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Using Data Available at the State Level for a Local Health Department Health Dashboard

By
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Degree to be awarded: M.P.H.
Executive MPH

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B.S.Ed., Baylor University, 1989
M.L.I.S., Clark Atlanta University, 1998

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An abstract of
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Abstract

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By Amy E. Allison

Background: Local health departments (LHDs)are called to base decisions about programs and services on evidence. Such evidence comes in the form of published studies, reports, and white papers of effective practices, as well as data on health outcomes and factors associated with those outcomes. Massive amounts of data are generated that can inform decisions about programs and resources. LHDs often do not have the technical infrastructure, expertise, or connections with other agencies to effectively use this data. Faced with these challenges, LHD staff and leadership often do not have timely access to relevant and useable data needed to make decisions about funding and planning of services and programs.

Purpose: To propose a model for aggregating data collected by a Georgia health district with data from the state Department of Public Health for evaluation and planning of programs around one of the district's health initiatives.

Methods: A semi-structured interview incorporating the Collaborative Requirements Development Method was conducted with staff involved in the processes around accessing data. Unstructured interviews were conducted of other staff at the health district, staff at the Georgia Department of Public Health, and with a data visualization consultant to gain information about the data, the infrastructure, and the challenges associated with data-sharing projects. A model solution was proposed.

Findings: A model solution was proposed in the setting of DeKalb County Board of Health and the Georgia Department of Public Health. The model includes a framework for determining project feasibility and inventorying technical assets, as well as a plan for implementation and evaluation.

Conclusion: Integrating data held by different organizations can be a feasible solution for local health departments to provide staff with timely access to metrics and other information related to a specific health outcome targeted by the department. Before embarking on a project, planning should include defining a clear purpose and goals for the project; inventorying data and technical assets; and identifying the external organization's level of interest, policies, and infrastructure for sharing data.

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Chapter 1: Introduction and Review of the Literature

Introduction and Rationale

Monitoring the health of the community and intervening to protect health have been important public practices for hundreds of years. One of the first recorded examples of surveillance in action occurred in the 14th century during the Black Plague when public health officials boarded ships in the Republic of Venice and quarantined the sick to stop the spread of the disease [1,2]. Using surveillance data became vital to public health action. In the mid-1800s Florence Nightingale collected data to track causes of death in soldiers and used a visualization to persuade others to improve sanitation as a means to decreasing deaths [3]. John Snow mapped the locations of cholera cases in London and determined a location associated with the outbreak [4]. Having the right information at the right time is critical to solving public health problems.

In the 1790s, the U.S. government initiated national health surveillance and action when John Adams signed into law The Act for the Relief of Sick and Disabled Seamen. It was recognized that crews on ships returning from Europe, the Middle East, and elsewhere sometimes contracted diseases along the voyage. This law established hospitals along the coast to provide a place to care for these patients and prevent the spread of disease [5]. Data collection in the U.S. became more systematic when national morbidity and mortality reporting began in 1925 and the first national health survey was conducted in 1935 [1]. Over the years, technology enhanced this practice as systems, such as the National Electronic Disease Surveillance System (NEDSS), came online. Such systems have come to play a crucial role in the nation's surveillance strategy to collect, store, and use data for detecting changes in the population's health. Collecting data has been a significant part of surveillance efforts in order to protect the public's health.

Local health departments (LHDs) in the United States have played a significant role in monitoring health by reporting cases to state and federal systems, and in addition, LHDs plan and deliver programs and services to promote health in their jurisdictions. Surveillance, as well as planning, implementing, and evaluating programs, are processes that involve the collection, exchange and use of data.

More recently, there has been a call for public health agencies to more effectively use evidence in making decisions about allocating resources for programs and services. Such evidence can include published reports, as well as data collected by health agencies. The Institute of Medicine's (IOM) Future of Public Health Report identified insufficient capability for assessing health and "disjointed decision-making without necessary data and knowledge" as two of the barriers to effectively solving problems in public health [6]. Around the same time, evidence-based medicine (EBM) gained momentum among clinicians. EBM requires the clinician to base decisions about patient care on scientific evidence as opposed to making patient care decisions based solely on what they learned in professional training or on the opinions of colleagues [7]. This evidence was in the form of clinical studies applying valid research methods to demonstrate whether a test or treatment was effective and safe. Incorporating evidence-based practice, or evidence-based decision making, into public health practice also became a focus of discussion [8,9].

Through official statements and initiatives, the Centers for Disease Control and Prevention (CDC), the National Association of County & City Health Officials (NACCHO), and other public health governmental and non-governmental organizations promoted the application of evidence to public health practice [10,11]. The embrace of evidence-based decision making highlighted the need for public health agencies, including LHDs, to collect and use data in

making decisions about priorities for health services and prevention and promotion programs. The NACCHO Board's current statement on evidence-based practice directs LHDs to make the best evidence available to decision-makers and practitioners through "ongoing systematic collection, analysis, and interpretation of specific health data" [11]. Furthermore, the IOM recommended accreditation for public health governmental agencies as a means to ensuring efficiency and quality in the delivery of services [12]. As this recommendation grew into a reality, evidence-based practice and quality improvement were among the requirements for accreditation [13,14].

Because of NEDSS and similar systems, LHDs have had access to data on the health of their respective populations. However, new developments in federal policy and technology have contributed to an environment where more relevant data is available to potentially inform public health decision-making. Providers and hospitals have generated data in electronic format due to Meaningful Use and other financial incentives [15]; laboratories, insurers, and public health agencies also produce health data. Even local government bodies, such as schools, law enforcement, and planning and zoning offices, create data, potentially useful to LHDs, but also resulting in massive amounts of information. Few described such a state as a "tsunami of data that rolls over and flattens us in its wake" [16].

New technologies and techniques to collect, share, store and analyze data have made it possible for organizations to "produce and collect vast amounts of data" [17]. Storage is inexpensive; more devices are connected to the internet; and an array of applications and programming languages exist to collect, to manage, and to analyze all types of data.

These three developments—the call for evidence-based practice, the generation of data that contributes to this evidence, and technological advancements in collecting, storing, sharing,

and analyzing—have made timely access to relevant, valid, and usable data a critical need for all public health agencies, including LHDs.

Literature Review

Federal agencies and organizations have advocated for more effective use of data in public health decision-making through initiatives, training, and advocacy to facilitate practices to make data more accessible and useable. The CDC supports improved data sharing through several initiatives and programs, including standardization of health data, improved access to publicly available data sets, and guidance in analysis and visualization of data [18,19]. The Joint Public Health Informatics Task Force (JPHIT), a coalition of nine public health organizations, led by NACCHO and the Association of State and Territorial Health Officials, lobbies national policy makers about information technology needs in public health practice. In order for public health to improve the infrastructure for storing, sharing, and using data, JPHIT has recommended all levels of public health agencies 1) to engage in planning that incorporates national standards for interoperability, 2) to focus on systems already proven successful, and 3) to invest in workforce development [20]. The Public Health Informatics Institute (PHII) has published guides, templates, and training to help public health organizations collect, store, share, and use information to improve public health outcomes [21]. In 2015 the Office of the National Coordinator released a vision for a Nationwide Interoperability Roadmap, a 10-year plan for achieving a Learning Health System that includes local public health agencies in proposing how data can be used to improve community health [22]. These efforts continue moving public health as a domain toward more effective and efficient use of data and information in practice. For planning and evaluating, public health decision-makers need tools that enable them to sift

through the massive amounts of data in order to focus on pertinent information in a timely manner [23].

Tools for seeing the right information for decision-making. Tools that present selected information to decision-makers have existed for some time. These have included executive information systems of the 1980s, which provided key financial measures, and in the 1990s online analytical processing of reports from data warehouses. Later the use of key performance indicators offered a view of an organization's progress on strategic and operational objectives [16].

Technology developments in data warehousing and visualization tools led to the rise of the performance dashboard as another tool for digesting and presenting information on individual, team, or organization performance [17]. By aggregating and depicting a visual of the data, a dashboard quickly highlights trends and other analyses to facilitate decision-making [24]. The dashboard often displays quantitative measures based on data drawn from different sources, and some applications allow the viewer to drill down from summary to detail information [24]. Measures, or indicators, on a dashboard can represent the performance of an individual, group, or organization [25], or they can summarize the current state of an event or environment [26].

The dashboard's purpose and the intended audience should drive the selection of information to display, as well as decisions about how to display the data. Additionally, a business process for using the dashboard information is critical for a department to receive the benefit of this tool. Analyzing and displaying data alone will not make a public health agency effective in accomplishing its mission. Rather, the data or metrics on a dashboard must be transformed into "actionable knowledge"; this requires 1) an organizational culture that "enables knowledge sharing," 2) a system (i.e., the dashboard and the information systems behind it)

providing the needed information, and 3) leadership that knows the questions to ask and can interpret the data and effectively communicate the meaning [17]. Staff responsible for planning and making decisions must be able to accurately interpret the information presented and to incorporate evidence of effective practices to implement effective programs and services.

Dashboards in practice. Dashboards have been pervasive in a variety of sectors, such as finance [27], information technology [28], manufacturing [29], and retail [30]. Applications in healthcare have been reported in an array of areas, including operating rooms [31], emergency departments [32], nursing units [33], and quality improvement projects [34]. Dashboard technology has also been adopted by governmental public health agencies. The CDC has produced multiple dashboards for communicating with the public about health issues, such as influenza [35] and infant mortality [36].

