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Socio-Cognitive Assessment of Physicians' Engagement with Electronic Medical Records (EMR): A Pre-EMR Implementation Study in Developing Countries

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ABSTRACT

This study assesses physicians' intention to engage with electronic medical records (EMR) in the context of pre-EMR implementation in developing countries. We developed a model and corresponding hypotheses grounded in the socio-cognitive theory and the decomposed theory of planned behavior. A survey of physicians in the Middle-East was conducted and the results empirically analyzed via PLS. We find that, in developing countries, in pre-EMR implementation stages, the critical predictors of intention to engage with complex technologies such as EMR are physicians' perceptions of computer self-efficacy, technology support, and effort expectations. Performance expectations and social influences did not have a significant impact on intention to use EMR. Theoretical and practical implications of this research are discussed.

Keywords

Computer-self efficacy, physicians, adoption and use, electronic medical records, developing countries.

INTRODUCTION

Computerization in the healthcare industry is a current and timely effort throughout the entire US healthcare system and around the world. Healthcare organizations both in the US and many other countries, have started investing millions of dollars into complex information technologies (IT) in the form of interoperable electronic medical records (EMR). EMR could save substantial amounts to the healthcare industry as a whole. For instance, in the US, EMR could save Medicare alone about \$23 billion per year (Hillestead et al. 2005). Despite the great potential of EMR, physicians have been notorious in resisting any IT-enabled changes (LaPointe and Rivard 2005). Lack of adoption of IT in healthcare is a direct inhibitor for realization of benefits such as reduced costs, higher quality of care and enhanced overall efficiency (Davidson and Heineke, 2007). Information systems (IS) literature is rather silent regarding adoption and use of EMR in healthcare, despite its long tradition investigating the phenomenon of user acceptance of IT. Furthermore, with notable exceptions (e.g. Karahanna et al. 1999), IS literature on acceptance and usage of IT has primarily focused on post-IS implementations. Users' perceptions of new and complex technologies such as EMR in early stages of implementation are largely untouched. In addition, most of the past EMR studies have explored EMR implementation within North American boundaries. Given the rapid globalization coupled with the impetus to leverage EMR in various regions of the world, there is a pressing need to address the issues associated with EMR adoption and corresponding usage across national boundaries. Little is known about IT acceptance in developing countries (Straub et al. 1997; Walsham et al. 2007). In fact, IS researchers have been encouraged to conduct studies in developing regions of the world (Saunders 2007) at various levels of analysis. As such, the main objective of the current study is to investigate the socio-cognitive factors that shape clinicians' EMR use intentions in the context of pre-EMR implementation in a developing region. The following research question is posed: "What are the motivational factors driving EMR use intentions among physicians practicing in developing countries during pre-EMR implementation stages?" In order to investigate this question, we leverage a theoretical framework based on the social cognitive theory (Compeau and Higgins 1995) and the decomposed theory of planned behavior (Taylor and Todd 1995). The results of the study are critical from both theoretical and practical standpoints. From a theoretical viewpoint, the current study extends the current knowledge base with respect to pre-EMR implementations in a developing region. Practically, a better understanding of the critical factors that shape clinicians' use intentions in pre-EMR stages, would

allow healthcare organizations and EMR vendors to formulate effective strategies for EMR implementations. The paper is organized as follows. The next section describes the theoretical framework and proposes seven hypotheses. We then discuss the data analysis method and present the results. The last section provides an in-depth discussion of the results along with the theoretical and practical implications of this study.

THEORY AND HYPOTHESES

In formulating our research model, we employ elements from the social cognitive theory (Compeau and Higgins 1995) and the decomposed theory of planned behavior (DTPB) (Taylor and Todd 1995). DTPB posits that EMR use intentions are jointly determined by three factors: attitudes, social influences and facilitating conditions (or perceptions of support with technology use). Some research challenged the importance of attitudinal constructs in a research model where both effort and performance expectations are present (Venkatesh et al. 2003). As such, we choose not to include attitudes in our theoretical model. Social cognitive theories suggest computer self-efficacy as one important factor in new technology adoption (Compeau and Higgins 1995; Compeau et al. 1999). As EMR constitutes a new and complex technology and the context of our study is the healthcare arena, we believe computer self-efficacy is a construct that is worth exploring. Further, based on Chiasson and Davidson's (2005) recommendations to formulate theoretical models within a context, we define the boundaries of our investigation to developing countries and a pre-EMR environment. Figure 1 presents our research model.

