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The Development of a Model on EMR Implementation Readiness: a Clinician Perspective

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ABSTRACT

Recently EMR implementation had become one of the main priorities for many hospitals and other similar health care institutions. This is due to the fact that outcome that would be obtained through the implementation of this technology is very significant, including an increase in productivity of clinicians, more integrated health services process, improved health services and improved patient safety. The success of this implementation depends on the clinician as the main end users of the EMR system. Despite so many advantages to be gained, the various forms of resistance may be shown by the clinicians on this technology implementation. In this study, factors affecting readiness for EMR implementation in an Indonesian setting were examined. A conceptual model was developed based on the concept of organizational readiness for changes. The model consists of 14 independent variables, and 1 dependent variable which is hospital readiness for EMR implementation. A survey in two hospitals in Indonesia was executed and 97 valid data were used to test the developed model using structural equation modeling (SEM). The result shows that the pressure for change and the organizational flexibility were proved to have a positive effect on hospital readiness for EMR implementation. Regarding the role of pressure for change, it can be concluded that the existence of pressure to implement EMR, from internal or external sources, has a positive and significant effect on hospital readiness to face the implementation of EMR technologies and the easier policies and procedures to be adjusted to various forms of change, the more ready the hospitals to face the implementation of EMR.

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INTRODUCTION

Rapid development of information technology brings many benefits to various sectors of life, including the health sector. Electronic medical record (EMR) is one of the important technological innovation which is very useful in healthcare institutions. EMR is a repository of information about an individual's health and health care records, stored electronically in such a way so that it can serve multiple legitimate users (Lapointe and Rivard, 2005). For many hospitals and other similar health care institutions, EMR implementation had become one of the main priorities recently (Jha *et al*., 2008). This is due to the fact that outcome that would be obtained through the implementation of this technology is very significant, including an increase in productivity of clinicians (Lepanto *et al*., 2006), more integrated health services process (Kuhn *et al*., 2006), as well as improving the quality of health services and patient safety (Goroll *et al*., 2009).

The success of this implementation depends on the clinician as the main end users of the EMR system. Despite so many advantages to be gained, the various forms of resistance may be shown by the clinicians on this technology implementation. In some cases, this resistance can be realized in the form of boycott of technology that has been implemented (Lorence and Richards, 2003) or the threat of a strike by the clinician to oppose the use of EMR (Shortliffe *et al*., 2001). Armenakis and Bedeian (1999) and Armenakis *et al*. (1993) defined readiness as a cognitive evaluation by the hospital staff to determine whether support or resistance that will be given by the staff to the EMR implementation in hospitals. Various empirical studies have shown that the behavior of clinicians towards the implementation of EMR determines the success rate of the use of such technology (Chau and Hu, 2002; Alquraini *et al*., 2007).

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The importance of user perceptions about the factors that influence an organizational readiness for change had been addressed by previous studies in the field of change management (Armenakis *et al*., 1993; Armenakis *et al*., 2007). The studies highlighted that studying the perception of users about the influencing factors can help to identify the sources of user resistance. In this case, it is necessary to identify factors affecting hospital readiness for EMRs implementation by the perception of the clinicians in order to identify potential sources of resistance that can lead to delays or failure in implementation of this technology. Earlier studies on factors effecting hospital readiness for information technology innovations implementation had been done by Snyder-Halpern (2001, 2002), Snyder-Halpern and Fields (2006), Lehman *et al*. (2002), Khoja *et al*. (2007), and Paré *et al*. (2010, 2011). In this study, factors affecting readiness for EMR implementation in an Indonesian setting were examined. The results of this study can be used to evaluate the readiness of hospitals in Indonesia to implement EMR.

