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Clinician user involvement in the real world: Designing an electronic tool to improve interprofessional communication and collaboration in a hospital setting

Terence Tang[a,b,*], Morgan E. Lim[c,d], Elizabeth Mansfield[c,e], Alexander McLachlan[f], Sherman D. Quan[c]

[a] Institute for Better Health and Program of Medicine, Trillium Health Partners, 100 Queensway West, Clinical Administrative Building, 6th floor, Mississauga, Ontario, L5B 1B8, Canada
[b] Department of Medicine, University of Toronto, Toronto, Ontario, Canada
[c] Institute for Better Health, Trillium Health Partners, Mississauga, Ontario, Canada
[d] Institute for Health Policy, Management, and Evaluation, University of Toronto, Toronto, Ontario, Canada
[e] Department of Occupational Science and Occupational Therapy, University of Toronto, Toronto, Ontario, Canada
[f] Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada

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ABSTRACT

Objectives: User involvement is vital to the success of health information technology implementation. However, involving clinician users effectively and meaningfully in complex healthcare organizations remains challenging. The objective of this paper is to share our real-world experience of applying a variety of user involvement methods in the design and implementation of a clinical communication and collaboration platform aimed at facilitating care of complex hospitalized patients by an interprofessional team of clinicians.

Methods: We designed and implemented an electronic clinical communication and collaboration platform in a large community teaching hospital. The design team consisted of both technical and healthcare professionals. Agile software development methodology was used to facilitate rapid iterative design and user input. We involved clinician users at all stages of the development lifecycle using a variety of user-centered, user co-design, and participatory design methods.

Results: Thirty-six software releases were delivered over 24 months. User involvement has resulted in improvement in user interface design, identification of software defects, creation of new modules that facilitated workflow, and identification of necessary changes to the scope of the project early on.

Conclusion: A variety of user involvement methods were complementary and benefited the design and implementation of a complex health IT solution. Combining these methods with agile software development methodology can turn designs into functioning clinical system to support iterative improvement.

1. Introduction

Although health information technology (HIT) has the potential to improve healthcare through enhancing efficiency and safety [1], this potential has not yet been fully realized [2]. Challenges to the success of HIT are largely due to non-technical issues such as poor usability that impact communication and workflow [3]. Therefore, HIT requires the design of user friendly tools that are context appropriate [4]. Implementation considerations including the impact on workflow must be addressed early in the initial planning and design stages if HIT applications are to be successful [5]. User involvement is one approach for achieving this.

Although there are multiple definitions of "user involvement" in the literature [6,7], we use this term in general to describe "any direct contact with users" [7].

There are three major strategies for involving users in HIT projects and they lie on a continuum from least to most user control [8,9]. The first strategy is *user-centered design*, where the designer actively studies and understands the users' perspectives and experiences to ensure the product is useful and usable to them [8]. Examples include usability testing and user observation [8]. Because the user is the object of study rather than driving the design process, it is considered to have the least

* Corresponding author at: Institute for Better Health and Program of Medicine, Trillium Health Partners, 100 Queensway West, Clinical Administrative Building, 6th floor, Mississauga, Ontario, L5B 1B8, Canada.
E-mail addresses: terence.tang@utoronto.ca, terence.tang@thp.ca (T. Tang).

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user control. The second strategy is *user co-design*, where the designer and users design the product together [8]. This gives the user more control in the design process and examples of such techniques include design meetings with prototypes and simulation [8]. The third major strategy is *participatory design*, where the user is an active participant in design and has a strong voice in decision-making, driving the innovation while the designer facilitates the creative process [8,10,11]. Examples of this strategy include design games, CARD, PICTIVE, and the third-generation participatory design method [8,11,12].

Reported benefits of user involvement in HIT projects include improved system quality due to accurate user requirements gathering, inclusion of useful features and exclusion of less useful features, higher level of user acceptance and adoption during implementation, decreased training needs due to increased system understanding by users, and higher level of participation by users in the organization [7,8,13].

Despite the reported benefits of user involvement in HIT development, it remains complex and difficult to achieve in practice due to social, cultural, organizational, and technical factors [14,15]. Other challenges identified include lack of time for both users and the project team, difficulty in obtaining representative users as clinicians have busy schedules, disagreement between users and the inability to reach a consensus, and the lack of necessary technical skills or knowledge by users to effectively participate in the design process [7,8]. The challenges has led to some projects paying only “lip-service” to user involvement, and one qualitative study concluded that physician users participating in one HIT project were not active participants in decision making, and were reduced to mere clinical consultants informing about needs and requirements [15,16].

