

Governance's Role in Local Health Departments' Information System and Technology Usage

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Vest, J.R., Menachemi, N. and [Ford, E.W.](#) (2012). Governance's Role in Local Health Departments' Information System and Technology Usage. *Journal of Public Health Management & Practice*. 18, 2, 160-168.

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Abstract:

Objective: The purpose of this article is to explore the relationship between local health departments' (LHDs') governance structures and their use of information systems (IS) and information technologies (IT). As the US health system moves toward more integrated models of delivering care, LHDs have been identified as key nexus for information exchange. Therefore, understanding how LHDs' governance facilitates or inhibits the adoption and use of such IS and IT tools is critical.

Design: The 2008 survey of the National Association of County and City Health Officials' members included a set of questions dedicated to the use of IS/IT and its relationship to governance structures. Ordinal logistic and Poisson regressions are used to identify significant relationships among the variables. The survey sample's results (n = 473) are extended to the national sample (N = 2794) using the variable weightings included in the study design. **Main Outcome Measures:** The 2 dependent variables examined are IS and IT use. The IS variable captures the software and analytic tools used in LHDs. The IT measure primarily captures hardware and infrastructure capabilities.

Results: Overall, the use of IS/IT by LHDs is low. Generally, LHDs that have shared governance structures with other state and community bodies tended to have greater IS/IT use. Similarly, larger LHDs with leaders that have higher educational levels used IS/IT in greater amounts.

Conclusions: With their current IS/IT capability levels, LHDs will struggle to play a meaningful role in the integration and exchange of health information. Given that LHD also serve at-risk

populations in disproportionate numbers, this digital divide may become a real divide in the access to high quality care for some communities.

Keywords:

health information technology | organizational structure | public health informatics | public health administration | health care management

Article:

Significant benefits from the application of information technology (IT) and information systems (IS) to public health practice have already been realized, but the potential exists for even greater transformation and improvement in the public health infrastructure.^{1–3} Public health lags behind general health care and other industries in the adoption and implementation of IT/IS.⁴ Even in the early part of the 21st century, basic e-mail and Internet access were still lacking in many local public health departments.^{2,3,5} Current trends in health informatics are focused on the implementation of electronic health records (EHRs) and other advanced data management and decision support systems built to the federal government's meaningful use standards. Public health on the other hand still relies extensively on consumer-level software programs (eg, Microsoft Excel and Access) or paper for information management needs.^{6,7} Despite progress in the development of staff training requirements and staff competency models, the Final Report of the Turning Point National Excellence Collaborative for Information Technology 8(p1) concluded that “Unlike private industry, public health has not valued information systems technology as a key ingredient to success. Rather, the practice of informatics is essentially an afterthought.”

The purpose of this study is to identify and measure the organizational factors associated with extent of IT/IS usage in local health departments (LHDs). In particular, the study analyzes data from the National Association of County and City Health Officials' 2008 Survey of LHDs that included a set of questions related to IT/IS use. The IT/IS measure is compared with organizational features to identify factors that either promote or hinder technology adoption.

For public health policy makers, this study helps to identify the determinants of IT/IS usage. Quantifying the organizational factors associated with IT/IS usage will facilitate the development of targeted policy interventions or specific recommendations to achieve the unrealized potential

of IT/IS in public health. For public health educators, this study helps to frame the environmental conditions in which students will have to apply IT/IS competencies. From a research perspective, the study serves as a baseline assessment of the IT/IS infrastructure of the US public health system. Given the important and growing roles informatics plays in the field of public health, our findings will be of interest to managers, educators, and researchers who have a stake in assessing and assuring the public's health.

