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The clinician in the Driver's Seat: Part 1 – A drag/drop user-composable electronic health record platform

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ABSTRACT

Creating electronic health records that support the uniquely complex and varied needs of healthcare presents formidable challenges. To address some of these challenges we created a new model for healthcare information systems, embodied in MedWISE,[2] a widget-based highly configurable electronic health record (EHR) platform. Founded on the idea that providing clinician users with greater control of the EHR may result in greater fit to user needs and preferences, MedWISE allows drag/drop user configurations and the sharing of user-created elements such as custom laboratory result panels and user-created interface tabs.

After reviewing the current state of EHR configurability, we describe the philosophical, theoretical and practical rationales for our model, and the specific functionality of MedWISE. The alternative approach may have several advantages for human–computer interaction, efficiency, cognition, and fit of EHR tools to different contexts and tasks. We discuss potential issues raised by this approach.

1. Introduction

Developing systems that best fit the needs of healthcare is a complex endeavor. Although decades of research have focused on defining requirements for systems that support clinicians and their tasks, studies suggest that healthcare information systems often fail to support effective and efficient clinical decision making and completion of relevant tasks [1,2]. Systems may fail to take into consideration the significant variability of medical information needs that differ according to context, specialty, role, individual patient, and institution. They may also fail to address the highly collaborative nature of the work, and challenges of addressing rapidly changing or emergent needs. User control of modular user-composable systems has promise for addressing these issues [3]. This approach involves supplementing automation by letting the nonprogrammer clinician user create and share systems (including patient-specific displays) by assembling information elements from multiple sources on screen via drag/drop actions. They can also share their creations (individual widgets or interface tabs or templates) with a click, making them available to colleagues or to all clinicians in a setting.

We expect three main advantages of this approach. First, the ability to move and assemble elements together on the same page has several desirable properties that can impact the cognitive efficiency and efficacy of coordinated interaction with an electronic health record (EHR) system. To substantiate this claim, we draw on theory from human computer interaction (HCI) and the theory of distributed cognition [4]. Second, we anticipate that clinicians can create a system that affords them the capability to solve problems and that better fits the tasks that they are required to perform. The premise is that by providing a set of building blocks that the user assembles to create novel elements and structures, we can leverage the fact that clinician data users have greater medical, contextual and tacit knowledge than do programmers. Their creations may also be more congruent with their mental models of the patients or the tasks. Third, the features that enable sharing may be used to facilitate communication/collaboration and 'produsage', which refers to the construction of a large set of user-created

Abbreviations: MedWISE, medical widget-based information sharing environment; HCI, human–computer interaction; NYP, New York Presbyterian Hospital; CIS, clinical information system.

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[2] Medical widget-based information sharing environment.

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Table 1
Configurability of current EHRs.

Feature or function and description	EHR examples
Order sets; allow user to select combinations of orders, stored and selected as desired or with specific conditions	Many
Documentation; wizards [13], note views [14,15], summaries, choice of layouts with varying screen information density [14]	eClinicalWorks, Allscripts, Epic
Expandable panels, dot phrases; for fast insertion of user-specified text phrases using an abbreviation [15,16]	Epic, Greenway
Problem list sorting by various categories, e.g. active problems, social history, specialty [14]	Allscripts
Adaptive learning selection lists [14]	Allscripts
Drag/drop appointment schedulers [16]	Greenway, others
Modifiable templates with automatic information import and user-definable norms [17,18]	Acrendo, Versasuite
Customizable meaningful use measures	Most EHRs
Crowdsourced decision support rules authoring [19]	Epic
Forms-based user specification of system generation [20,21]	iCIMS products
Draggable widgets for interface flexibility [22,23]	MIEweb, Medcafe

resources and tools adapted to specific user needs and different contexts.[3]

The purpose of this paper is to describe this novel approach to EHRs, as embodied by our system, MedWISE. We briefly state the theoretical rationale that supports this innovation. However, the primary purpose of this paper is to allow readers to understand the system's capabilities. Empirical studies of users engaging with the system are reported in other papers [6–9]. The conceptual model is covered in more depth in [3]. As background, we describe problems and user configurability in current EHRs, followed by concepts from theory and research in cognition and HCI. These suggest the relative value in this kind of approach. We then discuss our rationale, and describe the system.

