Pvalue<=0.05]
write.csv(SignificantVar_av17, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av17.csv')
---------------------------------
##Bivariate-AV18####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av18 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av18) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av18~dat[,i+24],family=binomial,data=dat)
  results_av18[i,1] <- names(dat)[i+24]
  results_av18[i,2] <- coef(model)[2]
  results_av18[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av18, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av18.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av18 <- results_av18$VarName[results_av18$Pvalue<=0.05]
write.csv(SignificantVar_av18, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av18.csv')
---------------------------------
##Bivariate-AV19####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av19 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av19) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av19~dat[,i+24],family=binomial,data=dat)
  results_av19[i,1] <- names(dat)[i+24]
  results_av19[i,2] <- coef(model)[2]
  results_av19[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av19, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av19.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av19 <- results_av19$VarName[results_av19$Pvalue<=0.05]
write.csv(SignificantVar_av19, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av19.csv')
---------------------------
##Bivariate-AV20####
#Create an empty data frame
###4=nacchoid, year, county_fips1, lhd_name
###20=av1-av20
results_av20 <- data.frame(matrix(0,nrow=274,ncol=3))

#Name the columns for the data frame
colnames(results_av20) <- c('VarName','Coefficient','Pvalue')

#Store VarName, Coefficient & P value
#Loop it through all potential independent variables
#Exclusion: av1-av20, 1st & last two vars)
for(i in 1:274){
  model <- glm(av20~dat[,i+24],family=binomial,data=dat)
  results_av20[i,1] <- names(dat)[i+24]
  results_av20[i,2] <- coef(model)[2]
  results_av20[i,3] <- summary(model)$coefficients[2,4]
}
#results_av1[i,1] <- row.names(summary(model)[[13]])[2]

#Use write.csv to locate which var error occurs
#error: subscript out of bounds
```

```
write.csv(results_av20, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/results_av20.csv')

#Keep vars that have P value <= 0.2
SignificantVar_av20 <- results_av20$VarName[results_av20$Pvalue<=0.05]
write.csv(SignificantVar_av20, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/SignificantVar_av20.csv')
----------------------------------------
##Frequency of SigVars####
#Compile av results and look across variable rows to calculate how often var is significant #
master_av <-
cbind(results_av1[,1],results_av1[,3],results_av2[,3],results_av3[,3],results_av4[,3],results_av5[,
3],results_av6[,3],results_av7[,3],results_av8[,3],results_av9[,3],results_av10[,3],results_av11[,3
],results_av12[,3],results_av13[,3],results_av14[,3],results_av15[,3],results_av16[,3],results_av1
7[,3],results_av18[,3],results_av19[,3],results_av20[,3])
colnames(master_av) <- c('Var
Name','av1','av2','av3','av4','av5','av6','av7','av8','av9','av10','av11','av12','av13','av14','av15','av16'
,'av17','av18','av19','av20')
Sig_Count <- cbind(master_av[,1],apply(master_av[,2:21]<0.05,MARGIN=1,FUN=sum))
colnames(Sig_Count) <- c('Var Name','Sig Count')
write.csv(master_av, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/!MASTER_av_pvalue.csv')
write.csv(Sig_Count, file='C:/Users/mengz/OneDrive/Desktop/Thesis/Bivariate
Analysis/!Sig_Count.csv')
----------------------------------------------------
#Load in infrastructure data frame ####
#edits: moved vars need to be excluded forward & delete Last column
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis')
dat <-read.csv('NACCHO_NALSYS_infrastructure.csv')

# add state variable
```

```
dat$state <- substring(dat$nacchoid,1,2)
-----------------------------------------------
#Multivariable Analysis####

  ##Multi-AV1####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av1_lookup <- read.csv('SignificantVar_av1_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form1 <- paste(colnames(dat[,SignificantVar_av1_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in c(2:133)){
  form1 <-  paste(form1,colnames(dat[,SignificantVar_av1_lookup[,2]])[i],sep="+",collapse="")
}

formula1 <- paste('av1',form1,sep='~')
options(max.print = 10000)        # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av1a <- dat[,c(5,SignificantVar_av1_lookup[,2])]

#Count the number of missing in each row #
av1_missingrows <- apply(is.na(dat_av1a),1,sum)
```

```
#Delete rows listwise #
dat_av1 <- dat_av1a[av1_missingrows==0,]
dim(dat_av1)

#reduced model_revised
model_av1_reduced <- glm(av1 ~ c4q34_Bachelors + c4q34_Masters + c4q502c +
                c5q70 + c5q43a + c5q59a + c5q55a + c5q60a + c5q47a + c5q48a +
                c5q61a + c5q49a + c5q50a + c5q52a + c5q56a + c5q65a + c10q307 +
                c6q58i + c6q60f + c6q65a + c6q65b + c6q66a + c6q66b +
                c6q67a + c6q69a + c6q69f + c6q71a + c6q74a + c6q76f + c6q78a +
                c6q82g + c6q85g + c6q86a + c6q87g + c6q89a + c6q89f + c6q90a +
                c6q145a + c6q146a + c6q143a + c6q111f + c6q113g + c6q115f +
                c6q116g + c6q120a + c6q127f + c6q144f + c6q134a + c6q137a +
                c10q405a + c10q406a + c10q408a + c10q418a + c12q260w + c12q260q +
                c12q260s + c12q260t + c12q260u + c12q260j + c12q260k +
                c7q217_Yes1 + c7q217_Yes2 + c7q217_No4, family = binomial,
               data = dat_av1)

model_av1_reduced2 <- step(model_av1_reduced) #backward selection is the default
summary(model_av1_reduced2)

#full model_revised
model_av1_full <- glm(av1 ~ c4q34_Masters + c5q43a + c5q59a + c5q47a +
                  c10q307 + c6q58i + c6q66b + c6q67a + c6q76f + c6q78a + c6q86a +
                  c6q145a + c6q146a + c6q113g + c6q115f + c6q144f + c10q405a +
                  c10q406a + c10q408a + c12q260s + c12q260u + c12q260k + c7q217_Yes1 +
                  c7q217_Yes2 + c7q217_No4+ state, family = binomial,
                 data = dat)

summary(model_av1_full)
```

```
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
# Don't forget to add form# single variable in c()!
dat_av1_run2 <- dat[,SignificantVar_av1_lookup[,2]]
#write.csv(dat_av1_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis
Results (missingness & bivariate @5%)/multi-av1_run2.csv')

