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# Centralized Versus Decentralized Public Health Infrastructure in the Us - Stronger Together

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**Abstract** With public health infrastructure improvements underway in the US strategies on how to best execute these improvements vary due to the governance structures at the state and local level. This study reviewed the literature to understand the strengths and weaknesses of centralized and decentralized governance frameworks. Understanding the strengths and weaknesses allows infrastructure improvement strategies to effectively deploy modernization, data integration, and data standardization practices. Incorporating data from the last 15 years, the study investigated both US and international governance structures to uncover best practices to further benefit the local and state governance structures in the US. In addition to capturing the current strengths and weaknesses this review also seeks to identify barriers the different governance structures may encounter while implementing the infrastructure improvement plans. The number of resources, both in terms of staff and funding, being dedicated to these initiatives underscores the importance of tailoring the initiatives to the strengths and weaknesses of the governance structures. A hybridized approach to public health infrastructure investments may maximize the strengths of both governance structures while minimizing their weaknesses.

***Keywords:*** *public health infrastructure, data infrastructure, interoperability*

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## 1. Introduction

Public health departments at the state level exist in a range of governance structures in the US. These governance structures, defined by the Association of State and Territorial Health Officials (ASTHO) and the National Opinion Research Center (NORC), separate the 50 states into seven different categories captured in Figure 1. [1] Due to the organization of these governance structures, states implement public health actions like monitoring, reporting, and case management using different methods. This poses unique challenges to initiatives like the Public Health 3.0 recommendations set by the US Department of Health and Human Services (HHS). Certain components of the Public Health 3.0 recommendations – notably recommendation four which focuses on infrastructure modernization, data integration, and data standardization – inherit unanticipated barriers from the various governance structures. To understand the possible barriers to these initiatives it is necessary to look at the strengths and weaknesses of the two largest formats for governance structures in the US, centralized and decentralized structures.

Understanding the status of current public health initiatives and their objectives like modernization contextualizes the strengths and weaknesses of both governance structures. Examining this allows us to adopt practices from the different governance structures to maximize the strengths and minimize the weaknesses for all versions. Without the context, any assessment of the different governance structures omits the full impact of their efforts as well as any confounding elements, like federal support or funding. Investigating some of these potential confounding elements also permits analysis of how both governance structures utilize outside resources, adding another data point in the strengths and weaknesses array. Combining these different data points establishes a common denominator for comparing the different governance structures while also highlighting possible improvements and recommendations to augment current efforts to achieve the Public Health 3.0 objectives.

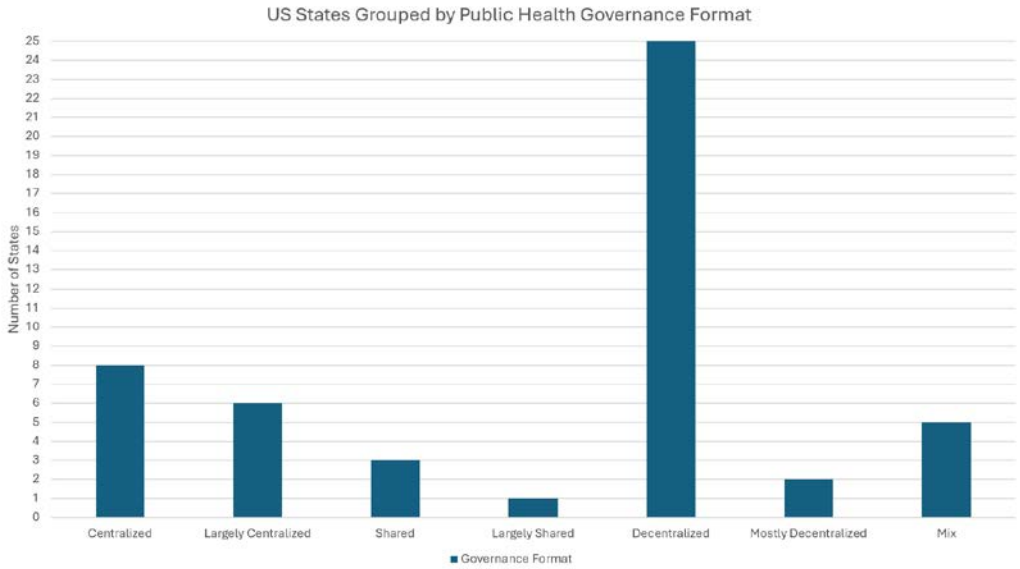


**Figure 1.** The different governance structures found in the US based on the ASTHO and NORC categorization

### 1.1. Current Modernization, Data Integration, and Data Standardization Initiatives

In 2016, the HHS launched its Public Health 3.0 model. This model translates the necessary actions required to modernize public health systems in the US into five recommendations. [2] Specifically, recommendation four calls for timely, reliable, granular, and actionable data to be shared so that public health actors can guide, focus, and assess the impact of prevention initiatives. [2] Modernization efforts across the United States continue, but the granular, actionable data required by recommendation four continues to be siloed between public health jurisdictions due to outdated systems with poor interoperability capability. [3] Breakthrough technologies like electronic laboratory results (ELRs) and HL7 messaging integrations – health data standardized and configured to pass between databases – are tools which enable local health departments (LHDs) to improve their interoperability with real-time data enhancements.