Model Development:

A conceptual model was developed based on the concept of organizational readiness for change by Holt *et al*. (2007). According to the concept of Holt *et al*. (2007), readiness for changes can be assessed by examining the readiness in four categories: the content of the change, the context of the change, the process of the change, and targets of the change. Besides, Paré *et al*. (2010, 2011) was also used as the basic model in developing the conceptual model. The developed model consists of one dependent variable (organizational readiness/OR) and the following 14 independent variables: vision clarity, change appropriateness, change efficacy, change valence, pressure for change, management support, presence of project champion, end user involvement, organizational history of change, organizational climate, organizational flexibility, end user skill, end user attitude, and end user experience. These variables were hypothesized to have a positive influence on the organizational readiness for EMR implementation. The developed conceptual model is presented in Figure 1. There are four groups of variables namely: content of the change, target of the change, process of the change, and context of the change. Each group of variables will be described in the next section.

Content of the Change:

According to change management theory, one of the important factors that should be prepared in the effort to create organizational readiness for change is perception that change is needed (Beath, 1991; Beer, 2003). Through the vision of the organization, discrepancy between the current performance of the organization with the expected performance can be identified. An unsatisfactory current organisation's performance can lead to a legitimation of the need for change. In addition to clarifying the organization's vision, Armenakis *et al*. (1993, 2007) also stressed the importance of the compatibility of the proposed amendment to the organisation's needs that have been identified. In his research, Paré *et al*. (2010, 2011) states that these variables are consistent with the theory of social account developed by Bies (1987) and is used to describe whether the proposed changes are appropriate for the organization current situation. If the staffs perceive that the proposed changes are not appropriate and in line with the vision of the organization, the staffs as the target for change will not support and implement these changes (Cole *et al*., 2006). Theory of motivation by Vroom (1964) stated the importance of having confidence that a change will be successfully implemented. To be motivated to support the change, staffs must feel that the proposed changes would be implemented successfully. In this case, the understanding of the organisation's environment determines the level of confidence of staff in this regard. If the proposed change has been successfully implemented in other similar organizations and this stituation has been understood by the staffs, the staffs as the target for change will feel that they are also ready to implement the change successfully. Theory of motivation by Vroom (1964) stated that the commitment to support the change is a function of the value of change itself. When staffs feel a change is needed, important, and useful to the organization, then staffs will increasingly want to implement and be involved in the change. Armenakis *et al*. (1993, 2007) claim that if the staffs consider the proposed changes will not bring benefit or loss will be greater than the benefits, then the staffs will reject these changes. The existence of the benefit is not enough, so it is necessary to emphasize on how to make these benefits seem attractive to staffs who will be the target of the change so that staffs can accept the proposed changes. According to Lehman *et al*. (2002), the pressure to implement a change can come from internal organization (e.g. staff) or external organization (e.g. government). This pressure can vary in intensity and higher intensity will make the organization more ready to take a decision to implement a change.

Context of the Change:

Every organization has a dynamically evolving system and have related success or failure experience in the development of the system that eventually formed the organizational environment (Kling and Iacono, 1989). Experience can affect the organization's staff perception regarding organizational readiness for a change and eventually will have an impact on the success of change implementation (Paré *et al*., 2010; Paré *et al*., 2011). According to Lehman *et al*. (2002), the climate of an organization is indicated by a collective assessment by organisation's staffs regarding the organisation's environment. Organizational climate that is relevant to the

context of organizational change is related to cooperation and trust among the staffs, pressures faced by staff, the atmosphere, and the political conflicts that occur in the organization (Fox *et al*., 1988; Porras and Robertson, 1992). The better the organizational climate the higher the staff's perception of organisational readiness for a change. Every organization has a different degree of flexibility and adaptability. When there is a flexibility for adjusting policies and procedures within an organization, the staffs will assume that the organization is ready for a change program (Beath, 1991). In this study, the clinician is likely to have a poor perception of the hospital 's readiness to change when staffs see that the organization structure, policies, and procedures are rigid and inflexible.