Dashboards at local health departments. To examine dashboard applications implemented at the regional or local public health agency level, the author conducted a search of the past five years of published literature, using PubMed, a health sciences database, and Scopus, a multi-disciplinary database. NACCHO's Model Practices Database was searched for reports not published in peer reviewed literature. A third source was the website of the Community Indicators Consortium (CIC), a private, not-for-profit organization that helps communities identify ways to use metrics for communicating and advocating for change [37]. The website contains sample projects from local and regional. For this review, the search was limited to reports explicitly identifying participation by a local or state health department, but the website is a useful resource for exploring formats of indicator projects.

The literature and NACCHO databases yielded 12 reports that included explicit descriptions of dashboard applications implemented by state, regional, or local health agencies

for use by an LHD. A search of the CIC website identified an additional eight reports explicitly describing participation by a health agency and providing details about either the architecture or the process for developing the dashboard. Table 1-1 summarizes the reports included in the review. Three projects were initiated at the state level although one of these was a state association of LHD leaders. Of the remaining projects about half were implemented by LHDs and half by multiple organizations, including the LHD, working together.

The stated purposes for each of these dashboards fell into three categories: performance management, surveillance, or enhancing communication or engagement with stakeholders. Surveillance dashboards focused content on specific topics, such as reports of foodborne illness or infectious disease [38,39]. Some of the performance management and communication dashboards focused on a single topic or initiative, such as the Salt Lake City dashboard on injury prevention [40], or the Volusia County project to monitor performance at clinical sites [41]. Others were broader in scope, including the Broward County dashboard, which monitored performance across the department [42].

Because the CIC highlights community-wide projects, each of the CIC projects reported on a broad array of indicators. Even the projects focused specifically on health [43-45] reported on a number of health outcomes and determinants of health. The Houston and Harris County project [46] began as an inclusive report of health indicators for the combined city and county region. In following years, the project grew to include content from 14 other agencies with seven partner organizations sponsoring the report. Now the data is presented as an interactive dashboard, addressing over 50 health topics, as well as data on education, the economy, public safety, and transportation [46]. This project was similar to the CIC projects in that each

Report	Dashboard characteristics		
	Implemented by	**Purpose of the dashboard**	**Sources of health data**
Austin/Travis Co (TX) [47]	City Health Dept led collaboration of private & govt.	Engaging the community in solving public health problems	Federal and state govt. health data sources
Baltimore (MD) [48]	Collaboration of private & govt., incl. LHD	Engaging the community in solving public health problems	Federal and state govt. health data sources
Boston (MA) [49]	Collaboration of private & govt., incl. LHD	Engaging the community in solving public health problems	Federal and state govt. health data sources
Broward Co. (FL) [42]	County Health Dept	Performance management across the department	Data from program and services, finance, HR
Central New York [50]	Collaboration of academic, private, & govt.	Engaging the community in solving public health problems	Federal and state govt. health data sources
Connecticut [43]	State association of LHD directors	Strategic planning and engagement for LHDs and community leaders.	Federal, state, and possibly local govt. health data sources
Houston & Harris Co. (TX) [46]	City and County Health Depts	Communicate state of health to the public, community partners, and other stakeholders	Local epidemiologic reports and surveys, Census, community data sources
Louisville (KY) [51]	Citywide initiative; LHD participated	Monitor performance of environmental health, communicate performance to stakeholders	Inspection reports and facility inspection histories, licensing of food service managers
North Carolina [52]	State	Surveillance of infectious of foodborne disease	State surveillance system
Salt Lake Co. (UT) [40]	County Health Dept	Inform the public of progress on preventing various types of injuries, enhance communication with community partners	Injury rates, prevention programs data
San Francisco (CA) [45]	City Health Dept led collaboration of private & govt.	Engaging the community in solving public health problems	Federal and state govt. health data sources
Shelby Co. (TN) [53]	Collaboration of private & govt., LHD participated	Engaging the community in solving public health problems	EHR, County Health Rankings, local sources
Solano Co. (CA) [25]	County Health Dept	Monitor performance related to strategic objectives across the department, which includes public health and social services	Clinics, local database of WIC utilization, data from other
Spartanburg (SC) [54]	Collaboration of private & govt., incl. LHD	Engaging the community in solving public health problems	Federal and state govt. health data sources
Spokane Co. (WA) [44]	Collaboration of private & govt., incl. LHD	Engaging the community in solving public health problems	Federal and state govt. health data sources
St. Louis (MO) [38]	City Health Dept	Surveillance for foodborne illness outbreaks	Twitter posts
Volusia Co. (FL) [41]	County Health Dept	Monitor performance at clinical sites	EHR, other local data
Washington, D.C. [39]	District of Columbia	Monitor and communicate trends in HIV testing coverage in high-risk populations	National HIV Behavioral Surveillance data (NHBS)
Weld Co. (CO) [55]	County Health Dept	Strategic planning, engaging and communicating with stakeholders	Strategic planning documents
Wisconsin [26]	State	Monitor obesity rates, associated factors, and related health policies	YRBSS, PedNSS, BRFSS, NSCH, NIS

Table 1-1 Summary of dashboard projects identified in the literature search.

improved the public's access to information about the community in order to stimulate action that could improve the quality of life.

An examination of these projects revealed several themes concerning the implementation and use of dashboards by LHDs. First, several reports identified commitment or support by department leadership as a crucial factor to successfully implementing the application [41,42,53]. Other projects highlighted support from other stakeholders. In the Houston/Harris County project commitment by the project partners was crucial to sustain the project over time [46]. In describing a model for a community-wide dashboard initiative, King, et al. noted that "long-term sustainability requires leadership, institutional change, trust building, collaboration, legislation and policy, and resources" [53]. In addition to a requirement for success, reports of the Spartanburg and Central New York projects identified increased engagement and collaboration between local government agencies as a positive outcome [50,54].

Even projects used predominantly within a single department need to ensure all staff understand the purpose of the dashboard and to instill confidence in the dashboard and how it will be used. For example, the Louisville Metro project was a dashboard tracking restaurant inspections, food safety investigations, and licensing of food safety personnel. This project depended on participation by front line staff to enter data about inspection and licensing transactions in a timely manner and to join in discussions about how to improve these measures. In fact, these staff became vital to the process of identifying factors adversely effecting performance and suggesting improvements [51].

Another theme was the selection of metrics to install on the dashboard. For the most part, dashboards focusing on surveillance did not involve lengthy analysis and discussion of metrics selection, but rather described the source of the metrics. The North Carolina dashboard communicated outbreak reports from the state surveillance system [52]. In the Washington, D.C., project the system was designed to report on HIV testing, drawing data from the NHBS

[39] while the St. Louis dashboard pulled data from Twitter to track potential food-borne illness [38].

In the state of Wisconsin the dashboard summarized obesity rates and factors associated with obesity or prevention, throughout the state [26]. The selection of metrics began with identifying potential indicators from the County Health Rankings & Roadmaps, a compilation of data representing indicators of health and health determinants for counties in the United States [56]. A second source of indicators for the Wisconsin project came from a review of literature of obesity prevention programs focusing on measures used to evaluate the programs. The San Francisco project included a manual for identifying and selecting indicators for social determinants of health. The manual identified potential indicators for social determinants of health along with specific guidance on how to analyze and present the data [57].

Many of the projects involved staff, program leadership, and community stakeholders collaborating to determine the metrics to be featured. In some projects, metrics were aligned with department or program objectives. The purpose of the Weld County project began as a way to select and track strategic goals for the department [55]. The project for Austin/Travis County began with a process for stakeholders to agree on four goals important to the community. Then an "indicator steering committee," composed of subject matter experts in each of the goal areas, identified a starting set of indicators [47]. Likewise, for the Connecticut project, health department directors throughout the state identified potential indicators; the list of indicators was then narrowed through multiple rounds of discussion and voting [43]. In fact, several of the community-based projects [44,49,50] applied this method of input from subject matter experts followed by rounds of review and voting to identify a final list of indicators.

When identifying and using metrics tied to individual and program performance, Harrison et al., emphasized the importance of the viewer to have a clear understanding of what the dashboard's indicators represented and how to interpret the numbers and trends [25]. Other reports [45,47] also underlined the need for viewers to understand how to interpret the information presented. Leadership, or any intended audience of a dashboard, must be able to accurately interpret and then act on the information presented; otherwise, the dashboard is ineffective. As such, it is essential to consider the dashboard's purpose and message, as well as to address preconceptions or knowledge gaps of the intended audience in order to ensure accurate interpretation and use of the information.

Engagement was another theme in these projects. Several papers mentioned using the dashboard as a tool for engaging with the public or with community partners. This engagement was one of the initial goals of Houston and Harris County [46] and Salt Lake County [40]. The Houston/Harris County project became such a collaborative project that ownership moved under a local non-profit consortium of health agencies. This broad engagement also led to a challenge in maintaining focus on the LHDs' original goal, reporting on the health status of the city of Houston and Harris County. Some of the project partners wanted to use the dashboard for other purposes, such as drawing attention to individual organization funding needs and activities [46]. Harris et al. reported that the dashboard enabled the St. Louis Department of Health staff to quickly identify and respond to Twitter posts about food poisoning and to interact with the public "on issues when the issue is relevant to the constituent" [38]. Finally, as staff at Weld County (CO) Health Department implemented an internal dashboard to track the department's strategic plan, they discovered that the project could also be used as a tool for communicating the plans to the public, making communication a key purpose for the tool [55].