To increase the success of future HIT projects, research into user involvement best practices in system development, and the dissemination of experiences of both successful and failed HIT projects are desired by the health informatics community [3,8]. With this in mind, we describe our real-life experience with applying a variety of user involvement methods in the design and development of a clinical communication and collaboration platform (called Care Connector) for frontline clinicians.

2. Materials and methods

2.1. Setting

Trillium Health Partners (THP) is a large community teaching hospital in Mississauga, Ontario, Canada, affiliated with the University of Toronto. In 2016/2017, it operated 1252 in-patient beds, had 63,334 in-patient admissions, and 270,929 Emergency Department visits.

2.2. Care Connector

Effective communication and teamwork are increasingly recognized as crucial to providing high quality, efficient, and safe care in healthcare organizations [17–21]. Care Connector is an interprofessional (when 2 or more professions work together to improve collaboration and quality of care [22]) clinical communication and collaboration platform that facilitates coordinated care of complex hospitalized patients. Its users include physicians, nurses, and the allied health team (physiotherapists, occupational therapists, dietitians, speech language pathologists, pharmacists, and social workers). It was designed and developed at THP to address limitations of existing communication technology including lack of context [23], workflow interruptions [24,25], reaching wrong recipients [26], privacy and security concerns [27], and not being inclusive of all team members [28]. It is a web-based application distinct from the primary hospital information system (HIS). However, to integrate seamlessly into clinicians’ workflow, it does retrieve information from and can write information to the primary HIS. This paper describes the user involvement methods used during the design of this platform.

Care Connector’s architecture is modular, allowing each module to be developed independently and address a different yet interconnected clinical workflow. To date, these include the physician sign-out, progress note, interprofessional care planner, patient centered messaging, patient flow planner, and electronic discharge summary modules (Table 1). These modules are interconnected by the sharing of information. Examples include displaying a patient’s medical information contained in the physician sign-out in the interprofessional care planner so that the entire care team shares this understanding, and the ability for the discharge summary module to pre-populate fields from the physician sign-out module to reduce the need for repeated data entry or the likelihood of missing information.

2.3. Approach to iterative design and development

We built Care Connector using Agile software development methodology where usable software is delivered on a frequent basis so that the product can be iteratively improved based on feedback from real use [29,30]. The design team directly engaged clinician users to ensure design decisions and software requirements fit the true needs of the users and their clinical workflows. Using this approach, a new version of software was released once every 2–4 weeks during active development. The design team meets on a weekly basis to review feedback from users, on-going development tasks, and prioritize development activities including bug fixes and new features. The design team is composed of 1 project lead, 1 project manager, 2 developers, 1 business analyst, 1 physician lead, 1 nursing lead, and a learner. The physician and nursing leads are users of the system themselves.

2.4. User involvement methodology

We used a variety of methods at different points to involve users in the design and development of Care Connector as the design needs arose. Due to rapid development timeline, we chose methods that were feasible (balancing effective feedback with resources required). Table 2 summarizes the user involvement methods and the timing of use in the Care Connector project.

2.4.1. Initial design of modules: user centered design, user co-design, and participatory design

We used all 3 strategies (user-centered design, user co-design, and participatory design) during the initial design of modules to ensure the software truly met the needs of frontline clinicians. We observed users (a *user-centered design* method) carrying out their daily work activities to better understand the potential impact of an electronic tool on clinical workflow. We shadowed physicians and nurses (weekdays, weekends, and nights) as they performed their work. We took notes and recorded the amount of time each spent on communication and documentation activities.

We also employed *user co-design* methods extensively during the requirements gathering and the initial design phase of each module. For each module, we held design meetings with relevant user groups (e.g. physicians for the physician sign-out module, and nursing and allied health staff for the interprofessional care planner). Invitations to these meetings were open (and non-mandatory) and any interested individuals were welcome to attend. The initial objective was to confirm and fully understand the problem to be solved from frontline clinicians’ perspectives. This then led to discussions for creating solutions tailored for the clinicians and determining how the new solutions would integrate into their clinical workflow. Based on this knowledge, the design team built prototypes of the solution in the form of screen mockups supported by workflow diagrams. The Balsamiq Mockups software [31] was used to produce these prototypes (see example in Fig. 1). In subsequent meetings, clinician users would provide feedback on these prototypes and the design was iteratively improved upon. Prior to deployment of a module, frontline clinicians worked collaboratively with