UNDERSTANDING HEALTH INFORMATION TECHNOLOGY ASSIMILATION AT INDIVIDUAL LEVEL: THE CASE OF ELECTRONIC MEDICATION MANAGEMENT SYSTEM

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Abstract

For technology to contribute to organizational performance, an essential prerequisite is not just adoption but full utilization by its users. Understanding IT assimilation is particularly important in contexts where system use is mandatory. This paper examines factors affecting the assimilation of electronic medication management system (eMMS) at the individual level in a hospital setting where the use of eMMS is mandatory. Drawing on literature in IT assimilation, a research model was proposed with both organizational (direct supervisor, job specification, and performance evaluation) and cognitive factors (intrinsic motivation, absorptive capacity, and perceived usefulness) that are hypothesized to have impacts on width and depth of eMMS assimilation. The model was tested with survey data from 196 eMMS users in a public hospital. The results show that factors have different effects on width and depth of eMMS assimilation for different user groups. Specifically, it was found that nurses with more absorptive capacity are more deeply and widely assimilated. For doctors, their direct supervisors and intrinsic motivation influence their depth of assimilation. Interestingly, nurses with more favorable perception of usefulness have assimilated more deeply, whereas more deeply assimilated doctors are those with less favorable perception of usefulness.

Keywords: health IT, electronic medication management system, individual level assimilation, survey
1 Introduction

There have been increasing and ongoing investments in electronic healthcare systems to provide better health care at a lower cost (Venkatesh et al., 2011b). Nevertheless, many healthcare organizations have been relatively slow to adopt and use electronic healthcare systems (Davidson et al., 2018; Cresswell and Sheikh, 2013; Black et al., 2011; Massaro, 1993; Sicotte et al., 1998; Southon et al., 1999). Even in healthcare organizations with successfully implemented electronic healthcare systems, there is an underutilization of such systems (Venkatesh et al., 2011b). Though there has already been a lot of literature about technology acceptance and adoption in healthcare settings over the past years, the discussed adoption or acceptance of a new technology simply can mean the initial success and does not imply whether that technology has moved beyond the initial trial and becomes embedded into the routines of organizations, that is, the extent to which it is assimilated. As opposed to adoption or acceptance, IT assimilation refers to the acquisition, full utilization, and institutionalization of a technology (Zhu et al., 2006). The concept of IT assimilation is very important as this concept can be a more substantial measurement of IT or IS success in terms of post-implementation evaluation. Examining the level of IT assimilation in particular is more crucial in a mandatory IS context as acceptance or use itself cannot be an indicator of IS success if not voluntarily used. The focus on healthcare IS assimilation is a critical key in healthcare organizations today and recognized as one of the main enablers to facilitate the delivery of superior healthcare outcomes (Wickramasinghe and Schaffer, 2010).

However, many studies (Maruping et al., 2017; Venkatesh et al., 2011a; Bhattacharjee et al., 2008; Bhattacharjee and Premkumar, 2004; Bhattacharjee, 2001) which explain post-adoption phenomena are focusing on IS continuance which is still not meaningful in mandatory settings. Therefore, there is a need for post-implementation study in mandatory settings with IT assimilation context. In addition, most of assimilation literatures are dealing with organizational IT assimilation not an individual level of assimilation (Gao et al., 2016; Gao et al., 2014; Liu et al., 2011). An organizational level IT assimilation means the degree of IT coverage of business processes and the extent of IT usage for decision making in an organization (Liang et al., 2007) whereas an individual IT assimilation means the extent of understanding IT and the ability to use IT for non-routine tasks by an individual user (Liu et al., 2011). The role of individuals was highlighted in IS success (Petter et al. 2008) and in performance of ERP (Kostianurit et al., 2006). Furthermore, Liu et al. (2011) argued that individual assimilation directly influences organizational level assimilation. As IT coverage of business processes does not necessarily mean effective IT use in those processes, a high organizational level assimilation cannot be achieved without a high individual assimilation (Liu et al., 2011).

Furthermore, there have been few studies which tried to examine the level of assimilation specifically in electronic healthcare systems (Venkatesh et al., 2011b; Mishra et al., 2012; Kim et al., 2015; Wang et al., 2016), and mostly assimilation was conceptualized as a simple and superficial usage in terms of frequency, time, and so on. Sulaiman and Wickramasinghe (2014) used the term “assimilation” in healthcare context and explored the issues relating to the assimilation of electronic healthcare systems. Despite the fact that there has been significant improvement in the healthcare sector, inefficiency still exists and little accomplished in understanding how to overcome those inefficiencies. For example, it took more time for doctors to prescribe medications and for nurses to perform medication administration using electronic healthcare systems than paper medication charts (Devine et al., 2010). As significant benefits may be derived only after the organization uses the technology effectively in all of their business operations and decision making processes, studies of individual IT assimilation in healthcare settings are critical. The distinction of different users (doctors and nurses) will help to conceptualize first the individual assimilation and understand the drivers of any differences among the users.

