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Multi-EMR Structured Data Entry Form: User-Acceptance Testing of a Prototype

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Abstract. Capturing standardized data from multiple EMRs at the point of care is highly desirable for a variety of uses, including quality improvement programs, multi-centered clinical trials and clinical decision support. In this paper, we describe the design, development and user acceptance testing of a prototype web-based form (the Form) that can integrate with multiple EMRs. We used the validated UTAUT questionnaire to assess the likelihood of uptake of the Form into clinical practice. The Form was found to be easy to use, elicits low anxiety, supports productivity and is perceived to have good support. Users would benefit from training and from better social signaling about the importance of using the Form in their practice. Making the Form more fun and interesting could help increase uptake.

Keywords. telehealth, teleprovider, virtualization, remote monitoring, integration, EMR

Introduction

Capturing standardized data from multiple electronic medical records (EMRs) for community-wide quality improvement programs, multi-centered clinical trials or clinical decision support is highly desirable [1-5]. We previously described an architecture that uses a web-based solution to solve the use case [5]. The architecture specifies four features that work together to provide a seamless experience for the user, while providing a standard, easily updateable and properly version controlled form for data entry: 1) a URL link in the EMR that retrieves a web-based form that can easily be updated whenever needed; 2) an EMR data extraction function that allows the form to be pre-populated at the time it is retrieved with the latest information about the patient and preventing duplicate data entry; 3) a web-based form that allows the user to enter relevant data from the current encounter for both clinical care and for any additional purposes, such as QI, clinical trials and clinical decision support and 4) a utility that can take the data from the form and amalgamate it back into the EMR [5]. In this paper, we describe the results from a user acceptance testing exercise of a prototype of the web-based, data collection form.

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1. Architecture of the Web-based Form

We co-designed a web-based form through multiple iterations with several different stakeholders in several convenience-sampled primary care clinics in Southern Ontario, including nurses, physicians, pharmacists, dieticians, administrators and quality improvement facilitators. The form was designed to collapse and expand based on up to eight cardiovascular diseases that the patient might exhibit. The form was designed to pre-populate a patient's demographic data, their diagnoses, their weight and height, the last set of lab results, their medications and their vaccinations. The form would use the diagnoses to automatically expand the form to the correct set of data elements for that combination of diseases and would use the patient's age and sex to calculate their age-sex risk. The form was also designed to automatically categorize the medications into their chemical classes.

A URL was inserted into an e-Form in an instance of OSCAR, an open-source EMR, which had been populated with de-identified data from one of the participating sites. Data was extracted every night from OSCAR into a format that allowed for easy and rapid retrieval of patient data when requested. When a user clicked on the URL, the current patient's identifier would be appended to the URL and sent to the extractor server. The extractor server would look up the patient identifier and package the required data into a JSON file and post it to the forms server. The forms server would pre-populate the form and display it on the OSCAR desktop. Users could then fill out the form and click on submit. The data would then be saved to the forms server. For this prototype exercise, we did not create the utility to repatriate data back to the EMR.

2. User Acceptance Testing

We recruited 12 clinicians (5 MDs, 2 Nurse Practitioners and 5 Registered Nurses) who were willing to test the prototype form using a structured approach. Each clinician was given 5 clinical scenarios with an initial visit and a follow-up visit. Scenarios ranged from a patient with simple hypertension to one that was complex with multiple co-morbidities. After performing the trial over a one week period, each participant completed the UTAUT questionnaire [6] and answered 2 open-ended questions about barriers to form use and feature requests.

3. Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) (Figure 1) has been validated in a variety of contexts where employees are expected to use a software tool within the context of the work environment. It has also been validated in a variety of health care settings [7, 8]. The UTAUT allows implementers to predict uptake of new technology and the drivers for that uptake.

The UTAUT has 4 main constructs: 1) Performance expectancy measures users' beliefs that they will be productive in using the technology; in this case, the form; 2) Effort expectancy measures users' beliefs about whether the form will be easy to use in their work; 3) Social Influence measures users' expectations about social cues in their work environment that promote use of the form and 4) Facilitating conditions measures users' expectations about the supports that will be provided to them for using the form.

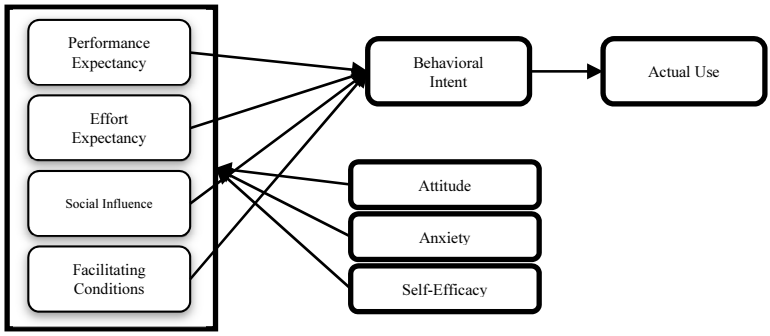

Figure 1. The main constructs and modifiers of UTAUT and their connections

In addition, the UTAUT has 3 individual user-based modifiers that affect uptake of new technologies: 1) Attitude measures whether the user has a positive or negative attitude to the form; 2) Anxiety measures the level of anxiety the user has about using the form? 3) Self-efficacy measures users' belief about their own abilities to use the form. These 7 elements have been shown to influence a user's "Behavioral Intent to Use" which in turn influences actual use of the form (Figure 1).

