

Public Health Infrastructure and Performance: Analyses of Local Health Department
Characteristics and Accreditation Performance Scores

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Abstract

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Local health departments (LHDs) work at the local level, through provision of essential PH services, to promote and protect their communities' health, and maintain effective response to PH crisis. LHDs' capacities to provide the essential PH services appears to depend on their organizational structure and infrastructures, which varies widely across jurisdictions. With varied LHDs capacities and emerging PH threats such as COVID-19, there is growing interest among PH leaders to understand how LHDs' characteristics and their investments in the core PH infrastructures relate to LHDs' performance in their PH functions. Public Health Accreditation Board (PHAB) accreditation standards provide means to assess LHDs' abilities to provide the

essential PH services through sets of standards and measures that relate to the ten essential public health services. The goal of this study is to examine how LHDs' organization structure and their investments in the core PH infrastructures, including foundational capabilities (FC), relate to their performance in PH functions as measured by PHAB accreditation scores. **Aims:** 1) Identified clusters of accredited LHDs based on variations in their performance scores in PHAB accreditation standards. Then, describe how the variation in their performance related to LHDs' characteristics in the identified clusters. 2) Examined the association between LHD total FC expenditures, FC funding allocation pattern, and performance score on related PHAB standards. 3) Explored the relationship between LHDs' local board of health (LBoH) authority on LHDs' budget-related activities and their performance scores in the PHAB standards while considering the governance structure under which the agencies operate. **Methods.** The conceptual framework was based on the Donabedian structure-process-outcome theory that stipulated that when structure-process is good, outcome may as well be good. Statistical analyses employed cluster analysis, and multilevel regression methods. **Results.** 1) Three clusters emerged showing a range in PHAB accreditation performance scores and differences in organizational and jurisdiction characteristics across clusters, notably in size of the jurisdiction served 2) There is a positive association between total FC expenditures the aggregate performance score in selected PHAB standards as well as the performance score on most of the individual standards examined 3) LHDs' governing authority on budget-related activities is positively associated LHDs' aggregate average performance score in PHAB accreditation, no apparent association between the type of governance structure under which an LHD operates and performance scores in PHAB accreditation standards. **Conclusions.** 1) Performance scores in PHAB accreditation can be a useful national standardized metric for assessing LHD ability to promote community well-being.

Smaller LHDs serving rural populations may require more targeted supports to boost their performance score. 2) Investment in FC could improve LHD performance score in PHAB accreditation standards. More importantly, how LHDs allocate the investment matters; a more evenly distributed Total FC allocation is associated with higher performance scores. 3) LBoHs with authority related to LHDs budget appear to have an influential role in budget-related activities and may improve LHDs' performance scores in PHAB accreditation standards. Vast variation in more specific LBoH roles and characteristics exists; thus, more research is needed to fully understand how the expanded LBoH authority over LHDs' budget-decision influences or benefits LHDs' performance scores in PHAB accreditation standards. Complex LHDs' characteristics have a relationship with their performance in PHAB accreditation scores. Understanding these relationships can allow evidence-based strategies for which PH leaders and policymakers need for a targeted intervention to support improved LHDs' performance in PHAB accreditation standards.

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DEDICATION

To my Redeemer, my Anchor, my Rock, and my Helper, who gives me the will, the strength,
and the grace.

To my beloved husband who supported me to succeed in this program.

To our children, Mercy, Grace, and Joy, who shower me with love and fun, and inspire me as
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CHAPTER 1: INTRODUCTION

BACKGROUND

The mission of the public health (PH) system in the United States is to promote population health by creating healthy conditions for all communities through the three core PH functions – assessment of population health, assurance of accessible and equitable health resources, and development of PH policies.^{1, 2} The core PH functions are operationalized by executing programs and activities through the ten essential PH services.¹⁻³ Within the PH system, local health departments (LHD) are the frontline actors directly responsible for executing the PH mission at the local level.⁴⁻⁷ Therefore, effectiveness of LHDs in providing the essential PH services – that is, to protect community health, respond to public health crises such as SARs, Opioid abuse, and the COVID-19 pandemic, and to assure health equity across all local communities – is crucial to population health.

There are significant variations among LHDs in the United states,⁸⁻¹⁰ in terms of their organizational characteristics, cross-cutting infrastructure capabilities, and their ability to provide the essential public health services.¹¹⁻¹³ These variations contribute to unequal performance among LHDs, and variation in community access to public health services across jurisdictions.^{11, 12, 14-18} For example, response to the COVID-19 outbreak varies dramatically across US jurisdictions. PH experts noted the reasons for the variation were in part due to chronically low funding of health departments, which has caused a crumbling PH infrastructure and under preparedness for the pandemic.¹⁹⁻²¹ Besides the characteristics of the agency themselves and funding availability for building core capacities, research has also showed that variations in LHDs' performance might be influenced by the characteristics of their jurisdiction and their governing authority.^{11, 12, 14, 22}

To address the variation and help LHDs perform at their best, there is a need for adequate and effective PH infrastructure, support for ongoing quality improvement, and a standardized performance assessment framework to guide LHDs quality improvement efforts.²² Research suggests that optimizing the infrastructure of LHDs such as their core capabilities, financial resources, and organizational structure can lead to improved performance in delivery of PH essential services, which in turn can produce better community health outcomes.^{22, 23} A performance measurement system built on a common set of standards against which health departments can be measured is, thus, crucial to the effort of promoting quality improvement among LHDs.

PH leaders and researchers have long been interested in measuring LHDs' performance and its implications for population health. Efforts in the '90s and early 2000s to conceptualize and measure LHDs' performance led to some well-known, early performance management initiatives such as the National Public Health Performance Standards Program (NPHPSP)^{24, 25} and the Turning Point Performance Management Framework.^{26, 27} Nevertheless, measuring LHDs' performance remained a challenge because evidence-based information using standardized performance data to inform targets for LHDs' quality improvement had not been established.²⁸⁻³³ Unlike in medical care where performance standards have become routine, often involving the Joint Commission on the Accreditation of Health Care Organization (JCAHCO),³⁴ a lack of agreed-upon standards or performance targets had hindered performance evaluation in public health.³⁰ In addition, wide variations in LHDs' data structures and reporting systems often hinder comparative assessment of LHDs' performance across jurisdictions.^{32, 33} Individual LHDs' data are usually unstructured and scattered across many systems,^{35, 36} as reflected in

previously reported studies,^{23, 37, 38} where public health agencies' financial comparability and performance practices across jurisdictions vary widely and are unable to support a robust comparative analysis.

In the last decade, public health leaders and researchers have emphasized the development of standardized PH data to support evidence-based policy development and interventions in public health practice.³⁹⁻⁴¹ Measures of the structural capacity of the public health system now exist and related data are available from The National Association of County and City Health Officials (NACCHO).⁴² Similarly, the establishment of Public Health Accreditation Board (PHAB) accreditation now makes it possible to understand not just which LHD is seeking the opportunity to demonstrate their performance but also how best to conceptualize LHDs' performance based on specific standards.⁴³⁻⁴⁶ Likewise, the development of a uniform chart of accounts (UCOA) by the Public Health Activities and Services Tracking (PHAST) team is enabling a standardized system of accounting that allows for comparability of expenditures, revenues, and services of LHDs across jurisdictions.^{35, 47, 48}

Recently, PH leaders and researchers have also introduced a foundational public health services (FPHS) framework in support of the effort to benchmark LHDs performance.²² The FPHS framework recommended foundational capabilities and foundational services as a basic set of programs and activities that should be maintained by all health departments.^{49, 50} Foundational capabilities are the cross-cutting skills and capacities needed to support basic public health protections and other programs and activities that are key to ensuring the community's health and achieving equitable health outcomes.^{49, 51} Foundational capabilities are the engine that drives foundational services (essential program and activities including communicable disease and control; chronic disease and prevention; injury prevention, environmental public health, maternal

child and family health, access to and linkage to clinical care, and others – that often include additional program areas of specific significance to a community’s health).⁵¹

Some of these nationally recognized organizations and initiatives – NACCHO, PHAB, and FPHS – provide a framework for common indicators that did not previously exist for benchmarking public health practice performance, but their utility for assessing LHDs’ performance has not been well-demonstrated. The objective of this dissertation is to demonstrate the use of the PHAB accreditation standards as an instrument for measuring LHDs’ performance. PHAB accreditation was conceived in 2004 and formally launched in 2011, with support from the Centers for Disease Control and Prevention (CDC) and the Robert Wood Johnson Foundation, as a national voluntary accreditation program for public health departments. Since 2011, PHAB has been advancing the quality and performance of public health departments in the United States by recognizing health departments that meet standards designed to foster continuous quality improvement.⁵²⁻⁵⁴ The PHAB standards, built on the three core PH functions and the ten essential PH services, identify opportunities to improve management, develop leadership, and advance relationships within the community.^{55, 56} Several reports have demonstrated that PHAB is encouraging LHDs’ commitment to quality improvement, performance management, accountability, transparency, and the capacity-building to deliver the essential public health services.^{43, 57-60} Therefore, the PHAB accreditation standards could support our understanding of how various characteristics of LHDs such as their jurisdiction characteristics, core capabilities, financial resources, and their governance authority relate to their performance in PHAB accreditation, and enable assessment of the capacity of LHDs to carry out their core PH functions.

The alignment and mutual relationship between the FPHS framework and PHAB accreditation also provide a means to assess how the foundational capabilities relate to LHDs' performance in PHAB accreditation.^{22, 61} The majority of PHAB accreditation standards and measures demonstrate LHDs' performance in providing core PH functions that support the health and well-being of their community. Foundational capabilities are built on core public health functions (assessment, policy development, and assurance) and relate to the LHDs' performance in PHAB accreditation through direct linkage with PHAB standards and measures that determine LHD capacity and core functions.

Relevance of Dissertation

This dissertation presents a novel approach that uses PHAB accreditation standards, for the first time, to assess LHD's performance in relation to their jurisdiction characteristics, financial allocations, and organizational structure. Understanding LHDs' aggregate performance in relation to PHAB accreditation can provide guidance for where LHDs may need more support to meet the accreditation criteria. Information about their performance scores in specific PHAB standards can reveal areas where LHDs lack proficiency and where targeted interventions for performance improvement are most needed. These insights will enable PH leaders and policymakers to employ systematic interventions that can go beyond individual LHDs' efforts to attain accreditation, and that more effectively promote equity across jurisdictions and support the ultimate mission of promoting, restoring, and protecting the well-being of the community.

The current COVID-19 pandemic has shown that the public health system capacity has been grossly under-resourced and under-prepared to address a national PH crisis, underscoring the need for an effective PH infrastructure for maximum LHD performance.^{19, 22} As a result, this

dissertation research is timely and of great interest among PH leaders and policy makers nationally. It is also important to nursing science as a significant contribution to promoting effective resource allocation, related health equity, population health improvement, and informed public health policy discussions. Understanding what is needed to support a more effective and high-performing PH system is a social policy issue that impacts the general health and well-being of communities across the U.S., and particularly the marginalized communities that are most often served by the least well-resourced and most poorly performing health departments.

Theoretical Framework

Similar to previous studies of PH performance, this research is based on Donabedian's classic quality of care model, which consists of three components: (1) structural quality, (2) process quality, and (3) outcome quality.^{29, 30, 62} The model stipulates that quality information can be obtained from each of the components and that structural quality makes processes possible, and process quality, in turn, leads to improved health outcomes.⁶² Handler et al.⁶³ expanded Donabedian's model with the argument that the measurement of PH system performance should include the macro context, along with the overall PH purpose and mission, in addition to PH structural capacity, process, and outcomes. Handler's expansion of Donabedian's framework allows the interaction of macro context, PH mission, structure, process, and outcome.⁶³ Handler's model has been previously adapted to study factors that are associated with local public health agency' performance improvement in North Carolina.³¹ The framework, by Hajat et al. (2009) considers an LHD's mission and purpose as distinct from the overall mission and purpose of the larger PH system. In addition to the triad structure-process-outcome

interactions, Hajat's framework indicates that performance information from structure and process can provide evidence of health outcome.³¹

For this research, I adapted both the Handler and Hajat models to create a model for assessing LHDs' performance in PHAB accreditation (Figure 1-1). The model consists of six components: macro context, structure, process, output, outcome, and PHAB accreditation standards, that are in dynamic interaction with each other. The macro context includes the characteristics of the jurisdiction that LHDs serve. LHD structure includes their mission and purpose, governance structure, and organizational capacity that can be achieved through available resources (including fiscal resources). The process component relates to implementation of foundational capabilities necessary to deliver foundational services. Outputs are foundational services provided by LHDs, and outcomes are community health status. In the model, the PHAB accreditation component is the measurement instrument. Theoretically, performance information can be obtained from structure, process, output, or outcome. However, a combination of the structure and process components provides more direct information about PHAB performance since PHAB standards are indicators of the three core PH functions and the ten essential PH services.

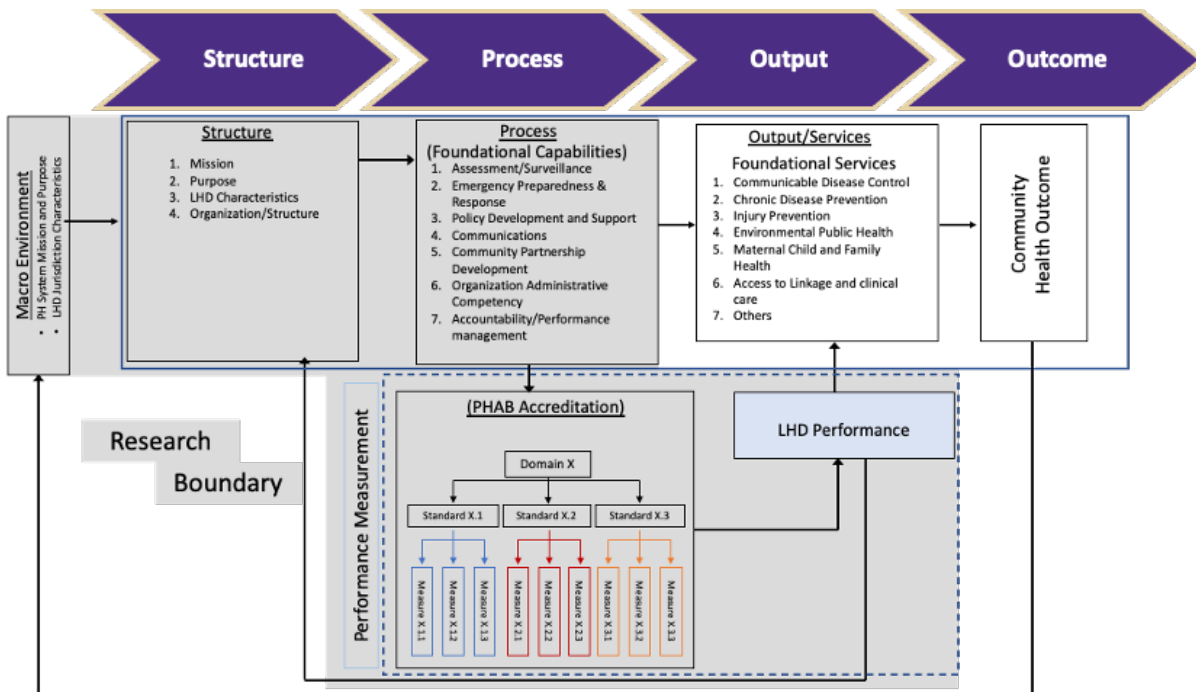


Figure 1-1: Conceptual framework for assessing LHD performance in PHAB Accreditation Standards

Objectives

The primary objective of this study is to understand LHDs' ability to carry out the essential PH functions as measured by their performance scores in public health accreditation standards in relation to their organizational and jurisdiction characteristics, expenditures in foundational capabilities (corresponding to core capability infrastructures), and governance structure. Therefore, this study has three main aims, each is a scholarly paper represented as chapter in this dissertation. The study aims are as follow:

1. To identify clusters of accredited LHDs, based on variations in their performance scores in PHAB accreditation standards, and how these performance clusters relate to LHDs' characteristics (governance structure, leadership and jurisdiction characteristics).

2. To examine the association between the amount of total Foundational Capabilities expenditures and specific Foundational Capabilities allocations, and LHD performance scores in PHAB accreditation standards.
3. To examine the association between LHDs' local board of health (LBoH) authority on LHDs' budget-related activities and LHDs' performance scores in PHAB accreditation.

Structure of the Dissertation

This dissertation contains three main papers that aim to address each of the study objectives. The first paper is a cluster analysis that examines variation in LHDs' performance scores in PHAB accreditation relative to their organizational and jurisdiction characteristics. The aim of the study was to identify and group LHDs with similar performance scores in PHAB accreditation standards and to characterize each LHD cluster group's organizational structure, jurisdiction characteristics, and core public health function activity levels. The second paper is a cross-sectional secondary data analysis of the association between LHD total Foundational Capabilities expenditures, as well as Foundational Capabilities funding allocation pattern, and performance scores on related PHAB standards. The primary purpose of the first and second papers is to understand the relationship between LHDs' characteristics associated with performance scores in PHAB accreditation standards to help inform evidence-based policy for improved LHDs performance. The third paper is a cross-sectional secondary data analysis of the association between LHDs' LBoH authority on LHDs' budget-related activities and their performance scores in the PHAB standards, while considering the governance structure under which the agencies operate. The goal of this third paper is to understand level of LBoH authority

over budget that will maximize LHDs performance scores in PHAB accreditation standards. Together, these papers present novel methods of understanding LHDs' performance in their core PH functions and essential PH services, dynamic relationships that exist in LHDs' characteristics, their core capabilities investments and the allocation pattern of the investments, and their governance. The implications of these relationships for an LHD's performance are examined to address knowledge gaps in our understanding for evidence-based strategies and policy that support LHD performance.

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CHAPTER 2: LOCAL HEALTH DEPARTMENTS' CHARACTERISTICS AND THEIR PERFORMANCE SCORES IN PHAB ACCREDITATION STANDARDS

Local Health Departments' Characteristics and Their Performance Scores in PHAB Accreditation Standards

ABSTRACT

Local health departments (LHDs) function at the local level to promote and protect population health by executing programs and activities through the ten essential PH services in operationalization of the three core functions of PH systems – assessment, policy development, and assurance. Public Health Accreditation supports LHDs by assessing their ability to promote community well-being through a set of standards and measures based on the ten essential public health services. Prior studies show variation in LHD characteristics relative to likelihood of participating in accreditation, but no studies have examined the variation in LHD accreditation scores to understand how specific areas and interventions relate to performance improvement. This work examines variation in LHD accreditation score relative to their organizational and jurisdiction characteristics. **Sample:** Cross-sectional data were obtained from 250 LHDs from 38 states that underwent PHAB accreditation review. **Analysis:** I used exploratory cluster analysis to identify and group LHDs with similar performance scores in PHAB accreditation standards. Descriptive analyses were undertaken to characterize each LHD cluster group's organizational structure, jurisdiction characteristics, and core public health function activity levels. **Results:** Three clusters emerged showing a range in PHAB accreditation performance scores (Cluster 1 = 0.95, Cluster 2 = 0.87, Cluster 3 = 0.71) and differences in organizational and jurisdiction characteristics across clusters, notably in size of jurisdiction served. LHDs in Cluster 3 tended to serve rural populations and serve more than one county. **Conclusions:** Performance scores in PHAB accreditation can be a useful national standardized metric for assessing LHD ability to promote community well-being. Smaller LHDs serving rural populations, who exhibit relatively

lower performance when compared with other LHDs, may require more targeted supports to close the gap in their performance score.

Key words: Local health departments, public health accreditation, performance score, public health infrastructure, population health.

BACKGROUND

LHDs work at the local level to promote and protect population health by executing programs and activities^{1, 2} that support the PH system's mission and purpose as operationalized by the three core PH functions – assessment, policy development, and assurance,³ and the ten essential PH services (APPENDIX I-C2).⁴ Evidence suggests that inequities exist in access to PH programs and services because of the variations in LHDs' performance in delivery of the core PH functions.⁵⁻⁷

Variation in PH performance has generated interest among PH leaders in how to measure LHD performance in delivering PH core functions and in identifying LHD characteristics that affect their performance.⁸⁻¹¹ The interest in LHD performance grew from the notion that effective performance of LHDs is crucial to the PH system^{6, 7, 12} and that population health should thrive when LHD performance is maximized.¹³ This assumption follows Donabedian's classical theory of quality assessment, stipulating that when the structure and the process of care delivery are good, the outcome is likely to be good.^{9, 10, 14, 15} As a result, PH researchers and practitioners continue to explore ways to assess LHDs' performance in the delivery of core PH functions and implement evidence-base quality improvement interventions.¹⁶⁻²⁰

Accreditation for health departments, as overseen and operationalized by the Public Health Accreditation Board (PHAB) serves as the nation's voluntary process to assess LHD performance and promote quality improvement within the PH system in the United States. PHAB standards and measures define expectations and assess health departments' capacity and proficiency to carry out core PH functions³ and the ten essential PH services.^{4, 4, 21} Studies report on the potential that PHAB accreditation has to transform public health practice and improve public health agency capabilities to deliver the ten essential PH services.²²⁻²⁴ For example,

benefits regarding performance management, quality improvement, accountability, and transparency have been associated with accreditation,²⁴⁻²⁷ as well as in areas such as resource planning,²⁸ community engagement,^{24, 29} and the ability to identify and address gaps in workforce training and development.²⁴

Despite these benefits, a majority of health departments have not been accredited.³⁰ In all of the approximately 2400 LHDs in the United States, only about 12% of them have been accredited at the time when data for this study were obtained.^{30, 31} Many studies of PHAB accreditation have revealed variation in aspects of the accreditation process, such as decisions regarding pursuing accreditation and preparation for accreditation; leading to variability in LHDs pursuing and participating in accreditation^{16, 23, 32-38} because of factors such as organizational and jurisdiction characteristics,³⁹ LHD size,^{31, 40} resources and time needed for the accreditation process,^{31, 41} type of governing structure,^{40, 41} perception of inadequacy to tackle accreditation demands and fear of underperforming,^{41, 42} and lack of will to invest in the process because perceptions that the effort exceeds the benefits.^{38, 41} However, among accredited LHDs, data show there is also variation in accreditation performance score.^{30, 43} No known study has examined LHD accreditation performance score variation in relation to LHD characteristics.

