Health IT & The Human Element of Medicine: Recent Lessons From Doctors and Their Patients

by Holly J. Lanham, PhD, MBA

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U.S. Health Care System

“Between 44,000 to 98,000 people die each year in U.S. hospitals as a result of preventable medical errors.”

Role of Health IT in U.S. Health Care

Six aims—care should be safe, effective, patient-centered, timely, efficient and equitable.

“…need dramatically improved IT infrastructure to support a 21st century health system.”

Health Information Technology: A Mixed Bag

The Benefits Of Health Information Technology: A Review Of The Recent Literature Shows Predominantly Positive Results

ABSTRACT An unprecedented federal effort is under way to boost the adoption of electronic health records and spur innovation in health care delivery. We reviewed the recent literature on health information technology to determine its effect on outcomes, including quality, efficiency, and provider satisfaction. We found that 92 percent of the recent articles on health information technology reached conclusions that were positive overall. We also found that the benefits of the technology are beginning to emerge in smaller practices and organizations, as well as in large organizations that were early adopters. However, dissatisfaction with electronic health records among some providers remains a problem and a barrier to achieving the potential of health information technology. These realities highlight the need for studies that document the challenging aspects of implementing health information technology more specifically and how these challenges might be addressed.

Health information technology (IT) has the potential to improve the health of individuals and the performance of providers, yielding improved quality, cost savings, and greater engagement by patients in their own health care. Despite evidence of these benefits, physicians and hospitals' use of health IT and electronic health records is still low.

To accelerate the use of health IT, in 2009 Congress passed and President Barack Obama signed into law the Health Information Technology for Economic and Clinical Health (HITECH) Act, as part of the American Recovery and Reinvestment Act. HITECH makes an estimated $14-27 billion in incentive payments available to hospitals and health professionals to adopt certified electronic health records and use them effectively in the course of care. The legislation also established programs within the Office of the National Coordinator for Health Information Technology to guide physicians, hospitals, and other key entities as they adopt electronic health records and achieve so-called meaningful use, as spelled out in federal regulations.

The legislation and subsequent regulations were designed to spur adoption and yield benefits from health information technology on a much broader scale than has been achieved to date. Building on that effort, the Affordable Care Act of 2010 underscored the importance of health IT in achieving goals related to healthcare quality and efficiency. Specifically, establishing the Center for Medicare and Medicaid Innovation emphasized the importance of identifying and testing innovative payment and care delivery models. Many of the payment and care delivery model opportunities in the legislation, and in the initial projects specified by the Innovation Center, require an information technology infrastructure to coordinate care. For example, the medical home demonstrations project in federally qualified health centers that is an initial focus of the Innovation
Electronic Health Records and Clinical Decision Support Systems

Impact on National Ambulatory Care Quality

Max J. Romano, BA; Randall S. Stafford, MD, PhD

**Background:** Electronic health records (EHRs) are increasingly used by US outpatient physicians. They could improve clinical care via clinical decision support (CDS) and electronic guideline-based reminders and alerts. Using nationally representative data, we tested the hypothesis that a higher quality of care would be associated with EHRs and CDS.

**Methods:** We analyzed physician survey data on 255,402 ambulatory patient visits in nonfederal offices and hospitals from the 2005-2007 National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey. Based on 20 previously developed quality indicators, we assessed the relationship of EHRs and CDS to the provision of guideline-concordant care using multivariable logistic regression.

**Results:** Electronic health records were used in 30% of an estimated 1.1 billion annual US patient visits. Clinical decision support was present in 57% of these EHR visits (17% of all visits). The use of EHRs and CDS was more likely in the West and in multiphysician settings than in solo practices. In only 1 of 20 indicators was quality greater in EHR visits than in non-EHR visits (diet counseling in high-risk adults, adjusted odds ratio, 1.65; 95% confidence interval, 1.21-2.26). Among the EHR visits, only 1 of 20 quality indicators showed significantly better performance in visits with CDS compared with EHR visits without CDS (lack of routine electrocardiographic ordering in low-risk patients, adjusted odds ratio, 2.88; 95% confidence interval, 1.69-4.90). There were no other significant quality differences.

