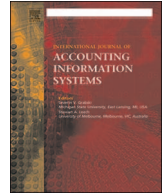


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International Journal of Accounting Information Systems

journal homepage: www.elsevier.com/locate/accinf

Do health information technology investments impact hospital financial performance and productivity?

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ARTICLE INFO

Keywords:

Hospital financial performance
 Hospital productivity
 Meaningful use
 Information technology expense
 Hospital quality
 Hospital business processes

ABSTRACT

In this study, we examine the associations between health information technology expenses, intermediate business processes, hospital financial performance and productivity. Research using hospital financial data prior to the Health Information Technology for Economic and Clinical Health Act is limited. Using Definitive Healthcare data, we find that health information technology expenses, including information technology operating expense and capital expense, are positively associated with hospitals' return on assets and productivity. In addition, investments also generate effects via hospital's intermediate business processes, such as electronic health records (EHR) adoption, and quality measures. Our findings suggest that hospitals' health information technology investments involving intermediate business processes are associated with positive financial performance and productivity following the implementation of the Health Information Technology for Economic and Clinical Health Act.

1. Introduction

The Health Information Technology for Economic and Clinical Health (HITECH) Act, enacted as part of the American Recovery and Reinvestment Act of 2009, promotes the adoption and use of Health Information Technology (HIT) by providing significant financial incentives and penalties to healthcare organizations. With large investments in information technology such as Electronic Health Record (EHR) systems, questions related to financial and productive payoffs become increasingly important. EHRs meet the goals of integrating patient medical history with current treatment thereby facilitating improved quality of care and increased productivity, but are expensive for organizations, potentially impacting financial performance and productivity (Kohli and Tan, 2016; Devaraj and Kohli, 2000; Li and Collier, 2000). Since the enactment of HITECH, the adoption rate of EHR systems has increased significantly.¹ As of 2015, 84% of hospitals report adopting at least a basic EHR system, representing a nine-fold increase since 2008 (Henry et al., 2016).

To encourage EHR adoption, the Centers for Medicare & Medicaid Services (CMS) provides incentive payments to hospitals that successfully demonstrate *Meaningful Use* of EHR technology. The meaningful use initiative supports several health care goals including the improvement of quality, safety, and efficiency; the reduction of health disparities; the engagement of patients and families in care decisions; the improvement of public health; and the ascertainment of privacy and security of patient health information. Ultimately, it is hoped that Meaningful Use compliance will result in better clinical outcomes, improved population health outcomes, increased transparency and efficiency, empowered individuals, and more robust research data on health systems (HealthIT.gov,

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E-mail addresses: tw26@txstate.edu (T. Wang), yangmei.wang@ttu.edu (Y. Wang), am@txstate.edu (A. McLeod).¹ In this paper, we use HIT as the broad concept, and EHR as the application system of HIT.

2015). Introduced in three stages, Meaningful Use Stage² 1 focused on data capture and sharing from 2011 to 2014. Stage 2 focuses on advance clinical processes from 2015 to 2017, and Stage 3 focuses on improved outcomes after 2017 (Holland, 2015). Meaningful Use sets specific objectives that hospitals must achieve to qualify for CMS incentive payments. For example, to meet Meaningful Use Stage 2 requirements for 2015 to 2017, EHR systems should support objectives such as protecting electronic health information and using clinical decision support systems to improve performance (CMS, 2016). In addition to CMS Meaningful use standards, HITECH also requires EHR systems be interconnected to improve the quality of health care. Because of these issues and requirements, Accounting Information Systems researchers continue to call for an expansion of healthcare research to include business process influences (Fichman et al., 2011).

In theory, IT investment can improve healthcare service efficiency and generate positive financial returns (Menon et al., 2000). However, the expected efficiencies and quality improvements remain elusive. Adding to these concerns, previous research used organizational data developed prior to the HITECH Act and its financial incentives. With the rapid adoption of EHRs, an examination of contemporary IT environments is required. Therefore, the purpose of this study is to examine the associations between health information technology expenditures, intermediate business processes, hospital financial performance and productivity. In the next section, we review related literature and propose our hypotheses. Then, we describe our sample selection procedure and empirical methods. Next, we present our results and conduct sensitivity analysis to alleviate endogeneity concerns and follow with a discussion, limitations and concluding comments.

