

Development of a Change Readiness Scale for Electronic Medical Record Systems Implementation at Hospitals

Research-in-Progress

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ABSTRACT

Medical errors are not only caused by individuals but are also associated with faulty systems and processes. Broad implementation of Electronic Medical Record (EMR) systems may reduce the errors. However, the failure rate of EMR implementations is still high. Therefore, understanding how to achieve a successful implementation is important. This paper looks at the human factor in EMR implementation at hospitals. It is argued that ensuring the clinical users' readiness for change is crucial for a successful EMR implementation. For this reason, a scale of three dimensions – Information Technology Savviness, Organizational Support, and Perceived Benefit – is proposed to measure clinical users' change readiness capacity. The processes of developing, testing and administering the scale are explained, as well as the related validity and reliability studies. The simulated score can be used to show the dimension(s) of change readiness capacity in which a user needs improvement in order to reach a successful EMR implementation.

Keywords

Change readiness, EMR implementation, clinical users, scale, reliability, validity.

INTRODUCTION

Up to 98,000 people die in the U.S. every year as a result of medical errors, which occur frequently in hospitals (Institute of Medicine, 1999). Most of the errors are not only caused by individual recklessness, but are also associated with faulty systems and processes. Broad adoption of health information technology (HIT) – of which electronic medical records (EMR) form the foundation – is believed to lower medical errors and ultimately improve health (Fonkych and Taylor, 2005; Hillestad, Bigelow, Bower, Girosi, Meili, Scoville and Taylor, 2005).

Despite this belief, EMR utilization by hospitals in the U.S. is generally low (Fonkych and Taylor, 2005; Gans, Kralewski, Hammons and Dowd, 2005; Jha, DesRoches, Campbell, Donelan, Rao, Ferris, Shields, Rosenbaum and Blumenthal, 2009), particularly compared to some European countries like Sweden, Netherlands, and Denmark (Taylor and Leitman, 2002). Studies show that many U.S. hospitals have not yet optimally utilized the system (Institute of Medicine, 1999), as only around 20% of the hospitals have adopted the system with various levels of implementation (Fonkych and Taylor, 2005; Jha et al., 2009). Even though the EMR adoption rate has gradually increased (Gans et al., 2005), the failure rate of EMR implementation is reportedly high, around 40% (Centre for Health Policy and Research, 2011).

Considering that EMR implementations are increasing and the possibility of having failed implementation is high, understanding how to make the implementations successful becomes important. Furthermore, since EMR implementation necessitates fundamental changes to the workflows, business processes and cultural fabric of a healthcare provider (Chandrasekaran and Afnan, 2012), which in this case is the hospitals, change readiness capacity of those who implement the change at the hospital is crucial to support a successful EMR implementation.

Current literature does not supply enough information regarding scales to measure readiness for change, especially at individual level. One of the few scales was developed by McConaughy, Prochaska and Velicer (1983). The scale is used to assess individual readiness to stop smoking. It contains four dimensions and 32 items in total. The dimensions relate to the four stages of psychotherapeutic change, which are: Pre-contemplation, the stage when the individual enters therapy but does not realize s/he has a problem; Contemplation, the stage when the individual starts realizing s/he has a problem; Action, when the individual starts to change; and Maintenance, the stage when the individual has achieved the desired change and is better off than s/he was previously. Despite the fact that the scale can be used to measure change readiness at an individual level, the scale cannot be used in an organizational setting since it is not organizationally relevant.

Another scale to measure readiness at individual level was developed by Holt, Armenakis, Field and Harris (2007). The scale is used to measure an individual's readiness toward a change in an organization, which is relevant to this study. The instrument has 25 items in total, which are grouped into four dimensions. The first dimension is Appropriateness, which assesses how appropriate the individual perceives the change to be for the organization. The second is Management Support, which assesses the level of management support perceived by the individual towards the implementation of the change. The third is Change Efficacy, which assesses the level of individual's efficacy to execute the tasks associated with the implementation of the change. Finally the fourth is Personally Beneficial, which assesses the benefits perceived by the individual from the implementation of the change.

