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Modeling factors explaining the acceptance, actual use and satisfaction of nurses using an Electronic Patient Record in acute care settings: An extension of the UTAUT

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ABSTRACT

Background and purpose: End-user acceptance and satisfaction are considered critical factors for successful implementation of an Electronic Patient Record (EPR). The aim of this study was to explain the acceptance and actual use of an EPR and nurses' satisfaction by testing a theoretical model adapted from the Unified Theory of Acceptance and Use of Technology (UTAUT).

Methods: A multicenter cross-sectional study was conducted in the medical-surgical wards of four hospitals ranked at different EPR adoption stages. A randomized stratified sampling approach was used to recruit 616 nurses. Structural equation modeling techniques were applied.

Results: Support was found for 13 of the model's 20 research hypotheses. The strongest effects are those between performance expectancy and actual use of the EPR ($r=0.55$, $p=0.006$), facilitating conditions and effort expectancy ($r=0.45$, $p=0.009$), compatibility and performance expectancy ($r=0.39$, $p=0.002$). The variables explained 33.6% of the variance of actual use, 54.9% of nurses' satisfaction, 50.2% of performance expectancy and 52.9% of effort expectancy.

Conclusions: Many results of this study support the conclusions of prior research, but some take exception, such as the non-significant relationship between the effort expectancy construct and actual use of the EPR. The results highlight the importance of the mediating effects of the effort expectancy and performance expectancy constructs. Compatibility of the EPR with preferred work style, existing work practices and the values of nurses were the most important factors explaining nurses' satisfaction. The results reveal the complexity of this change and suggest several avenues for future research and for the implementation of IT in healthcare.

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1. Introduction

1.1. Implementing information technology in healthcare

Increasingly, information technologies (IT) are being proposed as solutions to the challenges faced in health care systems, for addressing population health issues and encouraging the emergence of new modes of healthcare delivery [1]. Even though the benefits of implementing IT in healthcare have been well documented, too much variance remains in the rates of satisfaction expressed by health professionals [2]. The professional culture of nurses is generally favorable to adoption of innovations such as an Electronic Patient Record (EPR) [3], but affective response remains a critical factor that influences the decisions and behaviors of IT users [4]. The fundamental differences between the paper-based patient record and the EPR as well as significant transformations of clinical practices raise significant questions about IT's impact on the nursing workflow, care delivery and nurses' satisfaction [5]. In principle, an EPR should facilitate access to relevant information, patient evaluation, health promotion, clinical interventions and the organization of services [6]. These functionalities play a key role for nurses, since they make a unique contribution to the health system [7] by integrating information [8] and serving as pivots in the health team [9]. Furthermore, the adoption of an EPR is a complex change that occurs slowly, in a series of stages. Widespread adoption appears to be a prerequisite to achieving the overall benefits for a health system [10]. However, the EPR adoption stage varies from one facility to another, which limits interoperability. It is therefore important to identify and make use of explanatory factors to facilitate this important transition.

1.2. Aims of the study

The aim of this study was to investigate explanatory factors for nurses' acceptance and actual use of an EPR in acute care settings as well as for their satisfaction. More specifically, the research objectives examined: (1) nurses' perceptions of the compatibility of the EPR and their self-efficacy regarding acceptance of the EPR, (2) the actual use of the EPR, and (3) their satisfaction.

2. Theoretical foundations

2.1. Acceptance models and theories

Over the last few decades, many models and theories have been developed and tested in order to identify variables affecting the acceptance and use of IT provided to end-users. Among them, the Technology Acceptance Model (TAM) [11] stimulated one of the most active streams of research to predict intention to use an IT and explain actual use of IT [12]. Based on the Theory of Reasoned Action (TRA) [13], TAM examined the impact of external factors on the cognitive response of individuals (reactions based on values, beliefs, knowledge, etc.), on their affective response (the emotions and feelings generated), on their intention to change a behavior and, lastly,

on their behavioral response, i.e. their actual use of the system. In 2003, the Unified Theory of Acceptance and Use of Technology (UTAUT) [14] synthesized 32 constructs from eight well-known models and theories to study the acceptance of IT. UTAUT advanced several constructs as influencing intention to use and actual use of IT: performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC). These constructs focus on users' perceptions of the usefulness of the system in increasing their productivity, of the ease with which they can learn to use the system, of the role played by significant persons in the work environment to influence the end-user's behaviors and, lastly, on the measures taken to support change. These constructs are considered equivalent to the perceived usefulness, perceived ease of use, subjective norm and perceived behavioral control constructs, respectively [15]. However, some links frequently tested in TAM [11] and TAM2 [16] to measure acceptance and use of a system have not been modeled in UTAUT. This is true of the fundamental links between effort expectancy and performance expectancy and between social influence and performance expectancy. Often these links have proved to be significant when measured among the various types of health professionals affected when an IT is adopted [15].