# Count missing values
sort(apply(is.na(dat_av1_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av1_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/model_av1_missing count.csv')
-----------------------------------------------------
  ##Multi-AV2####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av2_lookup <- read.csv('SignificantVar_av2_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form2 <- paste(colnames(dat[,SignificantVar_av2_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in c(2:132)){
  form2 <-  paste(form2,colnames(dat[,SignificantVar_av2_lookup[,2]])[i],sep="+",collapse="")
```

```
}
formula2 <- paste('av2',form2,sep='~')
options(max.print =10000)       # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av2a <- dat[,c(6,SignificantVar_av2_lookup[,2])]

#Count the number of missing in each row #
av2_missingrows <- apply(is.na(dat_av2a),1,sum)

#Delete rows listwise #
dat_av2 <- dat_av2a[av2_missingrows==0,]

model_av2 <- glm(av2~.,data=dat_av2, family = binomial)
model_av2B <- step(model_av2) #backward selection is the default
summary(model_av2B)
dim(dat_av2)

#full model
model_av2_full <- glm(av2 ~ c4q26 + c2q501 + c5q63a + c5q48a + c5q64a +
                c10q307 + c6q58a + c6q59b + c6q60a + c6q65a + c6q73f + c6q74g +
                c6q78a + c6q80a + c6q90a + c6q146i + c6q95b + c6q107f + c6q118a +
                c6q127g + c6q131i + c6q136i + c10q418a + c12q260f + c12q260s +
                c12q260z + c7q147_Yes1 + c7q147_Yes3 + c7q217_Yes1 + c10q301_greater+
state, family = binomial,
              data = dat)

summary(model_av2_full)
```

```
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av2_run2 <- dat[,SignificantVar_av2_lookup[,2]]
#write.csv(dat_av2_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis
Results (missingness & bivariate @5%)/!multi-av2_run1.csv')

# Count missing values
sort(apply(is.na(dat_av2_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av2_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/model_av2_missing count.csv')

-----------------------------------------------------
  ##Multi-AV3####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av3_lookup <- read.csv('SignificantVar_av3_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form3 <- paste(colnames(dat[,SignificantVar_av3_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:53){
  form3 <-  paste(form3,colnames(dat[,SignificantVar_av3_lookup[,2]])[i],sep="+",collapse="")
```

```
}

formula3 <- paste('av3',form3,sep='~')
options(max.print = 10000)        # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av3a <- dat[,c(7,SignificantVar_av3_lookup[,2])]

#Count the number of missing in each row #
av3_missingrows <- apply(is.na(dat_av3a),1,sum)

#Delete rows listwise #
dat_av3 <- dat_av3a[av3_missingrows==0,]
dim(dat_av3)

#Reduced model_revised
model_av3_reduced <- glm(av3 ~ c5q63a + c5q55a + c5q48a + c6q56b +
                         c6q93i + c6q95f+ c6q136i + c7q501, family = binomial,
                 data = dat_av3)
model_av3_reduced2 <- step(model_av3_reduced)
summary(model_av3_reduced2) #NOTE: c5q48a is dropped after 2nd backward elimination

##Full model_revised
model_av3_full <- glm(av3 ~ c5q63a + c5q55a + c6q56b + c6q93i + c6q136i +
                      c7q501+state, family = binomial, data = dat)

summary(model_av3_full)
```

```
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av3_run2 <-
dat[,SignificantVar_av3_lookup[c(4,7,12:14,18,35,37,40,43,46,47,52,54,56,66,74,77,78,87),2]]
#write.csv(dat_av3_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis
Results (missingness & bivariate @5%)/multi-av3_run2.csv')

# Count missing values
sort(apply(is.na(dat_av3_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av3_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av3_run2_missing count.csv')

-----------------------------------------------------
  ##Multi-AV4####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av4_lookup <- read.csv('SignificantVar_av4_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form4 <- paste(colnames(dat[,SignificantVar_av4_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:60){
```

```
  form4 <-  paste(form4,colnames(dat[,SignificantVar_av4_lookup[,2]])[i],sep="+",collapse="")
}

formula4 <- paste('av4',form4,sep='~')
options(max.print = 10000)        # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av4a <- dat[,c(8,SignificantVar_av4_lookup[,2])]

#Count the number of missing in each row #
av4_missingrows <- apply(is.na(dat_av4a),1,sum)

#Delete rows listwise #
dat_av4 <- dat_av4a[av4_missingrows==0,]

model_av4 <- glm(av4~.,data=dat_av4, family = binomial)
model_av4B <- step(model_av4) #backward selection is the default
summary(model_av4B)
dim(dat_av4)

#full model
model_av4_full <- glm(av4 ~ c4q25 + c4q502b + c5q47a + c5q48a + c5q49a +
                        c6q61g + c6q75f + c6q79g + c6q86a + c6q91g + c6q146g + c6q95a +
                        c6q143b + c6q109g + c6q114g + c7q501 + state, family = binomial,
                      data = dat)

summary(model_av4_full)
#copy tables to av# table word doc side by side by the old table
```

```
#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av4_run2 <-
dat[,SignificantVar_av4_lookup[c(19,25,26,28:30,33,45,46,60,63,83,124,140,145,167),2]]
#write.csv(dat_av4_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis
Results (missingness & bivariate @5%)/multi-av4_run2.csv')

# Count missing values
sort(apply(is.na(dat_av4_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av4_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av4_run2_missing count.csv')

-----------------------------------------------------
  ##Multi-AV5####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av5_lookup <- read.csv('SignificantVar_av5_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form5 <- paste(colnames(dat[,SignificantVar_av5_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in c(2:159)){
  form5 <-  paste(form5,colnames(dat[,SignificantVar_av5_lookup[,2]])[i],sep="+",collapse="")
}
```