Among many mandatory systems used especially in healthcare organizations, we chose eMMS (Electronic Medication Management System) in an Australian hospital. NSW (New South Wales) Government of Australia has been injecting a huge amount of investment to enhance the quality of patient care and the health outcomes with the eHealth Strategy for NSW Health: 2016-2026. As a part of this...
long term digital health strategy, the roll-out of eMMS in hospitals has been undertaken systematically to support the improved quality, safety, and effectiveness of medication management in NSW hospitals. An injection of $236 million over seven years, including $18.7 million in 2017-18, to the roll out of the eMMS across NSW will reduce medication errors (NSW Health Ministry, 2017). The eMMS will be implemented in 178 NSW hospitals as well as a vast expansion over the scope of 58 hospitals in 2017 thanks to a funding addition as part of the 2017 state budget (eHealth NSW Government, 2017). With eMMS, medication management processes such as prescriptions, pharmacy review, administration, medication reconciliation, and so on are digitized to increase safety, efficiency, and effectiveness (Debono et al., 2017). Moreover, eMMS gives many organizational and individual benefits to hospitals and its users (Kim et al., 2017). To reduce medication errors, the needs for eMMS implementation have especially been growing (Agrawal, 2009). Westbrook et al. (2013) suggested that after implementing eMMS, doctors spent less time alone and more time with other doctors and patients and that prescribing error rates significantly decreased with eMMS by 66.1%. In this context, the main objective of this paper is to explore healthcare eMMS assimilation by different users and to understand the drivers of eMMS individual assimilation. We will see some organizational factors and cognitive factors studied in the literature such as performance evaluation, job specification, direct supervisor, intrinsic motivation, perceived usefulness, and absorptive capacity.

Therefore, our primary research questions are as follows: (1) What are the factors driving individual level assimilation in eMMS? (2) How are the drivers different, if any, among different user groups? From the theoretical perspective, we will apply the concept - individual assimilation - in a healthcare context and verify if the drivers and facilitating factors are playing the same role. We will also see if some specific actions should be developed for the medical and health sector to increase assimilation. The rest of this paper has been organized into the following six sections: theoretical background, research model, study design, analysis and results, discussion, and conclusion.

2 Theoretical Background

The focus of this literature review is to see theoretical development of general technology assimilation and cover other relevant models in the healthcare context. Such a review of general technology assimilation theories along with technology acceptance and use in HIT (Health Information Technology) will help in understanding what the key aspects of IT assimilation are, how it is different from IT adoption, the key benefits of IT assimilation, what the research gaps are in IT assimilation, and so on.

2.1 Acceptance and Use of Health Information Technology

The studies on HIT including EMR (Electronic Medical Record), EHR (Electronic Health Record), CPOE (Computerized Physician Order Entry) and eMMS, have increased enormously throughout the last decade (Sulaiman and Wickramasinghe, 2014; Ford et al., 2010; Heathfield et al., 1998; Ludwick and Doucette, 2009; Venkatraman et al., 2008). Most of these studies have expanded our understanding of different models such as TAM (Technology Acceptance Model; Davis, 1989), UTAUT (Unified Theory of Acceptance and Use of Technology; Venkatesh et al., 2003), TTF (Task Technology Fit; Goodhue and Thompson, 1995) and IS success Model (DeLone and Mclean, 1992) in the healthcare context. As there have been very limited studies specifically focusing on the assimilation of IS/IT in healthcare contexts, it could be better to cover relevant theories applied in healthcare contexts other than IT assimilation.

Two of the most applied models are TAM and UTAUT. They suggest a way of evaluating user adoption through one’s beliefs, attitudes, behavioural intentions, and actual technology adoption behaviour. Many studies showed that TAM and UTAUT are successfully applied in predicting the acceptance behavior in the health care context. Specifically, perceived usefulness and perceived ease of use, two major antecedents in TAM and UTAUT, showed significant effects on technology acceptance and use
in healthcare settings (Lu et al., 2012; Djamasi et al., 2009). There are also some studies which successfully applied all four drivers of UTAUT in healthcare contexts (Kim et al., 2017; Hennington and Janz, 2007; Kim et al., 2015). However, there are some differences in the results of other studies depending on the type of information systems and characteristics of the system users (Kim et al., 2015).

