Journal of Operations Management 33–34 (2015) 123–139

Contents lists available at ScienceDirect

Journal of Operations Management

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

Operational and strategic information processing: Complementing healthcare IT infrastructure

John W. Gardner[a,*], Kenneth K. Boyer[b], John V. Gray[b]

[a] Brigham Young University, Marriott School of Management, 663 TNRB, Provo, UT 84602, United States
[b] The Ohio State University, United States

ARTICLE INFO

Article history:
Received 6 December 2013
Received in revised form 6 November 2014
Accepted 12 November 2014
Available online 3 December 2014

Keywords:
Information processing
Healthcare
Information technology
Quality management
Data analysis

ABSTRACT

Healthcare information technologies (HIT) have been promoted as key enablers of improved patient safety, reduced medical errors, and increased patient satisfaction but have yielded mixed results. Drawing upon information processing theory and quality management concepts, we examine HIT infrastructure simultaneously with two distinct means of processing information: (1) operational use of error data for detecting and reducing hospital errors, and (2) strategic use of objective data for organizational planning. We use time-sequenced data to examine HIT infrastructure (secondary data in 2008), information processing mechanisms (primary survey data from 258 hospitals in 2009), and two measures of hospital performance: (1) care quality, and (2) patient satisfaction (secondary data in 2010). Using hierarchical regression analysis we find that whether and how investments in HIT infrastructure are complemented by information processing mechanisms depends upon the performance measure under consideration and the form of information processing employed. Specifically, operational error processing complements HIT infrastructure in its association with higher care quality but not with patient satisfaction. In comparison, higher levels of strategic information processing complement HIT infrastructure in its association with higher patient satisfaction.

1. Introduction

Information technology had a catalyzing effect on business in the 1990s and is credited with enabling enhanced efficiency, quality, and timeliness in the delivery of a broad range of products and services in many industries. Wal-Mart, Dell, Amazon, and General Electric are canonical examples of companies that successfully benefited from the information technology (IT) revolution. This same catalyzing effect of IT has been largely absent during the same period among hospitals, many of which continue to struggle with the adoption of IT. Proponents of healthcare information technology (HIT) advocate incentives to spur investment under the expectation that its widespread adoption will similarly revolutionize healthcare delivery. Naysayers note the lack of evidence that HIT will result in widespread improvements, and some warn of possible deleterious effects. Even the Institute of Medicine (IOM), which has advocated the use of HIT, notes: "As health IT products have become more intimately involved in the delivery of care, the potential for health IT-induced medical error, harm, or death has increased significantly" (Institute of Medicine, 2011, p. 21). In sum, forecasts regarding the value of HIT range from optimistic and enthusiastic to pessimistic and cautionary. How to gain the benefits from HIT investments is a multi-billion dollar question perplexing many organizations in the global healthcare system.

The research to date has been unable to address the question of whether and under what conditions HIT will spur improvements in key performance dimensions. In a meta-analysis of 257 studies published on HIT in the 1996–2005 timeframe, Chaudhry et al. (2006) conclude that the extant research indicated that HIT was effective in improving both quality and efficiency. However, they observe that the research was typically focused on benchmark hospitals that may not be representative of the broader hospital population (24% of the sample of studies came from the same four hospitals). Chaudhry et al. (2006) conclude that "without better information, stakeholders interested in promoting or considering adoption may not be able to determine what benefits to expect from health information technology use" (p. 749). In a later meta-analysis of 179 papers published from 2004 to 2007, Goldzweig et al. (2009) note an increase in the volume of research on healthcare IT in hospitals. However, they find "almost no information about the contextual factors and process changes that organizational process experts believe are critical to successful broad-scale

* Corresponding author. Tel.: +1 801 422 3113.
E-mail address: johnwgardner@byu.edu (J.W. Gardner).

http://dx.doi.org/10.1016/j.jom.2014.11.003
0272-6963/

implementation of health IT systems" (Goldzweig et al., 2009, p. 283). In a more recent review of 154 studies on HIT, Buntin et al. (2011) summarize generally positive results but also highlight ongoing mixed and negative outcomes. These meta-analyses and a careful review of the literature indicate a wide variety of outcomes following HIT implementation, with little understanding of key moderators of success.

Perhaps because of the lack of clear evidence of benefits and the high cost of implementation, the adoption rates of many HITs are low relative to rates in other industries (Angst et al., 2010; Agarwal et al., 2010). For example, computerized physician order entry (CPOE) had only been fully adopted in 8% of U.S. hospitals as of 2009 (Yu et al., 2009). Motivated by the slow rates of HIT adoption, President Obama signed the American Recovery and Reinvestment Act into law in 2009. The law allocated $27 billion for incentive payments under the Health Information Technology for Economic and Clinical Health Act (HITECH Act) to support the adoption and "meaningful use" of IT in healthcare (Blumenthal and Tavenner, 2010). This massive incentive has since spurred substantial investment, including over $15 billion in government-funded payouts from 2011 through June 2013 (Manos, 2013), despite mixed evidence of benefits.

