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Understanding information exchange in healthcare operations: Evidence from hospitals and patients

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ABSTRACT

Coordination – or the information exchange among physicians and hospital staff – is necessary for desirable patient outcomes in healthcare delivery. However, coordination is difficult because healthcare delivery processes are information intensive, complex and require interactions of hospitals with autonomous physicians working in multiple operational systems (i.e. multiple hospitals). We examine how three important variables distinctive of the healthcare operations context – use of IT for dissemination of test results (ITDR) (i.e. electronic health records systems) by physicians and hospital staff, social interaction ties among them, and physician employment – influence information exchange and patient perceptions of their care. Drawing from the literature on process inter-dependencies and coordination, vertical integration and social exchange, we develop and test research hypotheses linking ITDR, social interaction ties and physician employment to information exchange relationship, and information exchange relationship to provider–patient communication. Using a paired sample of primary survey data and secondary archival data from CMS HCAHPS for 173 hospitals in the USA, we find that increased information exchange relationship drives provider–patient communication, and increased social interaction ties drives information exchange relationship. Social interaction ties fully mediates the relationship between ITDR and information exchange relationship. Physician employment amplifies the link between ITDR and social interaction ties, but does not have an effect on the link between ITDR and information exchange. We do not find a direct relationship between ITDR, and information exchange relationship or provider–patient communication.

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1. Introduction

Healthcare is delivered to hospitalized patients by providers such as physicians, nurses, and other clinicians. Coordination, or the information exchange relationship among providers in healthcare delivery, is necessary to achieve desirable patient outcomes (Boyer and Pronovost, 2010). Drawing on the operations and information systems (IS) literature, information exchange relationship is defined as accurate, timely, adequate, and credible information interchange among those involved in a particular process (Lee, 1997; Metters, 1997; Li et al., 2005). Unfortunately, however, coordination is challenging given inherent difficulties in synchronizing operational activities and information in hospitals (Nembhard et al., 2009). Anecdotal patient accounts tellingly support and capture this challenge.

> "The caregivers didn't appear to be talking to one another." This is how retired internist Marsha Wallace described her recent inpatient hospital stay in Kaiser Health News. "Although hospitals, the federal government, nonprofit groups and insurers want to improve the system, efforts to boost coordination and teamwork still have a long way to go" (Rabin, 2013).

> "Without coordination, a patient can languish for weeks from one step to the next while her tumor grows and the illness progresses. Without integrated care, critical information is easily lost and treatment delayed or misdirected. Or, as happened to D'Agostino [a breast cancer patient], specialists offer complex and sometimes contradictory information to the patient who sorts it out alone" (Toussaint, 2012).

Physicians have substantial influence on hospital operations and the services delivered to patients (Ilie et al., 2009). Therefore it

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is important for hospitals to find ways to improve coordination with physicians to improve patient experiences (Ancarani et al., 2011; Fredendall et al., 2009). The information exchange relationship among the physician and a hospital's healthcare providers is an essential element of coordination and key to delivering experiences which patients find valuable (Queenan et al., 2011). The overarching objective of this research is to understand key factors involved in achieving information exchange in healthcare delivery operations. We address our study objective by conceptualizing a model that takes into account three distinctive characteristics of the context of healthcare delivery processes, each of which can influence information exchange relationships.

The first characteristic is the information intensive and complex nature of healthcare processes (Nembhard et al., 2009). The adoption and use of electronic health records (EHR) represents a key to addressing this by providing a platform for information standardization, storage and access that has the potential to improve coordination among healthcare delivery providers (e.g. AHRQ, 2013; Angst et al., 2011). However, the operational consequences in terms of coordination from health information technologies (IT), and specifically from EHR use by physicians, nurses, and hospital staff have been mixed and inconclusive (McCullough et al., 2010; Queenan et al., 2011). Therefore, our first research question is: *Does coordination in the form of information exchange relationship among physicians and hospital's healthcare providers mediate the link between IT use and patient experiences?* IT use is modeled as an antecedent of information exchange relationships.

Second, physicians have traditionally functioned as "...owner-operator[s] of [their] own ongoing firm" when providing services to patients in a hospital setting (McLean, 1989: p. 67). As a result, physicians tend to have higher professional than organizational loyalty and substantial autonomy (Nembhard et al., 2009; Boyer and Pronovost, 2010). Under these conditions, the social interaction ties that characterize the relationships among the hospital staff/nurses and doctors is an important consideration (Fredendall et al., 2009). 'Social interaction ties' describes the configuration of linkages among people or units (Nahapiet and Ghoshal, 1998) which aids in coordination among individuals and units (He et al., 2009). Therefore, our second research question is: *What is the effect of the social interaction ties among the physician and the hospital staff in mediating IT use and information exchange relationship*? Social interaction ties is modeled as another antecedent of information exchange relationships, partially mediating the effects of IT use.

