Health Information Technology in the United States:
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Chapter 1: Preface

Health information technology (HIT) has the potential to advance health care quality by helping patients with acute and chronic conditions receive recommended care, diminishing disparities in treatment and reducing medical errors. Nevertheless, HIT dissemination has not occurred rapidly, due in part to the high costs of electronic health record (EHR) systems for providers of care–including the upfront capital investment, ongoing maintenance and short-term productivity loss. Also, many observers are concerned that, if HIT follows patterns observed with other new medical technologies, HIT and EHRs may diffuse in ways that systematically disadvantage vulnerable patient populations, thus increasing or maintaining existing disparities in access to and quality of care. These and other concerns have led to public and private efforts that aim to increase the pace of and reduce disparities in HIT diffusion by formulating national plans for dissemination, catalyzing the development of standards to encourage interoperability and promoting public-private partnerships to develop HIT infrastructures at the local and regional levels.

Estimating EHR Adoption and Use

An information base that includes data on variation in EHR adoption by provider type and geography and reports on successful dissemination and implementation strategies is thought to be critical for future policy development in this area. Although numerous surveys have attempted to measure HIT adoption and use, our current understanding is limited by inconsistencies in sampling techniques, data collection instruments and terminology, as well as varying response rates. The existing research allows some general inferences, but it cannot be used to generate precise, valid and reliable estimates of rates and patterns of dissemination and use at any point in time or longitudinally. This research also cannot systematically identify areas where adoption and use are lagging, such as safety net institutions or other facilities serving vulnerable populations.

This report aims to improve the collection of data on EHR adoption among physicians, group practices and hospitals. The report first reviews existing data sources, including ongoing national surveys and one-time or regional studies. It then recommends a coordinated, systematic national approach to measuring EHR dissemination and implementation that builds on past data collection activities. Methodological guidelines, as outlined in this report, were developed to ensure that new survey content is designed to answer the following critical questions:

- What are the predictors of EHR adoption?
- Where are there gaps in adoption and do these vary by location, organization type, specialty, involvement with vulnerable populations and EHR functionality?
- How can precise, timely data on EHR adoption best be collected?

An important part of this work is to encourage efforts that focus on the accessibility of EHRs among vulnerable populations and the best ways to measure HIT adoption among providers serving these patients. This information should help policy-makers understand barriers to adoption among these physicians and hospitals and design policies to overcome them, laying the groundwork for detecting and reducing disparities in HIT diffusion.

Major Content Areas

This report builds on a previous project, initiated by the Office of the National Coordinator for Health Information Technology (ONC) last year, to design a standardized approach to measure and interpret the adoption of information technology within the American health care system. Our current work is funded by the Robert Wood Johnson Foundation (RWJF). The Foundation has a longstanding commitment to understanding and improving the quality of American health care. This commitment includes a multitude of efforts designed to help address all dimensions of the quality problem, including especially the inequities of care. The report aims to share the lessons of the ONC work more broadly and to provide a review of what is known about the state of HIT adoption, with a special focus on EHRs and vulnerable populations. It develops common terms and a definition of what constitutes "EHRs," as well as suggestions for the design and implementation of a multi-method approach to data collection.

Specifically, the second chapter, Defining Critical Concepts Related to the Adoption of EHRs, defines key terms related to the measurement of EHR adoption among doctors, medical groups and hospitals and recommends definitions for new and existing surveys. Based on its review of existing data on adoption, it proposes that an EHR definition based on multiple functionalities be used in future surveys. Chapter 3, Current Level of EHR Adoption: What Do We Know?, assesses the quality of existing surveys and their data and estimates current levels of adoption based on those surveys found to be of high quality. It also lays the groundwork for improving the information available to develop policies that promote EHR adoption by identifying critical information gaps and optimal approaches to addressing those gaps going forward. In Chapter 4, Will Differential HIT Adoption Exacerbate Health Care Disparities?, we define vulnerable populations and approaches for ensuring that the diffusion of EHRs among those providing care to these patients is monitored going forward. Chapter 5, Incentives and Barriers to HIT Adoption: Requirements for Policy Relevant Measurement, provides a framework for understanding barriers and incentives for HIT adoption. It also describes possible policies to increase adoption, including ways to evaluate their effectiveness. The next chapter, Survey Guidelines: Improving What We Know About EHR Adoption, recommends general methodological guidelines for applying best survey practices to the measurement of EHR adoption in the United States. Finally, Chapter 7 makes recommendations for improving existing, ongoing national surveys and for new survey efforts, where needed. It includes specific recommendations for surveying providers who serve vulnerable populations and for studying both the effect of EHRs on the provision of care and the use of EHRs to efficiently capture quality data.

Surveying Adoption: Current Findings and Future Directions

Based on existing, high quality survey data on EHR adoption, we estimate that 17 to 24 percent of physicians in ambulatory settings use EHRs to some extent. Our best estimate, based on the most recent data, is that the proportion of physicians with access to EHRs in 2005 was closer to 24 than to 17 percent. Also, 4 to 24 percent of hospitals have adopted computerized physician order entry (CPOE), the best proxy in current studies for EHR adoption in the inpatient setting. Our best estimate is that, as of 2005, the proportion of hospitals with functioning CPOE systems was closer to 4 than to 21 percent, and was possibly as low as 5 percent. Our review of the 36 surveys conducted in the past decade on the state of the science on EHR adoption in the United States also found that these surveys vary widely in the functionalities they measure, the respondents they target, the clinical settings they examine, the quality of their methodology, and, not surprisingly, their estimates of EHR adoption.

As mentioned above, the existing data on EHR adoption suffers from numerous technical problems. In addition, little information is available on stakeholders that disproportionately serve vulnerable populations, such as community health centers and public hospitals. Without reliable data on current EHR adoption levels, it will be difficult, if not impossible, for policy-makers to develop relevant incentives for their use, especially among providers serving vulnerable populations. Our review of existing survey data, in consultation with experts in information technology and survey design, led us to recommend a variety of methods to develop data that could be used for policies promoting the adoption and use of EHRs. As part of this process, we:

- Developed a common definition for EHRs and EHR adoption.
- Identified data needs for assessing EHR diffusion and use.
- Identified and evaluated existing data sources on EHR adoption and use.
- Identified gaps in the existing survey data.
- Designed a strategy for future data collection, including recommendations for new and existing surveys.

Previous Work

Our team draws from several institutions with relevant expertise: the George Washington University School of Public Health and Health Services, Department of Health Policy, the Institute for Health Policy at Massachusetts General Hospital/ Partners Health System, the Division of Internal Medicine, Brigham and Women's Hospital and the Clinical and Quality Analysis Group of Partners Health System. Previous projects of the groups involved include: a study defining and estimating the costs of developing a national health information network (NHIN), published in the *Annals of Internal Medicine*; a Robert Wood Johnson Foundation colloquium on measuring the diffusion of health care technology structured to assist the Office of the National Coordinator for Health Information Technology (ONC); an Agency for Healthcare Research and Quality (AHRQ)-funded evaluation of the Massachusetts' E-Health Collaborative; and an RWJF analysis of legal barriers to the widespread adoption of electronic health information reporting.

Also critical to our research process was the creation of an Expert Consensus Panel (ECP), composed of a group of national experts in areas relevant to developing definitive judgments and methodologies for measuring the adoption of EHRs, including survey design and interpretation, statistics, meta-analysis, EHR development and use, technology diffusion, qualitative research methods, economics, sociology, psychology, physician and hospital behavior, health care disparities and health care quality. These leaders represent agencies of the federal government currently conducting surveys that could be used for the purposes of this work; private sector consumers of the resulting data; and other potential funders of efforts to measure diffusion and use of HIT. The ECP held three meetings during the project, supplemented by smaller meetings of the technical subgroups (see Table 1 for a complete list of these groups and their members). These meetings addressed issues related to meta analysis, survey methods and identifying providers who disproportionately serve vulnerable populations.

We are grateful to these individuals for their enormous contributions to this effort and for their generosity in donating their time. We hope that their effort will be rewarded by contributing to improved understanding of the pace and determinants of HIT adoption and by the subsequent development of policies that optimize adoption and employment of innovative electronic technologies in medicine.

Table 1. **HIT Adoption Initiative Technical Working Groups**

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Chapter 2: Defining Critical Concepts Related to the Adoption of EHRs

Many groups and organizations have surveyed physicians and hospitals about their use of electronic health records (EHRs). But, to date, these measurement efforts have been of varying quality, used inconsistent terminology to describe EHRs and targeted different respondents.[1] Because of this methodological diversity, the available survey data cannot be combined or compared among different populations or among the same populations over time, and estimates of EHR adoption in the United States remain tentative.

One purpose of this report is to provide guidance on the best way to determine the level of EHR adoption nationally. Determining the level of EHR adoption must begin with a clear definition of critical terms so that both collectors and consumers of data on EHR adoption know what to measure and how to use the resulting data. In this chapter, we define key terms related to the measurement of EHR adoption among doctors and hospitals. We start by reviewing existing definitions of EHRs and EHR adoption as found in previous surveys and the health information technology literature, and then focus on how to further develop the content of EHR adoption surveys by specifying what it is they should attempt to measure. This includes recommended definitions for new and existing surveys, as well as implications for their use in these surveys, such as the appropriateness of various office personnel as respondents.

Guidance from the Expert Consensus Panel (ECP) was essential. The ECP helped us, for instance, develop definitions of an EHR and of EHR adoption for survey design. In order to generate better data than that currently available, we propose that an EHR definition based on multiple functionalities be used in future EHR adoption surveys. The steps the project team, along with the ECP, took to reach this conclusion included a modified Delphi process. We discuss these steps further in this chapter.

EHR Definitions: ISO and IOM

Many organizations have developed global definitions of EHRs. As an example, the International Organization for Standards (ISO)[2], a network of national standards institutes from 156 countries, issued a technical report that defines both a standard EHR and an EHR designed for an integrated health care system. The definitions are as follows:

> *Standard EHR*: A repository of information regarding the health of a subject of care, in computer processable form.
>
> *Integrated Care EHR*: A repository of information regarding the health of a subject of care, in a form able to be processed by a computer that is stored and transmitted securely and accessible by multiple authorized users using different applications. It has a standardized information model which is independent of an EHR system. Its primary purpose is the support of continuing, efficient and quality integrated health care and it contains information that is retrospective, concurrent and prospective.

