
AHRQ Update

Use of Information Technology to Improve the Quality of Health Care in the United States

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INTRODUCTION

In 1969, when the Internet was known as the DARPA net and the World Wide Web was nothing more than a glint in a creative student's mind, the Agency for Healthcare Research and Quality funded its first project in medical informatics.¹ Since then, the Agency has continued to support research and development projects in the use of information technology to improve health care, awarding \$250 million dollars to fund more than 150 projects in medical informatics. Today, the Agency is still blazing this technology trail with projects that seek to develop the knowledge and tools needed to improve the quality of care in the U.S. health care system.

BACKGROUND

In 1998, the Committee on the Quality of Health Care in America, established within the Institute of Medicine (IOM), was asked to identify strategies for improving the quality of health care in the United States. As part of this effort, the committee published a seminal report in March 2001, *Crossing the Quality Chasm: A New Health System for the 21st Century*, which focused on issues relating to health care quality in this country. The committee concluded that the U.S. health care system did not consistently deliver the type of high-quality care that Americans expect and deserve. The report includes a framework and strategy for redesigning the health care system to facilitate the delivery of high-quality care. One of the key findings was that information and communication technology (IT) is integral to achieving substantial quality improvement. More specifically, the report recommended the use of IT to improve access to

information and support evidence-based decision making. The committee called for a national commitment to building an information infrastructure to support health care delivery, consumer health, quality measurement and improvement, public accountability, clinical and health services research, and clinical education.

While IT has the potential to greatly improve the quality of health care, the evidence that IT improves important health related outcomes is limited. Even the IOM, which has endorsed the use of IT as part of a strategic plan to improve quality of care in the U.S., acknowledges that, “Although the potential benefits of IT are compelling, the evidence in support of these benefits varies greatly by type of application.” A recent study funded by AHRQ validates this assertion. As part of its Evidence-based Practice Center (EPC) program, AHRQ sponsored a systematic review to evaluate the evidence on interventions to reduce medical errors and improve patient safety. The report, *Making Health Care Safer: A Critical Analysis of Patient Safety Practices*, found that there was relatively little evidence that computerized physician order entry (CPOE) with clinical decision support or other IT innovations improved important outcomes across diverse practice settings. The lack of evidence was notable especially when compared to the strength of evidence regarding nontechnological safety practices such as prophylaxis for venous thromboembolism, use of sterile barriers during catheter insertion, or use of prophylactic antibiotics during surgery (Table 1). Although this is not a reflection on the potential importance of IT in health care, it does reveal that a great deal of work is still needed to determine how IT can be utilized to improve important outcomes and overall quality of care in diverse health care settings.

When Congress reauthorized and renamed the Agency in 1999, it specifically directed AHRQ to evaluate informatics applications, decision support systems, and computerized patient records to reduce medical errors, improve patient safety, and promote quality improvement in diverse patient settings. AHRQ is responding to this mandate by utilizing the full spectrum of funding mechanisms to support projects that will generate knowledge and evidence on the use of IT in health care.

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Table 1: Patient Safety Practices with the Greatest Strength of Evidence Regarding Their Impact and Effectiveness.

<i>Item</i>	<i>Patient Safety Problem</i>	<i>Patient Safety Practice</i>
1	Venous thromboembolism (VTE)	Appropriate VTE prophylaxis
2	Perioperative cardiac events in patients undergoing noncardiac surgery	Use of perioperative beta-blockers
3	Central venous catheter-related bloodstream infections	Use of maximum sterile barriers during catheter insertion
4	Surgical site infections	Appropriate use of antibiotic prophylaxis
5	Missed, incomplete, or not fully comprehended informed consent	Asking that patients recall and restate what they have been told during informed consent
6	Ventilator-associated pneumonia	Continuous aspiration of subglottic secretions
7	Pressure ulcers	Use of pressure relieving bedding materials
8	Morbidity due to central venous catheter insertion	Use of real-time ultrasound guidance during central line insertion
9	Adverse events related to chronic anticoagulation with warfarin	Patient self-management using home monitoring devices
10	Morbidity and mortality in post-surgical and critically ill patients	Various nutritional strategies
11	Central venous catheter-related bloodstream infections	Antibiotic-impregnated catheters

This article provides a brief overview of a portion of AHRQ’s portfolio of IT initiatives that include:

- Specific IT components;
- Development of IT products;
- Application of IT in AHRQ’s clinical research networks;
- IT as an essential component of translating research into practice; and,
- IT as the backbone of efforts to assure an effective health system response to bioterrorism.