Methods

Data source

Data for this study came from the National Association of County and City Health Officials' (NACCHO) 2008 National Profile of Local Health Departments Study.⁹ The 2008 Profile Study was the fifth survey of local health departments undertaken by NACCHO to describe the organization, structure, and capabilities of public health practice at the local level. All LHDs receive a core questionnaire covering jurisdiction, governance, funding, workforce, and public health activities. In addition to the core questions, each department is randomly assigned 1 of the 3 supplemental question modules. In 2008, the IT/IS questions appeared in one of the modules. The supplemental modules follow a stratified sampling frame so that results can be estimated for the entire population surveyed. Specifically, responses were weighted for organizational characteristics and nonresponse bias to estimate responses for all LHDs nationwide. The response rate for the sample that included the IT/IS questions was 87% and included 473 LHDs.⁷

Dependent variable

Two dependent variables were analyzed to assess IT and IS use separately and their relationships to organizational factors that may facilitate or hinder technology adoption. The first was the extent of public health IS utilized by LHDs. Generally speaking, the IS features are database management tools. The Profile Survey asked about the collection and maintenance of data on 6 key public health activities: childhood immunizations, reportable diseases, vital records, laboratory reporting, outbreak management, and restaurant inspections. The wording of the questions about the method of record keeping for each of these 6 activities was identical. We determined the proportion of activities, performed by the LHD, which utilized either a relational or a Web-based database. This excluded record keeping on paper and in spreadsheets. To prevent potential bias against urban LHDs, we did not consider management of well water records as part of the IS compiled measure. This percentage was then divided into a 3-level categorical variable of: complete IS utilization (all activities were supported by IS), high (not all, but more than 50% of activities), and low (no IS or less than 50% of activities using IS).

The second dependent variable of interest was a summated scale measuring the count of individual IT applications that had been implemented in the LHD including: EHRs, health information exchange (HIE), mobile IT, and wireless networks. These technologies were assessed using 5-point, Likert-type scale ranging from “not aware” to “have implemented.” The IT measures largely focused on both software applications and the hardware necessary to support interoperability beyond the LHD. The IT scale ranged from 0 to 4.

Independent variables

The independent variables were constructed from responses to questions that measured LHDs' organizational governance, IT/IS authority, leadership, and IT/IS capabilities. The LHD jurisdiction was defined as the local (city, town, county), district or state level. In addition, we included a variable representing LHD governance structure identified using the classification scheme created by the Association of State and Territorial Health Officials 10 to indicate the level of integration with state offices. This measure includes state responsibility for approving LHDs' budgets. Information on IT/IS authority for hardware acquisition, software selection, and IT security were included in the 2008 Profile Survey. The survey questions pertaining to “authority” allowed respondents to indicate whether decision making rests with the LHD, city/county department, state health agency, or some other organization. We created a 4-level categorical variable describing the type of control for each area: (1) LHD only, (2) local government only, (3) state only, and (4) multiple agencies. For our analysis, those LHDs who responded with unknown or missing decision authority were included in the multiple agency category because of small sample sizes. LHD leadership was described along 2 dimensions—highest academic degree attained and by full-time work status. Lastly, the ability to implement IT/IS was measured by the presence or absence of full-time IS specialists (a dichotomous variable).

In addition to the measures detailed earlier, factors known to be associated with technology adoption or general innovativeness in other organizations were explored. These additional variables were also drawn from the Profile Survey. Increasing organizational size and increasing financial resources are strong indicators of organizational innovation capacity and measured as the total number of full time employees and the total of all revenues from the previous fiscal year.¹¹ Likewise, formal connections to academic institutions, such as faculty positions, or service on advisory boards, tends to benefit public health organizations.¹² We also examined the total number of services offered directly by the LHD; because of the needs to coordinate and share information, increasing functional differentiation within health care organizations has been associated with the adoption of information systems.¹³ To account for the resources challenges

faced by rural LHDs that may impact IT/IS adoption, geography is included as a covariate. Lastly, the utilization of public health informatics competencies indicates a broader understanding and appreciation for the potential for and issues surrounding IT/IS.