```
formula5 <- paste('av5',form5,sep='~')
options(max.print = 10000)       # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av5a <- dat[,c(9,SignificantVar_av5_lookup[,2])]

#Count the number of missing in each row #
av5_missingrows <- apply(is.na(dat_av5a),1,sum)

#Delete rows listwise #
dat_av5 <- dat_av5a[av5_missingrows==0,]

model_av5 <- glm(av5~.,data=dat_av5, family = binomial)
model_av5B <- step(model_av5) #backward selection is the default
summary(model_av5B)
dim(dat_av5)

#full model
model_av5_full <- glm(av5 ~ c4q34_Masters + c5q60a + c5q47a + c5q52a +
                        c6q65b + c6q67a + c6q69b + c6q69i + c6q71a + c6q73f + c6q76g +
                        c6q79f + c6q81b + c6q83f + c6q86a + c6q89b + c6q146b + c6q100b +
                        c6q105f + c6q109g + c6q110f + c6q117g + c6q119f + c6q127f +
                        c6q134a + c6q136i + c10q406a + c10q417a + c10q418a + c12q260q +
                        c7q149_Yes + c7q217_Yes2 + c7q217_Yes3 + state, family = binomial,
                      data = dat)

summary(model_av5_full)
#copy tables to av# table word doc side by side by the old table
```

```
#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av5_run2 <- dat[,SignificantVar_av5_lookup[,2]]
#write.csv(dat_av5_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis
Results (missingness & bivariate @5%)/!multi-av5_run1.csv')

# Count missing values
sort(apply(is.na(dat_av5_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av5_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/model_av5_missing count.csv')

-----------------------------------------
  ##Multi-AV6####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av6_lookup <- read.csv('SignificantVar_av6_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form6 <- paste(colnames(dat[,SignificantVar_av6_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:74){
  form6 <-  paste(form6,colnames(dat[,SignificantVar_av6_lookup[,2]])[i],sep="+",collapse="")
}
```

```
formula6 <- paste('av6',form6,sep='~')
options(max.print = 10000)       # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av6a <- dat[,c(10,SignificantVar_av6_lookup[,2])]

#Count the number of missing in each row #
av6_missingrows <- apply(is.na(dat_av6a),1,sum)

#Delete rows listwise #
dat_av6 <- dat_av6a[av6_missingrows==0,]

model_av6 <- glm(av6~.,data=dat_av6,family=binomial)
summary(model_av6)
model_av6B <- step(model_av6) #backward selection is the default
summary(model_av6B)
dim(dat_av6)

#Full Model
model_av6_full <- glm(av6 ~ c5q36 + c5q37 + c5q51a + c6q61a + c6q65i +
                        c6q80a + c6q81a + c6q83g + c6q86a + c6q86i + c6q89b + c6q145a +
                        c6q107g + c6q120f + c10q418a + c12q260n + c12q260e + c12q260t +
                        c12q260j + c12q501 + c7q149_Yes + state, family = binomial,
                      data = dat)

summary(model_av6_full)
#copy tables to av# table word doc side by side by the old table
```

```
#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av6_run2 <-
dat[,SsignificantVar_av6_lookup[c(30,43,49,57,75,81,85,94,163,203,211,213,231,236,248,267,3
09,316,318),2]]
#write.csv(dat_av6_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis
Results (missingness & bivariate @5%)/multi-av6_run2.csv')

# Count missing values
sort(apply(is.na(dat_av6_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av6_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av6_run2_missing count.csv')

-----------------------------------------
  ##Multi-AV7####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av7_lookup <- read.csv('SignificantVar_av7_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form7 <- paste(colnames(dat[,SignificantVar_av7_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:60){
  form7 <-  paste(form7,colnames(dat[,SignificantVar_av7_lookup[,2]])[i],sep="+",collapse="")
```

```
}

formula7 <- paste('av7',form7,sep='~')
options(max.print = 10000)       # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av7a <- dat[,c(11,SignificantVar_av7_lookup[,2])]

#Count the number of missing in each row #
av7_missingrows <- apply(is.na(dat_av7a),1,sum)

#Delete rows listwise #
dat_av7 <- dat_av7a[av7_missingrows==0,]

model_av7 <- glm(av7~.,data=dat_av7,family=binomial)
summary(model_av7)
model_av7B <- step(model_av7) #backward selection is the default
summary(model_av7B)
dim(dat_av7)

#Full Model
model_av7_full <- glm(av7 ~ c4q26 + c5q49a + c6q57b + c6q81a + c6q89a +
                c6q90a + c6q145f + c6q95b + c6q95f + c6q117f + c6q131f +
                c10q417a + c10q418a+state,data=dat,family=binomial)

summary(model_av7_full)
#copy tables to av# table word doc side by side by the old table
```

```
#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av7_run2 <-
dat[,SignificantVar_av7_lookup[c(1,5,12,13,33,36,40,53,61,64,86,87,137,142,162,192),2]]
#write.csv(dat_av7_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis
Results (missingness & bivariate @5%)/multi-av7_run2.csv')

# Count missing values
sort(apply(is.na(dat_av7_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av7_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av7_run2_missing count.csv')

-----------------------------------------------
  ##Multi-AV8####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av8_lookup <- read.csv('SignificantVar_av8_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form8 <- paste(colnames(dat[,SignificantVar_av8_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:113){
  form8 <-  paste(form8,colnames(dat[,SignificantVar_av8_lookup[,2]])[i],sep="+",collapse="")
}
```

```
formula8 <- paste('av8',form8,sep='~')
options(max.print = 10000)       # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av8a <- dat[,c(12,SignificantVar_av8_lookup[,2])]

#Count the number of missing in each row #
av8_missingrows <- apply(is.na(dat_av8a),1,sum)

#Delete rows listwise #
dat_av8 <- dat_av8a[av8_missingrows==0,]

model_av8 <- glm(av8~.,data=dat_av8,family=binomial)
summary(model_av8)
model_av8B <- step(model_av8) #backward selection is the default
summary(model_av8B)
dim(dat_av8)