**Conclusions:** Our findings indicate no consistent association between EHRs and CDS and better quality. These results raise concerns about the ability of health information technology to fundamentally alter outpatient care quality.

Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors

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Abigail Cohen, PhD
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Stephen E. Kimmel, MD, MSCE
Brian L. Silver, MD, MPH

A growing body of evidence suggests that computerized physician order entry (CPOE) systems are widely viewed as crucial for reducing medication errors. However, several threats to the validity of this evidence exist, including reporting bias and the potential for CPOE systems to facilitate errors.

Context. Hospital computerized physician order entry (CPOE) systems are widely regarded as a solution to the problem of medication errors. Published studies report that CPOE reduces medication errors by up to 85%. However, few researchers have focused on the frequency or types of medication errors facilitated by CPOE.

Objective. To identify and quantify the role of CPOE in facilitating medication errors.

Design, Setting, and Participants. We conducted a quantitative study of patient medication errors in a tertiary-care teaching hospital (2002-2004) and a cross-sectional study of medication errors in a hospital in 2003. We recorded all medication errors reported by nurses, physicians, and pharmacists. In addition, we conducted interviews with medical staff and reviewed medical records.

Main Outcome Measure. Examples of medication errors caused or exacerbated by CPOE.

Results. We found that a CPOE system facilitated 22% of medication errors. Examples include fragmented CPOE displays, delayed notification of drug interactions, and the inability to update patient information. These errors occurred more frequently in patients on CPOE, and they were associated with increased odds of mortality (odds ratio: 1.25; 95% confidence interval: 1.04-1.50) after adjustment for other factors.

Conclusions. The widespread adoption of CPOE has led to significant improvements in patient safety. However, the implementation of CPOE systems has also facilitated medication errors, which can result in increased mortality. Future research should focus on identifying and implementing strategies to reduce the risk of CPOE-related errors.
Health IT Challenges Continued

National Research Council Report

“IT applications appear designed to automate tasks or business processes for administrative efficiency, and provide little support of the cognitive tasks of clinicians.”

“One result is poor system design that can increase the chance of error, add to rather than reduce workflow, and compound the frustrations of doing the required tasks”


AHRQ Summary Report

“Empirical evidence of health IT’s impacts on clinical workflow has been anecdotal, insufficiently supported, or otherwise deficient in terms of scientific rigor.”

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- Institute of Medicine Report
  Crossing the Quality Chasm, 2001
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- Donald M. Berwick, MD, President & CEO
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"Our recovery plan will invest in electronic health records and new technology that will reduce errors, bring down costs, ensure privacy, and save lives."
- President Barack Obama
  Address to Joint Session of Congress
  February 24th, 2009
$36B
American Recovery & Reinvestment Act 2009

- $787B intended to stimulate the economy through investments in infrastructure, unemployment benefits, transportation, education and healthcare
  - specifically directs almost $36B to healthcare information technology and electronic health record adoption
    - $27B incentive program to encourage greater use of electronic health records
    - Physicians eligible to earn a up to $44,000 from Medicare and $63,750 from Medicaid beginning Oct 1, 2011
Is Health IT Making a Difference?

EXHIBIT 1

Evaluations Of Outcome Measures Of Health Information Technology, By Type And Rating

- Access to care
- Preventive care
- Care process
- Patient satisfaction
- Patient safety
- Provider satisfaction
- Effectiveness of care
- Efficiency of care

Number of study outcomes

SOURCE Authors’ analysis of published peer-reviewed studies. NOTE A total of 278 outcome measures were evaluated across all studies included in our final sample.

Buntin et al., Health Affairs, 2011
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“The ‘human element’ is critical to health IT implementation.”

- Melinda Buntin, Office of the National Coordinator for Health IT, Health Affairs, 2011
“Medical errors kill enough people to fill four jumbo jets a week.”
- Wall Street Journal, Sept. 21, 2012
The Human Element of Health IT

- unexpected changes in workflow
- unintended consequences
- interruptions to workflow
- professional values shape EHR use
- the role of work relationships and communication patterns in EHR use
- individual views of uncertainty shape health IT use
- unanticipated challenges associated with asynchronous communication between patients and their providers (e.g. secure e-mail)
Physicians’ goals, values and perceptions of health IT not always aligned with the goals, values and perceptions of health IT held by the organizations in which they work.
Providers: “My job is to provide the best care possible to my patients.”