Analysis

The survey design command in STATA (StataCorp, College Station, TX) was used to account for the survey's stratified sampling design and weights. Weighted frequencies, percentages, and means described the study sample. Given the disparate nature of the 2 dependent variables, 2 different statistical methods were used to conduct the analyses. For the categorical extent of IS measure, we utilized ordinal logistic regression to measure the association with independent variables. Regression coefficients were exponentiated to express odds ratios (OR). Because of the count nature of the IT utilization scale, we utilized Poisson regression models. The IT scale in the unweighted data showed little indication of over dispersion in the distribution according to a goodness of fit tests. Regression coefficients were exponentiated to express the expected factor change (FC) in the count of implemented IT.¹⁴ For both analyses, because of potential multicollinearity between the primary variables of interest, we only adjusted the OR (aOR) and the FC (aFC) by jurisdiction, number of services, and geography. In addition, we set the significance testing for the coefficients at $[\alpha] = .05$ for both analyses. The study was approved by the institutional review board at Georgia Southern University.

Results

The sample of 473 respondents and the extrapolated results applied to the full sample of 2,794 LHDs and are described in Table 1. The majority of the LHDs in the sample had a city or county jurisdiction (92%), were headed by a full time chief executive officer (87%), and were part of a decentralized state governance structure (71%). In terms of technology, most were not aware of national IT data standards (57%) and few employed IS specialized staff (21%) or used informatics competencies.

The average number of IS applications used by LHDs was 3.4 and on average LHDs' utilized Web-based or relational databases to manage data for 70% of their activities. One in 5 (21%) LHDs reported a low use of IS to manage their activities. The most commonly implemented public health IS were databases to manage childhood immunizations (93%), reportable diseases (83%), and vital records (74%). Public health IT examples were less common. Less than 1 in 5 LHDs have implemented an EHR and less than 1 in 10 have implemented HIE. Hardware investments were more common with nearly half of LHDs reporting use of mobile IT devices

(eg, laptops or handheld devices) and more than one-third reporting wireless Internet connectivity in their facilities. Overall the average number of IT applications utilized was 1.1 (out of 4).

Table 1 is omitted from this formatted document.

Role of organizational governance and LHD leadership on public health IT/IS utilization

Local health departments with mixed or shared governance arrangements had higher IS utilization compared with LHDs where authority resided entirely at the state level (eg, more centralized governance arrangements) or entirely at the local level (eg, complete decentralization) (Table 2). After controlling for confounding factors, the adjusted odds of IS utilization increased by 2.43 times for LHDs with shared governance and 3.47 times for LHDs with mixed governance. Governance structure was not associated with public health IT utilization. Neither IT or IS utilization differed between LHDs with jurisdictions covering cities/counties and those covering districts or multiple counties. Local health departments in micropolitan, or suburban, areas had an 88% higher odds of greater IS usage than urban LHDs, but only in the unadjusted sample.

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The characteristics of the LHD's top executive officer were associated with both IS and IT utilization. Unadjusted for other factors, the extent of public health IS utilization was lower for part time leaders (OR = 0.33; 95% CI = 0.17–0.65). After adjusted for other factors, executives with doctoral degrees were positively associated with more extensive IS utilization than their counterparts with bachelors or associates degrees (aOR = 1.96; 95% CI = 1.14–3.37). In terms of the use of public health IT, the count of technologies in use by the LHD was also lower for part time executives by a factor of 35% (FC = 0.65; 95% CI = 0.43–0.99).

Role of IT/IS authority and capabilities on public health IT/IS utilization

Generally, the movement of authority over decisions concerning IT/IS from LHD to the local government's IT department was negatively associated with the extent of public health IS usage (Table 2). Controlling for other factors, local governments' IT departments control of hardware (aOR = 0.47; 95% CI = 0.20–0.76) or software decisions (aOR = 0.37; 95% CI = 0.20–0.68) reduced the odds of public health IS utilization. In addition, the odds of more public health IS utilization were decreased when local government IT departments had authority over data

management (aOR = 0.54; 95% CI = 0.31–0.96) or IT/IS security decisions (aOR = 0.60; 95% CI = 0.39–0.94).