2.2. Selection of the dependent variables

In this stream of research, most studies have measured the behavioral intention to use the system before the system is deployed, considering this variable as a proxy for actual use. An EPR is used by all health professionals for collective health care delivery. Its use is therefore not voluntary. In this sense, there may be limits to measuring the intention to use a system implemented for mandatory use.

Only four studies have measured actual use of a system in healthcare settings [17–20], and often this has been measured in terms of frequency, intensity of use and the scope of the functionalities used in the system [14]. Yet for clinicians using an EPR, such a measure more accurately reflects patients' need for care and professionals' workflows, rather than acceptance of the system. This study seeks to fill this gap by analyzing the nature of such use to support users' activities and sense making of the information. To this end, we employed a multidimensional construct of actual use of a system [21] that focuses on three IT functions: (1) decision support (problem solving and decision rationalization), (2) work integration (horizontal and vertical) and (3) customer service. Until this time, this construct and the self-reported instrument that was developed to measure the nature of the actual use have received very limited attention in the literature.

A suggestion has also been made to replace actual system use by a measure of user satisfaction [22]. To this end, nurses' satisfaction has been measured with respect to the PE and EE constructs [23], but instrumentally rather than affectively. In the TAM, the attitude toward the system construct has often been left out and is not found in UTAUT. Yet many studies have examined the attitudes of health professionals during adoption of an IT [15]. All the studies that measured the relationship between performance expectancy and attitude toward the system found a positive link [18,24–31] and only one, which examined a sample of physicians, found a non-significant link

with the effort expectancy variable [29]. However, when predicting a behavior, attitude precedes behavioral intention and actual use of the system [13]. When the EPR has already been implemented, it would appear more appropriate to measure user satisfaction after their experience with actual use of the EPR. In this respect, the Expectation-Confirmation Model [32] offers an affective conceptualization of user satisfaction that is similar to how attitude toward the system has been measured, but which has not yet been applied with TAM or UTAUT.

2.3. Antecedent factors

Many studies conducted in healthcare have examined the compatibility of the EPR with the professionals' clinical practices. All the tests performed with regard to the performance expectancy construct produced significant results [28,31,33–35]. This construct was positively associated with effort expectancy three times out of four [28,34,35] and with behavioral intention to use the EPR four times out of five [28,33,34,36]. These results demonstrate the value in investigating the compatibility of the EPR with care practices, which is considered one of the most important factors in clinicians' acceptance and use of an EPR [33,34]. In UTAUT, only one item in the facilitating conditions construct addressed the compatibility of the system. Considering the challenges related to integrating an IT, investigators have instead proposed a multidimensional construct of the compatibility of the system with preferred work style, existing work practices, prior experiences and users' values [37].

Another important dimension is the computer self-efficacy construct, which was removed from the final version of UTAUT because of a full mediation effect exercised by the effort expectancy construct. To date, all the studies conducted in healthcare settings have found that self-efficacy has a significant influence on effort expectancy [24,26,28,34,35]. However, we did not find a single study that measured a link between the self-efficacy construct and the satisfaction of clinicians using IT. By widening our literature review, we found a study on the implementation of an e-learning application that revealed a non-significant relationship [38]. By considering the attitude toward the system construct as an affective response comparable to satisfaction, a non-significant link was also found by applying UTAUT [24]. However, another study suggests that the self-efficacy construct is one of the strongest predictors of job satisfaction [39]. The results on this subject therefore appear to be mixed.

2.4. Additional theoretical considerations

According to theory of reasoned action (TRA) assumptions, measurement of a given behavior must be situated with respect to an action, a target and a context and within a specific time-frame [13]. In order to better specify the implementation of an EPR over time – a complex change that evolves through a series of adoption stages – we used the Electronic Medical Record Adoption Model (EMRAM) [40] in order to specify the adoption stages in the EPR deployment within our study settings.

2.5. Research model

All the UTAUT constructs were used to develop the theoretical model except for behavioral intention to use the system, since the nurses in our study were already using the EPR. To measure the behavioral response, we have proposed a multidimensional self-reported measure of actual use of the EPR [21]. To ensure that the model is supported in all the components of TRA [13], nurses' satisfaction was modeled as a second dependent variable, effectively re-introducing an affective measure. This model also reflects recommendations to measure user satisfaction in environments where actual use of the EPR is mandatory [41]. Also, two antecedent factors were added to the model: (1) computer self-efficacy [42] and (2) a multidimensional construct of the compatibility of the EPR [37] with preferred work style, existing clinical practices, prior experiences and nurses' values. Fig. 1 illustrates the theoretical model used in this study, and Table 1 presents the 20 research hypotheses along with their empirical support. The effects of the independent variables were modeled on two dependent variables: AU (actual use of the EPR) and Sat (satisfaction).