States, regardless of their governance structure, struggle to fund the data infrastructure improvements required to update their systems, increase interoperability, and utilize these novel tools. By creating the Public Health Infrastructure Grant (PHIG) in 2022, the Center for Disease Control and Prevention (CDC) seeks to address this funding gap. In addition to funding, the grant also empowers three private organizations to assist with training and technical assistance, providing a central source of guidance. [4] These implementation centers establish application programming interface (API) standards, data use agreements (DUAs), and defining the vital data required for public health outreach. [4] API standardization and DUAs combine to increase the interoperability of data systems by allowing each system to communicate in the same format under prearranged terms.

With the context of the current initiatives, we seek to evaluate the strengths and weaknesses of both the centralized and decentralized governance structures in the US. To evaluate them, we must first review the literature for the individual strengths and weaknesses of the respective governance structures. Next, we view them through the contextual lens of recommendation four to determine which components of the strengths and weakness enhance or detract from the objectives. Assessing the different structures along these criteria we can attain best practice for all structures. By completing these steps, we can answer the research question: what are the strengths and weaknesses of centralized and decentralized public health governance structures regarding data modernization, data integration, and data standardization?

## 2. Methods

We performed a comprehensive literature review on PubMed to include relevant, peer-reviewed articles pertaining to public health data infrastructure. Using a query with the title keywords of “centralization”, “centralized”, “decentralized”, “data infrastructure”, “public health infrastructure”, “IT infrastructure”, or “data sharing”, and “healthcare system”, “public health” in the abstract we included English, free-full-text articles published between 2010 and 2025. This query returned 41 articles matching the criteria. Utilizing a language learning model (LLM), ChatGPT, we evaluated these 41 articles for relevance against the research question. The LLM determined 4 articles did not have strong relevance. The remaining 37 articles were then evaluated by a human for infrastructure focus resulting in 5 additional articles being removed. The final 32 articles were assessed for eligibility and accepted for the review. Figure 2 captures the PRISMA method used.