#Full Model
model_av8C <- glm(av8 ~ c4q34_Masters + c4q502c + c2q501 + c5q36 +
                  c5q70 + c5q44a + c5q55a + c5q52a + c5q56a + c6q62a + c6q65b +
                  c6q67b + c6q78a + c6q81i + c6q83g + c6q89i + c6q90a + c6q145a +
                  c6q101g + c6q102a + c6q143a + c6q109g + c6q114a + c6q118a +
                  c6q118i + c6q124f + c6q128g + c6q134b + c12q260f + c12q260q +
                  c12q260t + c12q260x + c12q260y + c12q260z + c12q261 + c12q501
                +state,data=dat,family=binomial)

summary(model_av8C)
```

```
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic - delete it)
# Trim infrastructure data to only variables of interests
dat_av8_run2 <-
dat[,SsignificantVar_av8_lookup[c(22,55,59,82,105,121,183,213,229,230,242,293,298,305,313,320),2]]
#write.csv(dat_av8_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness & bivariate @5%)/multi-av8_run2.csv')

# Count missing values
sort(apply(is.na(dat_av8_run2),2,sum),decreasing = TRUE) # count and sort number of missing values for each variable
write.csv(sort(apply(is.na(dat_av8_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness & bivariate @5%)/multi-av8_run2_missing count.csv')

-----------------------------------------------
  ##Multi-AV9####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av9_lookup <- read.csv('SignificantVar_av9_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form9 <- paste(colnames(dat[,SignificantVar_av9_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
```

```
for(i in 2:118){
  form9 <-  paste(form9,colnames(dat[,SignificantVar_av9_lookup[,2]])[i],sep="+",collapse="")
}

formula9 <- paste('av9',form9,sep='~')
options(max.print = 10000)       # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av9a <- dat[,c(13,SignificantVar_av9_lookup[,2])]

#Count the number of missing in each row #
av9_missingrows <- apply(is.na(dat_av9a),1,sum)

#Delete rows listwise #
dat_av9 <- dat_av9a[av9_missingrows==0,]

model_av9 <- glm(av9~.,data=dat_av9,family=binomial)
summary(model_av9)
model_av9B <- step(model_av9) #backward selection is the default
summary(model_av9B)
dim(dat_av9)

#Full Model
model_av9_full <- glm(av9 ~ c4q26 + c2q301 + c5q37 + c5q55a + c5q47a +
                  c5q61a + c5q52a + c10q308 + c6q55g + c6q61a + c6q62a + c6q66b +
                  c6q74a + c6q78a + c6q80a + c6q81a + c6q83g + c6q85g + c10q418a +
                  c12q260s + c12q260u + c12q260y + c7q149_Yes + c7q149_No4 +
                  c7q217_Yes1 + c7q217_Yes2 + c7q217_No4+state,data=dat,family=binomial)
```

```
summary(model_av9_full)
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av9_run2 <-
dat[,SignificantVar_av9_lookup[c(34,82,119,121,176,192,230,286,332,344,351),2]]
#write.csv(dat_av9_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis
Results (missingness & bivariate @5%)/multi-av9_run2.csv')

# Count missing values
sort(apply(is.na(dat_av9_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av9_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av9_run2_missing count.csv')

---------------------------------------------
  ##Multi-AV10####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av10_lookup <- read.csv('SignificantVar_av10_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form10 <- paste(colnames(dat[,SignificantVar_av10_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
```

```
for(i in 2:133){
  form10 <-
paste(form10,colnames(dat[,SignificantVar_av10_lookup[,2]])[i],sep="+",collapse="")
}

formula10 <- paste('av10',form10,sep='~')
options(max.print = 10000)        # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av10a <- dat[,c(14,SignificantVar_av10_lookup[,2])]

#Count the number of missing in each row #
av10_missingrows <- apply(is.na(dat_av10a),1,sum)

#Delete rows listwise #
dat_av10 <- dat_av10a[av10_missingrows==0,]

model_av10 <- glm(av10~.,data=dat_av10,family=binomial)
summary(model_av10)
model_av10B <- step(model_av10) #backward selection is the default
summary(model_av10B)
dim(dat_av10)

#Reduced model_revised
model_av10_reduced <- glm(av10 ~ c5q70 + c5q43a + c5q47a + c5q61a + c5q49a +
                  c5q50a + c5q51a + c5q56a + c6q58a + c6q58b + c6q60a + c6q60f +
                  c6q62a + c6q65a + c6q65f + c6q66b + c6q69f + c6q80a + c6q81a +
                  c6q86a + c6q89a + c6q89i + c6q100b + c6q102a +
```

```
                c6q107g + c6q109f + c6q111f + c6q119f + c6q127f + c6q131f +
                c6q136g + c6q137a + c10q415a + c10q408a + c12q260e + c12q260w +
                c12q260r + c12q260u + c12q260k + c12q260y +
                c7q501 + c7q217_Yes1 + c7q217_Yes2 +
c7q217_No4,data=dat_av10,family=binomial)

model_av10_reduced2 <- step(model_av10_reduced)
summary(model_av10_reduced)

#Full model_revised
model_av10_full <- glm(av10 ~ c5q70 + c5q43a + c5q47a + c5q61a + c5q49a +
                    c5q50a + c5q51a + c5q56a + c6q58a + c6q58b + c6q60a + c6q60f +
                    c6q62a + c6q65a + c6q65f + c6q66b + c6q69f + c6q80a + c6q81a +
                    c6q86a + c6q89a + c6q89i + c6q100b + c6q102a +
                    c6q107g + c6q109f + c6q111f + c6q119f + c6q127f + c6q131f +
                    c6q136g + c6q137a + c10q415a + c10q408a + c12q260e + c12q260w +
                    c12q260r + c12q260u + c12q260k + c12q260y +
                    c7q501 + c7q217_Yes1 + c7q217_Yes2 +
c7q217_No4+state,data=dat,family=binomial)

summary(model_av10_full)



#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av10_run2 <-
dat[,SignificantVar_av10_lookup[c(11,13,17,31,41,49,54,69,85,93,95,111,116,122,134,137:139,
```