Both ISO definitions emphasize that EHRs are not simply paper records viewable in electronic form, but store information in a form that can be processed. The integrated care version further specifies that information from individual records be collected in a system that supports continuing, efficient and quality integrated

health care. This latter definition, however, focuses on the capacity of the EHR rather than how it is actually used in practice. As another example, the American Hospital Association (AHA), in a 2005 survey, defined EHRs as "electronically originated and maintained critical health information, derived from multiple sources, about an individual's health status and health care. An EHR replaces the paper medical record as the primary source of patient information."[3]

As an alternative to a global definition of an EHR, researchers may ask survey respondents about a series of functionalities that could be used to construct a measure of EHR use. The Institute of Medicine (IOM), for example, has proposed the following core EHR functionalities[4]:

Table 2: **Basic EHR Functions Necessary to Promote Patient Safety, As Defined by the IOM**

Core Functionalities	Key Elements
Health Information and Data: patient information needed to make sound clinical decisions	medical and nursing diagnoses, medication lists, allergies, demographics, clinical narratives and test results
Results Management: ability to manage results of all types electronically	computerized laboratory test results and radiology procedure result reports, automated display of previous and current test results
Order Entry Management: entry of medication and other care orders, as well as ancillary services, directly into a computer	computerized physician order entry (CPOE); patient laboratory, microbiology, pathology, radiology orders; electronic prescribing of medication orders; nursing orders; ancillary service and consult referrals
Decision Support: computer reminders and prompts to improve prevention, diagnosis and management of patient disease	screening for correct drug selection, dosing and interactions with other medications; preventive health reminders for vaccinations, breast cancer screening, colorectal screening and cardiovascular risk detection; clinical guidelines and pathways for patient treatment; management of chronic diseases
Electronic Communication and Connectivity: online communication between the health care team, other care partners and patients	electronic communication tools—including integrated health records, e-mail and Web messaging—for use among health care team members, between physicians, laboratories, radiology and pharmacies and with patients; telemedicine or electronic communications between providers and patients who reside in remote areas; home telemonitoring for the elderly or others with chronic diseases
Patient Support: education and self-testing	computer-based patient education; home telemonitoring for patients with chronic diseases
Administrative Processes: electronic scheduling systems and billing and claims management	electronic scheduling systems for hospital admissions, inpatient and outpatient procedures and visits; validation of insurance eligibility, claim authorization and prior approvals; identification of patients eligible for clinical trials
Reporting and Population Health Management: clinical data collection to meet public, private and institutional requirements	clinical data represented with standardized terminology and in a machine-readable format to meet federal, state, local and public health reporting requirements; also to meet organizational reporting requirements for key quality indicators

A single set of functionality measures, however, is not sufficient for every health care setting, or even for all respondents within a care setting (see following section for details). Adoption issues can differ significantly between ambulatory and inpatient settings, and separate content needs to be developed for each setting. Important functionalities in an inpatient setting may include:

1. Radiology department systems (such as the Physics and Astronomy Classification Scheme (PACS) and Radiology Information Management System (RIS))[i]
2. Medication administration subsystems, possibly with extensions for automated patient identification and bar coding
3. Laboratory information systems
4. Pharmacy department systems
5. Nursing notes
6. Operating room management systems
7. Critical care and cardiac monitoring systems
8. Emergency department systems
9. Clinical data repositories that integrate information from multiple departmental systems
10. Clinical decision support systems that provide alerts, reminders and other care guidance to the provider
11. Scheduling systems.

National Surveys: Defining EHRs

The need to develop a common, valid definition of an EHR is relevant both to the revision of existing surveys and to the design of new surveys. Currently, the only ongoing national surveys of physicians and physician groups that address the use of EHRs are the National Ambulatory Medical Care Survey (NAMCS) and the Medical Group Management Association (MGMA) Assessing Adoption of Health Information Technology project; the only ongoing national survey of hospitals is the National Hospital Ambulatory Medical Care Survey (NHAMCS). However, the NHAMCS survey only measures EHR adoption in outpatient hospital departments. (The AHA's annual survey does not yet include measures of EHR adoption).

First conducted in 1973, the NAMCS began asking about EHR use in 2001. The EHR module was expanded in 2005 to include a number of questions about EHR functionality. In 2005, the last year for which data is available, NAMCS surveyed 1,281 office based physicians, asking them to provide information on a random sample of patient visits during a one-week period.[5] The 2006 NAMCS survey asked: "Does your practice use electronic medical records (not including billing records)?"[6] If the answer is "yes, all electronic," or "yes, part paper and

i In medical imaging, picture archiving and communication systems (PACS) are computers or networks dedicated to the storage, retrieval, distribution and presentation of images. PACS replaces hard-copy based means of managing medical images, such as film archives. It expands on the possibilities of such conventional systems by providing capabilities of off-site viewing and reporting (distance education, tele-diagnosis). Additionally, it enables practitioners at various physical locations to peruse the same information simultaneously, (teleradiology). With the decreasing price of digital storage, PACS systems provide a growing cost and space advantage over film archives. A radiology information system (RIS) is a computer system that assists radiology services in the storing, manipulation and retrieval of information. These systems electronically manage different aspects of radiology workflow including exam ordering and scheduling, patient registration and worklist generation, transcription and management reporting and results distribution.

part electronic," it then asks: "Does your practice's electronic medical record system include:

1. Patient demographic information?

2. Computerized orders for prescriptions?
   If yes, ask– (a) Are there warnings of drug interactions or contraindications provided?
   (b) Are prescriptions sent electronically to the pharmacy?

3. Computerized orders for tests?
   If yes, ask–Are orders sent electronically?

4. Lab results?
   If yes, ask–Are electronic images returned?

5. Imaging results?
   If yes, ask–Are electronic images returned?

6. Clinical notes?
   If yes, ask– (a) Do they include medical history and follow-up notes?
   (b) Do they include reminders for guideline-based interventions and/or screening tests?

7. Public health reporting?
   If yes, ask– Are notifiable diseases sent electronically?"

Respondents could answer "yes," or "not known" for each question. Two questions that follow ask: *"Are there any of the above features of your system that you do not use or have turned off?"* and *"Are there plans for installing a new EMR system or replacing the current system within the next three years?"* The 2006 NAMCS, however, lacks items that address patient support or administrative functions.

The MGMA survey examines the use of information technology, including EHRs, among medical group practices with three or more physicians. Last conducted in 2005, it contains data on 3,354 medical group practices that can be used to create nationally representative estimates of adoption among medical group practices (Flaws in the MGMA database, however, somewhat limit the survey's findings.). The MGMA survey defined an EHR as "accessible through a computer terminal that stores patient medical and demographic information in a relational database." It then asked questions about a practice's current level of information technology adoption, including its patient appointment system, referral authorization system, referral tracking system, clinical laboratory order entry system, clinical laboratory results system, radiology or imaging order entry system, radiology or imaging results system, prescription writing system, prescription refill system, drug interaction warning system and medical records system.

Specific to EHRs, the MGMA survey asked: "As of today, what is your degree of electronic health record implementation?" and offers the following responses:

1. Fully implemented for all physicians and all practice locations

2. Implementation in process or EHR is fully implemented for a portion of practice physicians or locations

3. Implementation planned in next 12 months

4. Implementation planned in next 13 to 24 months

5. Not implemented

It then asked practices that have implemented an EHR about the cost of the system. The next question looked at the EHR system's functionality, asking: "If your practice has implemented EHR, identify the specific functions currently available from the system:"

a. Patient demographics

b. Presenting complaint

c. Past medical history

d. Physical exam/review of systems

e. Visit/encounter notes

f. Procedure/operative notes

g. Laboratory results

h. Radiology/imaging results

i. Patient medications/prescriptions

j. Problem lists

k. Referrals to specialists

l. Consult/reports from specialists

m. Clinical guidelines and protocols

n. Drug reference information

o. Drug formularies

p. Drug interaction warnings

q. Immunization tracking

r. Integration with practice billing system

The final questions assessed the potential benefits of various EHR features for physician practices and barriers that have slowed, prevented or encouraged EHR implementation.

NHAMCS is a nationally representative survey of hospital emergency and ambulatory care departments. It includes questions on EHR use identical to those in the NAMCS survey. NHAMCS data can be used to make representative national estimates of EHR use in the outpatient hospital setting, but it does not address inpatient EHR use.[7]

Physicians or practice managers can respond to the NAMCS and MGMA surveys. As perceptions of EHR adoption may vary between these participants, the lack of respondent specificity raises questions about the reliability of any survey findings. Moreover, unless respondent physicians have received significant training or are

highly motivated to learn about EHR systems, they are unlikely to be aware of functions they do not use. Practice managers and CIOs may be a more appropriate respondent for questions that focus on EHR capabilities and physicians for questions about their use in practice. Thus, to ensure appropriate interpretation of the data, researchers should carefully track who the respondents are within each practice.

One-Time Surveys: Further EHR Definitions, Different Respondents

In addition to the measures in these ongoing national surveys, other high quality survey items have been used to assess EHR adoption as part of one-time investigations that are unlikely to be repeated in the future. These surveys also developed their own explicit or implicit definitions of an EHR. The following surveys asked respondents about specific EHR functionalities:

A survey conducted by researchers at the University of California, Berkeley, School of Public Health in 2005, called the National Survey of Physician Organizations and the Management of Chronic Illness[8], asked:

1. Does your group make available an electronic medical record that includes any of these components?:
    a. Ambulatory care progress notes
    b. Patient problem list
    c. The patient's medications
    d. Alerts about important abnormal test results at the time they are received
    e. Automatic alerts of potential drug interactions
    f. Decision support in the form of prompts or reminders at the time the physician is seeing the patient?
2. Do the majority of physicians in your group have electronic access to?:
    a. Clinical information on the patient's emergency room visits
    b. Hospital discharge summaries
    c. Outpatient reports from specialist physicians
    d. Radiology results
3. If yes for each of the above—"Is this accessible within an individual patient's electronic medical record?"
4. Can a majority of your patients access any part of their electronic medical record online?
5. Does your group access these electronic records to collect data for quality measures?