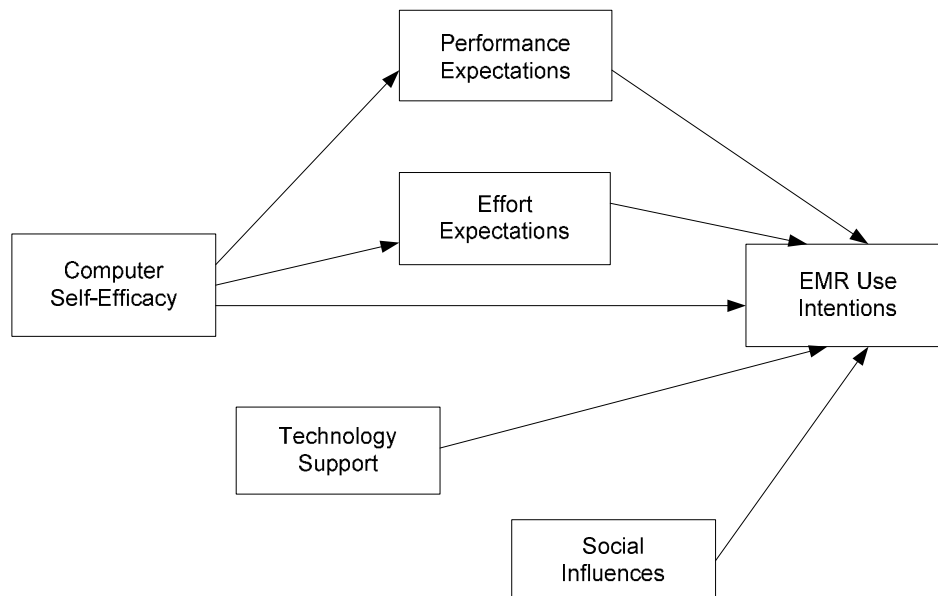


Figure 1. Research Model

Effort and Performance Expectations

Physicians' perceptions of effort expectations are shaped by their beliefs regarding the degree to which a system is perceived as being difficult to use (Moore and Benbasat 1991, p.195). We are focusing on effort expectations (or complexity) rather than ease of use of EMR. This is because EMR are complex systems that require increased time efforts for physicians in order to be used (Hennington and Janz 2007). In fact one study found that using EMR required physicians to spend an average of 37.5% more time than using a paper chart (Makoul et al. 2001). Other studies found that physicians are very sensitive to their time due to multiple demands that are part of the medical profession (Ilie et al. 2007). Therefore, if physicians perceive more effort is involved in using EMR, their usage intentions may be negatively affected. Physicians' perceptions of performance expectations reflect their beliefs about outcomes associated with improvements in job performance from using information systems (Compeau et al. 1999; Venkatesh et al. 2003). Both effort and performance expectations have been found to influence potential adopters' intention to use an information system (Karahanna et al.

1999). These constructs seem to also be important determinants of physicians' adoption decisions in healthcare (Ilie et al. 2009). We propose the following hypotheses within the context of pre-EMR implementation in developing countries:

H1: Physicians' perceptions of effort expectations regarding EMR will be negatively related to their intentions to use EMR.

H2: Physicians' perceptions of performance expectations regarding EMR will be positively related to their intentions to use EMR.

Computer Self-Efficacy

Computer self-efficacy is one important construct in the social cognitive theory that is deemed to impact human intentions and behavior. Computer self-efficacy (CSE) is defined as "an individual's belief about his or her capabilities to use computers" (Compeau et al. 1999, p.147). CSE is not concerned with what an individual has done in the past but rather with judgments of what could be done in the future (Compeau and Higgins 1995, p.192). As our context is pre-EMR, we are concerned with general CSE rather than task-specific CSE. CSE has been found to impact usage behavior (Compeau and Higgins 1995; Bhattacharjee et al. 2008) and also intentions to use a technology (Gong et al. 2004; Lam and Lee 2006). Because the context of our study is pre-EMR, we investigate the role of CSE in impacting EMR use intentions rather than actual usage. CSE has not been widely investigated in a healthcare setting and especially in pre-EMR contexts. Some authors (Dillon et al. 2003) have found CSE to significantly influence usage of computers by nurses. We believe CSE may play a very important role in influencing physicians' use intentions in pre-EMR environments, especially because computers have not been very pervasive in healthcare other than at an administrative level (Wholey 2000). Furthermore, in pre-EMR contexts in developing countries, physicians are assumed to have had limited exposure to computers. In addition, most physician-workflows are primarily focused on providing patient care rather than clerical tasks that involve computers. Several studies have also found indirect effects of CSE on use intentions via effort and performance expectations (Compeau and Higgins 1995; Klein 2007). Consequently, in the context of pre-EMR implementation in developing countries, we hypothesize both direct and indirect relationships on EMR use intentions through impacts on effort and performance expectations.