```
148,165,172,182,188,193,237,240,241,249,251,253,268,269,272,279,286,293,299,302,304,307,3
08,313,319,324,328,335,360),2]]
#write.csv(dat_av10_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av10_run2.csv')

# Count missing values
sort(apply(is.na(dat_av10_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av10_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av10_run2_missing count.csv')

-----------------------------------------------
  ##Multi-AV11####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av11_lookup <- read.csv('SignificantVar_av11_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form11 <- paste(colnames(dat[,SignificantVar_av11_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:112){
  form11 <-
paste(form11,colnames(dat[,SignificantVar_av11_lookup[,2]])[i],sep="+",collapse="")
}

formula11 <- paste('av11',form11,sep='~')
options(max.print = 10000)       # Change global options
```

```
# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av11a <- dat[,c(15,SignificantVar_av11_lookup[,2])]

#Count the number of missing in each row #
av11_missingrows <- apply(is.na(dat_av11a),1,sum)

#Delete rows listwise #
dat_av11 <- dat_av11a[av11_missingrows==0,]

model_av11 <- glm(av11~.,data=dat_av11,family=binomial)
model_av11B <- step(model_av11) #backward selection is the default
summary(model_av11B)
dim(dat_av11)

#Reduced Model
model_av11_reduced <- glm(av11 ~ c4q34_Masters + c5q60a + c5q50a + c5q56a +
                c5q64a + c6q58b + c6q59i + c6q60f + c6q66b + c6q76i + c6q81a +
                c6q86a + c6q145a + c6q146a + c6q97f + c6q119f + c6q127f +
                c6q134a + c6q134f + c10q405a + c12q260e + c12q260r + c12q260h +
                c7q147_Yes3 + c7q149_Yes + c7q149_Yes3 + c7q217_Yes1 + c7q217_Yes2 +
                c7q217_No4,data=dat_av11,family=binomial)

summary(model_av11_reduced)

#Full Model
model_av11C <- glm(av11 ~ c4q34_Masters + c5q60a + c5q50a + c5q56a +
                c5q64a + c6q58b + c6q59i + c6q60f + c6q66b + c6q76i + c6q81a +
                c6q86a + c6q145a + c6q146a + c6q97f + c6q119f + c6q127f +
```

```
            c6q134a + c6q134f + c10q405a + c12q260e + c12q260r + c12q260h +
            c7q147_Yes3 + c7q149_Yes + c7q149_Yes3 + c7q217_Yes1 + c7q217_Yes2 +
            c7q217_No4+state,data=dat,family=binomial)

summary(model_av11C)
#copy tables to av# table word doc side by side by the old table



#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av11_run2 <- dat[,SignificantVar_av11_lookup[c(),2]]
#write.csv(dat_av11_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av11_run2.csv')

# Count missing values
sort(apply(is.na(dat_av11_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av11_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av11_run2_missing count.csv')

---------------------------------------------
  ##Multi-AV12####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av12_lookup <- read.csv('SignificantVar_av12_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
```

```
#find av#_lookup file: row#-1
form12 <- paste(colnames(dat[,SignificantVar_av12_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:83){
  form12 <-
paste(form12,colnames(dat[,SignificantVar_av12_lookup[,2]])[i],sep="+",collapse="")
}

formula12 <- paste('av12',form12,sep='~')
options(max.print = 10000)        # Change global options
# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av12a <- dat[,c(16,SignificantVar_av12_lookup[,2])]

#Count the number of missing in each row #
av12_missingrows <- apply(is.na(dat_av12a),1,sum)

#Delete rows listwise #
dat_av12 <- dat_av12a[av12_missingrows==0,]

model_av12 <- glm(av12~.,data=dat_av12,family=binomial)
model_av12B <- step(model_av12) #backward selection is the default
summary(model_av12B)
dim(dat_av12)

#Add in state and rurality as control variables - Full Model
model_av12_full <- glm(av12 ~ c4q26 + c5q48a + c6q56i + c6q60b + c6q61a +
                c6q62a + c6q71i + c6q78b + c6q80a + c6q80i + c6q81b + c6q82g +
```

```
            c6q90a + c6q145a + c6q97f + c6q101f + c6q131b + c10q418a +
            c12q260r + c12q260t + c12q260u + c12q260k + c7q149_Yes3 +
            c7q217_No4+state,data=dat,family=binomial)

summary(model_av12_full)
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av12_run2 <- dat[,SignificantVar_av12_lookup[c(),2]]
#write.csv(dat_av12_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av12_run2.csv')

# Count missing values
sort(apply(is.na(dat_av12_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av12_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av12_run2_missing count.csv')

-----------------------------------------------
  ##Multi-AV13####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av13_lookup <- read.csv('SignificantVar_av13_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
```

```
form13 <- paste(colnames(dat[,SignificantVar_av13_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:104){
  form13 <-
paste(form13,colnames(dat[,SignificantVar_av13_lookup[,2]])[i],sep="+",collapse="")
}

formula13 <- paste('av13',form13,sep='~')
options(max.print = 10000)        # Change global options
# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av13a <- dat[,c(17,SignificantVar_av13_lookup[,2])]

#Count the number of missing in each row #
av13_missingrows <- apply(is.na(dat_av13a),1,sum)

#Delete rows listwise #
dat_av13 <- dat_av13a[av13_missingrows==0,]

model_av13 <- glm(av13~.,data=dat_av13,family=binomial)
model_av13B <- step(model_av13) #backward selection is the default
summary(model_av13B)
dim(dat_av13)

#Full Model
model_av13_full <- glm(av13 ~ c4q34_Masters + c5q37 + c5q70 + c5q43a +
                  c5q61a + c10q308 + c6q60f + c6q66b + c6q71i + c6q80a + c6q86a +
                  c6q90a + c6q91b + c6q93a + c6q145f + c6q95b + c6q110g + c6q111f +
```

```
                c6q119f + c6q134f + c6q136f + c12q260f + c12q260r + c12q260t +
                c12q260y + c7q147_Yes1 + c7q149_No4 + c10q301_greater
              +state,data=dat,family=binomial)

summary(model_av13_full)
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av13_run2 <- dat[,SignificantVar_av13_lookup[c(),2]]
#write.csv(dat_av13_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av13_run2.csv')