Even though Holt et al.'s scale can be used in an organizational setting and at individual level, it is too broad to be used for a specific purpose like measuring change readiness for EMR implementation. Nevertheless it will be used as a benchmark for the above purpose. It is hoped that by appropriately assessing the change readiness of the clinical users towards EMR implementation, any gaps that may exist in their capacities and expectations can be identified and mitigated to avoid implementation failure.

ITEM SELECTION

As mentioned above, Holt et al.'s scale (2007) to measure individual change readiness in an organization was consulted in order to develop the scale to assess the clinical users' readiness for EMR implementation. Since the unit of analysis is a person, then some of the items should involve the individual's confidence and capability working with computer systems and individual's awareness of the benefits of the EMR implementation change. Furthermore, since the setting is within an organization, some items should reflect the role of management in supporting the change. Therefore, the scale to measure clinical users' change readiness capacity towards the EMR implementation at hospitals will include three domains/dimensions related to the individual's confidence and capability working with computerized systems, individual's awareness of the EMR implementation benefits, and the organizational support perceived by the individual towards the EMR implementation, and the individual perceived benefits of the EMR implementation.

The following will explain the influence of Holt et al.'s work as well as other factors in the item selection of the scale to measure the users' readiness for EMR implementation.

The Information Technology Savviness domain is defined as the users' confidence working with technologies, particularly computer technology. The questions in this domain ask about the users' confidence working with a computer system's hardware and software components. There is also a question(s) that investigate various utilizations of computers by the users. These questions are adapted from Holt et al.'s scale and reflect the user's confident and capability working with a computerized system. Specifically, Holt et al.'s scale items used as references for this purpose are: *My past experiences make me confident that I will be able to perform successfully after this change is made*, and *I have the skills that are needed to make this change work*.

The Organizational Support domain is defined as supports that the hospital management demonstrates to the users, hence perceived by the users, related to the plan to implement the EMR system, as well as any assistance they have given to support previous technological changes in the organization. Therefore, some questions within this domain are related to the organizational support for the plan to implement the EMR system, while others are related to organizational support in previous technological changes. Question from Holt et al.'s scale, which are items in the Management Support dimension such as: *Our senior leaders have encouraged all of us to embrace this change* is used as a reference to derive organizational support related items for the scale developed in this study.

The Perceived Benefit domain is defined as benefits that the users perceive in relation to the EMR implementation. Some of the questions in this domain are drawn from the literature on the benefits of EMR systems (Fonkych and Taylor, 2005;

Hillestad et al., 2005). Other questions are adapted from Holt et al.'s scale, which are items in their Appropriateness dimension such as: *This change will improve our organization's overall efficiency* and *This change makes my job easier*.

The resulted items developed to measure the clinical users' change readiness capacity under their respective domain can be seen in Figure 1.

Domain	No.	Items
Information System Savviness	1	I am confident working with hardware components of a computer system (e.g. touch screen, hard disk, keyboard, and mouse).
	2	I am confident working with software components of a computer system (e.g. a word processor – Microsoft Word, a spreadsheet – Microsoft Excel, an electronic mail application – Microsoft Outlook).
	3	I use computers for various purposes (e.g. internet browsing, sending and receiving emails, online transaction – shopping or banking, printing documents).
	4	I have sufficient skills to work with a computerized system.
	5	I am confident working with an EMR system.
Organizational Support	6	Overall I received sufficient information from the senior managers regarding the implementation of the EMR system.
	7	Overall, I received sufficient information from my manager(s) regarding the changes in my work routine as the result of the EMR implementation.
	8	On average, I receive feedback within two days, e.g. from the information technology staff, if I have any questions related to the EMR system implementation.
	9	I am encouraged by the senior manager(s) to embrace the EMR system implementation.
	10	Overall, the senior manager(s) has been supportive towards any technological changes implemented at the hospital.
	11	On average, I received enough training, such as from information technology staff, on any technological changes that affected my work.
	12	On average, I received feedback within two days, e.g. from the information technology staff, if I have any technical problem(s) related to my work.
Perceived Benefit	13	I believe the EMR implementation can lower medical error.
	14	I believe the EMR implementation can improve the management of care of the patients.
	15	I believe the EMR implementation can facilitate standardization of clinical forms that may increase the reliability of the patients' records.
	16	I believe the EMR implementation can improve the overall efficiency of the hospital.
	17	I believe the EMR implementation can reduce the time required to enter patient's data.
	18	I believe the EMR implementation can avoid the duplication of patient's record.
	19	I believe the EMR implementation help in transferring patient's record from one department to another.