Duyck et al. (2008) investigated radiologists’ acceptance of PACS (Picture Archiving and Communication System) in Belgium and showed that perceived ease of use is not a significant factor affecting user acceptance as well. Maillet et al. (2015) studied 616 nurses’ satisfaction and actual use of EPR (Electronic Patient Record) from four hospitals and found that only performance expectancy influences both satisfaction and actual use and that facilitating conditions and effort expectancy have no significant effect on actual use.

The aforementioned studies focused on whether or not a system is adopted and used. However, the level, quality, or degree of the system use has not been studied much. Wang et al. (2016) proposed a new concept of ‘extended use’ in exploring physicians’ use of EHR and found that two of the social influence measures, rewards and group norm, have significant effects on physicians’ intentions to extend their use of EHR. Another study with the concept of extended use showed that extended EMR use increased perceived performance benefits (Raymond et al., 2015). Few studies similarly used the concept of IT assimilation. Mishra et al. (2012) measured EHR assimilation as a four-item factor consisting of the key functions EHR provides. To apply the IT assimilation concept to the healthcare context with this limited literature, we need to look further at general technology assimilation theories.

2.2 Information Technology Assimilation

The research on IT assimilation came from innovation and technology diffusion (Liu et al., 2011), the process whereby innovation spreads across a population (Fichman and Kemerer, 1999). In early IT assimilation literature, IT assimilation refers to the successful achievement by firms in utilizing the capabilities of IT to enhance their business performance, which means organizational IT assimilation (Armstrong and Sambamurthy, 1999). Massetti and Zmud (1996) provided four facets of organizational IT assimilation: volume, diversity, breadth, and depth. Of the four, Liang et al. (2007) used three, volume, diversity, and depth, which also measure organizational level assimilation. Similarly, Gallivan (2001) delved into the definition of organizational IT assimilation in terms of breadth and depth. Breadth reflects how broadly the technology is used in the organization. Depth reflects how extensively the technology is used by the organization and in the business processes.

The above-mentioned studies conceptualized and examined the level of IT assimilation in terms of the organization. Thus, the unit of analysis is not an individual but an organization. Such studies gathered data from many companies and then measured the firm level IT assimilation of each. As these studies did not look into individual level assimilation within each firm, it is incompatible to apply such frameworks to the individual level IT assimilation study. Zhu et al. (2006) suggested three assimilation stages including initiation, adoption, and routinization. The users who reach the routinization stage have the potential to use the system in a more comprehensive and sophisticated manner. If they go beyond routine and standardized usage, they achieve a higher level of usage that may allow them to exploit the full potential of the system, resulting in more positive organizational consequences (Cooper and Zmud, 1990).

One of the very first studies which presented a theoretical framework of individual level assimilation is by Liu et al. (2011), which focused on identifying the factors to ERP (Enterprise Resource Planning) user assimilation. This study defined individual assimilation as the degree of cognitive understanding of the technology and the extent to which the technology is used beyond routine tasks by an individual user. Moreover, there are two groups of factors, which are identified as organizational factors and cognitive factors. Organizational factors are job specification, direct supervisor, and performance evaluation whereas cognitive factors are intrinsic motivation, perceived usefulness, and absorptive capacity. The study, however, is a qualitative study, which conceptualized individual level assimila-
tion with no sub-dimension and proposed three different levels of assimilation classified as transactional users, power users, and VIP users.

More recently, Gao et al. (2016) developed and validated a scale for measuring individual level assimilation. The study measured individual ERP assimilation with three sub-dimensions of width, depth, and innovation. The definitions of each sub-dimension are different from above concepts of previous studies as this study touches individual level assimilation. Width is the breadth of technology that users know. Depth is the degree to which users understand technology and the extent to which technology is integrated into business knowledge. Innovation is the fact that users utilize ERP systems to accomplish tasks in novel ways. However, the study just presented a validated instrument to measure individual level assimilation but did not test any hypotheses which explain the drivers of IT assimilation.

Drawing on the works by Liu et al. (2011) and Gao et al. (2016), this paper proposes a research model on key factors that influence the assimilation of eMMS at the individual level. Specifically, Liu et al. (2011) identified organizational and cognitive factors that users at different assimilation level, whereas Gao et al. (2016) developed the different dimensions and measures for individual assimilation. This paper examines the effects of the organizational and cognitive factors on the width and depth dimensions of eMMS assimilation at the individual level.

### 3 Research Model

Figure 1 below shows the research model. Gao et al. (2016) suggest that, in the context of ERP, individual assimilation is a multidimensional concept with three sub-dimensions – width, depth, and innovation. However, the highly standardized and compliance-focused nature of eMMS limits innovative or novel ways of using eMMS. Since the appropriate use of eMMS is crucial to patient safety, the compliance of tasks as prescribed is particularly important. Thus, given this context, this study focuses on the individual assimilation of eMMS in terms of width and depth only.

