

findings brief

Is Health Information Technology Associated With Patient Safety in the United States?

key findings

- Estimates using national data provide tentative evidence of a positive relationship between health information technology (HIT) and clinical quality. Electronic medical records (EMRs) are associated with a statistically significant aversion of two post-operative infections per year at the average U.S. acute care hospital.
- The study found no significant relationships for two other types of HIT — nurse charting and picture archiving communication systems (PACS) — or for two other measures of patient safety — post-operative hemorrhages/hematomas and post-operative pulmonary embolism/deep vein thrombosis (DVT) — which could reflect either the true value of the HIT or limitations of the study.

Background

President Obama and Congress have made health information technology (HIT) investment a central component of U.S. health care reform. The American Recovery and Reinvestment Act of 2009 (P.L. 111-3) includes \$19 billion for HIT, the first part of a commitment by President Obama to invest a total of \$50 billion over five years “to move the U.S. health care system to broad adoption of standards-based electronic health information systems, including electronic health records.”¹ One key question for policy makers has been the ability of HIT to save money through quality improvements and efficiencies. While some analysts have suggested that HIT could lead to cost savings of as much as \$81 billion annually,² the Congressional Budget Office (CBO) has concluded that more modest savings are likely.³

Proponents of these efforts also argue that HIT has the potential to improve patient safety.⁴ Here too, the evidence is mixed. While some studies have demonstrated sta-

tistically significant relationships between HIT and better clinical quality outcomes, others have presented evidence that poorly designed computer systems can actually impair safety and require additional resources that do not contribute to patient care.⁵ Furthermore, existing evidence is primarily gathered from academic research centers and integrated delivery systems that are more technologically and clinically advanced than the country’s health care system as a whole. Hence, existing measures of HIT value may not be nationally representative.

In their recently published study, “Health Information Technology and Patient Safety: Evidence from Panel Data,”⁶ Stephen T. Parente, Ph.D., and Jeffrey McCullough, Ph.D., from the University of Minnesota address these limitations by using national data to examine the relationship between HIT and clinical quality. This study represents interim findings from McCullough and Parente’s HCFO grant, “The Costs and Benefits of Health Information Technology: Computerized Physician Order Entry” (see box on next page).



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Methods

For the years 1999 through 2002, Parente and McCullough linked the Healthcare Information and Management Systems Society (HIMSS) Analytics Database, which tracks the adoption of different types of HIT in all U.S. hospitals, with the Medicare Provider Analysis and Review (MEDPAR) inpatient dataset, a nationally representative 100 percent sample of Medicare claims. MEDPAR includes patient-specific outcomes as well as severity adjustment measures for inpatient Medicare admissions.

Parente and McCullough examined three types of HIT applications that they hypothesized were likely to affect patient safety and that diffused rapidly during the period examined. These applications were (1) electronic medical records (EMRs), which they define as a computerized patient record supported by a clinical data repository and providing clinical decision support capabilities,⁷ (2) nurse charts, which facilitate the creation, editing, and use of patient care plans, and (3) picture archiving communications systems (PACS), which allow electronic retrieval, routing, display, and archiving of images. For outcome measures, Parente and McCullough chose to look at three patient safety indicators (PSI), which are quality measures created by the Agency for Healthcare Research and Quality (AHRQ) using MEDPAR data. The three PSIs they examined were: (1) infection due to medical care, (2) postoperative hemorrhage or hematoma, and (3) postoperative pulmonary embolism or deep vein thrombosis (DVT).⁸ They chose those three measures because the measures occur relatively frequently and because a panel of clinical experts convened by Parente and McCullough identified them as most likely to be influenced by HIT. While those measures only capture a portion of HIT's potential value, this approach provides a foundation for studying the circumstances under which value is created.

Parente and McCullough measured the effect of each type of HIT on each of the three PSIs. The analysis controlled for hospital-specific effects as well as differences

The Costs and Benefits of Health Information Technology: Computerized Physician Order Entry

McCullough's HCFO grant builds on the findings presented in this brief by measuring the quality and cost effects of a specific type of HIT, computerized physician order entry (CPOE) systems. CPOE is an application through which physicians directly enter medical orders for patient services and medications. It reduces opportunities for miscommunication among disparate providers while facilitating the implementation of clinical guidelines. CPOE also captures information for both clinical and management purposes. HIT tools like CPOE have a potentially important role to play in helping providers reduce medical errors and use the results of comparative effectiveness research in their practices.

Although numerous case studies have documented successful CPOE implementations, McCullough's grant is the first effort using national data to measure the effects on quality and costs of both CPOE and complementary technological and organizational investments by hospitals. Using data from 1997 through 2006, the study will measure CPOE's effect on medical errors, on the financial costs of medical errors, on the financial value of CPOE-driven reduction in medical errors, and on "charge capture," which McCullough describes as more effective billing and the ability to extract higher payments from Medicare and other payers. The objective of the study is to provide new insights into how clinical HIT creates both financial and clinical value, while enhancing the empirical rigor with which that value is measured.

among patients such as age at admission, gender, race, and "risk score" (a measurement of the complexity of case). The analysis also allowed HIT value to change with time.