Figure 1. Scale Items according to the Domain

VALIDITY AND RELIABILITY STUDIES

In order to determine the content validity, all of the 19 items that have been developed would be presented to a group of judges consists of subject-matter experts. On the basis of the definition of each dimension, each judge will be asked to indicate in which dimension each item belongs.

The judges would rank their confidence from one (the lowest confidence toward the categorization/dimension) to three (the highest confidence) that each item belongs to a particular category or dimension. The total percentage of agreement among the judges on a specific item serves as the item’s degree of content validity. Since the judges have discretion in evaluating the test items, and the data that the test generates is ordinal, the Coefficient of Concordance will be used to measure the judges’ level of agreement toward their rank. It may be decided that only items which have 80% to 100% agreement among all the judges will be retained. At this stage, there is a possibility that some items will be eliminated due to low agreement among judges. The related content validity rating forms are provided in Figures 2 and 3.

It is not relevant to conduct a criterion validity study for this research since the intended assessment is not going to be compared with any existing measures. Furthermore, to the best of the authors’ knowledge, there is no established measure that assesses the change readiness of clinical users towards the implementation of EMR systems.

Once a pilot study is conducted, the data gathered during the pilot study can be used to evaluate the construct validity of the instrument. A principal component analysis can be performed on the data. The number of components/factors extracted can be determined using the Eigen value indicator or Scree plot or by theoretically defining the number of factors. In the context of this research, the three dimensions identified earlier can be empirically tested to determine whether they are valid dimensions to measure change readiness capacity.

Furthermore, the authors suspect that two of the underlying dimensions, Information Technology Savviness and Perceived Benefits, may be correlated with each other, since both are related to individual aspects of change readiness. Therefore, oblique rotation will be performed.

<p>Instruction: The statements below are planned to be included in a Change Readiness Scale for EMR implementation at hospitals within the Chicago area. Please help by examining which statement belongs to which category. There are three categories listed in the table below. In order to do the classification, you are expected to do two things: first, classify in which category each statement falls; and second rate how certain you are in choosing that category.</p> <p>Category Task: Please indicate the category of each statement by circling the appropriate numeral. Statements that do not fall into any category should be put into category IV.</p>		
No.	Category	Definition
I.	Information Technology Savviness	The individual’s confidence and capability in using technologies, particularly computer technology.
II.	Organizational Support	Supports that the hospital management show to the users related to the plan to implement the EMR system, as well as assistance they have given to support previous technological changes in the organization.
III.	Perceived Benefit	Benefits that the users perceived in relation to the EMR implementation.
IV.	No Category	The statement could not be classified in one of the above categories.

Figure 2. Category Task

Internal consistency reliability coefficients will be calculated for each of the dimensions. This will produce three Coefficient Alphas corresponding to the dimensions. Item analysis correlations for each dimension will also be calculated. Scale scores will be calculated for each user on each of the three dimensions. The scores are the sum of each of the items forming the individual dimension. The means and standard deviations and correlations between the three dimensions will be reported.