3. Methods

3.1. Design and settings

The research design was based on a multicenter cross-sectional study. Four acute-care academic settings were selected for the study: two university-affiliated hospitals and two teaching hospitals, all located in Montreal, Canada. All the study sites were implementing an EPR developed by the same vendor (Oacis™, Telus). The sites were at various EPR adoption stages ranging from 1 to 4. These adoption stages were assessed using the Electronic Medical Record Adoption Model – EMRAM [40]. One university-affiliated hospital was ranked at the first adoption stage (setting 1) and the other one was ranked at the second adoption stage (setting 2). One teaching hospital was ranked at a stage 3 (setting 3) and the other had reached the fourth adoption stage (setting 4). According to EMRAM, a stage 1 hospital is one that has all major ancillary systems (laboratory, radiology and pharmacy) installed and operational. At the second adoption stage, the ancillary systems feed data to a clinical data repository that can be accessed in the EPR. The third adoption stage is characterized by electronic nursing and clinical documentation (flow sheets, vital signs, nursing notes, etc.) that is integrated into the clinical data repository. The main characteristic of the fourth adoption stage concerns computerized practitioner order entry (CPOE). The study targeted a population of nurses working in 55 medical and surgical wards.

3.2. Instrument development

Data was collected using a closed questionnaire printed on paper. It contained 53 questions on: compatibility of the EPR (8 items), self-efficacy (4 items), PE (4 items), EE (4 items), SI (4 items), FC (3 items), AU (14 items), and nurses' satisfaction (4 items) as well as eight questions on the nurses'

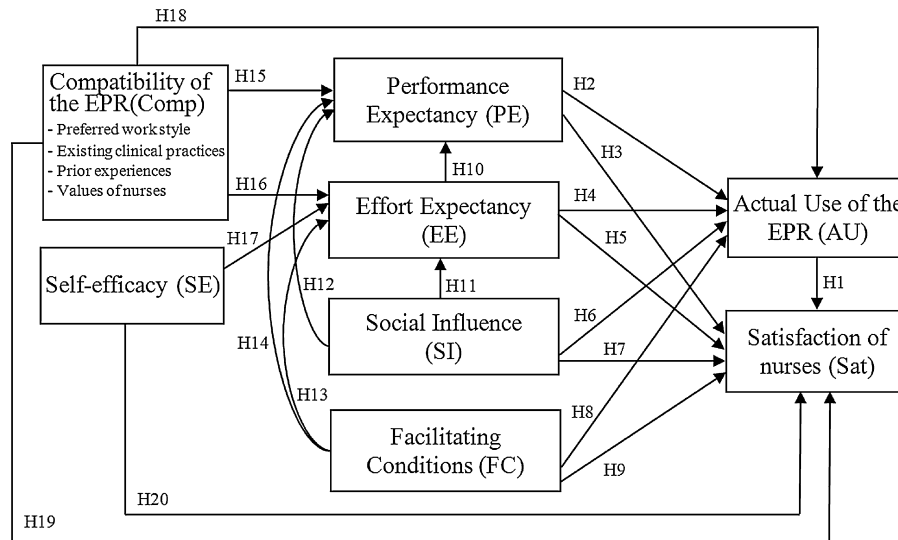


Fig. 1 – Hypothesized research model adapted from the UTAUT [14].

socio-demographic characteristics (age, gender, job level, etc.). The questionnaire took 5–10 min to complete. The items measuring compatibility of the EPR and UTAUT constructs used seven-point Likert scales (strongly disagree to strongly agree), a ten-point scale for self-efficacy (not at all confident to totally confident) and a five-point scale on actual use of the EPR (not at all to a great deal). The wording of the items used in prior studies was adapted to nursing practice. Some items were replaced or removed for reasons related to face validity, content validity and construct validity. For instance, for a nurse working in a public hospital, using an EPR does not increase the chances of obtaining a raise [14]. Also, an item of the Facilitating Conditions construct was removed because it was intended to measure the compatibility of the system, which this study measured with a separate instrument. There were two versions of the questionnaire (one in English and one in French) to account for language spoken at work. The French version was translated using the back-translation method [58]. This involves having the questionnaire translated first into French by one translator and then translated back into English by another translator. The items in the two final versions of the questionnaire were identical. The questionnaire was then pre-tested on 13 nurses speaking both languages who were not included in the study population. Based on the comments received, some items were removed because they were considered too redundant to measure compatibility of the EPR and actual use of the EPR. More specifically, seven of the 15 items in the original instrument measuring the compatibility of the EPR were removed. Similarly, 16 of the 30 items in the instrument measuring the actual use of the EPR were removed. This decision was made to avoid annoying respondents and to reduce overall questionnaire completion time.

