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Explaining Physician Technology Acceptance of Computerized Physician Order Entry (CPOE)

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Abstract

This study explores factors relating to physicians acceptance of technology for computerized physician order entry (CPOE. Given the complexity of the healthcare industry and its unique occupational dynamics, the Davis' Technology Acceptance Model (TAM) alone may not be an appropriate methodology for explaining technology acceptance as it applies to medical practitioners. Along with perceived ease of use and perceived usefulness, the constructs of the TAM, we posit that behavioral constructs also influence physicians' acceptance of technology. These include the physician work values of achievement, autonomy/independence, relationships and recognition, and physician subjective norms and perceived behavioral control. In this paper, we report findings which provide preliminary empirical support for the theory that work values, norms, and control also influence technology acceptance.

Keywords: work values, theory of planned behavior, technology acceptance model, computerized physician order entry, perceived usefulness, perceived ease-of-use, physician technology acceptance

Introduction

At the 2004 SAIS conference, we presented a paper entitled Computerized Physician Order Entry (CPOE): A Study of Physician Technology Acceptance which marked the beginning of a study seeking "to lay a framework for a new model of technology acceptance; one that incorporates the unique features of physicians and physician extenders, and the complex environment in which they work" (Rosenthal, Seeman & Gibson, 2004). The objective of this current paper is to provide an update on the study, report preliminary findings, and present the research agenda for extending the initial study.

Computerized Physician Order Entry. Computerized Physician Order Entry is an automated clinical decision support intervention which enables healthcare organizations to improve workflow processes and resource deployment. CPOE employs "evidence-based medicine" (Hieb & Handler, 2001) by developing and using predefined order sets to standardize protocols. A CPOE system represents a shift from paper-based care coordination activities toward automated order entry

processes. This shift can be an agent for change, eliminating confusing or illegible hand-written order documentation, minimizing transcription errors and fundamentally reducing clinical mistakes. The embedded rules and artificial intelligence technology that incorporate knowledge tools and clinical decision support capabilities makes physician workflow more efficient, ultimately enabling physicians to spend more quality time with their patients.

While the medical, fiscal, and overall strategic advantages associated with the use of CPOE have been recognized by healthcare organizations only one third of all U.S. hospitals had installed automated order entry systems by 2000 – with only 1 percent of those organizations mandating its use by physicians (Ferren, 2002). Explanations for the slow deployment of CPOE include expenses related to upgrading existing order entry systems for enhanced medication order processing, funding for additional workstations and resources, specialized system training, and the challenges associated with achieving and maintaining physician buy-in and acceptance. We have based our study on the last of these factors – physician acceptance of the Computerized Physician Order Entry technology.

Research Objective

Our original supposition was that that physicians accept technology based not solely upon the variables of perceived usefulness (PU) and perceived ease-of-use (PEU) – the integral constructs of Davis' technology acceptance model (TAM) (1989). As we progressed with our research, we have explored the relationship between technology acceptance and more behavioral constructs. Specifically we have included the Theory of Planned Behavior (TPB) (Ajzen, 1988) as well as the Taxonomy of Work Values (Dawis & Lofquist, 1984) to explicate physician acceptance of CPOE beyond that which is possible with the Technology Acceptance Model (Davis, 1989) alone. Based upon the data collected from our investigations conducted at the various hospitals and healthcare organizations within the health system under observation, we hope to create a model of technology acceptance that is specific to physicians, and medical practitioners.

Theoretical Background

The Technology Acceptance Model. The Technology Acceptance Model (TAM) (Davis, 1989) remains an important and viable tool for researchers as evidenced by the continued research that has offered valuable insights into how and why individuals choose to accept or reject technology. However, many of the studies utilizing the TAM or some variant thereof have focused on the technology acceptance dynamics associated with general user populations working in varying occupational settings, and utilizing a wide spectrum of information technology solutions (Taylor & Todd, 1995, Gefen & Straub, 1997; Venkatesh & Morris, 2000, Veiga, Floyd, & Dechant, 2001).

Physicians and physician extenders (i.e. physician assistants and nurse practitioners) however, are highly educated, highly trained professionals, working in stressful and highly politicized environments. Given the complexity of the healthcare industry and its unique occupational dynamics, we feel that the TAM in and of itself, may not be an appropriate methodology for explaining technology acceptance as it applies to medical practitioners.

The Theory of Planned Behavior. Advocates of the Theory of Planned Behavior suggest that all behavior is motivated by individual decisions that are based on an individual's intention to perform that behavior. Intention to perform a behavior, in turn, is influenced by the individual's perceived control over the performance of that behavior, his or her attitude toward performing the behavior and his or her perception of social norms (pressure or approval from important referent individuals to perform a behavior).

According to the Theory of Planned Behavior, individuals behave in accordance with their beliefs (Ajzen, 1988). This theory has considerable support for behaviors in medicine, education, business, and the general population. The Theory of Planned Behavior implies that doctors' attitudes, their subjective norms and perceived behavioral control are positively related to their planned and actual behavior concerning the acceptance of new organizational technology operationalized as a Computerized Physician Order Entry (CPOE) system.