The Commonwealth Fund National Survey of Physicians on Practice Experience asked the following questions in 2003[9]:

1. Are the following tasks currently performed in your office practice?
    a. Physician receives an alert or prompt when special follow-up care is needed

b. Physician receives an alert or prompt about a potential problem with drug dose or drug interaction

Responses:
Yes, using a computerized system
Yes, using a manual system
No, not done–plan to in the next year
No, not done–no plan to in the next year

2. With the patient medical records system you currently have, how easy would it be for you (or staff in your practice) to generate the following information about your practice?

   a. List of patients by certain age groups

   b. List of patients by diagnosis or health risk

   c. List of patients by laboratory results

   d. List of patients by medications they currently take

   Responses:
   Cannot generate
   Very difficult
   Somewhat difficult
   Somewhat easy
   Very easy

3. Do you currently use each of the following technology tools in your practice?

   a. Electronic access to your patients' test results

   b. Electronic or computer-based decision support tools that provide real-time treatment recommendations or diagnostic support based on data about your patients and practice guidelines

   Responses:
   Yes, used routinely
   Yes, used occasionally
   Not used, plan to use within the next year
   Not used, no plan to use within the next year

The extensive capacity of emerging EHR systems poses a practical problem for survey researchers trying to define EHRs, as guidelines and standards are likely to become even more detailed and complex. Already, the Commission on the Certification of Health Information Technology (CCHIT) has proposed draft guidelines for the certification of ambulatory EHRs that include some 280 detailed functions. Even though inpatient and outpatient EHRs share many of the same core functions, hospital EHRs are generally recognized to be different and CCHIT is in the process of developing different certification standards for these systems.[10]

ECP Defines EHRs by Selecting Essential Functionalities From IOM List

As this review of EHR measurement tools demonstrates, the lack of agreement regarding the definition of an EHR remains a major challenge in developing survey content about EHR adoption. Prior surveys, including those listed above, address this issue by:

1. Telling respondents to use their own definition of an EHR.
2. Providing a definition and then asking a single global question.
3. Asking a series of questions regarding specific EHR functionalities and then aggregating the results to determine whether EHRs have been adopted.

A simplified framework is critical to developing survey content that provides reliable and valid measures of EHR adoption and is practical for designing and conducting surveys. The project team used several information sources to develop recommendations for a single set of survey domains. First, as part of our effort to provide a definitive national estimate of EHR adoption, the project team reviewed all known surveys of EHR adoption in the United States, including those mentioned previously. (Details of this work are presented in Chapter 3). Throughout this process, we received guidance from the ECP, the survey content working group and the disparities working group.

At an ECP meeting, held January 24–25, 2006, in Washington, D.C., a subgroup of the panel was given the responsibility of bringing suggestions to the full committee on which measures identified by our research team should be used to define an EHR. The ECP subgroup met three times to review the definitions used in extant, high quality surveys. This led to a general agreement that the core functions proposed by the IOM provided a useful framework for future discussions. The ECP subgroup also proposed key questions that could be developed to determine whether each core function is accomplished as part of an EHR or as a paper or manual process.

Although the entire IOM list of functionalities could be included in new EHR adoption surveys, existing surveys are likely to have space limitations. In order to reduce the number of items that need to be included, the project team sought guidance from the ECP on the EHR functionalities thought to be critical for "EHR adoption."

At the second in-person ECP meeting, held on April 5, 2006, in Washington, D.C., ECP members participated in a modified Delphi process to rank the IOM functionalities. The goal was to limit the functions to those that represent a basic level of EHR use and that absolutely have to be present to call an electronic data system an EHR. Votes were tallied and displayed to ECP members, who discussed the results and then voted a second time. This led to the designation of the following functions as essential to report that a practice or organization has a functioning EHR:

- health information and data;
- results management;
- order entry management; and
- decision support.

Defining EHRs: Further Considerations

ECP members who participated in the modified Delphi process were quick to point out that many of the eliminated functions, specifically those addressing interoperability, were key to integrated EHR systems. However, the percentage of physicians and organizations with EHRs that currently are interoperable with other providers and institutions is thought to be low. Thus, including interoperability in the definition of a "basic EHR" might result in misleading information about the extent of effective EHR adoption.

As EHR dissemination advances, connectivity is expected to become a core element for inclusion in future EHR definitions. Also, the Department of Health and Human Services (HHS) is interested in connectivity as a key functionality for health information systems in the United States. Thus, the project team has considered, in detail, what measuring connectivity as a dimension of EHRs would entail.

The American Health Information Community (AHIC), a private and public sector collaboration was established by HHS to help develop standards for electronic health information and advise the Secretary of HHS on HIT policy. The AHIC has emphasized the following connectivity domains as priorities: consumer-clinician messaging that includes online consultations, prescription refills, scheduling and referrals and lab results available to patients; online patient registration and medication history; and biosurveillance or public health reporting.[11] These topics have not been well covered in the ongoing, national surveys, such as NAMCS, NHAMCS and MGMA.

As EHRs become more widespread, new survey question content should be considered for the following connectivity domains:

- exchange of information between hospitals and admitting physicians;
- exchange of information among hospitals within a community;
- exchange of information between physicians and physician groups within a community;
- exchange of information between patients and hospitals (such as availability of patient portals that enable access to personal health records);
- exchange of information between patients and physician offices beyond lab results, e-mail and appointment scheduling;
- exchange of information between health plans and patients; and
- exchange of information between or among hospitals, physicians, pharmacies, nursing homes and home health care providers.

A Second Challenge: Defining EHR Adoption

Assessments of EHR adoption must go beyond measuring system functionalities to consider the temporal element inherent to the implementation process. EHR adoption is not one measurable event that occurs at a defined moment in time, such as the purchase or acquisition of the technology. Instead, adoption measures also must take into account the implementation and successful use of EHRs and their component parts.

We define "adoption" as a process that, for measurement purposes, captures the acquisition, installation and use of EHRs. The term "acquisition" can be further understood as the process of obtaining the technology (through purchase or other means), while "installation" consists of its deployment in working order within a health care setting. The term "use" connotes the actual employment of EHRs

in providing patient care and related functions. Our final measures for EHR adoption reflect these elements, as defined.

Acquisition, the first stage of the EHR adoption cycle, includes several measurable steps: researching systems, budgeting to obtain a system and investing in a system. The 2006 NAMCS survey addresses acquisition with the following question: "Are there plans for installing a new EMR system or replacing the current system within the next 3 years?" Others, such as the MGMA survey, do not address the issue of acquisition, which suggests that it might be an area ripe for content development. Subdomains that could be developed to gain a fuller understanding of the acquisition process include:

- Is the respondent planning to purchase, lease, rent or use or subscribe to a system acquired by someone else?
- Has the purchase, lease or rental occurred?
- Has all the necessary hardware and software arrived?

Questions about whether a purchase, lease or rental has occurred are thought to provide more reliable data on EHR acquisition than questions regarding plans to purchase a system.

To measure physician acquisition accurately, it is critical that those most knowledgeable about a practice's IT purchasing decisions complete the survey. Physicians in solo practice are the preferred respondent for questions targeting acquisition, while practice managers, IT personnel, or CIOs are typically the most appropriate choice in group practices. Surveys in the inpatient setting need to measure the acquisition of EHR systems at the departmental level. This is because hospitals often acquire systems for specific departments, such as laboratories and radiology, first, and then move on to other departments. Thus, an overall question about EHR acquisition in the hospital might not accurately capture adoption data.

Prior surveys have included questions about the acquisition of EHR systems, such as the Electronic Medical Records in Family Medicine survey used by Glenn A. Loomis and colleagues to assess EHR adoption among family physicians in Indiana.[12] This survey asked:

1. Does your practice plan to implement an EMR?
2. When do you plan to implement the system?

The second stage of EHR adoption is system installation. The 2006 NAMCS survey does not address installation; the MGMA survey asked about the degree of electronic health record implementation and future plans for implementation (see full question above in the National Surveys: Defining EHRs section). The survey also asked group practices that have implemented an EHR system a second question about the system's cost.

Because installation is incremental, the following subdomains could be used to clearly delineate where practices or organizations are in this process:

- Has the deployment of hardware and software begun within the organization? (By deployment, we mean that the equipment is available and working at intended sites of use.)
- Has deployment been completed?

- If not, in what percentage of planned locations has it been deployed?
- When is complete deployment anticipated?

Questions about the implementation process are best directed to practice managers, IT personnel and CIOs at both the group practice and hospital level. Again, in order to yield a complete picture of EHR penetration in hospital settings, surveys should focus on the department level as well as the enterprise-wide integration of data from departmental systems.

Questions about the third stage of the EHR adoption cycle, system use, are included in both the 2006 NAMCS and the MGMA surveys. However, neither survey contains items that address the entire list of functionalities recommended by the IOM. To capture the dimension of use, the NAMCS survey first asks respondents about their system's functionality and then if any of those functions are not in use or turned off. However, these questions may not adequately capture EHR use for several reasons. The initial survey question asks if the practice's electronic medical record includes each of the functionalities but not if the physician actually uses them. As physicians could choose not to use functions that are turned on in their system or not use functions because they are unaware their EHR has those particular capabilities, the "turned off" response is not an adequate proxy for use. Also, they may be reluctant to report that they do not use particular functions, leading to an overestimation of use.

The MGMA survey, in contrast, asked about the following functionalities:

- clinical laboratory order systems;
- clinical laboratory results systems;
- radiology/imaging order entry systems;
- radiology/imaging results systems; and
- prescription writing and refill systems.

For each functionality, respondents select from the following responses to indicate how their EHR accomplishes the relevant task:

- manual system using paper documents;
- computerized system used by practice staff;
- computerized system used by practice physicians; or
- a combination of the responses above.

As with the NAMCS survey, it is not clear that the MGMA survey provides reliable data on the use of EHRs within medical group practices. A practice manager generally completes the MGMA survey; while they are likely to be aware of the EHR system's capabilities, practice managers may not be aware of the functionalities that physicians in their practice are actually using.

