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Implementing electronic lab order entry management in hospitals: Incremental strategies lead to better productivity outcomes

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ABSTRACT

This paper evaluates the impact of varying implementation of electronic lab order entry management (eLAB) system strategies on hospitals' productivity in the short run. Using the American Hospital Association's Annual Surveys for 2005–2008, we developed hospital productivity measures to assess facilities' relative performances upon implementing eLAB systems. The results indicate that different eLAB system implementation strategies were systematically related to changes in hospitals' relative productivity levels over the years studied. Hospitals that partially implemented an eLAB system without completing the roll-out experienced negative impacts on productivity. The greatest loss in short-term productivity was experienced by facilities that moved from having no eLAB system to a complete implantation in one year—a strategy called the "Big Bang". The hybrid approach of a limited introduction in one period followed by complete roll-out in the next year was the only eLAB system implementation strategy associated with significant productivity gains. Our findings support a very specific strategy for eLAB system implementation where facilities began with a one-year pilot program immediately followed by an organization-wide implementation effort in the next period.

1. Introduction

Among the factors that contribute to waste and inefficiency in the U.S. healthcare system, the duplication and unnecessary ordering of laboratory and diagnostic tests are among the most costly (Kwok & Jones, 2005; Mekhjian, Saltz, Rogers, & Kamal, 2003). Nearly seven billion lab tests are conducted each year (McCormack, 2011). Of these, 20 percent or more are unnecessary duplications or inappropriate requests (Grunden, 2009; Kwok & Jones, 2005). The Congressional Budget Office (CBO) estimates that five percent of the nation's GDP, about $700 billion dollars per year, goes towards unnecessary tests and procedures (Kendall, 2009). The effort to reduce waste has therefore centered on the implementation of Health Information Technologies (HITs) that can address the information asymmetries and unnecessary redundancies found in orders for laboratory tests, radiology studies, and other tests.

Electronic laboratory order entry and management (eLAB) systems provide important opportunities for technology to play a transformative role in the care provision across four foci of health reform. First, laboratory order entry has a well-defined ontological system (i.e., HL7) that lends itself to computerization and standardization (Gardner, 2003). Second, the large volume of such tests coupled with their high costs makes these procedures a good target for systemic savings through better information management and waste reduction (Hillestad et al., 2005). Third, eLAB technologies are sufficiently mature and cost effective (Chaudhry et al., 2006). Finally, eLAB systems have been found to serve as the foundation upon which EHRs are implemented, often serving as a leading-edge indicator of technological adoption among non-computerized facilities (American Hospital Association Annual Survey, 2009).

With potential savings in the billions of dollars over the next decade, eLAB systems are an integral part of the federal government's 'Meaningful Use' rewards and incentives program (Jain, Seidman, & Blumenthal, 2010). Hospitals, in particular, are targeted for adoption because they make extensive use of the most expensive laboratory and diagnostic procedures. However, as of 2009, eLAB systems were not widely implemented throughout U.S. hospitals (Jha, DesRoches, Kralovec, & Joshi, 2010). Therefore, hospitals must switch from paper-based systems to electronic systems in relatively short time frames in order to meet the government's Meaningful Use targets and avoid such penalties. It is unclear how implementing eLAB systems in short time frames impacts hospitals' productivity levels, but the studies to date have found mixed results at best (Hillman & Given, 2005; Jha et al., 2009).

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The purpose of this study is to analyze how implementing eLAB systems impact facility productivity in U.S. hospitals. First, taxonomy of eLAB systems implementation strategy is developed based on the stages of meaningful use for U.S. hospitals. Specifically, the taxonomy classifies facilities based on the change in percentage of orders processed using eLAB systems across two points in time—2007–2008. Next, using the Malmquist total factor productivity (TFP) Index and it underlying factors (viz., technical efficiency change (EFFCH) and technological change (TC)), facility relative productivity levels are measured and compared. The results and implications are discussed followed by a brief description of the study's limitations and potential future research.

With the federal government promoting the accelerated implementation of health information technologies (HITs) through large-scale investments, hospitals need guidance on the differential productivity outcomes associated with various strategies. With high profile implementation failures, such as the one experienced at Cedar-Sinai (Connolly, 2005), this paper seeks to illuminate how strategy selection impacts organizational productivity. For policymakers as well as healthcare executives, this paper not only demonstrates a positive link between eLAB systems use and productivity that would justify the major capital investments these systems require but provides an evidentiary basis for strategy decisions.

2. Background on eLAB systems

Computerized Provider Order Entry (CPOE) systems were first introduced in 1969 and have been evolving slowly ever since (Goolsby, 2002). There are three major classes of CPOE systems. The most frequently discussed is electronic prescribing (ePrescribing or eRx), often because of the focus on patient safety, and the significant role medication errors play in compromising care quality (Yu et al., 2009). Physicians have been financially incentivized to adopt eRx and its use has grown rapidly.