![Research Model](image)

**Figure 1. Research Model**

#### 3.1 Organizational Factors

Based on the qualitative work by Liu et al. (2011), we argue that job specification, direct supervisor, and performance evaluation are the three organizational factors that influence the depth and width of eMMS assimilation at the individual level. Job specification refers to the breadth of knowledge required in the job specification. If a clinician has a broader job specification, that person might have a chance to learn broader functions of eMMS (Liu et al., 2011). Similarly, if a clinician has a broader job specification, that person is likely to become a power user, which means user with more knowledge on eMMS. This assumption was argued by a case study (Liu et al., 2011), which shows that all power users in a case company have broader job specifications. Based on this, we hypothesize the following:
**H1:** Job specification has a positive effect on (a) width and (b) depth of assimilation.

Another factor that can influence width of knowledge about eMMS functionality is the direct supervisor. This construct can be considered a specific form of social influence in UTAUT (Venkatesh et al., 2003) that focuses on the social influence from the immediate superior who directly supervises the medical staff among many other social influences. While social influence from colleagues was found to have an indirect effect on users’ attitude (Kim and Kankanhalli, 2009) in the context of user resistance, social influence from direct supervisor or an immediate superior was specifically identified by Liu et al (2011) that had a direct impact on individual assimilation. Hence, we adapt the definition of social influence to and refer the influence from direct supervisor to as ‘the degree to which a clinician perceives that direct supervisors believe that he or she should use eMMS’. If the direct supervisor encourages broad use of eMMS, clinicians’ width of assimilation can be increased as the direct supervisor influences more formally and normatively. Liu et al. (2011) argued that direct supervisor has significant impacts on individual’s assimilation.

Similar to width of knowledge about eMMS functionality, depth of knowledge about eMMS and process integration can be influenced by direct supervisor. Influence of direct supervisor is different from that of top management or peers (Liu et al., 2011). Most employees’ jobs are normally assigned by direct supervisors. Thus, the direct supervisor has more power and control over an eMMS user’s behaviour. In this context, we hypothesize the following:

**H2:** Direct supervisor has a positive effect on (a) width and (b) depth of assimilation.

Organizations should have proper performance evaluation schemes to improve organizational performance (Latham, 1981). In order to measure the influence of performance evaluation on individual level of assimilation, we created this construct, performance evaluation, and define it as the degree to which performance evaluation is related to eMMS use. Liu et al. (2011) proposed that the performance evaluation scheme associated with ERP use has a positive effect on user’s level of assimilation. In a health context, Wang et al. (2016) suggested that rewards have a significant effect on physicians’ extended use of EHR. Based on these, we try to test the following hypothesis:

**H3:** Performance evaluation has a positive effect on (a) width and (b) depth of assimilation.

### 3.2 Cognitive Factors

Similarly, based on the work by Liu et al. (2011), we suggest three cognitive factors that influence the width and depth of eMMS assimilation at the individual level. Intrinsic motivation in this study is referred to as the perception that a clinician likes to learn and use eMMS without any condition other than the process of using eMMS itself (Davis et al., 1992). In other words, intrinsic motivation is self-motivation, which occurs when a clinician is satisfied with the content of the eMMS activity itself (Ko et al., 2005). In a case study of individual level ERP assimilation, people who have high intrinsic motivation showed higher level of assimilation (Liu et al., 2011). In other words, clinicians who like to learn new systems have greater understanding of the depth and width of the system. With this theoretical background, we derive the following hypothesis:

**H4:** Intrinsic motivation has a positive effect on (a) width and (b) depth of assimilation.

Perceived usefulness in this study is defined as the degree to which a clinician perceives that using eMMS would be useful for his or her job performance (Davis, 1989; Davis et al., 1989). Many HIT studies showed that perceived usefulness, or performance expectancy, has a positive effect on actual use (Lu et al., 2012; Djamasbi et al., 2009; Hennington and Janz, 2007; Kim et al., 2015). Furthermore, there was a study which suggested that higher perceived usefulness results in higher level of individual assimilation (Liu et al., 2011). Based on these, we propose the following hypothesis:

**H5:** Perceived usefulness has a positive effect on (a) width and (b) depth of assimilation.
Absorptive capacity is considered as a series of general abilities with which one can understand, utilize and apply new information, technology, and knowledge (Ko et al., 2005; Mowery and Oxley, 1995). If a clinician has a higher absorptive capacity, the person would more easily grasp and assimilate eMMS (Fichman and Kemerer, 1997). Moreover, Cohen & Levinthal (2000) imply that absorptive capacity has an impact on innovation adoption and diffusion. In line with the logic above, we suggest the following hypothesis:

\[ H6: \text{Absorptive capacity has a positive effect on (a) width and (b) depth of assimilation.} \]