It is also useful to consider more concrete factors related to development and implementation: technical specifications and evaluation. Most of the reports provided few details about how the dashboards were created and implemented. Broward and Volusia Counties briefly described the role of a programmer in development; others detailed web development activities. Several of the projects involved the purchase of commercial solutions. Only four of the implemented projects described an automated process for pulling the data presented in the dashboard [38,39,42,51].

Several projects described applications that facilitated viewer interaction with the data. For example, the Baltimore dashboard enabled the viewer to display information by neighborhood or by address [48]; the Boston dashboard interface allowed the viewer to create custom charts and maps [49]. These interactive features enhanced a key feature of a dashboard tool: to enable the viewer to quickly see the information of most interest. Guides on dashboard design also emphasize other design aspects, such as the effective use of color, space, and visualizations, to enhance the communication of the information [16,24].

Three papers specifically reported that compiling data and/or generating the dashboard displays required a great deal of time. One was the large Houston and Harris County project, which involved manual data entry of a large number of metrics. Authors of the papers describing the Salt Lake County and Solano County projects each noted future plans to automate the process of pulling data into the dashboard [25,40]. Time savings was a benefit of the dashboard in several projects: less time spent pulling data for reports and less time spent by managers and stakeholders in accessing data. Automation of the process or any part of the process would decrease staff time in pulling data and would make the data available in a more timely manner for dashboard viewers.

As for evaluating the projects, most papers described lessons learned from the process: what contributed to the success of the project, what worked and what did not work. This type of reflection is a valuable tool for evaluating and improving the work of future projects [58]. Beyond this, Broward County evaluated the dashboard by looking at how the values of the indicators changed after the implementation of the dashboard [42]. The implication was that presenting the data in the dashboard would be associated with staff actions resulting in change in the activities being measured. Houston/Harris County contracted faculty and students at an academic public health program to formally evaluate that project. Since the dashboard was intended to communicate and engage with other health agencies and community organizations, the evaluators surveyed members of these organizations about awareness and use of the dashboard [46].

To compare the reach of an outbreak dashboard versus the narrative listing of outbreaks, North Carolina public health officials conducted a pre- and post-implementation survey to determine if the dashboard format of outbreak notifications resulted in increased usage of the information by LHDs in the state [52]. The other papers reported using assessments based on whether project objectives were met, anecdotes of user satisfaction, other departments or agencies adopting the tool [55], or plans to expand the department's use of the tool [40]. The City of St. Louis compared reports of potential outbreaks via the dashboard to those via telephone or web reporting form [38]. The variety of methods used to evaluate the dashboards could stem from the differences in dashboard purposes or objectives, differences in staff expertise in system evaluation, or differences in organizational culture.

Challenges for local health departments. Aside from these projects, widespread adoption by LHDs of systems, technologies, and methods to make better use of data has been

slow [59,60]. The NACCHO 2015 State of Informatics Capacity and Needs Assessment Study explored an overview of the capacity of LHDs to effectively collect, store, protect, share, and use data in practice. Designated informatics staff from 324 (50% response rate) LHDs responded to the survey [61]. The results provided insight into the challenges to LHDs in efficiently and effectively using data.

First, an LHD's data is often scattered in multiple locations and formats. LHDs still tend to rely on paper records. Fifty-nine percent of responding agencies relied on paper records for non-clinical data and 28.9% used paper records for clinical data. In fact, the survey results indicated that individual LHDs tended to store non-clinical data in a variety formats: paper, basic software, vendor-built and custom information systems, federally provided systems, and open-source systems [62]. The program-centric structure of most LHDs also contributes to LHD data being stored in numerous data sources and in various formats because informatics decisions are often made to meet the individual program needs without considering the need for the LHD to manage information and data across the agency [63]. Often hardware and software is acquired through funding of individual programs in the department [64], which can result in an LHD having a collection of systems that do not integrate. While storing data in multiple formats is not necessarily a problem, the practice must be addressed in order to integrate data. A department must be proactive and plan for how to organize and store the data and information collected and generated, so that staff can find and access the data in order to reuse it for other purposes, including planning and evaluation.

Second, LHDs may not have ready access to data from other organizations. About two-thirds of surveyed LHDs received data from state departments and laboratories. However, LHDs were less likely to receive data from other sources, such as hospitals (39%), other county and city

departments (33%), and primary care clinics (25%). Furthermore, LHDs reported that they did not pursue electronic data exchange with external organizations due to concerns about privacy and legal requirements, insufficient availability of technical expertise or support, belief that the return on investment is insufficient, and lack of information about data exchange, such as potential partners and technical requirements [65].

Many department lack staff with the skills needed to create and operate systems for making data available in a format useable by staff and other stakeholders. Frequently reported training needs included how to use statistical or analytical applications, design and run reports from information systems, and manage projects. A majority of respondents from departments serving populations of 500,000 or more indicated the need for training in information technology development processes, such as project management, business process analysis and redesign, and development of requirements for information systems [66]. Smaller departments were more likely to report training needs in more fundamental areas, such as basic computing, using office applications, and maintaining a website, or even the use of statistical and analytical programs, which suggests that, for smaller health departments, staff would also lack the skills for more elaborate tasks of designing and using systems to collect, store, and analyze data.

A survey and interviews of LHD leaders on their respective departments' abilities to participate in information exchange with a regional health information network also revealed a need for additional training and resources in order for staff to effectively manage data exchange [67]. Other challenges included lack of funding for information technology, lack of interoperability of state public health and other systems, and poor relationship with information technology departments [68]. Over half of LHDs reported that an external department controlled the LHD's IT budget, system support, data management, and other aspects of the LHD's

infrastructure, and especially when the decisions were controlled by a city or county IT department, there was no shared decision-making [64]. LHDs must establish and maintain strong relationships with the department or agency that makes decisions about information technology.

Problem Statement

An enormous amount of data exists for analysis and potential action by LHDs to use in responding to health challenges in their communities. However, LHDs often do not have the technical infrastructure, expertise, or connections with other agencies to effectively use this data. Faced with these challenges, LHD staff and leadership often do not have timely access to relevant and useable data needed to make decisions about funding services and programs.

Purpose and Significance of This Project

Leaders and staff make decisions about how to deploy a health department's financial, human, and technological resources in order to effect the greatest positive change on the community's health. Decisions based on accurate evidence lead to solutions more likely to have the intended positive impact on health outcomes. Therefore, leaders and staff need access to accurate information that is relevant to the question, available at the point of need, and presented in a way that is actionable.

The primary goal of this project is to propose a model for aggregating data collected by Georgia health districts with data from the state Department of Public Health for evaluation and planning. In this case, all the data is related to a single health issue. The objective is to pull the state and LHD data and display it in a dashboard. The project will address issues related to relevance and timeliness of data, data-sharing, data visualization, as well as the method of redesigning a business process. Also, the project will determine plans for implementing and for

evaluating the system. The framework and model presented in the solution may inform LHDs about the application of methods to determine feasibility for this project and to plan, implement, and evaluate such a project to communicate information related to progress departmental objectives or work on a specific program.

Chapter 2: Methods

Setting

The model demonstrates integrating data for the DeKalb County (GA) Board of Health (DeKalb BOH), which is one of 18 health districts funded by the Georgia Department of Public Health [69]. Located in metropolitan Atlanta, Georgia, DeKalb County's population is estimated at over 740,000 [70]. Compared to the US population (Table 2-1), DeKalb County's population is slightly younger overall, has a greater representation of African Americans, and is somewhat more likely to have been born outside of the United States. Also, the county has a higher proportion of individuals without health insurance.

Descriptor	DeKalb Co.	Georgia	US
Age			
Under 20	25.8%	27.1%	25.5%
20-44	37.8%	34.1%	33.2%
45-64	25.2%	25.7%	26.0%
65 and over	11.0%	13.1%	15.2%
Race/Ethnicity			
Black or African American	54.5%	31.6%	12.7%
White	35.0%	58.7%	72.6%
Asian	6.2%	3.9%	5.4%
Other race	2.0%	3.4%	6.1%
Two or more races	2.3%	2.5%	3.2%
Hispanic or Latino origin (any race)	8.5%	9.3%	17.8%
Country of origin outside the US	16.4%	10.1%	13.2%
Median household income	$51,376	$49,620	$53,889
No health insurance coverage	13.7%	17.1%	8.6%

Table 2-1 Descriptive statistics of the population in DeKalb County, Georgia. All data is from American Community Survey 2016 1-year estimates except for median household income, which is from 2011-2015 5-year estimates [70].

The DeKalb BOH has 310 full-time and 114 part-time employees, with seven staff members serving on the Information Technology Team. In the Health Assessment and Promotion Department (HAP), the Chronic Disease and Prevention Team is responsible for planning and evaluating programs to prevent disease and promote health.