# Count missing values
sort(apply(is.na(dat_av13_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av13_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av13_run2_missing count.csv')

-----------------------------------------------
  ##Multi-AV14####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av14_lookup <- read.csv('SignificantVar_av14_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
```

```
form14 <- paste(colnames(dat[,SignificantVar_av14_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:93){
  form14 <-
paste(form14,colnames(dat[,SignificantVar_av14_lookup[,2]])[i],sep="+",collapse="")
}

formula14 <- paste('av14',form14,sep='~')
options(max.print = 10000)        # Change global options
# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av14a <- dat[,c(18,SignificantVar_av14_lookup[,2])]

#Count the number of missing in each row #
av14_missingrows <- apply(is.na(dat_av14a),1,sum)

#Delete rows listwise #
dat_av14 <- dat_av14a[av14_missingrows==0,]

model_av14 <- glm(av14~.,data=dat_av14,family=binomial)
model_av14B <- step(model_av14) #backward selection is the default
summary(model_av14B)
dim(dat_av14)

#Full Model
model_av14_full <- glm(av14 ~ c2q301 + c5q37 + c5q44a + c5q55a + c10q307 +
                  c6q60i + c6q65a + c6q65b + c6q71i + c6q81a + c6q86i + c6q89i +
                  c6q95b + c6q118i + c12q260n + c12q260t + c7q217_Yes1
```

```
            +state,data=dat,family=binomial)

summary(model_av14_full)
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av14_run2 <- dat[,SignificantVar_av14_lookup[c(),2]]
#write.csv(dat_av14_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av14_run2.csv')

# Count missing values
sort(apply(is.na(dat_av14_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av14_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av14_run2_missing count.csv')

-----------------------------------------------
  ##Multi-AV15####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av15_lookup <- read.csv('SignificantVar_av15_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form15 <- paste(colnames(dat[,SignificantVar_av15_lookup[,2]])[1],sep="+",collapse="")
```

```
#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:69){
  form15 <-
paste(form15,colnames(dat[,SignificantVar_av15_lookup[,2]])[i],sep="+",collapse="")
}

formula15 <- paste('av15',form15,sep='~')
options(max.print = 10000)        # Change global options
# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av15a <- dat[,c(19,SignificantVar_av15_lookup[,2])]

#Count the number of missing in each row #
av15_missingrows <- apply(is.na(dat_av15a),1,sum)

#Delete rows listwise #
dat_av15 <- dat_av15a[av15_missingrows==0,]

model_av15 <- glm(av15~.,data=dat_av15,family=binomial)
model_av15B <- step(model_av15) #backward selection is the default
summary(model_av15B)
dim(dat_av15)

#Full Model
model_av15_full <- glm(av15 ~ c5q36 + c5q37 + c5q52a + c6q56b + c6q75b +
                  c6q86a + c6q89b + c6q145b + c6q107g + c6q121g + c10q418a +
                  c12q260x + c10q303_less + c10q303_greater
                 +state,data=dat,family=binomial)
```

```
summary(model_av15_full)
#copy tables to av# table word doc side by side by the old table

#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av15_run2 <- dat[,SignificantVar_av15_lookup[c(),2]]
#write.csv(dat_av15_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av15_run2.csv')

# Count missing values
sort(apply(is.na(dat_av15_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av15_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av15_run2_missing count.csv')

-----------------------------------------------
  ##Multi-AV16####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av16_lookup <- read.csv('SignificantVar_av16_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form16 <- paste(colnames(dat[,SignificantVar_av16_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:72){
```

```
  form16 <-
paste(form16,colnames(dat[,SignificantVar_av16_lookup[,2]])[i],sep="+",collapse="")
}

formula16 <- paste('av16',form16,sep='~')
options(max.print = 10000)        # Change global options
# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av16a <- dat[,c(20,SignificantVar_av16_lookup[,2])]

#Count the number of missing in each row #
av16_missingrows <- apply(is.na(dat_av16a),1,sum)

#Delete rows listwise #
dat_av16 <- dat_av16a[av16_missingrows==0,]

model_av16 <- glm(av16~.,data=dat_av16,family=binomial)
model_av16B <- step(model_av16) #backward selection is the default
summary(model_av16B)
dim(dat_av16)

#Add in state and rurality as control variables - Full Model
model_av16_full <- glm(av16 ~ c5q48a + c10q307 + c6q65b + c6q79f + c6q80a +
                  c6q91a + c6q95b + c6q143i + c6q111f + c6q114i + c6q120i +
                  c10q406a + c10q418a + c12q260w + c12q501 + c7q149_No4 + c7q217_Yes1
                   +state,data=dat,family=binomial)

summary(model_av16_full)
#copy tables to av# table word doc side by side by the old table
```

```
#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av16_run2 <- dat[,SignificantVar_av16_lookup[c(),2]]
#write.csv(dat_av16_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av16_run2.csv')

# Count missing values
sort(apply(is.na(dat_av16_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av16_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av16_run2_missing count.csv')

---------------------------------------------
  ##Multi-AV17####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av17_lookup <- read.csv('SignificantVar_av17_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form17 <- paste(colnames(dat[,SignificantVar_av17_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:107){
  form17 <-
paste(form17,colnames(dat[,SignificantVar_av17_lookup[,2]])[i],sep="+",collapse="")
}
```

```
formula17 <- paste('av17',form17,sep='~')
options(max.print = 10000)        # Change global options
# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av17a <- dat[,c(21,SignificantVar_av17_lookup[,2])]

#Count the number of missing in each row #
av17_missingrows <- apply(is.na(dat_av17a),1,sum)

#Delete rows listwise #
dat_av17 <- dat_av17a[av17_missingrows==0,]

model_av17 <- glm(av17~.,data=dat_av17,family=binomial)
summary(model_av17)
model_av17B <- step(model_av17) #backward selection is the default
summary(model_av17B)
dim(dat_av17)

