Health Policy and Technology (2016) 5, 196–203

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/hlpt

A framework for understanding process interoperability and health information technology

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Available online 16 February 2016

KEYWORDS
Health information technology;
Interoperability;
Process;
Evaluation

Abstract
Objective: While health information technology (HIT) offers great potential for supporting healthcare delivery, interoperability issues can be a barrier to effective use of HIT. While technical and semantic interoperability issues have been well studied there is a shortage of research that addresses process interoperability.
Methods: This paper uses a two year case study of a Palliative Care Information System (PAL-IS) to study process interoperability and health information technology (HIT). We describe the design of PAL-IS and develop and describe three types of process interoperability issues that arose from its implementation.
Results: The implementation of PAL-IS caused care delivery, clinical practice and administrative process interoperability issues. Further, many of these issues emerged over time and a solution to address one type of process interoperability issue often led to a different type of issue. We used our evaluation of PAL-IS to develop a general framework for understanding process interoperability and HIT.
Conclusion: Designing HIT to support care delivery is a complex sociotechnical endeavor that can result in different types of process interoperability issues. Evaluating process interoperability takes time and longitudinal studies are necessary to understand the overall ecosystem where technology, processes, and people interact. The framework developed in this paper provides a starting point for the evaluation of process interoperability and HIT.

Introduction

The design and implementation of heath information technology (HIT) has not yet lived up to its potential to

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http://dx.doi.org/10.1016/j.hlpt.2016.02.007

impact the delivery of healthcare services. In 2012 the Institute of Medicine published a report stating the present healthcare trajectory has become too complex and costly and that digital technology will be a key driver of improved healthcare delivery [1]. HIT has been advocated as a solution to assist health care authorities to better provide service delivery in the context of shrinking workforces and increased need for services [2-4]. However, to-date the evidence base on the use and impact of HIT is limited and inconsistent. While studies have advocated positive outcomes from HIT [5], there is also a substantial body of research reporting on negative outcomes including workflow, communication, and safety issues [6-8].

HIT implementation frequently cause unintended consequences including communication issues, creation of new or more work, and even adverse events such as medical errors [6,7]. Unintended consequences occur for several reasons including poor fit with clinical workflow, differences in needs between different user groups (i.e. clinicians and administrators) or the co-existence of manual and automated processes [9,10-12]. To reduce unintended consequences we need to understand the interactions between the users of a system and the different facets of the environment in which the system is used [13]. HIT is more likely to introduce unintended consequences if it is designed to support specific tasks while ignoring other tasks or routines that interact with it [14].

Interoperability is an essential requirement for HIT because of the need to integrate patient care across a variety of settings and providers [15,16]. Interoperability can be divided into technical, semantic and process [17]. Technical interoperability moves data from system to system independent of domain or the meaning of what is exchanged [17]. Semantic interoperability gets at the meaning of the data and allows computers to share, understand, interpret, and use data without ambiguity [17]. Interoperability has been well studied from both technical and semantic perspectives such as the development of clinical interoperability models that describe compliance with standards and formalisms metrics for evaluating clinical models [18,19]. While these various models describe how to develop interoperable HIT at the semantic and technical levels, they do not provide insight on people and process interoperability with HIT. Process interoperability is defined as people having common understanding across a network, business systems being interoperable, and work processes being coordinated [17]. While there has been some work at developing process models for how to schedule and monitor the activity of users [20], process interoperability issues remain a frequent cause of implementation issues, regardless of how technically or semantically interoperable a HIT may be. For example, Smith and Koppel identified 45 HIT interaction issues across five general categories that adversely impacted clinical tasks including granularity of data and poor fit of HIT with clinical workflow [21]. Process interoperability also has a temporal component-Berg suggests HIT needs to be grown iteratively and organically, rather than delivered as a 'fait accompli', in order to achieve synergy between technical systems and primary (e.g., clinical care) and secondary work processes (e.g., audit, management) [22].

While various aspects of process interoperability have been described and/or studied there is no overarching framework that formalizes different types of processes interoperability and how it evolves over time [15,23,24]. This paper addresses the above shortcoming and uses a two year case study of a Palliative Care Information System (PAL-IS) [25] to develop a framework for process interoperability of HIT. The paper has three sections. First, we describe the case study of PAL-IS and present the three categories of process requirements PAL-IS needed to achieve. Second, we present our analysis of the PAL-IS implementation to identify process interoperability issues according to the three categories of requirements. We then formalize our interoperability issues as a general framework for process interoperability of HIT. Third, we discuss our research, limitations and next steps.

Materials and methods

Methods

In February 2010 we began the engineering and deployment of a Palliative Care Information System (PAL-IS), to support community care of palliative patients. Our method was a combination of participatory design and iterative design-oriented research [26,27]. Participatory design (PD) ensures we not only design a product but also address the usability and utility of the product by engaging end users in the design process while design science is based on an iterative cycle of design, build, and evaluation of outcomes. The hybrid method enabled us to achieve a systematic design, implementation and evaluation of PAL-IS while also incorporating user context and needs.

Data sources

As per the PD method we actively engaged members of the palliative pain and symptom management consultation service (PPSMCS) including nursing staff, administers, physicians, IT staff, and data entry clerks to understand the workflow and data requirements for how patients were registered, assessed and reassessed during clinical encounters. To make the system design feasible we focused on a specific care program involving palliative care patients of a family health team (FHT), which included a family physician, a family medicine resident, and a palliative care nurse. The goal of the FHT project was to increase awareness and adoption of palliative care amongst family physicians in order to increase the capacity to deliver palliative care services in the community. Using the iterative nature of design science research we conducted ongoing meetings with different combinations of the above listed participants. Meetings were a mix of requirements gathering and prototype evaluation. Initial meetings were more focused on requirements elicitation from which prototypes or mock-ups would be designed and feedback sought in subsequent meetings. Detailed notes were taken and transcribed after each meeting and included insight on requirements (e.g. data entry/retrieval needs workflows) and feedback on models and prototypes.