H3: Physicians' perceptions of computer self-efficacy will be positively related to their intentions to use EMR.

H4: Physicians' perceptions of computer self-efficacy will be positively related with perceptions of performance expectations related to EMR.

H5: Physicians' perceptions of computer self-efficacy will be negatively related with perceptions of effort expectations related to EMR.

Technology Support

DTPB suggests that perceptions of internal and external constraints on behavior impact use intentions of a new technology (Taylor and Todd 1995). As we already discussed the role of an internal factor on intentions (e.g. CSE), we are focusing on technology support as an external facilitating condition. We define technology support in terms of infrastructure support for using EMR and availability of specialized personnel (to sustain questions regarding EMR usage (Bhattacharjee and Hikmet 2008)). We postulate that physicians' perceptions of technology support available for EMR use play a significant role in impacting their intentions to use EMR. While we acknowledge that more technology support per se may not necessarily encourage usage, lack of adequate support may discourage usage (Taylor and Todd 1995). In other words, if physicians believe the technical infrastructure and support are deficient, their use intentions regarding EMR may be impacted. To this extent, technology support may act as an inhibitor to use (Cenfetelli 2004). As the context of our study is pre-EMR in developing countries, we believe technology support is worth investigating. As such, we propose:

H6: Physicians' perceptions regarding technology support with EMR will be positively related to their intentions to use EMR.

Social Influences

Social influences refer to the degree to which a physician perceives that important referents believe he/she should use (or not use) an information system (Taylor and Todd 1995). The role of social influences is mixed in the IS literature depending on context (Venkatesh et al. 2003). As our investigation is in a healthcare setting, we are primarily interested in the role that social influences play in this context. Several researchers have looked at social influences in shaping physicians' intentions to use telemedicine (Chau and Hu 2001; Chau and Hu 2002). Social influences were found to play no role in influencing use intentions in a healthcare setting and a developing region (Chau and Hu 2002). These results suggest that physicians are a professional user group with high autonomy that leads them to place less weight on peers' opinions in making technology acceptance decisions. Furthermore, the context of a developing region and early stages of technology development are other contextual factors that may reduce the significance of this construct (Chau and Hu 2001). Because our context is similar, we do not believe social influences will play a role in impacting physicians' use intentions in our sample. We choose to test this hypothesis however, to better establish the role of social influences in a healthcare pre-EMR context in developing countries. Thus, we propose:

H7: Physicians' perceptions of social influences regarding EMR will not be related to their intentions to use EMR.

METHODOLOGY AND DATA ANALYSIS

In order to test the research model and hypotheses, we used a field survey approach. The surveys were administered to physicians and medical residents participating in a healthcare conference in the Middle East. Our final sample had 106 physicians practicing in various hospitals in the Middle East. We had a variety of specialties represented ranging from general practitioners to pathologists, neurologists and infection control specialists to name a few. The sample included 54% male respondents and 46% female respondents. The mean age was 31 years. Physicians had various levels of experience in the medical field with a mean of 10 years and a maximum of 30 years in the field. 49% of respondents reported they had moderate IT experience, 21% stated they had high levels of experience with IT and 29% stated they had low IT experience.

Scale Validation

All scales measuring the constructs in this study used a 7-point Likert-type scale ranging from "strongly disagree" to "strongly agree." Scale items were drawn from existent IS literature but they were adapted to the context of the current study. The scale for measuring computer self-efficacy was drawn from Compeau et al. (1999), performance expectancy scale was adapted from Compeau et al. (1999) and Venkatesh et al. (2003), effort expectancy was measured using a scale by Moore and Benbasat (1991), social influence scale was adapted from Venkatesh et al. (2003) and the scale for measuring technology support was taken from Taylor and Todd (1995) and Moore and Benbasat (1991). The scale for use intentions was drawn from Venkatesh et al. (2002).

The descriptive statistics are presented in table 1.