#Add in state and rurality as control variables - Full Model
model_av17_full <- glm(av17 ~ c4q25 + c5q36 + c5q37 + c5q51a + c5q52a +
                    c5q64a + c6q56i + c6q57a + c6q60f + c6q62a + c6q78a + c6q80i +
                    c6q81a + c6q81b + c6q81i + c6q82g + c6q95a + c6q107g + c6q110g +
                    c6q111f + c6q114i + c6q124f + c6q124g + c6q130a + c10q405a +
                    c10q416a + c10q418a + c12q260e + c12q260q + c12q260h + c12q260t +
                    c12q260x + c12q261 + c7q149_Yes + c7q149_Yes3 + c7q149_No4 +
                    c7q501 + c7q217_Yes1 + c10q301_greater+state,data=dat,family=binomial)

summary(model_av17_full)
#copy tables to av# table word doc side by side by the old table
```

```
#Missing Values
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av17_run2 <- dat[,SignificantVar_av17_lookup[c(),2]]
#write.csv(dat_av17_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av17_run2.csv')

# Count missing values
sort(apply(is.na(dat_av17_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av17_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av17_run2_missing count.csv')

-----------------------------------------------
  ##Multi-AV18####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av18_lookup <- read.csv('SignificantVar_av18_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form18 <- paste(colnames(dat[,SignificantVar_av18_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:91){
  form18 <-
paste(form18,colnames(dat[,SignificantVar_av18_lookup[,2]])[i],sep="+",collapse="")
}
```

```
formula18 <- paste('av18',form18,sep='~')
options(max.print = 10000)        # Change global options
# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av18a <- dat[,c(22,SignificantVar_av18_lookup[,2])]

#Count the number of missing in each row #
av18_missingrows <- apply(is.na(dat_av18a),1,sum)

#Delete rows listwise #
dat_av18 <- dat_av18a[av18_missingrows==0,]

model_av18 <- glm(av18~.,data=dat_av18,family=binomial)
model_av18B <- step(model_av18) #backward selection is the default
summary(model_av18B)
dim(dat_av18)

#Add in state and rurality as control variables - Full Model
model_av18_full <- glm(av18 ~ c5q60a + c5q47a + c5q51a + c6q57a + c6q65a +
                  c6q80a + c6q89a + c6q89f + c6q146a + c6q100b + c6q116g +
                  c6q124f + c6q130b + c12q260e + c12q260r + c7q149_No4 +
c7q217_Yes2+state,data=dat,family=binomial)

summary(model_av18_full)
#copy tables to av# table word doc side by side by the old table


#Missing Values
```

```
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av18_run2 <- dat[,SignificantVar_av18_lookup[c(),2]]
#write.csv(dat_av18_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av18_run2.csv')

# Count missing values
sort(apply(is.na(dat_av18_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av18_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av18_run2_missing count.csv')

---------------------------------------------
  ##Multi-AV19####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av19_lookup <- read.csv('SignificantVar_av19_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form19 <- paste(colnames(dat[,SignificantVar_av19_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:84){
  form19 <-
paste(form19,colnames(dat[,SignificantVar_av19_lookup[,2]])[i],sep="+",collapse="")
}
```

```
formula19 <- paste('av19',form19,sep='~')
options(max.print = 10000)       # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av19a <- dat[,c(23,SignificantVar_av19_lookup[,2])]

#Count the number of missing in each row #
av19_missingrows <- apply(is.na(dat_av19a),1,sum)

#Delete rows listwise #
dat_av19 <- dat_av19a[av19_missingrows==0,]

model_av19 <- glm(av19~.,data=dat_av19,family=binomial)
model_av19B <- step(model_av19) #backward selection is the default
summary(model_av19B)
dim(dat_av19)

#Full Model
model_av19_full <- glm(av19 ~ c4q34_Masters + c5q59a + c6q57a + c6q69a +
                c6q77a + c6q91b + c6q100a + c6q131f + c10q405a + c10q418a +
                c7q149_Yes2+state,data=dat,family=binomial)

summary(model_av19_full)
#copy tables to av# table word doc side by side by the old table


#Missing Values
```

```
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic
- delete it)
# Trim infrastructure data to only variables of interests
dat_av19_run2 <- dat[,SignificantVar_av19_lookup[c(),2]]
#write.csv(dat_av19_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable
Analysis Results (missingness & bivariate @5%)/multi-av19_run2.csv')

# Count missing values
sort(apply(is.na(dat_av19_run2),2,sum),decreasing = TRUE) # count and sort number of missing
values for each variable
write.csv(sort(apply(is.na(dat_av19_run2),2,sum),decreasing = TRUE),
file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness &
bivariate @5%)/multi-av19_run2_missing count.csv')

---------------------------------------------
  ##Multi-AV20####
#Find all column # of infrastructure variables significant to av1
setwd('C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis')
SignificantVar_av20_lookup <- read.csv('SignificantVar_av20_lookup.csv')

#Use for loop to trim dat to only have predictors significant to av1
#form1 = first variable name
#find av#_lookup file: row#-1
form20 <- paste(colnames(dat[,SignificantVar_av20_lookup[,2]])[1],sep="+",collapse="")

#for loop starts with 2 because i=1 and i=2 repeats the first variable
for(i in 2:38){
  form20 <-
paste(form20,colnames(dat[,SignificantVar_av20_lookup[,2]])[i],sep="+",collapse="")
}
```

```
formula20 <- paste('av20',form20,sep='~')
options(max.print = 10000)       # Change global options

# Alternative Strategy to Backward Elimination #

#Remove all rows missing in the covariates #
#Note: 5 is the column position of av1 in dat data frame
dat_av20a <- dat[,c(24,SignificantVar_av20_lookup[,2])]

#Count the number of missing in each row #
av20_missingrows <- apply(is.na(dat_av20a),1,sum)

#Delete rows listwise #
dat_av20 <- dat_av20a[av20_missingrows==0,]

model_av20 <- glm(av20~.,data=dat_av20,family=binomial)
model_av20B <- step(model_av20) #backward selection is the default - Reduced Model
summary(model_av20B)
dim(dat_av20)