4 Study Design

Drawing on the qualitative work by Liu et al. (2011) as the theoretical foundation, this paper proposes a research model for eMMS assimilation at the individual level. Complementing the qualitative approach adopted by Liu et al (2011), which has typically been used in IS for exploratory research (Punch 2013; Walsham 2006; Venkatesh et al. 2013), this study adopts a quantitative approach where empirical data is collected and analysed to contrast the data against the theoretical propositions (Recker, 2013).

4.1 Data Collection

The research model was tested against survey data collected from a public tertiary teaching hospital in Sydney, with about 1,200 employees. The case hospital was a leading site for electronic medication record (EMR) implementation in New South Wales and has been an early adopter for digital transformation within Australia. Unlike most Australian hospitals that have implemented eMMS prior to a hospital-wide EMR, which in turn brought about delayed adoption (Gunja et al., 2018), the case hospital is the first site in Australia to have full EMR utilisation for 2 years prior to eMMS implementation. The experience of implementing EMR prior to eMMS had raised awareness and readiness of electronic health care.

The eMMS being implemented in the case hospital consists of different modules for reconciliation, prescription, review, and administration of medication. The different modules in the system are primarily used by different user groups, including doctors, pharmacists, and nurses. For example, the prescription module is primarily used by doctors, whereas the review module is primarily used by pharmacists, and the administration module is primarily used by nurses. Some modules, such as the medication reconciliation module, are used by multiple user groups.

Given the purpose of understanding the assimilation of eMMS at the individual level, a survey study was conducted one year after the initial implementation of eMMS in February 2018. The survey data was collected between early March and mid-May 2018. An online questionnaire was first distributed to all the users of eMMS, namely doctors, pharmacists, and nurses. The online questionnaire was followed by a paper questionnaire distributed to the users in different wards who had not responded to the online questionnaire. In total, 196 complete responses, including responses from 95 doctors (25%), 93 nurses (7%), and 8 pharmacists (42%) were collected.

The items used in the survey were adapted from or developed based on existing literature and theories. Items for job specification were self-developed based on Liu et al. (2011). Items for direct supervisor were adapted from social influence in UTAUT (Venkatesh et al, 2003). Items for performance evaluation were self-developed based on Liu et al. (2011). Items for both absorptive capacity and intrinsic motivation were adapted from Ko et al. (2005). Items for perceived usefulness were adapted from TAM (Davis, 1989; Davis et al., 1989). Items for both assimilation depth and assimilation width were adapted from Gao et al. (2016). Table 1 summarizes the items used in the survey. All the items were measured using 7 point Likert scale (from strongly disagree to strongly agree). To ensure the face and content validity of the items, the items were reviewed by the research team that consists of three IS researchers and four clinical researchers including a doctor, a nurse, and two pharmacists. Table 1 summarizes the items used in the survey.
### Table 1. Measurement Items

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Specification (JS)</td>
<td>My job requires knowledge of different tasks in medication management. My job requires a broad understanding of the medication management process.</td>
</tr>
<tr>
<td>Direct Supervisor (DS)</td>
<td>My direct supervisors have supported the use of eMMS. My direct supervisors have been helpful in the use of eMMS. People who supervise me think that I should use eMMS.</td>
</tr>
<tr>
<td>Performance Evaluation (PE)</td>
<td>My understanding of eMMS has an impact on my performance evaluation. The extent to which I use eMMS has an impact on my performance evaluation. My ability to use eMMS in new and innovative ways would be considered in my performance evaluation.</td>
</tr>
<tr>
<td>Absorptive Capacity (AC)</td>
<td>I have information on the state-of-the-art practice in my job. I am good at making the most of new information in my job. I am known as someone who can help others solve work-associated problems.</td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
<td>Using the eMMS system improves my job performance. Using the eMMS system enhances my effectiveness on the job. I find the eMMS system useful in my job.</td>
</tr>
<tr>
<td>Intrinsic Motivation (IM)</td>
<td>I enjoy the learning of software functions of eMMS that are completely new to me. I am personally interested in understanding how tasks are implemented in the eMMS system. Exploring new and innovative ways of using eMMS is fun to me.</td>
</tr>
<tr>
<td>Assimilation Width (AW)</td>
<td>I am familiar with different software functions of eMMS used across the hospital. I know how different software functions of eMMS are related. I know different software functions of eMMS used by others.</td>
</tr>
<tr>
<td>Assimilation Depth (AD)</td>
<td>I have knowledge of how work processes and the eMMS system integrate together. I understand how work processes are implemented in the eMMS system. I have understanding on how work processes are handled in the eMMS system.</td>
</tr>
</tbody>
</table>

