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Learning for healthy outcomes: Exploration and exploitation with electronic medical records

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ABSTRACT

Electronic Medical Record (EMR) systems have been a focus of the healthcare sector and have seen significant deployment around the world in recent years. Despite high expectations and widespread use, the outcomes of EMR have been mixed. In this study, we attempt to understand the dynamics of EMR adoption in the hospital environment through the lens of organizational learning. We find that while exploitative organizational learning is generally correlated with outcomes, the explorative use of EMR is only important to clinicians, and not administrators, in hospitals. Furthermore, combined explorative and exploitative learning does not enhance user benefits, signaling that ambidexterity in EMR is not a significant factor in achieving desirable outcomes. The findings indicate that when studying the implementation of a complex information system such as EMR, the multiplicity of the system functions and organizational separation must be taken into account.

1. Introduction

Hospitals and other healthcare organizations in the United States and around the world are making an extraordinary effort to go digital, and the electronic medical record (EMR) system is the hallmark of this great digitization of healthcare. Korea, for example, saw an over 80% adoption rate of computerized provider order entry systems at tertiary hospitals by 2010 [17,119]. The Health Information Technology for Economic and Clinical Health (HITECH) Act, part of the American Recovery and Reinvestment Act (ARRA) of 2009, provides a significant boost to EMR by designating more than $25 billion as an incentive for healthcare organizations to deploy EMR [7]. With its extensive functionality from record keeping to administrative reporting to data analytic tools, EMR has the potential to fundamentally transform how healthcare services are performed, and some expect EMR to bring about savings of up to $370 billion in the U.S. [51]. Based on a Centers for Disease Control and Prevention (CDC) survey, 78% of all office-based physicians have some type of EMR systems in their office [56]; the total market of EMR is expected to grow from $12 billion in 2012 to $17 billion in 2017 [38].

Despite the widespread implementation, the adaption of EMR has not always been smooth, and its benefits have not been universally recognized [26,31,35,55,59,66,115]. Consequently, a stream of research has emerged to examine the implementation and adoption issues with EMR. Some find benefits of EMRs, such as increased delivery of care based on guidelines, enhanced monitoring and surveillance activities, reduced medication errors, and decreased rates of utilization for potentially redundant or inappropriate care [18,43]. However, the extant literature also points to a lack of positive impact in the areas of attitudes concerning the impact of EMR on efficiency and quality of care (because little association has been found between a physician's order entry rate and years in practice) [79], clinical workflow (because EMR systems with poorly designed procedures only partially supported clinical work activities) [13], and a universal, radical transformation in "attitude, culture, and politics" [75]. Additionally, many indicate that physicians seem resistant to the implementation of EMR despite its touted benefits and even government incentives. Thus far, the literature has not specified the key issues that drive the gap between the expectations and the actual outcomes of EMR, and this study is an effort to examine the root cause of the problem.

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To this end, a thorough review of literature on healthcare information technology (HIT) implementation and adoption suggests a need to examine assimilation of EMR systems in clinical routines of interdependent actions involving multiple actors when assessing the role of IT systems in organizations in relation to performance outcomes [42,45,64]. Specifically, through interviews with clinicians, administrators, and project team members, Scott et al. [101] indicate that depending on the clarification of clinical roles and responsibilities, users could view EMRs as a flawed system. Lapointe and Rivard [69] also note the importance of understanding user cognitive absorption and the usefulness of the system in smoothing out routinization and avoiding rejection of EMR by users. Furthermore, Edmondson et al. [27] find that organizational learning has a direct impact on the successful implementation of new routines and technology adoption, and Kane and Alavi [63] also suggest that a different style of organizational learning could occur due to knowledge heterogeneity emanating from different tasks involved in clinical activities. Thus, motivated by and following the lead of the literature, the current study attempts to address the research question of how organizational learning and, more specifically, the differentiated learning mechanisms in an organization affect the user benefits of EMR adoption, which drive the outcomes of EMR. We hope to add to the theory of EMR adoption in a complex organizational environment, such as hospitals, and develop further insights that will help practitioners and IT health professionals make the transition to EMR smooth and successful.

2. Research background and hypotheses

2.1. Electronic medical records: Deployment and outcomes

EMR system is an umbrella term for many automated clinical systems that include many diverse functions in healthcare [111]. According to the Institute of Medicine, an EMR is a system that is capable of handling the following functions electronically: health information and data, results management, order entry and support, decision support, electronic communication and connectivity, patient support, administrative support, reporting, and population health management [10]. A survey of 28 leading EMR vendors confirms that these systems usually include functionality, such as records management, individual case management, administrative and quality reports, patient management and support, and decision support [95]. Successful implementation of EMR can lead to improved information quality and enhanced work effectiveness in healthcare provider organizations.