Asking about the use of these functions at the point of care is likely to result in the most reliable data. Physicians could be asked, for example, if they pull a paper chart or turn to a computer for a patient's health information during an office visit. Physicians are more likely to provide reliable data when questions are directly related to their behavior when providing care, such as whether or not they use a particular EHR function, rather than asking if the EHR that they use has a certain capability.

By asking doctors in solo or small group practice if they use a particular function, researchers can infer that the practice has both acquired and installed the function. This may not be the case for larger group practices and hospitals, where EHRs may have been acquired, installed and used in some parts of an organization and not even acquired in others. In order to ensure that researchers can infer acquisition and installation from use in these settings, the study would require a sufficient number of respondents distributed across all units of the organization.

CIOs also can provide information about EHR acquisition and installation and are likely to be the most knowledgeable respondent for questions about EHR functionalities. However, like practice managers, they may not be the most reliable respondent for information about physicians' actual use of the system, and survey researchers may have to ask physicians to report on their own use of various EHR components in hospitals where they admit patients. Physicians who admit patients to more than one hospital could be asked to report on the hospital where the majority of their patients are admitted. This would allow researchers to report on the percentage of physicians using an EHR when they are seeing patients in a hospital and not the percentage of hospitals where physicians use EHRs.

Like questions aimed at understanding the acquisition and installation process, surveys of EHR use in the hospital setting need to be focused at the department level. However, they also should include items that allow researchers to determine the degree of hospital-wide data integration. If several different systems are in place, questions should determine the extent of their interconnectivity and physicians' ability to access all relevant data from a single terminal proximate to where they provide services in the hospital. For example, key indicators of integration might be discovered by asking:

- Can all data be accessed from a single workstation?
- Is there a single log-on and password?
- Can data be pulled together on one screen for viewing?
- Does the clinical decision support system integrate knowledge from multiple systems, or is it confined to only a partial view of the data?
- Does the physician have to learn widely different user interfaces among these systems?

Other Surveys: Assessments of Use

One-time surveys also have attempted to measure the use of EHR systems. Berkeley's 2005 survey asked respondents, who reported that their practice used a system with a particular capability, specific questions about its use.[8] The Community Tracking Survey asked if computers or other forms of information technology were used for various care management functions and communication about clinical issues.[13] The Commonwealth Fund's National Survey of Physicians on Practice Experience asked whether specific "technology tools" were used in a practice–electronic ordering, electronic patient records and electronic or computer-based decision support tools–and, if so, how often they were used.[9] Finally, the Electronic Medical Records in Family Medicine Questionnaire asked physicians about their current EHR use as well as the year they began using electronic records.[12]

Conclusion

The following summarizes our conclusions about the preferred approaches to defining critical terms related to the adoption of EHRs and presents general methodological guidelines for future research based on those conclusions. These guidelines were developed for use by federal agencies, such as ONC and other organizations that seek to apply principles of best survey practice to the complex issue of measuring EHR adoption in the United States.

- The minimal criteria for defining an EHR when measuring adoption include four functionalities: collection of health information and data, results management, order entry management and decision support.
- EHR adoption surveys should ideally include the following domains: EHR functionalities; acquisition, installation and use; barriers and incentives to EHR adoption; and practice and market characteristics.
- Both the NAMCS and MGMA surveys contain useful items on EHR adoption; however, to meet the project's goal of reliable adoption measures for policy development and to assess the needs of providers serving vulnerable populations, new content must be developed.
- There will likely be a need to develop survey content specific to the inpatient setting. The project team will seek guidance from the ECP and the survey content subgroup on this issue.
- Asking physicians about EHR use at the point of care is likely to result in reliable data on their adoption of EHRs. Moreover, researchers can assume that, if a physician reports using a function, then the solo or small practice has both acquired and installed the function. This assumption may not be the case for larger group practices and hospitals, where EHRs may be fully installed and used in some parts of an organization, but not in others. In order to ensure that researchers could infer installation from use, the study would require a sufficient number of respondents distributed across all units of a hospital or large group.
- Hospital EHR adoption surveys should focus at both the departmental level and at the hospital-wide level.

Chapter 3: Current Levels of EHR Adoption: What Do We Know?

As interest in EHR adoption has grown, there has been a proliferation of adoption surveys with varying methodologic rigor. Given that EHR adoption will likely become an important component of quality measurement, performance-related payments and population health assessments, understanding the level of adoption will be critical to assessing these programs and to guiding private and public policy interventions.

This chapter further describes and summarizes the recent available surveys and their findings on EHR adoption. It also assesses the quality of existing surveys and their data and lays the groundwork for improving the information available to develop policies that promote EHR adoption. Specifically, this chapter provides: (1) a current estimate of EHR adoption; (2) a method for arriving at a definitive assessment of EHR adoption based on existing data; and (3) recommendations regarding critical information gaps and optimal approaches to addressing those gaps in assessing EHR adoption going forward. It also constitutes a building block and precursor to a publicly accessible, searchable database of surveys assessing EHR adoption and a summary assessment of those existing surveys.

Environmental Scan: Choosing An Approach

The environmental scan undertaken for this report represents the most comprehensive synthesis of available information on the status of EHR adoption in the United States to date. Prior to settling on this approach, the project team considered alternate methods of obtaining EHR adoption data from sources other than surveys. Information generated in the process of using EHRs that is recovered by the government or other agencies, for example, could provide valuable data on whether EHRs have been adopted. The ECP agreed to consider data collection options, such as those related to automatic reporting devices, as they become available, with careful consideration of any privacy concerns.

The Expert Consensus Panel (ECP) members also highlighted several other sources of non-survey data. Researchers could examine financial trends in the information technology sector to gain information on both the sales of EHR systems and the number of companies producing them. This data could serve as a proxy for the demand for these systems. Trended, it also could indicate adoption rates and changes in the functionalities sold reflect, indirectly, changes in the way EHRs are used. Further, the number of companies applying for system certification from the Office of National Coordinator for Health Information Technology (ONC) could be used to estimate demand for EHRs with the minimal functionalities defined by the ECP.

There are, however, several challenges inherent to using financial data for estimating EHR adoption: vendors may have an incentive to overstate their sales data; and hospital and large group practices may purchase a number of different systems that are then integrated to form an EHR. In addition, though sales figures could provide an estimate of the number of systems purchased in a particular year, they would not be as useful for estimating the total proportion of providers and hospitals using EHRs. Thus, for all these reasons, financial data are unlikely to constitute a valid and reliable source of information for assessing the rate of EHR adoption. Such data should be evaluated as part of a thorough assessment of trends in EHR adoption, but they are unlikely to serve as a substitute for data developed through sample surveys that meet the guidelines laid out in this report.

Environmental Scan: Process

This section discusses the process we used to identify and then evaluate existing EHR adoption surveys of physicians, group practices and hospitals–including regional as well as national and international surveys–for the environmental scan. Specifically, the project team identified and collected all extant surveys addressing EHR adoption and use; developed a comprehensive data abstraction protocol to use in the environmental scan; identified key domains and variables for the creation of a searchable database; developed an objective scoring system for assessing the quality of existing surveys, including explicit criteria for the quality of data sources and studies (e.g. methodological rigor, relevance to priority populations and policy issues); scored each study or data source in terms of performance against those explicit criteria; and provided a summary assessment of existing data on critical questions related to EHR adoption. This section also identifies critical information gaps concerning EHR adoption that remain to be addressed.

The environmental scan carried out by our project team included published and unpublished data and reports completed between 1995 and 2005. Published data were initially obtained from the peer-reviewed medical literature, based on PubMed searches. Standard search techniques–Ovid, Google, Google Scholar and other search engines–were then used to obtain reports and data from non-peer-reviewed sources. Local and national EHR adoption experts reviewed the identified surveys and pointed out surveys that had been overlooked. With the survey reports in hand, the project team attempted to collect actual survey instruments. In many cases, these were proprietary and could not be accessed easily. But, requests for cooperation with this effort enabled us to obtain 22 of 36 survey instruments.

The next step was to identify key survey characteristics, or variables, useful for searching and assessing available surveys. Using an iterative process, we created an initial set of survey variables, which were subsequently reviewed by the ECP and its subcommittees. The final variables include:

1. *Survey Demographics*: survey name, sponsor, periodicity, year fielded, target respondent

2. *Clinical Functionalities Measured*: clinical notes, access to clinical evidence, patient registries, clinical reminders, e-prescribing, electronic order entry (non-medication), results viewing/tracking, critical results viewing, electronic referrals, links to regional data exchange network, personal health records–access to electronic data, personal health records–access to scheduling, personal health records–communication with electronic billing

3. *Survey Population Characteristics*: national versus state level, rural versus urban providers, unit of analysis (provider), safety net providers data, practice size and composition

4. *Survey Design*: survey methods, survey quality

5. *Clinical Setting Studied*: ambulatory versus inpatient, solo versus group, rural versus urban, safety net providers versus others

EHR functionalities were defined from a clinical operations perspective, according to the EHR features that providers or patients would recognize as aids in the clinical or administrative tasks needed to provide patient care.

Survey Quality: Measures Established

The project team rated the quality of a survey's methodology independently from its content. This is because surveys of high methodological quality may contain content measures that are not useful for measuring the adoption and use of EHRs and surveys of low or medium quality may contain very useful questions.

Survey quality was judged according to benchmarks set by the quality assessment literature and practice, which we adapted to meet the challenge of assessing surveys of EHR adoption. These efforts drew on the consensus in the field on the standards, best practices and guidelines for the conduct of survey and polling research developed by professional organizations including: American Association for Public Opinion Research (AAPOR), American Statistical Association (ASA), National Council on Public Polls (NCPP) and Council of American Survey Research Organizations (CASRO). The federal Office of Management and Budget (OMB) survey clearance process and several survey research texts also provided useful guidance.