Results

The analysis found only one statistically significant relationship between HIT and patient safety. Specifically, a hospital's EMR utilization was associated with reduced infections resulting from medical care. In addition, the effect increased each year—suggesting that either the EMR technology improved over time or the hospital became better at using the technology. Although statistically significant, the magnitude of the effect was small — approximately two averted infections each year at an average hospital. In addition, there was no relationship found between EMR and either deep vein thrombosis or hemorrhages and hematomas. Neither nurse charting nor PACS applications were associated with any of the three PSIs.

Discussion and Policy Implications

This study offers tentative evidence that HIT can improve health care quality. Parente and McCullough point out that the association between EMR and reduced infections makes sense because EMR usu-

ally supports better tracking of patient care, especially in coordinating care among many different providers. In addition, EMR consolidates clinical information, thus facilitating analysis of how medical care processes affect patient safety.

Until now, researchers had primarily analyzed the relationships between HIT and patient quality through single-site studies done at clinically and technologically sophisticated academic medical centers. Existing national estimates are largely based on extrapolations from single site studies. This study builds on prior research by developing a framework for estimating HIT value from nationally representative administrative data.⁹ Parente and McCullough's study further finds that early adopters are otherwise high quality providers; thus, studies that fail to correct for this selection bias in HIT adoption may overestimate HIT's value. Following patient safety and HIT at the same hospitals across time may mitigate this problem.

The fact that Parente and McCullough find only one statistically significant relationship between HIT and the quality measures they examined also supports the hypothesis that the institutions where HIT has been studied in the past are not representative of the nation as a whole with respect to

their experience with information technology. While this might imply that HIT does little to enhance patient safety, the researchers suggest a variety of alternative explanations. For example, the study examines a narrow set of patient safety measures and likely excludes the outcomes where HIT creates the most value. They also point out that the age of their data precludes the examination of important HIT applications such as computerized physician order entry.¹⁰ Consequently, Parente and McCullough recommend that their approach be viewed as a framework for determining when and where HIT generates value rather than a comprehensive cost-benefit analysis. Pointing to the limited number of patient safety measures available from MEDPAR data, they also recommend that future research would benefit from the development of more comprehensive PSIs constructed using insurance claims or other administrative databases. They also support efforts to tie clinical data reporting to federal HIT initiatives.

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Endnotes

- 1 www.whitehouse.gov/agenda/technology/. Accessed on February 20, 2009.
- 2 Hillestad, R. *et al.* "Can Electronic Medical Record Systems Transform Health Care? Potential Health Benefits, Savings, and Costs." *Health Affairs*. Vol. 24, No. 3, September/October 2005, pp. 1103-1117. Pan, E. *et al.* 2004. *The Value of Healthcare Information Exchange and Interoperability*. Wellesley, MA: Center for Information Technology Leadership.
- 3 Congressional Budget Office. 2008. *Evidence on the Costs and Benefits of Health Information Technology*. Washington, DC: Congressional Budget Office.
- 4 Institute of Medicine. 2001. *Crossing the Quality Chasm*. Washington, DC: National Academy Press.
- 5 Berger, R. and J. Kichak. "Computerized Physician Order Entry: Helpful or Harmful?" *Journal of the American Medical Informatics Association*. Vol. 11, No. 2, 2004, pp. 100-103; Ash, J. *et al.* "Some Unintended Consequences of Information Technology in Health Care: The Nature of Patient Care Information Systems-Related Errors." *Journal of the American Medical Informatics Association* Vol. 11, No. 2, 2004, pp. 104-112; Koppel, R. *et al.* "Role of Computerized Physician Order Entry Systems in Facilitating Medical Errors" *Journal of the American Medical Association*. Vol. 293, No. 10. 2005, pp.1197-1203.
- 6 Parente, S and J. McCullough "Health Information Technology and Patient Safety: Evidence from Panel Data" *Health Affairs* Vol. 28, No. 2, 2009, pp. 357-360.

- 7 Fonkych, K. and R. Taylor. *The State and Pattern of Health Information Technology Adoption*. 2005. Santa Monica, CA: RAND Corporation, p. 9.
- 8 For greater detail see Agency for Health Care Research and Quality. *AHRQ Quality Indicators: Guide to Patient Indicators*. March 12, 2007. Ver 3.1. Washington, DC: U.S. Department of Health and Human Services. www.qualityindicators.ahrq.gov/downloads/psi/psi_guide_v31.pdf. Accessed on February 23, 2009
- 9 Parente, S.T. and R.L. Van Horn, "Valuing Hospital Investment in Information Technology: Does Governance Make a Difference." *Health Care Financing Review*. Vol. 28, No.2. Winter 2006/2007. pp. 31-43. While McCullough's study focuses on the association between HIT and patient safety, this earlier research by Parente and Van Horn used similar methods to compare the impact of HIT on the productivity of for-profit acute care hospitals with that of non-profit hospitals.
- 10 Among the other limitations of the study identified by Parente and McCullough, hospitals could have been making additional, unmeasured quality improvements during the years he studied. This would have led Parente and McCullough to overestimate the value of HIT. However, they point out that other important factors brought about extensive and rapid diffusion of HIT during the years they studied making other quality improvements less likely to explain the reduction in post-operative infections or the lack of any negative impacts on the other measures patient safety. Among the contemporaneous factors that led to HIT diffusion identified by Parente and McCullough are the full implementation of HIPAA privacy rules, the publication of a widely influential Institute of Medicine report on patient safety (*To Err is Human*. 2000. Washington, DC: National Academy Press), and the implementation of HIT to avoid Y2K problems at the start of the decade.