CLINICAL INFORMATICS TO PROMOTE PATIENT SAFETY (CLIPS)

AHRQ’s fiscal year 2001 appropriation included \$50 million for initiatives to reduce medical errors and improve patient safety. Accordingly, the Agency

developed a series of research solicitations (RFAs) to:

- Design and test best practices for reducing errors in multiple health care settings;
- Develop the science base to inform these efforts;
- Improve provider education to reduce errors;
- Capitalize on IT advances to translate effective strategies into widespread practice; and
- Build capacity to further reduce errors.

This represents the single largest investment the federal government has ever made to address the problem of medical errors.

One of these solicitations was the Clinical Informatics to Promote Patient Safety (CLIPS) RFA, which focused on the use of IT to reduce medical errors and improve patient safety. The CLIPS RFA generated enthusiasm among patient safety and informatics researchers and resulted in a large number of competitive proposals from a wide range of public and private sector organizations. Many proposals involved research using handheld wireless devices, electronic medical record systems, computerized decision support tools, or electronic prescribing applications. Other areas of proposed research included simulation models for education and training, automated error alerting mechanisms, structured electronic data sets, digital eye technology, database applications, computerized patient self-monitoring and communication tools, wearable mini computers, biometric technology, Internet and intranet applications, cognitive science and human factors engineering, data mining, and barriers to electronic prescribing. Examples of currently funded projects are summarized in Table 2.

SMALL BUSINESS INNOVATIVE RESEARCH (SBIR) PROGRAM

Like many other federal agencies, AHRQ devotes 2.5 percent of its extramural research budget to support the Small Business Innovative Research (SBIR) program, which helps small businesses develop innovative technology that will lead to improvements in health care quality in the United States. Over the past two years, AHRQ has funded 20 SBIR projects that have focused on developing innovative IT tools for improving patient safety and overall quality of care. For example, one group of investigators developed

Table 2: Examples of Projects Funded through the CLIPS RFA.

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- ◆ *Improving Primary Care Patient Safety with Handheld DSS.* This project examines the acceptance, benefits, and barriers in the use of stand-alone, handheld decision support systems (DSSs) in an ambulatory setting, and the clinical impact and cost-effectiveness of point-of-care, handheld ambulatory DSSs on medical errors.
 - ◆ *Mining Complex Clinical Data for Patient Safety Research.* Researchers are developing an infrastructure to support automated surveillance of errors by applying a natural language processor to code the information contained in patients' electronic medical records to detect and characterize medical errors.
 - ◆ *Using Prospective Minimal Data Set Data to Enhance Resident Safety.* This research project will determine whether preventable adverse outcomes for the frail elderly population in long-term care settings can be avoided by using computers that alert nursing and other staff to the likelihood of problems such as falls, pressure ulcers, and urinary tract infections.
 - ◆ *Using Handheld Technology to Reduce Errors in ADHD Care.* This project is using a real-time, point-of-care handheld computerized decision support module to reduce medical errors in the treatment of attention-deficit/hyperactivity disorder (ADHD) in children.
 - ◆ *Linking User Error to Lab and Field Study of Medical Informatics.* This project explores the relationship between human, machine, and environmental factors associated with the operation of infusion devices in clinical settings. The project will identify and characterize properties of infusion devices, environmental conditions, and operator cognition that promote user errors.
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a web-based communication and disease management system that provides clinical information and facilitates communication between patients with asthma and their providers. They are currently assessing the impact of their program on compliance with asthma management guidelines and overall quality of care. Another group of researchers is developing a prototype information exchange system that provides immediate access to patient information and facilitates communication during emergency response situations by integrating Internet resources, fingerprint technology, and smart cards. Finally, a third group of investigators is developing a computerized medical monitoring device that is enabled with a Bluetooth wireless network. The device automatically collects, analyzes and transmits patient data, and also alerts patients and providers to potential problems. The group is currently developing working prototypes of a weight scale, glucose monitor, and thermometer.