Understanding LHD characteristics according to accreditation performance scores can provide insight into ways PH leaders can support LHDs in the accreditation process or in even embarking on the accreditation process. This insight could also enable objective information for LHD leaders' decision-making in navigating the accreditation process and, thus, support evidence-based strategies for optimizing performance outcomes in the PHAB accreditation assessment and potential subsequent quality improvement interventions that impact community health.

Therefore, this study aims to: 1) to identify clusters of accredited LHDs based on variations in their performance scores in PHAB accreditation standards, and 2) to describe how the variation in their performance related to LHDs' characteristics (governance structure, leadership and jurisdiction characteristics) in the identified clusters.

METHODS

I employed exploratory cluster analysis to identify the structure of LHDs' performance scores in PHAB accreditation standards. Descriptive analysis was then undertaken to characterize the LHDs in each cluster group based on their organizational structure, jurisdiction characteristics, and activities in core public health functions. This study did not involve human subjects, hence did not require institutional review board review.

Data

This study used a cross-sectional dataset of 250 LHDs from 38 states that had completed PHAB⁴⁴ accreditation by March 31, 2020 and had also participated in the 2016 National Association of County and City Health Officials (NACCHO) Profile of Local Health Departments survey.⁴⁵ Accreditation data (performance scores, versions, and year of accreditation) were obtained from PHAB.⁴³ LHD characteristics were obtained from the 2016 NACCHO Profile which had a national response rate of 76%.⁴⁶ LHD characteristics included: governance structure, local board of health (LBoH) authority, education level of LHD lead executive, number of jurisdictions served, and whether an LHD provides specific selected activities that support the core PH functions (PH Programs and Services). The LHDs' characteristics included were based on prior research suggesting that they are related to LHDs' performance.^{35, 37, 47} LHDs' jurisdiction population size data were from the US Census Bureau.⁴⁸

Measures

Performance Score in PHAB Accreditation Standards

PHAB data categorize LHDs based on their proficiency across a variety of accreditation standards and measures reflecting the ten essential PH services. PHAB data include information for the domains, standards, measures, accreditation version (version 1.0 or version 1.5), accreditation status, and the score for each measure (labeled as “final_score” in PHAB data).²¹ Domains are the groups of standards that relate to a broad group of public health services, including management and administration, and governance.^{21, 49, 50} Standards are the required level of attainment that an LHD is expected to meet within a domain.^{21, 51} There are 12 domains and a total of 32 standards, with at least two standards in each domain. Measures are the metrics for evaluating proficiency in a specific standard, with at least two measures in each standard. An LHD is ranked in each measure on an ordered nominal scale of 1 – Not Demonstrated, 2 – Slightly Demonstrated, 3 – Largely Demonstrated, and 4 – Fully Demonstrated.²¹ For analysis, the score for each measure was transformed to a numerical scale by assigning 0.25 to represent a unit level on the Likert scale, such that a score of 0.25 is equivalent to Not Demonstrated and a score of 1.0 is equivalent to Fully Demonstrated. Performance score in a specific standard was defined as the average of scores in all measures for that standard. The final data for the cluster analysis contained 250 accredited LHDs. The descriptive analysis was based on the sample of these 250 accredited LHDs that participated in 2016 NACCHO Profile (n = 218).

Table 2-1 lists a summary of PHAB accreditation domains and standards version 1.5. Comprehensive descriptions of PHAB domain, standards, and measures version 1.0 and version 1.5 are available elsewhere.^{52, 53} There is no major difference in the structures of the versions.

Table 2-1: PHAB accreditation domains and standards compositions. D denotes PHAB domain, S denotes PHAB standards.

Domain	Domain Description	Standards	Standard Description	Derived Domain/Standard Index
1	Conduct and Disseminate Assessments Focused on Population Health Status and Public Health Issues Facing the Community	1.1	Participate in or lead a Collaborative Process Resulting in a Comprehensive Community Health Assessment	D1S1
		1.2	Collect and maintain reliable, comparable, and valid data that provide information on conditions of public health importance and on the health status of the population.	D1S2
		1.3	Analyze public health data to identify trends in health problems, environmental public health hazards, and social and economic factors that affect the public's health.	D1S3
		1.4	Provide and use the results of health data analysis to develop recommendations regarding public health policies, processes, programs, or interventions.	D1S4
2	Investigate Health Problems and Environmental Public Health Hazards to Protect the Community	2.1	Conduct Timely Investigations of Health Problems and Environmental Public Health Hazards	D2S1
		2.2	Contain/Mitigate Health Problems and Environmental Public Health Hazards	D2S2
		2.3	Ensure Access to Laboratory and Epidemiologic/Environmental Public Health Expertise and Capacity to Investigate and Contain/Mitigate Public Health Problems and Environmental Public Health Hazards	D2S3
		2.4	Maintain a Plan with Policies and Procedures for Urgent and Non-Urgent Communications	D2S4
3	Inform and Educate about Public Health Issues and Functions	3.1	Provide Health Education and Health Promotion Policies, Programs, Processes, and Interventions to Support Prevention and Wellness	D3S1
		3.2	Provide Information on Public Health Issues and Public Health Functions Through Multiple Methods to a Variety of Audiences	D3S2
4	Engage with the Community to Identify and Address Health Problems	4.1	Engage with the Public Health System and the Community in Identifying and Addressing Health Problems through Collaborative Processes	D4S1
		4.2	Promote the Community's Understanding of and Support for Policies and Strategies that will Improve the Public's Health	D4S2

5	Develop Public Health Policies and Plans	5.1	Serve as a Primary and Expert Resource for Establishing and Maintaining Public Health Policies, Practices, and Capacity	D5S1
		5.2	Conduct a Comprehensive Planning Process Resulting in a Tribal/State/Community Health Improvement Plan	D5S2
		5.3	Develop and Implement a Health Department Organizational Strategic Plan	D5S3
		5.4	Maintain an All-Hazards Emergency Operations Plan	D5S4
6	Enforce Public Health Laws	6.1	Review Existing Laws and Work with Governing Entities and Elected/Appointed Officials to Update as Needed	D6S1
		6.2	Educate Individuals and Organizations on the Meaning, Purpose, and Benefit of Public Health Laws and How to Comply	D6S2
		6.3	Conduct and Monitor Public Health Enforcement Activities and Coordinate Notification of Violations among Appropriate Agencies	D6S3
7	Promote Strategies to Improve Access to Health Care	7.1	Assess Health Care Service Capacity and Access to Health Care Services	D7S1
		7.2	Identify and Implement Strategies to Improve Access to Health Care Services	D7S2
8	Maintain a Competent Public Health Workforce	8.1	Encourage the Development of a Sufficient Number of Qualified Public Health Workers	D8S1
		8.2	Ensure a Competent Workforce through Assessment of Staff Competencies, the Provision of Individual Training and Professional Development, and the Provision of a Supportive Work Environment	D8S2
9	Evaluate and Continuously Improve Processes, Programs, and Interventions	9.1	Use a Performance Management System to Monitor Achievement of Organizational Objectives	D9S1
		9.2	Develop and Implement Quality Improvement Processes Integrated into Organizational Practice, Programs, Processes, and Interventions	D9S2
10	Contribute to and Apply the Evidence Base of Public Health	10.1	Identify and use the Best Available Evidence for Making Informed Public Health Practice Decisions	D10S1
		10.2	Promote Understanding and Use of the Current Body of Research Results, Evaluations, and Evidence-based Practices with Appropriate Audiences	D10S2
11	Maintain Administrative and	11.1	Develop and maintain an Operational Infrastructure to Support the Performance of Public Health Functions	D11S1

	Management Capacity	11.2	Establish Effective Financial Management Systems	D11S1
12	Maintain Capacity to Engage the Public Health Governing Entity	12.1	Maintain Current Operational Definitions and Statements of the Public Health Roles, Responsibilities, and Authorities	D12S1
		12.2	Provide Information to the Governing Entity Regarding Public Health and the Official Responsibilities of the Health Department and of the Governing Entity	D12S2
		12.3	Encourage the Governing Entity's Engagement in the Public Health Department's Overall Obligations and Responsibilities	D12S3

LHD Governance Structure Index

I derived multicomponent measure of LHD Governance Structure from the 2016 NACCHO Profile by generating index numbers representing different compositions of governance structures. Table 2-2 shows the composite index for governance structures generated from different combinations of governance class (1- State governed, 2-Standalone [independent of the state], 3-Mixed governance); from if the LHD operates under a health and human service agency (1 - Yes, 0 - No); and from if the LHD has a local board of health (1- Yes, 0 - No). The composite structures present a comprehensive combination of governance categories that may exist in LHDs. The characteristics of the composite governance structures, with respect to total PH expenditures, were found to be consistent with previously reported LHDs' characteristics.⁵⁴

⁵⁵ (APPENDIX II-C2)

Table 2-2: Composite governance structure derived from NACCHO Profile 2016				
Governance Class	Under Health and Human Services	Local Health Board	Composite Governance Structure Index	Description of the Composite Structure Index
1	1	1	111	State control, Under Health and Human Services, Has Local Board of Health
1	1	0	110	State control, Under Health and Human, No Local Board of Health
1	0	1	101	State control, Not Under Health and Human, Has Local Board of Health
1	0	0	100	State control, Not Under Health and Human, No Local Board of Health
2	1	1	211	Standalone, Under Health and Human, Has Local Board of Health

2	1	0	210	Standalone, Under Health and Human, No Local Board of Health
2	0	1	201	Standalone, Not Under Health and Human, Has Local Board of Health
2	0	0	200	Standalone, Not Under Health and Human, No Local Board of Health
3	1	1	311	Mixed, Under Health and Human, Has Local Board of Health
3	1	0	310	Mixed, Under Health and Human, No Local Board of Health
3	0	1	301	Mixed, Not Under Health and Human, Has Local Board of Health
3	0	0	300	Mixed, Not Under Health and Human, No Local Board of Health
Governance Class 1 – State control 2 – Standalone 3 – Mixed		Under Health and Human Services 1 – Yes 0 – No	Has Local Board of Health 1 – Yes 0 – No	

Local Board of Health (LBoH) Authority

LBoH authority (Authority) was defined as the number of actions under the control of a LBoH for each LHD in the sample. This is described in the 2016 NACCHO Profile as a list of actions that a LBoH has final authority to do (Table 2-3).

Table 2-3: Action areas under LBoH authority derived from the 2016 NACCHO Profile; Section: Jurisdictions and Governance, No. 5	
• Hire or fire agency head • Approve the LHD budget • Adopt public health regulations • Set and impose fees • Impose taxes for public health • Request a public health levy • Advise LHD or elected officials on policies, programs, and budgets • Set policies, goals, and priorities that guide the LHD • Impose or enforce quarantine or isolation orders • Other Areas	

Education level of LHD lead executive and number of jurisdictions served

Education level of the leader of each LHD were categorized as 1 – Doctorate or equivalent, 2 – Masters or equivalent, 3 – Bachelor or equivalent, 4 - Associate degree or equivalent.

Public Health Programs and Services

Public health programs and services are the health promotion and improvement programs and services LHDs provide to serve their jurisdictions. These programs and services are based on the three PH core functions – assessment, policy development, and assurance, and the ten essential health services.^{3,4} The list of programs and services, depicted as activities in the 2016 NACCHO Profile, were used to characterize clusters of LHDs.

Jurisdictions' Characteristics

Population size indicates the number of people in the jurisdictions served by an LHD. Population size was categorized based on the 2013 Rural-Urban Continuum Codes classification. The classification scheme distinguishes metropolitan counties by the population size of their metro area, and nonmetropolitan counties by degree of urbanization and adjacency to a metro area.⁵⁶ Using this classification, I grouped counties into group 1 – population >1 million; group 2 – between 500,000 - 1 million; group 3 – between 20,000 - 249,999, and group 4 – <20,000. The number of jurisdictions served was depicted as the number of counties in an LHD jurisdiction.

Analyses

I applied *k*-means cluster analysis as an exploratory tool to group similar LHDs into clusters, based on the LHD's performance score in individual PHAB standards. Cluster analysis identifies the natural grouping of observations for forming mutually exclusive and collectively exhaustive classifications.⁵⁷ This approach minimized variation among the selected variables, identifying observations within a cluster that were similar to one another, even as they were different from observations in other clusters. For the *k*-means clustering, I used the Hartigan–Wong algorithm which is known to be both efficient and effective in assigning observations to the nearest cluster centroid.⁵⁸ Clusters were defined by *k* cluster centroids, and cluster

membership was determined by which cluster center was closest to the observation, if doing so minimized the total within-cluster sum of square.^{58, 59}

To determine the optimal number of clusters, I used the Elbow method,^{60, 61} which computes the total within-cluster sum of squares (WSS) as a function of the number of clusters, k . Optimal k is determined by the number that minimizes WSS. The optimum cluster number was found to be 3, which was consistent with the prediction by the gap statistics I performed⁶² and the average silhouette (silhouette) method.⁶³ I then used descriptive statistics to characterize LHDs in each of the clusters, based on their organizational structure, jurisdiction characteristics, and the percentage of LHDs offering PH programs and activities reported in 2016 NACCHO Profile. All data treatment and statistical analyses were performed in R Software package version 4.0.2.

RESULTS

PHAB Performance Descriptives

The LHDs in this study participated in PHAB accreditation from 2013 to 2019, during which there were two versions from which accreditation assessments were made – PHAB Standards and Measures version 1.0 and 1.5 (Figure 2-1). About 62% of LHDs were assessed based on Version 1.0. Figure 2-2 shows the PHAB score distribution by domains, standards, and measures. Although the majority of the LHDs were scored “Fully Demonstrated” (68%) for all of the measures and by version, the ratio of LHDs that scored “Fully Demonstrated” was observed to be lower for Version 1.5 (61%) than Version 1.0 (72%) with a corresponding increase in the lower ranking scores on the related measures. The performance scores in PHAB standards were numerical percentage points derived from transforming the measures scores from a categorical scale to a numerical scale. The histogram of the derived performance scores in the

standards was observed to show density distributions that were comparable to the distribution of the measure scores in the categorical scale (APPENDIX III-C2).

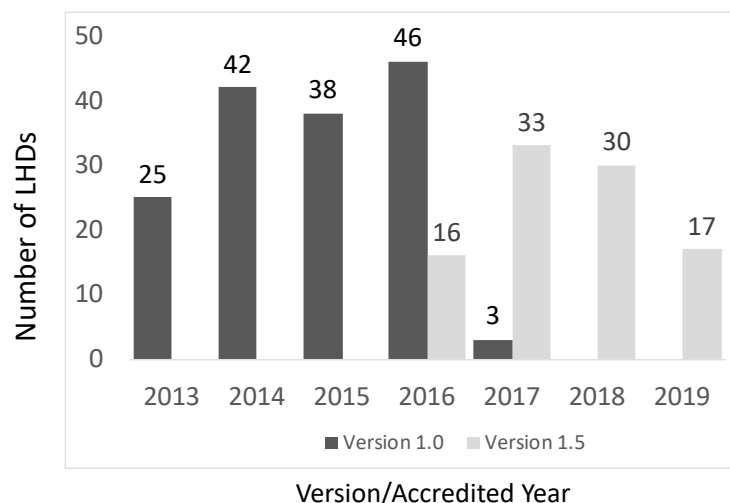


Figure 2-1: Number of LHDs that participated in in PHAB accreditation between 2013 and 2019 under version 1.0 and version 1.5

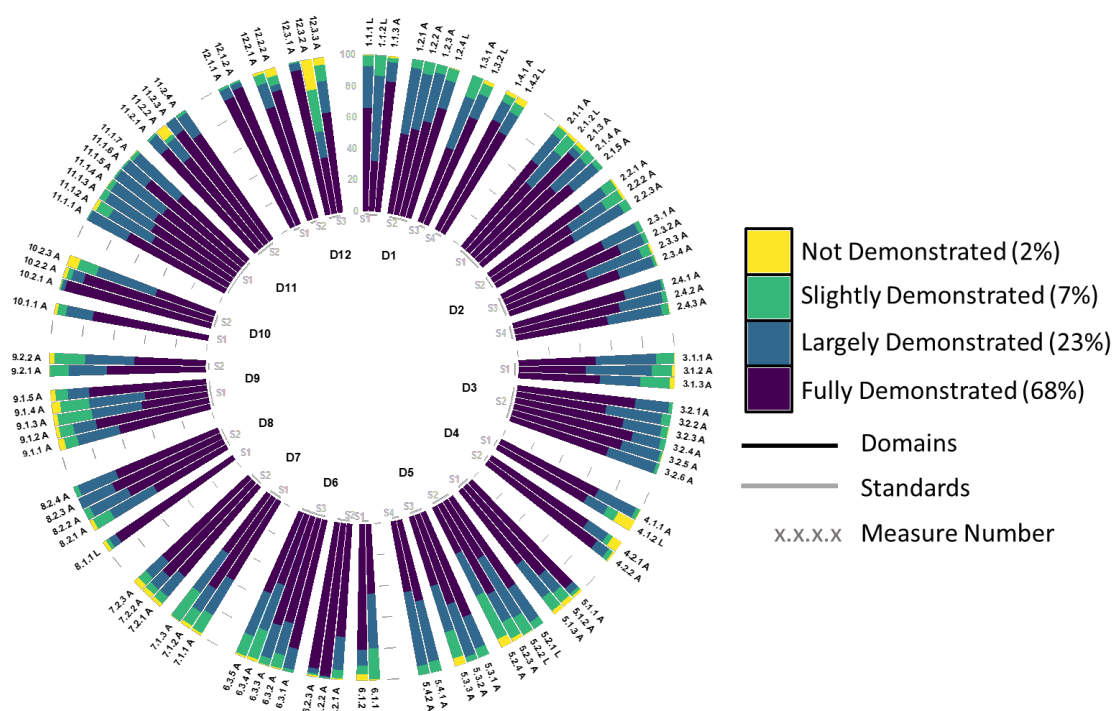


Figure 2-2: Distribution of LHD scores by domain, standards, and measures and percent of LHDs in each score rank.

Cluster Analysis

I identified 3 discrete clusters of LHD performance scores in all combinations of PHAB standards (Figure 2-3). Within each of the clusters in Figure 2-3, the violin shapes indicate the distribution of the LHDs' score in each standard and each dot represents a specific LHD. The most common of the clusters was Cluster 2, with 54% ($n = 135$) of LHDs in the sample present in this group. The second most common was Cluster 1, with 41% ($n = 103$) of LHDs. Cluster 3 represented only 5% ($n = 12$) of study LHDs. The mean and standard deviation of performance scores in the individual PHAB standards and their average are shown in APPENDIX IV-C2.

Cluster 1 includes LHDs with average standard performance scores of 0.95 ± 0.02 (High-performance group), Cluster 2 represents LHDs with average performance scores of 0.87 ± 0.04 (Medium-performance group), and Cluster 3 represents LHDs with average performance scores of 0.71 ± 0.06 (Low-performance group).

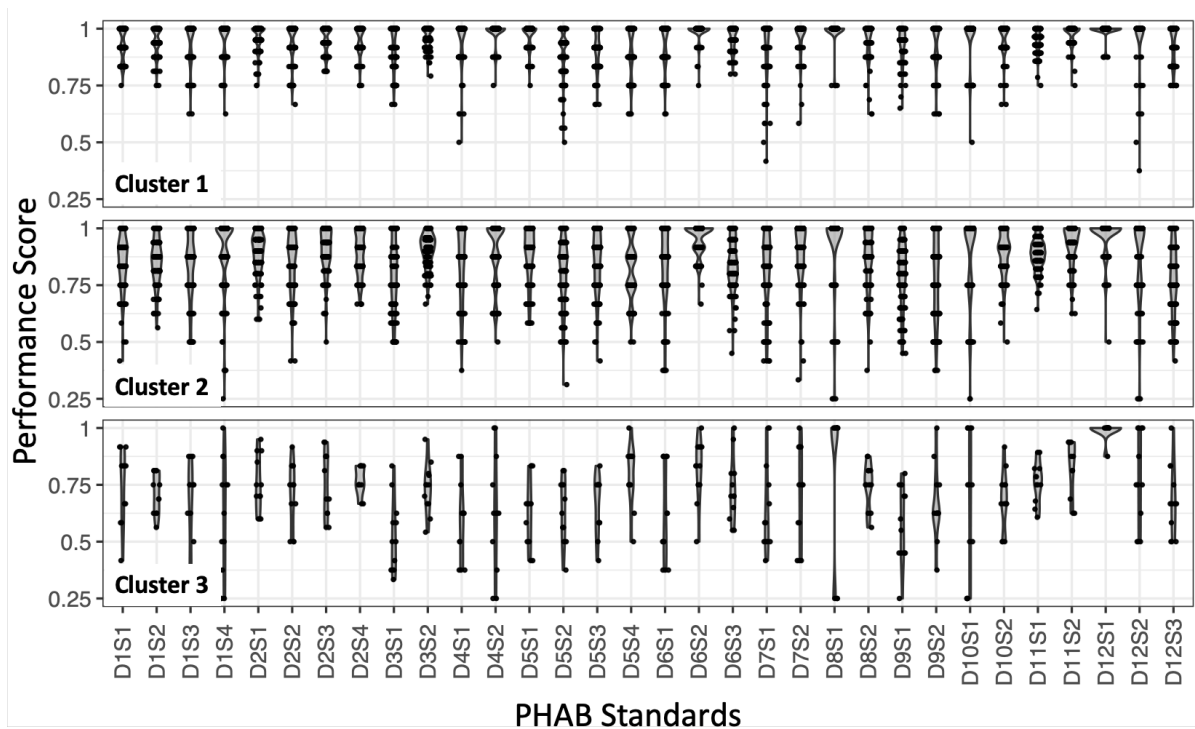


Figure 2-3: Performance score clusters and the distribution of scores for individual PHAB standards. Each dot represents a specific LHD, and the distributions of the LHDs are represented by the width of the violin shape. D denotes PHAB domain, S denotes PHAB standards.