### 5 Analysis and Results

#### 5.1 Measurement Model

The measurement model was first assessed by conducting a confirmatory factor analysis (CFA) using Smart PLS 2.0 (Ringle et al, 2005). The results are summarized in Table 2. Validity is the extent to which a set of measurement items precisely represents the construct (Hair et al., 1998). Firstly, convergent validity was assessed by examining the standardized factor loading, composite reliability (CR), and average variance extracted (AVE). The standardized factor loadings were all greater than the commonly employed threshold of 0.7 (Hair et al., 1998). The values of composite reliability (CR) for all latent variables are greater than 0.7 and the values of the average variance extracted (AVE) for all latent variables are also greater than 0.5. Hence, convergent validity of the survey instrument was deemed satisfactory (Fornell and Larcker, 1981; Hair et al., 1998). Secondly, discriminant validity was assessed by examining the square root of AVE for each latent variable and the correlations between the latent variables. The square root of AVE for each latent variable (diagonal element) is greater than the correlations between latent variables (off-diagonal elements). Thus, discriminant validity of the survey instrument was deemed satisfactory (Fornell and Larcker, 1981).
Table 2. Assessment of Measurement Model

<table>
<thead>
<tr>
<th>Construct and Item</th>
<th>Loading</th>
<th>AVE</th>
<th>CR</th>
<th>JS</th>
<th>DS</th>
<th>PE</th>
<th>AC</th>
<th>PU</th>
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<td>0.922</td>
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<tr>
<td>AC</td>
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Note: Diagonal elements represent the squared root of AVE for that construct.

5.2 Structural Model

Given a satisfactory measurement model, the structural model is evaluated using Smart PLS 2.0 (Ringle et al., 2005). Overall, the factors account for 29.9 percent of the variance of assimilation width, and 38.2 percent of the variance of assimilation depth. Among the three organizational factors, direct supervisor has a significant effect on assimilation depth, supporting hypothesis H2b. Among the three cognitive factors, absorptive capacity has a significant effect on both width and depth of assimilation, supporting H6a and H6b.

Prior studies suggest that the implementation of HIT has different impacts on different groups of users, and therefore different user groups are often influenced by different sets of factors (Kim et al., 2015). Consequently, the research model was examined separately for the different user groups. Due to the small number of pharmacists in the entire hospital, the research model was not examined separately for the pharmacists’ group. Figure 2 shows the results for the doctors and Figure 3 shows the results for nurses.
The results suggest different set of factors in place for different user groups. Specifically, direct supervisor and intrinsic motivation have a positive effect on assimilation width for the doctors but not nurses. Conversely, absorptive capacity has a positive effect on both width and depth of assimilation for nurses but not the doctors. Interestingly, perceived usefulness has a negative effect on assimilation depth for doctors but the effect is positive for the nurses. Table 3 summarises the hypothesis testing results for different user groups.

<table>
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<th>Factor</th>
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<th>Nurses</th>
<th>Overall</th>
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<td>Not supported</td>
<td>Not supported</td>
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<tr>
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<td>Positive on depth (H2b)</td>
<td>Not supported</td>
<td>Positive on depth (H2b)</td>
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<tr>
<td>Performance Evaluation</td>
<td>Not supported</td>
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<td>Intrinsic Motivation</td>
<td>Positive on depth (H4b)</td>
<td>Not supported</td>
<td>Not supported</td>
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<td>Perceived Usefulness</td>
<td>Negative on depth (H5b)</td>
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<td>Not supported</td>
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<tr>
<td>Absorptive Capacity</td>
<td>Not supported</td>
<td>Positive on width (H6a) and depth (H6b)</td>
<td>Positive on width (H6a) and depth (H6b)</td>
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*Table 3. Summary of Hypothesis Testing*
6 Discussion

Interpretation of the results is based on literature review, own experience, and discussions of a research team which includes a medical doctor, a registered nurse, and academics from multidisciplinary fields. The nature of IT assimilation is basically different from the traditional use concept that has been discussed so far in many technology acceptance literatures (Po-An and Wang, 2007). The use or usage concept simply represents repeated and regular use or usage, which is mandatory in this study, whereas assimilation means more voluntarily extended use or usage with wider and deeper knowledge about the system.