Construct	Mean	Std. Dev.
Computer Self Efficacy	4.69	1.19
Performance Expectations	5.24	0.94
Effort Expectations	4.74	1.38
Technology Support	5.77	1.19
Social Influences	4.64	1.48
EMR Use Intention	5.63	1.09

Table 1. Descriptive Statistics

Smart PLS Version 2.0 was used for scale validation. In order to assess convergent and discriminant validities, we used the method recommended by Fornell and Larcker (1981). We conducted a confirmatory factor analysis and examined the factor loadings of our scales. As presented in table 2, most loadings were above the 0.7 criterion (see Table 2).

	CSE	EE	TS	PE	SI	UI
CSE1	0.754					
CSE2	0.923					
CSE3	0.923					
CSE4	0.678					

EE1		0.887				
EE2		0.811				
EE3		0.772				
PE1				0.856		
PE2				0.525		
PE3				0.618		
PE4				0.678		
SI1					0.967	
SI2					0.846	
TS1			0.670			
TS2			0.976			
TS3			0.976			
TS4			0.976			
UI1						0.913
UI2						0.792
<i>Legend:</i> CSE: computer self-efficacy TS: Technology Support PE: Performance Expectations EE: Effort Expectations UI: Use Intentions SI: Social Influences						

Table 2. Factor Loadings

We also examined the reliabilities of our scales. For most constructs, composite reliabilities exceeded the recommended value of 0.8 and Cronbach's coefficient alpha was above 0.7. Reliabilities for technology support items had highest values of 0.949 for composite reliability and 0.921 for Cronbach's alpha. Lower values were observed for performance expectations construct. The average variance extracted (AVE) was high for most constructs, exceeding the threshold of 0.5. Table 3 presents the scale reliability values. Thus, we can safely conclude that our scales exhibit sufficient convergent validity. We note however, that the scale for performance expectations had slightly lower values for the various measures used to assess validity (with a composite reliability of 0.76 and an AVE of 0.46). In order to establish discriminant validity, we compared the square root of AVE for each construct against all bivariate correlations involving that construct (Fornell and Larcker 1981). In our case, the highest bivariate correlation is 0.38 for performance expectations which is lower than the lowest AVE square root of 0.68 (see Table 3). Thus, we conclude that the discriminant validity criterion is met in our study.

	AVE	CR	Alpha	CSE	EE	TS	PE	SI	UI
CSE	0.683	0.894	0.841	0.826					
EE	0.680	0.864	0.769	0.293	0.824				
TS	0.826	0.949	0.921	0.289	0.345	0.909			
PE	0.462	0.769	0.593	0.243	0.289	0.384	0.680		
SI	0.826	0.904	0.811	0.209	0.138	0.295	0.266	0.909	
UI	0.730	0.843	0.643	0.248	-0.067	0.313	0.187	0.102	0.854
<i>Legend:</i> CSE: computer self-efficacy SI: Social Influences TS: Technology Support PE: Performance Expectations EE: Effort Expectations UI: Use Intentions									

Table 3. Scale Properties

Hypotheses Testing and Results

Once we established the validity of our scales, we consider the hypothesized path model. PLS was used to estimate the paths and their significance levels. Overall, our model explains about 20% of the variance in use intentions. Figure 2 presents the PLS results together with the t-values and their significance levels. The bold paths show the paths that have received support according to our hypotheses.