Performance Score Cluster vs LHD Organizational Structure and Jurisdiction Characteristics

Table 2-4 depicts LHDs' organizational structures and jurisdiction characteristics, relative to the percentage of LHDs exhibiting each characteristic in each cluster. A mix of governance structure categories was observed for LHDs in Cluster 1 and Cluster 2 but LHDs in Cluster 3 appeared to primarily have a Standalone governance structure and, thus, independent of the state. The majority (58% – 78%) of LHDs in each cluster have governance structure 201. About 5% of LHDs in Cluster 1 and about 2% in Cluster 2 are State-controlled (governance structure categories 100 and 101 combined). Cluster 1 has about 10% of LHDs in governance structure category 301 and 311 combined. Cluster 2 has about 11% of LHDs in governance structure category 300, 301, and 311 combined. No State-controlled or Mixed governance classes were observed in Cluster 3. No major differences were observed in LBoH authority and education level of LHD lead executives across the three clusters. LHDs in Cluster 3 were also predominantly responsible for jurisdictions with less than 250,000 population and tended to serve 2 or more counties. Although the majority of LHDs in Cluster 1 and Cluster 2 also served this population size, there were still a substantial number (35% to 42%) of LHDs in Cluster 1 and Cluster 2 that served jurisdictions with populations 250,000 or more. There were 11% of LHDs in Cluster 3 with responsibility for jurisdictions with less than 20,000 populations, compared with 1% in Cluster 1 and 0% in Cluster 2.

Table 2-4: LHDs' organizational structures and jurisdiction characteristics			
	Cluster 1 (n=103)	Cluster 2 (n=135)	Cluster 3 (n=12)
LHD Governance Structure			
Class 100	2	1	0
Class 101	3	1	0
Class 110	0	0	0
Class 111	0	0	0
Class 200	14	11	11
Class 201	58	60	78
Class 210	5	4	0
Class 211	8	11	11
Class 300	0	1	0
Class 301	7	9	0
Class 310	0	0	0
Class 311	3	1	0
LBoH Authority			
Mean (SD)	4.5 (3.2)	4.5 (3.3)	4.9 (3.0)
No Authority (%)	23	20	11
Authority 1 to 5 (%)	26	29	45
Authority 6 to 10 (%)	51	51	45
LHD Executives Education Level			
Doctorate or equivalent (%)	1	0	0
Master or equivalent (%)	8	12	33
Bachelor or equivalent (%)	68	58	33
Associate or equivalent (%)	23	30	33
Jurisdiction Population Size			
Population group 1 (1M >) (%)	7	10	0
Population group 2 (250,000 -1M) (%)	28	32	0
Population group 3 (20,000 - 249999) (%)	64	58	89
Population group 4 (<20,000) (%)	1	0	11
Others			
Serving 1 county (%)	87	88	67
Serving 2 or more county (%)	13	12	33

Performance Score Cluster vs. LHDs' Programs and Services

Table 2-5 shows the Mean in percentage of LHDs in each cluster that reported performing activities in various community health services. The reported Mean represents the average of the subcategories of services under each of the higher-level categories of community health service listed in the NACCHO Profile and in Table 2-5. The number of subcategories in each service ranges from 2 to 20 (APPENDIX V-C2). Some LHDs in Cluster 3 were observed to have no apparent activities in some activities under Maternal and Child, Other Environmental Health Activities, Other Health Activities, and Other Activities.

Table 2-5: Mean (Range) in percentage of LHDs in each cluster that reported performing services/activities in various PH Programs			
	Cluster 1 Mean (min – max)	Cluster 2 Mean (min – max)	Cluster 3 Mean (min – max)
Treatment for Communicable Disease	67 (42 – 80)	63 (40 – 75)	58 (38 – 68)
Epidemiology and Surveillance Activities	83 (58 – 100)	70 (48 – 90)	61 (42 – 87)
Immunization	94 (94 – 95)	88 (87 – 90)	82 (77 – 86)
Maternal and Child	49 (14 – 86)	48 (9 – 75)	27 (0 – 59)
Other Environmental Health Activities	48 (22 – 88)	38 (9 – 84)	49 (0 – 84)
Other Health Services	28 (8 – 55)	26 (13 – 45)	17 (0 – 29)
Other Activities	38 (13 – 72)	34 (5 – 62)	21 (0 – 58)
Population-based Primary Prevention Activities	64 (26 – 92)	61 (29 – 86)	51 (23 – 78)
Regulation, inspection and/or Licensing	56 (6 – 89)	49 (9 – 84)	45 (17 – 76)
Screening for Diseases/Conditions	61 (33 – 95)	57 (32 – 87)	45 (19 – 88)

Performance Score Cluster vs. Capability Programs

The three clusters were also compared based on the percentage of LHDs in each cluster and the number of activities in each of the broad capability programs that represent an agency's foundational capacity (Emergency Preparedness, Community Health Assessment and Planning, Partnership and Collaboration, Policy Making and Advocacy, Health Disparities, and Quality Improvement). These programs relate to their capability to respond effectively during a PH crisis and to function effectively in their daily activities when there is no crisis.⁴⁹ The comparisons of each cluster based on the percentage of LHDs that reported providing activities for each capability program and the actual percentage values with respect to the number of activities they provided are reported in APPENDIX VI-C2. The results showed about equal performance for each cluster in all program areas except in the area of activities conducted to address health disparities, where Cluster 3 tended to perform slightly lower.

DISCUSSION

This study demonstrated the use of specific performance scores in PHAB accreditation standards as a means for comparative study of LHDs' that goes beyond accreditation status alone. By examining the aggregate score distributions for all PHAB measures, LHD scores were predominantly "Fully Demonstrated", suggesting most LHDs met the criteria in PHAB measures. This suggests that PHAB accreditation appears to be achieving its aims of promoting high performance and continuous quality improvement among LHDs and supports prior research regarding accreditation efforts and agency performance.^{24, 64}

However, stratifying the scores in all the measures by the versions on which accreditation was based showed a subtle difference. Those accredited under version 1.0 appear to have more

“Fully Demonstrated” scores than those accredited under version 1.5. The disparity in score distribution between the versions could be because those accredited earlier under version 1.0 may have had more resources to pursue early accreditation and, thus, support their PH efforts, in general. It may also indicate they provided a greater mix of programs and services which led to better performance. Studies have shown that LHDs that provide a mixed portfolio of services were more likely to pursue PHAB accreditation earlier than those that did not.^{31, 54}

The performance clustering approach in this study allowed for an innovative means to conduct a comparative assessment of performance among LHDs, that has not otherwise been described in the literature. The three clusters of LHDs identified and examined revealed subtle differences in the aggregate (Mean of scores in all standards) performance scores in PHAB standards. Although the aggregate performance score provides a general overview of which LHDs may need more support to meet the accreditation criteria, identifying the specific PHAB standards in which they lack proficiency is even more valuable to facilitate targeted interventions for performance improvement in areas where support is most needed. Most LHDs in the sample (95%) belonged to Cluster 1 and Cluster 2 which demonstrated strong performance (>80% performance score) in most of the individual PHAB Standards. LHDs that fell into Cluster 3 were observed to perform relatively lower (<80% performance score) in many of the individual PHAB standards except in four standards (D6S2, D8S1, D11S2, and D12S1). Having this standard specific performance information across different groups of LHDs could be a useful tool for PH leaders, practitioners and researchers to formulate and implement an effective system-based quality improvement process, focused on these standards. Such systematic intervention could go beyond individual LHDs’ efforts to attain accreditation and more

effectively promote equity across jurisdictions and support a main goal of the PHAB model “to achieve greater equity in PH capacity.”⁶⁵

The analyses also described the organizational and jurisdiction characteristics of the LHDs in each of the clusters in the sample. These characteristics have been shown to be associated with whether LHDs were involved in accreditation or not.^{29, 36, 38-40, 66} For example, LBoH authority, LHDs’ governance structure, and LHDs’ jurisdiction population have been associated with LHDs’ decision to participate in PHAB accreditation.^{29, 38, 40} Therefore, these characteristics may be similarly important for understanding the factors that could affect the performance score of LHDs who have completed accreditation assessments in each of the standards. However, many of these characteristics examined did not show significant variation between the clusters except in their jurisdictions’ population size. The analyses showed that LHDs in Cluster 3 tended to serve rural populations and are probably smaller in size. Previous research has indicated that small rural LHDs could use more support to enhance their resources and capacity in order to meet PHAB accreditations criteria.^{31, 67} Nevertheless, some relatively small LHDs are also performing strongly in PHAB accreditation, as suggested by the percentage of LHDs serving <250,000 population size in Cluster 1 (65%), providing an opportunity to learn from the strategies of these smaller agencies. LHDs in Cluster 3 were also more likely to serve more than one county, which may place an extra burden on their resources and capabilities, and possibly translate to a low performance score in PHAB accreditation.

Evidence shows that health departments that are better performing in carrying out the essential PH services are more likely to participate and do well in PHAB accreditation assessments.^{31, 68, 69} Fully-demonstrated scores in PHAB accreditation measures could be seen as evidence of more PH services and thus better service to communities. Disproportionate

community access to PH services results when LHDs fall behind in the service provision to meet the needs of their communities to the fullest, a condition that could exacerbate community health disparities.^{7, 13} Surprisingly, comparing the three clusters based on the programs and services they provide did not reveal major variation, however. While the mean of LHDs in all of the PH programs and activities examined appeared to be lower for Cluster 3, compared to the other two Clusters, it was not apparent that Cluster 3 LHDs were considerably underperforming in those PH services. A marginal variation in the percentage of LHDs providing activities to address health disparities suggested that LHDs in Cluster 3 tended to provide less activities to address health disparity in their community than LHDs in Cluster 1 and Cluster 2. Yet, this difference does not explain the relatively low performance score observed for LHDs in Cluster 3, since their scores were also lower in standards that did not relate directly to addressing health disparities.

Limitations

This study has limitations. The LHDs in this analysis do not represent the universe of LHDs nationally, as LHDs in this study have commonalities that predispose them into early accreditation adoption. At the time of data collection for this analysis, there were 250 health departments who had been accredited.³⁰ Since accreditation uptake is ongoing, it is likely that a future sample of accredited LHDs might vary in different ways. Also, a number of LHDs (n = 31) in this study completed the PHAB accreditation but did not participate in the 2016 NACCHO Profile survey. That set of LHDs may have obscured associations between LHD characteristics and performance score. Furthermore, there are heterogeneous characteristics and behaviors among LHDs, but the performance distribution exhibited by the study sample may not fully capture this heterogeneity.

The descriptive analytical approach of this study also limited the ability to identify associations or infer causal relationships between LHD characteristics and performance score. However, this study provides insight into the effectiveness of PHAB accreditation assessment scores as a potential national performance assessment instrument for public health. As accreditation uptake increases among PH agencies, future studies will benefit from more representative data, and longitudinal studies that could reveal the dynamics of how accreditation is impacting LHDs' performance and quality improvement, overall and with regarding to specific performance standards.

CONCLUSIONS

Rather than looking at accreditation status as an indicator for LHDs' capacity to provide PH essential services, this study advanced previous accreditation research by examining variations in LHDs' accreditation performance scores, relative to their organizational and jurisdiction characteristics. Through examination of LHDs' performance score in PHAB accreditation standards, this study reaffirms PHAB standards as a viable instrument to measure LHDs performance, demonstrates an approach to comparing performance scores, and supports the existing evidence that PHAB accreditation is fostering LHDs' quality improvement in PH system for capacity to promote population health. This analysis also revealed performance score differences that exist among LHDs that participated in PHAB accreditation from 2013 to 2019, with some LHDs seemingly needing more help to meet specific accreditation standards--especially smaller LHDs serving rural populations. Looking closely at PHAB standard areas in which these agencies have lower scores and examining how their characteristics are impacting them can guide the type of interventions that will be most effective for agencies that have

difficulties meeting the standards. Likewise, since PHAB accreditation reports are not publicly available to individual LHDs for peer-to-peer comparison, this cross-sectional evaluation of the performance scores highlights the potential to identify specific opportunities for system-based interventions to achieve equitable performance in the PH system.

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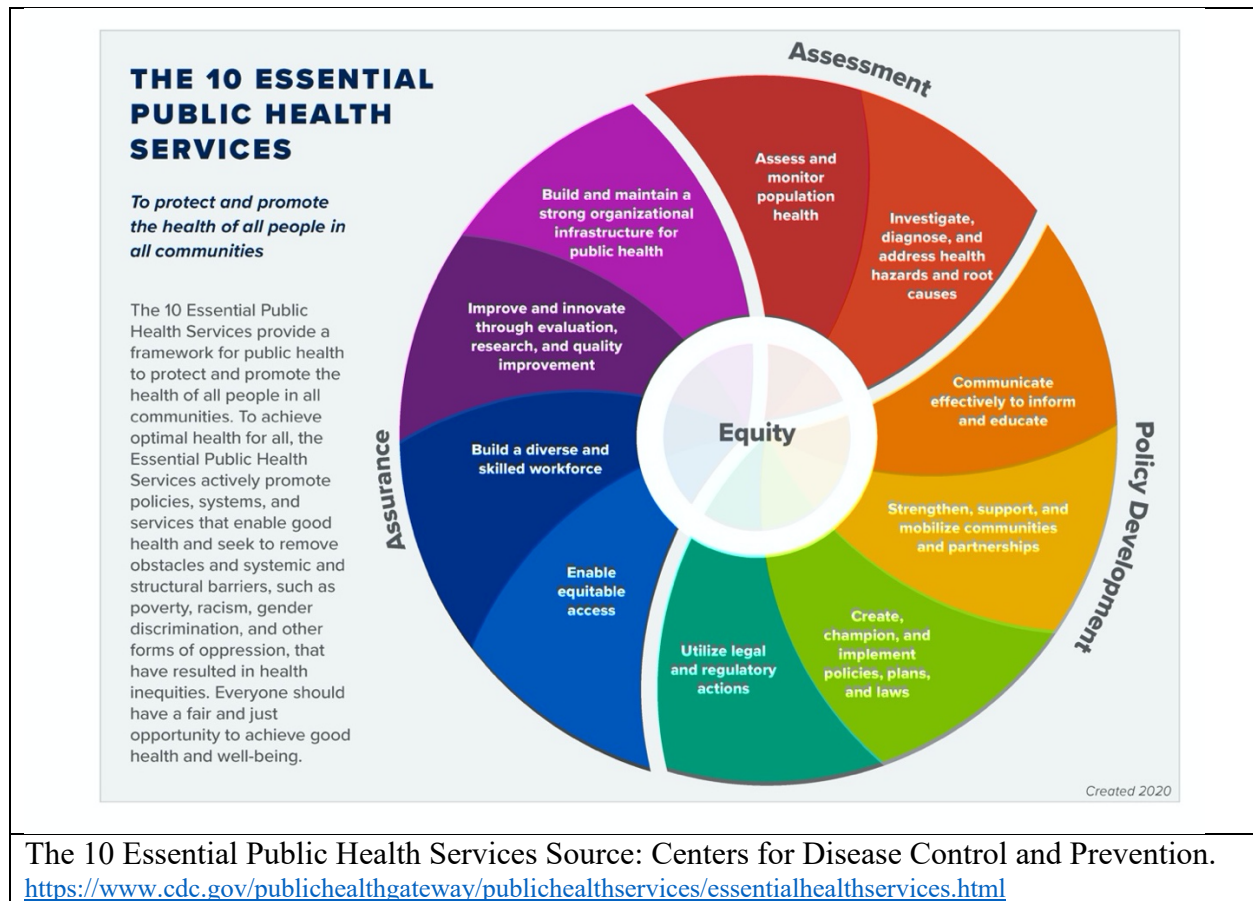
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APPENDIX I - C2



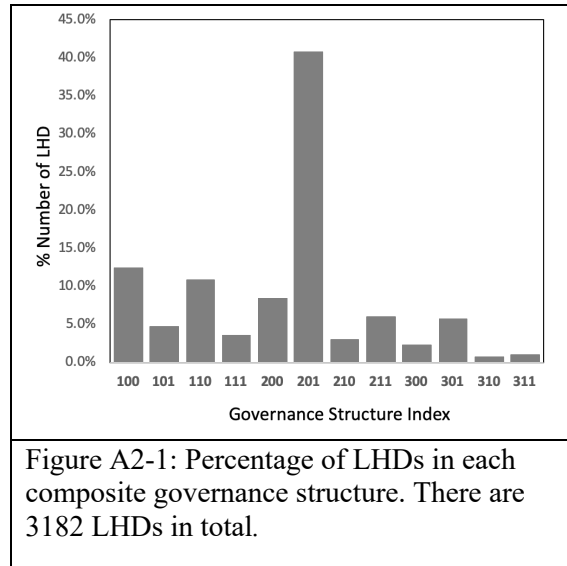
APPENDIX II - C2

Validation of Composite Governance Structure

Association between the composite governance structure and public health expenditure was used, as a validation method, to compare the characteristics of the composite governance structure with established knowledge in the literature. This was achieved with bivariate and multilevel regression methods. The data for this validation contained cross sectional observations for 3182 LHDs. Missing values were imputed using amelia multiple imputation method with five replicates. All spending were reported in inflation-adjusted 2018 dollars.

Table A2-1. Number of LHDs in each composite governance structure and their average PH expenditure per capita before and after multiple imputation							
Governance Structure Index	Number of LHD	%Total	PH Expenditure Per Capita (U.S. Dollar) Before Imputation		Missing N Before Imputation	PH Expenditure Per Capita (U.S. Dollar) After Imputation	
			Mean	S.D.		Mean	S.D.
100	395	12.4%	34.6	31.7	213	33.20	37.21
101	152	4.8%	35.8	18.8	96	35.14	36.53
110	345	10.8%	42.6	26.1	266	27.22	38.61
111	116	3.6%	33.3	18.4	95	26.85	38.54
200	270	8.5%	46.2	56.8	79	47.52	53.43
201	1299	40.8%	44.9	40.4	270	45.77	41.76
210	96	3.0%	57.6	41.0	46	54.27	40.44
211	191	6.0%	41.6	44.0	54	47.92	68.72
300	75	2.4%	47.5	38.0	9	48.18	38.13
301	185	5.8%	67.3	57.1	27	65.98	54.46
310	25	0.8%	73.9	55.0	3	71.94	52.92
311	33	1.0%	72.6	45.8	15	67.14	45.14

Of the total 3182 LHDs, there are missing data for 1173. Average PH expenditures per capita for each category were calculated before and after multiple imputation (Table A2-1). The average PH expenditure per capita before and after imputation suggests that LHDs in categories 1xx (State governance class) tend to spend less than other categories. Figure A2-1 shows the ratio of LHDs in each composite governance structure with the majority (41%) of LHDs in category 201 (local governance class, not under HHS, and has local board of health).



The result of the bivariate analysis of the composite governance with total public health expenditure (Table A2-2) also shows that LHDs with state governance class tend to spend less than LHDs with local governance class and LHDs with mixed governance class spend the most. This observation was also confirmed with a multilevel regression model where the composite governance structure was modeled as the group level (Figure A2-2). The multilevel model controls for local board of health's authority, LHD executive's education, number of jurisdictions served, and median household income of the jurisdiction served. While the results of the bivariate and the multilevel models agree with previous studies that suggests standalone (independent) LHDs are more likely to have higher public health expenditure, being under HHS or having local board of health did not show any particular association.