RESEARCH NETWORKS

Integrated Delivery System Research Networks (IDSRNs)

The Integrated Delivery System Research Network (IDSRN) was developed to capitalize on the research capacity of large integrated delivery systems in the

United States. The network includes nine partners that encompass a wide variety of organizational care settings and provide health care services to more than 55 million people. These IDSRN partners are well suited for conducting relevant research due to (1) their ability to collect and maintain administrative, claims, clinical, and other data on large populations that are clinically, demographically, and geographically diverse; (2) their access to many of the country's leading clinicians, health services researchers, and health care facilities; (3) their expertise in quantitative and qualitative methodologies, including emerging areas with important policy or managerial implications; and their leadership and management authority to implement and evaluate various interventions, including financial and organizational changes. The AHRQ is taking advantage of the research capacity of the IDSRNs to generate results within a relatively quick turnaround time (e.g., 12–18 months) to study various ways that IT can improve the quality of health care in diverse settings. In FY 2001, sixteen IDSRN projects were funded, and seven of these projects specifically targeted to the use of IT in health care.

For example, two network partners are studying how automated electronic reminders affect compliance with recommended guidelines for the management of patients with diabetes. Another network partner is studying how different integrated delivery systems in California, Washington, Oregon, Alaska, North Carolina, Utah, and Idaho transfer medication information within each system. Another partner is studying the use of automated computerized reminders that utilize the Centers for Disease Control and Prevention (CDC) guidelines to improve screening and detection of patients at increased risk for tuberculosis. Finally, two partners are studying how electronic communication can be used by patients and providers to improve quality of care.

Practice-Based Research Networks (PBRNs)

One of the innovative ways AHRQ is supporting important outcomes research is through the development of the Primary Care Practice-Based Research Networks (PBRNs). The PBRNs are made up of community-based, primary care clinicians working together with experienced health services researchers to address clinically relevant health care issues and translate research findings into practice to improve quality of care. The PBRNs were established in September 2000, when 19 networks from across the country were funded with planning grants. The PBRNs represent a wide variety of practice settings located in 50 states and the District of Columbia, providing

access to more than 5,000 primary care providers and almost seven million patients. The PBRNs foster a “user-driven” agenda, where clinical and research ideas emanate directly from the “front-line” clinicians who are seeing patients in their daily practice, and they provide the Agency with a unique opportunity to conduct “real-world” effectiveness research in “living laboratories.” Despite its brief tenure, the PBRN program has met with great success, as evidenced by the program’s recent expansion to 36 networks and an increase in the FY 2003 budget to \$3 million dollars.

Many of these recent awards will support the development of the PBRNs’ IT infrastructure and evaluate ways of using IT to improve quality of care. For example, one PBRN is testing the feasibility of clinicians using handheld devices with computerized algorithms for assessing and counseling patients who smoke. Another network is testing an Internet-based communication, surveillance, and data management system to enhance linkages between community practices, state health departments, and the State Epidemiological and Bioterrorism Surveillance System. A third network is testing the use of a computerized automated reminder system for lipid management within an electronic medical record. The system integrates a patient’s clinical information with current research findings, calculates the risk of cardiovascular disease for an individual patient, and generates reminders to the clinician. Finally, three PBRNs are developing interactive surveillance systems to recognize bioterrorism events.

TRANSLATING RESEARCH INTO PRACTICE (TRIP)

Research on Translation and Implementation

In health care, many clinical practices are not based on good scientific evidence regarding an intervention’s impact on important outcomes or quality of care. Sometimes this occurs because evidence from well conducted, randomized controlled trials is not available. However, even when good evidence is available and there is strong consensus regarding the effects of an intervention, there is often inappropriate utilization of the intervention, resulting in suboptimal care. Studies suggest that it takes an average of 17 years for research evidence to be incorporated into standard clinical practice. The use of IT can help overcome this gap in knowledge management and application through tools to enhance the translation, implementation, and dissemination of important research findings in clinical practice. With this in mind, AHRQ launched its Translating Research into Practice (TRIP-I)

program in 1999, funding 14 projects to generate new knowledge about facilitating the use of rigorously derived evidence to improve patient care.