Target of the Change:

Snyder-Halpern (2001, 2002) and Snyder-Halpern and Fields (2006) explain the importance of incorporating the capability and expertise of staff in analysing IT implementation readiness. If the clinician is able to and feel comfortable with using computers in routine work, it will have an impact on the growing perception of the hospital's readiness for EMR implementation. Snyder-Halpern (2001, 2002) and Snyder-Halpern and Fields (2006) also highlight the importance of incorporating the attitude of the staff in analysing IT implementation readiness. If the clinician is open, adaptable, and always trying to improve performance with any system used, it will result in increased perception of the hospital's readiness for EMR implementation. Further, Snyder-Halpern (2001, 2002) and Snyder-Halpern and Fields (2006) state the importance of incorporating experience of the staff in in analysing of IT implementation readiness. If the clinician at the hospital have experience or have ever been involved in the implementation of IT projects, it will result in increased individual clinician's perception of the hospital's readiness for EMR implementation.

Process of the Change:

Many researchers argue that management plays an important role in determining the success of IT implementation related change (Ngai *et al*., 2008). When management supports the IT implementation project, the resources are more likely to be allocated to develop and support a new system that will be implemented (Yap, 1989). This support increases the staff 's perception of the organization's readiness for EMR implementation. Project champion is someone who actively share their personal vision in the use of new systems as well as helping the proposed project going through various obstacles during the planning and implementation phases(Beath, 1991). Dong *et al*. (2007) found that staff perception of the existance of a project champion has a positive effect on the attitude of the staff towards the change. This fact further confirms that the project champion is a leader who is effective in conveying the vision and collective goals related to the use of new IT systems (Beath, 1991). Snyder-Halpern (2001, 2002) and Snyder-Halpern and Fields (2006) discuss the importance of incorporating aspects of staff involvement in the planning the implementation of new IT-based systems. Through their involvement staffs will have the feeling of ownerships to the change project that will result in increased perceptions of staff regarding the implementation readiness. The descriptions of research variables and their operationalisation are presented in Appendix 1.

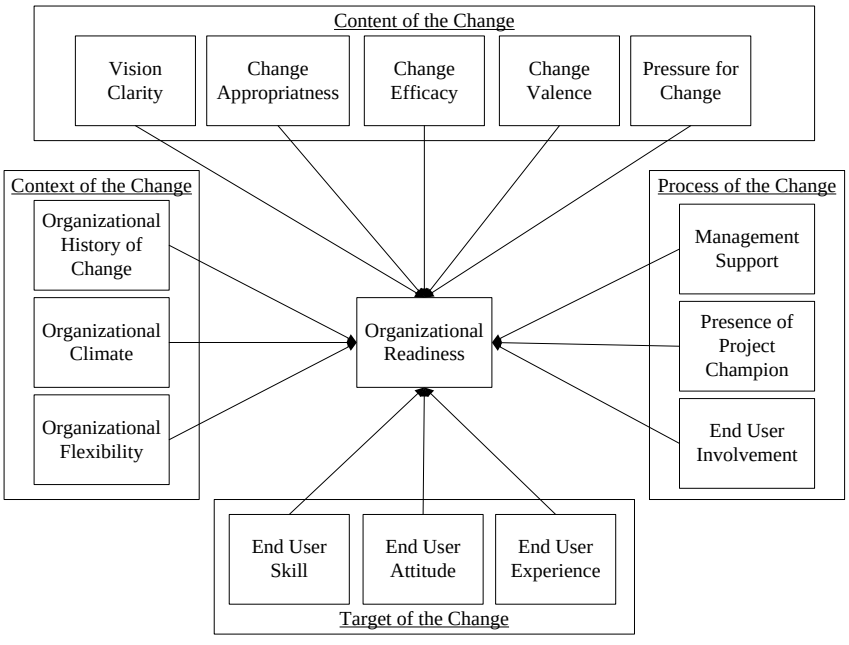

Fig. 1: A conceptual model on factors influencing the organizational readiness for EMR implementation.