Patients: “I’m sick and need help.” Or, “I want a high quality service that is safe and free of harm.”

Physician-patient relationship oriented

Focused on individual patients (right here, right now)
Increasing pressure to measure and report quality and safety indicators (ACO, pay for perf., PCMH)

Increasing pressure to implement health IT and demonstrate a linkage between health IT use and quality of care (HITECH)

Patient satisfaction oriented

Focused on population health
Physicians’ Professional Values and Health IT Use
Professional Values

“I solve complex problems”

“I take care of patients”

“I’m a consultant”

“I’m not a typist”

“I run my own small practice”

“I treat diseases”

“I’m part of a medical group”
“I do still believe that people can heal themselves and can take better care of themselves and I haven’t been in practice so long that I’ve given that up. Even though I see it all the time that people are self destructive. So I think I still have, the belief that maybe naively; that people will take care of themselves and will do what I’ve asked.”

-- Nell
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“...if someone over 80 calls and needs anything, we’ll do it. I mean we’ll have them come in. If they’re here they’ve earned it. So they get a little bit more attention I think than someone who can probably wait a day or two. So I think I value the older generations a lot. I kind of like history too. I know they grew up in the great depression. I think they tend to; it’s just different. They go to their doctor appointments with their coats and all dressed up and looking nice. They’re always on time. They’re super early as a matter of fact. They don’t miss their appointments. If they do you know something has happened, something is wrong. So, I really value that generation a lot.

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“I have a mission to each patient to help them; help them maintain their health. And give them; guidance so that they can be healthier. And to help them to get through medical crisis.”

-- Brian
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-- Brian

“Because the work we do is so intense, doctors need a stable platform on which to work. If this platform becomes unstable, doctors can be terrorists.”

-- Tate
Professional Values

- Profession-oriented
  - “MDs want to be heroes.”
  - “I’m not a typist.”
  - “I got into medicine to help people.”

- Patient-oriented
  - “The patient is priority #1.”
  - “I’m here for the patients.”
  - “I take care of people.”

- Organization-oriented
  - “I’m part of a medical group.”
  - “What I do affects others.”
Professional Values & EHR use

Values and EMR Use

Value Dimensions

EMR Use
- High
- Low
- Med

Physicians

One: 3 High, 2 Low
Two: 5 High
Three: 10 High
Individual Views of Uncertainty and Health IT Use
“And you know you wanna have the information you need, when you need it. I guess at some point we put all the information into electronic medical records and we do away with the charts and if we get records somewhere else, we’ll maybe they can just download all in that information in there you know.”

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“I’m just maybe a little more compulsive than other people and it satisfies that need in me to know exactly what medicines my patients are on; know exactly what interactions they may have; you know and so for someone with those needs this is a great system.”

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“I take pride in the fact that if a patient gets dumped in our hospital for an admission, I want them to go to my note first; rather than the internal medicine doctor’s history and physical because they get better and more information out because I did write down that they had an append- appendectomy. That they had three pregnancies but only two kids, and one spontaneous abortion. That kind of information. That’s a personal note of pride that actually drives me more to be an excellent record keeper in that way, that’s; my information that can be used.”

-- Norman
“I’m not sure what the purpose of having a medication list in there if we pretty much don’t know if it’s correct or not. For example, any medication list in the system assumes that every doctor the patient sees is within the clinic which is not true, most of the time; and it also assumes that somebody updated the list every time that medication has changed, which is not true most of the time. But still the fact is that you don’t know what someone’s taking unless you ask them that day; because that could have changed the day before; you wouldn’t know. We never actually have all the medications that someone is taking. We never have a complete list.”

-- Charlie
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-- Mirelle

“I don’t know if the information I need is really in there [EHR].

-- Morgan

“Information has no value unless it is quickly retrievable and in the right/useable form. When I read other people’s notes I don’t get very much information; I’m interested in practitioner’s assessment of putting it all together.”