EMR systems have been widely available for some time, and many countries adopted the technology early with strong mandates by their governments. In South Korea, for example, a concerted effort on technology assessment led by the National Evidence-based Healthcare Collaborating Agency has promoted the adoption of EMR systems in Korea since 2006. The use of EMR to facilitate evidence-based medicine therefore promises to substantially improve health care quality and is also a crucial strategy in achieving a sustainable national health care system. This initiative is part of a paradigm shift from the traditional prevalence of acute care toward a greater focus on preventive health care, particularly in an era of rising chronic disease; this shift was deemed necessary for maintaining both the sustainability of the National Health Insurance (NHI) system and the health of the population [20]. EMR adoption was also supported by the Ministry for Health, Welfare, and Family Affairs (MIHWFA) in its emphasis on the importance of evidence-based health care – the practice of medicine based on the best available scientific evidence – in many parts of the health care system as a means of improving clinical outcomes [103].

In the U.S., however, interest in EMR has until recently remained low. A 2005 RAND study estimates that the adoption of EMR technology can produce savings from improved efficiency and safety upward of $300 billion [51]. With the perception that EMR could reduce healthcare costs while improving healthcare quality, it is argued that governments should implement programs or provide financial incentives to promote the use of EMR [97,107]. Subsequently, monetary incentives were built into the HITECH Act, enacted under Title XIII of the ARRA of 2009, to subsidize and reward those healthcare providers that implement EMR within a certain timeframe and meet certain standards. As a result, interest in EMR surged in the U.S., and the race to adopt it was on: A national study shows that U.S. primary care physicians' adoption of EMR rose 50% – from 46 to 69% – between 2009 and 2012 [4]; in the state of New York, more than 48% of nursing homes had implemented EMR by 2012 [12]. These are dramatic increases in a very short period.

The U.S. HITECH Act mandated a set of "Meaningful Use" measures to certify the eligibility of financial incentives for EMR adoption [11]. These measures are designed to ensure that EMR has indeed improved the information quality and work effectiveness in the adopting healthcare organization. There are three stages of Meaningful Use, gradually moving the focus of EMR from administrative improvement to clinical decision support [49]. Stage 1 targets data capture and sharing with core objectives, such as "maintain active medication list," "report clinical quality measures to federal and state agencies," and "provide patients with an electronic copy of their health information" [115]. Stage 2 focuses on advanced clinical processes, and its core objectives range from "record and chart changes in vital signs" to "perform medication reconciliation" to "identify patients who should receive reminders for preventive/follow-up care" [49]. Stage 3 targets improved outcomes; detailed objectives are not yet available.

Despite the rosy outlook, government support, financial incentives, and clear regulatory guidelines, the results of EMR implementation have been mixed. On the one hand, EMR systems are clearly being used by the healthcare organizations that have deployed them. For example, in a survey of hospitals where the computerized physician order entry (CPOE) system, a module of EMR, was deployed, the majority of physicians – more than 70% – regularly use the system to place orders and look up results [79]. However, the use is uneven at best. Jha et al. [59], for example, find that clinical documentation and test results functionalities of EMR are implemented at a much higher rate than decision support features in U.S. hospitals. Furthermore, the actual outcomes of EMR adoption have been mixed. Xue et al. [117] find that EMR deployment in China is associated with declining patterns of length of stay, infection rate, and mortality but no impact on patient costs. A study of hospital EMR use data from 2006 to 2010 shows that those transitioning to EMR systems capable of meeting "Meaningful Use" objectives have seen improved process quality in general; however, in some cases, hospitals moving to more advanced systems saw a decline in quality [3]. Fukurama et al. [39] find that hospital use of EMR does not reduce lengths of stay and may actually increase costs and nurse staffing levels. A meta-study of research published between 1998 and 2010 concludes that EMR appears to provide process benefits; however, its impact on clinical outcomes is not clear [55]. In the 2011 Physician Workflow study, physicians reported that EMR use enhanced patient care overall; however, the impact was higher in operational functions, such as chart access, than in clinical improvements, such as identifying needed lab tests [66]. Even with strong government-driven adoption of EMR in South Korea, it is found that substantial work remains in clinical decision support system-facilitated evidence-based healthcare to realize the potential benefits [20].