Among these criteria sets, the AAPOR's standards for assessing survey quality are highly regarded and widely used. They include:

- have specific goals for the survey;
- consider alternatives to using a survey to collect information;
- select samples that well represent the population to be studied;
- use designs that carefully balance the costs of the survey with the need for data that is as accurate as possible.
- take great care in matching question wording to the concepts being measured and the population studied;
- pretest questionnaires and procedures to identify problems prior to the survey;
- train interviewers carefully on interviewing techniques and the subject matter of the survey;
- construct quality checks for each stage of the survey;
- maximize cooperation or response rates within the limits of ethical treatment of human subjects;
- use statistical analytic and reporting techniques appropriate to the data collected; and
- carefully develop and fulfill pledges of confidentiality given to respondents.

As mentioned above, the environmental scan only rated surveys of physicians, group practices or hospitals (and not the general public or consumers), including regional as well as national and international surveys. Also, in cases where a publication reported the results of more than one survey, the individual data sets underlying the reported surveys were separated out and rated independently when possible.

Assessing Quality of Survey Methods

Survey methodology was evaluated through a two-part assessment protocol: (1) availability of key methodologic issues, and (2) performance on critical methodologic indicators. The project team referred to publications, Web sites and other sources to evaluate whether information about the following survey variables was available: source of sample; sample size attempted and completed; sample design, response rate and method used to calculate it; dates of fieldwork; full questionnaire; disclosure of sponsor; and professional survey or research organization.

The second step involved rating the quality of survey administration on four critical dimensions:

1. *Representativeness*: Was the survey designed and conducted in such a way that the collected data well represents the stated population of interest?
   - High quality surveys had a well-defined population and sample source that avoided bias; they used a scientific method of drawing a random sample subset and data collection methods that minimized selection and response bias.
   - Medium quality surveys exceeded the standards of low quality surveys but fell short of the highest quality.
   - Low quality surveys used convenient or volunteer samples and modes of data collection that created unacceptable bias.

2. *Response rate effort*: Were diligent efforts made to enhance response rate and reduce response bias?
   - High quality surveys were diligent in achieving high response rates (50 percent or greater)–used multiple and varied respondent contacts, a sufficient field period, efforts to convert non-responders and refusals, and incentives where appropriate. They disclosed sufficient sample disposition elements to allow examination of cases (individuals in the original sample) from sample selection to completion.
   - Medium quality surveys (response rates of 30 to 50 percent exceeded the standards of low quality surveys but fell short of the highest quality.
   - Low quality surveys (response rates of less than 30 percent) used minimal contacts.

3. *Questionnaire development*: Was the survey pre-tested? Was the reliability and validity of key measures assessed in prior survey efforts or in the present one? Did the researchers attempt to minimize response bias and other sources of bias in question wording and context?
   - High quality surveys documented the questionnaire development processes, include pre-testing and provided information on the reliability and validity of key measures.
   - Medium quality surveys exceeded the standards of low quality surveys but fell short of the highest quality.
   - Low quality surveys had poorly designed or biased questions, were not pre-tested and provided inadequate information on the validity and reliability of key measures.

4. *Sample size*: Was the sample size sufficient to minimize sampling error and to achieve analytical objectives?
   - High quality surveys had sample sizes sufficient to minimize sampling error and assure sufficient statistical power for the analysis of critical variables and outcome measures.
   - Medium quality surveys exceeded the standards of low quality surveys but fell short of the highest quality.
   - Low quality surveys had sample sizes that provided inadequate statistical power to have confidence in survey results or to conduct key analyses.

Surveys that scored high on at least three of the four areas were given an overall "high" methods score, those that rated low on at least three of the four items were given a "low" score and all other combinations received a "medium" score.

Assessing Quality of Survey Content

Unlike the methods assessment, an overall indicator for content quality was not created because each content issue stands alone as an important and useful contributor to our understanding of EHR adoption. Also, numerous pieces of information about a survey, including the survey itself, must be available in order to rate a survey successfully and critical elements for assessing quality were missing or had to be inferred or calculated for several surveys identified by the environmental scan. A lack of data limited our ability to assess the quality of some surveys.

Content quality was rated according to a survey's relevance to six key areas approved by the ECP as the critical core elements for measuring EHR adoption. (One domain, "distinctions between acquisition, installation and use," was subsequently dropped as the project team found this content was rarely included in identified surveys). These areas include:

1. Whether the practice or organization has an EHR
2. Nature of EHR functionalities
3. Whether the survey distinguishes between EHR acquisition, installation and use
4. Measures of incentives for EHR adoption
5. Measures of barriers to EHR adoption
6. Ability to identify disparities in adoption among different at-risk populations.

Content quality in these areas was rated through a two-stage process. First, the project team determined (yes/no) whether the content area was addressed. Second, in areas that were addressed, the team then assessed whether the survey questions were well-designed and likely to result in valid and unbiased content estimates. Surveys with questions that were judged to both adequately cover one of the five content areas and result in valid, unbiased estimates were given a high quality rating in that content area; those that adequately covered a content area, but with questions in which the project team had only modest confidence, received a medium content quality rating; and surveys that covered a content area but with questions unlikely to provide valid, unbiased estimates received a low content quality rating.

Survey Quality Assessed

Four members of the project team, all experienced researchers, examined each survey, discussed their assessments, reconciled discrepant judgments and arrived at consensus quality assessments for both its methods and content. The team was able to obtain both the survey instrument and complete results for 22 of the 36 identified surveys and definitively rated the quality of these 22 surveys–17 of which were physician or physician group surveys and five of which were hospital surveys. (Sufficient information was collected from the remaining 14 surveys to determine that they were unlikely to contribute meaningfully to our estimates of EHR adoption.)

Only ten surveys received a high quality methodology rating. All surveys were given a content quality rating, regardless of their methodology rating, in the five content areas (see Table 3 for details).

Table 3. **Quality Assessments of Available Surveys**

	Physicians or groups	Hospitals
Methodology Quality		
High quality methodology	8	2
Medium quality methodology	3	1
Low quality methodology	6	2
Content Quality		
Practice/organization has an EHR		
High quality content rating	7	2
Medium quality content rating	3	2
Low quality content rating	4	1
EHR Functionalities		
High quality content rating	7	2
Medium quality content rating	5	3
Low quality content rating	1	0
Barriers to adoption		
High quality content rating	4	1
Medium quality content rating	2	2
Low quality content rating	1	0
Incentives for adoption		
High quality content rating	4	0
Medium quality content rating	0	1
Low quality content rating	0	1
Disparities		
High quality content rating	1	1
Medium quality content rating	3	2
Low quality content rating	0	0

No survey was rated high in all five content areas. Only three physician/physician group surveys and one hospital survey were rated as having high quality content in at least three of the five content areas. Further, only two surveys achieved a high quality rating for both methodology and at least three of the five contents areas, leading us to conclude that the quality of available surveys is variable and generally inadequate to form the basis for national policy development.

Environmental Scan: Results

This section summarizes the results of the surveys identified by the environmental scan. In drawing conclusions, we emphasized surveys with high ratings for methodology or content quality.

The first of the 36 surveys was fielded in 1997 and the latest in 2005, with all but four fielded or published in the last five years. The scan also included ten surveys that used a nationally representative sampling frame. About half of the rated surveys assessed outpatient use of the EHR exclusively, an additional 25 percent assessed both outpatient and inpatient EHR use and the remainder assessed inpatient EHR use only. Most outpatient studies focused on EHR use, but EHRs usually were not well defined. Two surveys[i] were judged to be high quality in both methodology and content:

The 2005 National Ambulatory Medical Care Survey found that 24 percent of physicians had a full (11 percent) or partial (13 percent) EHR in their office-based practice.[1] This represents a significant increase from prior NAMCS surveys which estimated EHR use at 17 percent (NAMCS 2001–2003).[2] The earlier NAMCS surveys lacked definitional precision, asking only one global EHR question. The 2005 NAMCS survey[1] asked physicians about a series of functionalities, including minimal set of functionalities that had to be present for a functional EHR as defined by the ECP: health information and data; results management; order entry management; and decision support. This does not track exactly to the items used in the 2005 NAMCS. In order to estimate the ECP definition as precisely as possible within the NAMCS survey items, the analysis included computerized orders for prescriptions, computerized orders for tests, reporting of test results and physician notes. Using this minimal definition, the 2005 NAMCS found that only 9 percent of physicians had an EHR with the minimal functionalities identified by the ECP.

Another high quality survey, completed by the Commonwealth Fund in 2003, found that 18 percent of physicians routinely use EHRs.[3] A study conducted by the Center for Studying Health System Change was rated high in methodological and content quality. It reported EHR use by specific functionalities and found that about 25 percent of respondents used IT for at least one EHR function, while 10 percent reported using at least four EHR functions.[4]

Differences in the results of these high quality surveys are likely due to variations in the questions that were asked, the specificity with which EHRs were defined and the time at which they were fielded. Expanding the environmental scan's scope to include surveys of high or medium quality in both methodology and content led to the inclusion of two additional studies: the 2005 MGMA survey of medical groups, which used a strict EHR definition and found that 15 percent of group practices had EHRs,[5] and another survey by the University of Kentucky, which, while high in quality, focused only on a small number of physicians in Kentucky and found that 21 percent use EHRs.[6]

Some surveys suggest adoption levels are higher, such as the 2005 American Academy of Family Physicians survey, which found that 46 percent of 2,569 respondents had some form of undefined EHR.[7] However, surveys that defined EHRs very carefully tended to have lower estimates of adoption and are believed to be more accurate. For example the 2004 *Medical Economics* survey of

i Please note that in determining the number of surveys with high quality content ratings, we considered all four domains of content quality. This differs from the number reported in the related paper by Jha et al. in which high content quality was only attributed to those surveys rated as high for 'presence of an EHR'.

10,000 physicians that found 15 percent of physicians had adopted "electronic documentation of clinical information." The data from these studies also suggests that solo practitioners were less likely to have EHRs than practitioners who worked in groups, especially those who worked in large groups. This includes the 2003 Commonwealth survey, which found 13 percent of solo practitioners routinely or occasionally use EHRs compared to 57 percent of physicians in groups of 50 or more.[9] The MGMA survey found that while 15 percent of all groups used EHRs, this number varied from 13 to 20 percent based on practice size.[5] Similarly, the NAMCS survey found that only 13 percent of solo practitioners used EHRs, but nearly 39 percent of physicians in practices with 20 or more physicians used EHRs.[10]

Results: Inpatient EHR Use

There were very few high quality surveys of inpatient EHR use. The following section details the findings of surveys that were rated as either high or medium quality on methodology and content. The 2005 NHAMCS survey is not included here. Although it is rated high on methodology, the survey only measures EHR use in hospital outpatient departments and emergency rooms.