6.1 Cognitive Factors

The overall results suggest that three cognitive factors play different roles in driving the width and depth of eMMS assimilation for different user groups. First of all, nurses with greater absorptive capacity are associated with greater width and depth of assimilation. In other words, nurses with higher general abilities to understand, utilize, and apply information, technology, and knowledge in their job are better assimilated in terms of how eMMS is used across the hospital and how eMMS supports the medication management processes. However, the positive relationship between absorptive capacity and assimilation does not apply to the doctor group. Instead, doctors with higher intrinsic motivation are associated with greater depth of assimilation. In other words, doctors who are better assimilated in terms of how eMMS supports the medication management process are primarily driven by their self-motivation in applying the technology to support the medication management processes.

Intrinsic motivation and absorptive capacity complement each other. For example, even if clinicians have a high self-motivation and interest to learn deeper and wider, it is hard to be highly assimilated without high absorptive capacity. In contrast, people with high absorptive capacity won’t be highly assimilated if they have no motivation to use all a system can offer. As doctors generally have higher intellectual capacity, general ability, and learning capacity than ordinary subjects, absorptive capacity is not a determinant of assimilation for doctors (Hu et al., 1999; Yi et al., 2006). On the other hand, intrinsic motivation makes a difference in assimilation with given similar high absorptive capacity of doctors.

Given the nature of the prescription tasks in terms of low dependency and high autonomy, a broad understanding on how eMMS is subsequently used by pharmacists and nurses in their tasks is generally not necessary for doctors. A deep understanding on how eMMS supports the prescription tasks is encouraged in the hospital, and is primarily driven by self-motivation of individual doctors. However, given the administration tasks in terms of high dependency and high compliance, nurses are required to have not only a deep understanding on how administration tasks themselves are performed in eMMS, but also a broad understanding about the precedent tasks performed in eMMS by doctors and pharmacists. Hence, eMMS assimilation in both width and depth is necessary for nurses to perform the administration tasks, and is primarily determined by the absorptive capacity, rather than intrinsic motivation.

Another interesting result is that perceived usefulness has opposite effects on assimilation depth for doctors and nurses. The effect is positive for nurses, suggesting that nurses better assimilated with the eMMS are driven by a more positive perception on the usefulness of the system. However, the effect is negative for doctors, suggesting that doctors better assimilated with the eMMS are driven by less positive perceptions on the usefulness of the system. One plausible reason for the opposite effects is the degree of structure in the tasks performed by nurses and doctors, and the current state of eMMS technology in supporting the tasks. In general, the administration tasks performed by nurses (e.g., documenting the medication has been administered at the prescribed time, in the prescribed dosage, etc.) are more structured, and are well supported by eMMS. Hence, nurses who perceive the eMMS as useful in their job are those who have better understanding on how the system supports the underlying medication management process. However, the prescription tasks performed by doctors (e.g., deciding
on which medication to prescribe, in what dosage, and in what form, etc.) are generally less structured, involving many alternative ways of performing the tasks by different doctors. As with many enterprise systems, the eMMS often imposes constraints on the ways the prescription tasks should be performed by doctors. With these points in mind, we can interpret the results in the reverse way that doctors who have better understanding on how the prescription tasks are performed in the hospital may see the limitations on the eMMS in supporting the tasks, hence associated with less positive perception on the usefulness of the eMMS.

6.2 Organizational factors

Direct supervisor is among the organizational factors that plays a significant role on depth of eMMS assimilation for doctors. However, direct supervisors do not have a good reason to help users to extend the knowledge about the system functions widely which are not directly related to their job. The direct supervisor and the user are related with the same job category. This is why direct supervisor does not show a significant effect on width. For doctors, their direct supervisors are influential in encouraging them to have more in-depth knowledge of eMMS within their job. However, the influence of direct supervisors does not necessarily extend to the knowledge about the system functions that are not directly related to their job. Furthermore, the influence of direct supervisor is not significant for the nurse group. One plausible reason is the relationship between doctors (e.g., JMOs) and their direct supervisors (SMOs, registrars, etc.) are more professional than functional in nature. To many junior doctors, their direct supervisors are more like their professional mentors in the same medical specialty field rather than their functional managers, in addition to the case of nurses. Hence, it is not surprising that doctors are more likely to be influenced by their professional mentors than nurses influenced by their functional managers. Moreover, functional managers are normally interested in the use of mandated parts of eMMS. Other usages beyond mandated parts, which means assimilation, are mostly from voluntariness and are not necessarily encouraged by functional managers.