ResearchMethodology:

Data Collection:

The model was further operationalized and used to develop the research instrument in the form of a questionnaire. The operationalization of 15 latent variables generated 44 reflective indicators. 200 questionairres were distributed to clinicians at two hospitals in Jakarta, Indonesia, and 101 were collected (response rate of 50.5%). Due to incompleteness, 97 of 101 sample can be used for further data processing.

Data Processing and Analysis:

Data processing was done using a PLS (partial least squares) structural equation modeling (SEM) method, by the support of SmartPLS statistical software.

***Measurement Validation*:**

To validate the measurement model, convergent validity, discriminant validity and internal consistency of the model were evaluated. Discriminant validity is assured when each item has an item loading greater than 0.6 on its constructs (Hair *et al*., 2006) and an item outer loading on a construct is greater than all its cross-loading with other constructs (Hair *et al*., 2006). The cross loadings of all the indicators are presented in Table 1.Convergent validity is assured when a construct has an average variance extracted (AVE) of at least 0.5 (Hair *et al*., 2006). Internal consistency is assured when the reliability of each measurement is > 0.6 (Hair *et al*., 2006). Reliability is assessed by Cronbach's alpha and composite reliability. The final model after the measurement model test consist of 15 latent variables with 43 indicators (1 indicator was found to be invalid). The results of convergen validity and internal consistency test are presented in Table 2.

Table 1: Cross loadings of all the indicators.

