

NBER Productivity, Innovation, and Entrepreneurship Program
Post-Doctoral Fellowship Proposal

The Effects of Digitization on Productivity in Health Care: The Case of Electronic Medical Records

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The digitization of medical records is perhaps the most important business process innovation in health care in the 21st century. When investment in information technology (IT) accelerated in the 1990s, it transformed many service industries such as retail, travel and banking, by reducing the costs of processing information and coordinating production (Brynjolfsson and Hitt, 2003; Stiroh, 2002). Relative to the rest of the service sector, the health care industry has lagged behind in IT adoption. But that may be changing. Hospitals have poured large sums into the digitization of medical records since the passage of the HITECH Act in 2009, which set aside billions of dollars in subsidies for the adoption of certified electronic medical records (EMRs). The percentage of hospitals with a basic EMR has increased rapidly from under 10% in 2008 to almost 60% in 2013.¹

My dissertation explores the contingent effects of IT in health care delivery organizations. I consider whether IT, in the form of EMRs, is having as large an impact in health care as it did in the rest of the service sector. My research builds upon and complements existing work that has produced mixed evidence on the effects of health IT (Athey and Stern, 2002; Miller and Tucker, 2011; Agha, 2014). Why are the benefits not obvious in health care?² As the price of computing power has fallen, computers have displaced workers doing explicit, codifiable tasks that follow precise procedures (Autor, 2014). On the other hand, computers cannot improvise solutions for unexpected cases and automation is difficult for tasks requiring flexibility and judgment (Levy and Murnane, 2012). It is possible that IT has a more nuanced impact on healthcare organizations than it did in other service industries because such complex tasks form a larger proportion of what doctors have to do. In my dissertation, I investigate the impact of hospital adoption of EMRs on the length of stay and clinical outcomes of patients in US hospitals and present evidence of heterogeneous effects by patient complexity. I find that EMRs have the largest impact for relatively less complex patients.

*haque@fas.harvard.edu. I am applying to the Digitization area but I would also like to be considered for the Innovation Policy area in case that happens to be an appropriate fit given the policy implications of my research.

¹<<http://www.healthit.gov/sites/default/files/oncdatabrief16.pdf> >

²For instance, Dranove et al. (2012) find that EMRs help to reduce hospital costs only in IT-intensive locations.

Admission to a hospital with an EMR is associated with a 2% reduction in length of stay and a 9% reduction in thirty-day mortality for such patients. In contrast, there is no statistically significant benefit for more complex patients.

I delve deeper into more complex cases and present three additional results. First, patients returning to the same hospital benefit relative to those who previously went to a different hospital, which could be due to easier access to past electronic records. Second, EMR is associated with higher billed charges for more complex medical cases. Finally, hospitals that have a high share of publicly insured patients, and hence a bigger incentive to curb resource use, achieve a greater reduction in length of stay for complex patients after EMR adoption. Thus, it appears that EMRs have heterogeneous effects that depend on both patient and organizational characteristics.

I would like to develop my research agenda in several clear directions during my time as a post-doctoral researcher at NBER. Most immediately, I would extend the work in my dissertation to consider the effects of specific functionalities such as clinical decision support and computerized order entry on patient outcomes. In fact, the AHA Health IT supplement database, which is currently available through the NBER, contains information on 24 components of EMR systems. This level of granularity combined with patient level data from Medicare, also available through the NBER, would allow a careful empirical study. I also plan to explore the effects of IT adoption on several organizational outcomes. I believe that the healthcare industry provides one of the most detailed settings for these questions, and the availability of the rich IT adoption data at the NBER would enable me to successfully answer the following questions as part of my post-doctoral research project.

First, does management quality modify the effect of EMRs? Bloom et al. (2012) find that better-managed firms obtained larger productivity gains from IT adoption. In ongoing research, I find preliminary results indicating that EMRs seem to have a larger impact in better-managed hospitals.³ I would like to examine this issue in more detail using patient-level data and try to understand specifically when better management is complementary to digitization. Is the complementarity more evident for standard conditions with existing protocols that need to be properly executed, or for non-standard conditions that are characterized by greater managerial discretion?