Governance Structure Index	Point Estimates	Standard Error	t-value	p-value
111	-2.9469	4.8737	-0.6109	0.3908
110	-2.9025	3.4008	-0.8500	0.4394
101	4.2749	4.4050	0.9432	0.4817
201	14.2328	2.6517	5.3580	0.0000
200	15.5483	3.6442	4.2834	0.0001
300	16.2007	5.8129	2.7887	0.0073
211	17.6951	4.0673	4.3434	0.0000
210	22.8899	5.2515	4.3744	0.0000
301	34.4481	4.1116	8.3854	0.0000
311	39.0553	8.3626	4.6756	0.0000
310	43.6123	9.5177	4.5813	0.0000

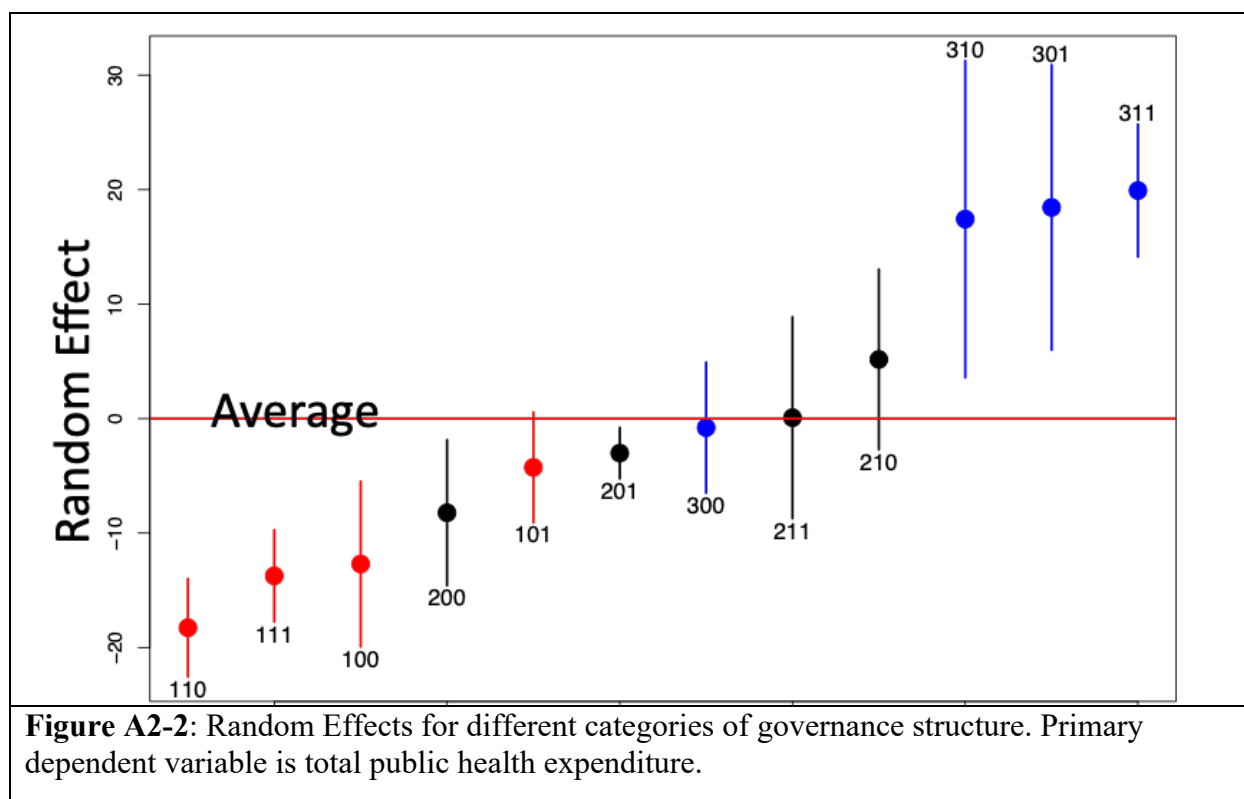
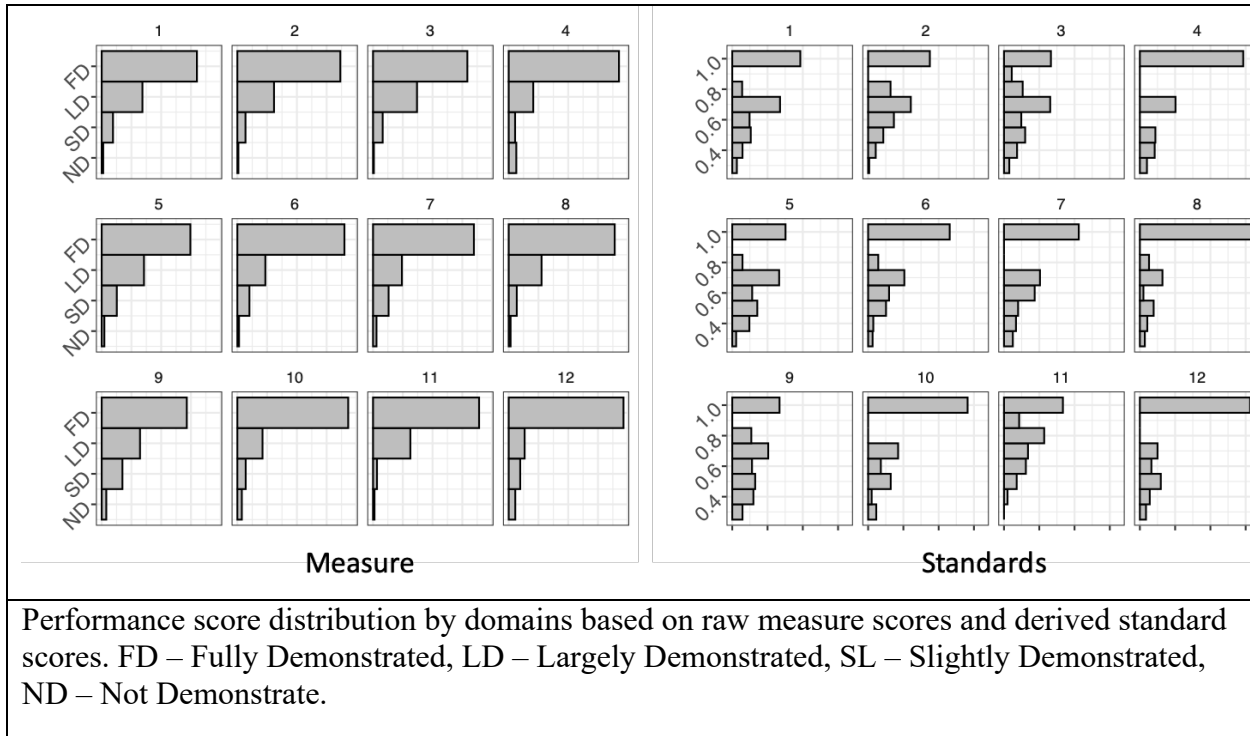


Figure A2-2: Random Effects for different categories of governance structure. Primary dependent variable is total public health expenditure.

APPENDIX III - C2

Histogram of the Categorical Scores in PHAB Measures and the Histogram of the Derived Numeric Performance Scores in PHAB Standards



APPENDIX IV - C2

Performance score clusters with their average score (Mean) and standard deviation (SD) in individual PHAB standards. D denotes PHAB domain, S denotes PHAB standards.						
	Cluster 1 (n = 103)		Cluster 2 (n = 135)		Cluster3 (n = 12)	
Standards	Mean	SD	Mean	SD	Mean	SD
Average	0.95	0.02	0.87	0.04	0.71	0.06
D1S1	0.94	0.07	0.85	0.11	0.75	0.16
D1S2	0.95	0.06	0.85	0.10	0.71	0.09
D1S3	0.94	0.09	0.84	0.14	0.68	0.18
D1S4	0.96	0.08	0.90	0.15	0.63	0.25
D2S1	0.95	0.06	0.89	0.09	0.75	0.12
D2S2	0.94	0.09	0.86	0.13	0.71	0.14
D2S3	0.95	0.06	0.90	0.10	0.76	0.15
D2S4	0.95	0.06	0.89	0.10	0.77	0.06
D3S1	0.92	0.09	0.80	0.14	0.52	0.16
D3S2	0.96	0.04	0.91	0.07	0.74	0.11
D4S1	0.95	0.10	0.84	0.16	0.59	0.18
D4S2	0.98	0.05	0.90	0.13	0.63	0.26
D5S1	0.97	0.05	0.89	0.12	0.63	0.15
D5S2	0.89	0.11	0.80	0.14	0.64	0.14
D5S3	0.91	0.08	0.85	0.13	0.67	0.13
D5S4	0.91	0.11	0.83	0.13	0.79	0.13
D6S1	0.93	0.10	0.83	0.16	0.62	0.21
D6S2	0.99	0.04	0.95	0.07	0.82	0.14
D6S3	0.96	0.05	0.85	0.11	0.73	0.14
D7S1	0.91	0.12	0.82	0.16	0.65	0.20
D7S2	0.97	0.07	0.89	0.13	0.70	0.22
D8S1	0.99	0.05	0.94	0.16	0.81	0.34
D8S2	0.95	0.08	0.86	0.13	0.75	0.10
D9S1	0.93	0.07	0.80	0.14	0.58	0.17
D9S2	0.93	0.10	0.79	0.17	0.67	0.16
D10S1	0.97	0.09	0.89	0.18	0.67	0.31
D10S2	0.95	0.07	0.89	0.10	0.68	0.13
D11S1	0.94	0.05	0.88	0.07	0.77	0.09
D11S2	0.98	0.05	0.93	0.09	0.83	0.12
D12S1	0.99	0.03	0.97	0.08	0.99	0.04
D12S2	0.97	0.11	0.88	0.18	0.77	0.21
D12S3	0.93	0.08	0.78	0.14	0.68	0.15

APPENDIX V - C2

PH ACTIVITIES	CLUSTER 1	CLUSTER 2	CLUSTER 3
Treatment for Communicable Disease			
HIV/AIDS	41%	40%	38%
Tuberculosis	80%	75%	68%
Other STDs	80%	75%	68%
Epidemiology and Surveillance Activities			
Communicable/infectious disease	100%	90%	87%
Chronic disease	88%	61%	42%
Injury	58%	48%	50%
Behavioral risk factors	74%	62%	54%
Environmental health	91%	86%	74%
Syndromic surveillance	84%	66%	72%
Maternal and child health	84%	77%	48%
Immunization			
Adult Immunization	94%	87%	77%
Childhood Immunization	95%	89%	86%
Maternal and Child			
Family planning	61%	65%	49%
Prenatal care	36%	39%	10%
Obstetrical care	14%	20%	0%
WIC	84%	75%	59%
MCH home visits	86%	69%	37%
EPSDT	39%	42%	12%
Well child clinic	23%	29%	19%
Other Environmental Health Activities			
Indoor air quality	60%	39%	43%
Food safety education	87%	84%	74%
Radiation control	23%	14%	28%
Vector control	77%	61%	84%
Land use planning	36%	23%	40%
Ground water protection	55%	49%	61%
Surface water protection	43%	36%	50%
Hazmat response	25%	23%	23%

Hazardous waste disposal	28%	20%	0%
Air pollution	33%	22%	40%
Noise pollution	22%	9%	20%
Public health nuisance abatement	88%	79%	75%
Other Health Services			
Comprehensive primary care	16%	21%	0%
Home health care	8%	13%	19%
Oral health	55%	45%	29%
Behavioral/mental health services	32%	25%	19%
Substance abuse services	32%	25%	20%
Other Activities			
Collection of unused pharmaceuticals	31%	22%	9%
Emergency medical services	13%	5%	0%
Animal control	24%	22%	19%
Occupational safety health	16%	13%	18%
Laboratory services	60%	58%	29%
Outreach and enrollment for medical insurance (include Medicaid)	72%	59%	19%
School-based clinics	28%	30%	28%
School health	43%	50%	28%
Asthma prevention and /or management	40%	34%	18%
Correctional health	21%	14%	0%
Vital records	70%	62%	58%
Population-based Primary Prevention Activities			
Injury	59%	55%	63%
Violence	26%	29%	23%
Unintended Pregnancy	56%	62%	38%
Chronic disease programs	84%	74%	68%
Nutrition	86%	86%	78%
Physical activities	82%	75%	58%
Tobacco	92%	85%	58%
Substance abuse	52%	49%	38%
Mental illness	37%	34%	38%
Regulation, inspection and/or Licensing			
Mobile homes	45%	41%	19%

Campgrounds & RVs	64%	51%	43%
Solid waste disposal sites	42%	39%	20%
Solid waste haulers	40%	37%	27%
Septic systems	74%	61%	66%
Hotels/motels	58%	56%	53%
Schools/daycare	83%	76%	65%
Children's camps	68%	53%	51%
Body art (tattoos, piercings)	70%	60%	56%
Recreational water (e.g., pools, lakes, beaches)	80%	73%	75%
Tobacco retailers	48%	34%	29%
Smoke-free ordinances	87%	67%	55%
Lead inspection	68%	50%	27%
Food processing	30%	33%	27%
Milk processing	6%	9%	17%
Public drinking water	47%	34%	37%
Private drinking water	67%	56%	41%
Food service establishments	89%	84%	75%
Health-related facilities	26%	31%	55%
Housing inspections	32%	32%	55%
Screening for Diseases/Conditions			
HIV/AIDS	87%	78%	68%
Other STDs	80%	75%	67%
Tuberculosis	95%	87%	88%
Cancer	41%	39%	19%
Cardiovascular disease	33%	32%	19%
Diabetes	38%	41%	29%
High blood pressure	52%	51%	39%
Blood lead	67%	60%	48%
BMI (Body Mass Index)	55%	49%	30%

APPENDIX VI - C2

OTHER PROGRAMS	CLUSTER 1	CLUSTER 2	CLUSTER 3
Emergency Preparedness	(%)	(%)	(%)
Number of emergency preparedness activities conducted in the past three years			
0	0	0	0
1 to 3	7	0	0
4 to 6	17	22	0
7 to 9	45	51	50
10 or more	31	27	50
Health Disparity			
Number of activities conducted in the past two years to address health disparities			
0	0	0	0
1 to 3	17	16	25
4 to 6	41	49	75
7 to 9	41	35	0
10 or more	0	0	0
Community Health Assessment and Planning			
Completed community health assessment for the jurisdiction			
Yes, within the last three years	77	72	88
Yes, more than three but less than five years ago	21	24	13
Yes, five or more years ago	0	3	0
No, but plan to in the next year	2	1	0
Participated in Health Improvement Plan			
Yes, within the last three years	82	80	88
Yes, more than three but less than five years ago	16	14	13
Yes, five or more years ago	0	3	0
No, but plan to in the next year	2	3	0
Partnership and Collaboration			
Number organization worked with in partnership or collaboration in the past year			
0	0	0	0
1 to 10	0	0	0
11 to 20	55	75	67
21 to 30	45	25	33

31 or more	0	0	0
Policy – Making and Advocacy			
Number of areas actively involved in policy or advocacy activities in the past two years			
0	1	0	0
1 to 3	8	14	22
4 to 6	18	23	33
7 to 9	31	31	33
10 or more	42	33	11
Quality Improvement			
Number of formal projects implemented to improve the quality of a service, process or outcome in the past 12 months			
0	73	73	67
1 to 3	27	17	33
4 to 6	0	10	0
7 to 10	0	0	0
11 to 20	0	0	0
20 or more Projects	0	0	0

**CHAPTER 3: ASSOCIATIONS BETWEEN LOCAL HEALTH DEPARTMENT
EXPENDITURES ON FOUNDATIONAL CAPABILITIES AND PHAB
ACCREDITATION STANDARD SCORES**

Associations Between Local Health Department Expenditures on Foundational Capabilities and PHAB Accreditation Standard Scores

ABSTRACT

Foundational Capabilities (FC) are those public health infrastructure areas that are essential for local health departments (LHDs) to support a “minimum package” of programs and services that promote population health and provide effective responses during public health crises. Despite being a critical component of LHD programs, FC are chronically underfunded. As a result, LHDs are looking for ways to restructure limited resources while advocating for more resources to maintain the core capabilities necessary to respond effectively on a day-to-day basis and during crises. Public health leaders and policymakers are increasingly interested in evidence-based approaches to assess how public health infrastructure investment can improve public health performance. While studies have reported associations between overall public health expenditures and LHDs’ performance, studies on the specific relationship between LHD FC expenditures and their performance – and, thus, their ability to provide essential PH programs and services to their community – were not found in the literature. Public Health Accreditation Board (PHAB) accreditation is a nationally recognized accreditation program for the public health system. Alignment between FC and the PHAB standards presents a means for assessing LHD FC expenditures relative to their performance in PHAB accreditation, which could indicate their potential performance in maintaining a minimum package of programs and services for the well-being of their community. In this study, I examined the association between LHD total FC expenditures, as well as FC funding allocation pattern, and performance score on related PHAB standards. I used Bayesian regression methods to estimate the coefficients for the aggregate performance score, and performance scores on individual PHAB standards. Analyses showed that a one dollar increase in total FC expenditures is associated with a 0.2% increase in the

aggregate performance score in selected PHAB standards as well as the performance score on most of the individual standards examined. LHDs that allocated FC budgets more evenly across a combination of FC programs were also more likely to perform higher. This study contributes to advancing the understanding of public health finance in relation to performance and could help guide practice and policy-making in terms of LHD resource allocation.

Key words: Local Health Departments, Foundational Capabilities, Public Health Accreditation, Performance, Public Health Services, Population Health

BACKGROUND

In the United States, there are about 2400 local health departments (LHDs) that are responsible for preventing, promoting, and protecting local communities' health and wellbeing.¹ ² They play key roles in ensuring an effective public health (PH) system through provision of essential population-based programs and services in infectious disease control, chronic disease and injury prevention, environmental public health, maternal and child health, and access to and linkage with clinical care, and other major programs.^{3, 4} LHDs are, thus, crucial elements of the PH system and are expected to equitably maintain PH programs and services across communities in the United States. However, differences in LHD resources and cross-cutting infrastructure capabilities⁵⁻⁹ result in variability in their performance – the ability to provide essential PH programs and services to their community.¹⁰ Variability in LHD performance creates unequal community access to public health services across jurisdictions.^{5, 6, 11-15} Thus, PH leaders seek opportunities to advance LHDs' performance through improved resources and infrastructure capabilities.^{8, 9, 16-18}

In 2012, the National Academy of Medicine (NAM) called for LHDs to maintain a 'minimum package' of programs to support effective responses to public health crises and to assure population health is promoted equitably.^{7, 16, 19, 20} NAM's recommendation led to the establishment of the Foundational Public Health Services (FPHS) framework. The framework established a minimum set of Foundational Capabilities (FC) that LHDs should maintain in every jurisdiction to support a core set of Foundational Services (FS) to assure basic health promotion and protection in all communities.^{7, 20} These cross-cutting infrastructure capabilities include Assessment and Surveillance, Emergency Preparedness and Response, Policy Development and Support, Communications, Community Partnerships Development,

Organizational Administrative Competencies, and Accountability and Performance Management.²⁰

FC are considered the “building blocks” for LHDs’ services such as maternal, child, and family health; immunization programs; and communicable disease control.⁸ LHDs’ ability to respond effectively during a PH crisis and maintain efficient day-to-day operations, appear to be dependent on their investments and activities regarding FC.²⁰ There is a growing interest among PH leaders to understand how investments in FC relate to performance in PH functions, so that PH systems can be most responsive to local needs.^{9, 16, 21, 22}

Several studies have reported associations between LHD performance and PH funding,^{23, 24} PH expenditures,²⁵ and PH infrastructure.^{23, 24} However, studies on the association between FC and performance are limited. An earlier study by Scutchfield *et al.* showed that higher spending in organizational competency, a sub-component of FC, relates to significantly higher performance in nine out of the ten essential PH services.²⁴ Mays *et al.* also found a positive association between PH expenditures on programs that relate to PH agencies’ capabilities and agency performance.²⁶ The framework for these previously reported studies from the early 2000’s was based on performance information collected through survey-driven, self-reported evaluation that focused on individual LHD units. A number of these studies noted the need for a standardized national performance assessment instrument,^{22, 24, 27, 28} as variations in LHDs’ data structure and reporting processes often hinder comparative assessment of agency performance.^{16,}

28-30

Public Health Accreditation Board (PHAB) accreditation is a nationally recognized program for assessing health agencies’ capacity to deliver the ten essential public health services.³¹ PHAB was launched in 2011 as a national voluntary accreditation program for public

health departments with the aim of improving and protecting population health by advancing the performance and quality of the nation's health agencies.³²⁻³⁷ Accreditation recognizes health departments that meet standards designed to assess agencies' readiness to respond to PH needs and facilitates continuous quality improvement and performance.³⁶ PHAB accreditation assessment serves as a national performance assessment instrument for public health that had been noted as a need in previous studies.^{22, 24, 27, 28} Performance assessment instruments³⁸⁻⁴³ developed prior to the PHAB initiative lacked wide spread acceptance and standardized PH performance measures.^{35, 36, 44}

Though the establishment of FPHS and PHAB were different initiatives, they both describe core elements of PH practice that are meant to create healthy communities,⁴⁵ and the alignment of these elements within them has been established.⁴⁵ Expenditures on FC is an indicator of the level of FC (the infrastructure areas such as Assessment and Surveillance, Emergency Preparedness and Response, Policy Development and Support^{8, 9, 20}) that exist in a LHD and evidence suggests there is a link between FC expenditure and PHAB accreditation.⁴⁵ A recent study by Singh *et al.* examined variation in LHDs spending on FC among 16 LHDs from 4 states, and noted that accredited LHDs tend to have higher spending on FC than those that were not-accredited.⁹ Rather than looking at overall PHAB accreditation status in relation to FC expenditures, the present study examined LHDs' actual performance scores in PHAB accreditation, as a measure of their ability to provide essential PH services, relative to their FC expenditure.

Studying the association between LHD performance scores in PHAB accreditation standards and their expenditures on FC could support a better understanding of LHDs' financial management strategies that maximize accreditation outcomes, and, thus, provide information that

could help guide accreditation policy and improved performance for LHDs. The objectives of this study, therefore, were to examine the association between the amount of total FC expenditures, as well as LHD budget allocation to the seven broad FC areas, and LHD performance scores in PHAB accreditation standards.

METHODS

To meet the objectives of this study I used Bayesian regression methods to estimate the coefficients for the aggregate performance score, and performance scores in individual PHAB standards with respect to LHDs' expenditures on FC.

Data

There were multiple data sources for this study. Accreditation scores were obtained from the dataset of over 200 accredited LHDs from PHAB.³⁶ FC expenditures, FS expenditures, and jurisdictions' population size came from the University of Washington Public Health Activities and Services Tracking (PHAST) Uniform Charts of Accounts (UCOA) database compiled and maintained by the PHAST team.⁴⁶ The UCOA data included 67 LHDs from 18 states. Only 31 of these LHDs had completed PHAB accreditation. Data regarding LHD organizational structure and education level of LHD lead executives were obtained from the 2016 National Association of County and City Health Officials (NACCHO) Profile of Local Health Departments Survey^{1, 4} and included due to previous research suggesting their relationship to LHD performance and accreditation involvement.^{24, 47-49} All dollar amounts were converted to per capita expenditures based on each LHD jurisdiction's population size.