The Taxonomy of Work Values. The concept of work values originated from studies on work adjustment begun in 1957 by Rene Dawis and Lloyd Lofquest (McCloy et al., 1999). Their research explored aspects of an individual's work adjustment and developed assessment tools to measure and predict and individual's adjustment to work. Adjustment was found to be related to 21 vocational needs or "reinforcers" which were measured by having individuals complete the Minnesota Importance Questionnaire (MIQ) (Rounds et al., 1981). The reinforcers were then factored into six occupational values: Achievement, Working Conditions, Recognition, Relationships, Support and Autonomy/Independence. Occupations are now described by the Occupational Information Network (O*NET) based upon their relative standing on variables within this domain as a means of creating a taxonomy of work (Peterson et al., 1999).

Research supports the contention that the fit between individuals' values and occupational characteristics has important consequences for both individuals and organizations –including improved performance and job satisfactions (McCloy et al, 1999). The Taxonomy of Work Values suggests that the acceptance of CPOE will be furthered when CPOE reinforces those occupational values which are most important to physicians (Dawis, 1991). According to the O*NET, the occupational values most strongly associated with physicians include: achievement, autonomy/independence, relationships, and recognition. It is these four occupational values that we explore in our study.

Furthermore, in light of the unique nature of the work performed by physicians, the values espoused within a physician's code of medical ethics are also expected to be potential motivators for technology acceptance. Although there does not exist one unique set of practices or principals guiding the ethical conduct of physicians, the values expressed in the Hippocratic Oath are most widely accepted

Methodology

Data collection is ongoing in a 755-bed tertiary-care, level-1 trauma center, in an orthopedic inpatient unit, and will continue over to move across the hospital until all medical units have integrated CPOE into their outcomes management processes. From there, CPOE will be diffused out to the healthcare enterprise over the next 3 – 5 years in conjunction with the initial implementation plan. Data collection is being accomplished utilizing the following combination of proven qualitative techniques widely used in healthcare research: semi-structured interviews, direct observations, field notes, and documentation/record analysis. Participants are being chosen for this study based upon availability and clinical specialization. Technology acceptance will be observed longitudinally, across the continuum of care, and will ultimately encompass practitioners with varying specializations assigned to all hospitals

Results and Discussion

At this juncture, data has been collected from the health system medical leadership, as well as the attending physicians and physician extenders assigned to the primary hospital's inpatient orthopedic unit and level-1 trauma center. The orthopedic unit was chosen to be the first pilot area to implement CPOE in part because of that unit's less complex treatment protocols, and also because one of the attending physicians had been identified as a technology advocate and project champion. Rollout of CPOE then moved to the level-1 trauma center as a way to test the system efficacy in a highly stressful treatment environment indicative of progressively more complex treatment protocols.

Qualitative analyses of the interviews conducted thus far support our research assertions. The constructs associated with the Theory of Planned Behavior impacted the physicians' acceptance (or lack thereof) of CPOE within the current environment. Also, the occupational values of interest were found to be appropriate to physicians and perceived as being related to the hospital's implementation of the Computerized Physician Order Entry system.

To assess the impact of the Theory of Planned Behavior on physician technology acceptance, doctors and their extenders were asked several questions gauging the constructs of perceived behavioral control, attitudes toward technology, and perceived social pressure regarding technology usage. When asked "To what degree do you feel individual physicians will influence the decisions regarding CPOE?" there was a good deal of variability in responses. Specifically, some physicians expressed the opinion that they have little or no input in these decisions, whereas other physicians expressed the belief that individual physicians do or can have a great deal of impact in CPOE implementation. Of interest was the fact that those physicians who had played significant roles (i.e. physician liaisons, champions, etc.) in the CPOE implementation process had markedly more positive attitudes toward the new technology and expressed a greater willingness to use the new technology. This supports the contention that perceived sense of control plays a role in doctors' behavioral intentions.

In order to examine attitudes toward technology, physicians and extenders were asked questions regarding their general use of computers and their expectations toward CPOE. When asked to describe personal computer usage (both at home and on the job), only one physician indicated a lack of comfort using the internet, email, and basic word processing programs. However, some responses indicated a considerable sophistication above and beyond this – things such as complicated database management, website development/maintenance, extensive use of PDAs, and some computer programming. Not surprisingly, the more sophisticated technology users tended to be those directly involved in the development and roll-out of CPOE at the hospital.

Physicians' attitudes toward CPOE specifically were evaluated via two questions – one to assess the degree to which they found the technology "appropriate for physicians," and one to measure their expectations for "success" of the technology initiative. With regard to whether or not CPOE is an appropriate tool for physicians, there appeared to be consensus that it is, but with a large caveat. Almost all physicians expressed the opinion that while CPOE is "appropriate" for their use, it was considered equally appropriate to have their extenders (physician assistants and nurses) utilize the technology on their behalf.

