

# AHRQ Health Information Technology Ambulatory Safety and Quality

Findings and Lessons  
From the AHRQ  
Ambulatory Safety and  
Quality Program



Agency for Healthcare Research and Quality  
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HEALTH IT



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## Preface

The purpose of the Agency for Healthcare Research and Quality's (AHRQ's) Ambulatory Safety and Quality (ASQ) program is to improve the safety and quality of ambulatory health care in the United States. The program's components, with the exception of the risk assessment grant initiative (FOA HS-07-003), emphasize the role of health information technology (IT). The ASQ program included the following grant initiatives:

- Enabling Quality Measurement Through Health IT (FOA HS-07-002), which focused on strategies for the development of health IT to assist clinicians, practices, and systems to measure the quality and safety of care in ambulatory care settings.
- Ambulatory Care Patient Safety Proactive Risk Assessment (FOA HS-07-003), which supported research in risk assessment and modeling to identify preventable patient injuries and harms and to inform the development and deployment of intervention strategies to reduce threats to patient safety in ambulatory care settings and during transitions of care.
- Improving Quality Through Clinician Use of Health IT (FOA HS-07-006), which supported research related to the development, implementation and use of health IT to assist clinicians,

practices, and systems in improving the quality and safety of care delivery in ambulatory care settings.

- Enabling Patient-Centered Care Through Health IT (FOA HS-07-007), which was designed to investigate approaches to improve the patient experience of care through the use of health IT in ambulatory care settings.
- Improving Management of Individuals With Complex Healthcare Needs Through Health IT (FOA HS-08-002), which was aimed at clinician and patient and family use of health IT in ambulatory settings to improve outcomes through more effective decision support or care delivery for patients with complex health care needs.

This is one of a series of five reports highlighting findings and lessons from the ASQ program initiatives. Separate reports were developed for each of the four health IT-focused initiatives listed above. Those reports describe the projects in each initiative and identify practical insights specific to the areas of interest in the initiative regarding the use of health IT to improve safety and quality in ambulatory settings. This report summarizes this information across the ASQ program, organized according to key aspects of ambulatory care that can be supported and improved through the use of health IT.

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## Executive Summary

A large and growing number of clinical services are delivered in ambulatory care settings such as physician offices, hospital-based outpatient clinics, and public health and other types of clinics. Patients seen in ambulatory settings vary widely in terms of health status and the types and severity of illnesses. Ambulatory care is often logistically complex, depending upon coordination and exchange of information both within and across organizations to address patients' interrelated medical care and social support needs. Ambulatory care providers must also help patients navigate effectively and efficiently through the health care system to achieve optimal outcomes, in accordance with patient preferences. Appropriate implementation and use of health information technology (IT) systems such as electronic health records (EHRs), personal health records (PHRs), and health information exchange (HIE) systems can support the delivery of ambulatory care. These systems can provide clinicians with information and decision support, engage patients and support self-management, and facilitate communication among clinicians and between clinicians and patients.

In 2007, the Agency for Healthcare Research and Quality (AHRQ) launched the Ambulatory Safety and Quality (ASQ) program to foster research on how to improve the safety and quality of ambulatory health care in the United States. This report is the fifth in a series of reports highlighting findings and lessons from the health IT-focused ASQ program initiatives. It summarizes the experiences and findings from those initiatives, organized according to key aspects of ambulatory care that can be supported and improved through the use of health IT. The ASQ projects involved the development, implementation, and evaluation of a range of health IT systems

including EHRs, HIE applications, secure messaging, interactive voice response (IVR) systems, PHRs, and clinical decision support (CDS) systems.

This report is organized around 10 key aspects of ambulatory care that illustrate ways in which health IT can be used to improve safety and quality in ambulatory settings. It includes a brief background section on each aspect as well as highlights describing how the ASQ projects addressed that topic. The 10 aspects of ambulatory care discussed in the report are as follows:

1. Developing and Testing Quality Measures
2. Capturing and Integrating Data to Support Quality Measurement and Improvement
3. Providing Clinicians With Patient-Specific Information, Clinical Knowledge, and Decision Support
4. Providing Clinician and Patient Access to Medical Information
5. Improving Shared Decisionmaking and Patient-Clinician Communication
6. Managing Medications
7. Supporting Patient Self-Management
8. Integrating Patient Information Across Transitions in Care
9. Coordinating Care
10. Improving Outcomes for Vulnerable Populations

Additional details on the design, objectives, and results of each ASQ project can be found on the AHRQ ASQ Web page at <http://healthit.ahrq.gov/asq>.



# Introduction

## Overview of ASQ Program and Its Goals

A large and growing number of clinical services are delivered in ambulatory care settings such as physician offices, hospital-based outpatient clinics, and public health and other types of clinics. In 2009, there were over 1 billion physician office visits in the United States, an increase of more than 25 percent from the year 2000 (NCHS, 2010). Patients seen in ambulatory settings vary widely in terms of health status and the types and severity of illnesses. Ambulatory care is often logistically complex, depending upon coordination and exchange of information both within and across organizations to address patients' interrelated medical care and social support needs. Ambulatory care providers must also help patients navigate effectively and efficiently through the health care system to achieve optimal outcomes in accordance with patient preferences (Antonelli et al., 2009, Lorincz et al., 2011). Similar to many care settings, patients play an important role in the delivery of ambulatory care. Patients and their families or caregivers may help to establish care plans and make treatment decisions in collaboration with clinicians. They also are often called upon to be active participants in their own care by carrying out home monitoring and therapeutic regimens, remembering to take medications, and attending followup appointments.

