Geographic variation in health IT and health care outcomes: A snapshot before the meaningful use incentive program began

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ABSTRACT

Background: The 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act, which includes the Meaningful Use (MU) incentive program, was designed to increase the adoption of health information technology (IT) by physicians and hospitals. Policymakers hope that increased use of health IT to exchange health information will in turn enhance the quality and efficiency of health care delivery. In this study, we analyze the extent to which key outcomes vary based on the levels of health ITness among physicians and hospitals before the HITECH and MU programs led to increases in adoption and changes in use. Our findings provide an important baseline for a future evaluation of the impact of these programs on population-level outcomes.

Methods: We constructed measures of the degree of hospital and physician adoption and use ("health ITness") at the level of the hospital referral region (HRR). We used data from the 2010 IT Supplement of the American Hospital Association (AHA) Annual Survey of Hospitals to capture hospital health ITness and data from the 2010 survey of ambulatory health care sites produced by SK&A Information Services for the physician measure. We conducted cross-sectional analyses of the relationship between market-level Medicare costs and use and three measures: (1) physician health ITness, (2) hospital health ITness, and (3) an overall measure of health ITness.

Results: In general, greater levels of physician health ITness are associated with decreasing costs and use. Many of these relationships lose statistical significance, however, when we control for population and market characteristics such as the average age and health status of Medicare beneficiaries, mean household income, and the HMO penetration rate. Several of the relationships also change according to the level of hospital health ITness.

Conclusions: Our findings suggest that greater levels of physician health ITness are associated with decreasing costs and use for a number of services, including inpatient costs and stays, imaging services, and lab tests, in 2010. Our health ITness and outcomes measures are aggregated at the HRR level; as such, these results do not suggest that the adoption and use of health IT by individual physicians or hospitals leads to decreases in costs or use for their individual patients. Nevertheless, these baseline findings provide important information to be considered in future research analyzing the impact of HITECH and the MU incentives.

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1. Introduction

The 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act, which includes the Meaningful Use (MU) incentive program, was designed to increase the adoption of health information technology (IT) by physicians and hospitals. Policymakers hope that increased use of health IT to exchange health information will in turn enhance the quality and efficiency of health care delivery.[1] The ability of health IT to improve local population health and reduce

local health care costs depends on a variety of factors, including the existing levels of health care quality, use, and expenditures.

The variation across markets in health care use and costs is well-documented.[2,3] The authors of these studies have recognized and attempted to capture not only the market characteristics that affect utilization and costs, but also the local culture that affects provider and patient behavior. Although several authors have analyzed the characteristics associated with higher levels of hospital and physician adoption of health IT, variation across markets in health IT adoption is not as well documented, especially the variation that existed before the implementation of HITECH and the MU program.[4–7] Not only do these studies typically ignore the impact of market characteristics on health IT adoption, but most investigate adoption within only one group,

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such as hospitals or physicians in medical offices. This disregards a potential spillover between providers within a health care market.

In this study, we present a market-level analysis of the levels of health IT adoption and use—"health ITness"—among physicians and hospitals, in relation to various measures of population health as well as to health care costs and use in 2010. We sought to understand the extent to which these key outcomes vary based on the levels of health ITness among physicians and hospitals before the HITECH and MU programs led to increases in adoption and changes in use. Our findings provide an important baseline for a future evaluation of the impact of these programs on population-level outcomes.

2. Methods

2.1. Data and market-level measures of health IT and key outcomes

We constructed measures of the use and adoption of health IT and of key outcomes at the level of the hospital referral region (HRR). The HRR is defined by the *Dartmouth Atlas of Health Care* as a regional market based around hospitals providing tertiary care to Medicare beneficiaries.[8] There were 306 HRRs in the United States in 2010.

We obtained data from several sources to construct measures of health IT adoption and use among physicians in ambulatory care settings and among general medical and surgical hospitals. We constructed measures for physicians in each HRR using data from a 2010 survey of physicians produced by SK&A Information Services, a market research firm that collects information about use of electronic health records (EHRs) in physician offices. The SK&A database is based on a census of ambulatory health care sites having at least one provider with prescribing authority in the 50 states and the District of Columbia. The physician health IT index for each HRR is the percentage of physicians in the HRR who were working in a medical office that reported adopting an EHR and using it for e-prescribing. The SK&A survey in 2010 had an 83 percent response rate for this variable.