2. Literature review³ and hypothesis development

The benefits of using information technology have been widely studied, however the IT-performance relationship has been far from conclusive (Devaraj and Kohli, 2000). Melville et al. (2004) summarize how information technology can contribute to organization performance, including productivity enhancement, profitability improvement, cost reduction, competitive advantage, inventory reduction, and other measures of performance. Similarly, information technology has been shown to significantly change the way hospitals interact with patients and other healthcare stakeholders (Kohli and Tan, 2016). HIT can contribute to hospital profitability by reducing paper chart pulling and document transportation (Wang and Biedermann, 2010), reducing medical errors, potentially lowering medical liability costs (Mello et al., 2010) as well as decreasing back office expense (McLeod et al., 2008).

Li and Collier (2000) developed a theoretical model to analyze the causal relationship between HIT and financial performance in hospitals. Their model suggests that HIT can improve clinical quality, process quality and intermediate business processes contributing to hospital financial performance. Using survey data gathered from 142 community hospitals, they find that information technology directly affects a hospital's financial performance.

The advent of new information technology typically builds heightened expectations, but often such expectations fall short and the expected benefits of new technology do not come to fruition (Venkatraman, 1994). HIT increases hospital capital and operating expenses (Smith and Coustasse, 2014), however, many studies find no evidence of positive associations between hospital financial performance and HIT investments. For example, Kazley and Ozcan (2007) found operating margin was not associated with EHR adoption. Wang et al. (2005) found IT adoption was not associated with hospitals' return on assets. The results of Ginn et al. (2011) are consistent with Wang et al. (2005) and Kazley and Ozcan (2007) indicating no association between IT investments and hospital margins. These findings align with Kohli and Tan's (2016) call for the development of analytical revenue models.

Some researchers suggest positive financial performance based on estimated savings with assumptions that EHRs would be interconnected, interoperable, adopted widely, and used effectively (e.g., Grieger et al., 2007; Wang et al., 2003.) Health information exchanges, standardization and financial incentives have been proposed to meet these EHR goals (Yasnoff et al., 2004). Other studies provide limited evidence of positive financial measures from HIT investments using empirical methods and include a number of hospital-related variables and financial measures deemed to affect hospital profitability (Devaraj and Kohli, 2000). Menachemi et al. (2006) looked at 82 Florida hospitals' financial statements and an IT survey administered finding a positive association between case mix (i.e., inpatient revenue, net patient revenue, hospital expenses, and total expenses) and intermediate processes involving clinical IT use. Their financial performance indicators were revenue and expense indicators, instead of financial returns, which are better measures of financial performance.

In another revenue model evaluation, Collum et al. (2016) merged data from the 2007–2010 American Hospital Association Annual Survey with its Information Technology Supplement, and the 2007–2011 Medicare Cost Reports from the Centers for Medicare and Medicaid Services. Using operating margin, return on assets, and total margin as financial performance measures, their results indicate no association between operating margin, return on assets and the level of EHR adoption, but total margin significantly improved after two years, in hospitals adopting an EHR system. These findings are consistent with Lee and Kim (2006) who noted a “Lag Effect” of IT investment on performance and this effect has also been noted in healthcare (Devaraj and Kohli, 2000).

Finally, Baker et al. (2017) examined IT investment from the perspective of productivity measures. This work expands the current understanding of how IT investments might improve productivity, reversing the question – Can increased productivity lead to greater IT investments? This study adds to the discussion, considering if the relationship of productivity followed by IT investment is positive or negative, while suggesting a positive impact. Analyzing data from 1236 health organizations, results indicated support for this

² In 2010, the timeframes and objectives for each Meaningful Use Stage were set in the Meaningful Use Final Rule (2011 Edition). In 2015, CMS revised the timeframes and objectives for each Meaningful Use Stage. Here, we use the modified stage timeframe and objectives because they are the most current requirement.

³ We limit our literature review in hospital settings.

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