Likewise, when the local government IT departments had decision authority concerning information systems and technology the extent of utilization on the IT scale was lower. This was true when the local government controlled software (aFC = 0.71; 95% CI = 0.51–0.98) and hardware (FC = 0.71; 95% CI = 0.56–0.91) decisions instead of the LHD.

The relationship between state agencies' IT/IS authority and utilization was not as clear. State decision making on software (OR = 1.68; 95% CI = 1.09–2.59) and data management (OR = 1.82; 95% CI = 1.15–2.88) both increased the odds of greater IS utilization over LHD control. However, after controlling for confounding factors, state authority over any information systems and technology decisions was not associated with a greater usage of public health IS by LHDs. In addition, whereas state authority may be positively related to IS utilization, in no instance was it associated with increased public health IT utilization. Public health IT utilization was negatively associated with state level control over decision making on hardware (aFC = 0.55; 95% CI = 0.41–0.74), software (aFC = 0.61; 95% CI = 0.47–0.78), data management (aFC = 0.68; 95% CI = 0.53–0.87), and security (aFC = 0.62; 95% CI = 0.49–0.82). Overall, state IT/IS authority was associated with a reduced number of utilized public health IT by 39% to 54%.

For both dependent variables, the presence of information system specialists in the LHD was positively associated with the extent of public health informatics usage. This was the case before and after controlling for confounding factors. LHDs with IS employees had nearly 3 times the odds of having a greater proportion of activities supported by IS and the count of public health IT in use increased by 75%.

Role of other factors on public health IT/IS utilization

Two factors were associated with the extent of both public health IS and IT utilization: (1) the total number of services delivered by the LHD (IS: aOR = 1.05; 95% CI = 1.04–1.07 and IT: aFC = 1.02; 95% CI = 1.01–1.03) and (2) academic linkages (IS: OR = 1.64; 95% CI = 1.12–2.41 and IT: FC = 1.20; 95% CI = 1.00–1.44).

Discussion

According to the 2008 NACCHO Profile Survey, the widespread use of public health informatics is still not the norm among LHDs. Many LHDs utilize Web-based or relational databases to manage key public health activities. However, the practice is not universal and not equal across all activities. In addition, few LHDs have implemented EHRs or HIE. These low levels of implementation are problematic, because public health agencies are envisioned as serving as leading elements in the widespread adoption of HIE among the private sector.¹⁵ In addition, many LHDs provide services with enough of a clinical orientation, such as communicable disease treatment or prenatal care, that an EHR would provide benefits for data management and sharing information with health care providers. Without active utilization of these technologies it will be difficult for LHDs to be included in the national dialog or to leverage the benefits electronic patient information.

From the earlier analyses, the extent of utilization IS and IT is a concomitant of the LHD's governance relationships with state and local agencies. Information technology and information system governance refers to an organization's arrangements and authority patterns for all IT/IS-related activities and incorporates decision-making paradigms, strategic planning, system acquisition, application deployments, and budgeting.¹⁶ Governance typically involves the interaction of 3 actors within the organization: executive leadership, IT professionals, and department leaders or professionals.¹⁷ How these actors work together to identify decisions, determine who will make the decisions, and execute the decisions around IT/IS is highly contingent upon the qualities of the IT/IS, the external environment and the organization's culture.^{17,18}

The complex nature of the public health system in the United States means that LHDs have a wide degree of variation in the structures that can influence IT/IS governance patterns. For example, LHDs are not independent entities in many regions. Rather, their strategic planning, purchasing decisions, and agendas are influenced by larger state agencies.¹⁹ Likewise, LHDs vary in their dependence upon their local and state governments for financing and budgetary oversight.^{20,21}

Role of local government

Generally, the movement of IT and IS decision authority from the LHD to other governmental departments or agencies was associated with lower levels of IT and IS utilization. The negative

effect on public health IT/IS utilization in the instance of local government department authority instead of the LHD might be attributable to a lack of domain expertise by those empowered to make the decisions. The IS included in this study fulfill very specific public health needs and target specific conditions. If not public health professionals, those making decisions about software may not appreciate the importance of these systems, and may not see the need to adopt more than is necessary to meet state or federal requirements. Likewise, the same may be true for removing hardware decisions from the LHD.