In the Georgia Department of Public Health, the Office of Health Indicators for Planning (OHIP) is responsible for presenting information on the health of Georgia's population [71]. The Office's Online Analytical Statistical Information System (OASIS) and Community Health Needs Assessment Dashboard are interactive tools that display information on health conditions by indicators, such as mortality or emergency department visit rate, by age, by race, and by county. OASIS also displays interactive maps for some health indicators using geographic breakdowns by county, health district, or individual Census Tracts [72].

Project Design

The data integration solution for this project includes descriptions of the user groups and their needs, the data, and the proposed architecture. The project also recommends plans for implementation and evaluation. The project focuses on data related to men's health because the department's Chronic Disease and Prevention Team is currently developing an initiative to promote health in men in the county. According to the team, HIV prevention and improvement of access to care are potential areas of focus for this initiative.

A mixed methods approach was used to develop the solution, incorporating elements from the Public Health Informatics Institute's (PHII) Collaborative Requirements Development Methodology™ (CRDM) [73]. This method has been used to document, analyze, and redesign business processes for many informatics projects. Investigators described applying the process to analyze the national Newborn Dried Bloodspot Screening program in order to identify the requirements for an information system [74]. In another example, PHII staff used CRDM in discussions with multiple groups representing state and local public health departments to examine and redesign surveillance system processes. The resulting requirements from this project were used to evaluate and compare surveillance systems from multiple vendors [75].

CRDM engages individuals who participate in a business process to discuss how information is exchanged throughout the process. The method includes defining the process; identifying all unique actors; and documenting each task involved in completing the process. Documented tasks include creating, identifying, transmitting, editing, storing, or acting on information. CRDM templates document the input from participants through the discussion and organize the results into actionable information, such as a clear definition of the process and an inventory of requirements for redesigning a process or developing a system.

Other interviews with staff at GDPH and DeKalb BOH gathered information about the data needed for the dashboard, the organizational environments, and technology infrastructure relevant to integrating data from the two agencies. A key informant interview was conducted about technical and social issues related to designing and implementing visualization projects for organizations. Researchers have used the key informant interview to gain information and insight from individuals familiar with an environment [68]. An informal interview with a staff member recently employed by DeKalb BOH to lead the development of the Men's Health Initiative provided information on health outcomes of interest for this program. According to the county's most recent Status of Health Report, from 2008 through 2012, males and blacks accounted for the highest percentages of new diagnoses of HIV (79.3% males; 56.9% blacks) and AIDS cases (77.9% males; 73.2% blacks) in the county [76]. Since data has yet to be collected for this initiative, for purposes of the project the source of the DeKalb BOH data is a fictitious locally stored database containing responses collected as part of the work of the Men's Health Initiative. The GDPH data is stored in databases on the agency's network.

No protected health information was accessed for the purposes of this project, and the project was exempt from institutional review board review.

Procedures

Data collection involved two phases: 1) a semi-structured interview with DeKalb BOH HAP staff who regularly participate in the process of accessing data for use in their work and 2) unstructured interviews with two individuals at the GDPH, a member of the DeKalb BOH Information Technology Team, and a data visualization consultant.

The business process was documented any analyzed using the PHII templates [73], and a list of system requirements documented. Themes were identified from the unstructured interviews. Information from the interviews and from the cases identified in the literature review provided a basis for developing a model to illustrate how the LHD can complete a project to integrate data from the two agencies and display it in a meaningful way for staff at the LHD.

Chapter 3: Findings and Proposed Model

Six interviews (Table 3-1) were conducted between August and October 2017. A focus group interview at DeKalb BOH included two HAP staff and a member of the Epidemiology Team. This interview defined and documented tasks in the current process for staff to request and receive data they use in their work. The discussion also provided insights on other processes involving the use of health data. After the business processes were documented, participants provided feedback.

Individual interviews were conducted with 1) a member of the DeKalb BOH Information Technology Team, 2) the Coordinator of the Men's Health Initiative at DeKalb BOH, 3) the head of the Georgia Department of Public Health (GDPH) Office of Health Indicators for Planning (OHIP), 4) the head of the GDPH HIV Epidemiology Section, and 5) a cognitive visualization consultant who works with organizations, including governmental agencies.

Interviewee	Organization	Role
	Focus Group	
Omatola Gordon-Rose	DeKalb BOH	Chronic Disease Prevention Coordinator
Elizabeth Harlan	DeKalb BOH	REACH Program Coordinator
Chris Crane	DeKalb BOH	Epidemiology and Statistics
	Individual Interviews	
Sabrina Rawls	DeKalb BOH	System and database management support
Kevin Humphries	DeKalb BOH	Coordinator, Men's Health Initiative
Gordon Freymann	GDPH	Director, Office of Health Indicators for Planning
Pascale Wortley	GDPH	Director, HIV Epidemiology Section
Joss Stubblefield	Entelechy Technology	Data visualization consultant

Table 2-1 List of interviewees for the project.

Current Processes

The focus group discussed the current process for DeKalb BOH staff to request and receive data and statistics for use in their work. For clarity, this business process has been broken down into three processes: 1) requesting data, 2) identifying, retrieving, and preparing the data, and 3) using the data.

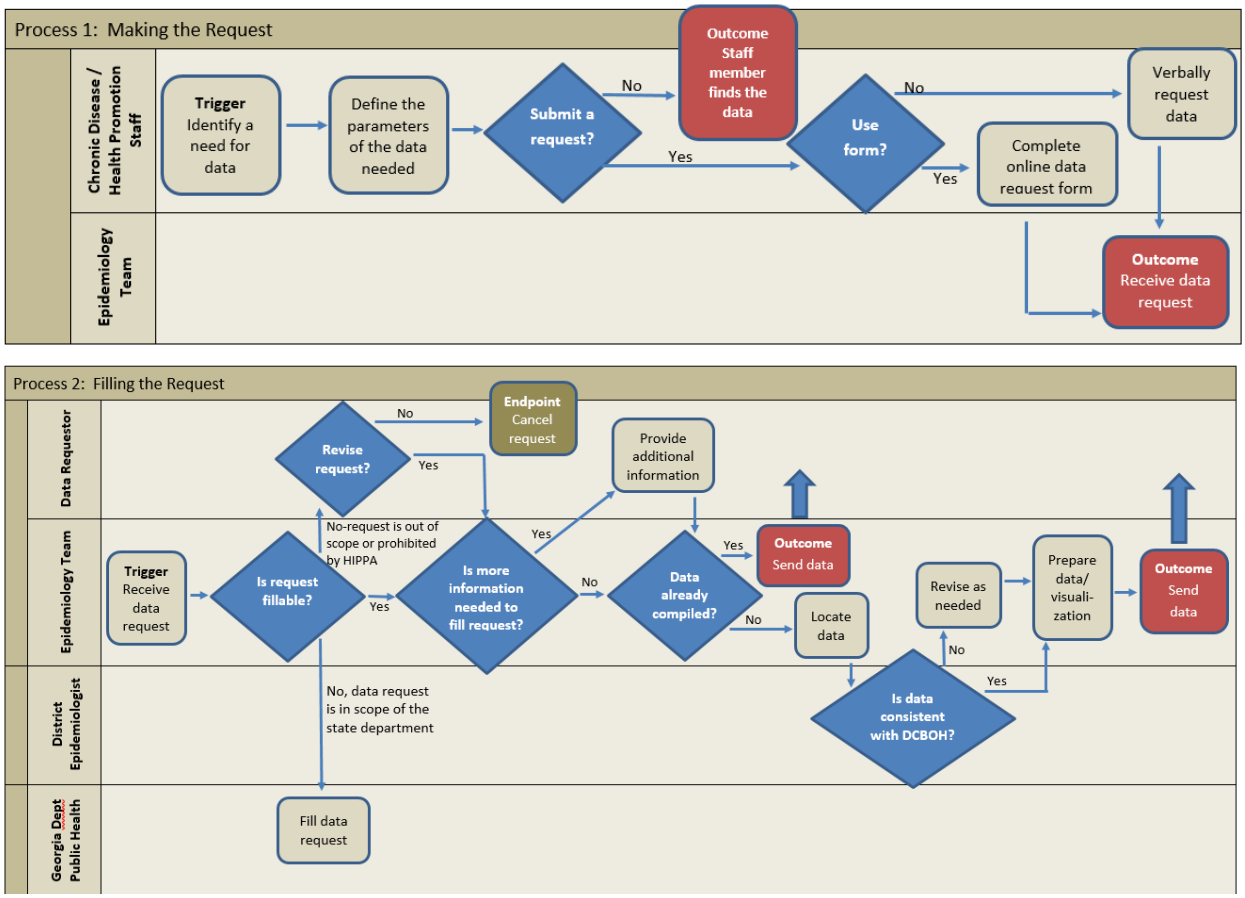

Figure 3-1 Tasks completed to request data and to fill the requests. The left column identifies each actor involved in the process. Tan boxes=tasks; diamonds=decision points in the process; red boxes=intended outcomes of the process; Endpoint box=an unintended end to the process

Figure 3-1 depicts the tasks that must be completed to request data and to fill the request. In Process 1, staff initiate a request when they identify a need for data to use in applying for grants, communicating to stakeholders, evaluating and reporting on programs, conducting research, or performing needs assessment for program planning. First, the staff member determines parameters of the data they need, such as period of time or demographics of the population. Other parameters include the type of visualization and specific file format needed. The staff member can verbally request the data or statistics for simple requests or use an online form for more complex requests. An Epidemiology Team member evaluates each request, seeking clarification as needed.