The 2005 CMS/Mathematica Hospital survey,[11] rated high on methodology and medium on content, asked senior hospital executives about the use of several EHR functionalities. It reported that 83 percent of hospitals used electronic lab results with decision support; 59 percent used electronic clinical notes, although the functionalities weren't specified and could include patient demographics, medical history, physician or nurse notes, or follow-up orders; 50 percent had electronic images available throughout the hospital and used electronic lab orders; and smaller percentages used electronic reminders for guideline based interventions (24 percent) and e-prescribing (21 percent).

Many inpatient surveys have focused on CPOE. A nationally representative survey of randomly selected hospitals by Ash, Gorman, Seshadri, & Hersh (2004) found that 16 percent had CPOE in 2002.[12] A more recent survey by the American Hospital Association (AHA) found that 21 percent of hospitals had CPOE in 2005.[13]

The 2003 Leapfrog survey, which explicitly scored adoption, indicated that only 5 percent of hospitals had fully implemented CPOE.[14] Although it is difficult to reconcile these estimates, the discrepancies are likely due to differences in survey question wording and their success in eliciting responses from small and large hospitals.

Table 4. **EHR Adoption Based on Best estimates Data (through 2005)**

	Range from Medium or High Quality Surveys	Best Estimates Based on High Quality Surveys
EHRs in physician offices	17 to 25%	24%
Solo practitioners	13 to 16%	16%
Large physician offices*	19 to 57%	39%
EHRs in hospitals	N/A	None
CPOE in hospitals	4 to 21%	5%**

* Large is defined as ≥ 20 physicians by one study (with an estimate of 39 percent) and ≥ 50 physicians (with an estimate of 57 percent) in another.

Limitations: Safety Net Providers

A striking finding from this review is that there is a dearth of data on the adoption and use of EHRs among those who care for vulnerable populations. An example is the lack of data about EHR adoption among safety net providers. Though safety net providers do not deliver the majority of care to vulnerable populations, they are an important component of the health care safety net. A recent Institute of Medicine (IOM) report defined safety net providers as those "that organize and deliver a significant level of health care and other health-related services to uninsured, Medicaid and other vulnerable patients." Public hospitals, community health centers, and, to some extent, rural providers in some areas have a mandated responsibility to provide care to all patients regardless of ability to pay.[15] The 2006 NAMCS survey will include a subsample of 100 community health centers, however this data will not be available until the summer of 2008.

The environmental scan only identified one survey expressly devoted to assessing HIT adoption among safety net providers. Sponsored by the Community Clinics Initiative (CCI), it surveyed community clinics in California, which had applied for funding from the Tides Foundation to improve their clinic's HIT, about their level of EHR adoption. The CCI survey found that two-thirds of 112 clinics surveyed in 2000 and 2001 had implemented basic IT systems to support their business operations, but fewer than 10 percent were using these systems to support individual patient care such as appointment scheduling and patient tracking and recall.[16]

To the extent that EHRs enhance quality of care, ensuring safety net providers have access to EHRs is a critical component of reducing disparities in the care received by low-income, uninsured or minority Americans. Tracking the adoption and use of EHRs among safety net providers relative to other provider groups, understanding unique barriers to adoption that contribute to the HIT "adoption gap," and identifying appropriate policy levers to close this gap remain important challenges.

More Limitations and Future Challenges

Other limitations of current survey data make it difficult to reliably assess EHR adoption levels. There are insufficient numbers of national surveys with an adequate sample size, adequate response rates and high quality content to allow valid, generalizable estimates of EHR adoption in the American health care system. Nearly all-available surveys are based on self-reported data, with no auditing mechanism to confirm reported levels of adoption and use. Even surveys that are well formulated, have high response rates and use national samples, rarely provide adequate information about adoption rates among specific types of providers (e.g., solo practitioners versus group-based providers).

Further, the majority of identified surveys are proprietary, making efforts to obtain the full set of survey results and the survey instruments challenging, and there is a lack of uniformity in definitions and measures among those that provide detailed information. Most surveys do not clearly define terms such as "electronic health record," leaving the meaning of these terms open to interpretation by survey respondents and making comparisons of results across surveys and over time extremely difficult. Even when surveys use precise definitions, they are usually novel and lack consistency with other surveys. Therefore, although existing surveys might provide insights into rates of adoption or barriers to adoption of specific functionalities, they do not provide information that is generalizable to other functionalities.

Another limitation is inpatient EHR surveys' frequent use of physician respondents. Their analyses do not account for the clustered nature of the sample and, thus, their estimates of EHR use within hospitals may be biased. Also, some surveys asked physicians about inpatient and outpatient use while others asked exclusively about inpatient use. Finally, adoption of certain functionalities, such as computerized physician order entry, may be subjective. These systems typically take years to fully adopt and use and, therefore, whether a hospital "has" CPOE will depend to a large extent on how the question is asked.

Future work must address these definitional issues. It may be helpful to include a legal definition of medical records–the systemic parent of EHRs–in this process. All states, through statutes, regulations and judicial decisions, define and regulate the content, structure, maintenance, ownership and preservation of medical records. We anticipate that a body of law related to model medical records exists, given the central importance of the medical record to the legal environment in which health care practice takes place. The concept of a medical record undoubtedly appears in numerous places in federal law and we expect federal legislation addressing HIT and EHRs will address this basic definitional issue. EHRs inevitably will operate as a technological "overlay," transforming the current medical system over time but inevitably linked into and harmonized with the legal underpinnings of care. We believe that gaining a greater understanding of medical record legal policy will help ensure that EHR adoption research is structured to measure the adoption of systems that are consistent with existing expectations and patient safeguards.

Both the definition of key terms related to EHR adoption and the measured rates of adoption will likely change over time. The definitions and rates discussed in this report represent our current, best judgment for defining those terms and assessing the extent of adoption. EHR adoption is a dynamic phenomenon that will require continued evaluation and tracking over time to lay the best foundation for policy formation in the future.

Chapter 4: Will Differential HIT Adoption Exacerbate Health Care Disparities?

Eliminating health disparities has emerged as a national priority in recent years. Healthy People 2010,[1] a set of health objectives developed by the federal government through a broad public-private consultative process, named the elimination of health disparities as one of its two primary goals for improving the health of Americans. The *Crossing the Quality Chasm* report, issued by the Institute of Medicine (IOM) in 2001, further highlighted the importance of eliminating health disparities, including "the provision of equitable health care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographical location and socioeconomic status,"[2] as one of its six priority goals. A subsequent IOM report, *Unequal Treatment* (2002), provided further impetus for public efforts focused on reducing disparities by comprehensively documenting racial and ethnic disparities across a wide range of health care settings.

There has been a concomitant focus on the potential for health information technology (HIT) and electronic health records (EHRs) in particular, to significantly improve health care by enhancing the clinical quality and effective management of care.[4] While empirical evidence documenting the impact of HIT in practice remains limited, its potential to improve the care received by the general population–and possibly reducing health disparities–is widely affirmed.[5-25] *Crossing the Quality Chasm*, for example, drew attention to EHRs' potential to produce care that is more equitable,[2] and the American Medical Informatics Association (AMIA) 2003 Congress (Bridging the Digital Divide: Informatics and Vulnerable Populations) proceedings concluded that members of underserved and vulnerable populations are "particularly in need of health information support" due to their increased risk for adverse outcomes.[26]

To the extent that EHRs prove to be a powerful means for improving care, monitoring EHR diffusion among providers who serve vulnerable populations will be essential to eliminating health disparities. Enhanced EHR capacity may provide new leverage points for addressing health disparities, but only if underserved patients have access to the clinical benefits associated with HIT. Conversely, slower adoption of EHR-enhanced health care among providers serving these patients could exacerbate existing health disparities. Concerns that underserved populations may have reduced or delayed access to the benefits of EHRs are underscored not only by existing disparities in care, but also by studies that document a lag in access to beneficial developments in clinical care among these communities.[27, 28] A recent study, for example, found that minority children were the last to receive new asthma medications,[29] perhaps partially explaining racial differences in asthma outcomes.

EHR adoption, if uneven, may further exacerbate existing health disparities. Thus, monitoring the diffusion of EHRs among providers who serve populations most likely to experience poorer quality care is an important public policy goal and should be part of any comprehensive approach to reducing health disparities in the United States. This chapter assesses the current state of knowledge regarding EHR adoption among providers of underserved populations and discusses strategies for ensuring that the diffusion of EHRs among these providers is monitored going forward. First, we define vulnerable populations and review conceptual frameworks and analytic approaches for studying EHR adoption among providers serving these populations. We then review existing data that might be useful in assessing current rates of EHR adoption among providers

of care to populations more likely to experience disparities. Finally, we address concrete methods and strategies for building the capacity to assess whether there is differential adoption of EHRs among providers who serve vulnerable populations and, if so, what impact this might have on quality of care and health disparities in the future.

