The Public Health Information Technology Maturity Index: An Approach to Evaluating the Adoption and Use of Public Health Information Technology

Kenyon Crowley
University of Maryland, kcrowley@rhsmith.umd.edu

Robert S. Gold
University of Maryland, rsgold@umd.edu

Sruthi Bandi
University of Maryland, sbandi@umd.edu

Ritu Agarwal
University of Maryland, ragarwal@rhsmith.umd.edu

Recommended Citation

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Abstract

Background: Public health information technology (PHIT) has the potential to improve the effective and efficient use of information in achieving public health objectives. Information technology maturity models have been extensively used in other domains to guide information technology assessment and planning, but an information technology maturity model tailored for public health departments has heretofore been unavailable.

Purpose: The purpose of this study was to develop a Public Health Information Technology Maturity Index.

Methods: An extensive literature review and content analysis was conducted of information system adoption, use, and maturity in general and in the public health systems and services research context in particular. Primary data were collected through staff interviews (61), staff observations (16), patient focus groups (3), and staff surveys (3) over the course of a multi-year technology implementation, including pre- and post-implementation of an electronic health record system at a large suburban public health department. Data were analyzed using qualitative and quantitative methods to extract potential categories for inclusion in the index. A Delphi exercise whose panelists included experts from state and local public health departments and national multi-stakeholder groups was conducted.

Results: A Public Health Information Technology Maturity Index, questionnaire, and scoring guide were created. The Maturity Index consisted of four primary categories: Scale and Scope of PHIT Use; PHIT Quality; PHIT Human Capital, Policy and Resources; and, PHIT Community Infrastructure, along with fourteen subdimensions.

Implications: The PHIT Maturity Index represents a practical approach to aid public health system stakeholders, notably health departments, in the evaluation of their information technology deployment decisions. As benchmark data become available, it will enable comparative assessment and possible linking of information technology maturity and multi-agency interoperability to population health outcomes.

Keywords

Cover Page Footnote

INTRODUCTION

The quality, effectiveness, and efficiency of public health services in communities nationwide is critically dependent on the effective coordination and use of information both within local health departments and across the network of community partners servicing the local population.[1] Coordination of information can be particularly critical for underserved and "safety net" utilizing populations, which reflect many of the most vulnerable, disadvantaged, medically complex, and socioeconomically challenged individuals.

Public health information technology (PHIT), consisting of the information systems supporting the public health mission such as electronic health records (EHRs), analytics and business intelligence, surveillance systems, registries, consumer digital resources, administrative systems (e.g. billing and practice management), health information exchange, and related systems, provide unique opportunities for improved synchronization within public health departments and across community partners.[2] However, limited evidence and understanding have existed to aid communities in guiding decisions about which PHIT investments and strategies may be most suitable.

The maturity of any system or process addresses the extent to which it has evolved in response to environmental contingencies and is able to more effectively address the key objectives for which it was originally designed. IT maturity models have been successfully applied in healthcare and various business domains to measure improvement in relation to a set of stages that progressively and incrementally achieve better use of information technology.[3] For example, the Capability Maturity Model, which is designed to improve software engineering, has been shown to result in higher quality products and services outcomes across a wide range of business sectors. In the healthcare domain, hospitals advancing in the HIMSS' Electronic Medical Record Adoption Model maturity have shown improvement in quality outcomes such as infection control and adverse medical events.[4,5] However, an information technology maturity model has not been tailored to the unique characteristics of public health organizations. Although the Public Health Accreditation Board's (PHAB) "Measures and Standards" contain two standards directly related to information technology, the first (Standard 3.2) relates only to transmission of communications to the publics the departments serve, and the second (Standard 11.1) addresses the issues of data collection and management, but does not specifically describe how complex systems and data in a community may be leveraged.[6] The PHIT Maturity Index is designed to help fill this gap. It is intended as an aid for public health departments to assess their current status with respect to PHIT, benchmark with peers, and develop strategies for improved use of PHIT in the future.

METHODS

The development of the PHIT Maturity Index used a mixed-methods approach. An extensive literature review was conducted of past work regarding maturity models and maturity of information systems broadly, and within the public health systems and services research context specifically. Peer reviewed published literature and reports from multi-stakeholder organizations such as The National Association of County and City Health Officials (NACCHO), Institute of Medicine, Public Health Accreditation Board and the PHSSR Consortium were assessed. (A full

list of citations reviewed for this study can be found at http://go.umd.edu/phitmaturityindex). Structured content analysis was performed, key measure categories were synthesized and defined, and scores for categories were developed. A category's impact in public health value realization from IT and the degree to which the public health department had control over the result were assessed to help define scoring weights.

This research includes a detailed study of a natural experiment enabled by the public health IT transformation efforts of Montgomery County, Maryland, a large suburban county. Montgomery County has been engaged in on-going efforts to improve public health services leveraging new IT systems. Notably, the Montgomery County Department of Health and Human Services (DHHS) and a public–private network of safety net clinics supported by the Primary Care Coalition of Montgomery County (PCC) embarked on the process of implementing an EHR that supports coordination across Social, Somatic, Dental, and Behavioral Health Services. The EHR aimed to provide greater visibility of patient information across service areas and more efficient communication and management of information both internally and externally. Qualitative and quantitative data collection techniques were used in assessing these activities.