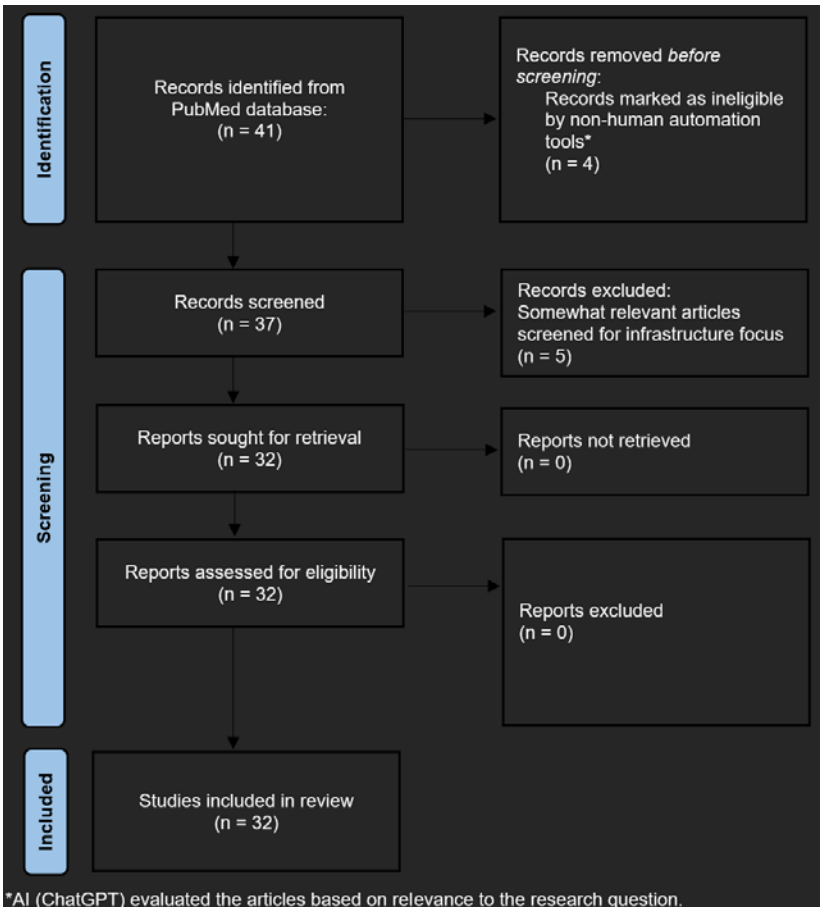


**Figure 2.** PRISMA method for article inclusion

## 3. Results

For clarity, we group the themes distilled from the literature into strengths and weaknesses regarding their respective governance structure. We attempted to not replicate the strengths or weaknesses of one model as its opposite in the contrasting model.

### 3.1. Decentralized Strengths

Common strengths of the decentralized model center on the autonomy and flexibility of the decentralized structure. Several articles underscore the ability of local agencies to tailor responses to culturally and equitably deliver solutions and resources. [5,6,7] This is important for underserved communities, like the unhoused, that can receive improved outreach under decentralized models. [8] Community leaders can also be more involved in the decision-making process, further enhancing the ability of LHDs to deliver equitable and culturally appropriate solutions to their communities. [9] Empowering local leaders also helps to deliver resources where they are needed during public health events like outbreaks and pandemics. [10,11] Similarly, enhancements to the digital infrastructure empower community leadership to tackle public health problems.

Harnessing this digital infrastructure to synchronize the systems, user interfaces, and data standards can augment the strengths of the decentralized models. Networked and synchronized digital infrastructure can improve localized interventions like point of care testing. [10,12] The key component for this success is the integrated network especially if this network utilizes a centralized data warehouse or repository to enable data sharing. This allows the originating systems to isolate patient identifying data, increasing data security without compromising interoperability. [13] The department of Veteran's Affairs (VA) demonstrates the successes of this structure.

Though the VA is an example of a centralized governance structure, it also enables local branches to direct their delivery of care. This removes barriers like screening, linkage to specialty care providers, and insurance approval criteria and wait times, co-pays, and deductibles for chronic disease like HCV. [14] Their delegation to the local divisions highlights the benefits of decentralized models promoting local directives and leveraging networked resources. [14] Automated systems that can extract or implant this data into nationally available databases can refine policy-driven directives and improve reporting. [15]

Leveraging networked data infrastructure via integrations allows decentralized systems to model the centralized data structure without imposing technology requirements. These isolated systems can develop technological innovations which can be exported and adapted in other local programs. [16,17] Innovative solutions for data and system structure thrive in the decentralized model. [11] Modeling another data system allows one system to benefit from another without losing their autonomy or ability to innovate. [11,16] Combined with the advent of AI, this poses a unique opportunity in data analysis. Decentralized data with robust differences

can expand machine learning algorithms and better train AI. [15]

### 3.2. Decentralized Weaknesses

Although autonomy means the ability to ignore higher level directives, the isolated format in which decentralized models operate may create access and resource barriers for the local community. [5] This can also mean the higher authority or oversight body must expend resources to enforce compliance with the higher directives. [5] The resulting uncoordinated responses can be detrimental to isolation or eradication efforts in decentralized models. [6,18] Data is frequently unstructured and stored in different, decentralized silos creating access and sharing issues. [19] The need for data sharing agreements and the duplication of network resources poses a problem in decentralized models. [7] Access to aggregate data systems of patient records remains uncommon despite the increased efforts in interoperability. [15] The lack of real-time data sharing also hampers the identification, mitigation, and eradication of large-scale communicable diseases. [15] Critical infrastructure required to share data effectively are sometimes not available and typically there is little funding to create them. [20,21,22]

Responding to mandate for increased sharing of health system data is more challenging I decentralized models. [18] The duplication of data, data requests, and data storage infrastructure burden decentralized systems. [5,9,18] Not only do these systems require additional physical resources, but they must be configured with a common format and API metadata must be available. [23] For example, during the pandemic response the sharing of genomic data benefited LHDs greatly, but this data is massive. [24] Local and state agencies require additional resources to integrate this data and configure their networks to participate in data sharing. [24] Autonomous decentralized jurisdictions without interoperable data systems could not participate as easily in viral data sharing even though this data could be freely shared. [24]

While fundamental to public health interventions, sharing data requires DUAs accompanied by properly configured networks, physical infrastructure, and staff to operate them. [17,22,25] Data sharing barriers for underserved communities, like sovereign Native America nations, cause inequity burdens and resource strains. [7] Outbreaks and pandemics create economic disruptions making local-level modifications more difficult without reallocating resources. [26] This is a challenge in decentralized models where outside funding must fill the gap to address these additional barriers.