Although the Epidemiology Team receives data requests both from DeKalb BOH staff and from the public, the focus of this process analysis is on requests from staff. An online form prompts the requestor for information about the parameters of the data, such as population demographics, health indicator (e.g., mortality, rate of hospital discharge), health condition, and measure (e.g., count, rate, or proportion). DeKalb BOH staff can use a notes field to add information about the request, such as how to visualize the data.

Process 2, Filling the Request, includes a number of steps, and at several points an Epidemiology Team member must make a decision and/or communicate with the data requestor. First, the team member determines if the team can fill the request. Unfillable requests include those asking for data about areas outside of DeKalb County or for data that would violate HIPAA or other laws or regulations. Such requests are either forwarded to GDPH or are sent back to the requestor, respectively. If needed, the Epidemiology Team member goes back to the data requestor to confirm what data is needed, and sometimes the Epidemiology Team member suggests modifications to the request based on his/her past experiences and knowledge of definitions of data attributes. Once a request is deemed fillable, the Epidemiology Team member checks to see if the same request had previously been filled. If so, the team member sends that previously created document. At the time of the interview it was unknown how frequently this occurs. Otherwise, the team member compiles the data, creating visualizations when needed.

As a quality assurance step, the Epidemiology Team member confirms with the District Epidemiologist that the data is accurate, relevant, and appropriate for the stated purpose and that the data does not conflict with information already published by the DeKalb BOH. For example, a staff member might request data on infant mortality for 2015. The most current infant mortality information might be based on data compiled as of July 2017, but the DeKalb BOH

might have published a rate of infant mortality based on data compiled as of January 2017. The team member and other staff may need to reconcile the newly available information with what is disseminated by the county in the earlier publication to reduce confusion. After approval by the District Epidemiologist, the team member compiles the information, which can involve creating a chart, graph, or table, and sends the information to the requestor, which begins Process 3 with the requestor using the data for planning, evaluating, or communicating.

In summary, DeKalb BOH staff can access needed data by

- Searching the state's OASIS tool or other state or federal source for publicly-available data or accessing the specific file or database on the DeKalb BOH network for department-specific data.
- Requesting data from the Epidemiology Team for data

Other Key Findings about the Process

- A member of the Epidemiology Team stores all requests and periodically reviews them to identify recurring requests. The team does not take any follow up action based on these findings.
- For some number of requests the data has already been compiled and approved, but the compiled data or visualizations are not discoverable by the data requestor. This is done to ensure that staff do not use outdated data or inadvertently distribute data in violation of HIPAA. It is unknown what proportion of these files contain personally identifiable health information covered by HIPAA. Therefore, in fielding each request, the Epidemiology Team determines if the data has already been collected and if so, sends the file to the requestor.

- In addition to locating data and preparing visualizations, the Epidemiology Team has other responsibilities, including the production of the Board's Health Status Report every five years. The Health Status Report describes the current state of health of the county's population using narrative, statistics, and visual images. The Epidemiology Team participant expressed that working on the status reports was a large project requiring a large amount of staff time.
- Health Assessment and Promotion staff observed that accessing certain key data without having to go through the request process or look through the GDPH's OASIS system would be useful and give them quicker access. One participant stated that it would be helpful to quickly see current values on key indicators from the health status report during the years between each report. Another participant suggested that perhaps data used for the health status report could be charted on a dashboard and updated each year. Then current data would be available between the publication of the reports, as well as when needed for the next report.
- The Epidemiology Team member participant suggested using these key indicators to develop a profile for each of the county's Community Health Assessment Areas (CHAAs). Each CHAA is a geographic area composed of multiple contiguous Census Tracts, and the county uses CHAAs to target areas for intervention and community partner development. The profile could be used in communicating with partners about needs in the specific area as opposed to presenting information in terms of the entire county.

Findings from Individual Interviews

The interviews with the representative from the Information Technology Team provided information on the infrastructure at DeKalb BOH. The team maintains and supports hardware and software for the organization, including the department's network, as well as clinical, scheduling, and finance systems. Technology projects are approved by DeKalb BOH administration up to a given cost. Above that amount the Board Members of The DeKalb County Board of Health must approve the project. There is no approval required by other county offices.

The other interviews provided information about HIV data stored at GDPH; technology and policies impacting data-sharing at GDPH; and opportunities, requirements, and challenges of using health indicators and of visualizing data in general. Following are significant findings from those interviews.

Selection of indicators. Selecting indicators to track progress is a challenge because 1) it is sometimes difficult to identify measures that truly represent the outcomes or changes of interest and 2) there can be a lack of clarity about what the measures do represent. The tendency is to use data already collected to track progress in an area. However, this data might not directly report on the outcome of interest. Even if the correct measure is identified, care must be taken to ensure that the measures on which judgments are based are accurate. The state HIV epidemiologist gave an example of using new diagnoses of HIV as a measure of HIV infection in a community. If there is a decrease in the number of new diagnoses, it is important to determine whether the decrease in the rate of positive diagnoses is from a decrease in infected individuals or just caused by a decrease in the rate of HIV testing.

Also, the data about behaviors or outcomes of most interest are sometimes not feasible to collect because of ethical, practical, or financial reasons. Again, the expedient option is to use data already being collected. If a dashboard does not display valid metrics, then the viewer does not have an accurate picture of what the numbers supposedly represent. The data visualization consultant quoted Charlotte Kahn of the Community Indicators Consortium to express that "we need to stop caring about what we measure and start measuring what we care about."

Impact of technology used for the system. The specific technologies selected for transmitting the data and for creating the display for the end user can impact the operation and performance of the system. In this case, the state offers four options for LHDs to access health data (Table 3-2). A publicly available web-query tool only provides statistics that can be shared with the public. This means the tool might prevent reporting on geographic areas, such as Census Tracts, for some health indicators in order to maintain patient privacy.

	Publicly available web-query tool	**Query tool available to public health practitioners**	**Request data sets from GDPH**	**VPN connection between DeKalb BOH and GDPH**
Types of GDPH data available	Less	More	Most	Most
Flexibility	Can only execute functions available on the form	Can only execute functions available on the form	Can determine the analysis performed on data set	Can determine the analysis performed on data set
Process for extracting and transmitting data	Can be automated	Can be automated	Manual	Automated
Start up	Easy for manual queries; Programming required to automate queries	Easy for manual queries; Programming required to automate queries	Easy – contact OHIP to request data sets	More complex; Requires technical expertise and permission from the Georgia Technology Authority

Table 3-2 Comparison of alternatives for transmitting data from the state department to the local department

Another option is a query tool available only to public health practitioners. This tool offers access to additional data, but refreshing the data using either of these query tools would require either manually executing a query to refresh numbers for each indicator or writing a

program to execute the queries through the web-form and download the results. Still, options for how to analyze the data are limited by the functions included on the web forms.

Third, DeKalb BOH can request entire datasets from the state department. This alternative offers flexibility in how to analyze the data, but the manual process of obtaining the data sets can result in potentially more repetitive tasks for staff and take more time, especially for frequently updated data. Finally, creating a virtual private network (VPN) connection between the LHD and the state's databases offers more straightforward access to the data and the most flexibility because once the VPN is established, the LHD can use the connection to query and transmit data for other indicators or other projects. Currently, the Epidemiology Team has used the two web tools to manually retrieve data on various health indicators. Another LHD in the state requests full datasets on an annual basis.

The type of visualization tool also impacts the project. The cost of an application for creating the visualizations can increase the total cost for implementation and on-going operation of dashboard display. Options include open source code to program visualizations, licensing general data visualization products, and licensing more expensive turn key products for specific uses, such as monitoring individual and department performance or tracking strategic goals and objectives.

In thinking about how the target audience will interpret a visualization, the consultant observed that bar charts are a standard, but maps can be useful because "most audiences intuitively understand maps." Including even a basic level of interactivity improves a viewer's engagement with visualizations.

Impact of legal and social factors. Legal and social factors play a prominent role in the success of IT projects. A project will fail if a proposed system functions in a way that violates

government regulations or laws, such as HIPAA. An organization's policies on data sharing can also derail a project. For example, the Georgia Technology Authority (GTA) sets information technology policy and standards for state agencies which includes policies related to data and information system security [77]. According to the OHIP official, another LHD abandoned a data-sharing project because of the cumbersome process for gaining permission to establish the VPN connection to state health department databases. The consultant had a similar experience in obtaining permission to access data at a federal government source. It took one year and several trips to speak with agency staff responsible for the data in order to gain permission and proceed with the project.

Social factors that can impact the success of data sharing include an inability of the department to influence another organization to cooperate on data sharing. It might be that the other organization is not interested in cooperating or does not have or does not want to commit resources to collaborate on the project. A key to addressing these issues is establishing positive relationships with individuals and organizations whose cooperation is needed for any project involving data-sharing. Also, it is important to demonstrate exactly what resources the other organization would need to contribute to the project, as well as how the collaboration could benefit them.

Proposed Solution

The focus group discussion revealed that while the current process works, participants would value enhancements that would 1) enable health staff to more quickly access some key indicators, 2) present data for enhancing communication with community partners, and 3) also be useful for other purposes, such as compiling the department's 5-year Health Status Reports. A

dashboard is the solution selected to provide LHD staff with more timely access to relevant and useable data for planning and communicating with community partners.

