Organizational framework for health information technology

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ABSTRACT

Purpose: We do not yet know how best to design, implement, and use health information technology (IT). A comprehensive framework that captures knowledge on the implementation, use, and optimization of health IT will help guide more effective approaches in the future.

Methods: The authors conducted a targeted review of existing literature on health IT implementation and use, including health IT-related theories and models. By crosswalking elements of current theories and models, the authors identified five major facets of an organizational framework that provides a structure to organize and capture information on the implementation and use of health IT.

Results: The authors propose a novel organizational framework for health IT implementation and use with five major facets: technology, use, environment, outcomes, and temporality. Each major facet is described in detail along with associated categories and measures.

Conclusion: The proposed framework is an essential first step toward ensuring a more consistent and comprehensive understanding of health IT implementation and use and a more rigorous approach to data collection, measurement development, and theory building.

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1. Introduction

How can we maximize the benefits and minimize the risks of health information technology (IT)? We do not yet know how best to design, implement, and use health IT. Although there are stellar applications that are implemented successfully on all fronts within a given organization [1], it is too often the case that applications are partially implemented, implemented but never used, or implemented with disappointing or even adverse health or business impacts. What are the factors that affect whether or not an application is a success or a failure? What measures can we use to assess success and failure? How can we apply our understanding of how health IT is used to mitigate the risk of failure and maximize the benefits of success? To answer these questions, we must go beyond a piecemeal approach that captures only discrete aspects of health IT such as the health IT product or the outcome. This requires a comprehensive organizational framework to structure the array of information around the implementation and ongoing use of health IT. This organizational framework can provide the foundation for a more rigorous approach to data collection, measurement development, and theory building.

A framework is an effective way to present a clear, parsimonious, but comprehensive understanding of a complex topic. It provides a road map to organize current knowledge and to indicate gaps where further knowledge is needed. Because frameworks can effectively highlight key dimensions, relationships, and research needs, they are often used to guide data collection, measurement development, and

theory building. For example, the Institute of Medicine's landmark report, *Crossing the Quality Chasm* [2] presented six aims and ten rules for quality improvement as a framework to guide the redesign of the health care system. The framework was subsequently used and refined to guide data collection, measurement development, and theory building across a range of patient care processes, health care settings, and patient populations [3–5]. Frameworks are ideally suited to elucidate a complex field such as health IT. Although the beginnings of medical informatics can be traced back to at least the 1950s, its development as a formal discipline took place more recently with a focus on information and how to collect, analyze, and disseminate it within the health care delivery process [6]. By 1990, medical informatics was defined as "a rapidly developing scientific field that deals with resources, devices and formalized methods for optimizing the storage, retrieval and management of biomedical information for problem solving and decision making" [7].

The development of medical informatics as a scientific field owes much to attempts to understand the use of IT in non-health business areas and in consumer markets, especially its rapid growth and winning and losing applications and investments that resulted. In the 1980s, major theories and approaches to IT included classic diffusion of innovation theory [8], organization assimilation of innovation analysis [9], socio-technical theory [10], the behavioral intention model [11], socio-cognitive theory [12] and change management [13]. From the 1990s through the 2000s, these models were applied to technology in a health care setting, with the focus on the technology alone. In the mid to late 1990s, it became increasing clear that the success of health IT implementation and use involved more than just technology since health care organizations implementing health IT often encountered high failure rates and other significant challenges. However, few probed other factors [14]. Since then other fields such as change management [13] and usability [15] have contributed to a richer understanding of health IT [16].

2. Theories related to health IT

Publications on health IT implementation are often based on case studies that report before-and-after outcomes assessments of health IT as an intervention. Although they can provide rich detail on particular examples, they are often so focused on the specific aspects of the cases at hand that they are difficult to use as building blocks for constructing more generalizable theory. In addition, because of their focus on the process and impact of implementation, they offer limited insight into the underlying factors and conditions that shaped the outcomes [17].

To begin to build a more robust approach to the study of health IT, some researchers are assessing the applicability of major theories and models developed outside of health IT to better predict outcomes, to identify the important factors relating to success, and to determine how to mitigate risk. Table 1 lists the aims and major components of several of these theories. The last column lists major aspects of health IT addressed in these theories and will be discussed in more detail in the following section.

Individually and collectively, these approaches make valuable contributions by calling attention to the role of a range of key factors influencing the implementation and use of health IT beyond the features of the technology itself. For example, some perspectives such as sociotechnical theory and social-cognitive theory focus on the important impact that individuals can have on health IT mediated through social systems such as incentive and value structures, organizational processes, and organizational cultures. Other perspectives, such as technology diffusion and change management, seek to assess health IT use in a broader context of the relationship of individuals, groups, organizational features and other elements to the technology. These perspectives underscore the complex, interactive, and often subtle range of influences that shape health IT use and that must be considered in evaluating its initial use and ultimate outcomes. Still other perspectives, such as PRECEDE/PROCEED and multi-method, underscore temporal dimensions as initial health IT implementation and use over time is affected by change over time in the environment or other factors.

While these theoretically driven approaches are broader and often richer than case studies, they are still highly focused, which allows them to deeply explore the impact of a limited number of factors. However, this prevents them from explaining the effects of others. For example, change management theory can be used to address environmental variables critical for successful implementation, but it will neither predict nor explain an implementation that fails because the technology does not work (e.g., shuts down unexpectedly or does not scale). In addition, many of the measures used to substantiate them have not been validated in the context of health IT as indicated by a paucity of validation studies in the literature.

3. The organizational framework for health IT

An organizational framework for health IT would provide a critical step toward the development of a comprehensive model of implementation by supplying a structure to organize and capture information around its use, the relevant measures and tools, and the relationships between and among different factors. Based upon our understanding of the health IT field, a targeted review of the health IT implementation literature [12–14,17,18,27–39], and the key theory-based components highlighted in Table 1, we have identified five major facets of an organizational framework. These facets are:

1. *Technology*—elements relevant to the specific health IT;
2. *Use*—elements relating to the actual use of the technology;
3. *Environment*—elements relating to the context influencing the use of the technology;
4. *Outcomes*—elements capturing the end results of the technology in use in that environment;
5. *Temporality*—time and the developmental trajectory of other elements such as implementation and clinical disease processes.

The following explains each of the major facets in more detail, along with associated categories and measures.