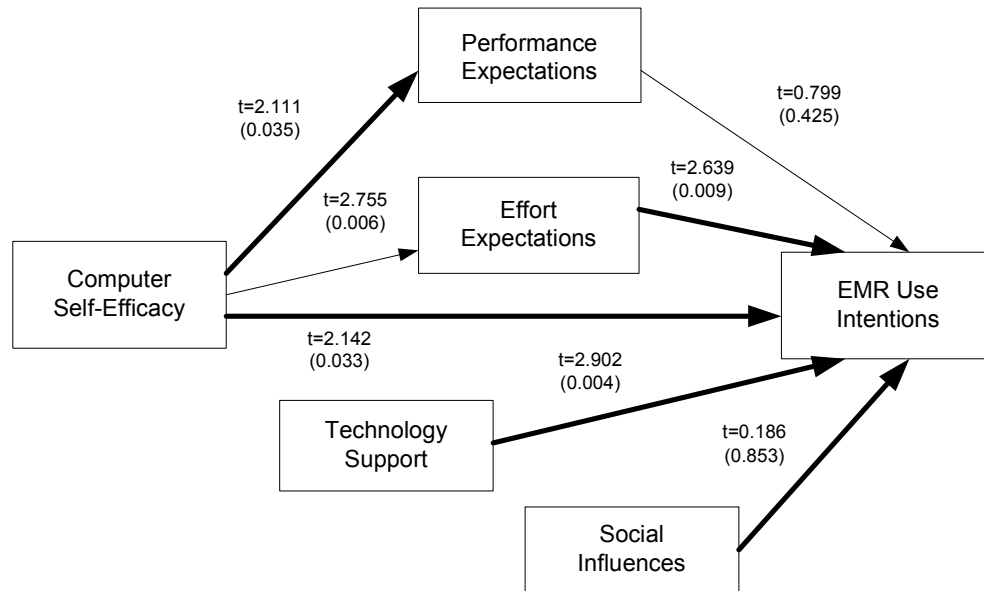


Figure 2. Path Model Results

While examining the individual path coefficients, we learned that two paths in our model were supported at $p < 0.01$ while two other paths were significant at $p < 0.05$. EMR use intention was positively predicted by perceptions of technology support ($\beta=0.31$, $p < 0.01$) and computer self-efficacy ($\beta=0.22$, $p < 0.05$). H3 and H6 were thus supported. As expected, effort expectations had a negative association with EMR use intentions ($\beta = -0.26$, $p < 0.01$), supporting H1.

Performance expectations did not significantly impact use intentions and so H2 is not supported in our model. This may be because as some authors observed, in early stages of IS implementation effort expectations are more salient in impacting intentions, while performance expectations play a more important role in later implementation stages (Venkatesh et al. 2003).

As expected, social influences played no role in influencing physicians' EMR use intentions, thus supporting H7. These findings are consistent with other results found in the IS literature with regards to physicians and their usage of technology (Chau and Hu 2001; Chau and Hu 2002).

In addition to direct effects, we also hypothesized indirect effects of computer self-efficacy on physicians' beliefs regarding effort and performance expectancy. We found that computer self-efficacy had strong effects on perceptions of performance expectations ($\beta=0.24$, $p < 0.05$) regarding EMR, supporting H4. Computer self-efficacy had a strong relationship with effort expectations, however the sign was in the opposite direction ($\beta=0.29$, $p < 0.01$) than hypothesized.

Table 4 summarizes this study's findings.

Hyp.	Path	Std. Beta	t-value	p-value	Supported?
H1	Effort Expectations → EMR Use Intention	-0.262	2.639	0.009	Yes
H2	Performance Expectations → EMR Use Intention	0.097	0.799	0.425	No
H3	Computer Self Efficacy → EMR Use Intention	0.216	2.142	0.033	Yes
H4	Computer Self Efficacy → Performance Expectations	0.243	2.111	0.035	Yes
H5	Computer Self Efficacy → Effort Expectations	0.293	2.755	0.006	No (opposite sign)
H6	Technology Support → EMR Use Intention	0.311	2.902	0.004	Yes
H7	Social Influences → EMR Use Intentions	-0.024	0.186	0.853	Yes

Table 4: Results

DISCUSSION AND IMPLICATIONS

The current study explored socio-cognitive factors to assess future engagement of physicians in developing countries with EMR. Results provide valuable insights into assessing the readiness of clinicians in developing countries for accepting new and complex IT systems such as EMR. This research has both theoretical and practical implications which are discussed below.

Theoretical Implications

This research contributes to increasing our understanding of the applicability of SCT and DTPB constructs to EMR use intentions in developing countries. If the benefits of interoperable medical records are to be achieved on a global scale, we need to account for motivational factors that may lead physicians from other parts of the world to engage with EMR adoption. This is especially important as the world is becoming increasingly global, however little is known about IT in developing countries (Walsham et al. 2007). We believe we contribute to the body of knowledge that investigates individuals' perceptions of IT in developing countries.

This study is among the first to test established constructs from the IS literature in developing countries at an individual level of analysis. We respond to calls for more research into developing regions (Saunders 2007) with a focus on particular technologies (Walsham et al. 2007) such as EMR. Our results suggest that clinicians' perceptions of technological support, effort expectations and computer self-efficacy are the strongest drivers of EMR use intentions during a pre-implementation stage. Among these constructs, it is worth noting that technology support plays a dominant role in driving EMR use intentions. This result may imply that the "digital divide" remains an issue that can deter technology diffusion in certain parts of the world. The Middle-East in particular seems to lag behind in the digital race. The penetration of IT in terms of landlines, mobile phones and Internet access are still only at 10%, 24% and 8% respectively, way behind the developed world (Government Technology Summit for IT strategy for Arab governments, 2006). In fact, lack of technological support may be an inhibitor to technology diffusion in developing countries. Some researchers have suggested that inhibitors are primarily sensed when they acquire a negative connotation (Cenfetelli 2004). If physicians believe technological support is not readily available, their intentions to use emergent technologies such as EMR may be subdued. This idea is also supported by past studies in developing countries. For instance, lack of proper technology infrastructure was deemed to be a crucial factor affecting use of Internet resources by Nigerian scientists (Ehikhamenor 2003).