From GDPH databases the system pulls attributes, such as date of HIV diagnosis, whether a CD4 or viral load was performed at diagnosis, dates of CD4 or viral load tests, and values of most recent CD4 or viral load. The source of the DeKalb BOH data is a locally stored database containing responses collected as part of the work of the Men's Health Initiative. For purposes of this solution an example would be data collected during an assessment of knowledge and attitudes about services offered by DeKalb BOH and about follow up care for HIV. The system will aggregate the data by Community Health Assessment Area and will combine and display the data on a dashboard available only on the DeKalb BOH intranet.

Table 3-3 compares the differences between how staff access health data in the current system and in the proposed solution. The proposed system would mean staff could view the currently available data related to the program without having to request updated data from the Epidemiology Team.

Proposed system	**Current system**
Check the Men's Health dashboard for relevant data from the state databases, including data not publicly available, or for data collected by the program or department.	Search the state's OASIS tool or other governmental sources for state or federally-collected data Access the specific file or database on the DeKalb BOH network for department or program-specific data.
Request from the Epidemiology Team new types of data to capture on the dashboard or for uses not requiring monitoring of the data over time.	Request data from the Epidemiology Team, especially for external health data that is not publicly available.

Table 3-3 Comparison of staff access to data under the proposed system and under the current system

Requirements

Based on definitions of business, functional, and non-functional requirements in the CDC's Unified Process Requirements Definitions documentation [78], an analysis of the

business process and information from the individual interviews resulted in the following requirements for this solution.

Business requirements.

- The dashboard must display on the DeKalb BOH intranet the metrics selected to track HIV infection and the impact of the Men's Initiative HIV Program.

Functional requirements.

- Data captured and the calculations used for the indicator values depicted on the dashboard must be selected by an HIV Program Data Team and approved by the District Epidemiologist.
- The system must accurately capture the following data from the GDPH system to calculate selected metrics: address of patient, date of HIV diagnosis, tests performed at diagnosis, dates of all CD4 or viral load tests, and values of most recent CD4 or viral load.
- The system must capture the data from the DeKalb BOH database on HIV program assessment selected for this dashboard. Selected attributes could include the clinic location, responses about the participant's knowledge of and attitudes about services provided locally, the importance of regularly seeing a provider and of compliance with therapy.
- The system must display additional information as determined by the HIV Program Data Team.
- The system must automatically refresh the data on a schedule determined by the HIV Program Data Team (e.g., weekly, monthly, quarterly).

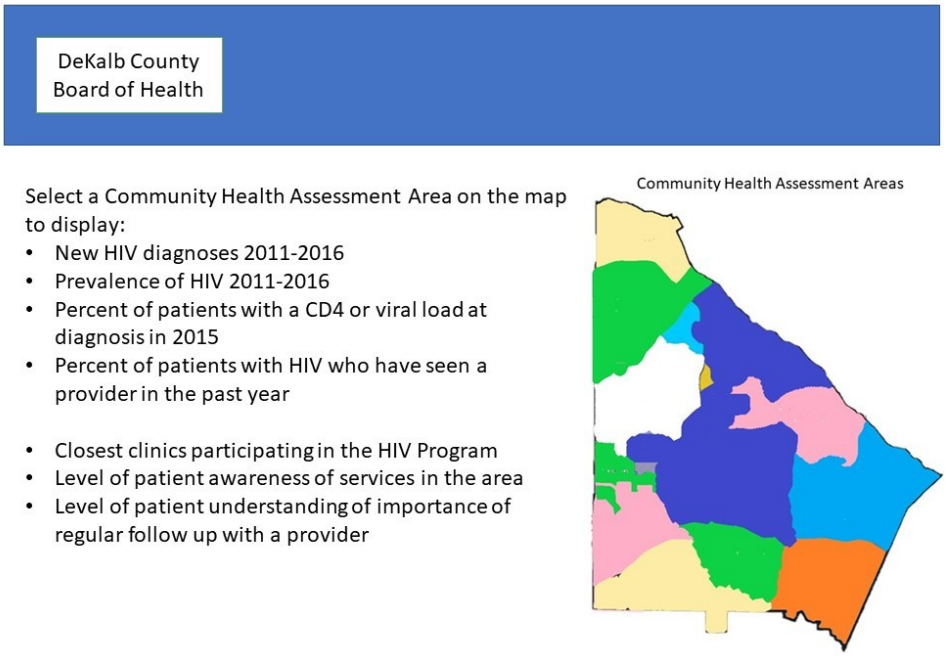

Figure 3-2 Sample dashboard display allowing the viewer to display selected metrics for a CHAA on the map.

Interface requirements.

- The dashboard must allow the viewer to select to view information about the entire county or for a specific CHAA (Figure 3-2)
- Authorized users must be able to view the dashboard via the DeKalb BOH intranet.
- Authorized users must be able to add, remove, or edit indicators.

Non-functional requirements.

- The dashboard must be scalable to support aggregating data from other sources inside and outside the DeKalb BOH.
- The system must have a process for selecting metrics and for reviewing metrics once the dashboard is operational.

Security requirements.

- Patient privacy must be maintained since the system will contain personally identifiable health information.
- The system must impose access controls for editing the dashboard indicators and other information.
- The system must track all changes to the dashboard indicators and display.
- The system must be hosted with hardware and software in accordance with industry standards for securing protected health information.

Additional requirements.

- Training must be provided to staff.
- The project team must provide documentation on the specifications, operation, and maintenance of the system, including the interface with external data sources and the visualization tool.
- The system must comply with HIPAA.

Model

Analyzing data from different sources for use in an application, such as the dashboard, can be accomplished either by copying the datasets to local storage, such as a data warehouse or multiple databases on the local network, or by executing the analysis on the original data source and using the results in the application. This solution proposes the latter method. Analyzing the data as stored in the original database ensures that the system is always accessing the most current version of the dataset. Figure 3-3 depicts the architecture of the system. First, data is compiled in each of the databases. Although the solution presumes the existence of the data sources, acknowledging this step is important if the department wants to expand the use of the

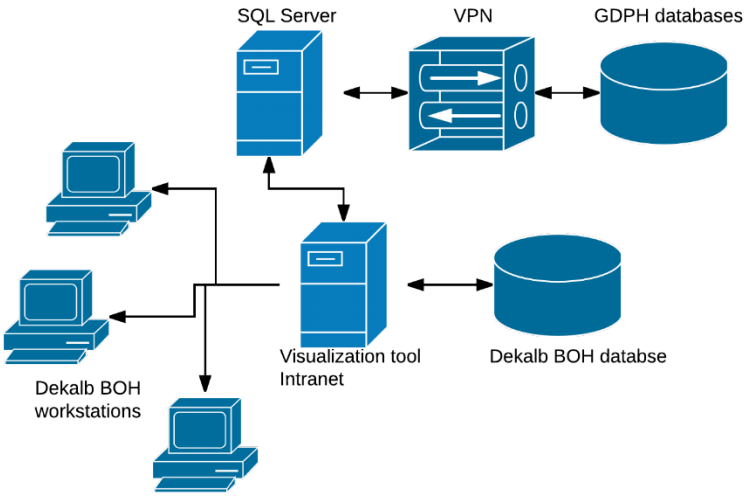

Figure 3-3 Depiction of the dashboard system architecture populated by data from different organizations

dashboard for other purposes. Future dashboard indicators might be based on data that is not yet collected. Therefore, the solution should include guidelines for the selection, collection, and storage of data to ensure that future data is in a format compatible with the visualization tool.

A secure connection to the state network enables the visualization tool to execute commands to query the database and return the desired metrics. The visualization tool completes a similar rendering of the data in the DeKalb BOH database. Queries are also executed on the local database. Visualizations of the results are rendered by the tool and displayed on the department's intranet. The visualizations can be programmed to refresh at specified intervals.

The dashboard (Figure 3-2) permits the viewer to display the data for the entire county or for a single CHAA. The display can also link to information about the program or service, such as a description of the program and associated funding.

Pre-Implementation Assessment and Planning

Before implementation of the dashboard project commences, stakeholders should assess the benefits and feasibility of the project. Following is a framework (Table 3-4) for guiding decisions about

Determine the content	Determine benefit and cost	Determine feasibility
What outcomes, activities, behaviors, or attitudes can demonstrate that the program or project is achieving stated goals and objectives? (These are the indicators.) Are data for those indicators currently collected? If not, is it feasible – ethically, legally, and financially, for the department to collect this data? Is there additional information that would be useful for staff to access at the same point?	Does the department have a need for multiple staff to access this content on a regular basis for monitoring, planning, or communicating? How difficult is it for the staff to access this information in the current state? Are there other benefits or uses of displaying the information in this manner?	For data from external sources, who owns the data? What is the data owner's policy about sharing this data? Can the department meet the data owner's requirements for data sharing? What infrastructure exists for accessing and transmitting the data? Does the department have the technical expertise, equipment, and human and financial resources to develop and maintain: • connections to the external data? • a server for hosting the visualization tool and dashboard? • the dashboard display?

Table 3-3 Project Decision Framework to use in determining the feasibility of implementing the model.