	CA	CE	CV	EA	EI	ES	EX	MS	OC	OF	OH	OR	PC	PP	VC
CA1	**0.8612**	0.5951	0.5151	0.4177	0.3423	0.2965	0.1826	0.6808	0.255	0.3503	0.4114	0.5169	-0.113	0.2183	0.92
CA2	**0.8806**	0.6961	0.505	0.2493	0.2862	0.046	0.205	0.7435	0.0807	0.3939	0.2761	0.3489	-0.2092	0.078	0.8292
CA3	**0.8709**	0.6492	0.4761	0.192	0.2005	0.1031	0.2854	0.68	0.095	0.3655	0.2529	0.3808	-0.1854	0.1387	0.7321
CE1	0.6137	**0.8427**	0.4805	0.3175	0.1017	0.1067	0.2028	0.5945	0.1258	0.4428	0.2413	0.3156	-0.0309	0.0457	0.6005
CE2	0.3164	**0.7078**	0.193	0.2068	0.1658	0.0964	0.1876	0.3634	0.2446	0.3044	0.1022	0.278	-0.0416	0.0412	0.272
CE3	0.7064	**0.7066**	0.4968	0.2286	0.3342	0.001	0.2026	0.634	0.0884	0.2264	0.2392	0.2851	-0.0598	0.1775	0.6757
CV1	0.5128	0.4156	**0.8753**	0.6642	0.2074	0.3784	0.3095	0.5453	0.1124	0.3032	0.4432	0.2252	-0.0432	0.0098	0.5202
CV2	0.4777	0.4872	**0.8336**	0.4322	0.1031	0.2182	0.1516	0.5383	0.094	0.1634	0.283	0.3641	0.2313	-0.0344	0.4743
CV3	0.4928	0.4044	**0.8685**	0.6197	0.1794	0.3563	0.3198	0.5175	0.1093	0.298	0.4157	0.192	-0.0538	-0.0112	0.5027
EA1	0.112	0.2104	0.2442	**0.5553**	0.1632	0.2268	0.0465	0.2075	-0.0513	0.0359	0.0208	0.0702	-0.0046	0.0469	0.117
EA2	0.303	0.2663	0.5927	**0.9479**	0.1436	0.5909	0.3138	0.3441	0.0079	0.1145	0.3484	0.2391	-0.0136	-0.0419	0.3259
EA3	0.3775	0.3624	0.6535	**0.9621**	0.2273	0.4997	0.2939	0.4543	-0.0098	0.1057	0.3508	0.2703	-0.0576	-0.0023	0.3974
EI1	0.2953	0.2319	0.1948	0.1969	**0.8866**	-0.0981	0.2043	0.4742	0.0163	0.1753	0.3136	0.0761	0.0323	0.2541	0.3203
EI2	0.3205	0.2585	0.1648	0.197	**0.99**	-0.1104	0.174	0.5368	0.1745	0.2309	0.3587	0.2497	0.05	0.3182	0.3315
ES1	0.2579	0.1318	0.3071	0.5574	-0.1462	**0.8662**	0.0105	0.1347	-0.0049	0.1183	0.1155	0.3055	0.0147	0.029	0.2795
ES2	0.1426	0.078	0.305	0.4704	-0.0811	**0.928**	0.0983	0.0933	0.0152	0.0916	0.0877	0.2536	-0.0032	0.0441	0.153
ES3	0.1001	0.0275	0.3219	0.4486	-0.0627	**0.885**	0.1331	0.0794	0.0241	0.1453	0.139	0.2675	0.0428	-0.0394	0.1168
EX1	0.1184	0.1812	0.347	0.2287	0.0929	0.1233	**0.6146**	0.2387	0.0987	0.1897	0.3722	-0.0008	0.0333	-0.0561	0.1115
EX2	0.253	0.262	0.2807	0.3005	0.1873	0.1052	**1**	0.2864	-0.0331	0.2083	0.1787	0.0902	-0.1094	0.0324	0.2036
MS1	0.6493	0.5518	0.4945	0.3088	0.4297	0.0424	0.2411	**0.8828**	0.0884	0.5431	0.4295	0.4292	0.0025	0.1588	0.6447
MS2	0.7903	0.687	0.599	0.3506	0.365	0.0987	0.3314	**0.8776**	0.1468	0.4974	0.3944	0.4003	-0.133	0.2005	0.7545