Performance Measure: LHDs' Score in PHAB Standards

The PHAB data categorize LHDs based on each LHD's proficiency in various accreditation standards and measures that relate to the ten essential PH services.⁵⁰ The data are

organized into 12 domains, 32 standards, and 100 measures.^{31, 51} Domains are the groups of standards that relate to a broad group of public health services.^{20, 31, 52} Standards are the level of attainment that an LHD is expected to meet in a domain.^{31, 45} Measures are the metrics for evaluating proficiency in a specific standard, and, each standard contains at least two measures.³¹ Details of PHAB domains, standards, and measures are available elsewhere.³¹ In accreditation assessment, an LHD is scored by trained external reviewers in each of the PHAB measures on an ordered nominal scale of “Not Demonstrated” to “Fully Demonstrated,” with a range of four categories. For analytical purposes, I transformed the categorical scores into a numeric scale by assigning 0.25 to represent one unit on the Likert scale, with a score of 0.25 corresponding to “Not Demonstrated,” and a score of 1.0 on the other end of the “Fully Demonstrated” scale. I then defined performance score in each standard as the average of scores for all measures in the standard. Aggregate performance score is defined as the average of performance scores in all the individual standards examined.

The PHAB standards examined in this study are a subset of those established by the Public Health National Center for Innovation as being directly aligned with Foundational Capabilities.⁴⁵ The selected standards were those that uniquely align with FC infrastructure areas and minimally overlap with other standards. An overview of the selected 19 standards, the corresponding domains, and the connection with the FC infrastructure areas are shown in APPENDIX I-C3. APPENDIX II-C3 shows an overview of PHAB and FPHS alignment.⁴⁵ I used the nomenclature I created in another study [Chapter 2] to represent the domain-standard composite, where Domain 2, Standard 3 is represented as D2S3, for example.

Total FC Budget and FC Allocation Pattern

The UCOA data contained uniquely detailed and comparable financial data for a total of 67 LHDs whose leaders have cross-walked their financial reports into the PHAST UCOA and for which there were no missing data. From the UCOA data, I extracted LHD expenditures on FC and FS. I defined Total FC Budget as the aggregate total spending on the seven FC infrastructure areas as characterized by the FPHS framework.²⁰ FC Allocation is the percentage of the total FC budget allocated to each FC infrastructure area. FC Allocation Pattern was then defined as the distribution of FC Allocation across the seven FC infrastructure areas. Only accredited LHDs from the UCOA dataset (n = 31) were used for modeling LHD performance score.

Other Covariates

FS budget was the total spending on the FS programs as defined by the FPHS framework.²⁰ Education level of LHD lead executives was coded as 1 – Master’s degree or higher and 0 – bachelor’s degree or lower. Population groups 1 (> 1 million population size), 2 (250,000 – 1 million population size), and 3 (100,000 – 249,999 population size) were as defined in UCOA data. Population groups 4, 5, and 6 from UCOA data were merged to create population group 4 (< 100,000 population size) because the population groups were overlapped in the UCOA data. Performance cluster number was the index derived from the k-means cluster analysis of performance scores in PHAB standards and used to assign LHDs into groups relative to their performance scores [Chapter 2, APPENDIX II-C2]. In the performance clustering conducted with a much larger dataset (n = 250) of LHDs, three groups were identified [Chapter 2, pg.14]. In the data set for this study, Cluster 1 included 13 LHDs with an aggregate performance score of 0.95; Cluster 2 (n = 17) had an aggregate score of 0.87; and Cluster 3 (n = 1) had an aggregate score of 0.71.

Analysis

First, I used k-means cluster analysis to categorize the initial 67 LHDs with UCOA data into similar groups based on their budget allocation pattern in FC program areas. I then sampled accredited LHDs from each cluster group identified. The cluster group indices (FC Cluster 1, FC Cluster 2, and FC Cluster 3) for the accredited LHDs ($n = 31$) were used in modeling performance score as a function of FC Allocation pattern.

For the regression analyses, I used Bayesian methods to evaluate the association between LHD FC budget amounts (Total FC Budget) and performance scores in the PHAB accreditation standards, and between a FC pattern clusters (FC Allocation) and performance scores in PHAB accreditation standards. The regression analyses were performed using the *stan_glm()* function in *rstanarm* package. Total FC Budget and FC Allocation were the primary independent variables examined separately with performance score in PHAB standards. For both models, I used standard student-t ($df = 7$) prior with a mean of 0. The model parameters were estimated for the performance score in each of the selected 19 PHAB standards, and their average. Percent difference in performance score (relative to a unit change in FC expenditures) was calculated by transforming the loglinear coefficients to a linear scale.

The model for examining associations between Total FC Budget and performance scores in PHAB accreditation standards included FS expenditure, education level of the LHD lead executive, and performance cluster as covariates to control for their potential effects. The model for examining associations between FC Allocation Pattern and performance scores in PHAB accreditation standards included Total FC Budget and education level of the LHD lead executive as covariates to control for their potential effects. The FC Allocation model did not control for FS expenditures because once the total FC budget has been determined, total FS budget is

unlikely to impact decisions regarding the distribution of FC budget to various FC infrastructure areas. A list of models tested for variable selection is shown in APPENDIX III. All data treatment and statistical analyses were performed in R Software package version 4.0.2.

RESULTS

Descriptives

There were no major differences between performance scores in each of the 19 selected PHAB standards for the sample of 31 accredited LHDs with UCOA data, when compared to the scores for the total sample of 250 LHDs in the full PHAB dataset. Nor was there a major difference in the average Total FC Budget and spending in each FC infrastructure area for the accredited and not-accredited LHDs in the sample. Also, the distribution of FC expenditures relative to FC allocations among specific FC infrastructure areas (**Figure 3-1**) did not differ substantially by accredited versus not-accredited status.

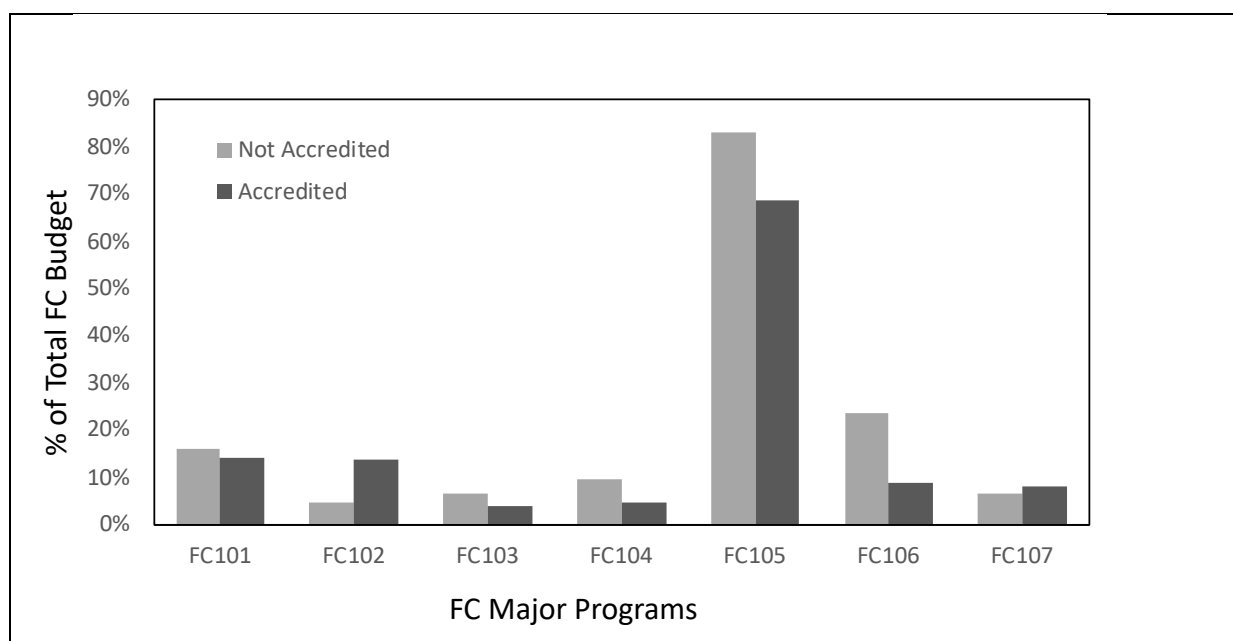


Figure 3-1: Distribution of FC expenditures relative to allocations among specific FC program areas. Fcap101: Emergency preparedness and Response, fcap102: Assessment, fcap103: Communication, fcap104: Community Partnership and Development, fcap105: Organizational Competency, fcap106: Policy Development and Support, fcap107: Other Capabilities

Accredited and not-accredited LHDs in the full dataset of 67 LHDs from the UCOA data differed in some ways from each other. These 67 LHDs showed that, when compared to not-accredited LHDs, the accredited LHDs tended to have lead executives with graduate level degrees and served larger population sizes. The percent of accredited LHDs with a lead executive with an education level of a master's degree or higher was 87%, compared to 64% for LHDs that were not-accredited (Table 3-1). The percent of accredited LHDs serving population sizes greater than 100,000 (population group 1, 2, and 3) in the sample was 70% compared to 50% for LHDs that were not-accredited.

Table 3-1: Lead executive education levels and population size of LHDs that were accredited and those that were not from among LHDs in the UCOA data

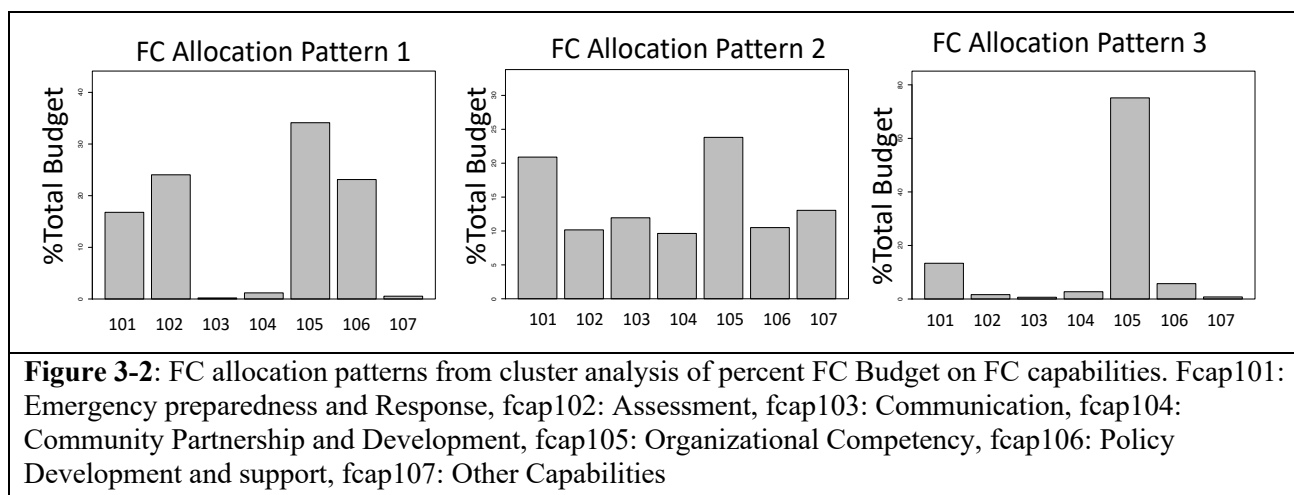
N = 67		Accredited	Not-Accreditation
Executive Education Level	Master's or higher	87%	64%
	Bachelor's or lower	13%	17%
	Education Level Not Reported	0%	19%
Population Group of LHD's Jurisdiction	PopGrp1: > 1 million	32%	3%
	PopGrp2: (250,000 – 1 million)	19%	39%
	PopGrp3: (100,000 – 249,999)	19%	8%
	PopGrp4: < 100,000	28%	50%

Cluster Analysis: Distribution of FC budget in each FC infrastructure area (FC Allocation Pattern)

The result of the cluster analysis with the initial UCOA dataset (n = 67) showed three distinct clusters of LHDs with similar FC allocation patterns (percent of Total FC Budget spent on each FC infrastructure area). After including only accredited LHDs (n = 31) from the initial

clusters, the percent of LHDs in each cluster remained very similar to the cluster for the initial 67 LHDs (Table 3-2). The majority of the 31 LHDs (61%) fell into the Allocation Pattern 3 cluster. Figure 3-2 shows the average FC allocation patterns for LHDs in each cluster. LHDs in Allocation Pattern 1 allocated most of their FC budget to a mix of four FC areas (fcap101 - Emergency preparedness and Response, fcap102 - Assessment, fcap105 - Organizational Competency, and fcap106 - Policy Development and support) ranging from 18% to 30% of the Total FC Budget in each of these four areas. LHDs in Allocation Pattern 2 had a more evenly distributed allocations, ranging from 10% to 23% in all seven FC programs. LHDs in Allocation Pattern 3 allocated more than 70% of their Total FC Budget to fcap105 - Organization Competency.

Table 3-2: Comparison of LHDs from full UCOA dataset and accredited sample by FC expenditure allocation pattern derived from cluster analysis of percent FC budget expenditure in each FC infrastructure area.				
Cluster #	LHDs in full UCOA dataset (n = 67)		Regression Model LHD Sample (n = 31) (Accredited LHDs in UCOA data)	
1	12	18%	6	19.4%
2	14	21%	6	19.4%
3	41	61%	19	61.2%
Total	67	100%	31	100%



Total FC Budget Level and Performance Score in PHAB Accreditation Standards

Table 3-3 shows the change in performance score with respect to one dollar increase in Total FC Budget per capita. The aggregate performance score in PHAB accreditation standards was found to be associated with an increase in the Total FC Budget per capita. Aggregate performance score in PHAB accreditation standards increased by 0.2% with a unit increase in the Total FC Budget per capita. Most of the individual PHAB standards also showed positive associations between performance score improvements for each dollar increase in Total FC Budget—ranging from improvements of 0.08% to 1.2% on average. Negative coefficients were observed in five of the PHAB specific standards (D1S1, D1S3, D1S4, D5S3, and D6S1 [see APPENDIX I-C3 for a description of each of these]).

Table 3-3: Bayesian estimates for percent change (with 95% credible interval) in performance score with a unit change in FC budget per capita. D denotes PHAB domain, S denotes PHAB standards. Brief Domain description below. Full descriptions of domains and standards are described elsewhere and listed in APPENDIX I-C3.³¹

Measure	Mean (%)	CI Lower	CI Upper
Average score	0.23	-0.09	0.56
D1S1	-0.48	-1.38	0.65
D1S2	0.53	-0.33	1.41

D1S3	-0.26	-1.20	0.71
D1S4	-0.90	-1.88	0.03
D2S1	0.85	-0.10	1.85
D2S2	1.22	-0.02	2.47
D2S3	0.40	-0.53	1.40
D2S4	0.24	-0.52	1.07
D3S1	0.25	-0.65	1.20
D3S2	0.08	-0.51	0.69
D5S1	0.14	-0.48	0.75
D5S2	0.28	-1.08	1.63
D5S3	-0.21	-1.20	0.76
D5S4	0.50	-0.82	1.86
D6S1	-0.52	-1.31	0.32
D6S2	0.22	-0.46	0.91
D6S3	0.77	-0.09	1.63
D9S1	0.89	-0.18	1.94
D9S2	0.44	-0.87	1.76

Domain Description: Domain 1- Conduct and Disseminate Assessments Focused on Population Health Status and Public Health Issues Facing the Community; Domain 2 - Investigate Health Problems and Environmental Public Health Hazards to Protect the Community; Domain 3 - Inform and Educate about Public Health Issues and Functions; Domain 5 - Develop Public Health Policies and Plans; Domain 6 - Enforce Public Health Laws; Domain 9 - Evaluate and Continuously Improve Processes, Programs, and Interventions;

FC Allocation Pattern and Performance Score in PHAB Standards

To analyze the association between LHDs' performance score in PHAB accreditation standards and FC Allocation pattern, I used the FC Allocation cluster indices as the primary independent variable. Table 3-4 shows the percent difference in performance scores for FC Allocation pattern 2 and pattern 3, relative to pattern 1. Positive values indicated improvements in performance scores relative to pattern 1. Negative values indicated performance scores decreased relative to pattern 1. On average, the results indicated an improvement of approximately 9% for an LHD with FC Allocation Pattern 2 (i.e., spending on a relatively evenly distributed pattern in all seven FC areas) relative to pattern 1. The results also suggest a drop of approximately 8% in performance scores for pattern 3 (i.e., spending primarily on Organization Competency) relative to pattern 1. In terms of the relative improvement by cluster (Table 3-4),

the best performance improvement was observed for FC Allocation pattern 2 in most of the specific PHAB standards. However, FC Allocation pattern 3 had the best performance in D2S2 and D6S3 (APPENDIX I-C3).

Table 3-4: Bayesian estimates for percent change (with 95% credible interval) in performance score with change in FC Allocation Pattern 2 and Pattern 3 relative to Pattern 1.

	FC Allocation Pattern 2			FC Allocation Pattern 3			
Measure	Mean	CI Lower	CI Upper	Mean	CI Lower	CI Upper	Relative Improvement
Average score	8.5	-13.5	34.9	-7.7	-23.6	11.3	C2 > C1 > C3
D1S1	-2.0	-29.6	33.8	-6.2	-26.9	20.5	C1 > C2 > C3
D1S2	6.2	-30.2	60.2	-11.0	-36.7	24.5	C2 > C1 > C3
D1S3	-14.5	-42.5	30.5	-31.5	-50.5	-3.7	C1 > C2 > C3
D1S4	18.1	-17.6	68.3	-3.3	-27.0	28.5	C2 > C1 > C3
D2S1	-9.3	-40.5	39.9	-6.8	-33.5	30.5	C1 > C3 > C2
D2S2	15.8	-28.9	83.6	22.0	-15.4	75.1	C3 > C2 > C1
D2S3	7.8	-31.3	68.6	-2.7	-33.5	40.8	C2 > C1 > C3
D2S4	16.1	-21.6	69.4	2.4	-25.7	39.2	C2 > C3 > C1
D3S1	7.8	-31.4	69.4	-24.4	-48.1	9.2	C2 > C1 > C3
D3S2	-14.6	-32.1	8.3	-3.5	-19.9	16.4	C1 > C3 > C2
D5S1	35.7	1.0	80.6	4.5	-16.7	32.9	C2 > C3 > C1
D5S2	17.5	-30.2	92.5	-15.2	-43.2	27.0	C2 > C1 > C3
D5S3	-19.8	-43.8	13.6	-21.4	-40.5	3.9	C1 > C2 > C3
D5S4	99.6	25.9	216.1	28.6	-10.3	86.1	C2 > C3 > C1
D6S1	6.2	-26.1	55.5	-12.1	-34.9	19.0	C2 > C1 > C3
D6S2	-4.6	-31.5	33.3	-13.5	-33.1	11.9	C1 > C2 > C3
D6S3	7.1	-28.2	61.4	10.1	-19.5	51.7	C3 > C2 > C1
D9S1	21.5	-24.2	94.8	-11.3	-39.2	30.0	C2 > C1 > C3
D9S2	10.7	-35.1	94.9	-21.2	-49.3	22.0	C2 > C1 > C3

Domain Description: Domain 1- Conduct and Disseminate Assessments Focused on Population Health Status and Public Health Issues Facing the Community; Domain 2 - Investigate Health Problems and Environmental Public Health Hazards to Protect the Community; Domain 3 - Inform and Educate about Public Health Issues and Functions; Domain 5 - Develop Public Health Policies and Plans; Domain 6 - Enforce Public Health Laws; Domain 9 - Evaluate and Continuously Improve Processes, Programs, and Interventions. Full descriptions of domains and standards are described elsewhere and listed in APPENDIX I-C3.³¹

DISCUSSION

No known prior study has investigated LHD performance score in PHAB accreditation standards with respect to specific FC expenditures. This study supports the notion that LHDs with adequate resources are more likely to be successful in accreditation, given the positive association found between performance score in PHAB accreditation and the Total FC Budget. The analyses suggest that one dollar increase in FC spending per capita could improve LHDs' performance score in PHAB accreditation standards by 0.2% on average. This overall improvement is a result of positive associations in most of the individual PHAB standards. While previous studies have shown that accredited LHDs tend to spend more on PH activities than those that are not-accredited,⁹ the results of this analysis further extends our understanding of PH system infrastructure and the importance of adequate resources for foundational capabilities for LHDs to perform well in PHAB accreditation assessments. Lack of adequate resources in these areas could put LHDs at a disadvantage during preparation and assessment for accreditation.^{53, 54}

PH leaders continue to advocate for more resources to improve LHDs' core capabilities necessary to respond effectively, on a day-to-day basis and during health crises.^{5, 55-57} The COVID-19 outbreak has further reinforced the need for better funding to improve PH infrastructure and preparedness in the United States. For example, Senator Patty Murray of Washington, is championing a legislative effort advocating for more funding to improve the PH infrastructure in the amount that will reach \$4.5 billion annually in 2025. The legislation not only calls for funding to revamp LHDs' infrastructure but also calls for "a standardized approach to financial reporting" (such as the UCOA) and funding to develop and implement an accreditation program to ensure LHDs are meeting rigorous standards.¹⁷ Since FC are considered the building blocks of LHDs' activities to provide PH services, providing adequate funding for tracking, supporting, and allocating FC could improve agency performance in delivering PH essential

services and be better prepared for PH crises, which in turn can produce better community health outcomes.^{9, 16, 24, 58, 59}

While it is apparent that increasing funding for PH infrastructure may lead to improved performance for LHDs in the United States,⁶⁰ this study also suggests that the approach in which LHDs allocate available funds to the various FC areas could impact their performance scores in PHAB accreditation standards. The majority of LHDs in the sample examined allocate a large percentage of their FC budget to Organization Competency (cluster 3 – Allocation Pattern 3). This spending pattern appears not to produce optimal performance in PHAB accreditation standards, compared to LHDs that allocate resources more evenly across FC areas, as a more mixed spending pattern (Allocation Pattern 2) showed the best performance in this study. Recent research on the rate of accreditation uptake among small LHDs indicates that LHDs with a more balanced mix of activities were more likely to participate in accreditation.^{61, 62} Here, additional knowledge is gained regarding how LHDs can prioritize their FC programs to increase the odds of success in accreditation.