Further, we find effort expectations and computer self-efficacy to be two other important drivers of EMR use intentions in pre-EMR environments and developing countries. In general, because emphasis is on patient care, physicians are not a user group that directly interacts with computers on a daily basis for their work. In addition, the dataset for this study comes from physicians practicing in developing countries, who may have had even less exposure to computers. These may be some reasons why, physicians' level of comfort with using computers is an important cause of physicians' intention to use EMR. In addition to CSE, the expected level of effort involved in using EMR is an important driver of EMR use intentions. To the extent physicians believe that EMR may involve much effort, their use intentions are lowered. These results suggest

some preliminary parallels between physicians in developing countries and their counterparts in developed countries (such as the US). In fact some studies have shown that physicians (in the US) tend to act based on a principle of "least effort" (Ilie et al. 2009). To the extent more effort is involved in using EMR, physicians will not take the time to use it. It appears that physicians in developing countries are also very sensitive to the amount of effort involved in using EMR. Consistent with SCT, CSE also impacts physicians' perceptions of EMR's performance expectations. These results suggest that to the extent physicians' confidence with using computers is increased, they will perceive EMR as being a more useful tool in their clinical profession. Interestingly, while significant, the relationship between CSE and effort expectations was in the opposite direction. These results suggest that individuals with high CSE will also perceive more effort involved with using EMR. These results may be in part explained by the fact that effort expectations are focused on longer-term goals of using EMR while CSE is more short-term and related to an individual's perceived ability to use computers at present. Furthermore, lack of exposure to EMR technology may be a factor. Despite current high levels of CSE, EMR may still be perceived as requiring a lot of effort to use in the future.

We find no support for performance expectations influencing EMR use intentions in our context of study. These results may be explained in part by the context of study. It is known that in a healthcare arena, most performance enhancements do not accrue directly to the physicians but rather to the hospitals and the payers; in fact, physicians may experience unfavorable workflow issues from using EMR (Hennington and Janz 2007). These may be some potential explanations why performance expectations construct is not significant in our sample. On the other hand, it is also possible that due to the limited exposure to the EMR technology, middle-eastern physicians could not entirely assess the significance of EMR to their clinical work. Furthermore, as some authors noted, in early stages of IS implementation effort expectations are more salient in impacting intentions, while performance expectations play a more important role in sustained use in later implementation stages (Venkatesh et al. 2003).

Consistent with expectations, social influences do not seem to play a role in pre-EMR contexts among physicians. These results validate findings from previous studies in a healthcare setting. This may be due to the fact that physicians are enjoying a certain degree of autonomy which leads them to respect others' opinions but not being influenced by them (Chau and Hu 2002).

Practical Implications and Limitations

From a practical standpoint, we show the importance of computer self-efficacy, effort expectations and technical infrastructure in pre-EMR contexts in developing countries. EMR implementation strategies in developing countries should first address the infrastructure support for EMR. Such support may not necessarily promote EMR use, but lack of technological support may deter use and further the "digital divide" gap. EMR designers should constantly focus on designing EMR interfaces that are simple to use and require less effort to learn. We also suggest that implementation teams working with EMR in developing countries involve physicians in training sessions designed to provide a solid computer education to medical staff before EMR is implemented. Such sessions should boost physicians' confidence regarding EMR which in turn may lead to stronger intentions to use EMR. This is especially important as many physicians (including those in developed countries) are uncomfortable with their keyboarding skills and simple word processing applications (Dansky et al. 1999). Addressing CSE during or after EMR implementation may be too late and lead to physicians' resistance to EMR implementations. As social influences were not found significant in our sample, relying on this tool to promote EMR in a healthcare arena in developing countries may not be a wise consideration.

This study is not without limitations. We used a convenient sample of physicians gathered at a large conference in the Middle-East. As such, this sample may not be representative of the entire Middle-Eastern physician population. We caution generalization of results from this study to other developing countries. It is possible the Middle-Eastern context benefits from unique characteristics that contributed to the results found in this study. Due to space limitations, we were not able to collect data on any cultural variables in our survey. Future studies should validate our model in other developing countries during pre and post-EMR.

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