Appropriate implementation and use of health information technology (IT) systems such as electronic health records (EHRs), personal health records (PHRs), and health information exchange (HIE) systems can support the delivery of ambulatory care by providing needed information and decision support at the point of care, providing for the exchange of information for patients undergoing a transition in care or receiving care from multiple clinicians or organizations, and by making it less burdensome to measure and report on quality and safety. These are all challenges that are particularly pressing in ambulatory care settings because of the volume of patient

visits, the need for coordination across providers of care, and the often limited resources for quality measurement and improvement. Furthermore, health IT is an essential component of emerging care models such as accountable care organizations and patient-centered medical homes; as such, the findings and lessons from the ASQ program can provide timely, relevant information to assist in development of these new care models.

In 2007, the Agency for Healthcare Research and Quality (AHRQ) launched the Ambulatory Safety and Quality (ASQ) program, which was designed to foster research on how to improve the safety and quality of ambulatory health care in the United States. This report is the fifth in a series of reports highlighting findings and lessons from the health IT-focused ASQ program initiatives. It summarizes the experiences and findings from those initiatives, organized according to key aspects of ambulatory care that can be supported and improved through the use of health IT. Separate reports were developed for the four health IT-focused initiatives listed below. Those reports describe the projects in each initiative and identify practical insights regarding the use of health IT to improve safety and quality in ambulatory settings. Each report is organized around areas of interest that AHRQ identified in the request for application (RFA):

- **Enabling Quality Measurement Through Health IT** (EQM) (FOA HS-07-002) focused on strategies for the development of health IT to assist clinicians, practices, and systems in measuring the quality and safety of care in ambulatory care settings. The EQM initiative report can be found at <http://healthit.ahrq.gov/asqeqmreport>. Areas of interest highlighted in the EQM report include developing new measures, accuracy of measurement, capturing and integrating data, feedback to clinicians, and efficiency of measurement.

- **Improving Quality Through Clinician Use of Health IT** (IQHIT) (FOA HS-07-006) supported research related to the development, implementation, and use of health IT to assist clinicians, practices, and systems in improving the quality and safety of care delivery in ambulatory care settings. The IQHIT initiative report can be found at <http://healthit.ahrq.gov/asqiqhitreport>. Areas of interest highlighted in the IQHIT report include providing patient-specific information, clinical knowledge, and decision support; supporting clinical workflow; coordinating care; and understanding the impact on outcomes.
- **Enabling Patient-Centered Care Through Health IT** (PCC) (FOA HS-07-007) was designed to investigate approaches to improve the patient experience of care through the use of health IT in ambulatory care settings. The PCC initiative report can be found at <http://healthit.ahrq.gov/asqpc-report>. Areas of interest highlighted in the PCC report include patient self-management, providing access to medical information, patient clinician communication, and shared decisionmaking.
- **Improving Management of Individuals With Complex Healthcare Needs Through Health IT** (MCP) (FOA HS-08-002) supported projects that investigated novel methods or evaluated existing strategies for both clinician, and patient and family use of health IT in ambulatory settings to improve outcomes for patients with complex health care needs. The MCP initiative report can be found at <http://healthit.ahrq.gov/asqmcpreport>. Areas of

interest highlighted in the MCP report include providing high-quality appropriate care through the use of health IT; integrating patient information across transitions in care; shared decisionmaking and patient-clinician communication; strategies for safe, successful, and productive adoption of health IT in ambulatory settings; and impact of health IT on outcomes related to patients with complex health care needs in ambulatory settings and across high-risk transitions in care.

### Characteristics of the Projects

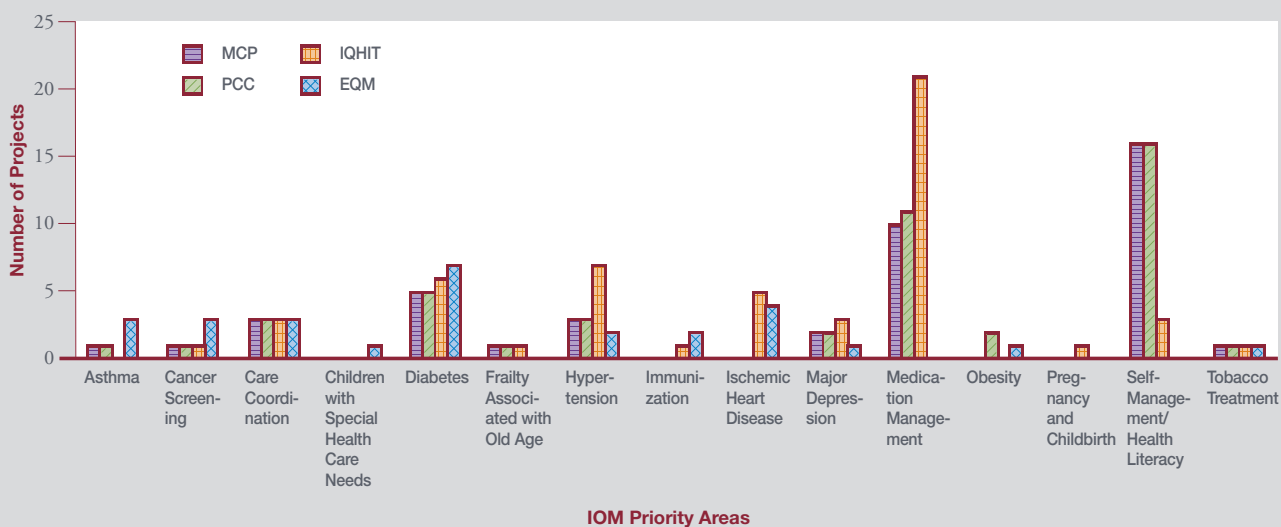
The ASQ projects involved the development, implementation, and evaluation of a range of health IT applications including EHRs, HIE applications, secure messaging, interactive voice response (IVR) systems, PHRs, and clinical decision support (CDS) systems. Forty-eight of the projects took place in a primary care setting and 10 projects in specialty care ambulatory settings; specialty settings included oncology, mental health, and dental practices. Organizationally, the clinical settings included community health centers, federally qualified health centers, physician offices, public health clinics, and hospital-based outpatient clinics.