Rating Task: Please indicate how strongly you feel about your placement of a statement into a category by circling the appropriate number as follows:									
1 – Not Confident			2 – Fairly Confident			3 – Very Confident			
No.	Statement	Category *				Rating			
1	I am confident working with hardware components of a computer system (e.g. touch screen, hard disk, keyboard, and mouse).	<i>I</i>	II	III	IV	1	2	3	
2	I am confident working with software components of a computer system (e.g. a word processor – Microsoft Word, a spreadsheet – Microsoft Excel, an electronic mail application – Microsoft Outlook).	<i>I</i>	II	III	IV	1	2	3	
3	I use computers for various purposes (e.g. internet browsing, sending and receiving emails, online transaction – shopping or banking, printing documents).	<i>I</i>	II	III	IV	1	2	3	
4	I have sufficient skills to work with a computerized system.	<i>I</i>	II	III	IV	1	2	3	
5	I am confident working with an EMR system.	<i>I</i>	II	III	IV	1	2	3	
6	Overall I received sufficient information from the senior managers regarding the implementation of the EMR system.	I	<i>II</i>	III	IV	1	2	3	
7	Overall, I received sufficient information from my manager(s) regarding the changes in my work routine as the result of the EMR implementation.	I	<i>II</i>	III	IV	1	2	3	
8	On average, I receive feedback within two days, e.g. from the information technology staff, if I have any questions related to the EMR system implementation.	I	<i>II</i>	III	IV	1	2	3	
9	I am encouraged by the senior manager(s) to embrace the EMR system implementation.	I	<i>II</i>	III	IV	1	2	3	
10	Overall, the senior manager(s) has been supportive towards any technological changes implemented at the hospital.	I	<i>II</i>	III	IV	1	2	3	
11	On average, I received enough training, such as from information technology staff, on any technological changes that affected my work.	I	<i>II</i>	III	IV	1	2	3	
12	On average, I received feedback within two days, e.g. from the information technology staff, if I have any technical problem(s) related to my work.	I	<i>II</i>	III	IV	1	2	3	
13	I believe the EMR implementation can lower medical error.	I	II	<i>III</i>	IV	1	2	3	
14	I believe the EMR implementation can improve the management of care of the patients.	I	II	<i>III</i>	IV	1	2	3	
15	I believe the EMR implementation can facilitate standardization of clinical forms that may increase the reliability of the patients' records.	I	II	<i>III</i>	IV	1	2	3	
16	I believe the EMR implementation can improve the overall efficiency of the hospital.	I	II	<i>III</i>	IV	1	2	3	
17	I believe the EMR implementation can reduce the time required to enter patient's data.	I	II	<i>III</i>	IV	1	2	3	
18	I believe the EMR implementation can avoid the duplication of patient's record.	I	II	<i>III</i>	IV	1	2	3	
19	I believe the EMR implementation help in transferring patient's record from one department to another.	I	II	<i>III</i>	IV	1	2	3	

* Categories printed in italic are the intended ones. The categories are not disclosed to the judges.

Figure 3. Rating Task

THE CHANGE READINESS SCALE FOR EMR IMPLEMENTATION

The proposed scale can be seen in Figure 4. The scale consists of 19 items, which covers three domains: Information Technology Savviness, Organizational Support, and Perceived Benefits. As mentioned before, the first domain relates to the clinical users' confidence and capability in working with a computer/computerized system; the second domain relates to the clinical users' perceived organizational support with regards to the EMR implementation and previous technological changes; and the third domain relates to the clinical users' perceived benefits regarding the EMR implementation.

Each item requires the clinical users to give a response that reflects their level of agreement towards the content of the item. The entire questionnaire takes around ten minutes to complete. The questionnaire will be administered by the authors to clinical users at ten hospitals. Ten physicians and ten nurses will be randomly selected from each hospital, which will account for 200 respondents in total. The ten hospitals will also be randomly selected within the Chicago area.

The instructions for questionnaire administration will emphasize several aspects including:

1. The clinical user's information/responses are anonymous and there is no way to identify a respondent from a completed questionnaire.
2. There is no right or wrong response, therefore for each question, the clinical user is asked to select the response that best reflects her/his own situation.
3. The clinical user can only select one response per question.
4. The survey administrator will remind the clinical user to answer all the questions before submitting the questionnaire.

RESPONSE SCALE FORMAT

The scale was constructed using a Likert type scale with four-point response format; i.e. Strongly Disagree, Disagree, Agree, and Strongly Agree. The four points show the clinical user's level of agreement towards the content of each item.

The choice to provide an even number of options for the response was made to avoid having a neutral response option. Since the intention of the questionnaire is to measure change readiness, the authors believe that the users must have only one out of two opinions towards the change, which are agree or disagree. The difference in each option is the level of agreement or disagreement, hence Strongly Agree and Strongly Disagree are provided. Furthermore, the authors believe that the presence of a neutral option may attract the users to select that option due to easiness and safety issues. Therefore, the neutral option is undesirable and excluded in the context of this research.