As LHDs advocate for more resources and look for ways to structure limited resources⁶³ for better community health outcomes, there is a need to embrace evidence-based approaches when setting priorities.⁶⁴⁻⁶⁷ In a study by Baum *et al.* researchers examined how LHD leaders make funding allocation decisions, the process they used to make decisions, and the factors that influence decisions on how public health resources are used to ensure effective activities and access to needed services.⁶⁷ They observed that only a small number of LHDs used evidence-based approaches such as economic analyses or conducted needs assessments when setting priorities. Instead, most agencies based their decisions on previous budget allocations and input from their boards of health to make allocation decisions.⁶⁷

PH leaders' and policy makers' emphasis on addressing the issue of limited resources for LHDs should also include evidence-based financial models to ensure PH resources are efficiently managed for optimal health outcomes.¹⁷ Therefore, effective resource allocation strategies are needed for LHDs to achieve optimal performance in delivering their PH programs and services. Understanding FC allocation patterns in relation to performance score in PHAB standards provides information and potential guidance on how FC resource allocation may affect PH agencies' performance.

The findings of this study also reinforce the convergence of the goals of the FPHS framework and the PHAB accreditation and demonstrate the potential of PHAB accreditation standards as an effective instrument for assessing performance in PH systems. The alignment of PHAB standards with the FPHS framework enabled the means to gain further insight here into the significance of FC expenditures in relation to PH performance and quality improvement. Within the FPHS framework, FC encompass LHDs' structure and processes, and thus represent a component of the PH system at which performance information could be obtained. Maintaining FC, in this case synonymous with increases in FC expenditures, would appear to enhance PH services that promote healthy communities. Finally, the use of standardized financial data along with PHAB accreditation data demonstrates the value of uniform structured PH information for comparative financial and performance assessment.

Limitations

Due to the low sample size, the predictive power and the covariates in the model were limited. However, the use of Bayesian estimation methods was effective for handling sample size limitations. Descriptive analyses suggest the sample size, though limited, was a generally

representative sample as the sample of 31 agencies with UCOA data was very similar to the 67 LHDs without UCOA. The same was true with the 31 accredited LHDs versus the 250 accredited LHDs in the PHAB data. This analysis also does not assume causal inference and the potential feedback loop that may exist between total FC budget and PHAB scores was not considered in this analysis. Future research with longitudinal data should explore this interaction.

CONCLUSIONS

Findings of this study suggest that investment in FC could improve LHD performance score in PHAB accreditation standards and support their ability to meet the required capability level for improving community health outcomes. The study also suggests that allocating available FC resources across the various FC programs could support better LHD performance, as indicated by accreditation standard scores. Insights gained regarding FC allocation patterns and their impact on LHD performance scores could help LHDs objectively allocate their resources based on the specific purpose or target they want to achieve at a particular period. LHDs are generally underfunded ^{8, 68} and managing available limited resources for optimal performance is key.^{67, 69} Understanding how public health investments in FC improve LHDs' PHAB accreditation performance score will extend our knowledge of how PH resources and capabilities relate to PHAB accreditation performance and could also inform how LHDs can improve their budgeting and resource allocation for better performance.

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APPENDIX I - C3

Selected (19) Standards and FC areas alignment: D – Domain, S – Standards. Detailed description of the alignment is available elsewhere.⁴⁵

https://phaboard.org/wp-content/uploads/PHABSM_WEB_LR1-1.pdf

Domain	Standards	Domain/Standard Composite	FC Alignment
1: Conduct and disseminate assessments focused on population health status and public health issues facing the community	1	D1S1	Assessment/Surveillance; Health Equity; Information Technology Services, including Privacy and Security
	2	D1S2	
	3	D1S3	
	4	D1S4	
2: Investigate health problems and environmental public health hazards to protect the community	1	D2S1	Emergency Preparedness and Response; Communications;
	2	D2S2	
	3	D2S3	
	4	D2S4	
3: Inform and educate about public health issues and functions	1	D3S1	Leadership; Health Equity; Communication
	2	D3S2	
5: Develop public health policies and plans	1	D5S1	Policy Development and Support; Assessment/Surveillance; Emergency Preparedness and Response; Community Partnership Development; Leadership and Governance
	2	D5S2	
	3	D5S3	
	4	D5S4	
6: Enforce public health laws	1	D6S1	Emergency Preparedness and Response; Policy Development and Support; Legal Services and Analysis
	2	D6S2	
	3	D6S3	
9: Evaluate and continuously improve processes, programs, and interventions	1	D9S1	Quality Improvement
	2	D9S2	

APPENDIX II - C3

The FPHS column list each activity per the national FPHS model. The PHAB Standards and Measures Version 1.5 Domains columns provide one column per PHAB domain. Where the alignment between the activities and the domain, the cells filled in with color green indicates the alignment. This excerpt was from the Public Health National Center for Innovations.

<https://phnci.org/uploads/resource-files/Aligning-Accreditation-and-the-Foundational-Public-Health-Capabilities-November-2018.pdf>⁴⁵

FPHS	PHAB Standards & Measures Version 1.5 Domains											
	1	2	3	4	5	6	7	8	9	10	11	12
Assessment/Surveillance												
Emergency Preparedness and Response												
Policy Development and Support												
Communications												
Community Partnership Development												
Organizational Administrative Competencies:												
– Leadership and Governance												
– Health Equity												
– Information Technology Services, including Privacy and Security												
– Human Resources Services												
– Financial Management, Contract, and Procurement Services, including Facilities and Operations												
– Legal Services and Analysis												
Accountability/Performance Management												
– Quality Improvement												

APPENDIX III - C3

Model Variable Selection

To determine the model specification for modeling the association between Total FC Budget (primary independent variable) and PHAB accreditation score (dependent variable), I used a fixed effect loglinear model using *glm()* for different model specifications. I used the Bayesian information criterion (BIC) and Akaike information criterion (AIC) as diagnostics for variable selection. Table A1-C3 shows the list of models tested and the corresponding diagnostic values. Model 5 has the lowest BIC and AIC, suggesting was the best model fit.

Table A1-C3: Model variable selection with BIC and AIC diagnostics			
Model	Variables	BIC	AIC
1	fcapbudget + fserbudget + exeeducode + version + authority + log(MEDHHINC) + pctLessHS + phabscorecluster	-28.36285	-42.20191
2	fcapbudget + fserbudget + exeeducode + version + log(MEDHHINC) + pctLessHS + phabscorecluster	-43.908	-58.248
3	fcapbudget + fserbudget + exeeducode + version + log(MEDHHINC) + phabscorecluster	-43.306	-56.212
4	fcapbudget + fserbudget + exeeducode + version + phabscorecluster	-44.801	-56.273
5	fcapbudget + fserbudget + exeeducode + phabscorecluster	-48.096	-58.134
6	fcapbudget + fserbudget + phabscorecluster	-46.350	-54.954
7	fcapbudget + fserbudget + exeeducode + version + authority + phabscorecluster	-32.788	-44.111
8	fcapbudget + fserbudget + authority + phabscorecluster	-36.114	-44.921
9	fcapbudget + fserbudget + version + phabscorecluster	-43.448	-53.487
10	fcapbudget + fserbudget + version + authority + phabscorecluster	-34.377	-44.442
11	fcapbudget + fserbudget + exeeducode + version + phabscorecluster	-44.801	-56.273
Authority: Number of budget related areas under the LBH authority CountyNum: Number of Jurisdictions served by an LHD medhhinc: Per Capita median household income of the jurisdiction served by an LHD (US Dollar) totalPHExp: Per Capita Total Public Health Expenditure (US Dollar) ExecEdu: Education level of LHD executive (1-Associate, 2-Bachelor, 3-Masters, 4-Doctorate) Version: PHAB Accreditation version (version 1.0 or version 1.5) Kmeanscltr: PHAB Standard Score Cluster (1 – Moderate Score, 1 – Low Score, 3 – Low Score) The dependent variable was the Average Score of the selected 19 PHAB standards			

**CHAPTER 4: ASSOCIATION BETWEEN LOCAL HEALTH DEPARTMENTS
GOVERNANCE STRUCTURE, LOCAL BOARD OF HEALTH'S AUTHORITY
OVER BUDGET AND PHAB ACCREDITATION STANDARD SCORE**

Association Between Local Health Departments Governance Structure, Local Board of Health's Authority Over Budget and PHAB Accreditation Standard Score

ABSTRACT

Context: The performance of local health departments (LHDs) is crucial to the public health (PH) system and the wellbeing of the populations in the jurisdictions served. Existing evidence suggests that several factors such as LHDs' governance structures and local boards of health (LBoH) can affect LHDs' performance. Thus, further understanding is needed regarding the nature of these factors as PH leaders seek evidence-based strategies and policy approaches to improve LHDs' performance. Public health accreditation board (PHAB) accreditation, which was developed to promote PH performance through assessment of health departments' capacity to carry out the ten essential PH services, has emerged as an instrument for appraising PH performance. In this study, I examined the relationship between LHDs' LBoH authority on LHDs' budget-related activities and their performance score in the PHAB standards, while considering the governance structure under which the agencies operate. **Methods:** Data from 250 LHDs were obtained from PHAB and combined with data from the 2016 National Association of City and County Officials Profile Survey. Multilevel regression analysis was used to examine the relationship between LBoH authority on LHDs' budget-related activities, using the governance structure as the group level unit. **Results:** The analyses identified positive associations between LBoH authority on LHDs' budget-related activities and their aggregate average performance score in PHAB accreditation. However, there was no apparent association between the type of governance structure under which an LHD operates and performance scores in PHAB accreditation standards, perhaps attributable to variation in the characteristics and roles of their governing bodies. **Conclusions:** The analyses suggest that LBoHs with authority related to

LHDs budget appear to have an influential role in budget-related activities and may improve LHDs' performance scores in PHAB accreditation standards. Vast variation in more specific LBoH roles and characteristics, however, exist across LHDs and for which there are no national data. More research is, thus, needed to control for or examine the influence of specific LBoH characteristics before the benefits of expanded LBoH authority over LHDs' budget-decision making to LHDs' performance can be fully understood.

Keywords: Local Health Departments, Governance Structures, Local Board of Health, Authority, Budgets, Performance, Population Health.

BACKGROUND

Local health departments (LHDs) are key to the effectiveness of the public health (PH) system in the United States (US). LHDs' programs and activities are dedicated to protecting and promoting population health.¹⁻⁴ It is believed that when LHDs' performance in these prevention programs and activities is maximized, population health should thrive.⁵⁻⁷ This assumption agrees with Donabedian's structure–process–outcome theory that stipulates that when structure is good, outcome is expected to be good.^{8,9} As optimal LHD performance is crucial to communities' wellbeing, there is great interest in LHDs' continuous quality improvement and a clear need for a strategies to measure and examine their performance.⁸⁻¹¹

Various factors have been shown to facilitate or hinder LHDs' performance.¹²⁻¹⁴ Among these factors are LHD governance structures, and the presence and functions of a local board of health (LBoH). The common classification of LHD governance structure is based on the delegation of control between a state agency and local agencies and is thus classified into three categories: (1) a centralized governance structure where state agencies have extensive legal and operational control over LHDs; (2) a decentralized governance structure where LHDs are independent; and (3) a shared or mixed governance structure in which some public health responsibilities are provided directly by the state agencies with others assumed by the LHDs.^{15, 16} Regarding the influence of governance structure on LHDs' performance in PH services, the evidence from existing studies has diverse conclusions. Some studies have found that LHDs operating under centralized governance structures (state-governed) have higher mean percentage performance of public health practices when compared to health departments with decentralized (standalone) or mixed (mixed-governed) structures.¹⁷⁻¹⁹ Other studies found mixed-governed health departments to have higher performance in essential PH services.^{13, 20} For example, Mays

et al²¹ discovered that centralized governance structures performed well in several PH services including policy development and planning, enforcement of health laws and regulations, linking people to needed health services, and evaluating the effectiveness of health services.²¹ In another study based on twenty items instrument developed by the Centers for Disease Control and Prevention to measure the three core PH functions, Mays et al. found that centralized governance structures performed by 13% lesser than mixed or standalone governance structure.²⁰

An LHD's LBoH is defined as a "legally designated body whose members are appointed or elected to provide advisory functions and/or governing oversight for the primary governmental public health agency, and/or public health activities (assessment, assurance, or policy development), for the protection and promotion of health in its community."^{22, 23} Not all LHDs have LBoH and evidence on the association between LBoH and LHDs' performance and activities are also mixed.^{7, 17, 21, 24, 25} In some reports, LBoH authority was shown to relate positively to LHD performance in ten essential public health services.^{14, 20} One study, for example, indicated that jurisdictions governed by a LBoH with policy-making authority was positively associated with performance in some PH services but noted that this relationship may not hold true for all jurisdiction sizes, especially those with populations less than 100,000.¹⁴ Other studies showed that although LBoH may influence LHDs' performance, their lack of experience in public health²² and/or lack of awareness of the statutory power they have²⁶ to set or recommend health priorities could limit the leverage they have to enhance LHDs' performance.

Some existing studies demonstrate that both LHDs' governance structure and their LBoH can influence an LHD leader's decision to participate in PHAB accreditation²⁷⁻²⁹ – a national accreditation program developed to promote health department performance through a set of standards and measures that determine proficiency in the ten essential public health services.^{30, 31}

Studies showed that LHDs' involvement in performance improvement activities such as interest in accreditation was related to having a LBoH.³²⁻³⁴ In another study by Shah *et al.*, LBoH that engage in continuous quality improvement functions are more likely to engage in directing, encouraging, and supporting LHDs' participation in accreditation.²⁸

In support of the widespread interest in standardized national public health performance assessment,^{7, 12, 35-38} PHAB accreditation³⁹ provides a means for appraising LHDs' performance since the program provides a set of standards that public health departments must achieve to demonstrate proficiency in delivering the ten essential PH services.⁴⁰ Besides looking at the influence of LHDs' governing structure and LBoH on decisions to participate in the PHAB accreditation process, examining the association between these factors and specific performance scores in the PHAB standards could provide further insight into these currently unclear associations. Understanding these more nuanced relationships could identify ways in which PH practitioners and policy makers can guide decisions regarding LHD governance and LBoH oversight to support improvement in specific areas of public health performance.

In chapter 3, I examined the relationship between LHD expenditures on an agency's foundational capabilities (FC) and their performance scores in PHAB accreditation standards. The analyses suggest that an increase in FC expenditure is likely to increase LHD performance scores in the PHAB accreditation standards. The study also indicated that how LHDs distribute their total FC budget to each FC program can influence their performance score. Budget decisions for an LHD could be influenced by their governing authority, LBoH, or the agency's ability to use its own discretion in distributing available resources to PH programs.⁴¹ For example, a state-governed LHD may not have the discretion to allocate available FC resources in a way that appears to optimize PHAB accreditation performance, due to state policy on

allowable program expenditures. Here, I examine the association between LBoH authority on LHDs' budget-related activities and LHDs' performance score in PHAB accreditation, considering the type of governance structure of the LHD. Until now, no study has been identified that examines the relationship between LHD governance structure and LBoH budgetary authority on LHD performance scores in PHAB accreditation standards.

METHODS

This secondary analysis used cross-sectional data to quantitatively examine the relationships stated above. The study did not involve human subjects nor require review and approval by the University of Washington Human Subjects Division.

Study Sample

The study sample included 250 LHDs from 38 states that completed the accreditation process with PHAB and participated in the 2016 National Association of County and City Health Officials (NACCHO) Profile survey.

Data

Data for LHD governance structure, LBoH authority over budget, education level of LHD lead executive, and number of jurisdictions served were obtained from the NACCHO Profile Survey.⁴² Accreditation version and scores were obtained from PHAB.³⁰ Jurisdictions' social and economic data came from the US Census Bureau.⁴³

LHD Governance Structure Index

Governance structure in previous studies has been defined based on a single component.^{44, 45} Mays *et al.*⁴⁶ described LHD governance structure as whether an LHD's

governance is under state control or independent. Other studies characterized governance structure as whether an LHD has a LBoH or not.^{27, 47, 17, 22} In this study, I used a multicomponent definition to classify LHDs based on different governance classes as reported in the 2016 NACCHO Profile. Details of the governance structure composite derivation and validation has been described elsewhere [Chapter 2]. Table 4-1 shows the overview of composite indices for the governance structure classification. The first digit of the index indicates whether an LHD is one of three options: 1- state-governed, 2 – standalone, or 3-mixed-governed. The second digit indicates whether an LHD operates under a health and human service (HHS) agency or not (1- Yes, 0-No). The last digit indicates whether or not the LHD has a LBoH (1- Yes, 0-No). Validation of the governance structure characteristics with respect to total PH expenditure agrees with previous studies that suggest state-governed (centralized) LHDs tend to have lower public health expenditures compared to standalone (independent) and mixed-governed LHDs.^{17, 48} Unlike definitions based on a single component, this multicomponent approach allows a more comprehensive classification of governance structure that may exist in LHDs.

Table 4-1: Composite governance structure derived from NACCHO Profile 2016			
Governance Class	Under Health and Human Services	Local Health Board	Composite Governance Structure Index
1	1	1	111
1	1	0	110
1	0	1	101
1	0	0	100
2	1	1	211
2	1	0	210
2	0	1	201
2	0	0	200
3	1	1	311
3	1	0	310
3	0	1	301
3	0	0	300

Governance Class	Under Health and Human Services	Has Local Board of Health
1 – State control		
2 – Standalone	1 – Yes	1 – Yes
3 – Mixed	0 – No	0 – No

LBoH Authority Level Over Budget

The majority of LHDs (approximately 75%)²² have a LBoH and they carry out governing functions on issues related to legal matters, policy, accountability, and resources, thus, suggesting that LHDs' quality, efficiency, and performance can be influenced by the effectiveness of the LBoH that governs them.^{22, 26, 28, 49} In this study, the scope of LBoH authority is narrowed to activities that relate to budget decision making, given that this is a common role of LBoHs within their resource stewardship functions.^{22, 23, 50} LBoHs' budget-related activities include reviewing, recommending, and approving LHDs' budget.²² LBoH authority, as characterized in the 2016 NACCHO Profile,⁴² is specific to the level of influence a LBoH has over certain agency activities (APPENDIX I-C4). Budget-related activities for this study were determined by considering whether an LBoH's activity could impact an LHD's budget decision making. LBoH authority level over budget was then defined as the number of budget-related activities that an LBoH has control over. The observable value for LBoH authority level over budget is between 0 – 4, but this value could be even greater because “other areas” not specifically defined in the NACCHO Profile, and thus not captured in this study, could be budget-related.

Performance Score in PHAB Standards

PHAB data categorize LHDs based on their proficiency in various accreditation standards and measures related to the ten essential PH services.⁴⁰ The details of the PHAB data structure have been described elsewhere [Chapter 2], but, briefly, there are 12 domains, 32 standards with

at least two standards for each domain, and each standard contains at least two measures.⁵¹

Domains are the groups of standards that relate to a broad group of public health services.⁵²

Standards are the required level of attainment that an LHD is expected to meet.⁵² Measures are the metrics for evaluating proficiency in a specific standard.⁵² The data also contain information on accreditation version (version 1.0 and version 1.5), accreditation status, and final scores in each measure.⁵²

In the PHAB accreditation assessment, an LHD is ranked in each measure on an ordered nominal scale of 1 – Not Demonstrated, 2 – Slightly Demonstrated, 3 – Largely Demonstrated, and 4 – Fully Demonstrated. For analytics purposes, I employed the same approach used in Chapter 2, first transforming the ranking to a numeric scale by assigning 0.25 to represent a unit on a Likert scale, such that a score of 0.25 is equivalent to Not Demonstrated and a score of 1.0 is equivalent to Fully Demonstrated. I then derived a performance score for each standard by averaging the scores of all measures in that standard. Only accredited LHDs were included in the analysis. The final data set for modeling LHDs' performance scores in PHAB accreditation standards contained cross sectional observations of 250 accredited LHDs.

Other Covariates

Other variables known to be associated with LHD performance were also included in this analysis.^{14, 17, 21} A variable for County Number was included to control for the number of counties served by an LHD. In most cases, this was one. Executive Education served as a variable for the education level of the LHD lead executive. Accreditation version was defined by 1 indicating version 1.5 and 0 indicating version 1.0. Median household income was the average median household income (in US Dollars) of an LHD's jurisdiction.

Analysis

I used a multilevel regression approach to evaluate the association between LBoH authority and LHD performance scores in PHAB accreditation standards with the LHDs grouped by governance structure. The primary independent variable was ‘LBoH authority.’ The dependent variable was performance scores in PHAB accreditation standards. I first used a generalized least square model to determine covariates that best fit the models. The tested models and diagnostic results for variable selection are shown in APPENDIX II-C4. The selected model included accreditation version, number of jurisdictions served, average median household income of the jurisdiction served, and education level of LHD lead executive as covariates, to control for their potential effects on the performance score. I used a mixed-model lognormal regression (assuming varying intercept, fixed slope for the independent variable and all covariates) to model the aggregate performance score and performance scores in each of the PHAB standards. The general definition for the mixed-model was given as:

$$\begin{aligned} \log(Pscore)_i &\sim N(\alpha_{h[i]} + \mathbf{X}_i\beta, \sigma^2) \\ \alpha_h &\stackrel{iid}{\sim} N(\mu_\alpha, \sigma_\alpha^2) \end{aligned}$$

Where:

$Pscore_i$ was the performance score for an LHD i ,

$\alpha_{h[i]}$ was the group level intercept parameter,

$\mathbf{X}_i\beta$ was the linear individual level covariate effects,

σ^2 was the variance of the $\log(Pscore)$,

μ_α was the mean of the group level intercept parameter,

σ_α^2 was the variance of the group level intercept parameter.