As shown in Figure 1, the projects addressed a range of relevant care topics, including 16 of the priority areas for health care quality improvement identified by the Institute of Medicine (IOM, 2003). Figure 1 shows the number of projects in each initiative that addressed each IOM priority area. Each project addressed at least one IOM priority area.



FIG.

1

**IOM Priority Areas Addressed Across ASQ Initiatives\***

\*Some projects addressed multiple priority areas.

**Organization of This Report**

This report is organized around 10 key aspects of ambulatory care that illustrate ways in which health IT can be used to improve safety and quality in ambulatory settings. It includes a brief background section on each topic, as well as highlights describing how the ASQ projects addressed that topic. The 10 aspects of ambulatory care discussed in the report are as follows:

1. Developing and Testing Quality Measures
2. Capturing and Integrating Data to Support Quality Measurement and Improvement
3. Providing Clinicians With Patient-Specific Information, Clinical Knowledge, and Decision Support
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6. Managing Medications
7. Supporting Patient Self-Management
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## Using Health IT To Support and Improve Key Aspects of Ambulatory Care

This section discusses approaches taken by researchers across the ASQ initiatives to use health IT to support and improve key aspects of ambulatory care. For each subsection, the ASQ initiatives that most directly focused on the aspect of care are noted, although some projects in other initiatives also addressed each topic area. More information on the specific projects, approaches, and findings in each topic area can be found in the initiative-specific reports discussed in the Introduction.

### Developing and Testing Quality Measures

#### Background

Quality measurement and feedback are important aspects of improving the delivery of ambulatory care. Yet traditional approaches to clinical quality measurement usually required labor-intensive, time-consuming manual record reviews, analysis of claims data from third-party payers, voluntary reporting of rare or adverse events, or combinations of these approaches. These measurement approaches are particularly challenging in ambulatory care settings, which often have limited resources for quality improvement activities. It may be difficult to collect the needed data and conduct the analysis needed to support effective quality measurement using these approaches, as the costs of manual record review may be prohibitively expensive, the analysis of claims data may lack clinical nuance and accuracy, and voluntary reporting systems may be underused. EHRs and other types of health IT can help overcome these limitations, making it possible to create new quality measures focusing on specific clinical areas or care processes.

#### Highlights From the Projects

Among the ASQ initiatives, EQM most directly focused on developing and testing the validity and accuracy of health IT-enabled quality measures, with 12 projects addressing these areas. By using

EHR-based data, the EQM researchers were able to measure clinical service delivery of preventive care and chronic disease management processes, communication, care coordination, or medication management of particular relevance to ambulatory quality and safety. Examples of the types of measures developed and tested in these studies include measures of diabetes treatment intensification and cardiovascular disease management, and indicators for potential diagnostic errors.

Several of the ASQ researchers assessed health IT-enabled measures for validity and accuracy by, for example, testing the association between high performance on process or intermediate outcome measures and improved health outcomes. In addition, these projects evaluated the extent to which new measures were accurate relative to an accepted source of information, such as manual record review, to understand the likelihood of false positive or false negative results. In general, these projects found that the accuracy of health IT-enabled quality and safety measures is relatively high compared to manual record review and the approach requires significantly less time and effort.

### Capturing and Integrating Data To Support Quality Measurement and Improvement

#### Background

EHR systems are primarily designed to support the delivery of health care services by documenting the health of a patient, diagnoses, procedures, medications, and history, as well as facilitating the flow of information among clinicians. The data stored in EHRs also can be used for quality measurement if they are adequately captured in enough detail at the time that services are delivered, extracted from clinical databases where they may be stored in multiple or varied formats, and integrated and merged across

multiple sources and systems when necessary to assess a particular quality measurement concept.

Health IT can support and improve quality measurement by efficiently combining data from multiple sites and data sources, a function that is particularly important in ambulatory care settings where patients may receive care from multiple providers. To be useful, however, all the data must be consistent and comparable. The process of bringing the information together—commonly referred to as “data integration”—can be challenging. The various data sources may not communicate with each other, the data may not be coded or stored in the same place or manner, or it may not be available at the same time.

### Highlights From the Projects

Among the ASQ initiatives, EQM most directly focused on approaches for capturing and integrating data to support quality measurement and improvement, with 12 projects addressing this area. These projects used one or both of two major strategies to enhance the ability of health IT systems to capture and extract data for measurement. The first strategy focused on capturing structured data, whereby researchers developed and implemented customized prompts, templates, and other tools to allow clinicians to enter relevant data in a standardized format, in some cases working directly with EHR vendors. The second strategy related to extracting unstructured data, with researchers employing natural language processing (NLP) techniques that use advanced algorithms to search the free-text portions of the EHR (e.g., narrative notes) to extract relevant data not available in structured fields.

To address the challenges of data integration, the projects devoted a significant amount of time to mapping information from multiple sites and sources, taking into account variations in coding practices, database designs, and data availability. Mapping refers to the process of determining which data elements from different systems or sources get used in the calculation of quality measures. Projects set in integrated health systems or from organizations with a history of collaboration on data sharing (e.g., practice-based research networks) seemed to have an

advantage in this regard, as the sites involved used similar health IT systems or had access to an integrated database. In most cases, however, creative, new strategies such as the development of matching algorithms and new procedures for coding and reviewing data were required to achieve successful data integration, even in organizations with significant experience using EHRs. These efforts at data integration were often complicated by legal and privacy restrictions on sharing data across organizations.