Building on the success of TRIP-I, AHRQ launched TRIP-II in September 2000, funding 13 projects that focused on implementation issues, such as organizational and clinical characteristics, that are associated with successfully translating research findings into clinical practice in diverse settings. With TRIP II, the Agency emphasized the use of IT as a key strategy for translating research into practice and improving quality of care. One group of investigators is using an interactive, multi-media computer program to improve diabetes-related knowledge, attitudes, self-efficacy, and compliance with self-care recommendations in clinics serving predominantly African American and Hispanic patients. Another group of investigators is assessing a computerized decision support system that provides automated reminders, alerts, and guidelines in the outpatient setting. A third group of investigators is evaluating Internet-based learning modules designed to increase screening of female patients who are at risk for chlamydia infection and to decrease the incidence of pelvic inflammatory disease in primary care practices. Finally, investigators are evaluating the impact of a quality improvement model using electronic medical records and academic detailing on adherence to clinical practice guidelines for prevention of cardiovascular disease and stroke in 22 primary care settings across the United States.

The 27 projects funded under TRIP-I and TRIP-II will provide important information that can help narrow the gap between knowledge and practice—between what we know and what we do—to improve the quality of the nation's health care.

Strategic Partnerships

The Agency is developing strategic partnerships to generate and disseminate research findings, facilitate use of its resources, and promote evidence-based medicine at the point of care among large and diverse audiences. The IT vendors are important partners in these efforts, as illustrated by AHQR's partnership with ePocrates Inc., which maintains the largest U.S. network of clinicians who use handheld computers. The Agency will distribute recommendations from the United States Preventive Services Task Force to physicians and other health care professionals through ePocrates' DocAlert[®] messaging system.

AHRQ is spearheading a federal initiative to integrate and simplify the collection and reporting of patient safety data from the Department of Health

and Human Services. Over the next two years, AHRQ will develop and pilot-test a Web-based reporting system featuring a common user interface. Ultimately, this system will hasten the collection and use of data from the CDC's National Healthcare Safety Network and several systems within the Food and Drug Administration (FDA), including the Adverse Events Reporting System, Medical Device Surveillance Network, and Vaccine Adverse Event Reporting System.

The Agency is also working with the National Committee on Vital and Health Statistics, the eHealth initiative, the Markle Foundation, and other federal, state, local, and private sector partners to improve health care quality and public health through the use of IT, including the development and adoption of national standards and the development of a national electronic health information infrastructure.

BIOTERRORISM PREPAREDNESS

Even before the events of September 11, 2001 and the subsequent anthrax attacks, AHRQ was supporting research initiatives to improve the nation's ability to respond to bioterrorism. In fiscal year 2000, the Agency received \$5 million to support and conduct research to improve the capacity of the nation's health care system to respond to incidents of bioterrorism. By 2002, funding for bioterrorism initiatives had increased to \$10 million dollars.

The Agency's bioterrorism efforts have focused on assisting clinicians, hospitals, and health care systems in the following areas:

- Emergency preparedness of hospitals and health care systems for bioterrorism and rare public health events;
- Technologies and methods to improve the linkages between clinical health care systems, emergency response networks, and public health agencies; and
- Training and information needed to prepare community clinicians to recognize the manifestations of bioterrorism and manage patients appropriately.

The Agency's bioterrorism research is a natural outgrowth of its ongoing efforts to develop evidence-based information to improve health care quality. (Some of these projects were previously described in the discussions on the IDSRNs and PBRNs.) Other examples include: the use of computer simulations to develop models for planning citywide responses to bioterrorism

attacks, including optimal distribution of antibiotics to ambulatory patients and improvement of hospital treatment capacity; development of an electronic “Real-time Outbreak and Disease Surveillance” system to provide early warnings of infectious disease outbreaks so treatment and control measures can be initiated; and generation of an evidence report on the ability of currently available IT and decision support systems to serve the needs of clinicians and public health officials in the event of a bioterrorist attack.

CONCLUSION

Health care has lagged far behind many other industries in harnessing the capabilities of IT to improve services, knowledge, communication, outcomes, quality, and efficiency. Given the complexity of modern medicine, it is inevitable that IT will play an ever increasing role in improving health care quality. As noted by the IOM’s Committee on Quality Health Care in America, “Information technology must play a central role in the redesign of the health care system if a substantial improvement in quality is to be achieved over the coming decade.” To make significant progress, a major re-engineering of the health care delivery system is needed, which requires changes in technical, sociological, cultural, educational, financial, and other important factors.