Second, do EMRs result in better adherence to process-of-care guidelines published by the Center for Medicare and Medicaid Services? Many believe that EMRs might help to standardize care and reduce the variation in healthcare costs across the US. Medicare's Hospital Compare website releases hospital-level data on several process-of-care measures. I would like to merge these outcomes measures into the NBER's Health IT dataset to investigate if certain features of EMR systems such as clinical decision support are associated with better adherence to best practices, as advocates would argue. This empirical exercise would inform the general question of whether digitization leads to standardization due to better dissemination of guidelines, which become more salient at the point of service.

Third, what is the effect of IT adoption on the organizational form of health care providers? IT can have several distinct effects on the organizational structure of firms (Bloom et al., 2009; Brynjolfsson, 1994). On one hand, better IT could lead to more consolidation

³I thank Nick Bloom, Rafaella Sadun and John Van Reenen for sharing their management data on US hospitals with me.

since it is easier to monitor employees. However, digitization could also promote fragmentation by making communication *across* organizations easier. In ongoing research, I document the rise in hospitalist programs in US. Hospitalists are full time physicians who spend all their professional time at the hospital and take over responsibility for admitted patients. They have replaced the traditional care model in which primary care physicians do rounds at the hospital to check up on their patients. I would like to explore if digital records have facilitated this trend by reducing the cost of handoffs across care settings.

Finally, the NBER post-doctoral position will enable me to explore the question how EMR adoption affects productivity in physician practices. I would be able to obtain these data from the NAMCS Electronic Medical Records (EMR) Supplement (2008-2011), renamed as the National Electronic Health Records Survey (NEHRS) (currently available for 2012 and 2013), which is available at the Census Bureau Research Data Center (RDC) at the NBER. Moreover, the Office of the National Coordinator for Health Information Technology sponsored a follow-up data collection initiative to provide a better understanding of physician experiences with adoption and use of electronic health records. This dataset, known as the NAMCS Physician Workflow Supplement, would also be available in the RDC for years 2011, 2012 and 2013.

In addition to the specific plans that I have outlined above, I believe there are several other questions that might be interesting to explore. Since the AHA Health IT Supplement asks hospitals which vendors they have contracted with, it is possible to develop a better sense of the market structure of the EMR vendor industry. Platforms that enable health care consumers to store and share their data will enable further analysis of the determinants of good health and adverse outcomes. Will services such as Microsoft's HealthVault and Apple's HealthKit empower consumers by making them more informed and conscious of their health? From the consumer's perspective, digitized personal health records would solve problems such as transferring records, having to bring test records from previous appointments and repeating medical history, and re-doing tests because earlier results are not available.⁴

For researchers interested in this issue, the explosion of data from EMRs and end-user technologies will facilitate the use of machine learning and predictive analytics techniques. However, I believe that building economic frameworks that enable us to understand how digital records affect organizational decisions and consumer behavior will be a complementary approach. As Greenstein et al. (2010) point out, such theoretically grounded empirical studies must account for key characteristics of digital content such as increasing returns, zero marginal cost, and a long tail pattern of usage. I hope to be able to contribute to this research agenda as a postdoctoral fellow at NBER by completing the specific research plans that I have described above. I believe that my proposed projects take advantage of a unique setting to study the effects of digitization at the transaction level, and to understand specific aspects of digitization such as organizational complementarities as well as the impact on standardization and organizational structure.

⁴From the perspective of the government, which is now pushing for the interoperability of medical records, the rules governing this new technology are an important issue in innovation policy. In fact, privacy concerns have limited the adoption of EMRs as shown by Miller and Tucker (2014). Setting privacy policy in the digitized world will be extremely important, since there are unique benefits to customization and close monitoring in this setting, while the privacy imperative is also particularly strong given the sensitive nature of health data.

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