## Providing Clinicians With Patient-Specific Information, Clinical Knowledge, and Decision Support

### Background

Because of the large amount of medical research that is published and the corresponding development of evidence-based clinical practice guidelines, clinicians face a challenge in staying abreast of current knowledge of prevention and treatment recommendations. This is especially challenging in ambulatory care settings because of the wide range of conditions that may be seen. Health IT has the potential to address this challenge by making available relevant information about evidence-based practices, along with important information about each patient’s history, values, and preferences, to guide and support clinical decisionmaking. The goal of such efforts is to improve the quality and patient-centeredness of care by increasing adherence to evidence-based practices relevant to the care of individual patients.

### Highlights From the Projects

The IQHIT initiative focused most directly on providing clinicians with patient-specific information, clinical knowledge, and decision support, with 15 projects addressing this topic. Many of these projects developed or tested electronic CDS systems that provide evidence-based information to clinicians at the point of care, typically by matching patient-specific information (e.g., a current medication regimen or a recent laboratory result) to an evidence-based clinical knowledge set (e.g., known drug interactions or clinical contraindications). The systems then gener-

ated customized assessments or recommendations that were communicated to clinicians in a variety of ways. For example, several developed and tested interventions that offered multiple forms of decision support at the point of care, such as guideline-based alerts or recommendations, order sets, documentation templates, and clinical reminders. Some of these approaches also included retrospective feedback on quality measures, such as comparisons of clinician or clinic performance relative to benchmarks and lists of patients in need of services. Other projects created and assessed CDS systems that emphasized one or a few of these forms of support, or focused on specific clinical processes.

In addition, some of the researchers addressed barriers to the effective use of CDS systems and other types of health IT systems. While generalizations are difficult, success seemed to be driven by the degree to which clinicians received timely and actionable performance feedback and decision support. In addition, the project findings show the importance of having clinicians provide input into which measurement and improvement-related activities will be implemented and how they should be structured to fit into clinical workflows. They also highlight the need for training, tools, and support to help clinicians perform these activities. Such support proved to be important even in situations where clinicians had substantial prior experience using EHRs.

## Providing Clinician and Patient Access to Medical Information

### Background

Health IT has great potential to improve access to medical information that can inform and allow for the tailoring of health care service delivery to the health conditions, needs, and preferences of individual patients. Through health IT, patients and their families and caregivers can receive information drawn from patients' medical records to guide followup activities and support self-management. Health IT also can provide clinicians with timely access to health information from patients that would not oth-

erwise be readily available, such as patient-reported symptoms or side effects. This information can support rapid review and intervention as needed, and may be especially useful in ambulatory care settings where patients and clinicians often have ongoing, long-term relationships.

### Highlights From the Projects

The PCC initiative specifically focused on providing access to medical information, with 10 projects addressing this area. These projects used technologies such as personal health records, interactive voice response systems, and interoperable medical devices to enhance the ability of patients, families, and caregivers to share information with clinicians on symptoms, side effects, vital signs, health behaviors, and treatment adherence, with the goal of improving monitoring and facilitating timely interventions when warranted. Several also used health IT to support the two-way flow of appropriate medical information between patients, families, caregivers, and clinicians, including the exchange of care plans, laboratory or radiology results, problem lists, and reminders for needed services. Many of these projects demonstrated improvements in outcomes, such as preventive and chronic disease management process measures and patient self-management, although often these improvements were concentrated among patients who used the technologies most intensively.

## Improving Shared Decisionmaking and Patient-Clinician Communication

### Background

Shared decisionmaking is a process in which both the patient and physician contribute to the medical decisionmaking process to arrive at informed, mutual choices. Clinicians explain treatment alternatives to patients, along with information on risks and benefits, so that patients can choose the option that most closely aligns with their values and priorities. When a patient more fully participates in the decisionmaking process, self-management behaviors improve. The use of health IT can support shared decisionmaking along



with other aspects of patient-centered care that depend upon successful patient-clinician communication. Electronic communications can enhance and extend the personal connections patients have with their doctors and other clinicians, offering patients the opportunity for sustained collaboration and more involvement in their own care, especially for the ongoing patient-clinician relationships often found in ambulatory care settings. For example, secure messaging or electronic visits can substitute for or supplement in-person clinical visits. They can also support effective clinical interactions during office visits by helping patients and clinicians better prepare for the visit.

### Highlights From the Projects

Both the PCC and the MCP initiatives focused on improving shared decisionmaking and patient-clinician communication, with nine PCC projects and four MCP projects addressing this area. Several projects used health IT applications to help patients and clinicians develop and carry out collaborative care plans arising from a shared decisionmaking process. Others used health IT to support synchronous or asynchronous secure messaging or electronic visits to facilitate timely interactions between patients and clinicians. Some of these projects used structured forms or templates that standardize the information to improve its completeness and consistency and reduce the possibility of miscommunications, with the information becoming a part of the medical record. Others took advantage of the convenience and efficiency of telephone communication for automated gathering of information. These health IT-enabled forms of patient-clinician communication served a variety of clinical goals. Some supported convenient medication refills or consultations with care managers or dietitians. Others supported effective office visits by helping patients and clinicians prepare for the visit by gathering pre-visit information on medications, risky behaviors, signs and symptoms, or care plans. Among the barriers to the use of health IT for patient-clinician communication identified by these researchers were concerns for the privacy of personal health information and limited reimbursement for e-visits.