Defining Vulnerable Populations

Developing the capacity to monitor HIT diffusion among providers who serve vulnerable populations requires an operational definition of vulnerable populations and an effective way of identifying providers who care for them. Ultimately, our policy concern is the health care experience of vulnerable patients and the ways in which variable access to the benefits of EHRs might affect their quality of care or health outcomes. These populations, which experience diminished access to health services and lesser quality of care once they do access the health care system, have been variously defined. Available data documents health disparities according to a patient's race,[30-38] socioeconomic status,[39-41] and insurance status.[42-44] Other relevant populations include patients with a primary language other than English,[33, 45-47] those living in rural or other underserved areas,[48, 49] and those with special health care needs.[48, 50] At an Expert Consensus Panel (ECP) meeting in April 2006, there was agreement that racial and ethnic minorities and low-income patient populations were the highest priority groups with respect to tracking access to EHRs and their potential implications for health disparities.[51]

While race and ethnicity continue to be a primary criterion for assessing health disparities in the United States, there have been longstanding definitional and procedural issues surrounding the collection of race data to track them. Nearly all race and ethnicity data is collected according to categories specified in the 1997 Office of Management and Budget (OMB) revised minimum standards for presenting data on race and ethnicity.[52] OMB Directive No. 15 specifies five minimum race categories for data collection: American Indian or Alaska Native, Asian, Black or African-American, Native Hawaiian or other Pacific Islander and White and two ethnicity categories: Hispanic or Latino and non-Hispanic or non-Latino. These categories are used in the U.S. Census and are the most often used categories for health data collection. In October 2001, the National Institutes of Health (NIH) amended its Policy on Inclusion of Women and Minorities in Clinical Research[52] to formally adopt the OMB categories for monitoring underrepresented groups in all agency research. This further solidified these categories as the favored approach for capturing racial and ethnic variation in health and health care. However, even when the OMB racial and ethnic categories are used, data collection can vary and includes self-identified report, birth certificate data and assignment by others. Changes to census protocol in 2000, which allow individuals to select more than one racial group to identify themselves, have further complicated analyses of racial and ethnic disparities.[53]

Medical, epidemiological and health services research lack a consistent definition of race.[54-56] And while thousands of publications address racial health care disparities, the underlying variables used in these analyses are not consistent or clearly defined.[57] The OMB racial and ethnic categories are by far the most consistent and widely used categories. Hence, it makes sense to use these categories in efforts to track HIT diffusion and the potential impact on health outcomes and racial and ethnic disparities.

Identifying Safety Net Providers

Researchers seeking to understand the impact of health system change on vulnerable populations often have focused on providers whose patient base is overwhelmingly drawn from uninsured, minority or other underserved or vulnerable populations. Community health centers (CHCs), for example, serve about one in eight uninsured patients nationally. This strategy has been driven by two main factors. First, data is available on "core safety net providers" (e.g., CHCs and public hospitals) that have a legal obligation to serve all patients regardless of their ability to pay. Second, it is difficult to identify and collect data from the many providers, such as not for profit hospitals, that individually make a modest contribution to care for vulnerable populations but in aggregate account for the majority of all such care provided.

The most exhaustive assessment of the U.S. health care safety net to date, the recent IOM study titled "The Health Care Safety Net: Intact but Endangered,"[48] did not provide an operational definition of safety net providers. Instead it offered a broad definition of the "health care safety net" as "those providers that organize and deliver a significant level of health care and other related services to uninsured, Medicaid and other vulnerable patients."[48] Core safety net providers were defined by the IOM study as follows: "(1) either by legal mandate or explicitly adopted mission they maintain an 'open door,' offering access to services for patients regardless of their ability to pay; or (2) a substantial share of their patient mix is uninsured, Medicaid and other vulnerable populations."

Safety net providers have a unique perspective on the needs of underserved populations, as these populations make up the bulk of such providers' patient panels (e.g., more than three-fourths of CHC patients are uninsured or on Medicaid).[58] But focusing only on this subgroup of providers to study EHR adoption has important limitations. Most notably, measuring EHR penetration among providers with a large proportion of vulnerable patients does not capture the experiences of vulnerable patients in a nationally representative way. Private, not-for-profit hospitals, for example, account for the vast majority (about 56 percent) of all free care provided,[59] even though the proportion of uninsured patients at public hospitals is far higher.

Another approach is to focus on providers who serve large numbers of patients from designated subpopulations, or "high volume" providers. Due to their large size, these providers may account for the majority of services provided to minority or uninsured patients in their service area–even though these patient subgroups only account for 10 percent or less of their total patient panel.

In the end, it is likely that a multi-pronged approach will be necessary to capture patterns of EHR use in the care of poor, minority, uninsured or other vulnerable populations. This combination of data from traditional safety net providers and those who serve many such patients will allow us to understand whether and to what extent patterns of EHR adoption differ among providers serving distinct patient subsets and what impact this variation has on quality of care, clinical outcomes and health disparities.

Current EHR Adoption Levels

As discussed in Chapter 3, our environmental scan found that the data currently available on EHR adoption among physicians, physician groups and hospitals is limited and variable.[60] Even less information is available on providers serving a large proportion or a large number of minority or low-income patients. Most of the available data have focused on community health centers and clinics in California. CHCs are key ambulatory providers for poor, uninsured, minority and other underserved populations. By statute, CHCs receiving federal 330 grants are mandated to serve all patients regardless of their ability to pay. Nationwide, about 76 percent of CHC patients are covered either by Medicaid or are uninsured, 64 percent are minorities and 29 percent have a primary language other than English.[58, 61] Overall, they care for more than 10 percent of uninsured patients.[62]

The California Community Clinics Initiative (CCI), a partnership between the Tides Foundation and the California Endowment, has provided about $41 million to help 163 clinics and 15 regional associations strengthen their health information management capacity. Over the last six years, these clinics have upgraded their practice management systems, hired HIT staff, improved their communications networks and developed more comprehensive plans for using HIT to support their missions. Each year, CCI and its external evaluator, Blueprint Research and Design Inc., have administered a written survey to these clinics, titled "The Clinic Information Management Assessment Survey." Surveys collected in the fall of 2002 yielded an 80 percent response rate from executive directors and 84 percent from medical directors. CCI's 2003 Information Technology Fact Book reported that 5 percent of medical clinics had EHRs and 3 percent of dental clinics; in addition, about 23 percent of medical clinics and 9 percent of dental clinics had established EHR implementation planning committees.

EHR use in Hospital Emergency Outpatient Departments

Hospital emergency rooms and outpatient departments play an important role in providing care to the uninsured, those on Medicaid and those with no other regular source of care. The National Hospital Ambulatory Medical Care Survey (NHAMCS) collects annual data on the state of EHR adoption in both of these settings. In between 2001 and 2003, the last year for which data is publicly available, finds that 31 percent of emergency departments and 29 percent of hospital outpatient departments have an EHR.[i]

New Analyses

We have sought to address the gap in information on EHR adoption among providers who serve vulnerable populations by analyzing unpublished data, including new findings on CHCs as well as analyses of 2004 National Ambulatory Medical Care Survey (NAMCS) visit data and 2005 NAMCS physician survey data. With respect to NAMCS, we are indebted to the National Center for Health Statistics (NCHS), the agency that fields the survey, for their help in making these data and analyses available to us.

Community Health Centers

The most recent CCI survey, conducted in March 2005 (76 percent response rate for executive directors and 78 percent for medical directors), showed marked improvements in key aspects of EHR adoption including: connectivity and communications capabilities; practice management systems; clinical technology such as disease registries and immunization registries; staff technical skills such as

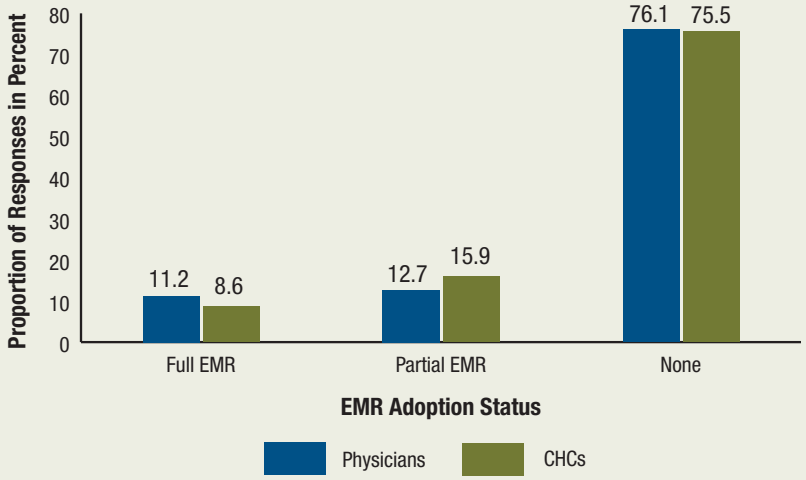
i Burt C, Hing E. Use of Computerized Clinical Support Settings in Medical Settings: 2001–2003. Advance Data from Vital and Health Statistics. No 353. March 15, 2005

application support and systems administration; and quality of data available to support business and clinical administration decisions. In 2000, for example, two-thirds of multi-site clinics had remote sites that were unable to access the clinic's practice management system. But, by 2005, this decreased to only 7 percent. Also in 2005, 73 percent of clinics had a diabetes registry, up from 55 percent in 2002, and 61 percent had an immunization registry, up from 55 percent in 2002.[64] The California experience suggests that substantial gains in connectivity across practice sites is possible within a short period of time among providers who serve a disproportionate number of vulnerable patient populations, but only with substantial capital investment, such as the $41 million invested in community clinics in California.

Alexandra Shields and colleagues, in collaboration with the National Association of Community Health Centers, fielded a survey in March 2006 to generate the first national estimates of EHR capacity and adoption barriers among federally funded health centers.[65] In order to facilitate comparisons between CHCs and physicians, this survey (N=912, response rate=79.5 percent) included items from the 2005 NAMCS survey of physicians. One of these items asked providers if their practice had an electronic medical record, with the following possible responses: "yes, all electronic; yes, part paper and part electronic; no; and don't know." Virtually all CHCs were able to answer this question without resorting to the "don't know" response.

Figure 1 summarizes data from the 2005 NAMCS survey of physicians and 2006 data on EHR adoption among CHCs. Close to 9 percent of CHCs report having a *fully* electronic medical record and an additional 15.9 percent report having a partial EHR, compared to more than 11 percent and 13 percent respectively of physicians in the NAMCS data. Thus, a greater proportion of CHCs have at least some electronic capability, most notably in maintaining patient registries, than does a representative sample of American physicians. Some portion of this difference is likely due to the Health Disparities Collaborative, sponsored by the Health Services Resource Administration, which requires that participating CHCs maintain disease registries.[66] CHCs also stand as an example of the kinds of substantial improvements in HIT capacity that can be realized with targeted resources and programmatic support. Indeed, among CHCs nationally who currently do not have an EHR, nearly 90 percent cited lack of capital to invest in an EHR as the primary barrier .[65] Overall, about one fourth of both physicians generally and CHCs reported using a full or partial EHRs and the remaining three fourths had no electronic health information capability.