Third, in response to the autonomy of physicians and complexity of healthcare delivery processes, increasingly hospitals are pursuing vertical integration strategies by employing the physicians who provide services to hospitalized patients with the hope of enhancing operational efforts to achieve coordination (e.g., Williamson, 1985). An 'employed physician' is a doctor who receives financial compensation from a hospital in exchange for treating patients (Schneller, 2001; Fink and Hartzell, 2010; Andrabi, 2012). Our third research question is: *What is the effect of vertical integration (physician employment) on the link between IT use and social interaction ties, and between IT use and information exchange relationship?* We draw from the social interaction ties and vertical integration literature to understand how IT use can improve coordination and ultimately patient outcomes, by modeling physician employment as a moderator of the relationships emanating from IT use to information exchange relationship and social interaction ties.

We address our research questions by developing research hypotheses and testing them using Structural Equation Modeling. Specifically, we analyze a matched dataset consisting of (1) primary survey data collected from hospitals measuring hospital practices and (2) secondary archival data collected from the Centers for Medicare and Medicaid Services (CMS) Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey measuring service experiences as reported by patients. The study makes four theoretical contributions. First, we show that provider–patient communication can be enhanced by improved coordination in the form of information exchange relationships among healthcare providers (i.e., physicians and staff). Second, we reveal a fully mediating role for social interaction ties in the relationship between IT use and coordination. Third, we show that there is no *direct* relationship between IT use and provider–patient communication. Through these two findings, we highlight the difficulties in achieving information exchange based coordination *solely through use of IT*. In doing so, we extend current studies that focus on the role of social interaction ties industrial settings (e.g., Carey et al., 2011; Villena et al., 2011). Fourth, we show that vertical integration (in the form of physician employment) positively moderates the relationship between IT use and social interaction ties. Vertical integration has been considered in the context of inter-organizational IS (Xue et al., 2013). We describe and empirically demonstrate the importance of vertical integration in appropriating benefits from use of *internal* IS. Through these contributions we open the somewhat intractable EHR–patient outcomes black box (Poissant et al., 2005). Our study provides important insights for practitioners who recognize the need for better coordination in healthcare, but lament the challenges of actually realizing it even when EHR are implemented and used (Evans, 2008; Scott et al., 2005; Smelcer et al., 2009). We further provide direction regarding the effects of physician employment in hospitals, an important point of discussion, with far from conclusive points of view (Andrabi, 2012).

2. Healthcare operational context and research model

A number of key aspects characterize work processes in healthcare delivery. First, the exact content of tasks needed to be performed for a given patient evolves during treatment to some extent (Nembhard et al., 2009). The processes of diagnosing and treating patients can follow some standard procedures such as testing, but often involve emergent tasks that require iteration among physicians, nurses and technical specialists (Tucker, 2004). Second, the order or flow of activities is often not in a given sequence, but involves recursive tasks of collecting data about patients, consultations among specialists, and diagnosis of the patient's condition (Malone and Crowston, 1994). Third, multiple and specialized providers are involved in diagnosis and treatment for a given episode of care for a patient (Leape and Berwick, 2005). Further, providers need to exchange information, due to the growth and specialization of clinical knowledge and variety of conditions afflicting patients (Gittell and Weiss, 2004). Fourth, different care delivery processes occur in different locations (e.g. laboratories, hospital beds, imaging rooms), with potential information handoff problems among them (Kenagy et al., 1999; Boyer and Pronovost, 2010). These conditions increase the information intensive and complex nature of healthcare delivery and make coordination in healthcare operations difficult (Chen et al., 2013). As a consequence of inadequate communication or coordination among providers, important medical information may not be available at the time of treatment and is thus impossible to share with patients (e.g., Green, 2012; Buell, 2013).

The implementation and use of health IT is seen as an important means to addresses the requirements of coordination (AHRQ, 2013). Agarwal et al. (2010) provide a comprehensive literature review of health IT (and EHR) use and anticipated improvements. However, research shows mixed findings from the use of EHR systems. For example, studies report positive outcomes such as reduced costs (Li and Benton, 2006) and increased patient satisfaction (Queenan et al., 2011), negative outcomes such as increase in physicians' documentation time and workload, and reduced