An intensive analysis of this EHR implementation was conducted across DHHS and PCC facilities (12), using interviews (61), observations (16), patient focus groups (3), and surveys (55.5% overall response rate; 602 surveys completed) of EHR users before and after the EHR implementation, and client chart reviews (67), which provided a rich qualitative record.[*] Staff participating in the study included DHHS and PCC clinical providers, administrative and client services staff, and managers at multiple levels across worksites including Access to Social and Health Services, Behavioral Health Programs, Public Health Clinics, and Public Health Dental Services. Patients included in this study typically received a mix of somatic, behavioral and social services through the health department. A detailed chart review was conducted to enable our understanding of the use, breadth, capability, interaction, and usability of both legacy and existing systems. The experiences of implementing PHIT and the factors important to successful value realization were distilled and assessed for Index inclusion. Survey data were analyzed using factor analytic strategies to assess the reliability and validity of subscales and their conceptual structure, and t-tests and multivariate regression provided inferential insights. The factor analysis included components relating to pre and post-implementation staff perceptions of: Information Gaps; EHR Impacts; Perceived Usefulness; Perceived Ease of Use; Future Use Intentions; Knowledge about System; and Training. The factors in combination with controls for demographics, employment history, and computer literacy were used in the regression models.[*]

Further, a Delphi exercise was conducted with six experts representing public health systems at the state and local level and multi-stakeholder national groups. The Index design, narrative, and corresponding questionnaire received written feedback, followed by a virtual focus group to obtain further feedback. Experts were asked to provide feedback on how instructive and measureable Index elements were, which elements needed to be added, changed or removed, and how to best design the Index to reflect macro and micro-level areas of importance. After the virtual focus group, a refined model was distributed for a concluding round of written comments, which were incorporated into the final PHIT Maturity Index.

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[*]Further details related to the data and analyses are reported elsewhere and are beyond the scope of this article.

RESULTS

The PHIT Maturity Index includes four primary measurement categories and 14 subdimensions associated with 57 questions and a scoring rubric. The resultant Index is the product of an iterative process of refinement. The Delphi exercise provided for an expanded view of the capabilities required of diverse health departments, the challenges they face, and the strategic, political, and tactical operating environments health departments must manage, all of which may influence information technology strategy. The Montgomery County Department of Health experience of implementing a new EHR system towards public health objectives highlighted the importance of many elements, such as usability, meeting unique public health requirements, and providing adequate initial and ongoing training. These experiential insights were incorporated into the final Index. Table 1 summarizes the PHIT Maturity Index's components.

The Index scoring is based on 57 questions that each consist of four multiple choice answers corresponding to each of the four maturity stages and scored at 1 point at Level 1; 2 points at Level 2; 3 points at Level 3; and 4 points at Level 4 (most mature). The points for each category are averaged and the average category score is multiplied by the category's weight to produce a total weighted category score. The four weighted category scores are summed for a total score. The categories are weighted such that they reflect the degree of impact the category has on IT maturity and the relative control a health department has to effect change in the category:

- Scale and Scope of Use: 3.0
- Quality of PHIT: 3.0
- PHIT Human Capital, Policy and Resources: 2.0
- PHIT Community Infrastructure: 2.0

The total score generated by summing the weighted average category scores results in a number from 10–40. The scoring bands to approximate the PHIT Maturity Index level are:

- Level 1: 10–14 points
- Level 2: 15–24 points
- Level 3: 25–34 points
- Level 4: 35–40 points

While a total score may be an instructive approximation, each category and each question should be reviewed independently to understand positioning of the health department (HD) along the specific subdimension elements as a way to assess the current status of IT development, benchmark with peers, set specific goals for progress, and foster a cycle of continuous improvement.

Table 1. PHIT Maturity Index components

PHIT Maturity Index				
Category	**Weight**	**Subdimension**	**Description**	**Questionnaire Items**
Scale and Scope of Use	**3.0**	**Nature of Use**	Types of systems used and how the information systems are utilized, across administrative, surveillance, digital consumer resources, electronic health record and practice management systems, registries, analytics & business intelligence, and health information exchange systems.	1–8
		Breadth of Use	Extent of IT use across the 10 essential services of a public health department and primary service areas	9–24
PHIT Quality	**3.0**	**System Quality**	Measured in terms of ease of use, system usefulness, learnability, user satisfaction, reliability, and support services	25–30
		Information Quality	Measured by availability of relevant information, information accuracy, information usefulness and timeliness	31–34
		Interoperability and Standards	Extent to which technical standards are available, implemented and adhered to, and the extent of multi-system interoperability; and, ability of different IT systems and software applications to communicate, exchange data, and use exchanged information	35–38
		Privacy and Security	Development and use of privacy and security practices	39–41
PHIT Human Capital, Policy and Resources	**2.0**	**Training**	Existence and effectiveness of courses, curricula or other training to prepare for PHIT implementation and improve the PHIT competency	42–43
		Competency	The set of skills and knowledge that are essential for the public health workforce to have productive interactions with technology-based tools	44, 45
		Policy	The degree to which IT supportive policy mechanisms have been defined and implemented	46
		Innovation and Discovery	Presence and use of policy, technology and processes to support open data innovation and public health research using health department data	47, 48
		Resources	Extent to which adequate financial support is available	49
PHIT Community Infrastructure	**2.0**	**Community Partner Infrastructure**	Extent of the IT capabilities of partners in the public health ecosystem that are complementary to the HD and partners' ability to exchange information electronically with the HDs	50–53
		Health Information Exchange	Level and type of health information exchange use in the community	54, 55
		Integrated Reporting	Ability to report data through integrated systems at the state level	56, 57