## Managing Medications

### Background

Medication management is a complex process that includes prescribing and ordering, order communication, dispensing, administration, monitoring, education, and reconciliation.<sup>1</sup> Medication management is part of effective care management for a large percentage of the population, especially older adults or individuals with complex health care conditions. These patients may require complex medication regimens to effectively manage their conditions. This is a key safety issue in ambulatory settings, as medications are managed at three-fourths of all office visits (NCHS, 2010). Health IT has the potential to improve all phases of medication management through the use of both clinician and patient-focused applications as described below.

### Highlights From the Projects

Both the PCC and IQHIT initiatives specified medication management as a funding preference area. Many projects within PCC and IQHIT received this funding preference, and a total of 11 PCC projects and 21 IQHIT projects addressed aspects of medication management. These projects studied the use of health IT, including IVR, NLP, videos, PHRs, and EHRs, to improve various aspects of medication management such as—

- Evaluating the design and operation of e-prescribing systems, testing the impact of medication safety alerts, and facilitating the transmission of medication orders to the pharmacy.
- Evaluating improvements in the design of clinician interfaces for e-prescribing and medication management components of EHRs, using qualitative methods and simulation studies.
- Supporting medication reconciliation through communication and sharing of information in ambulatory settings and during transitions from the hospital setting to ambulatory care.

1. Medication reconciliation is a process used by health care providers and pharmacists to gather a complete and accurate list of a patient's prescribed and home medications; identify discrepancies in drug regimens in different levels of care, care settings, or points in time; and use that information to inform prescribing decisions and identify and prevent medication errors (Boockvar et al. 2006).

- Improving patient adherence to medication regimens by reporting instances of potential non-adherence to clinicians and facilitating interventions with those patients.
- Enhancing the capabilities of EHRs to support appropriate prescribing, dosing, and monitoring of medications.
- Increasing the ability to detect and prevent medication errors that can harm patients.
- Educating patients on appropriate medication adherence, medication safety, and other issues.

Through these projects, the researchers learned how to better gather, organize, and present medication information to improve clinician recall and use of this information during medication management. The studies demonstrated that successful medication management is a complex process that is distributed across multiple professionals and settings that requires continuous collaboration over time.

## Supporting Patient Self-Management

### Background

Ambulatory clinicians can support patient self-management, which can enable patients to improve their own health outcomes, by providing education and other interventions to increase patients' skills and confidence in their ability to set health goals, assess progress towards goals, and overcome barriers to achieving goals. Self-management support programs may be able to help patients with chronic conditions such as asthma, cardiovascular disease, depression, diabetes, heart failure, or migraine headaches. They can also support patients in managing other health-related activities that may not be specific to a given condition such as medication management, prevention and wellness, or self-management before or after ambulatory visits.

### Highlights From the Projects

The PCC initiative designated supporting patient self-management as an area of interest, and all 16 PCC projects addressed this area. Projects that

addressed this area focused on studying how health IT can help patients manage a range of chronic conditions, including diabetes, hypertension, asthma, major depression, cancer, and sleep apnea. Several focused on educating patients and supporting self-management before or after ambulatory visits or after hospital discharge. Projects also supported patient self-management of prevention, wellness, or monitoring activities such as exercise and nutrition or the receipt of clinical preventive services. Multiple projects used PHRs to support patient self-management by giving patients a way to document and monitor their own symptoms or biological indicators such as blood pressure, weight, or blood glucose. These systems also provided a platform for delivering educational materials to patients. Several of the PCC researchers used focus groups or other qualitative methods to gather input from patients during the process of designing their interventions. This input helped them address patient concerns regarding the privacy and security of personal health information, allowed them to translate medical information into consumer-friendly language that was culturally and linguistically appropriate and guided the design of electronic user interfaces.

## Integrating Patient Information Across Transitions in Care

### Background

Safe and effective transitions across care settings or providers of care are critically important, as there is increased risk of adverse events (e.g., medication interactions, new or worsening symptoms, transfer to a higher intensity care setting, or death) during transitions between ambulatory care settings, or to ambulatory settings from other settings such as hospitals, home care, and nursing homes. Health IT can play an important role in ensuring effective transitions by integrating or transferring patient information across settings. Key topics for research are to better understand what information is needed from the various participants in care delivery (e.g., primary care practices, home health care, skilled nursing facilities, and patients themselves) to enable effective ambula-



tory care and improve patient outcomes; how the integration of information from all clinicians (e.g., physicians, nurses, and other clinicians) and settings can improve the quality and safety of care, including effectiveness, patient-centeredness, efficiency, and equity; and how health IT can support effective communication at the time of patient hand-offs and transitions to institutional and community settings.

### Highlights From the Projects

The PCC and MCP initiatives designated care transitions as an area of interest, with two PCC projects and eight MCP projects addressing the area. These projects focused on patients who were transitioning to or from an ambulatory setting and included strategies for transferring or integrating information across settings of care. The investigators used a variety of technologies for this purpose, including regional HIEs, PHRs linked with EHRs, and automated telephone systems. These technologies supported a range of approaches for delivering high-quality care across transitions, such as enhanced hospital discharge management, improved patient monitoring following transitions, transmittal of information from hospitals to primary care practices following patient discharges, and improved medication reconciliation and management. The researchers confronted challenges when integrating data from one setting of care into the clinical workflows in another organization. In some cases they devised alternative solutions, such as use of manual faxes when it proved impossible to transfer data directly into the EHR at the receiving organization. In other situations, clinician usage of the information regarding transitioning patients remained low despite the efforts of the research teams to make the information as accessible and useful as possible, highlighting the difficulty of this type of practice change.