MS3	0.6605	0.6097	0.528	0.3355	0.3628	0.0701	0.136	**0.8553**	0.1268	0.3939	0.3686	0.4338	0.125	0.0881	0.6519
MS4	0.7222	0.64	0.5977	0.4524	0.3627	0.2692	0.2623	**0.8236**	0.3137	0.4689	0.4337	0.5062	-0.076	0.1007	0.6857
MS5	0.2783	0.2343	0.17	0.1524	0.9575	-0.1558	0.1734	**0.5085**	0.1649	0.2201	0.3475	0.2186	0.0686	0.2588	0.305
OC1	0.112	0.1446	0.0553	0.0746	0.2248	-0.0061	-0.0742	0.1487	**0.6122**	0.2097	0.4116	0.2902	0.0849	0.2386	0.1504
OC2	0.1573	0.1285	0.1439	0.0041	0.089	0.0447	-0.0716	0.1475	**0.7895**	0.1832	0.2917	0.2458	-0.124	-0.0665	0.172
OC3	0.058	0.0692	0.084	-0.0756	0.0434	0.0971	-0.0425	0.0795	**0.7974**	0.1685	0.2655	0.2238	0.014	0.0149	0.0797
OC4	0.1081	0.142	0.0646	-0.0222	0.0064	-0.0331	0.0544	0.109	**0.771**	0.2443	0.1433	0.2522	-0.1529	0.0199	0.1236
OC5	0.2134	0.2302	0.0973	-0.0291	0.1287	-0.0419	0.0107	0.274	**0.7063**	0.2951	0.1323	0.2722	-0.1141	0.0219	0.217
OF1	0.361	0.373	0.236	0.1009	0.1822	0.1487	0.1828	0.4702	0.2925	**0.9625**	0.4062	0.5627	0.0012	0.1166	0.3489
OF2	0.476	0.4736	0.3026	0.1185	0.2653	0.1101	0.2164	0.5855	0.2962	**0.9154**	0.4631	0.6939	0.0529	0.129	0.4547
OF4	0.3443	0.3742	0.2391	0.0933	0.1813	0.1236	0.1861	0.4765	0.2747	**0.9671**	0.4034	0.5705	0.0142	0.0954	0.3447
OH1	0.5137	0.3883	0.4528	0.3622	0.4733	0.0611	0.2575	0.5985	0.2358	0.4526	**0.899**	0.3865	-0.0071	0.209	0.5276
OH2	0.1261	0.053	0.2878	0.2356	0.1463	0.1731	0.0424	0.2483	0.3828	0.3402	**0.871**	0.3442	0.2182	0.0367	0.1888
OR1	0.441	0.362	0.2937	0.2059	0.2902	0.1767	0.1999	0.4786	0.329	0.6223	0.4331	**0.8612**	0.1257	0.232	0.4216
OR2	0.3276	0.3041	0.2107	0.1236	0.1555	0.229	0.0759	0.3903	0.2149	0.5161	0.1528	**0.8232**	0.2308	0.1277	0.3004
OR3	0.4583	0.3082	0.316	0.3045	0.096	0.3713	-0.0469	0.4166	0.3373	0.492	0.4296	**0.8269**	0.1253	0.1569	0.4795
PC1	-0.1263	-0.0107	0.1634	-0.0221	0.0488	0.0186	-0.1046	0.0787	-0.0801	0.0982	0.0824	0.178	**0.9378**	0.0373	-0.1202
PC2	-0.2237	-0.0984	0.015	-0.0463	0.04	0.0198	-0.1018	-0.1053	-0.0643	-0.0505	0.1274	0.1742	**0.9349**	0.0938	-0.1969
PP1	0.1804	0.1165	-0.0164	-0.0104	0.3123	0.0151	0.0366	0.1827	0.072	0.1217	0.1444	0.2102	0.068	**0.9999**	0.1588
PP2	-0.0188	0.0004	-0.127	-0.1921	0.2744	-0.0999	-0.1576	0.0022	0.0333	0.0502	0.0853	0.0042	0.1302	**0.6144**	-0.0177
VC1	0.8511	0.5631	0.5018	0.4015	0.326	0.3016	0.1688	0.6658	0.2475	0.3394	0.417	0.492	-0.1291	0.2069	**0.9239**
VC2	0.845	0.6745	0.5232	0.2089	0.2614	0.0121	0.1959	0.7264	0.0849	0.3942	0.2901	0.3273	-0.1786	0.0345	**0.8179**