IMPLICATIONS

The PHIT Maturity Index represents a practical approach to aid public health system stakeholders, notably HD's, not only in the evaluation of their existing public health information technology infrastructure, but also to learn what capabilities should be included in a high functioning PHIT system, and to develop a road map for moving from the current state to one with improvements in system performance and outcomes.

As additional benchmark data become available, the Index will enable a comparative assessment of an HD's PHIT maturity in relation to other similarly structured HDs and systems across the country. The Index is being placed in the public domain and communication and dissemination efforts are being pursued to foster engagement and additional data. Montgomery County will use the Index as it evaluates its information technology strategy and decision-making, enabling an assessment of the advancement of their IT maturity over time. The Index may also be linked to population health outcomes to better comprehend which PHIT levels, configurations and services may offer the most value for individual public health system types across different regions with varying attributes, needs and goals, which may promote greater alignment of health department strategy with technology decision-making. For example, certain IT configurations may be found to more efficiently identify, and moreover, reduce emergency room "frequent flyer" visits through better coordination of services, event alerts (e.g., health information exchange-based admit/discharge/transfer notification), and care management. There may also be an opportunity to align the PHIT Index to goals of the Public Health Accreditation Board (PAHB) and other quality efforts to extend the breadth of review.

The current PHIT Maturity Index version is focused largely on achieving population health outcomes and includes an emphasis on the provisioning of public health services, including for somatic, behavioral, dental, and social determinant needs. We recognize that some public health departments are shifting out of direct care services. While the current model is generalizable, future work may include assessing possible model modifications based on a range of structural and other attributes of individual health departments. We plan to analyze the Index results of relatively high- and low-performing health departments in order to further illuminate the relationship between PHIT status and performance, and help to assess Index validity.

[**]Additional resources related to the PHIT Maturity Index, including the full Project Report with literature review summary, Questionnaire and Index User Guide may be found at: http://go.umd.edu/phitmaturityindex.

SUMMARY BOX

What is already known about this topic? It is well known that information management is critical to excellence in performing the essential services of public health. Yet, a deep understanding of the technology infrastructure and guidance needed to effectively leverage health information technology and informatics to achieve the public health mission is lacking. Maturity models to guide information technology decision-making are available in other domains, but one has not been created for public health.

What is added by this report? The PHIT Maturity Index, questionnaire, and scoring methodology provide a new approach that can assist public health departments in understanding various stages of information technology adoption and use, which may support strategic decision making in regard to future investments and strategies for better leveraging IT.

What are the implications for public health practice, policy, and research? Over time, the Index can enable benchmarking of PHIT maturity and support the construction of improvement plans. When linked to outcomes data, the Index can enable assessment of which PHIT configurations and services may offer the most benefit for different populations, regions, and scenarios.

REFERENCES

1. Honore P, Wright D, Berwick D, et al. Creating a framework for getting quality into the public health system. Health Aff 2011;30(4):737–45.
2. Olsen J, Baisch M. An integrative review of information systems and terminologies used in local health departments. J Am Med Inform Assoc 2013;21(e1):e20–e27.
3. Rocha A. Evolution of information systems and technologies maturity in healthcare. Int J Healthc Inf Syst Inform 2011; 6(2):28–36.
4. HIMSS Analytics. EMR Effectiveness: The Positive Benefit Electronic Medical Record Adoption has on Mortality Rates [Internet]. 2014; 3–7. Available from: http://www.entretechforum.org/Sept2014Mtg/HIMSS Healthcare Analytics EMR.pdf
5. Goldensen D, Gibson D. Demonstrating the Impact and Benefits of CMMI®: An Update and Preliminary Results [Internet], 2003. Available from: http://www.sei.cmu.edu/reports/03sr009.pdf
6. Public Health Accreditation Board (PHAB). Standards & Measures Version 1.5 [Internet]. PHAB; 2014;110, 242. Available from: http://www.phaboard.org/wp-content/uploads/PHABSM_WEB_LR1.pdf.
7. CDC.gov. CDC - National Public Health Performance Standards Program [Internet]. 2016 [cited 13 February 2016]. Available from: http://www.cdc.gov/nphpsp/.