SCALE SCORING

A scoring sheet was developed using Excel to aid in the scoring process. The resulting Excel table for scoring can be seen in Figure 5.

Since the response format is a 4-point Likert scale, the value for each response was assigned as follows:

1. Strongly Disagree is equal to 1
2. Disagree is equal to 2
3. Agree is equal to 3
4. Strongly Agree is equal to 4

The scores of each clinical user are transferred to the relevant cells according to the item number and the column label in the Excel file. For example, if the first user answers Strongly Agree for item 1, then nominal 4 will be transferred to the cell under column "Item 1" for clinical user 1.

The sum of all the scores under one dimension becomes the raw score for the dimension. This score will be calculated automatically using the sum function in Excel and will be put in a separate cell. Similarly, the average for each dimension is calculated automatically using the average function in Excel; i.e. dividing the raw score of a particular dimension with the number of items in that dimension. For example, the raw score for the Information Technology Savviness (ITS) dimension is calculated by adding all the scores from items 1 to 5, and the result is stored in the Raw Score ITS column. The average of

the dimension is the Raw Score ITS value divided by 5, and the result is stored in the Avg. ITS column. The ranges of the raw score values are 5 to 20 for the ITS dimension, 7 to 28 for the Organizational Support (OS) dimension, and 7 to 28 for the Perceived Benefit (PB) dimension. A Total Score in a particular row is the sum from all Raw Scores (ITS, OS, and PB) which is also calculated automatically. This score represents the total change readiness score for a particular clinical user. The range of the score is from 19 to 76.

Date:					
Age:					
Gender:					
Position (e.g. nurse, physician):					
Hospital Name:					
Your responses to all items below are confidential. No personal information that can be used to disclose your identity will be stored.					
Please read the items carefully. For each item, please circle only one response; i.e. Strongly Disagree, Disagree, Agree, or Strongly Agree. There is no right or wrong response; therefore, please select the response that best reflects your own situation.					
No.	Item	Response			
Information System Savviness					
1	I am confident working with hardware components of a computer system (e.g. touch screen, hard disk, keyboard, and mouse).	Strongly Disagree	Disagree	Agree	Strongly Agree
2	I am confident working with software components of a computer system (e.g. a word processor – Microsoft Word, a spreadsheet – Microsoft Excel, an electronic mail application – Microsoft Outlook).	Strongly Disagree	Disagree	Agree	Strongly Agree
3	I use computers for various purposes (e.g. internet browsing, sending and receiving emails, online transaction – shopping or banking, printing documents).	Strongly Disagree	Disagree	Agree	Strongly Agree
4	I have sufficient skills to work with a computerized system.	Strongly Disagree	Disagree	Agree	Strongly Agree
5	I am confident working with an EMR system.	Strongly Disagree	Disagree	Agree	Strongly Agree
Organizational Support					
6	Overall, I received sufficient information from the senior managers regarding the implementation of the EMR system.	Strongly Disagree	Disagree	Agree	Strongly Agree
7	Overall, I received sufficient information from my manager(s) regarding the changes in my work routine as the result of the EMR implementation.	Strongly Disagree	Disagree	Agree	Strongly Agree
8	On average, I receive feedback within two days, e.g. from the information technology staff, if I have any questions related to the EMR system implementation.	Strongly Disagree	Disagree	Agree	Strongly Agree
9	I am encouraged by the senior manager(s) to embrace the EMR system implementation.	Strongly Disagree	Disagree	Agree	Strongly Agree
10	Overall, the senior manager(s) has been supportive towards any technological changes implemented at the hospital.	Strongly Disagree	Disagree	Agree	Strongly Agree
11	On average, I received enough training, such as from information technology staff, on any technological changes that affected my work.	Strongly Disagree	Disagree	Agree	Strongly Agree
12	On average, I received feedback within two days, e.g. from the information technology staff, if I have any technical problem(s) related to my work.	Strongly Disagree	Disagree	Agree	Strongly Agree