3.3. Sampling method, data collection and data analysis

A random stratified sampling method was applied, based on the nurses' work shifts, as strata criteria to ensure that the

sample would be representative of nurses in terms of age and experience. The list of nurses provided by the human resources or nursing departments were cleaned before sampling by removing nurses on long-term leave (sick leave, maternity leave, study leave, etc.). For instance, in a teaching hospital, we used a random numbers table to sample 140 nurses (42% on the day shift, 100 nurses (30% on the evening shift and 60 nurses (18% on the night shift. A total of 875 survey questionnaires were personally handed out to the selected nurses from October 2012 to March 2013. A reminder was sent one month following the first contact. Approvals for the study were obtained from the research ethics committee of each setting. The data was analyzed using the IBM Statistical Package for the Social Sciences (SPSS, Chicago, IL), Version 20, and Structural Equation Modeling (SEM) analysis was performed using AMOS, Version 19.

4. Results

4.1. Demographic characteristics of the sample

A total of 656 questionnaires (75.0%) were returned. The data were inspected to correct outliers caused by data entry errors. Mean substitution of missing data was performed by creating composite scores [59] based on the average of 75% of the remaining items for each construct. It nevertheless proved impossible to replace some of the values missing from forty questionnaires, so they were removed from the sample. SEM analyses are sensitive to missing data when estimating parameters using the maximum likelihood estimation method [60]. Ultimately, 616 questionnaires were eligible for analysis: 60/115 respondents in Setting 1, 94/160 in Setting 2, 250/300 in Setting 3 and 212/300 in Setting 4. The sample comprised 524 women (85.1%) and 92 men (14.1%). The average age of the nurses was 38.4 years (standard deviation (SD) = 11.53) and they had 11.8 years of experience on average (SD = 11.15). With respect to level of nursing education, 67% of the participants had a college degree ($n=412$), 6% ($n=37$)

Table 1 – Research hypotheses, relationships and supporting literature.

Research hypotheses	Relationship	Supporting literature
H1: Actual use of the EPR will have a significant positive effect on the satisfaction of nurses.	AU → Sat	[43,44] Information Systems Success Model [45,46]
H2: Performance expectancy will have a significant positive effect on actual use of the EPR.	PE → AU ^a	[15,17,18,20,24–26,35,47–54]
H3: Performance expectancy will have a significant positive effect on nurses' satisfaction.	PE → Sat ^b	[18,24–31,54]
H4: Effort expectancy will have a significant positive effect on actual use of the EPR.	EE → AU ^a	[15,17,20,24,26,35,48–54]
H5: Effort expectancy will have a significant positive effect on nurses' satisfaction.	EE → Sat ^b	[18,24–27,54]
H6: Social influence will have a significant positive effect on actual use of the EPR.	SI → AU ^a	[19,20,24,50,51,54–56]
H7: Social influence will have a significant positive effect on nurses' satisfaction.	SI → Sat ^b	[18,54]
H8: Facilitating conditions will have a significant positive effect on actual use of the EPR.	FC → AU ^a	[19,20,24,29,31,50,55–57]
H9: Facilitating conditions will have a significant positive effect on nurses' satisfaction.	FC → Sat	^c
H10: Effort expectancy will have a significant positive effect on the performance expectancies of nurses.	EE → PE	[15,20,24–27,48,49,51–53]
H11: Social influence will have a significant positive effect on the effort expectancies of nurses.	SI → EE	[52]
H12: Social influence will have a significant positive effect on the performance expectancies of nurses.	SI → PE	[24,25,52,53]
H13: Facilitating conditions will have a significant positive effect on the effort expectancies of nurses.	FC → EE	[24,25,27,28,35,51]
H14: Facilitating conditions will have a significant positive effect on the performance expectancies of nurses.	FC → PE	[24,28,35,51,56]
H15: The compatibility of the EPR will have a significant positive effect on the performance expectancies of nurses.	Comp → PE	[28,30,33–35]
H16: The compatibility of the EPR will have a significant positive effect on the effort expectancies of nurses.	Comp → EE	[28,34,35]
H17: Computer self-efficacy will have a significant positive effect on the effort expectancies of nurses.	SE → EE	[24,26,28,35,51]
H18: The compatibility of the EPR will have a significant positive effect on actual use of the system.	Comp → AU ^a	[28,33,34,36]
H19: The compatibility of the EPR will have a significant positive effect on nurses' satisfaction.	Comp → Sat	^c
H20: Computer self-efficacy will have a significant positive effect on nurses' satisfaction.	SE → Sat	[39]

^a Since very few studies have measured actual use of an EPR, we have accounted for links measured on behavioral intention to use the system.

^b Since the attitude toward the system construct is an affective response comparable to the user satisfaction construct (predictive vs. explanatory perspective), we considered these relationships as equivalent.

^c Links were modeled taking into account theoretical considerations that suggest replacing the measure of actual use with user satisfaction in settings where system use is mandatory.

had an undergraduate degree, and 25.9% ($n = 159$) had a bachelor's degree in nursing science. Only seven nurses (1.1%) had a degree at the post-graduate level.

