

# Research Statement

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My research interests lie at the intersection of Health Economics, Industrial Organization, and Applied Econometrics. I am particularly interested in the diffusion of health IT and how the adoption of Electronic Medical Records (EMRs) in hospitals has affected pricing strategies, financial performance, and health outcomes. For instance, does the adoption of EMRs lead to increases in billing for hospitalized Medicare patients? If yes, does it result from billing inflation (called *upcoding*) or more accurate coding due to better matches between codes and patient conditions? I am also interested in how the differences among EMR vendors and differences in innovativeness of EMR products affect hospital performance metrics. Given that the innovativeness of EMR systems is likely to vary over time, I am also interested in the extent to which the timing of EMR adoption affects hospital performance over time. Finally, I am interested in the extent to which government policies designed to accelerate health IT diffusion for the purposes of reducing costs and improving quality have been successful.

## **Current Research**

DOES HEALTH IT ADOPTION LEAD TO BETTER INFORMATION OR WORSE INCENTIVES? (with *Gautam Gowrisankaran* and *Keith Joiner*)

Over the past decade, many hospitals in the U.S. have adopted EMRs, spurred in part by the HITECH Act of 2009, which provided \$27 billion to promote health information technology. On one hand, researchers have found that EMRs have led to higher patient quality, higher productivity, and in some cases, lower costs. On the other hand, there is a concern that EMRs may lead hospitals to inflate their bills, in order to seek a higher rate of reimbursement than justified — a practice that is called *upcoding*. To the extent that EMRs cause *upcoding*, this could become a hidden

cost of EMRs that limits their benefits and the benefits of government policies that encourage EMR adoption. In this paper, we evaluate whether hospital adoption of EMRs leads to *upcoding* or more accurate coding and explore alternative explanations how EMR adoption might affect billing.

EMRs lower both the cost of *upcoding* and accurate coding, and particularly affect hassle costs differently for *medical* and *surgical* admissions. With *upcoding*, we should expect to see EMR hospitals report more severe illnesses in response to changes in financial incentives. If EMRs reduce hassle costs of accurate coding, billing for EMR hospitals should increase the most where the hassle costs drop the most. We consider the 2007 payment reform, which provides variation in financial incentives to upcode across base DRGs, as well as variation in hassle costs from EMRs. We investigate the separate impact of EMR adoption and the 2007 payment reform on *medical* and *surgical* DRGs using a panel of data from 2006 to 2010. A simple difference-in-difference shows that there is an increase in *medical* DRG top codes following the reform for EMR hospitals, but no significant change in *surgical* DRG top codes, nor any evidence of top coding among base DRGs where the financial incentives increased. This is consistent with EMRs lowering the hassle cost of accurate coding for *medical* admissions. The fact that the changes in coding do not follow financial incentives suggests that this is not due to *upcoding* by hospitals based on financial incentives.

#### THE IMPACT OF ELECTRONIC MEDICAL RECORDS ON HOSPITAL PERFORMANCE: DOES VENDOR HETEROGENEITY AND PRODUCT NOVELTY MATTER? (with *Mary Olson*)

Since the implementation of the HITECH act, the government has provided \$23.5 billion in subsidies under the reform and the use of EMRs in hospitals has become widespread. However, studies have found limited and mixed evidence that EMRs are reducing costs or producing the anticipated effects. One limitation of prior studies is that they largely neglect the innovative nature of the product and assume products made by different vendors are homogeneous. These assumptions may not be warranted especially in the research-intensive, competitive health IT industry. In particular, the innovative nature of the product has implications for understanding how the timing of EMR adoption may impact hospital performance.

To better understand the impact of EMRs, we examine the extent to which vendor heterogeneity and variation in the timing of EMR adoption impacts financial and

patient outcomes for U.S. hospitals. We find that EMR adoption leads to a reduction in hospital costs for Medicare inpatients, but that the reduction varies substantially by vendor. Without vendor heterogeneity, results show that hospitals who adopted EMRs see a modest reduction of 2.6% in total charges compared with those without EMRs. With vendor heterogeneity, we see that a reduction in total charges is only observed for the EMRs from some vendors and the magnitude of the reduction varies from 3.1% to 10%. Our results relating to the timing of EMR adoption show that cost reductions accrue to both early and late adopters; however, the pattern varies among vendors. We also find that vendor heterogeneity helps to explain the impact of EMRs on Medicare patient outcomes. These results provide further evidence that the differences among vendors matter in terms of understanding the impacts of EMRs on hospital performance.

## **Ph.D Thesis**

### PROFIT COMPLEMENTARITIES IN THE ADOPTION OF ELECTRONIC MEDICAL RECORDS BY U.S. HOSPITALS

This paper tries to evaluate hospital choices of EMR vendors, in particular to examine by how much hospital profits can be increased/decreased if it chooses a local market-leading vendor, which has the highest local market share. Hospitals benefit from using the market leading technology due to complementarities, but also worry about losing patients to competitors that share the same vendor. I use both reduced-form and structural estimation to address the question. The reduced-form estimation is a multinomial logit model, regressing hospital choices on hospital characteristics and the market leader indicator. The results suggest that complementarities dominate competition pressure. The structural model estimates a dynamic oligopoly game with a series of structural parameters. The estimates suggest that complementarities are significant but become moderate when compared with the sunk cost of implementation. I also run some counterfactual experiments and find that if hospitals were incentivized to choose the locally leading vendor, it would help improve market coordination with lower costs on subsidies. Moreover, providing more generous assistance to small hospitals tend to be more effective in achieving market integration.

### COORDINATION VS. DIFFERENTIATION: EVIDENCE FROM THE ADOPTION OF ELECTRONIC MEDICAL RECORDS BY HOSPITAL SYSTEMS

This paper specially focuses on hospitals affiliated to a hospital chain and seeks to understand their incentive in choosing EMR vendors: whether to adopt the market-leading technology for coordination or otherwise to differentiate from the local market. In particular, the decision confronting these hospitals is characterized by the tradeoff between purchasing from the market leader and following the choice of the parent system when both differ. Using a nationwide sample of U.S. hospitals from 2006 to 2010, I find that member hospitals are more likely to pick what has been chosen by the parent system. Particularly for more integrated hospital systems, a vendor being the local market leader could even become a disadvantage. It may imply that hospital systems are likely to create information silos with low propensity for external information exchange. The methodology applied in this paper only involves reduced-form estimation instrumented with outside market approximation. Further evaluation of different factors requires a model with much richer structure, and it is part of the future study.

### **Research Agenda**

In addition to the current studies involving Health IT, I also plan to investigate the pricing issues in the health care sector. A few studies have examined the impact of price transparency tools on patient choice of providers, out-of-pocket spending, and utilization outcomes. However, little evidence was found that consumers react to price information. As consumers are bearing a larger fraction of health cost, it will be very important to explore further how the availability of price information affects the *demand* side. What are the factors stopping consumers from choosing the least expensive provider? Price transparency is described as an effective mechanism to reduce health care costs. However, there is also a concern that observable price information may contribute to a rise in price in the long term, especially when price information is publicly available to providers. Understanding the final impact of price transparency on the health care sector also entails a rigorous estimate of the response to price transparency on the *supply* side.