This appears to reflect ambivalence toward actually using this technology in a hands-on way and a preference for the "old way of doing things." All of the physicians associated with the roll-out of this technology expected it to be successfully implemented at their hospital, and this appears to be a direct reflection of their interaction with the hospital's leadership and IS departments during this process. Among those physicians who have only been end-users, there was consensus that something akin to CPOE will eventually be implemented, but they did not appear certain that the current CPOE system would succeed. Overall, these individuals expressed less enthusiasm and support for the system as a whole.

Hospital medical leadership fully supports CPOE, and as such pressure to use the technology is coming from above. All physicians indicated that they believed that the hospital leadership and culture "embraces technology," however some physicians indicated that leadership should pursue technological innovation more aggressively. It should be noted that leadership's support of technology did not appear to affect individual acceptance of CPOE. What mattered was knowledge of peer institutions' CPOE projects and, once again, participation in the roll-out of the project. Those physicians indicating that they had "read about successful CPOE implementations at other hospitals in the U.S." appeared more positive toward the CPOE project at their own hospital. Perhaps this is because they see the technology as being embraced by other physicians – peers whose opinions they value. For those actively engaged in the CPOE implementation, it is suspected that being surrounded by peers who obviously value and embrace the new system creates expectations for, or social pressure to accept CPOE.

With regard to whether or not appropriate work values had been selected for study, all physicians have indicated that a sense of achievement or success and autonomy, were important motivators for them on a daily basis. Relationships with patients were important to most; however, some doctors indicated that having a relationship was less important than successful treatment of the patient. Fewer physicians indicated that recognition from leadership was important. An interesting distinction arises when physician medical administrators were asked how important these factors were in motivating physicians. Administrators unanimously indicated that recognition from hospital leadership was of little or no importance to practicing physicians.

The second, and more central issue, was the degree to which CPOE was seen as impacting the values that physicians hold in high regard. If, as anticipated, CPOE was seen as furthering them, then the motivation to embrace CPOE should be increased; however, if CPOE was seen as undermining or negating these values, then the physicians should be much less likely to accept this new technology. All respondents except one felt that those values embodied by a physician's code of medical ethics could be advanced with a suitable CPOE initiative. However, a strong emphasis was consistently placed on the caveat that the technology must be structured and implemented in such a manner as to support the physicians' normal functioning, rather than creating additional work. One manifestation of this caveat was the desire to allow physician extenders (physician assistants and nurse practitioners) full and easier access to the order entry system, since extenders have historically had full access to written patient orders.

Results also indicated that a strong case for adopting CPOE could be made based on the linkage between CPOE and the value physicians placed on patient relationships and professional achievement/success. Specifically, all medical personnel saw the potential that CPOE presented for providing better care to patients by avoiding pharmaceutical errors, increased time efficiency, and better communication with other hospital personnel. These factors underlie both physician occupational values.

The current study indicated that CPOE was viewed by some physicians as undermining their independence, resulting in the possible rejection of the technology. Physician autonomy is may be undermined by CPOE's mandating usage of pre-defined order sets, enabling other physicians to second-guess patient orders, and setting the stage for scrutiny over medication and other care decisions. Each of these potentialities is seen as detrimental to physician autonomy.

Recognition from medical leadership did not have a clear impact on physician acceptance of CPOE. Two plausible explanations for this are: 1) few respondents saw a direct linkage between using the new CPOE technology and appreciation expressed by hospital leadership, and 2) hospital administration does not believe that their recognition of physicians is important. They do not now, nor do they intend to, offer extrinsic reinforcement for adopting CPOE.

Plans for Future Research

The longitudinal nature of this study provides multiple opportunities for future research. The richness and variety of physician specialties would encourage comparison studies relating to possible work value differences within specialties or medical roles. Preliminary results indicate differences in the acceptance of technology between the orthopedic and the trauma units. Interestingly, the trauma physicians at this hospital are also School of Medicine faculty with research requirements and

orientation. The orthopedic physicians have a more fee-based orientation. It will be interesting to compare acceptance among other specialties as CPOE rolls out to further units.

Similarly, a comparison of physician acceptance verses extender acceptance may provide additional insight into how CPOE is viewed across the continuum of service providers. Regarding Computerized Physician Order Entry, does the use of extenders defeat the purpose of the CPOE System?

Since this study is being conducted at a teaching hospital, there is an opportunity to compare physician acceptance of CPOE with medical resident acceptance. Additionally, further research into work values may prove useful in helping residents choose medical specialties. Might ONet work values prove helpful in matching individuals to these specialties?

More general questions for future research might include the role of organizational culture in the success of technology acceptance. To what degree do expectations of success influence success? Lastly, do work values facilitate or impede acceptance of technology?

Conclusion

Whereas previous studies have examined the role work values play in job performance, as well as the roles that attitudes, norms, and control play in diverse behaviors, the current study provides preliminary empirical support for the theory that they (work values, attitudes, norms, and control) also influence technology acceptance. Although the four occupational values characteristic of physicians do not apply to all professions, all professions can be characterized in terms of their standing within the occupational value taxonomy. As such, the potential for organizations to tap into these values and utilize them to facilitate large-scale technology-based change initiatives exists.

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