We used data from the 2010 IT Supplement of the American Hospital Association (AHA) Annual Survey of Hospitals to capture hospital health ITness. Following Blavin et al. (2010), our measure is based on whether a hospital was "MU ready"—that is, whether it had implemented eight core health IT applications included in Stage 1 MU criteria that are reported in the AHA IT Supplement.[9] The eight applications are (1) patient demographics, (2) patient problem lists, (3) patient medication lists, (4) discharge summaries, (5) computerized physician order entry for medications, (6) drug-allergy alerts, (7) drug–drug interaction alerts, and (8) any one of the four clinical decision support rules. We constructed a weighted measure—the percentage of hospital admissions in an HRR that took place in an MU-ready hospital—to investigate the relationship between health ITness and the population-based health outcome measures.

Because of low response rates in the AHA IT survey, we supplemented the 2010 data with 2009 and 2011 survey data. For example, if a hospital was MU ready in 2009 and the data are missing in 2010, we assumed the hospital was MU ready in 2010, regardless of 2011 status; similarly, if the hospital was not MU ready in 2009 and the data are missing in 2010, we assumed it was not MU ready in 2010. There were 106 HRRs in which less than 75 percent of the hospital admissions in the HRR took place in hospitals that responded to the survey. We ran all analyses using both the full set of 306 HRRs and the set of 200 HRRs in which 75 percent or more admissions were in responding hospitals; our key findings hold regardless of whether the full set of 306 HRRs or the high-response subsample was used.

In addition to continuous market-level measures of both physician and hospital use of health IT, we also stratified markets according to low, medium, or high levels of health ITness. For the physician measure, HRRs in the bottom quintile of the distribution constituted the low physician health ITness category, those in the

Table 1
Number of HRRs by "Health ITness" category of physician and hospital health IT adoption and use.

Hospital health IT index	Physician health IT index			
	Low	Medium	High	Total
Low	26	78	21	125
Medium	24	74	22	120
High	11	32	18	61
Total	61	184	61	306

top quintile were in the high category, and those in the middle three quintiles composed the medium category. The low hospital health ITness category comprised the 41 percent of HRRs with no hospitals meeting MU Stage 1, the high hospital health ITness category comprised the top quintile, and all remaining HRRs were in the medium hospital health ITness category. The distribution of HRRs across these categories is shown in Table 1.

We relied on several sources for data on population and market characteristics and clinical outcomes for Medicare beneficiaries. We used 2010 data on Medicare beneficiaries—specifically, their health care use and expenditure rates, health status, and demographic characteristics at the HRR level—from the Institute of Medicine's (IOM) and the Center for Medicare & Medicaid Services' (CMS) Medicare Geographic Variation website.[10] We also used zip code-level census data on educational attainment and mean household income from American FactFinder.[11] Finally, we relied on several sources to construct our health care market variables, including the AHA Annual Survey and Interstudy data on the market share of health maintenance organizations (HMOs).

2.2. Analyses

We conducted cross-sectional analyses of the relationship between market-level Medicare costs and use and three measures: (1) physician health ITness, (2) hospital health ITness, and (3) an overall measure of health ITness.

2.2.1. Relationship between Medicare costs and use and separate measures of physician health ITness and hospital health ITness

We regressed the outcomes of interest on the physician and hospital health IT indices, controlling for market factors that researchers have hypothesized are associated with these outcomes based on prior research on geographic variation.[3,12,13] The market factors included the following:

- Number of Medicare beneficiaries and their average age and health status, as measured by the average hierarchical condition category (HCC) score
- Mean household income
- Rate of high school graduation (or higher degree)
- Proportion of the population in rural areas
- Herfindahl Hirschman Index (HHI) score
- HMO penetration rate
- The presence of at least one teaching hospital
- Proportion of admissions to hospitals with salaried physicians, to private nonprofit hospitals, and to hospitals that belong to a multihospital system

2.2.2. Relationship between Medicare costs and use and overall market health ITness

To capture the interaction between physician health ITness and hospital health ITness, we constructed nine categories of HRR health ITness based on the level of health ITness for *both* physicians and