### 3.3. Centralized Strengths

Strengths for the centralized model focused on the coordination, standardization, and interoperability required for centralized models to function. Established DUAs and centralized leadership means centralized governance systems can operate with a singular directive. [22] Centralized leadership can identify needs utilizing shared, real-time data and address them with support efficiently and equitably. [27] By martialing resources, states and LHDs can increase their speed and coordination in executing central directives. [5,27] Centralized models benefit from their wider scope of public health environment their individual components operate in, further enhancing the equitable deployment and coordination of these resources. [5]

The coordination of resources is vital to central repositories which in turn power comprehensive datasets involved in case surveillance and disease monitoring. [18,26] To achieve this coordinated effort, centralized systems utilize shared data. Data sharing requires standardized data for systems to transmit and ingest. [24,25] Centralized systems enhance data sharing and make training staff on public health systems easier and more accessible. [7] Relying on the existing data standards like HL7, LOINC, and SNOMED can benefit local, national, and international public health efforts via data sharing. [19,28] Combining these standard sharing practices with a de-identified patient record allows centralized systems to securely share patient records interdepartmentally. [29] Increased data accessibility and data sharing in the centralized model also allows better control of the data through compliance committees. [29]

Due to the segregated nature of the underlying systems in centralized models, these systems rely on established data standards and integration protocols. [15,19,23] The flexibility granted by this design means that resources like staff, funding, and hardware can flow as LHDs and providers need. [22,26] The VA's centralized model demonstrates this resources allocation ability when examining targeted disease interventions. [14] Strengths of the system include staff redirects, standardized monitoring and reporting, and data system familiarity. [14] Notably, the centralized models benefit from the ability to redirect funding, increasing both resource utilization and equity. [30]

Finally, because centralized models employ a modular system structure, they can scale to fit the community or disease intervention. [16] Centralized models benefit from this during outbreaks and pandemics, like COVID-19. [16,25] Integrations with central databases like vaccination registries and standard definitions like cases and disease mortality enhance the scalability of centralized models. [31] By creating a minimal infrastructure model, centralized public health programs can build and scale the basic components as needed. [18] The customizability of these scalable centralized models benefit from the modular configuration as well as the combined resources of the entire governance structure.

### 3.4. Centralized Weaknesses

While centralized models derive strength from their networked resources, the weaknesses spawn from excessive decision-making lead times, lack of local adaptability, and single points of failure. As seen during the COVID-19 pandemic, public health entities do not always agree on the best course to respond to a crisis. [9] These long debates over how best to deploy resources can slow down response times at the local level. [5] Once leadership agrees on a decision, extensive communication and collaboration requirements can hinder centralized models from quickly implementing data systems or updates. [23] These top-down approaches to public health

can also ignore the strength of community engagement, like changing individual behavior to slow the spread of COVID-19. [9] When centralized models try to incorporate community feedback the messaging lag-time between the community and leadership can limit the timeliness of intervention modification. [13,32]

Similarly, data must flow for leadership to make informed decisions. Transmitting data between databases opens these transfers up to risk and data security concerns. [15] Sensitive data requires extra permission barriers for every different jurisdiction operating in a centralized system further increasing the complexity to ensure data security. [33] Additionally, this data, which must adhere to the data standards, can block local innovation and customizations. [13] Without the ability to customize protocols and data systems locals may not be able to tailor their interventions to the community requirements. [5] The inability to adapt to local needs can delay response times and increase the resource needs adding cost to the centralized models.8

Due to the top-down nature of centralized models, leadership failures can cripple the public health systems. [27] Leadership changes or shifts in operational directives can create a disruption in public health services. [21] Decision-making bottlenecks and infrastructure risks like cyberattacks pose challenges unique to the centralized model. [21] Rural and remote population may lose service if key integrations stop functioning. [12] Restoring service may be difficult or come with an increased expense if critical infrastructure cannot be repaired or replaced. [12] Protecting against these single-points of failure requires redundancy which reduces some of the cost-reduction benefits in the centralized model. [32]

# 4. Discussion

To facilitate the discussion appropriately we examined the strengths and weaknesses of each structure as they apply to the recommendation four objectives of, data standardization, data integration, and modernization.

## 4.1. Data Standardization

Both the centralized and decentralized governance models utilize data standardization to some degree. Difficulties arise for each model in a different way though. Drawbacks in the decentralized model frequently stem from lack of data standardization in addition to standardized data acquisition techniques. [34] Due to the siloed and non-uniform design of some decentralized data systems, these standards vary and pose an additional barrier to data sharing. As standardized data formats slowly roll out from the federal government some decentralized agencies must now realign with these standards adding cost to data integration for decentralized systems. Alternatively, standardization is a requirement for centralized models to communicate internally. This allows them to streamline integrating with external networks, but with a more rigid existing structure changes to accommodate new standards are more costly.

