Enhancing the TURF Framework with a Workflow Ontology

Craig Harrington, MS, MSSW¹, Cui Tao, PhD¹, Keith Butler, PhD², Jiajie Zhang, PhD¹
¹University of Texas at Houston Health Science Center, Houston, TX;
²University of Washington, Human Centered Design & Engineering, Seattle, WA

Abstract

The TURF Framework enables usability analysts evaluate EHRs by analyzing work tasks, users, representations, and functionality. Currently the TURF framework does not have a focus on evaluating clinical workflows across multiple tasks or across individuals ¹. Because clinical workflows are vital to the successful implementation of an EHR, this study will augment the capabilities of the TURF usability framework by incorporating a workflow ontology. A novel feature of the workflow ontology is its use of Butler’s Cognitive Work Product (CWP), which complements the TURF framework through its ability to classify workflow actions and resources as contributing to the end goal of the workflow or as overhead. The combination of the TURF framework and the workflow ontology provides a more comprehensive method of evaluating the usability of EHRs.

Introduction

The surge in adoption of electronic health records (EHRs) is not without challenges. As highlighted in a recent NIST report and other sources, a key usability issue is the negative impact that EHRs are having on clinical workflows ², ³. This study defines a clinical workflow as “a modular sequence of tasks, with a distinct beginning and end, performed for the specific purpose of delivering clinical care” ⁴. To address the challenges of clinical workflows in EHRs, our study shows the value of an ontology as an addition to Zhang’s TURF framework for evaluating the usability of EHRs.

Ontologies represent domain knowledge declaratively using formal rules and constraints. After defining the abstract nature of a domain, instances of the domain can be created and validated according to the rules and constraints. We have developed a clinical workflow ontology (CWO) for EHR workflow. The declarative reasoning of the CWO complements the nature of clinical workflows to deviate from templated processes. The CWO further enhances TURF through the application of Butler’s Cognitive Work Product (CWP), which views workflows involving cognitive processes as changing the CWP from an initial state to a goal state ⁵. Necessary activities are identified as advancing the CWP towards the end goal; other activities are likely to qualify as overhead. By combining the CWO with the TURF framework analysts can evaluate EHRs with a proven framework that supports clinical workflows. With this capability, analysts can identify gaps and design solutions that maximize the usability of their EHRs.

Methods

The TURF framework describes methods to analyze the usability of an EHR based on the work tasks, user requirements, information representations, and system functionality. The CWO will enable the usability analyst to also define the steps of a workflow from the initial state to the completion of the workflow using Protégé (6), an open-source visual ontology editor. As the analyst constructs the steps of the workflow, the CWO will apply logic rules to recognize inconsistencies, missing information, or errors while classifying the activities and resources for each step as necessary or overhead. Additionally the CWO supports entry and exit conditions for each step, enabling the workflow to transition to subsequent states based on event triggers or satisfying conditions as opposed to workflows that are represented as ordered sequences of activities. These features enable the CWO to accurately model clinical workflows, where a medical crisis can short-circuit a swim lane diagram.

Results

Two pilot projects previously modeled with UML class and state diagrams serve as reference models to evaluate the resulting CWO models. By enhancing the TURF framework with the CWO, analysts will be able to leverage the logical reasoning capability of the CWO to accurately represent clinical workflows, classify activities as necessary or overhead, and identifying inconsistencies or errors in the modeled clinical workflow.

Discussion

The clinical workflow ontology has the ability to represent workflows in a declarative fashion instead of a procedural fashion. This represents a novel way to represent workflows which mirrors the way clinical workflows occur. Future considerations for the ontology are to incorporate the ability to generate timings for different paths that a workflow can take and the ability to suggest representation methods for the data.
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