The respondents worked in four practice settings at a different EPR adoption stage. For example, the ancillary systems were operational in Setting 1, in Setting 2 clinical data can be accessed and viewed from a data repository, nurses in Setting 3 could document patient data directly on flow sheets in the EPR (allergies, vital signs, skin integrity scale, etc.), and Setting 4 was the only practice setting with a computerized provider order entry (CPOE) for radiology tests. Statistical analyses were performed to determine whether or not the four groups were comparable. No differences were found in terms of male–female ratios and experience levels. However, the results revealed a statistically significant difference in age and level

of nursing education (Setting 3 vs. Setting 4). Non-parametric analyses were performed based on Kruskal–Wallis tests with independent samples and Chi-squared tests, since discrepancies were found when verifying normality assumptions for the analyses of variance. Furthermore, t-tests revealed the presence of differences between the average ages of nurses in the sample and their respective populations (Settings 1 and 4). However, based on the sampling method used and the similarity of the nurses' work environments, we consider that these differences did not affect the SEM analyses.

4.2. Psychometric properties of the measures

To measure construct validity, principal component analysis (PCA) was performed on the items of each construct in the

Table 2 – Reliability, operational definitions and descriptive statistics for each construct.

Variable	Cronbach's α	Operational definition	Mean	SD	Min.	Max
Performance expectation	0.90	Nurses' perception that using the EPR will enhance their productivity, enable them to accomplish tasks more quickly, and improve quality of care.	20.87	4.77	4	28
Effort expectancy	0.92	Nurses' perception that it is easy to learn, become skillful, and use the EPR.	22.00	4.11	5	28
Social influence	0.77	Nurses' perception of the degree to which important other persons in the work environment approve (or do not approve) of acceptance and use of the EPR.	20.99	2.01	9	28
Facilitating conditions	0.76	Nurses' perception of the factors in the hospital that impede or facilitate the acceptance and use of the EPR.	11.13	2.01	3	14
Compatibility of the EPR	0.82	Nurses' assessment of the congruence between the EPR and their preferred work style, existing practices, and values.	32.03	6.42	10	42
Self-efficacy	0.73	Nurses' perception of their degree of comfort using the EPR on their own or with help provided in their workplace.	30.02	6.35	10	40
Actual use of the EPR	0.93	Nurses' evaluation of the use of the EPR to support decision making (problem solving and decision rationalization) and work integration (communication and coordination) and to give information on nursing care to patients.	37.22	12.70	14	70
Nurses' satisfaction	0.91	Nurses' affective response (feelings and emotions) as a result of acceptance and use of the EPR.	20.04	4.10	4	28

theoretical model, since the sample size was highly satisfactory [61]. All the coefficients were found to be above a threshold of 0.3 following inspection of the correlation matrices [62]. To verify whether the data could be used in a factorial analysis, Kaiser–Meyer–Olkin (KMO) tests and Bartlett's sphericity test were performed. The results confirm that the PE, EE, SI, FC, SE and Sat variables are unidimensional. Since compatibility of the EPR and actual use of the EPR are multidimensional constructs, we performed a Varimax rotation. Two components were detected for the actual use of the EPR construct. For the compatibility of the EPR construct, reducing dimensions led to the extraction of one of the three components affecting reliability (compatibility with prior experiences). This reduced the number of items for this construct to six.

The internal consistency of the scales used to measure the constructs of the theoretical model was verified using the Cronbach's alpha (α) method. Following these analyses, removing one item from the facilitating conditions construct led to a slight increase in the scale reliability score ($\alpha=0.74$ increased to $\alpha=0.76$). Concerning the sub-dimension of compatibility of the EPR with prior experience, removing the two items increased the Cronbach's alpha from 0.72 to 0.82. All the reliability scores exceeded the 0.70 acceptability threshold [63,64] and several were over 0.90. The scales' reliability results are reported in Table 2, which also provides operational definitions and results of descriptive statistics for each of the model's constructs. The average values for each construct suggest that nurses had a rather positive perception for most of the model's constructs. However, for the actual use of the EPR construct, the score of 37.2 (out of a maximum of 70) suggests that the EPR is only moderately used to support nursing practice.

4.3. Data-model fit assessment

Two iterations were required following the results of the chi-squared test and the fit and modification indices. Fig. 2 illustrates the most plausible theoretical model. Several types of fit measures (absolute, parsimonious and incremental indices) were considered to assess data-model fit [60,65]. The results suggest an excellent fit between the model and the data from the sample, as shown in Table 3. The final model rejected 5 of the 20 research hypotheses (H4, H7, H8, H11 and H14). Setting aside the Comp \rightarrow UR (H18) and SE \rightarrow Sat (H20) links, which lost their significance during the standardization process, the non-standardized regression weights for all the other links had a significance level below $p < 0.001$ (not shown).