Role of the states

The role of state agencies is nuanced, because with regard to public health IS utilization, some integration with the state agency appears beneficial. Local health departments with shared or mixed forms of management had higher levels of IS usage. This may indicate that the need for information exchange between LHDs and other government bodies with common activities drives some IS adoption. Because no benefit was seen among centralized structures, those LHDs may not have an expectation of providing feedback to the oversight body that generally promulgates instructions.

Not accounting for governance structure or other factors, state health agencies' decision authority over software and data management are both associated with above average levels of public health IS utilization. The fact that both of the areas had similar effects is not surprising because data management and software use are closely tied. State health agencies have domain expertise and that may be why their role was positively associated with IS utilization. Moreover, many of the Internet-based public health IS applications in use at the local level, may actually be state products. By use of state developed systems LHDs may tangentially benefit from the financial resources and technical expertise at the state level. A similar phenomenon exists in hospital system affiliation, where centralized decision making can lead to technological investments. However, after controlling for governance structure, which includes those centralized arrangements, moving authority over IT/IS to the state did not improve the extent of IS utilization.

Furthermore, complicating the role of state health agencies in LHD IT/IS governance is the fact state authority for any technology decision over the LHD negatively affected the extent of IT utilization. Electronic health record, HIE, mobile technologies, and wireless communication were not more commonly utilized when the decision authority rested with the state. Again, state health agencies would understand the value and public health application of each of these technologies. The difference between the IS and the IT examples may be in the different sources

and qualities of these technologies. As noted above, many public health IS are state or federal products, some of which are delivered over the Internet. In contrast, the public health IT examples are predominately private vendor solutions not often identified with state health departments. Therefore, for LHDs the utilization of these IT examples might be hampered by larger state procurement processes. Alternatively, the installation of the IT examples may be logistically more complex than the Internet-based IS examples. Local health departments in control of their own IT/IS governance could have smaller and quicker installations, than states with responsibility for numerous disparate LHDs.

LHD characteristics

Other organizational factors beyond those directly related to IT/IS governance were associated with the extent of both IT and IS utilization. The negative association with a part time executive and a positive association with increasing IT and IS utilization for a higher trained top executive were consistent with the general public health performance literature. More than a decade ago, Handler and Turnock²¹ suggested that a full-time executive was more effective in assuring LHD performance. In terms of training, top executives in government agencies need to be both innovative and champions of IT/IS,²² and the fact that LHDs with higher-trained top executives were associated with greater IS utilization in this study may support that contention. However, that cannot be certain because previous research on LHD executive leadership training has demonstrated inconsistencies in relation to departmental performance.²³ Lastly, the presence of IS employees within the LHD was positively associated with both extent of IT and IS utilization. Specialized IS/IT employees are an indicator of an organization's technological capacity to adopt and implement technology.²⁴ However, in this data set, we are unable to tell whether the presence of these individuals encourages additional adoption or is the result of IT/IS adoption.

Recommendations

Although we identified the relationship between IT/IS governance and utilization in the data set, the possibility of LHDs to directly change these features of IT/IS governance may be limited. An LHD's ability to assume, or resume, authority over IT/IS selection and acquisition in most cases would not be a unilateral decision. Also, because of the lack of a temporal sequence in the study, our advice to practitioners is not necessary to seek to change these arrangements. Instead, we suggest these findings be viewed as educational for LHDs, state health agencies, and schools of public health.