4. Results

Table 1 shows the results from administering the UTAUT. The "% top 3" column indicates the percent of responders who selected Somewhat Agree, Agree or Strongly Agree to the question on a 7 point Likert scale.

Respondents rated the form favorably in terms of performance, with a low rating for increase in productivity. Effort expectancy was very favorable, indicating that users felt the Form was easy to use. This is corroborated by the low anxiety elicited by the Form. We noted that social influence was low for the Form. This is not unexpected since the Form was still in the early stages of design and is not well known in the community. It appears that the sponsor is well-regarded and can likely make a strong impact on local social influencing factors such as developing local clinician champions who can encourage use of the Form. The facilitating conditions do appear to be well in place, if a bit more assistance was made available when the Form is rolled-out on a wider scale.

Table 2 shows the results from the individual user-based modifiers. Although most users think the form is a good idea and they like the form, they did not think the form was fun to use nor does it make their work interesting. These aspects of form use will require additional investigation. Self-efficacy for the form was very good (most people feel comfortable with no support), indicating that there is likely to be a strong benefit of providing training and peer-support. Behavioral intent to use the form was low at 44%, indicating that the form is not ready for prime time.

Table 1. Responses to the 4 Major Constructs of the UTAUT

Main constructs	Question	% Top 3	Aggregate %
Performance expectancy	The Form is Useful	67%	65%
	Allows me to Accomplish Tasks	67%	
	Helps Increase Productivity	50%	
	Allows Better Patient Management	75%	
Effort expectancy	Form was clear and understandable.	67%	75%
	Easy to become skillful at using the Form.	83%	
	I would find the Form easy to use.	75%	
	Learning to operate the Form is easy for me.	75%	
Social Influence	People who influence my behavior think it is important	42%	50%
	People important to me think it is important	25%	
	Sponsor is helpful	58%	
	Sponsor will support my use	75%	
Facilitating conditions	I have the resources to use the Form	64%	70%
	I have the knowledge to use the Form	75%	
	Form must be compatible w/ other systems	92%	
	Assistance is available for use	50%	

Table 2. Responses to the Three Individual User-based Modifiers

Modifiers	Question	% Top 3	Aggregate %
Attitude	The Form is a good Idea	64%	43%
	Makes Work Interesting	33%	
	The Form is Fun	33%	
	I like working with the Form	42%	
Anxiety	I feel apprehensive about using the Form.	17%	15%
	It scares me to think that I could lose a lot of information using the Form	17%	
	I hesitate to use the Form for fear of making mistakes I cannot correct.	17%	
	The Form is somewhat intimidating to me.	9%	
Self-Efficacy	I could complete a clinical encounter or task using the Form, if there is no one around to tell me what to do as I go.	67%	N/A
	I could complete a clinical encounter or task using the Form, if I can call someone for help if I get stuck.	17%	
	I could complete a clinical encounter or task using the Form, if I have a lot of time to complete the job	25%	
	I could complete a clinical encounter or task using the Form, if I have just the built-in help facility for assistance.	33%	

Users liked the one flow sheet design for multiple diseases compared to the current approach of having multiple flow sheets, one for each disease. Users also appreciated the integrated clinical decision support, automated drug classification, the shrinking and expanding form and links to appropriate clinical reference resources.

One major barrier identified was poor curation of medications (we provided list of all prescribed drugs, not only current medication list). Fixes requested for the next iteration included: misclassification of some drugs, fix inconsistent use of brand and generic names (we displayed what we extracted from the EMR) and improve the clinical decision support features. Requested features included better integration of the Form into the EMR; 1-click access, single sign-on, ability to order lab tests, prescribe medications and record administration of vaccines directly in the form instead of having to go to the core EMR.

5. Discussion

In this project, we developed and tested a prototype of a new web-based form that can integrate into multiple EMRs. We obtained excellent feedback from clinician users. We believe that by solving the few key issues identified in this study, we will be able to create a Form that will be ready for routine use in clinical practice. Areas which require further investigation include 1) a better understanding of what respondents mean when they say the form does not increase their productivity and 2) what it means to make a form 'fun' and 'interesting'. The form was designed to automate several aspects that are currently done manually, such as transfer of lab results to a flowsheet in the EMR and categorizing drugs into their classes, which can be quite time-consuming. The form does collect more information than most users currently record during a clinical encounter and users may be conflating additional data entry with decreased productivity. The form was rather monotonic and may benefit from some artistic input to increase the elements of 'fun' and 'interest'.

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