The importance of data sharing makes data standardization imperative for both systems. For instance, Ardesch suggested that standardizing dashboards for public outreach allows the public health community and the general population to access and understand reported data. [29] Implications here range from increased visibility of public health data (e.g. disease statistics) to better visualization of return on investments in public health. The general population receiving access to de-identified data and interacting with tools not only helps them feel like public health officials pay attention to their communities but provides a tangible result for public health infrastructure spending.

Lastly, standardization allows staff to be redirected without burdening them with additional training on the user interface. Case surges – especially like we saw with COVID-19 – can create case backlogs for local staff. With data standardization across jurisdictions, rural or understaffed LHDs could redirect staff or hire contractors to alleviate temporary burdens and backlogs with little additional training. [16] This also allows public health systems to communicate using similar terms and reporting metrics. With data standardization for both case definitions and disease metrics, public health departments can further improve their community communication.

## 4.2. Data Integration

Data is paramount for public health and data sharing enables decision making and directs policy. [13,31] To achieve data sharing objectives, both centralized and decentralized models use integration in conjunction with data standardization. Again, integration points are commonplace in centralized systems. The barriers presented to data sharing here consist of the availability of API meta-data and the rigidity of the existing integration considering new interoperability protocols. Decentralized models utilize integrations to export data both to federal systems and interdepartmentally. The advent of HL7, LOINC, SNOMED, and EHRs allows for predefined and standardized integrations nationwide, reducing some of the access issues for both structures. [15,28,29] Building on these existing data integrations may be easier for decentralized systems as they update to the current integration standards.

Leveraging a hybrid strategy from both centralized and decentralized models could incorporate the strengths of both models – autonomy and integration standardization. A hybrid approach allows decentralized entities to maintain local adaptability while still benefiting from centralized data repositories. This achieves broader public health surveillance and policy coordination for disease initiatives. Utilizing a federated data system, LHDs could retain control over their data implement standardized interfaces that allow interoperability with federal data systems. [5] The flexibility granted by this approach could mitigate some of the rigidity seen in centralized systems and the barriers to collaboration that decentralized systems experience.

## 4.3. Infrastructure Modernization

Efforts to modernize the public health systems in the US are already underway. The different governance structures face similar barriers to modernization. Barriers

center on lack of funding and federal guidelines to implement modernization efforts. Specifically for the decentralized models, state health departments remain chronically underfunded which causes modernization efforts to be disjointed and inequitable. [21] The PHIG could help cover the gaps for both funding modernization and enabling technical solutions to encourage modernization efforts. [35] The technical support and funding provided by the PHIG also benefits centralized systems. By incorporating best practices established through the PHIG into their existing modernization efforts, centralized systems can safeguard their systems against the future.

To properly prepare for the future, public health infrastructure must also be hardened against technological and natural disasters. Both decentralized and centralized governance structures must be updated with some level of redundancy in order to accommodate potential system disruptions. [30,36] Resiliency in public health systems also helps alleviate the undue stress to underserved and resource limited agencies. [32] Gaps in coverage due to system failures can magnify the negative outcomes in a public health system as seen during the COVID-19 pandemic. Utilizing the modular concept from the centralized model combined with the decentralized model's ability to tailor their systems and outreach to local communities could bridge this gap. Modernization directives incorporating both these strengths could provide the resiliency public health systems of the future require.

## 5. Limitations of the Review

Although our efforts to limit non-applicable studies in the queries resulted in more tailored literature to pull from, this could have removed articles that would have been applicable to the review. Additionally, the strengths and weaknesses of both systems, while a good contrast, leave out some upstream downstream considerations. We tried to be comprehensive but there are several mentioned topics in the literature that could be focused on further. Finally, bias in the emphasis on specific points – modernization, data integration, data standardization – in the writing and interpretation of some articles could warp the presentation of the best practices for each governance structure.

## 6. Conclusion and Future Opportunities

Contrasting centralized and decentralized strengths and weaknesses highlights the current struggles for the different governance structures in the US. Solutions to improve either model derive from strengths found in the other model. Future enhancements to state and LHD governance structures would benefit from examining the VA's centralized model utilizing decentralized practices at the local level. Blending the decentralized model's strengths – autonomy and community empowerment – with the centralized model's strengths – data sharing and coordination – creates a more effective and resilient public health system.

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