This model has four dependent variables (AU, Sat, PE and EE), two of which (PE and EE) are mediating variables. The compatibility of the EPR (H15), effort expectancy (H10) and social influence (H12) variables explain 50.2% of the variance in the performance expectancy variable. Also, three constructs explain 52.9% of the variance in effort expectancy: compatibility of the EPR (H16), facilitating conditions (H13) and self-efficacy (H17). Only two constructs explain 33.6% of the variance in the actual use of the EPR variable: performance expectancy (H2) and social influence (H6). Concerning nurses' satisfaction, with the exception of social influence (H7) and self-efficacy (H20), all the model's direct links are statistically significant and explain 54.9% of the nurses' affective responses associated with their acceptance and use of the EPR.

Subsequently, Table 4 presents the direct, indirect and total effects (standardized regression weights) between the model's various constructs. The strongest links are PE \rightarrow AU (H2: $r=0.550$, $p=0.006$), FC \rightarrow EE (H13: $r=0.453$, $p=0.009$) and

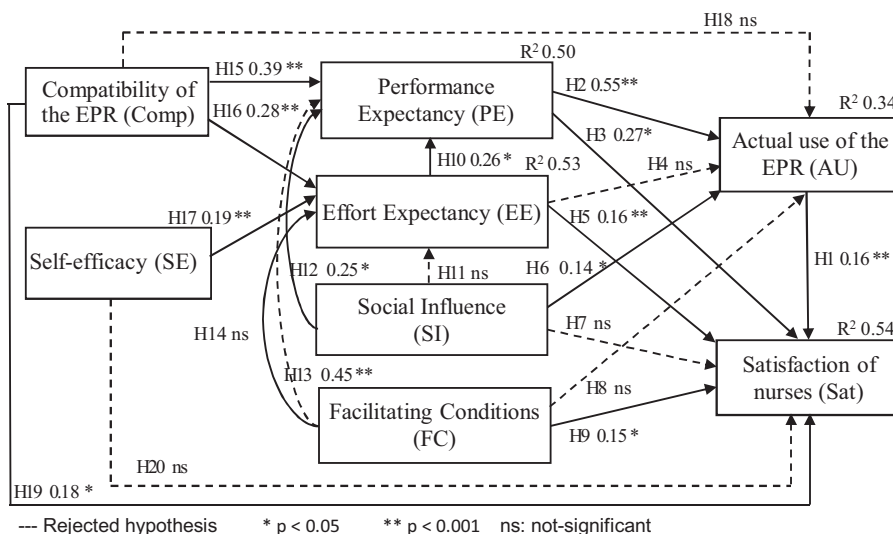


Fig. 2 – Model explaining the actual use of an EPR and nurses’ satisfaction (direct effects).

Table 3 – Model fit indices and target values in structural equation modeling.

	χ^2	d.f.	p	χ^2 /d.f.	GFI	AGFI	NFI	CFI	RMSEA
Recommended value	–	–	>0.05	<3	≥0.90	≥0.90	≥0.90	≥0.90	≤0.06
Model	8.08	7	0.36	1.15	0.997	0.98	0.996	0.999	0.02

χ^2 : Chi-squared test; d.f.: degree of freedom; p: significance level; GFI: goodness of fit index; NFI: normed fit index; AGFI: adjusted goodness of fit index; CFI: comparative fit index; RMSEA: root mean square error of approximation.

Table 4 – Standardized regression weights between the model’s constructs.

		EE R ² = 52.9%	PE R ² = 50.2%	Actual use R ² = 33.6%	Satisfaction R ² = 54.9%
Self-efficacy	Direct	0.185**			ns
	Indirect				0.047**
	Total	0.185**			0.040**
Compatibility of the EPR	Direct	0.283**	0.391**	ns	0.184*
	Indirect		0.072**	0.252**	0.199**
	Total	0.283**	0.463**	-0.161**	0.382**
Facilitating conditions	Direct	0.453**	ns	ns	0.148*
	Indirect				0.114**
	Total	0.453**			0.262*
Social influence	Direct		0.247*	0.135*	ns
	Indirect			0.136**	
	Total		0.247*	0.442*	
Effort expectancy	Direct		0.256*	ns	0.160**
	Indirect				0.092**
	Total		0.256*		0.252**
Performance expectancy	Direct			0.550**	0.272*
	Indirect				0.088**
	Total			0.550**	0.359**
Actual use of the EPR	Direct				0.159**
	Indirect				
	Total				0.159**

* <0.05.