-- Tate
Views of Uncertainty

- **Traditional View of Uncertainty**
  - Uncertainty is reduced with more information or better information processing capacity

- **Irreducible Uncertainty**
  - Uncertainty that is not a result of ignorance or the partiality of human knowledge but is a characteristic of the world itself
  - Outcomes often described as probabilistic, not predictable
  - Nonlinearity in complex systems contributes to this type of uncertainty
  - Idea originates in chaos theory and complexity theory

- **Hybrid View of Uncertainty**
  - Some uncertainty is reducible with more information or better information processing
  - Some uncertainty is irreducible
Views of Uncertainty & EHR Use

Lanham et al., *Journal of the American Medical Informatics Association*, 2013

Fisher’s exact: \( p < 0.0001 \)
“Uncertainty creeps into medical practice through every pore. Whether a physician is defining a disease, making a diagnosis, selecting a procedure, observing outcomes, assessing probabilities, assigning preferences, or putting it all together, he is walking on very slippery terrain. It is difficult for nonphysicians, and for many physicians, to appreciate how complex these tasks are, how poorly we understand them, and how easy it is for honest people to come to different conclusions.”

-- David Eddy, 1984
Secure Messaging Between Patients and Providers in the VA
Content Analysis of Secure Messages

- **Unresolved Problems**
  - 11/100 threads

- **Urgent Medical Issues Raised**
  - 3/100 threads

- **Mismatches in Tone b/w Veterans and Primary Care Team Members**
  - 10/100 threads

- **Information and Uncertainty Management**
  - Information exchange (34/100 threads)
  - Problem solving (38/100 threads)
  - Sensemaking (10/100 threads)
  - Relationship building (6/100 threads)
Discussion Supported by Three Studies

- **Study 1: EHR use in outpatient care**
  - Funded by McCombs School of Business (2007-2009)

- **Study 2: Health IT implementation and workflow**
  - Funded by Agency for Healthcare Research on Quality (AHRQ) 2012-2015

- **Study 3: Secure email b/w patients & doctors**
  - Unfunded pilot study at South Texas Veterans Health care System (STVHCS)
Same organization, same electronic health records (EHRs) system, different use: exploring the linkage between practice member communication patterns and EHR use patterns in an ambulatory care setting
Holly Jordan Lanham, 1,2,3 Luci K Leykum, 1,2 Reuben R McDaniel Jr 1,4

ABSTRACT
Objective Despite efforts made by ambulatory care organizations to improve the use of electronic health records (EHRs), practices often incorporate these systems into their workflow differently from each other. One potential factor contributing to these differences is within-practice communication patterns. The authors explore the linkage between within-practice communication patterns and practice-level EHR use patterns.
Design Qualitative study of six practices operating within the same multi-specialty ambulatory care organization using the same EHR system. Semistructured interviews and direct observation were conducted with all physicians, nurses, medical assistants, practice managers, and office staff from each practice.
Measurements An existing model of practice relationships was used to analyze communication patterns within the practices. Practice-level EHR use was defined and analyzed as the way in which a practice uses an EHR as a collective or a group—including the degree of feature use, level of EHR-enabled communication, and frequency that EHR use changes in a practice. Interview and observation data were analyzed for themes. Based on those themes, within-practice communication patterns were categorized as fragmented or cohesive, and practice-level EHR use patterns were categorized as heterogeneous or homogenous.
Results Practices where EHR use was uniformly high across all users were further categorized as having standardized EHR use. Communication patterns and EHR use patterns were compared across the six practices.

RESULTS
We have implemented EHR systems in four of the practices. In practices where communication patterns were fragmented, EHR use was heterogeneous. In practices where communication patterns were cohesive, EHR use was homogenous. Additional analysis revealed that practices with standardized EHR use (uniformly high use across all users) exhibited high levels of mindfulness and respect for EHRs, as well as that EHRs were used to its fullest potential. No differences were found between EHR use and communication patterns.

CONCLUSION
Within practice communication patterns provide a unique perspective for exploring the issue of standardization in EHR use. A major focus of setting homogeneous EHR use as the goal for practice-level EHR use can lead to lowering EHR use and could be considered successful. Achieving uniform high EHR use across all users in a practice is more consistent with the goals of current EHR adoption and use efforts. It was found that some communication patterns among practice members may enable more standardized EHR use patterns. Understanding the linkage between communication patterns and EHR use can inform understanding of the human element in EHR use and may provide key lessons for the implementation of EHRs and other health information technologies.