## Coordinating Care

### Background

Care coordination is “the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient’s

care to facilitate the appropriate delivery of health care services” (AHRQ, 2007). It is very important in ambulatory care settings because patients often see more than one ambulatory care provider, or are transitioning to or from an ambulatory setting. Ineffective care coordination leads to many inefficiencies and costs, including duplicate testing and procedures, lack of medication reconciliation, unnecessary emergency department visits, and preventable hospital admissions and readmissions. Health IT, particularly HIE technologies that support the sharing of information across multiple clinicians and organizations involved in a patient’s care, can play a critical role in promoting effective care coordination by ensuring that all of the clinicians involved in a patient’s care have access to the right information at the right time across settings of care. Health IT systems may also be used for initiating referrals and returning results from lab and radiologic tests, and specialty consultations. They may also facilitate the development and oversight of care plans, and improve tracking and monitoring of the delivery of care across clinicians and settings.

### Highlights From the Projects

Care coordination was an area of interest within the IQHIT initiative and three of the IQHIT projects addressed the topic. Eight of the MCP projects also addressed this topic. Several of these projects focused on ensuring that primary care physicians receive timely, appropriate information from hospitals after one of their patients has been discharged. Others developed or used health information exchange capabilities across providers of care in a region, facilitating the exchange of patient-specific clinical information. The types of information exchanged include diagnoses, procedures, the identities of clinicians on the care team, scheduled appointments, medications, and specialist notes. Health IT systems that supported care coordination were frequently used by care managers responsible for developing and managing individualized care plans tailored to the needs of patients. In several studies the care manager role proved to be especially important for facilitating successful care coordination, as clinicians often did not change their routine clinical workflows in ways that would

be necessary for timely information sharing and use across organizations. The care managers were effective at transmitting and receiving patient information so that it could be used at the point of care to guide clinical and patient-centered decisionmaking, as this was one of their primary responsibilities.

## Improving Outcomes for Vulnerable Populations

### Background

Vulnerable populations include individuals with little or no access to stable health care coverage and who are typically served by safety net providers. These include the uninsured, low-income individuals, Medicaid beneficiaries, patients with special health care needs, minority populations, immigrant populations, and geographically or economically disadvantaged communities. Many rural and inner-city communities are medically vulnerable as well. These groups are at risk of not obtaining necessary medical services because of financial, social, geographical, or health-related barriers. Health IT may have the potential to improve the quality and accessibility of care for a variety of vulnerable populations by connecting

vulnerable populations to primary care and other ambulatory care settings rather than higher cost settings such as hospitals and emergency departments.

### Highlights From the Projects

Both the PCC and IQHIT initiatives specified vulnerable populations as a funding preference area. Eight of the PCC projects and eight of the IQHIT projects received the funding preference, and others within these and other ASQ initiatives also focused on facilitating the use of health IT to improve the quality of care for vulnerable populations. These projects were designed to meet the health care needs of populations such as low-income patients without insurance, Medicaid beneficiaries, low-literacy populations, racial and ethnic minorities, the frail elderly, and patients served by rural primary care practices. Several used focus groups, user testing, and other qualitative research methods to design interventions to be sensitive to the language, technological, and other relevant needs and considerations of these populations. The researchers found that technologies such as cellular phones and DVDs could be effective ways of communicating with members of vulnerable population groups to engage them in the care process and support self-management.

## Impact on Outcomes

This section summarizes the impact of selected ASQ projects on several types of outcomes, including process outcomes,<sup>2</sup> intermediate outcomes,<sup>3</sup> health outcomes,<sup>4</sup> and economic outcomes.<sup>5</sup>

### Process Outcomes

Many ASQ projects demonstrated improvements in process outcomes, including the provision of appropriate evidence-based preventive and chronic care (including medication therapy), acceptance and use of health IT by clinicians for decision support or documentation purposes, increasing effective communication among clinicians and between clinicians and patients, and the completion of ambulatory follow up visits. Highlights from five projects that illustrate the significant impact of health IT on process outcomes appear below:

**Grant Carrow, Ph.D.** (R18 HS 017157) evaluated the safety, security, quality, and effectiveness of electronic transmission of prescriptions for federally controlled substances such as narcotics, stimulants, and sedatives in the ambulatory setting. The research team found a number of provider workflow issues affecting the ability to use the e-prescribing system including provider identity authentication problems, inadvertent changes in operating system settings, and password changes. The researchers found that physicians' concerns about security measures were not realized after adoption. As providers gained confidence with the system, usage increased dramatically. At the community level, adoption depends upon a critical mass of pharmacies being capable of dispensing electronically transmitted controlled substances prescriptions.

**Elizabeth L. Ciemins, Ph.D.** (R18 HS 17864) developed and implemented a system that facilitates the exchange of information between the hospital and ambulatory care providers after a patient in a

rural area is discharged home from the hospital. The program initially focused on adults with at least two chronic conditions, but was later expanded to all patients. The care transition information system provides electronically generated discharge instructions, including a patient-friendly medication list, to the patient at discharge, and sends by fax the same information to the patient's outpatient clinic. The system prompts clinicians in rural areas to access more complete medical information through the hospital EHR. Participating patients were significantly more likely to visit a PCP within the first 14 and 30 days following discharge.

**Alex Krist, M.D., M.P.H.** (R18 HS 017046) created a PHR that gives patients direct access to information in their clinician's EHR and displays any of 573 tailored recommendations and reminders for 18 clinical preventive services based on information in the EHR and a patient-completed risk assessment. It also provides primary care practices with an easy-to-use summary of information from the PHR that is transmitted electronically to the EHR task list of the patient's primary care clinician for use at the point of care and whenever patients are due for services. Users of the PHR significantly increased the proportion of recommended preventive services that were up to date, from 68 to 74 percent. By contrast, the proportion of up-to-date services fell in both the control group and among members of the intervention group who did not use the PHR. More details on this project can be found at <http://healthit.ahrq.gov/KristSuccessStory2010.pdf>.