Hypothesis Testing:

Structural model evaluation was done to measure the amount of influence were given by all independent variables to the dependent variable (organizational readiness/OR). The structural model evaluation was also used to test the significance of the proposed relationships by evaluating path significance (Hair *et al*., 2006). The

path significance is estimated through t-test values using the bootstrapping procedure with 500 sample size. The T-test scores show which independent latent variables have a significant influence towards organizational readiness. The PLS results for hypoteses testing are presented in Table 3. The result shows that the pressure for change and the organizational flexibility were proved to have a positive effect on hospital readiness for EMR implementation.

Table 2: Composite reliability and Cronbach Alpha

Latent Variable	Composite Reliability	CronbachAlpha
CA	0.9041	0.8451
CE	0.7980	0.6174
CV	0.8944	0.8396
EA	0.8751	0.8011
EI	0.9377	0.8965
ES	0.9222	0.8737
EX	0.8073	0.7655
MS	0.8974	0.8540
OC	0.8561	0.7886
OF	0.9642	0.9446
OH	0.8784	0.7239
OR	0.8755	0.7870
PC	0.9343	0.8594
PP	0.8071	0.7516
VC	0.8640	0.6974

Table 3: Results of hypotheses testing.

	Original Sample (O)	Sample Mean (M)	T Statistics (|O/STERR|)
CA -> OR	0.5364	0.3795	1.0407
CE -> OR	-0.1288	-0.0556	0.5804
CV -> OR	-0.1512	-0.1306	0.8670
EA -> OR	0.1689	0.1260	0.8387
EI -> OR	-0.0325	-0.0207	0.1950
ES -> OR	0.1377	0.1380	0.8772
EX -> OR	-0.0682	-0.0829	0.4664
MS -> OR	0.0198	0.0285	0.0714
OC -> OR	0.2043	0.2047	1.6020
OF -> OR	0.4827	0.4441	3.2098
OH -> OR	-0.0230	0.0366	0.1457
PC -> OR	0.2712	0.2533	2.4586
PP -> OR	0.0660	0.0137	0.4417
VC -> OR	-0.1335	-0.0424	0.3129

Discussion and Conclusion:

The main contribution of this research is the development of a comprehensive model on factors affecting the perception of clinicians regarding the organisational readiness for EMR implementation in hospitals. Another special thing of this research is the examination of EMR implementation readiness in a different cultural and technological setting. In this study, the two hospitals participate in the data collection phase are Indonesian hospitals with Indonesian clinicians who are basically not very familiar with the use of high technology-based.

The study found out that pressure for change and the organizational flexibility were proved to have a positive effect on hospital readiness for EMR implementation. Regarding the role of pressure for change, it can be concluded that the existence of pressure to implement EMR, from internal or external sources, has a positive and significant effect on hospital readiness to face the implementation of EMR technologies. With the pressure from internal and external parties, hospitals are required to make a change so that clinicians' perception of readiness arises as the intensity of the pressure increased. In other words, increased pressure for implementation has led to an increase in the readiness of the hospital itself. This finding is in line with the results of the study of Lehman *et al*. (2002). The result of data processing also shows that implementation of a new information technology in the hospitals would result in a change in some policies and procedures that already exist. The easier policies and procedures are adjusted to various forms of change, the more ready the hospitals to face the implementation of EMR. This finding is in line with the results of the study Paré *et al*. (2010, 2011).The R^2 of organizational readiness (OR) is 0.624. This means that the independent variables of the model can explain the factors influencing organisational readiness for EMR implementation from the perspective of clinician by 62.4%.

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Appendix 1.

Category	Variable	Definition	References
Content of the change	*Vision clarity*	Clarity about the gap between the current state with the desired state (vision) that gives rise to the need for change	(Paré *et al*., 2010; Armenakis *et al*., 2007)
	Change appropriate-ness	Correspondence between the proposed changes to the requirements and current conditions of the organization	(Paré *et al*., 2010; Armenakis *et al*., 2007)
	Change efficacy	Belief that the proposed changes can be implemented successfully	(Paré *et al*., 2010;Judson, 1996)
	Change valence	Awareness of the benefits that would be gained if a change is implemented in the organization	(Armenakis *et al*., 2007; Judson, 1996)
	Pressure for change	The existence of pressure to implement changes that come from both internal and external organization	(Lehman *et al*., 2002)
Process of the change	*Management support*	The existence of the support from management	(Paré *et al*., 2010; Armenakis *et al*., 2007)
	Presence of project champion	The presence of individuals who actively promote change and help the project passing the obstacles and challenges during change planning and implementation	(Paré *et al*., 2010; Armenakis *et al*., 2007)
	End user involvement	The involvement of clinicians as potential users in the change planning process	(Snyder-Halpern, 2001)
Context of the change	*Organizational history of change*	The experience with previous IT projects	(Paré *et al*., 2010)
	Organizational climate	Collective assessment of staff regarding the the organization internal working situation (climate)	(Beath, 1991; Lehman *et al*., 2002)
	Organizational flexibility	Flexibility in adjusting organizational policies and procedures according to the needs	(Beath, 1991)
Target of the change	*End user skill*	The ability of the clinician as a potential user in the use of information technology	(Paré *et al*., 2010; Snyder-Halpern, 2001; Lehman *et al*., 2002)
	End user attitude	The attitude of the clinician as a potential user in response to the proposed changes	(Paré *et al*., 2010; Snyder-Halpern, 2001; Lehman *et al*., 2002)
	End user experience	Clinician experience in previous IT projects	(Snyder-Halpern, 2001; Lehman *et al*., 2002)
Organizational readiness		Hospital readiness for EMR implementation	(Paré *et al*., 2010)