The models were also stratified by performance cluster – the cluster number identifying the performance group to which an LHD belonged. The cluster number was generated from a k-means cluster analysis of performance score in PHAB standards [Chapter 2, APPENDIX IV-C2]. The cluster analysis identified three distinct groups: Cluster 1 (n = 103) with average score of 0.95; Cluster 2 (n = 135) with average score of 0.87; and Cluster 3 (n = 12) with average score of 0.71.

The regression estimates were used to predict the aggregate average score in PHAB accreditation for an average LHD with different LBoH authority levels. The prediction was stratified by accreditation version and performance cluster, and the final output was transformed from log scale to linear (percent) scale. All data treatment and statistical analyses were performed in R Software package version 4.0.2. Missing values were imputed using Amelia bootstrap expectation maximization (EM) algorithm with five replicates. The percentage of missing values for each covariate ranged from 0.8% to 13%. Total missing values were approximately 3.5% of the total observations.

RESULTS

Descriptive Statistics of Composite Governance Structure and LBoH Authority

Table 4-2 shows the percentage of LHDs in each composite governance structure and the percentage of LHDs with respect to the number of budget-related activities under the LBoH authority. The descriptive results shown were computed prior to multiple imputation and the results after imputation were very similar. The majority (52%) of LHDs have governance structure category ‘201’ (standalone governance class, not under HHS, and has a LBoH). The governance structure for a few (13%) of the LHDs in the PHAB accreditation sample (n = 250) were not reported in the 2016 NACCHO data. Also, none of the LHDs had governance structure

‘110’ or ‘111’ or ‘310.’ The percent of LHDs with respect to the number of budget-related activities under the LBoH authority indicate that LBoH of state-governed LHDs (categories ‘101’ and ‘111’) had less authority than those that were standalone (categories ‘201’ and ‘211’) or mixed-governed (categories ‘301’ and ‘311’). Among LHDs that reported having a LBoH (n = 176), 86% (n = 151) reported having a standalone governance structure (category ‘201’ and ‘211’) and a high percentage (> 67%) of these LHDs had a LBoH with 3 or more authority levels. This was followed by the LHDs with mixed-governance structures with 40% from category ‘301’ and 56% from category ‘311’ having 3 or more LBoH authority levels. None of the state-governed LHDs has 3 or more LBoH authority level and as expected, LHDs that do not have a LBoH (categories ‘100’, ‘110’, ‘200’, ‘210’, ‘300’, and ‘310’) reported no authority.

Table 4-2: Percent of LHDs in each governance structure category and different LBoH Authority levels on budget-related activities

Governance Structure Index	Percent of LHD (n = 250)	LBoH Authority Level: Number of Budget-Related Activities Under LBoH Control			
		0	1	2	3 or more
100	1%	100%	0%	0%	0%
101	2%	0%	75%	25%	0%
110	0%	0%	0%	0%	0%
111	0%	0%	0%	0%	0%
200	11%	100%	0%	0%	0%
201	52%	2%	10%	15%	73%
210	4%	100%	0%	0%	0%
211	8%	0%	19%	14%	67%
300	0%	100%	0%	0%	0%
301	6%	13%	13%	19%	56%
310	0%	0%	0%	0%	0%
311	2%	0%	40%	20%	40%

Modeling Authority and Performance Score in PHAB Accreditation

The fixed effects estimate for average performance score and performance scores in each of the selected PHAB standards are shown in APPENDIX III-C4. Figure 4-1 shows the deviation of the regression intercepts (random effect), for the aggregate average performance score, with 95% confidence intervals from the intercept of an average LHD with respect to different composite governance structures. The random effect shows no significant difference between the composite governance structure as indicated by the overlap of the confidence intervals. The random effect for performance score in each of the PHAB standards (results not shown) also behaved similarly. The random effects model suggests that performance scores in PHAB accreditation standards has no apparent association with governance structure.

In contrast, there appears to be strong association ($p < 0.01$) between LBoH authority level and the aggregate average score in PHAB accreditation (Table 4-3). The model suggests that the aggregate average score in PHAB accreditation is likely to increase by 0.7% with a unit increase in the number of budget-related activities under LBoH authority. Positive associations were also observed for performance scores in each of the PHAB standards except for eight standards, each from a variety of different domains (Table 4-3). The strength of association with individual standards varied, with a significance of $p < 0.05$ found in 12 of the 32 standards. For a unit increase in the level of LBoH authority, the magnitude of a performance score increase in each of the standards ranged from 0.1% to 5.6%.

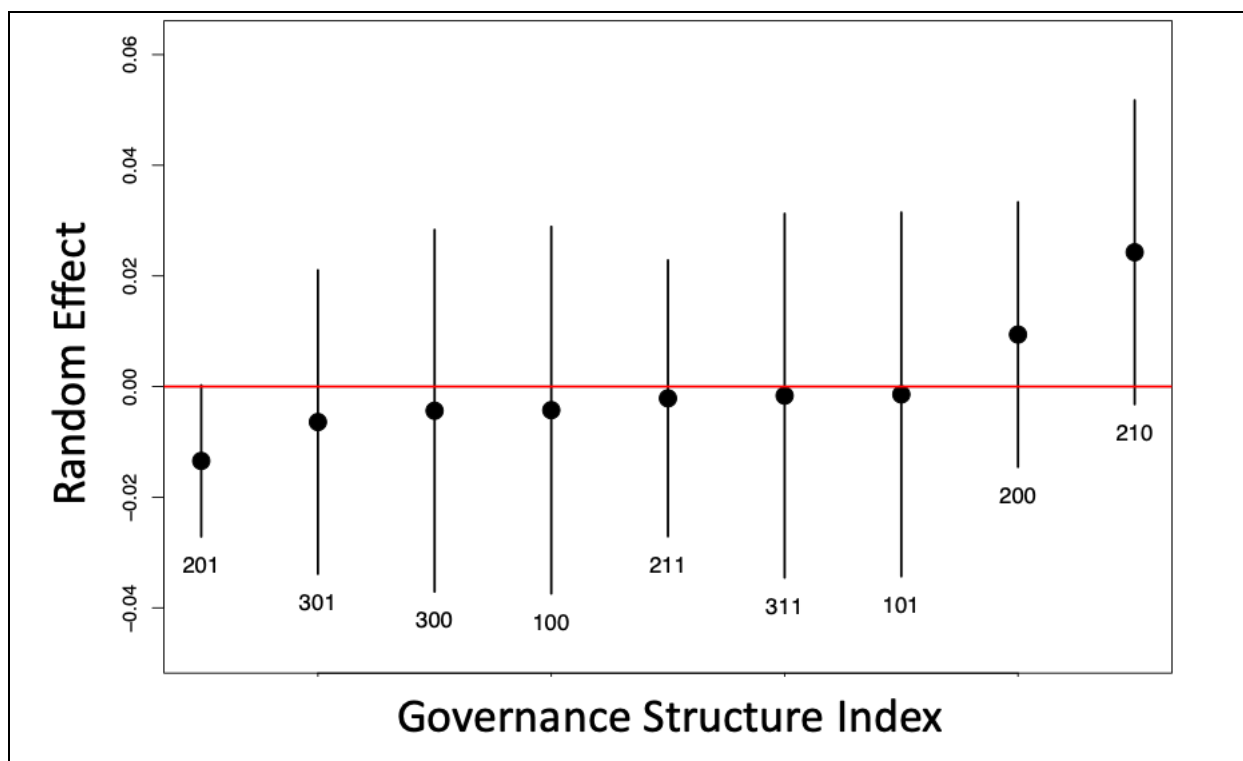


Figure 4-1: Deviation of the regression intercepts (random effect) with 95% confidence interval for different categories of governance structure. Primary dependent variable: Average performance score in PHAB Standards, Primary independent variable: LBoH authority. None of the accredited LHDs had governance structure ‘110’, ‘111’, and ‘310’.

Table 4-3: Change in performance score (%) for the aggregate average (aggavescore) of standards and each PHAB standards. D – Domain, S - Standard

	LBoH Authority	p-value
aggregate average	0.72	0.006
D1S1	2.06	0.013
D1S2	1.78	0.046
D1S3	0.74	0.343
D1S4	0.10	0.757
D2S1	-0.21	0.219
D2S2	1.17	0.080
D2S3	0.83	0.259
D2S4	1.41	0.054
D3S1	-1.30	0.035
D3S2	0.45	0.264
D4S1	3.24	0.003
D4S2	-1.29	0.113
D5S1	2.14	0.019

D5S2	2.43	0.038
D5S3	2.44	0.012
D5S4	0.68	0.481
D6S1	0.98	0.214
D6S2	-0.07	0.607
D6S3	-0.83	0.259
D7S1	-1.01	0.189
D7S2	-0.79	0.244
D8S1	-1.16	0.245
D8S2	0.29	0.521
D9S1	0.97	0.251
D9S2	1.85	0.042
D10S1	0.18	0.327
D10S2	0.23	0.569
D11S1	0.72	0.173
D11S2	1.76	0.022
D12S1	0.64	0.122
D12S2	5.55	0.000
D12S3	0.53	0.359

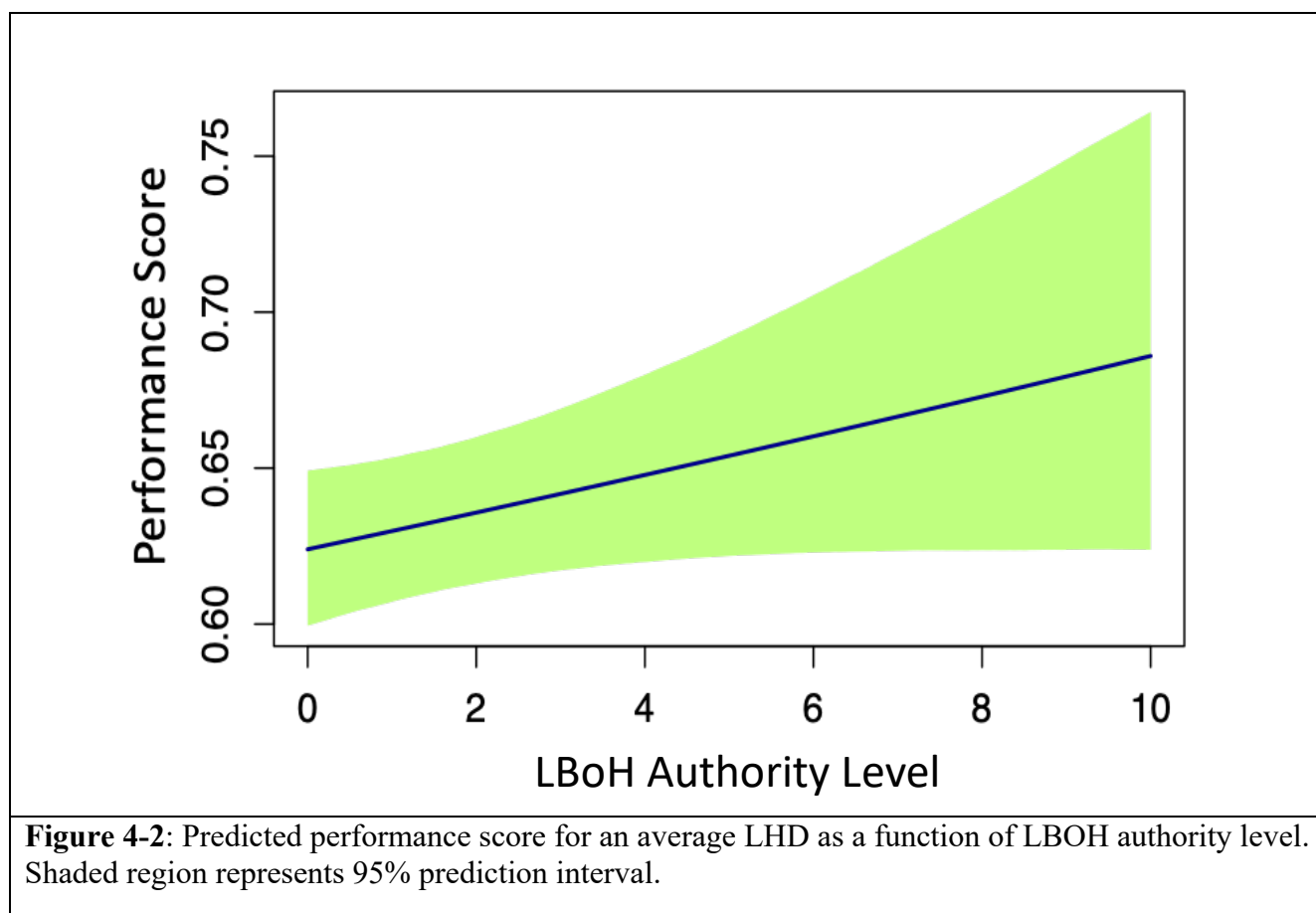
Domain Description: Domain 1- Conduct and Disseminate Assessments Focused on Population Health Status and Public Health Issues Facing the Community; Domain 2 - Investigate Health Problems and Environmental Public Health Hazards to Protect the Community; Domain 3 - Inform and Educate about Public Health Issues and Functions; Domain 5 - Develop Public Health Policies and Plans; Domain 6 - Enforce Public Health Laws; Domain 9 - Evaluate and Continuously Improve Processes, Programs, and Interventions. Full descriptions of domains and standards are described elsewhere and listed in APPENDIX I-C3.³¹

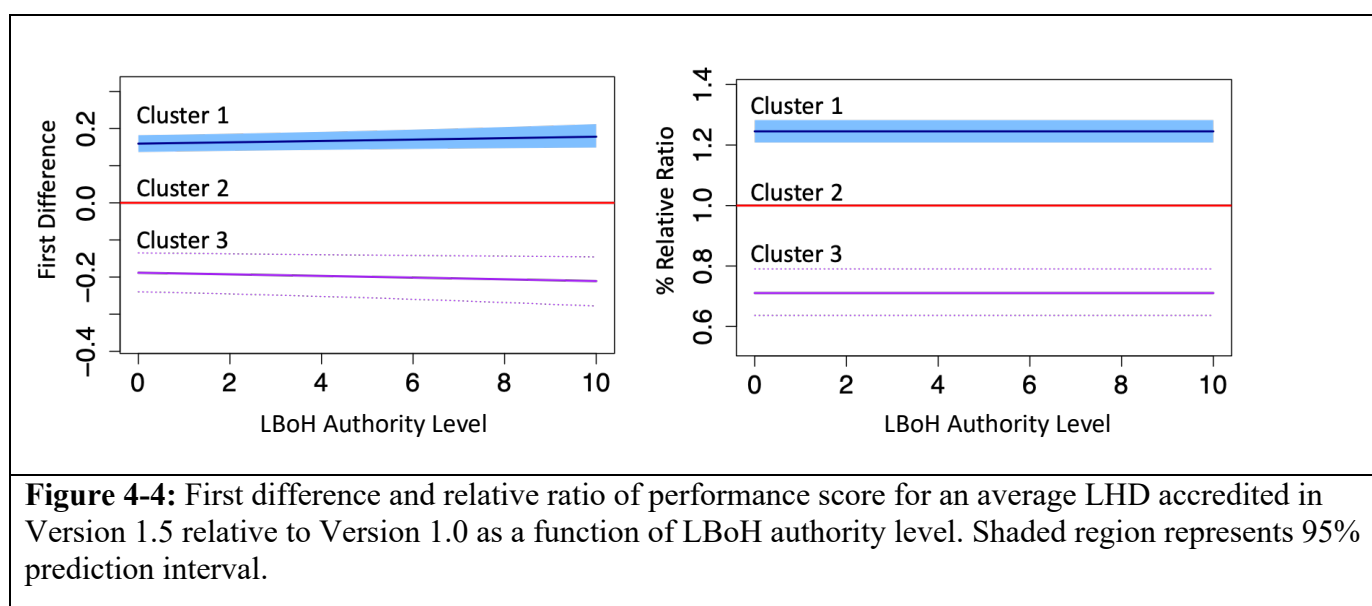
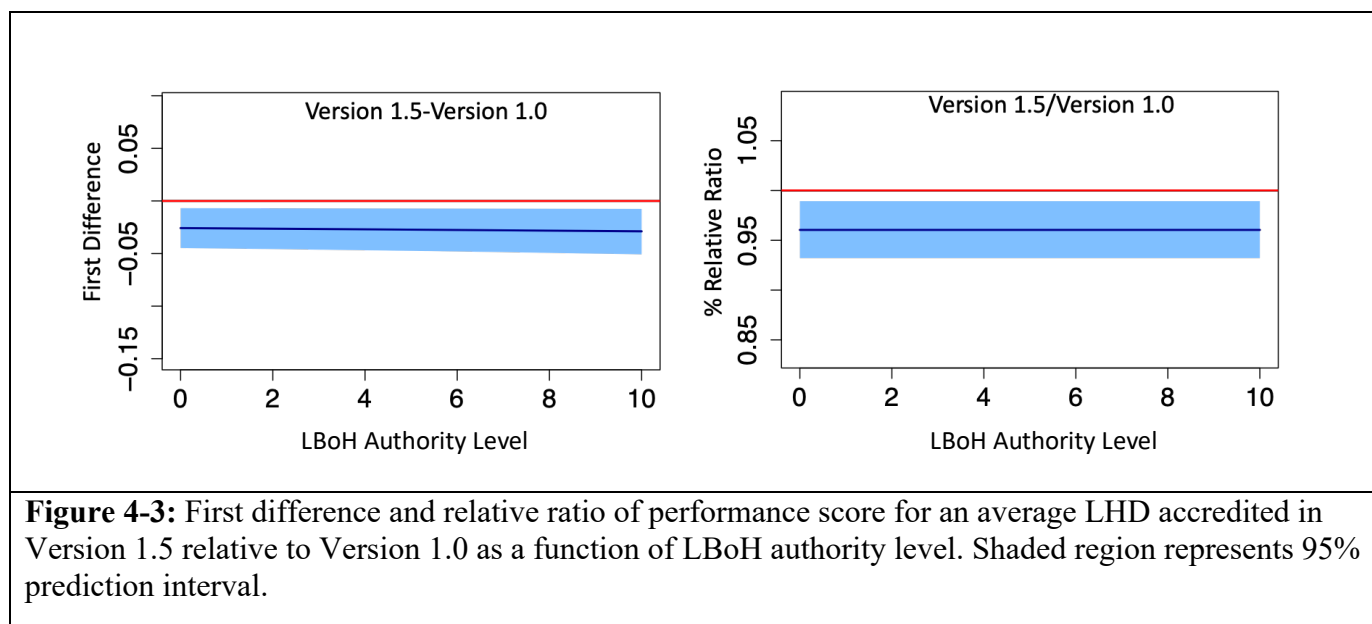
Prediction of Performance Score with Different Levels of Authority.

Using the fixed effects estimates of the loglinear multilevel regression (APPENDIX II-C4), a prediction of performance score with respect to LBoH authority level for an average LHD was examined using a counterfactual do-calculus approach. Figure 4-2 shows the performance score with 95% prediction interval for an average LHD with LBoH authority from 0 to 10, accredited with PHAB Accreditation Standards and Measures version 1.5, and in performance Cluster 2 (moderate-performance group). Other covariates were kept constant at their average. In general, performance score increased with LBoH authority level.

Accreditation version also appeared to influence performance score for the sample used in this study. As shown in Figure 4-3, relative difference in performance score, LHDs accredited

with PHAB Standards and Measures version 1.0. were likely to score approximately 4% higher than those accredited with version 1.5. Figure 4-4, shows the relative difference and relative risk ratio of performance score for an LHD in performance Cluster 1 (high-performance group) and Cluster 3 (low-performance group). The results indicate that the performance score for LHDs in Cluster 1 were approximately 15% higher than for LHDs in Cluster 2 at any level of authority between 0 and 10. Conversely, the performance score for LHDs in Cluster 3 were approximately 20% less than that of LHDs in Cluster 2 at any level of authority between 0 and 10.





DISCUSSION

From the descriptive analyses, it is apparent that the LBoH of LHDs that reported standalone-governance were more likely to have more budget-related authority than the LBoH of those that reported state-governed or mixed-governance. This suggests that LBoH of LHDs that are standalone have more power and responsibility to direct and influence LHDs' activities.

Being under HHS also appears to reduce the LBoH's authority level, but to a lesser degree than being under state governance. Despite these apparent relationships between LBoH and governance, no apparent relationship between LHDs' governance structures and performance score in PHAB accreditation was observed. Although, analysis of the average PH expenditures per capita in a previously reported study suggests that state-governed LHDs tend to spend less than standalone or mixed-governed LHDs,⁴⁸ performance scores in PHAB accreditation seemed here to be similar for each of the governance structure categories. This observation seems to be consistent with previous studies where the conclusions on association between governance structure and PH agencies' performance were mixed and perhaps underscores a lack of relationship.^{13, 17-20} Lack of distinct association between governance structure and PHAB performance score may be as a result of the influence of accreditation policy in some states. For example, Ohio, North Carolina, Michigan, Missouri, Illinois, and Florida have statewide mandatory or favorable accreditation policies.^{53, 54}

Even though some previous studies have attributed likelihood of accreditation uptake to the presence of a LBoH,¹²⁻¹⁴ the LHDs with no LBoH, LHDs in all governance structure categories ending with 0, among the sample for this study did not perform less well on their accreditation scores than those that reported having a LBoH. This may be explained by many variations that exist in the roles and characteristics of LBoH across LHDs. The mere presence of LBoH is unlikely to increase accreditation performance scores, if the LBoH is not committed to supporting LHDs' quality improvement efforts and essential community health services at or with the LHD. Another possible explanation is that the standalone agencies may be more likely to encounter challenges in pursuing accreditation than state-governed or mixed-governed

agencies who may have better resources, especially when the state has favorable accreditation policy that supports LHDs operating under them.