**James Mold, M.D., M.P.H.** (R18 HS 017188) created a PHR that enables patients to manage preventive services history, monitor personal risk factors and preferences, and create a tailored wellness plan. Patients are reminded to review and update their records, complete a health risk appraisal before their

2 Process outcomes include actions taken by members of a clinical team or by patients in the course of care delivery or self-management.

3 Intermediate outcomes are indicators that are impacted by processes and that may precede or lead to health outcomes.

4 Health outcomes are symptoms and conditions that patients can feel or experience.

5 Economic outcomes include costs, and measures of utilization that drive costs, such as hospitalizations and emergency department visits.

annual wellness visit, and print a copy of the wellness report before the visit so they can discuss it with their primary care clinician. Clinicians reacted negatively to the first version (implemented using a full-size kiosk in the waiting room), finding it too intimidating and conspicuous for private medical information. Instead, they supported replacing the kiosk with a small tablet computer with a touch screen, which fit in better to existing workflows. The evaluation of the project found that 84 percent of adult study participants received all recommended preventive services, well above the 67-percent rate in the control group. Among children, 95 percent of participants received all recommended services, compared to 87 percent in the control group. At the end of the study, participants had significantly fewer unaddressed preventive service needs than did those in the control group. More details on this project can be found at <http://healthit.ahrq.gov/MoldSuccessStory2013.pdf>, and <http://healthit.ahrq.gov/AHRQHealthITSuccessStoriesMoldVideo>.

**Dean Schillinger, M.D.** (R18 HS 017261) and his project team developed an automated telephone system to support shared decisionmaking. The system was programmed with a rotating set of queries about diabetes self-care, psychosocial issues, and access to preventive services. The system uses medication claims data to provide tailored queries and prompts based on each patient's medication history, with patients responding via touch-tone commands. Based on their answers, patients either hear relevant automated health education messages or receive a telephone call within 3 days from a language-concordant health coach who provides education and engages in collaborative goal-setting and action planning. The researchers found that participating patients exhibited improvements in key processes tied to better diabetes outcomes, such as regular glucose monitoring and foot examinations.

### Intermediate Outcomes

Several ASQ projects also demonstrated improvements in intermediate outcomes, including patient engagement and self-management skills; chronic disease control for hypertension, diabetes, heart disease, and other chronic conditions (with larger gains

often achieved by more frequent users of health IT); medication management; patient perceptions of and experience with care; patient use of personal health information; clinician perceptions of the usefulness of health IT; and patient satisfaction. Highlights from seven projects that illustrate the significant impact of health IT on intermediate outcomes appear below:

**William Adams, M.D.** (R18 HS 017248) used interactive voice-response technology to develop an automated conversational system to gather pediatric previsit personal health information and counsel parents by telephone. Parents reported that their children's pediatricians were more likely to discuss important issues identified by the previsit telephone system, including depressive symptoms exhibited by the parent, tuberculosis risk for the child, and medication use. Furthermore, parents who used the system reported feeling more prepared for their child's visit (81 versus 68 percent), were more likely to bring their medications to the visit (20 versus 9 percent), and were more likely to discuss medication issues with the clinician (85 versus 72 percent) compared to the usual care group.

Patients who received the care transition intervention implemented by **Dr. Ciemins** that facilitates the exchange of information after a patient in a rural area is discharged home from the hospital were more likely to report receiving education on their medications by phone after their hospitalization, and clinicians were significantly more likely to report that the care transition process was efficient and reliable.

**Penny Feldman, Ph.D.** (R18 HS 17837) developed two interventions designed to facilitate patient-clinician communication when they move to home health care from an acute care setting, with a particular focus on avoiding serious medication problems. The first uses an algorithm to provide alerts, reminders, and point-of-care decision support to home health nurses visiting patients at risk of a potentially serious medication problem after discharge from an acute care setting. The second intervention provides information about their medications to the patients at home, using electronic, CD, and hard-copy formats. Patients whose nurse used the system were more



likely to move below the threshold for medication complexity, indicating that their medication regimens had been simplified.

**Kevin Johnson, M.D., M.S.** (R18 HS 017216) developed and integrated a pediatric dose rounding algorithm into a Web-based system that can be integrated into an e-prescribing system to address the complexity of calculating the correct medication dose for children and infants. The algorithm also took into account the medication form along with patient age and weight. This algorithm eliminated the need for manual rounding to the nearest measurable and easily administered amount, which can lead to possible over or underdosing. Clinicians who used the system described it as potentially useful to assist with dosage rounding, but expressed preference for more flexibility in the recommendations for nonstandard medication schedules. Physicians in subspecialties that more frequently prescribe compounded medications found it useful that the system included these medications. More details on this project can be found at <http://healthit.ahrq.gov/JohnsonSuccessStory2013.pdf>.

**Kate Lapane, Ph.D.** (R18 HS 017281) created educational DVDs and associated print materials tailored to the specific drug regimens of individual patients who use warfarin or who have insomnia, depression, heart failure, or diabetes. Developed for elderly patients with low health literacy, the materials were designed to be culturally and linguistically inclusive and hence meet the needs of older adults from diverse backgrounds. The evaluation found that more than three quarters (76 percent) of patients who watched the tailored DVDs found them to be helpful, with many watching more than once and sharing them with friends and family. Overall, the program had a positive impact on medication self-management, including self-efficacy, reading of labels, storing of medications, and obtaining help with medications. Among those with insomnia or diabetes, knowledge scores increased after watching the DVDs. More details on this project can be found at <http://healthit.ahrq.gov/LapaneSuccessStory2010.pdf> and <http://healthit.ahrq.gov/AHRQHealthITSuccessStoriesLapaneVideo>.