2. Background

2.1. Challenges with current systems

Many current systems offer limited end-user configurability and require skilled programmers to make significant changes. At the individual level, the majority of EHRs requires the user to adapt to the program. However, the interface may not reflect how clinicians think about patient problems, and this may result in a workflow that is not optimally tuned for patient care. Communication and collaboration needs are also frequently not met because systems are designed solely for an individual's linear workflow without the ability to share or to leverage features that support collaboration [1,2]. Accessing large amounts of information via finite screen space necessitates negotiating multiple screens. In addition, the organization of information on a cluttered or poorly organized display may create a burden on limited human cognitive resources [10]. Furthermore, most systems lack the agility required for rapid adaptability to emergent conditions. Integration of multiple information sources may be difficult. Even minor modification or customization of EHRs can be delayed by vendor- and programmer-controlled development processes that require consensus, time, extra cost, and often vendor agreement. Overall, the current approach does not leverage user expertise or provide users with creative potential solutions to clinical technology problems based on their understanding of patient problems. It also sometimes fails to accommodate the complexity of health care and the changes occurring in this sector, which continue apace.

Giving users greater control of a modular system could potentially address some of these problems, and EHR approaches are evolving to that end. However, current EHRs generally permit user participation and control of configuration and display only in limited areas as determined by the vendor [11]. User-configurable order sets are a well-known example [12], and permit users to select combinations of orders to be stored and selected as desired, or as associated with specific patient conditions. Current EHR user-customizable features are summarized in Table 1.

Overall, most current EHRs require the user to negotiate multiple screens in the course of obtaining information sufficient for the diagnosis and treatment process. Their configuration features are usually form-based, sometimes requiring the user to learn forms navigation, and move away from the usual EHR screens in a separate workflow, or even a separate program. In general, they do not employ a direct-manipulation interaction approach. Most allow the user only partial control of certain categories of information.

2.2. Rationale for a different approach

In recent years, there have been a growing number of resources, tools and applications that facilitate user control of the computing experience. Modern approaches in the public internet space emphasize the creation of platforms for user-directed remixing of snippets of information from multiple sources, mashups, and interactive visualizations. They also employ social networking, aggregation of user-created resources in new useful ways, and crowdsourcing. These approaches accentuate user participation and control more than the typical highly directed and circumscribed applications to which users must adapt. Metadesign is one of the core concepts underlying our approach. Fisher describes it as follows:

> Meta-design extends the traditional notion of system design ... to include an ongoing process in which stakeholders become co-designers—... throughout the whole existence of the system. A necessary ... condition for users to become co-designers is that software systems include advanced features that permit users to create complex customizations and extensions. .... broad participation in design activities (in both design time and use time) is as important as creating the artifact itself. [24]

2.3. Human–computer interaction and EHR research

The recently enacted Health Information Technology for Economic and Clinical Health Act (HITECH) has served to dramatically increase the number of EHR implementations and this has revealed the extent to which usability problems impede adoption and diminish the user experience [25–27]. Studies of HCI in EHRs have focused on providing cognitive support [28], particularly on interactive information visualizations such as timelines. Incorporating sufficiently flexible interaction into the highly varied institutional

[3] Produsage has been defined by Alan Bruns as collaborative and continuous building and extending of existing content in pursuit of further improvement, by creation of shared content in a networked, participatory environment, in a way that breaks boundaries between consumers and producers [5] Bruns. Produsage, 2009. All participants are users and producers, (hence 'produser'). Usage is necessarily also productive, as the participant's very patterns of *usage* become direct inputs. An example is Amazon recommendations based on aggregated user browsing and purchasing actions.