Research is needed to:

- Evaluate the role of IT in improving clinical decision making, information management, communication, costs, and access to care;
- Assess barriers to successful implementation of proven IT, as well as strategies to overcome these barriers so that all patients and providers have access to technologies that can improve safety and quality of care;
- Generate solutions to eliminate the digital divide;
- Document the costs and resources associated with adopting and maintaining proven IT applications; and
- Evaluate transferability of IT solutions to other health care settings.

The AHRQ is working diligently to develop a portfolio of IT initiatives. The Agency’s research and demonstration projects will provide the evidence

needed to guide future IT implementation to improve the effectiveness and efficiency of health care delivery in the United States.

To learn more about these and other informatics initiatives at AHRQ, please visit the Agency's Web site at www.ahrq.gov. To stay current on AHRQ's activities and research findings, readers are encouraged to sign up for the Agency's free LISTSERV[®] and electronic newsletter at www.ahrq.gov/news/ahrqlist.htm.

NOTE

1. In 1969, AHRQ was known as the National Center for Health Services Research and Development (NCHSR&D).

REFERENCES

- Agency for Healthcare Research and Quality. 2001. *Primary Care Practice-Based Research Networks*. 2001. AHRQ Publication No. 01-P020. Rockville, MD: Agency for Healthcare Research and Quality. Available at <http://www.ahrq.gov/research/pbrnfact.htm>.
- . 2001b. "AHRQ Issues Request for Applications on Clinical Informatics and Patient Safety Research." Press Release, February 23. Rockville, MD: Agency for Healthcare Research and Quality. Available at <http://www.ahrq.gov/news/press/pr2001/clipspr.htm>.
- . 2001c. *Translating Research Into Practice (TRIP)-II*. AHRQ Publication No. 01-P017, March. Rockville, MD: Agency for Healthcare Research and Quality. Available at <http://www.ahrq.gov/research/trip2fac.htm>.
- . 2001d. *Making Health Care Safer. A Critical Analysis of Patient Safety Practices: Summary*. AHRQ Publication No. 01-E057, July. Rockville, MD: Agency for Healthcare Research and Quality. Available at <http://www.ahrq.gov/clinic/ptsafety/summary.htm>.
- . 2002a. U.S. Preventive Services Task Force. *About USPSTF*. February. Rockville, MD: Agency for Healthcare Research and Quality. Available at <http://www.ahrq.gov/clinic/uspstfab.htm>.
- . 2002b. *AHRQ Research Relevant to Bioterrorism Preparedness*. AHRQ Publication No. 02-P018, March. Rockville, MD: Agency for Healthcare Research and Quality. Available at <http://www.ahrq.gov/news/focus/bioterror.htm>.
- . 2002c. *Bioterrorism Preparedness and Response: Use of Information Technologies and Decision Support Systems*. Summary, Evidence Report/Technology Assessment: Number 59, July. Rockville, MD: Agency for Healthcare Research and Quality. Available at <http://www.ahrq.gov/clinic/epcsums/bioitsum.htm>.
- Balas, E. A., and S. A. Boren. 2000. "Managing Clinical Knowledge for Health Care Improvement." *Yearbook of Medical Informatics*. Amsterdam: Schattauer.

- Corrigan, J. M., M. S. Donaldson, and L. T. Kohn, eds. 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, D.C.: National Academy Press.
- Fitzmaurice, J. M., K. Adams, and J. M. Eisenberg. 2002. "Three Decades of Research on Computer Applications in Health Care: Medical Informatics Support at the Agency for Healthcare Research and Quality." *Journal of the American Medical Informatics Association* 9 (2): 144–160.
- Keyes, M. A., E. Ortiz, D. Queenan, R. Hughes, G. S. Meyer, F. Chesley, N. E. Foster, and E. M. Hogan. (In review). "A Strategic Approach for Funding Research: An Overview of the Agency for Healthcare Research and Quality's Patient Safety Program." *Quality and Safety in Health Care*. Forthcoming.