Our results suggest that performance evaluation has no impact on eMMS assimilation. In terms of performance evaluation, although the assimilated use of eMMS will lead to better medication management and improved patient outcomes, it is not a part of the formal performance evaluation in the hospital. Similarly, job specification has no impact on eMMS. Liu et al. (2011) found that, in the context of ERP, users with a broader job specification are generally more assimilated in ERP. However, in the context of eMMS, the jobs of doctors and nurses are well specified and clearly defined. In fact, unlike senior managers in business organizations who may have a broader job responsibilities, senior clinicians (registrars) may have a more specialist job responsibilities. Hence, the positive relationship between job specification and eMMS assimilation does not necessarily apply in the hospital context. Furthermore, there are clear borders which cannot be crossed in the job specification between doctors, nurses, and pharmacists. Thus, width of job specification can only be extended within the same job group. For example, the width of job specification in nursing cannot be extended to a doctor-specific job. With this limitation, extending width of job specification within the same group of job does not make a significant difference on width of knowledge about the system use as most users in the same group are using same functions.

6.3 Implications and Future Research

The findings of this study have significant implications for research. First of all, this study contributes to health IT literature by proposing a theoretical model for understanding eMMS assimilation in the healthcare context. Drawing on concepts and theories in assimilation studies in the enterprise system context, this study examines the organizational and cognitive factors that influence eMMS assimilation at the individual levels. Our results suggest that not all the factors apply in the context of eMMS assimilation, and the effects are different for different clinical users.

Existing studies on IT assimilation (e.g., Liu et al., 2011) were mostly conducted based on qualitative research methods. This study provides a quantitative evaluation on the propositions from qualitative
studies. Furthermore, this study provides the quantitative measures for some of the theoretical constructs, such as job specification, direct supervisor, and performance evaluation. The constructs and measurement items have been validated quantitatively and can be used for future empirical research, especially in the healthcare context.

Practically, this study provides management of the hospital with prescriptive implications and insights specific for a healthcare setting. It helps management develop a strategy to achieve a higher level of assimilation with the drivers empirically verified in this study. As IT assimilation is an indicator of the success especially in the post implementation stage of a mandatory information system, one of the key practical implications is that the hospital’s management should recognize the importance of IT assimilation and keep watching and measuring the level of IT assimilation as an ongoing process that continues after technical implementation (Massey et al. 2001).

As discussed previously, there are differences between doctors and nurses in determining their assimilation. Accordingly, management of the hospital should apply different approaches to each group. For instance, the impact of direct supervisors on doctors should be considered more seriously. Management should deal with direct supervisors as key people to increase doctors’ level of assimilation. As for the nurse group, management should consider absorptive capacity and perceived usefulness. Even if users have a high self-motivation and interest to learn deeper and wider, it is hard to learn by themselves. Moreover, for more than one year since eMMS implementation, there has not been on-going training or education on eMMS especially on deeper and wider use of eMMS. As Liu et al. (2011) argued that user training plays an important role in improving individual absorptive capacity, management should focus on providing proper and consistent training to enhance users’ absorptive capacity, which ultimately leads to higher level of individual assimilation. Moreover, management should try to increase perceived usefulness of nurses to increase their level of assimilation, and conjointly their intrinsic motivation. This can be done by explaining and highlighting the benefits of eMMS from the perspectives of nurses. Overall, the management of the hospital should spend enough time and effort to convince nurses that the system is important, useful, and beneficial to them.

The contributions of this study should be interpreted together with its limitations. First, the findings of this study is based on self-report survey data on users’ perception on IT assimilation rather than actual IT assimilation. Future studies are encouraged to study the actual assimilation of system by the users in their practice, and more thorough reflections about the assimilation by the users. Second, our research model is based on the qualitative work of Liu et al. (2001) conducted in the context of ERP assimilation. While the model does not necessarily cover all the important drivers of assimilation in the context of electronic medication management, it provides a good starting point of understanding the assimilation of eMMS, and further works are required to identify other drivers using different methods such as focus group and interviews with different user groups. Lastly, this study examined individual assimilation by each user group (doctors, nurses) but did not analyse by different level of users (transactional, power & VIP) as identified by Liu et al. (2011). Therefore, another future direction will be refining the distinction of different users and analysing such user groups to conceptualize the individual assimilation with a different angle.

7 Conclusion

This paper attempts to mainly understand individual levels of system assimilation and examine what factors affect users’ assimilation in a specific healthcare setting. The results showed that there are clear differences in drivers of eMMS assimilation between user groups. The most significant factors in the doctor group are direct supervisor and intrinsic motivation whereas absorptive capacity and perceived usefulness are more important in the nurse group. Interestingly, perceived usefulness has opposite effects on assimilation depth for doctors and nurses. With suggested explanations for eMMS assimilation in an Australian hospital, this study contributes to the body of knowledge in individual level IT assimilation. The results and experiences of this study can be helpful to other researchers in this area to build onward to a deeper understanding of IT assimilation at an individual level.
References