** <0.01.

Comp \rightarrow PE (H15: $r=0.391$, $p=0.002$). Surprisingly, rejection of Hypothesis 4 (EE \rightarrow AU), which targeted a fundamental link found in TAM and UTAUT, was an unexpected result that stands in stark contrast to widely documented empirical data. Furthermore, the results demonstrate the important role played by mediating effects, which are captured by the performance expectancy and effort expectancy constructs. For example, the direct link between compatibility of the EPR and actual use (H18) turned out not to be statistically significant. On the other hand, PE is the strongest determinant of AU, and the construct of the compatibility of the EPR has a very large total effect on PE ($r=0.463$, $p=0.005$). This total effect was due to the direct link (H15) and indirectly due to the role played by the effort expectancy construct (H16: $r=0.283$, $p=0.009$). This suggests that it is not enough for nurses to consider an EPR simply compatible; they must also consider it useful and user-friendly. Another major mediating effect is the total effect of social influence on actual use of the EPR ($r=0.442$, $p=0.036$). The direct link SI \rightarrow AU is weak (H6: $r=0.135$, $p=0.032$), but the indirect link SI \rightarrow PE (H12: $r=0.247$, $p=0.012$) substantially increases the effect observed between the two constructs.

5. Discussion

This study investigated explanatory factors for the acceptance and actual use of an EPR and nurses' satisfaction with the EPR by testing a model based on UTAUT. The sample was comprised exclusively of nurses from comparable clinical environments, i.e. medical and surgical wards in acute care hospitals. The four settings used in this study were at different EPR adoption stages, which provided for more variation in the data. This decision was based on the fact that it can be difficult to capture acceptance and use of an EPR in the early adoption stages. Even when a hospital has reached the fourth adoption stage and has implemented CPOE, a large proportion of the patient record remains paper-based. Most Canadian hospitals are now in the third adoption stage [66], so our sample is a good reflection of the current situation across Canada. Since the transition to an EPR is occurring slowly, we tried to derive a general model that would explain the determinants of the acceptance phenomenon and allow identification of change management drivers. The factors we have studied are important, since integrating an EPR whose design is not an optimal response to nurses' needs can have a negative impact on productivity and generate frustration [67]. In addition, the simultaneous use of paper-based records and an EPR may affect nurses' decision-making process as well as care quality and safety [68].

Out of our 20 research hypotheses, 13 were supported with high levels of statistical significance. This number increased when indirect and total links were included. Several results supported with the evidence, such as the significant links PE \rightarrow AU and EE \rightarrow PE. However, the study also produced divergent results, such as the non-significant link EE \rightarrow AU; this may have been due to a discrepancy between an actual behavior and an intention. In addition, researchers have suggested that when use of a system is mandatory, the EE construct (perceived ease of use) will have an effect equal to or even greater than the PE construct (perceived usefulness) on users'

intention to use a system [69,70]. This study did not find the EE \rightarrow AU link to be strong, and in fact it did not prove to be statistically significant. This result suggests that, first and foremost, nurses value the usefulness of the EPR as support for their clinical practice. The results on mandatory system use may be different for health professionals compared to other categories of IT end-users.

These results do not, however, indicate that the effort expectancy construct does not help explain acceptance and use of an EPR, nor do they suggest that a user friendly EPR design is not essential. Rather these results underscore the importance of the mediation effects at work in this phenomenon of change. For example, in order for the EPR to be used and perceived as satisfactory, it does not appear to be sufficient for the system to be compatible with the preferred work style, existing work practices, and nurses' values; the system must also be perceived as useful and user friendly. The presence of a strong mediation effect by PE and EE had been noted when a multidimensional construct of EPR compatibility was developed [37]. In this sense, compatibility appears to play a key role in increased use of the EPR, as a way of influencing performance and effort expectancies. The self-efficacy construct did not make a major contribution to explaining acceptance of an EPR. The results from our study are similar to results obtained when UTAUT was developed [14], but the direct effect on EE is very weak.

Furthermore, a multidimensional instrument [21] was used to measure the nurses' behavioral response. The results demonstrate the importance of implementing an EPR that nurses consider useful to improving their performance, as well as the role played by the influence of significant people in the work environment with respect to EPR use. However, it came as somewhat of a surprise that only two factors, PE and SI, have a direct influence on EPR use. However, these results shed new light on the important role played by the PE construct's mediation effects. Furthermore, when we examined the average score for AU we noticed that the EPR is moderately used to support key aspects of nursing practice: decision making, communication, coordination and care provided to patients. However, these results were due to the EPR being poorly integrated into nursing practices in the early adoption stages. They may also provide additional avenues to explore in terms of the EPR's impacts on nursing practice. Since many different types of IT are being implemented in healthcare, it might also be informative to take into consideration empirical results of studies that have focused on administrative systems and applied SEM methodology to a population of nurses [71]. Concerning nurses' satisfaction, the average score for this construct suggests that they had a rather favorable affective response. The compatibility of the EPR is the factor whose total effect plays a larger role in nurses' satisfaction, slightly more than the total effect of the performance expectancy construct. The number of factors explaining nurses' satisfaction justifies re-introducing an affective measure into UTAUT. However, we cannot support recommendations to replace the actual use of the EPR construct with the users' satisfaction construct in a setting in which users are given no choice over whether or not to use the system [22]. These two dependent variables provide complementary information that helps explain acceptance of an EPR.