- the type of information to be displayed in the dashboard
- whether the project benefit will outweigh the costs
- the type of visualization tool to use in the system

Initiating the project. If the project is deemed feasible, the initial step is to identify the executive stakeholder(s) and the project team. The executive stakeholder will provide final approval on the appointment of the project team and on planning documents and milestones. An executive stakeholder for this project should demonstrate a high level of interest in the success of the project. Since selecting and communicating information is the purpose of this project, the executive stakeholder should also represent the interests of maintaining validity and consistency in communicating data and statistics on behalf of the department. The project team should consist of a project manager, a representative of the staff who will build and maintain the system,

one or more representatives of staff who will use the system, and one or more representatives of staff who have expertise in defining indicators of specific health outcomes.

Other initial tasks include agreeing on the objectives and deliverables for the project. Project objectives are based on one or more of the requirements and should be measurable to serve as the basis for project evaluation. Deliverables are products representing the work of the team and should include items, such as the operational VPN and the dashboard display. Deliverables for more abstract project work can include a metrics dictionary defining and describing how to calculate each metric on the dashboard, a work breakdown structure dividing the work into smaller, assignable components, or documentation for creating the visualizations and the dashboard display. All deliverables should include a description of unique requirements, such as level of detail for documentation, or a specific measure to indicate acceptable performance, such as the dashboard refresh occurring every Sunday.

Engaging other stakeholders. The team should identify the various stakeholders, determine their respective interest levels in the project, and decide how and when to communicate with each as the project progresses. The team in conjunction with department leadership, should also decide whether engaging other organizations to collaborate on creating and using the dashboard is appropriate for the department's intended uses. If appropriate, these other organizations can share in the cost or contribute expertise or other assets toward developing the dashboard.

In the case of the DeKalb BOH, potential partners include

- Georgia Department of Public Health: The GDPH already produces a dashboard of health outcomes by county or by Census Tract and also provides options for accessing state-held health data for use by the LHDs. Another option is to consider a

model, such as Connecticut's CT Health Index, developed by the state with input from the county health departments.

- Other Georgia Boards of Health: The Volusia County project was adapted by other county departments in the state. This would offer a source of cost-sharing if others were interested.
- Atlanta Regional Commission (ARC, https://33n.atlantaregional.com/). ARC's Research and Analytics division maintains a dashboard of indicators for 20 counties in the metropolitan Atlanta area. There are currently only a few health indicators on the site: rates of uninsured, low birthweight births, teen pregnancies, hospital discharge by selected conditions. ARC also collaborates with the Community Foundation of Greater Atlanta on a Neighborhood Nexus (http://neighborhoodnexus.org), which maintains a dashboard that includes health indicators. The Neighborhood Nexus also provides interactive maps, drawing data from GDPH and other sources, for exploring relationships between over 170 health indicators and a data dictionary for these indicators. Although this group would not be a likely partner for this project, these groups would be potential partners for a dashboard project intended to engage the community.

Planning by the team. Other planning and information-gathering tasks should also commence at the outset of the project:

- Gathering information
    - Data inventory: A list of the metrics desired for the dashboard. Each metric should be defined, including the data source for the metric, how frequently this data is updated, and specifications on how the metric is calculated. This

information will guide the development of the visualization tool and provide specific measures for quality assurance and for evaluating the success of the system. Depending on the scope of the dashboard, a committee with more representation by staff working in the health areas of interest and those with expertise in the data and statistics should engage in this work, perhaps utilizing the model of identifying an initial list followed by rounds of discussion and narrowing of the list.

- Technical assets: Identified in the Feasibility column of Table 3-4, these assets include numbers of information technology staff hours that can be devoted to the project; level of expertise for setting up the VPN and servers, administering databases, programming in SQL or similar language, and working with data visualization tools; and expertise in calculating the metrics needed for the health indicators.
- Options for needed technology or expertise: For any materials or human resources which the department must acquire for the project, the team should compile a list of alternatives along with advantages and disadvantages. The application for visualizing data and a developer to create the visualizations are two examples of entries on such a list. For the application, options include proprietary products, such as Tableau, and open source programming libraries, such as D3. Proprietary products increase the cost of developing and maintaining the system, but can offer more support than would be available for a hand-coded visualization. As for the developer, the cost depends on the time required to create the visualizations and the complexity of the dashboard. A flat static display

of data is the most basic and requires the least time. Introducing interactivity to the display will require more time to develop. The consultant suggested that the dashboard development portion of this project could be accomplished by a computer science student, possibly reducing this cost.

- Guidance and Training: The team should begin discussing and documenting policies and procedures deemed important for operating the dashboard once the project is complete. For example, as discussions occur on how an HIV Program team should compile data from the survey, the project team can document general procedures for collecting and storing data generated by other systems, such as the electronic medical record. Such guidelines can include preferred applications to use for storing data and file naming conventions. These procedures can guide other program teams in collecting future data to populate the dashboard for other purposes. In another example, the focus group discussion revealed that the department values consistency in communicating statistics. There is also a concern about maintaining confidentiality of identifiable health information. Documenting a policy for using and updating the dashboard will help to avoid misuse of the information.
- Quality assurance: The team should define minimum standards that the system must meet before the project progresses to the next phase of development. As an example, standards can be set for
    - Establishing connections to the GDPH database and the department's database
    - Constructing the queries to provide the values for the dashboard metrics. Define a procedure for confirming the accuracy of the calculations as executed by the system.

- Creating the visual presentation of the data. Expectations can include dashboard size, amount of white space, image contrast, appropriate type of visualization (e.g., bar graph, table), and level of interactivity of the dashboard.

Development

After planning and compiling needed information, work begins to develop the dashboard. Milestones, and measures for indicating their successful completion, include:

Milestone	**Success measure**
Connections established to the local database and to the GDPH database	A test query can successfully transmit data from each source
Queries developed in the visualization application to provide the values for the selected metrics	Using a test data set, the calculation of each metric is the same when executed through the dashboard as when calculated through a valid means, such as an Excel function.
A draft dashboard is completed	A dashboard is displayed to a test audience
The dashboard is completed	Usability testing of the dashboard interface is completed along with any adjustments based on user feedback.

Evaluation Plan

The purpose of the evaluation is to determine if the project solves the problem or adds the expected benefit identified in the pre-implementation assessment and planning phases. Of the projects described in the literature review, all indicated that measuring achievement of the dashboard objective was one, and in some cases the only, stated method of evaluating the system. Post-implementation evaluation of this project should examine the extent to which the system successfully combines state and LHD data and displays it in a dashboard. This can be

done through documenting how the project performs at transmitting, aggregating, and displaying the data according to the requirements.

The significance of this project is that LHD staff need access to data at the time it is needed and data that is accurate and presented in a way that is understandable and useable. The evaluation should also examine the extent to which the project achieves these things. Confirming accuracy of the metrics should be addressed in the development phase of the project through quality assurance activities, but confirming accuracy after the first refresh of data in the production dashboard is another useful component of evaluation. Additionally, the HIV Program Team, should meet at least annually to discuss the appropriateness of the dashboard metrics.

To measure usefulness and availability, the target audience of the dashboard can be surveyed to determine

- Purposes for using of the dashboard
- Number of data requests from staff before and after dashboard implementation
- Any suggestions for improving the display or content

In addition, after the next 5-year health status report, the Epidemiology Team can provide input on whether the HIV data was useful for the report.

Chapter 4: Discussion

Project Summary

There has been a call for more evidence-based decision making by public health practitioners at national, state, and local levels. In the current environment, more information is collected now than ever before for public health practitioners to use in determining actions and allocating resources for promoting health. However, many LHDs in the United States currently have limited capacity to utilize technology in order to effectively use this data.

In an interview to analyze the business processes around accessing metrics of health status for the county, staff at the DeKalb BOH indicated that they would value some changes to the current system for accessing data. The ability to access some standard indicator measures without having to request them from the Epidemiology Team or go the state system to look them up could make the data available in a more timely manner. Presenting the measures using the department's geographic groupings of Census Tracts would also save staff time and aid communications with community partners working in those geographic areas.

A dashboard is an approach that LHDs can employ to deliver information on health status and program performance to staff for planning and assessing. By establishing secure and reliable connections to all data sources, such a system can provide currently available data, and by making the information available through a central dashboard, the system ensures consistency of information being communicated. As with implementing any new technology, an LHD must decide if the return on investment makes implementation worth the cost.

For this project, interviews with key informants at a local department and state health department revealed that one of the greatest challenges to developing and using a dashboard is identifying the most relevant and accurate indicators of the outcomes of interest. There are

various methods to identify and select indicators, and engaging the stakeholders in these decisions is critical. If the metrics are not valid, the dashboard is not useful. Aside from the validity of the metrics themselves, any programming used to populate the dashboard must also be valid; that is, the programming must accurately execute functions of extracting and analyzing the data. The project must include steps to assure the quality of the code used to automate processes of extracting data and calculating metrics.

As crucial as the dashboard content is, perhaps the greatest potential obstacle to integrating data for a dashboard is gaining access to the needed data when it is held by other agencies or organizations. The external organization must appreciate the value of sharing the data such that any cost is outweighed by the value the project. An LHD can reduce some of this cost by taking steps to ensure that the process of sharing data requires the least amount of effort on the part of the external organization. Laws or regulations restricting data sharing can also halt this type of project. Sometimes just a lack of understanding of how a law or regulation applies can prevent public health departments from pursuing data sharing.