Understanding differences in electronic health record (EHR) use: linking individual physicians' perceptions of uncertainty and EHR use patterns in ambulatory care
Holly Jordan Lanham, 1,2,3 Dean F Sittig, 4,5 Luci K Leykum, 1,2,3 Michael L Parchman, 6 Jacqueline A Pugh, 7,8 Reuben R McDaniel 1,2

ABSTRACT
Objective Electronic health records (EHR) hold great promise for managing patient information in ways that improve healthcare delivery. Physicians differ, however, in their use of this health information technology (HIT), and these differences are not well understood. The authors study differences in individual physicians' EHR use patterns and identify perceptions of uncertainty as an important new variable in understanding EHR use.
Design Qualitative study using semi-structured interviews and direct observation of physicians (n=28) working in a multispecialty outpatients care organization.
Measurements We identified physicians' perceptions of uncertainty as an important variable in understanding differences in EHR use patterns. Drawing on theories from the medical and organizational literatures, we identified three categories of uncertainty: reduction, adaption, and hybrid. We used an existing model of EHR use to categorize physician EHR use patterns as high, medium, and low based on degree of feature use, level of EHR-enabled communication, and frequency that EHR use patterns change.
Results Physicians' perceptions of uncertainty were distinctly correlated with their EHR use patterns. Uncertainty reduction tactics exhibited high levels of EHR use, uncertainty absorbers tended to exhibit low levels of EHR use, and physicians demonstrating both perspectives of uncertainty (hybrid) exhibited variable levels of EHR use.

Conclusions We find evidence linking physicians' perceptions of uncertainty with their EHR use patterns. Study findings have implications for health IT research, practice, and policy, particularly in terms of impacting health IT design and implementation efforts in ways that consider differences in physicians' perceptions of uncertainty.

INTRODUCTION
Despite recent increases in electronic health record (EHR) use, physicians' perceptions of uncertainty is often overlooked. Complexity science framed our study from the beginning, influencing data collection and analysis activities. Physicians' perceptions are often framed in the context of the human element in medical decision-making. We used both medical and organizational theories to interpret our study findings. Although these two frameworks were applied at different points in the study, we introduce them both here.

Complexity science Complexity science is the study of complex systems,2,27 and has been applied to organizational2,13–17 and information systems2,18–21 research for over several decades and more recently to medical informatics research.19 Complex systems are comprised of heterogeneous and interdependent components that work together to achieve emergent properties among the parts influence the functioning of the system at local and global levels in unpredictable ways.22 Prior to the introduction of complexity science, the dominant conceptualization of organizations was that of mechanistic systems characterized by predictability.19 From a complexity science perspective, we must consider the emergence of emergent properties on the systems made up of diverse agents and non-linear dynamics.23 As agents interact locally over time they self-organize and exhibit changes in their emergent nature;24,25 the role of work relationships and communication patterns in practice-level EHR use,14 and the reality of negative unintended consequences.11,16 In spite of major advances made through the application of socio-technical theory to health IT, topics17,19 significant knowledge gaps exist in the intersection of human behavior and health IT, particularly with regard to understanding physicians' information needs in the context of EHR-enabled healthcare delivery.26,27 Drawing on statements in a recent report from the Office of the National Coordinator for Health Information Technology (ONC) articulating a lack of understanding of the human element in health IT communication and implementation efforts,12 this study seeks to contribute to the literature on the intersection of human behavior and health IT use in understudied ambulatory care settings.28 We conducted a mixed-method qualitative study to better understand individual physician-level differences in EHR use patterns.

THEORETICAL FRAMEWORKS
We drew insights from two distinct literatures in conducting this study: complexity science and physicians' perceptions of uncertainty. Complexity science framed our study from the beginning, influencing data collection and analysis activities. Physicians' perceptions of uncertainty, however, emerged as a secondary construct during data analysis. We used both medical and organizational theories to interpret our study findings. Although these two frameworks were applied at different points in the study, we introduce them both here.

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