5.1. Study limitations

A cross-sectional study cannot be used to establish causality, nor open the black box to know, for example, the exact meaning of the performance expectancies to increase nurses' productivity, or to identify which of the nurses' values are considered compatible with the EPR. Second, implementing an EPR is a complex undertaking of successive stages. This study used a sample of nurses that covers the first four EPR adoption stages. In these adoption stages, integration of the EPR slowly increases but the paper-based patient record still plays a predominant role. In this respect, the instrument used to measure actual use of the EPR [21] was adapted to reflect the current state of progress in implementing the EPR. Items were therefore removed (for example, clinician-patient interactions in the EPR) and the remaining items were focused on functionalities that were currently available. Results may differ in the more advanced stages of EPR implementation. However, the results of this study are still highly useful, since they reflect the situation at many health facilities due to the slow diffusion of EPRs, and they qualify a high-risk situation that may mean the difference between failure and success. Lastly, the data we analyzed may have been affected by the bounded rationality since, in the early stages, nurses have limited experience using the EPR. As EPR adoption evolves to a more advanced stages, clinicians' answers might differ due to their experience with a more mature system. Also, social desirability might be a study limitation, since it is associated with self-reported actual behavior and is not a direct measure, such as system-generated log files of actual use by each EPR user. However, the psychometric properties of the instruments, the sample size and the fact that we examined a sector with a critical mass of nurses allow us to conclude that our results can be generalized to other sectors and other health disciplines. This statement is based on the fact that the supporting literature in this research stream in healthcare has been focused mainly on physicians, but also on many professionals such as nurses, occupational therapists and physiotherapists. Furthermore, given the scale of investment required to implement an EPR in a healthcare institution, it will be mandatory for all professionals to use the system to care for their patients in the more advanced adoption stages.

5.2. Implications of this study

The results show that in order to grow actual use of an EPR to support clinical practice, it is important to focus on the usefulness of the EPR. Most of the studies to date on this subject measured intention to use the system and examined acceptance of IT. With the current EPR deployment, we can now focus on the actual behavior of end-users. The discrepancies observed between the results of our study and the empirical evidence appears to be due to the research perspective chosen and the dependent variables. One implication for future research concerns the importance of testing a complete model that covers cognitive, affective and behavioral responses. For this reason, measuring users' attitudes toward the system and their intention to use it appears to be worthwhile when the purpose of the study is to make predictions. When the study seeks explanations, a measure of actual use of the

system and users' satisfaction would appear more appropriate. Such a measure could also be operationalized downstream, by modeling AU and Sat as independent variables. These considerations are even more justified when the study seeks to elucidate acceptance in a context where system use has been made mandatory. It is therefore important to focus not only on a meaningful use of the EPR but also on a meaningful measure of EPR use for healthcare professionals. In addition, we cannot ignore the emotions and feelings engendered by such a change, and the impact it may have on the work environment. In this respect, our study has revealed the complexity of the acceptance phenomenon, use of an EPR and the factors that contribute to nurses' satisfaction. The model tested in this study may serve as a roadmap and could undoubtedly guide management of this major change in health systems.

6. Conclusion

Drawing inspiration from a well-known research stream, this study was based on a robust theory and research instruments that have once again proved their value. They have allowed us to test a theoretical model comprised of eight constructs and explain the phenomenon of EPR acceptance in four settings, using a relatively large sample of nurses. The results of our study strongly suggest that professionals should be provided with an EPR that they consider useful for improving their performance and the quality of the care they provide as a major determinant of both EPR use and their satisfaction. It is also important to implement an EPR that they will perceive as compatible with their preferred work style, existing practices and values, in order to generate a favorable affective response. Nurses play a major, pivotal role in the care team, ensuring cohesion among the system's various components and the actors involved in patients care. In this respect, a meaningful measure of actual use of an EPR to support their decision making process, collaborative work and support nursing care would appear to be a promising approach if health systems are to reap the benefits of an EPR for patients and their families.

Author contributions

All the authors contributed equally.

Conflicts of interest

None.

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Summary points

What was already known on the topic?

- Technology acceptance models and theories can be applied to health professionals to measure a diverse range of health IT, in varied care contexts.
- Several independent variables have been tested, with most studies measuring intention to use the system as a dependent variable.
- Often the studies left out the affective measure from the models they tested.
- Integration problems related to EPR compatibility have sometimes affected nursing practice.

What did this study add to our knowledge?

- The model we tested underscored the importance of the mediation effects of the performance expectancy and effort expectancy constructs.
- All the model's factors influence nurses' satisfaction as an affective measure of acceptance and use of an EPR, except for the self-efficacy and social influence constructs.
- The links that are often studied in TAM/TAM2 and that were reintroduced into UTAUT were statistically significant, such as social influence and effort expectancy on the performance expectancy construct.
- The most important determinant of their satisfaction was the compatibility of the EPR with the nurses' preferred work style, existing practices and values.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ijmedinf.2014.09.004>.

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