Perceived Benefit					
13	I believe the EMR implementation can lower medical error.	Strongly Disagree	Disagree	Agree	Strongly Agree
14	I believe the EMR implementation can improve the management of care of the patients.	Strongly Disagree	Disagree	Agree	Strongly Agree
15	I believe the EMR implementation can facilitate standardization of clinical forms that may increase the reliability of the patients' records.	Strongly Disagree	Disagree	Agree	Strongly Agree
16	I believe the EMR implementation can improve the overall efficiency of the hospital.	Strongly Disagree	Disagree	Agree	Strongly Agree
17	I believe the EMR implementation can reduce the time required to enter patient's data.	Strongly Disagree	Disagree	Agree	Strongly Agree
18	I believe the EMR implementation can avoid the duplication of patient's record.	Strongly Disagree	Disagree	Agree	Strongly Agree
19	I believe the EMR implementation help in transferring patient's record from one department to another.	Strongly Disagree	Disagree	Agree	Strongly Agree
Please make sure you have given responses to all the items. Thank you very much for your time.					

Figure 4. Change Readiness Scale for EMR Implementation at Hospitals

SIMULATED SCORE

A simulated score for a clinical user (clinical user number 1) will we explained based on the score presented in Figure 5. In short, the breakdown of the user's total raw score of 52/76 is as follow:

1. Information Technology Savviness is 15/20
2. Organizational Support is 14/28
3. Perceived Benefit is 23/28

It can be seen from the total raw scores that the clinical user has a slightly above average level of readiness for change for EMR implementation. From the breakdown of the scores by dimension, it is shown that the reason for this rather average score is the low score in the Organizational Support dimension, which is 14/28 with an average of 2 points. A higher score of 15/20 with an average of 3 points can be seen in the Information Technology Savviness dimension, which indicates that the user's familiarity and capacities in information technology use are above average. An even higher score of 23/28 with an average of 3.3 points is shown in the Perceived Benefit dimension, which depicts that the user is able to recognize the benefits of EMR implementation. Clearly, the results explain that the rather average score for the user's change readiness is not caused by her/his individual factors (which materialized in the first and third dimensions), but is caused by the external factor, i.e. the level of organizational support instead.

Scoring Guide:

1. The clinical users’ responses are scored as follow: Strongly Disagree = 1, Disagree = 2, Agree = 3, and Strongly Agree = 4.
2. For each item on a clinical user’s questionnaire, transfer the scores to the relevant cells in the Excel table below.
3. The sum of all the scores under one dimension becomes the raw score for the dimension. This score will be calculated automatically using the sum function in Excel and will be put in a separate cell. For example, the raw score for the IT Saviness dimension is calculated by adding all the scores from items 1 to 5, and the result is stored in the Raw Score ITS column. The range of the score value are 5 to 20 for IT Saviness, 7 to 28 for Organizational Support, and 7 to 28 for Perceived Benefit.
4. The average for each dimension is calculated automatically using the average function in Excel, dividing the raw score of a particular dimension with the number of items in that dimension.

Clinical User	Information Technology Savviness (ITS)					Organizational Support (OS)								Perceived Benefit (PB)								Total Raw Score				
	Item 1	Item 2	Item 3	Item 4	Item 5	Raw Score ITS	Avg. ITS	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Raw Score OS	Avg. OS	Item 13	Item 14	Item 15	Item 16	Item 17		Item 18	Item 19	Raw Score PB	Avg. PB
1	2	2	4	3	4	15	3	4	1	2	4	1	1	1	14	2	3	4	4	3	4	2	3	23	3.3	52
2																										
:																										
n																										

Figure 5. Scoring Sheet

CONCLUSION

Measuring the change readiness capacity of the clinical users involved in EMR systems implementation at hospitals is crucial to support a successful implementation. This research proposes a scale to measure the clinical users’ readiness for change. The process of developing the scale--including the format of response options, item selection and scale scoring--have been presented along with the reliability and validity studies. The simulated score provides an example of the level of change readiness capacity of a clinical user. It is hoped that the score can show not only the overall change readiness capacity of the clinical user but also in which dimension the user excels and/or needs further enhancement. This paper lays a foundation for conducting further quantitative analysis for the ongoing research associated with effective EMR implementations.

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