First, LHDs need to look internally to their own IT/IS capabilities, needs, and governance. Local health departments need to move to more strategic thinking about IT/IS. Effective strategic planning around IT/IS does not mean LHDs have to control all aspects of the decision-making process, but they must establish IT/IS goals and understand how decisions are made, influenced, and how to work in those processes within their own jurisdictions and states. To do this, as these results point out, LHDs need to take a more active role within their local governments' IT department. Broadly, engagement with an IT department could take the form of basic public health trainings for IT staff, invitation of IT staff to participate in existing projects, working with department leaders require previous health information experience for select IT positions, or improved communication between executive level government officials. However, the specific form of engagement with other departments obviously will be unique for each LHD depending upon the structure of government and local politics.

Second, state health agencies may use these findings to help target LHDs for assistance. Sufficient domain expertise may explain the positive association between public health IS utilization and increased levels of training for top executives as well as the positive association between the presence of IS staff within the department and both IT and IS utilization. Local health departments with executive leadership less than a master's degree or with part-time leadership, or few IS staff are easily identifiable organizations to which the state agency can offer support or training. Although state agencies are reaching out to assist, they must also be willing to accept input from the LHDs. After controlling for the organizational relationship with the state health agency, moving IT/IS authority from the LHDs to state agencies was associated with fewer implemented IT and did not particularly benefit the extent of IS utilization. Although not definitive, the results suggest state health agencies review and think strategically about their IT/IS governance relationships with LHDs. It might be local authority over select IT decisions may be beneficial and more desirable. At a minimum, state agencies with decision authority can incorporate LHD planning into their own IT/IS plans, or make their IT/IS planning transparent so LHDs can easily follow the process and adjust their own strategy as necessary.

Third, we see both a potential new student population for schools of public health and a potential benefit from partnering with LHDs. Already, numerous schools of public health offer certificates of public health or even MPH degrees through distance education. Although it would be too ambitious to populate the public health workforce by training IT/IS professionals, increasing public health knowledge and appreciation among existing IT/IS professionals would benefit public health. In practice, this idea is the inverse of the American Medical Informatics Association's 10×10 initiative. Instead of training health professionals about applied IT/IS, it would be training IT/IS professionals about applied public health. Also, this study found some relationships between academic linkages and the extent of public health IT and IS utilization. In

practice, it does not matter if academics encouraged LHDs to be more innovative, or if LHDs with extensive IT/IS portfolios sought out academic partners. Both parties can benefit from these arrangements. Local health departments have access to research analysts, subject matter experts, and data management expertise. Schools of public health gain access to data for research, opportunities for professional service, and potential job placement for students.

Limitations

The earlier findings are limited by the cross-sectional and secondary nature of the data. Most importantly, we are unable to establish a temporal sequence. For some characteristics that are fairly stable, such as jurisdiction, governance, geography, and measures of size, we can reasonably assume they preceded the levels of IT and IS adoption. For the others, we are not as certain whether the extent of IT or IS usage occurred afterwards. In addition, these data are self-reported. It is possible that respondents overestimated their IT/IS capabilities. Fourth, our adjusted measures of association controlled for key factors, but it is very probably we have uncontrolled confounding. We did not control for factors external to the LDH such as local socioeconomic conditions, changes in the broader economy, or legislation. These are potential avenues for future investigations. Fifth, we structured the categories of the extent of IS utilization to be both logical and ensure a sufficient number of observations per category. However, the sample size prohibited more elaborate modeling and we did not explore any potential relationships, synergies or interactions between the implemented IT and implemented IS examples. A future step in research would be move from these basic counts to a more complete description of the LHD's actual IT/IS strategy, which better reflects the complexity IT/IS utilization.

Conclusions

The public health benefits of health IT are at the forefront for the justification of the federal government's huge investments in EHR adoption and HIE establishment.^{15,25,26} The practice of public health depends on timely, accurate, and population-based information, which are more available through the recent advances in IT/IS and the more widespread of adoption of health IT. LHDs can capitalize on these dramatic changes the broader health care system only if they possess the technological capacity. Unfortunately, LHDs currently have not engaged in IS and IT to their fullest extent.

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