Some LHDs have successfully partnered with other organizations in their respective communities to develop and implement more comprehensive dashboards of the community that include indicators of health. Since health outcomes are often related to other factors, such as education, economy, and the built environment, identifying and partnering with these other organizations can be a practical solution to getting started with a dashboard. All parties can see the indicators important for them and can share the costs and risks of the project. Partnering with local organizations can also increase the department's interactions with the community. However, dashboards intended for the public cannot contain any personally identifiable health information, so this type of collaboration is not always an option. Also, engaging multiple

partners in developing a dashboard, or any other technology, can also pose a challenge for maintaining the scale and focus of the project. All partners should agree on clearly delineated goals and objectives in order to prevent the project from increasing in size and scope to become untenable.

As with any technology project, planning comprises a significant portion of a dashboard implementation to ensure that the dashboard fulfills its purpose and is acceptable to the users. While it might seem like staff or other users will immediately appreciate the dashboard, if the technology alters the steps in a business process, then staff need training about what to expect, how the new system fits into their workflow, and how to handle any problems. Stakeholders must agree on the purpose and goal of the dashboard because this guides all other decisions about the project. Other key decisions include:

- Determining the indicators to be included
- Identifying data owners and how to engage them
- Exploring options for securely transmitting data and for automating the process of calculating and displaying metrics
- Allocating resources for developing the system
- Selecting a platform to make the dashboard accessible to the intended audience
- Establishing methods for assuring the quality of the various pieces of the system and for evaluating the project and system once it is operational.

Implications

The process used to develop this model demonstrates how an LHD can employ aspects of the Collaborative Requirements Development Methodology™ to engage LHD staff in discussing the type and presentation of data that is most useful in their work processes. This demonstration corroborates the findings of other cases using this method. A department's goals for using a dashboard, available technical assets, and need to gain cooperation from owners of external data all determine the level of collaboration. The Project Decision Framework and implementation planning guide included in this model provide more detail about the process of developing this type of project than has been identified in other publications and documents identified in the literature. This detail can provide other LHDs with a framework for how to approach such a project.

For the DeKalb BOH, implementing this dashboard will require an investment of time and financial resources. The benefit will be quicker and more efficient access to accurate metrics derived from the department and external data sources and displayed by Census Tract groupings customized according to the department's needs.

Limitations

The primary findings serving as the basis for this model come from interviews of selected staff at one local department and one state department. Interviews with other staff or other departments might reveal a different perspective on the need or purpose for the project. Also, at the time of the interviews, the Coordinator for the department's new Men's Health Initiative was not available to participate in the focus group. While the metrics for measuring progress on the Men's Health Initiative have not yet been finalized and while the HIV metrics used in the model were selected for demonstration, not including staff directly involved in the Initiative limits the

conclusions about how the system can be used for this purpose. Also, the CRDM method used to guide the focus group discussion was adapted to accommodate the time permitted for the discussion, limiting the generalizability of the CRDM method as a whole. Finally, the information needs, organizational cultures, level of information technology infrastructure, and unique relationship between these two departments limit the generalizability of the findings and application of the model by other LHDs.

Recommendations

Conducting and evaluating a pilot of this project will provide more information on how an LHD can select and apply methods of data transmission, solutions for ensuring metrics integrity, and best practices for interactivity to engage users with the data. Also, as LHDs face constraints of financial resources, technical expertise, and organizational support for implementing information technology, they should continue looking outside the department when it is feasible. One approach is to develop partnerships with other stakeholders, including non-health agencies in their communities, the state health departments, and community partners, such as local business or economic development councils. Departments should also look at other ways to address scarcity of technical resources, especially human resources. This can include establishing a relationship with an academic computer science program to have access to a potential pool of programmers or identifying open source applications.

LHDs in the United States do utilize dashboards and other similar displays of metrics for planning, tracking progress, and engaging stakeholders. Creating an efficient process for integrating and displaying the data requires identifying the goals and intended dashboard users, pinpointing appropriate indicators of the health behaviors or outcomes of interest, cultivating

relationships with the owners of external data, and understanding available internal and external technical resources.

Chapter 5: Executive Summary

Introduction

Staff at local health departments (LHDs) make decisions about when a health issue rises to a need for action and which action is most likely to effectively address the issue. These decisions affect how quickly the department can respond, how resources are allocated for the response, and how effective the response will be. Therefore, staff need timely access to information that accurately and clearly reflects the status of the community's health and the progress of programs and services in tackling the issue. Often this information is collected and stored by the LHD, as well as by external organizations.

Purpose of this project

This project proposes a model to aggregate data collected by LHDs with data from the respective state health department for monitoring health and for planning and evaluating programs around a specific health issue. The objective is to describe how an LHD can integrate the state and LHD data and display metrics of associated health outcomes and of the programs designed to impact those outcomes. The project addresses issues related to relevance and timeliness of data, data-sharing, and visualization, as well as organizational and other non-technical factors critical to implementation and sustainability.

Solution

Based on a scenario of DeKalb County Board of Health (DeKalb BOH) using data from the Georgia Department of Public Health (GDPH), the solution generates metrics on health outcomes and associated programs and services associated with prevention and control of HIV infection in DeKalb County. A system displays these metrics for staff to quickly access and scan data to determine the level of progress throughout the service area. For the environment at

DeKalb BOH, a VPN connection to the GDPH databases permits a visualization application at DeKalb BOH to analyze relevant data. The application also analyzes locally held data and renders visualizations of all metrics, which are displayed on a platform hosted on the DeKalb BOH intranet. The dashboard enables the viewer to display information for the entire county or for a department-defined geographic division of the county. An implementation plan describes discussions and planning before initiating the project. This includes identifying a project team, which to engage in identifying local infrastructure and available technical expertise, as well as deciding the requirements for the new process and system.

Background

The Institute of Medicine, the CDC, and NACCHO have each identified timely access to relevant and accurate data as requirements for public health practitioners to effectively solve problems. These organizations have led the call for public health agencies to base decisions on evidence, which includes data on health conditions and factors contributing to those conditions. Health data is abundant. Surveillance systems, healthcare providers, hospitals, labs, insurance companies, non-health, local government offices, online mapping services, and social media each generate data describing aspects related to the health of the population. The challenge for supporting public health practitioners is focusing on information key to the issues of interest.

In business decision-makers have employed various tools over time to help them focus on the information that is relevant to decisions at hand. One of these tools, the dashboard, displays only the data that is pertinent to the area of interest to highlight trends and other analyses that facilitate decisions about that area.

There are reports of LHDs implementing or participating in dashboards. No similar projects have been identified that were implemented at LHDs in Georgia. The LHD dashboards

were used for surveillance, internal performance management, and communicating with the public. Keys to successful projects include a clearly defined purpose and intended audience; stakeholder engagement in selecting the metrics; and buy-in by department leadership and staff who will use the dashboard. Automation of the data extraction and analysis processes is a desired feature. Despite these examples, many LHDs lack resources for widespread adoption of technology and methods to make better use of data in decision-making.

Methods

This project proposed a model for use in the setting of the DeKalb BOH (GA) and the GDPH. The purpose was to integrate data for reporting metrics supporting decisions about a Men's Health Initiative being planned by the DeKalb BOH.

A guided interview with DeKalb BOH staff incorporated elements of the PHII's Collaborative Requirements Development Methodology™ (CRDM) to document how the staff currently gains access to data needed for program planning and evaluation. Other interviews with GDPH staff, DeKalb BOH information technology staff, and with an expert in data visualization provided information on data and data-sharing resources at GDPH, availability of technical expertise at DeKalb BOH, and challenges with using dashboards and visualizing data.

Discussion

A dashboard is an approach that an LHD can employ to deliver information on health status and program performance to staff. By establishing secure and reliable connections to all data sources, the system can provide currently available data. By making the information available through a central dashboard, the system can ensure that all staff are accessing the same information. As with implementing any new technology, an LHD must decide if the return on investment makes implementation worth the cost. LHDs can use the CRDM to document

current processes and to guide discussions and analysis of potential improvements, as well as to describe concrete requirements for a new process or system.

Stakeholders must agree on the purpose and metrics. The validity and accuracy of the metrics must drive quality assurance throughout development and operation of the dashboard. Thorough documentation of the data, the calculations and analytical methods, and the code is crucial for ensuring accuracy of the information populating the dashboard and for modifying the dashboard in the future. Accessing external data requires exploring options and requirements of the data owners and establishing relationships with key individuals at those organizations.

Because the solution for this project is based on interviews and experiences at a single LHD, the generalizability of the conclusions and application to other LHDs is limited. The information needs, organizational cultures, level of technology infrastructure, and unique relationship between the DeKalb BOH and the GDPH may not be applicable in other settings. Also, because the CRDM was adapted to accommodate the time permitted for meeting with the participants, the project is limited in the generalizability of the CRDM as a whole to other similar projects.

Conclusion

Integrating data held by different organizations can be a feasible solution for a local health department to provide staff with timely access to metrics and other information related to a specific health issue targeted by the department. Before embarking on a project, planning should include defining a clear purpose and goals for the project, inventorying data and technical assets, and identifying the external organization's level of interest, policies, and infrastructure for sharing data.

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