#Full Model
model_av20_full <- glm(av20 ~ c6q60a + c6q73g + c6q74i + c6q75b + c6q79b +
                c6q145a + c6q101f + c6q113g + c6q118f + c6q120b + c6q128f +
                c10q418a + c12q260j + c7q147_No4 + c7q149_Yes3 + c7q217_Yes1 +
                c10q301_greater+state,data=dat,family=binomial)

summary(model_av20_full)
#copy tables to av# table word doc side by side by the old table


#Missing Values
```

```
# Note: Threshold=5% (=660*0.05=33; If a variable has at least 33 missing, then it's problematic - delete it)
# Trim infrastructure data to only variables of interests
dat_av20_run2 <- dat[,SignificantVar_av20_lookup[c(),2]]
#write.csv(dat_av20_run2,file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness & bivariate @5%)/multi-av20_run2.csv')

# Count missing values
sort(apply(is.na(dat_av20_run2),2,sum),decreasing = TRUE) # count and sort number of missing values for each variable
write.csv(sort(apply(is.na(dat_av20_run2),2,sum),decreasing = TRUE), file='C:/Users/mengz/OneDrive/Desktop/Thesis/Multivariable Analysis Results (missingness & bivariate @5%)/multi-av20_run2_missing count.csv')
```

APPENDIX H. FREQUENCY OF SIGNIFICANCE: MULTIVARIABLE ANALYSES

Significant Infrastructure Variables	Total Count	Significant Infrastructure Variables (cont.)	Total Count
Ani Cont Contracted Out	1	Pri Prev Phys Act Contracted Out	1
Lab Worker	1	Pol/Adv Other Env Health	1
Insp Private Water DK	1	Lab Serv NA	1
Pri Prev Sub Abuse Directly	1	Full-Time Top Exec	1
Env Health Vect Cont Contracted Out	1	Epi&Surv Injury DK	1
Insp Campg & RVs NA	1	Pri Prev Mental Ill NA	1
Pol/Adv Other Pol Areas	1	Env Health Food Sft Edu NA	1
Info Sys Specialist	1	Env Health Air Qual NA	1
PCare Directly	1	Com Health Ass Future	1
Screening Other STDs Directly	1	Screening CVD Directly	1
Insp Sep Sys Directly	1	Serv Epi&Surv	1
Screening Cancer NA	1	Pri Prev CD Contracted Out	1
Health Imp Plan (3-5 yr ago)	1	Rookie Top Exec	1
Treatment HIV/AIDS NA	1	Pol/Adv Em Prp&Resp	1
Pol/Adv Fund HC	1	Serv HBP Screen	1
Schl Clinic DK	1	Treatment HIV/AIDS Contracted Out	1
# Filled FTEs	1	Sub Abuse NA	1
Pol/Adv None	1	PCare via Others	1
Insp Milk Proc NA	1	PH Physician	1
Com Health Worker	1	Epi&Surv BRFs NA	1
Pol/Adv Occp Hea&Saf	1	WIC Health via Others	1
Behav Health Staff	1	Nutritionist	1
NP Hospital ≥ 1	1	Schl Clinic NA	1
Well-child Clinic Directly	1	Insp Lead DK	1
Pol/Adv Inf Disease	1	Env Health Noise Polu NA	1
Insp Schl/DC Directly	1	Agency Leadership	1
Budget Decrease Expected	1	EMS Contracted Out	1
Env Health Noise Polu DK	1	Child Imm Contracted Out	1
Epi&Surv M&C Health via Others	1	Adopted New PH Ord/Reg	1
Lab Serv Contracted Out	1	Pri Prev Tobacco via Others	1
Treatment Other STDs Contracted Out	1	Env Health Food Sft Edu via Others	1
Pol/Adv Clim Change	1	Combined HHS Agency	1

Significant Infrastructure Variables (cont.)	Total Count
Treatment TB Directly	1
Screening TB Contracted Out	1
Insp Food Proc DK	1
Pri Prev Sub Abuse via Others	1
Pri Prev Opioids NA	1
Insp Tobacco Ret NA	1
Comp Pri Care Contracted Out	1
RN	1
Oral Health Directly	1
Screening STDs via Others	1
# Vacant FTEs	2
B/M Health Directly	2
Lab Serv Directly	2
Env Health Haz Resp NA	2
# Lost Employees	2
Master Top Exec	2
Env Health Rad Cont NA	2
Epi&Surv C/I Disease via Others	2
Major Revision PH Ord/Reg	2
Insp Food Serv via Others	2
Env Health Food Sft Edu Directly	2
# Vacant FTEs	2
B/M Health Directly	2
Lab Serv Directly	2
Env Health Haz Resp NA	2
# Lost Employees	2
Master Top Exec	2
Env Health Rad Cont NA	2
Epi&Surv C/I Disease via Others	2
Major Revision PH Ord/Reg	2
Insp Food Serv via Others	2
Env Health Food Sft Edu Directly	2
Schl Clinic via Others	2
Env Health Worker	2
Pol/Adv Fund Local PH	2
Oral HC Staff	2
Screening Diabetes Directly	2
Pol/Adv Oral Health	2
Pol/Adv Mental Health	2
Prep Staff	2

Significant Infrastructure Variables (cont.)	Total Count
Pri Prev CD Directly	2
# Hired	2
Insp Sep Sys Contracted Out	2
Ani Cont NA	2
Env Health Air Polu NA	2
Pol/Adv Housing	3
Pri Prev Mental Ill Contracted Out	3
Pub Info Professional	3
Epi&Surv CD Directly	3
Pol/Adv Alc Opi Drug	3
Pri Prev CD via Others	3
Pri Prev Opioids Directly	3
Budget Increased	3
Health Imp Plan Future	3
Strategic Plan (3-5 yr ago)	4
Epidemiologist/Statistician	4
Pol/Adv Obe/Phys Act	4
Health Imp Plan (≤ 3 yr)	4
Epi&Surv C/I Disease Directly	4
Serv Obe Prev	6
Strategic Plan (≤ 3 yr)	7
Epi&Surv M&C Health Directly	7
Total Count	**189**