**Dr. Mold** found that those using the aforementioned PHR reported a greater increase in their degree of activation than did those in the control group; 80 percent of participants felt that the system facilitated participation in their own care.

**Dr. Schillinger** showed that, when combined with medication counseling, the health IT and coaching intervention generated statistically significant improvements in diabetes self-efficacy and some subscales of self-management behaviors (e.g., exercise).

### Health Outcomes

Several projects from the PCC and IQHIT initiatives demonstrated improvements in health outcomes, including adverse drug events, physical functioning, and overall health status. Examples from two projects that demonstrated a significant impact on health outcomes include the following:

**Dr. Schillinger** found that participating patients (all of whom had diabetes) reported significantly greater improvements in physical function after 6 months than did similar patients in the control group.

**Gurdev Singh, Ph.D.** (R18 HS 017020) employed a systems engineering approach to improving medication safety. The study team worked with a group of four primary care practices, helping them to implement a Web-based Team Resource Management System built on an existing platform. The team focused on workflow issues, supporting each practice in identifying and prioritizing hazards, and then designing and implementing tailored interventions to improve medication safety. The study found that participating practices experienced a decreasing trend in adverse drug events (from 25.8 to 18.3 per 100 patients per year), while the rate remained the same in a control group of non-participating practices. While the difference was not statistically significant, the finding suggests that the program may be effective in improving medication safety.

## Economic Outcomes

Several projects from the MCP initiative demonstrated improvements in economic outcomes, such as hospital and emergency department utilization. Examples from four projects that demonstrated a significant impact on economic outcomes include the following:

**David Dorr, M.D.** (R18 HS 17832) assessed a health IT-enabled approach to care coordination and care management in primary care. This approach uses financial incentives, specially trained care managers, and monitoring software to help clinics better care for patients, such as frail elders, with complex chronic illness, those with multiple comorbidities, or patients with previous high utilization. The researchers found a significant decrease in hospital bed days in the 6 months following the implementation of the enhanced care coordination program.

In **Dr. Feldman's** study of medication management clinical decision support for home health nurses, patients whose nurse used the system were significantly less likely to be hospitalized (17.9 versus 21.3 percent).

**Terry S. Field, D.Sc.** (R18 HS 17817) created an electronic medical record-based medication recon-

ciliation system to enhance medication monitoring and follow up care for elderly patients with complex medical conditions transitioning from a skilled nursing facility to home. Most of the patients were in a skilled nursing facility following a hospital stay. The system provides alerts and key medication information to ambulatory care clinicians and to nurses making home visits, and demonstrated significantly lower ED visits within 30 days of discharge in the intervention group (17 versus 7 percent).

**Christine Ritchie, M.D., M.S.P.H.** (R18 HS 17786) developed an alternative to the traditional approach of having a nurse conduct home visits and telephone follow up after discharge from the hospital. The project team developed an IVR system that helps coach primarily patients in rural areas after they are discharged from the hospital to the home. The IVR system calls patients during specified intervals after discharge and stores the patient responses regarding symptoms, signs, behaviors, or other issues in a secure database that is monitored by a care transitions nurse. The nurse follows up on potential warning signs by telephone. The evaluation found that intervention patients had significantly fewer days out of the community due to a readmission in the first 30 days after discharge (0.5 versus 1.6).



## Conclusion

The projects funded under the AHRQ ASQ program advanced understanding of how to use health IT to support quality and safety measurement, facilitate clinician efforts to improve the quality of care, enable the delivery of patient-centered care, and better deliver care to patients with complex health care needs. These 69 projects addressed a wide range of interventions, methodologies, populations, technologies, and priority areas, reflecting the diversity of important research questions and implementation needs in this field. Researchers developed and tested new quality measures and assessed the accuracy and efficiency of health IT-enabled measurement, confronting the challenges of data capture, extraction, and integration across data sources. Other studies developed and tested a range of approaches to delivering patient-centered care with a focus on providing access to medical information and supporting patient-clinician communication, patient self-management, and shared decisionmaking. Projects that focused on clinician use of health IT developed and tested approaches for enhancing CDS, providing clinical information at the point of care, improving care coordination, and integrating health IT systems into clinical workflows. Some projects focused particularly on providing high-quality, appropriate care during transitions to ambulatory settings.

The findings and lessons from the ASQ program can inform researchers and front-line implementers who have a stake in using health IT to improve ambulatory safety and quality. Many of the projects dem-

onstrated impacts on the delivery of evidence-based care, increases in the patient-centeredness of care, and improvements in health outcomes. The rapid pace of technological change, plus the dynamic health care policy and reform environment, make the results and insights from this body of research particularly timely and relevant. These findings can provide a foundation for advances in the National Quality Strategy priority areas of making care safer, ensuring that patients are engaged as partners in their care, promoting effective communication and coordination of care, and promoting the delivery of effective care (HHS, 2012).

Several of the ASQ areas of interest were not substantively addressed. These include studying the use of HIE as a data source for quality and safety measurement, including public reporting, as well as studying the economic implications of health IT adoption and building the business case for these investments in ambulatory settings. These remain important yet challenging areas where additional research is needed. Many of the studies also highlighted the challenges of integrating new health IT systems or components into established clinical information systems and workflows, indicating the need for further research.

The continuing interest in use of health IT to improve health and health care delivery, and the positive impact of these approaches on a range of health care outcomes, make the results of the ASQ program timely and relevant to ongoing efforts to improve the quality and safety of care in ambulatory settings.

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