The second class of CPOE involves the standardization of clinical order set entry and use. Clinical order sets describe the activities of care that a patient is to receive. For example, post-operative order sets may describe the dietary restrictions, physical therapy and wound care that a patient should receive in accordance with evidence-based medicine (Payne, Hoey, Nichol, & Lovis, 2003). The use of these systems has been the slowest to take hold because of the difficulty associated with moving physicians away from their traditional practice and towards standardized regiments of care (Stolle, 2010).

The third class of CPOE, and the subject of this research, is the use of eLAB systems for ordering of diagnostic tests that are conducted in a controlled manner such as imaging (e.g., radiology) and hematology (e.g., blood work). eLAB systems provide a structured and auditable framework in which laboratory data may be captured and communicated. Through the establishment of a single point of contact for laboratory ordering and results, the basic principal of eLAB systems is that redundant tests can be minimized and clinical decision-making is further supported. The use of eLAB systems is a necessary component in achieving the policy aims of automating public health registry reporting and providing patients with test results that can be stored in an electronic personal health record (Hinman & Ross, 2010; Tripathi, Delano, Lund, & Rudolph, 2009; Williams & Boren, 2008).

The HIT system required to make eLAB systems work requires an ecosystem that makes their adoption more complicated than stand-alone technologies, which has slowed their widespread use (DeVore & Figlioli, 2010). The ability to integrate eLAB system data into existing information technologies, such as revenue cycle management systems, can also slow adoption. Such issues have been at the heart of the interoperability challenges highlighted in the literature and are consistently noted as a significant barrier to HIT adoption (Lovis, Spahni, Cassoni, & Geissbuhler, 2007).

In addition to concerns about technical issues, there is a reticence to move forward as a result of several reports of costly implementation failures (Heeks, 2006). The implementation of a high performing eLAB system requires extensive workflow redesigns across the hospital's service and support units. In fact, this is one of the concerns that led the American Hospital Association (AHA) to petition the Office of the National Coordinator for Health Information Technology to delay demonstrating 'Meaningful Use' of eLAB systems as part of the Patient Protection and Affordable Care Act (PPACA) requirements (Segal, 2010).

On the other hand, there are several significant factors helping to accelerate eLAB system adoption. One of the most common benefits discussed in support of increased eLAB system adoption is the savings that result from eliminating unnecessary or duplication orders. The labor costs associated with a laboratory order include staff time preparing the patient (e.g., X-rays, blood draws, and other screening), materials costs, and coordination and transportation. The latter of these often requires a patient hand-off, which creates a source of potential medical errors that can prove costly (Catalano, 2009). When inpatient services are provided, these duplicative services create unbillable expenses and unnecessary costs, which are not reimbursed and must be absorbed by the hospital.

eLAB systems can also increase the availability of electronically compiled information supporting payment claims. This information often plays a key role in efforts to maximize reimbursement rates through better documentation of clinical activities (e.g., Medicare's Premier pay-for-performance program; Becker, 2003; Tieman, 2003). These changing payment schemes create important external influences on technology innovation that can impact adoption rates (Robinson et al., 2009).

Finally, there is a change in the generation expectations associated with newly trained physicians. Residents and medical students are bringing with them an increased familiarity and comfort with technology. This evolutionary shift within the medical field has changed the expectations for technology innovation (Ford, Menachemi, & Phillips, 2006).

Cultural expectation, technological availability and challenges, and policy forces are working together to shape implementation strategies. What is missing is evidence on the effect of eLAB systems implementation on hospital productivity. Without this data, it would be difficult to determine a pathway to the most likely cost efficiencies that will help bend the healthcare inflation curve.

3. Methods

3.1. Taxonomy of eLAB system adoption rates

In 2007, hospitals were asked (from the AHA annual survey) to categorize the percentage of physicians in the facility that "routinely order laboratory or other tests electronically." The answer set was anchored at '0%', and had options of '1–24%; '25–49%'; '50–74%; and '75–100%'. In 2008, hospitals were asked the same question. Based on changes in the percentage of lab orders entered from one year to the next, a taxonomy of change was created.

The taxonomy is as follows: The first group, the 'Never Adopter' (NA: $n = 895$) hospitals are those facilities that reported no system in place in either 2007 or 2008. The second group is facilities that reported less than 50 percent usage in 2007 and 'No Change' (NC1: $n = 312$) in adoption level in the usage of the system in the next year. Hospitals in this group have physicians using the system; however, this group is separated from the subsequent group to discriminate between facilities that met the standard and those that need to increase eLAB use to qualify. The third designation is for hospitals with 'No change' (NC2: $n = 190$) in utilization from 2007 to 2008, but