Research and theory outside of the hospital setting suggest that the hardware and software that comprise IT infrastructure may be complemented by appropriate organizational and operational structures for processing and acting upon useful information. For example, Gattiker and Goodhue (2005) utilize information processing theory (IPT) to document the importance of organizational and contextual factors in enhancing performance improvements following the implementation of ERP hardware and software. Similarly, Premkumar et al. (2003) apply IPT as a lens to examine the application of IT in a supply chain context – specifically the fit between information processing needs and capabilities. In our study, we apply IPT as a framework to examine whether and when different types of information processing capabilities complement investments in HIT in delivering two prominent performance outcomes of hospitals.

The relationship between HIT and specific mechanisms for processing information has been neglected despite the importance of managing information and analysis in organizational design (Galbraith, 1973; Tushman and Nadler, 1978) and in quality management (Evans, 2004; Sila, 2007). While existing research presents some evidence of a positive relationship between the use of information technologies and patient-related outcomes (Yu et al., 2009; Queenan et al., 2011; Aron et al., 2011), these works, along with other previous studies, are limited in their ability to explain how HIT infrastructure interrelates with information processing mechanisms for better patient care and satisfaction. Additionally, much of the existing research on HIT is limited to small samples, case studies, specific technologies (Chaudhry et al., 2006), or focus on select groups of larger organizations (Goldzweig et al., 2009). Further, empirical survey studies that measure information and analysis generally utilize aggregate, multi-dimensional scales (Meyer and Collier, 2001; Goldstein and Naor, 2005; Sila, 2007) and are often prone to concerns with common methods and self-reports of performance.

Given the state of the research, more understanding is needed regarding how organizational approaches to processing information interrelate with HIT to drive performance. We focus on two forms of information processing that have significant implications in healthcare: (1) operational use of error data for detecting and reducing hospital errors, i.e. error processing, and (2) strategic use of objective data for organizational planning, i.e. strategic processing. Error processing focuses on operational issues of care and is critical given ongoing medical errors (Kohn et al., 2000) and potential risks of increased errors due to HIT (Koppel et al., 2005; Campbell et al., 2006; Ash et al., 2007). However, its use has historically been limited in many healthcare settings (Edmondson, 1996). Strategic processing has timely importance given healthcare reform and growing competition among hospitals, manifest in many ways including the comparison of hospitals amongst peers for both government compensation and improvement (Blumenthal and Tavenner, 2010).

In this study, we examine the relationship between adopted HIT infrastructure, information processing methods, and hospital performance. In particular, we examine three research questions:

- How does HIT infrastructure relate to important hospital metrics: care quality and patient satisfaction?
- How do two different information processing methods, i.e. error processing and strategic processing, relate to care quality and patient satisfaction?
- Is the relationship between HIT infrastructure and outcomes complemented (i.e. positively moderated) by these different methods of information processing, and is that relationship consistent across processing methods and performance dimensions?

Using time-sequenced data over a three-year period, we simultaneously examine HIT infrastructure (using secondary data, reported by HIMSS Analytics in 2008), primary survey data on information processing (based on our 2009 survey of hospitals across the U.S.), and two different metrics of hospital performance in 2010: (1) care quality, and (2) patient satisfaction (both secondary data from the U.S. Center for Medicare and Medicaid Services [CMS]).

This research provides multiple contributions to research and practice, heeding calls for studies regarding HIT implementation during a period of unprecedented change for U.S. healthcare (Agarwal et al., 2010). Our study examines the association of HIT infrastructure in conjunction with different forms of information processing with hospital performance. The results provide evidence that the two forms of information processing (error processing and strategic processing) interact differently with HIT when examined with two key outcomes (care quality and patient satisfaction). Specifically, error processing complements HIT in care quality, but not in patient satisfaction. In contrast, strategic processing complements HIT in patient satisfaction, but not in care quality. Since the Affordable Care Act ties a material portion of compensation from Medicare/Medicaid directly to performance dimensions, hospitals may benefit both clinically and financially from our results. The contrasting results point to the need for leaders and researchers to match the appropriate mechanisms of information processing with outcomes to gain complementary benefits of their substantial investments in HIT. Our results and conclusion provide guidance in that regard.

2. Hypothesis development via information processing theory

Information processing has been defined as "the gathering, interpreting, and synthesis of information in the context of organizational decision making" (Tushman and Nadler, 1978, p. 614). Information processing theory (IPT) was developed by Galbraith (1973) who integrated the work of Burns and Stalker (1961), Lawrence and Lorsch (1976), and others. The origins of IPT focused on the ways in which organizations structure information and the means by which this information is applied. Galbraith examined variations in organizational form based on the use of information to reduce task uncertainty. He observed variations in organizational structure that were correlated with the amount of information required to reduce task uncertainty. Such task uncertainty has generally been accepted to mean the absence of information.