Prior studies suggest that presence of LBoH positively associates with per-capita spending, and may thus influence LHDs' activities and their performance.^{14, 20, 22, 48, 55} The results of this study support this prior evidence and further suggests that, when established to play a vital role with an LHD, LBoH appear to be a potentially important partner and benefit to the LHD's performance and, thus, its ability to serve its community. In particular, the degree of LBoH authority, especially the budget-related activities, can have a positive influence on an LHD's performance. LBoH can influence LHDs' activities in several ways, including the authority to recommend or establish agencies' priorities, and budget approval.²² One study suggests that LHDs rely on LBoH's inputs on resource allocation decisions to support LHDs programs and activities.⁴¹ The observed increase in average accreditation performance score by almost 1% when budget-related activities under LBoH authority increases by one unit, may be indicative of the effectiveness in LBoH's roles when helping set and support LHDs' priorities. This may also indicate that LBoH budget advice can be supportive of LHDs' quality improvement efforts, especially when LBoH utilize their authority effectively in support of LHD programs and activities.^{28, 32-34}

While the analyses here suggest giving LBoH more authority on budget-related activities, such broad power over LHDs' budget policy could lead to an unfavorable outcome, especially if the LBoH is not committed to the shared responsibilities of the agency's quality improvement efforts to support community health outcomes. Previous studies have reported "low performance of LBoH" in accreditation prerequisite activities (community health assessment, community health improvement planning, and strategic planning) and "underutilization of the boards" in

agencies' efforts to improve community health outcomes.^{22, 26} A recent study found significant gaps in LBoH's participation in the quality improvement efforts of LHDs.⁵⁶ Insights from these previous studies indicate that lack of LBoHs' engagement in LHDs quality improvement efforts may inhibit LHDs' performance in accreditation. However, as suggested by the findings of this study, LBoHs can seemingly play a role in strengthening LHDs' performance in PHAB accreditation when LBoH statutory power are used for the common good of the agency and the community they serve. Research showed that LBoH who are engaged in quality improvement functions are likely to support LHDs' accreditation activities.⁵⁷ Also, as resource availability is a major factor for successful accreditation,^{58, 59} when LBoH supports LHD accreditation, both LBoH and LHDs' leadership can engage in mutual collaboration on strategic planning and resources management to ensure a successful accreditation. Therefore, for the positive association found in this study to be meaningful to LHDs' works and their accreditation performance, LBoH must see the broader authority on budget policy as a shared responsibility, together with the agency, to improve LHDs ability to provide the essential public health services.

The findings of this study also present implications for policy. The study supports PH leaders' efforts to understand how LHDs' governing structures, as well as the authority and functions of LBoH influence LHDs' effectiveness, efficiency, and community health outcomes. The legal powers and functions of LBoH and the governing boards can influence LHDs' policy decision-making on finances, accreditation, and other areas that are central to LHDs' performance. The National Association of Local Board of Health (NALBOH), which serves as a voice for the nation's boards that govern PH agencies, developed a model of six functions of PH governance in an effort to strengthen and improve PH governance.^{23, 50} These six functions include policy development and resource stewardship. Resource stewardship entails PH

governance to develop or approve a budget that aligns with the agency's identified needs. It also allows PH governance to advocate for necessary funding to sustain LHD activities, when appropriate, and to exercise fiduciary care of the funds entrusted to the agencies.²³ These responsibilities require an understanding of how the authority entrusted to LBoH affects LHDs' activities, and the implication for LHDs' accreditation performance is important for evidence-based strategies and policy to improve LHDs' performance. The results of this study suggest that involving LBoH in budget decision making could be one possible strategy to improve LHDs performance scores, by broadening the responsibility for and influence of the LHD through LBoH partners that are ideally committed to collaboratively achieving better population health outcomes.

Limitation

There are limitations in this study. The limited sample size for modeling performance scores hampered the model ability to demonstrate significance; as more statistical power would have been preferred. Also, the cross-sectional data used in this study limited the ability to infer a causal relationship between LBoH authority and LHD's performance score in PHAB accreditation. Some potentially influential factors were unobserved, such as the individual district variation and the differences in make-up or membership of individual LBoH, that may have impacted LHD performance. Future study could explore, for example, how LBoH contributions to LHDs' performance in PHAB accreditation differs when LBoH are composed entirely of elected officials or more inclusive of health experts. Nevertheless, the analysis here provides insight to the understanding of the influence of LHD governance structure and the LBoH authority level. This insight is needed for evidence-based strategies and policies that can benefit LHDs' performance in PHAB accreditation assessments.

CONCLUSIONS

This study demonstrates that LBoH with authority over budget-related activities are positively associated with LHDs' performance scores in PHAB accreditation. A broader LBoH authority on budget-related activities should likely be seen as shared responsibility for budget policy and strategic planning that enhances LHDs' performance in accreditation and their efforts to improve community health outcomes. This study contributes to the existing body of knowledge regarding the impact of LHDs' governing authorities on quality improvement in public health. Such insight could guide strategies and policies that can benefit LHDs' accreditation uptake and improved performance scores, that may in turn serve to more effectively support their communities' health.

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APPENDIX I - C4

Table A1-C4. Activities under LBoH authority as characterized in 2016 NACCHO Profile. Section: Jurisdiction and Governance, No. 5.		
	Activities	Could Impact LHD Budget Decisions
1	Hire or fire agency head	X
2	Approve the LHD budget	X
3	Adopt public health regulations	
4	Set and impose fees	
5	Impose taxes for public health	
6	Request a public health levy	
7	Advise LHD or elected officials on policies, programs, and budgets	X
8	Set policies, goals, and priorities that guide the LHD	X
9	Impose or enforce quarantine or isolation orders	
10	Other Areas	

APPENDIX II - C4

Variable Selection for Modeling Performance Score in PHAB Standards

To examine the association between the LBoH authority (primary independent variable), composite governance structure (group), and PHAB accreditation score (dependent variable), I used a fixed effect lognormal model using *glm()* function with Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) diagnostics for variable selection. Table A2-C4 shows the list of models tested and the corresponding BIC and AIC values. Model 5 has the lowest BIC and lowest AIC, suggesting it had the best model best fit.

Table A2-C4. Model variable selection with BIC and AIC diagnostics			
Model	Variables	BIC	AIC
1	Authority + Countynum + log(MEDHHINC) + exeeducode + pctLessHS + version + kmeanscltr + log(TotalPHExp)	-302.3597	-342.737
2	Authority + CountyNum + ExecEdu + Version + log(medhhinc)+ log(totalPHExp) + phabscorecluster	-305.2774	-342.5488
3	Authority + CountyNum + ExecEdu + Version + log(totalPHExp) + phabscorecluster	-309.6102	-343.7756
4	Authority + CountyNum + Version + log(totalPHExp) + phabscorecluster	-330.5925	-355.6317
5	Authority + CountyNum + ExecEdu + Version + log(medhhinc) + phabscorecluster	-389.6803	-426.3403
6	Authority + ExecEdu + Version + log(medhhinc) + phabscorecluster	-306.6431	-343.9145
7	Authority + ExecEdu + Version + log(totalPHExp) + phabscorecluster	-308.9886	-343.154
Authority: Number of budget-related areas under the LBOH authority CountyNum: Number of Jurisdictions served by an LHD medhhinc: Per Capita median household income of the jurisdiction served by an LHD (US Dollar) totalPHExp: Per Capita Total Public Health Expenditure (US Dollar) ExecEdu: Education level of LHD executive (1-Associate, 2-Bachelor, 3-Masters, 4-Doctorate) Version: PHAB Accreditation version (version 1.0 or version 1.5) Kmeanscltr: PHAB Standard Score Cluster (1 – Moderate Score, 2 – High Score, 3 – Low Score) The dependent variable was the Average Score of the selected 19 PHAB accreditation standards			

APPENDIX III - C4

Regression fixed-effect coefficients for aggregate average (*aggavescore*) of standards and each PHAB standards. *D* denotes PHAB Domain, *S* denotes PHAB Standards. Full Description of PHAB Domains and Standards can be found elsewhere. https://phaboard.org/wp-content/uploads/PHABSM_WEB_LR1-1.pdf

	Intercept	Authority	countynum	ExecEdu2	ExecEdu3	ExecEdu4	Cluster1	Cluster3	log(medhhinc)	Version1.5
aggavescore	-0.6959	0.0071	-0.0040	-0.0532	-0.0457	-0.0255	0.2284	-0.3398	0.0293	-0.0364
D1S1	-0.8411	0.0203	-0.0113	0.2030	0.1141	0.1645	0.2077	-0.2070	0.0288	-0.1318
D1S2	-0.5500	0.0176	0.0015	-0.1610	-0.1560	-0.1387	0.2433	-0.3090	0.0227	-0.0515
D1S3	-2.0549	0.0074	-0.0077	-0.0397	-0.0236	0.0186	0.2584	-0.3070	0.1484	-0.0456
D1S4	-1.9343	0.0010	-0.0040	-0.1594	-0.2749	-0.1502	0.1386	-0.5640	0.1721	0.0065
D2S1	-1.6019	-0.0022	0.0117	0.1093	0.1349	0.1082	0.1748	-0.2985	0.1051	-0.0516
D2S2	-0.3056	0.0116	0.0093	-0.2116	-0.2045	-0.2199	0.1994	-0.3200	0.0111	-0.1345
D2S3	0.0434	0.0083	-0.0113	-0.2648	-0.2774	-0.2727	0.1335	-0.3323	-0.0021	-0.1121
D2S4	1.0484	0.0140	0.0033	0.0475	0.0038	0.0687	0.1334	-0.3481	-0.1223	-0.1959
D3S1	-1.2511	-0.0131	-0.0070	0.3219	0.3781	0.3433	0.2751	-0.4680	0.0408	-0.1248
D3S2	-0.4779	0.0045	0.0000	-0.2566	-0.2327	-0.2446	0.1541	-0.3759	0.0399	-0.0862
D4S1	0.0875	0.0319	-0.0077	-0.3250	-0.2977	-0.2565	0.2603	-0.4921	-0.0187	-0.1437
D4S2	-0.9112	-0.0130	-0.0041	-0.3769	-0.2345	-0.2046	0.2012	-0.4885	0.0891	-0.1448
D5S1	0.1554	0.0212	-0.0017	0.1839	0.1505	0.1833	0.2485	-0.5659	-0.0635	0.0233
D5S2	-0.5573	0.0240	-0.0159	-0.0461	-0.0815	-0.0508	0.2198	-0.3396	0.0050	0.0635
D5S3	0.4151	0.0241	-0.0091	-0.3877	-0.3564	-0.4047	0.1657	-0.3932	-0.0489	0.0728
D5S4	0.4650	0.0067	-0.0046	0.2164	0.2714	0.2949	0.2051	-0.0841	-0.1094	-0.0462
D6S1	-3.0256	0.0097	-0.0124	0.0887	0.0710	0.1362	0.2018	-0.3968	0.2285	-0.0494
D6S2	0.4053	-0.0007	0.0022	0.0748	0.1000	0.0701	0.1063	-0.3527	-0.0573	-0.0281
D6S3	-0.6512	-0.0083	0.0030	0.1439	0.1568	0.1926	0.2940	-0.2411	0.0070	-0.0452
D7S1	-2.0478	-0.0101	0.0072	0.3144	0.2598	0.2745	0.2022	-0.3162	0.1216	-0.0916
D7S2	-0.0347	-0.0079	-0.0051	-0.0099	-0.0373	-0.0038	0.1927	-0.4035	-0.0160	-0.1028
D8S1	-0.4150	-0.0117	0.0074	-0.1306	-0.1572	-0.1884	0.1026	-0.2294	0.0407	0.0405
D8S2	-0.2924	0.0029	0.0113	-0.3650	-0.3366	-0.2944	0.2062	-0.2876	0.0206	-0.0275
D9S1	-2.5442	0.0096	-0.0071	0.0195	-0.0122	-0.0569	0.3023	-0.3841	0.1852	-0.0364
D9S2	-1.8867	0.0183	-0.0095	0.0501	-0.0487	-0.0407	0.3262	-0.2663	0.1217	0.0791
D10S1	1.0163	0.0018	0.0033	-0.3791	-0.1698	-0.1179	0.1982	-0.4037	-0.1032	0.0344
D10S2	0.0063	0.0023	-0.0042	-0.0082	0.0671	0.1703	0.1746	-0.4585	-0.0390	0.0235
D11S1	0.0605	0.0072	0.0014	0.0425	0.0782	0.0666	0.1733	-0.2609	-0.0442	-0.0906
D11S2	-0.3499	0.0174	-0.0066	-0.1851	-0.1619	-0.1317	0.1461	-0.2410	0.0212	0.0404
D12S1	-0.3042	0.0064	-0.0013	-0.0857	-0.0727	-0.0720	0.0644	0.0661	0.0253	-0.0120
D12S2	-0.3351	0.0540	-0.0150	-0.2190	-0.1557	-0.1936	0.2183	-0.2062	0.0127	-0.1176
D12S3	0.5683	0.0053	-0.0221	-0.0619	-0.1028	-0.0891	0.3870	-0.2238	-0.0963	0.0705

Regression fixed-effect coefficients for aggregate average (*aggavescore*) of standards and each PHAB standards (estimates with PHAB performance scores cluster stratification and estimate without performance scores cluster stratification).

	Authority (Model Stratified with PHAB Scores Cluster)	Authority (Pooled Model Estimates)
aggavescore	0.0071	0.0115
D1S1	0.0203	0.0227
D1S2	0.0176	0.0238
D1S3	0.0074	0.0123
D1S4	0.0010	0.0052
D2S1	-0.0022	0.0028
D2S2	0.0116	0.0167
D2S3	0.0083	0.0131
D2S4	0.0140	0.0167
D3S1	-0.0131	-0.0120
D3S2	0.0045	0.0065
D4S1	0.0319	0.0384
D4S2	-0.0130	-0.0071
D5S1	0.0212	0.0262
D5S2	0.0240	0.0295
D5S3	0.0241	0.0308
D5S4	0.0067	0.0100
D6S1	0.0097	0.0152
D6S2	-0.0007	0.0034
D6S3	-0.0083	-0.0023
D7S1	-0.0101	-0.0004
D7S2	-0.0079	-0.0030
D8S1	-0.0117	-0.0080
D8S2	0.0029	0.0079
D9S1	0.0096	0.0186
D9S2	0.0183	0.0240
D10S1	0.0018	0.0053
D10S2	0.0023	0.0085
D11S1	0.0072	0.0114
D11S2	0.0174	0.0213
D12S1	0.0064	0.0069
D12S2	0.0540	0.0589
D12S3	0.0053	0.0160

CHAPTER 5: CONCLUSION

SUMMARY

This study generated results that are valuable to public health (PH) leaders, policymakers, and researchers in understanding the relationship between local health departments' (LHDs) characteristics, finance, and governance structure, and their performance scores in PHAB accreditation standards as a means to prioritize public health system infrastructure needs to be addressed. Such research requires innovative approaches to uncover the complex relationships among the factors that affect LHD performance.

The three papers described in this research used innovative methods to advance the science of LHD performance. To improve the financing and economics of public health systems that impact LHDs' performance in delivering core PH services for community health and the equitable distribution of prevention resources, I used a unique approach to examining PH accreditation data by individual standard. I then employed a novel means to identify more specific areas of LHDs' performance that need to be addressed for communities to be adequately served. Performance scores in Public Health Accreditation Board (PHAB) standards were used as a direct measure of LHDs' ability level in demonstrating provision of the core PH functions for effective response to health threats and promoting community health. Statistical methods that included cluster analysis and multivariate regression were used to analyze LHDs' performance scores in PHAB accreditation standards as a function of their characteristics, their investments in the core PH infrastructures, including foundational capabilities (FC), and their organizational structure. Specific to the second paper (Chapter 3), I also used a novel approach to making use of new, crucial, and comparable financial data^{1,2} – LHDs' uniform chart of accounts (UCOA) data – and linked it with data from the National Association of County and City Health Officials (NACCHO)³ to specifically identify the most critical mix of core public health department

infrastructure elements like emergency preparedness, communications, and policy development that support LHDs' performance.

In Chapter 2, I identified clusters of accredited LHDs based on variations in their performance scores in PHAB accreditation standards and described the variation in their performance related to LHDs' characteristics in the identified clusters. Three distinct clusters emerged, showing a range in PHAB accreditation performance scores and differences in organizational and jurisdiction characteristics across clusters, notably in the size of the jurisdictions served. The results showed that performance score clusters can be a useful national metric for classifying LHDs based on their potential to promote community well-being and suggested that smaller LHDs serving rural populations may require more targeted supports to boost their performance scores.

In Chapter 3, I examined the association between LHD total FC expenditures, FC funding allocation patterns, and performance scores in related PHAB standards. The analyses showed a positive association between total FC expenditures and the aggregate performance score in selected PHAB standards, as well as the performance scores in most of the individual standards examined. The results suggest that the investment in FC could improve LHD performance scores in PHAB accreditation standards, but, more importantly, it showed that how LHDs allocate their FC resources matters. A more evenly distributed total FC allocation is associated with higher performance scores.

The third paper (Chapter 4) examined the relationship between LHDs' local board of health (LBoH) authority on LHDs' budget-related activities and their performance scores in the PHAB standards, while considering the governance structure under which agencies operate. The results showed that LHDs' LBoH governing authority on budget-related activities is positively

associated with LHDs' aggregate average performance score in PHAB accreditation. However, there was no apparent association between the type of governance structure under which an LHD operates and performance scores in PHAB accreditation standards. The results showed LBoHs with authority related to LHD budgets appear to have an influential role in budget-related activities and may positively influence an LHDs' performance scores in PHAB accreditation standards. However, vast variation in more specific LBoH roles and characteristics exists that were not observable in this study. Therefore, more research is needed to fully understand how the expanded LBoH authority over LHDs' budget-decision influences or benefits LHDs' performance scores in PHAB accreditation standards.

Implications for PH Practice, Policy and Research

The results of this dissertation research suggest areas of focus that might support further development of a stronger public health infrastructure and LHD performance. These areas include support for rural jurisdictions and guidance related to roles for local boards of health and the allocation of foundational capability resources.

National Strategy

The COVID-19 pandemic has further reinforced the need for a stronger and more effective public health infrastructure and its importance to promoting and maintaining population health and the restoration of health for communities.⁶ The evidence generated here suggests that an effective national PH strategy with policies that guide LHD financial allocations and structures are important for assuring LHD performance and supporting their role in promoting population well-being, including during a public health crisis.^{6, 7 8} Study results reveal how

LHDs' characteristics, their budgeting, and allocation pattern of scarce resources can be managed to improve the core PH infrastructure for promoting population health.

Effective Resource Allocation

For decades PH leaders have advocated for more resources for LHDs' core capabilities necessary to respond effectively, on a day-to-day basis and during health crises.⁹⁻¹¹ This study shows that increases in PH investments are positively associated with aggregate performance scores and performance scores in several standards. While it is apparent that increasing funding for PH infrastructure may lead to improved performance for LHDs in the United States, the analysis also revealed that the approach in which LHDs allocate available funds to the various FC areas could impact their performance scores in PHAB accreditation standards. Therefore, effective resource allocation strategies are needed for LHDs to achieve optimal performance in delivering their PH programs and services. Understanding FC allocation patterns in relation to performance scores in PHAB standards provides information and potential guidance to LHDs on how FC resource allocation may affect their agencies' performance.

Financial Priority Setting

As COVID-19 brought to light the impact of an underperforming PH infrastructure on the public's health, policy makers responded with some significant efforts to infuse funds into the PH system, which were intended to cushion LHDs' financial stress. PH leaders are therefore obliged to ensure efficient stewardship of these funds for the benefit of the communities they serve and to promote population health equity. This study provides evidence for seemingly effective approaches for setting priorities when allocating PH resources for maximum LHD

performance. This study also shows the impact of LHDs' governing authorities on quality improvement in public health and can provide insight into understanding the influence of LHD governance structures and the LBoH authority levels that can effectively support LHDs in their quality improvement and performance efforts.

Use of Individual PHAB Standards

Furthermore, PHAB accreditation appears to be achieving its aims of promoting high performance and continuous quality improvement among LHDs as this study supports prior research regarding connections between accreditation efforts and agency performance. The insights gained through this study's deeper use of individual PHAB standards and conducting a comparative assessment of performance among accredited LHDs, can guide PH leaders' strategies and policies to maximize the benefits of LHD accreditation uptake and improve performance scores, which may in turn provide more support for the health of the communities they serve.

Aggregate performance scores provide a general overview of where LHDs may need more support to meet the accreditation criteria. The specific PHAB standards examined here advances the field of PH accreditation research and revealed areas where LHDs lack proficiency and where targeted interventions for performance improvement are most needed. As accreditation uptake increases among PH agencies and thus provides a more uniform means of assessing LHDs' performance, future research will benefit from longitudinal studies that could reveal the dynamics of how accreditation is impacting LHDs' performance and quality improvement overall and with regard to specific performance standards. Such longitudinal

studies will also benefit PH when these studies can be conducted with more robust uniform LHD financial data.

Conclusion

Our public health system infrastructure has been historically and chronically under-resourced and thus under-prepared for the current pandemic.¹² The evidence presented in this research is timely and important. The results provide a significant contribution to promoting effective resource allocation and ongoing public health policy and infrastructure discussions. Understanding what is needed to support more effective and high-performing LHDs is crucial to the PH system due to its impacts on population health and the well-being of communities across the U.S., particularly the marginalized communities that are often served by the least well-resourced and most poorly performing health departments. These findings are, thus, useful to PH leaders, policymakers, and researchers for prioritizing how to address specific public health system infrastructure needs to support LHDs' performance in effectively meeting community health needs.

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