Figure 1: **EHR Adoption Among U.S. Physicians and Health Centers (2005-2006)**



Note: Physicians percentages are based on preliminary data from the 2005 National Ambulatory Care Survey (N=1,281 eligible physicians; 66.2 percent response rate). CHC percentages are based on preliminary data from the 2006 Survey of Health Center Use of Electronic Health Information (N=725 health center CEOs or Executive Directors; 79.5 percent response rate)

County-Level Population Characteristics

Researchers from the National Center for Health Statistics analyzed 2005 NAMCS data to investigate whether physicians' self-reported adoption of EHRs differed according to key characteristics of their practice location. Burt, Hing and Woodell[67] used zip codes to link county-level data from the Area Resource File (ARF)[68] (i.e., percent county population that is non-Hispanic white and per capita income for the county in which the practice is located) to physician practices. They then determined if EHR adoption varied according to a county's per capita income or racial composition; they also assessed geographic variation. The study found EHR use was not significantly associated with these county-level variables (Table 5). This may be due to the segregation of vulnerable populations within county-level markets, which is not captured in geographic analyses, or there may be little actual variation in EHR adoption among providers who serve vulnerable populations compared to those serving the general population. Thus, further research is needed to understand patterns of adoption among policy relevant subsets of providers. Adoption was found to vary with a practice's geographic region: physicians in the Midwest and West were more likely than those in the Northeast to use EHRs and physicians in metropolitan statistical areas (MSAs) were more likely than non-MSA physicians to use EHRs (Table 5).

Table 5. **Location Characteristics of Office-Based Physicians: United States, 2005.**

	Percent distribution of all physicians (based on weighted responses from 1,281 sample physicians)	Percent of physicians reporting full or partial use of electronic medical records[a] (standard error)	Percent of physicians reporting minimum set of required features for electronic medical records[b] (standard error)
All physicians[c]	100.0	23.9 (1.5)	9.3 (1.1)
Geographic region[d]			
Northeast	20.9	14.4 (2.3)	3.4 (1.2)
Midwest	21.4	26.9 (3.6)	7.5 (1.5)
South	34.9	21.7 (2.7)	9.3 (2.2)
West	22.7	33.4 (3.5)	16.7 (2.8)
Metropolitan status[d]			
Metropolitan statistical area	89.4	24.8 (1.6)	10.1 (1.1)
Non-metropolitan statistical area	10.6	16.9 (3.1)	3.1 (1.7)
Per capita income for county[e]			
Under $25,000	11.6	20.3 (5.3)	10.0 (3.2)
$25,000-$45,000	77.2	24.0 (1.8)	8.8 (1.2)
Over $45,000	11.3	27.2 (4.2)	12.3 (3.4)
Percent of county population that is non-Hispanic white[e]			
Over 75%	40.5	24.8 (2.4)	8.3 (1.6)
50–75%	34.1	21.6 (2.6)	10.6 (1.9)
Under 50%	25.4	25.8 (3.2)	9.3 (2.2)

[a] Electronic health record (EHR) refers to physicians reporting that their medical records are either fully or partially electronic. Percentages may underestimate because electronic health record use is unknown for 4.5 percent of physicians and they are assumed not to use EHRs.
[b] Required minimum features include computerized prescription ordering, computerized test ordering, electronic results and electronic physician clinical notes.
[c] Includes nonfederal, office-based physicians who see patients in an office setting and excludes radiologists, anesthesiologists and pathologists.
[d] Significant relationships between electronic health record (EHR) use and characteristic location.
[e] Based on data from the Area Resource File

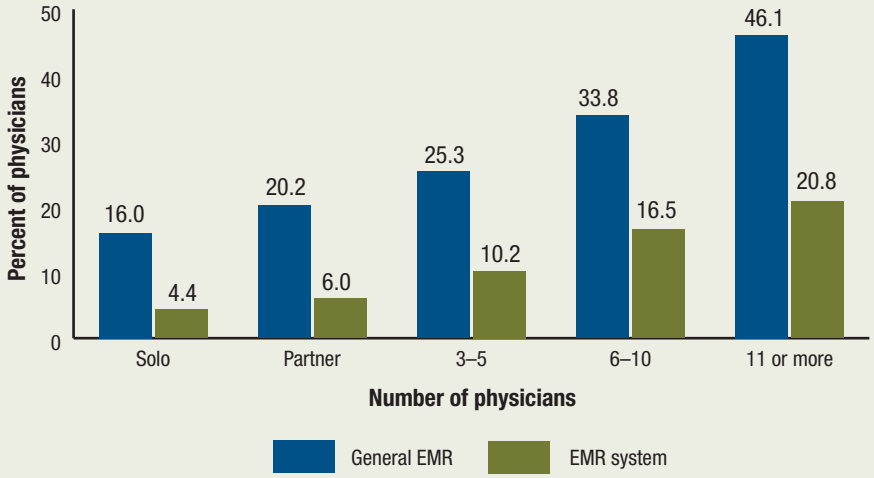
EHR Adoption and Percent Medicaid Revenue

The proportion of a practice's revenues derived from Medicaid is often used as a proxy for the proportion of low-income patients served. Burt and colleagues[67] analyzed EHR adoption among physicians with varying levels of Medicaid revenues, along with other covariates, using the 2005 NAMCS physician data. They compared rates of self-reported EHR adoption and rates of EHR adoption, using a variable that represents a minimal set of EHR functionalities, among providers with varying Medicaid revenues. As determined by the ECP, the minimum set of EHR functionalities[51] include: health information and data, results management, order entry management and decision support. This does not track exactly to the items used in the 2005 NAMCS. In order to estimate the ECP definition as precisely as possible within the NAMCS survey items, the analysis included computerized orders for prescriptions, computerized orders for tests, reporting of test results and physician notes.

As shown in Table 6, the impact of patient-mix is seen only when analyzing EHR adoption among providers with EHRs that have a minimal set of functionalities. There is early evidence of slower diffusion of EHRs among physicians who serve a greater proportion of low-income patients. Specifically, only about 5 percent of physicians in practices that receive 20 percent or more of their practice revenue

from Medicaid have an EHR with a minimal set of functionalities, compared to about 10 percent of physicians whose practice revenues are less dependent on Medicaid. Tracking access to EHR-enhanced medical care among Medicaid beneficiaries and other low-income patients deserves particular attention in future research. EHR use was significantly related to other practice characteristics as well, including the number of physicians in the practice, scope of services as measured by single- or multi-specialty practices, ownership and number of managed care contracts (see Table 6). The primary driver of EHR adoption was practice size, with a clear linear relationship between practice size and EHR use (see Figure 2).

Figure 2: **Percent of physicians using electronic medical records and percent of physicians using electronic medical record system by practice size: United States, 2005**



NOTES: Both trends are significant ($p<.05$). EMR is electronic medical record. General EMR is positive response to single question on full or partial EMR use. EMR system is a positive response to four minimal features: computerized orders for prescriptions, computerized orders for tests, test results and physician notes. Includes nonfederal, office-based physicians who see patients in an office setting. Excludes radiologists, anesthesiologists and pathologists

SOURCE: National Ambulatory Medical Care Survey.

Table 6. **Use of electronic medical records by characteristics of office-based physicians: United States, 2005**

Physician or practice characteristic	Percent distribution of all physicians (based on weighted responses from 1,281 sample physicians)	Percent of physicians reporting full/partial use of EMRs[a] (standard error)	Percent of physicians reporting minimum set of required features for EMR[b] (standard error)
All physicians[c]	100.0	23.9 (1.5)	9.3 (1.1)
Age of physician			
Under 35 years	3.92	44.0 (8.5)	15.2 (8.1)
35–44 years	27.2	26.8 (3.0)	10.4 (2.0)
45–54 years	34.5	25.1 (2.5)	10.5 (1.8)
55–64 years	24.5	18.1 (2.4)	7.0 (1.6)
65 years and over	9.9	18.4 (4.2)	5.7 (2.0)
Physician specialty type[e]			
Primary care	50.5	22.4 (2.3)	9.2 (1.6)
Surgical	21.7	22.3 (2.6)	8.5 (1.8)
Medical	27.8	28.1 (2.8)	10.3 (2.0)
Physician gender			
Male	76.4	24.1 (1.8)	9.4 (1.2)
Female	23.6	23.5 (2.7)	9.2 (2.0)
Practice characteristic			
Practice size[d]			
Solo	38.5	16.0 (2.2)	4.4 (1.3)
Partner	11.3	20.2 (4.2)	6.0 (2.6)
3–5	25.4	25.3 (2.9)	10.2 (1.8)
6–10	12.9	33.8 (4.7)	16.5 (3.2)
11 or more	9.7	46.1 (5.8)	20.8 (4.9)
Unknown	2.2	12.0 (7.9)	11.2 (7.8)
Scope of services[d]			
Solo and single-specialty	78.6	21.8 (1.5)	7.5 (1.0)
Multi-specialty	20.0	34.2 (4.1)	17.1 (3.4)
Unknown	1.4	—	—
Practice ownership[d]			
Physician/physician group	83.3	20.3 (1.6)	7.3 (1.0)
Health maintenance organization (HMO)	2.9	66.5 (10.1)	49.6 (11.5)
Other	13.9	37.1 (5.1)	13.2 (3.6)
Number of managed care contracts[d]			
None	9.7	15.4 (3.5)	6.8 (2.6)
1–2	9.8	38.2 (5.4)	22.6 (4.4)
3–10	35.6	23.0 (2.2)	5.4 (1.2)
More than 10	39.3	23.7 (2.4)	9.8 (1.7)
Unknown	5.5	22.0 (6.0)	11.8 (4.7)
Percentage revenue from Medicaid[d]			
Under 5%	30.9	21.9 (2.4)	11.1 (2.0)
5–19%	32.1	25.6 (3.0)	10.1 (1.9)
20% or more	25.11	21.5 (2.8)	5.5 (1.6)
Unknown	11.81	30.2 (4.3)	10.8 (2.6)

a Electronic medical record (EMR) refers to physicians reporting that their medical records are either fully or partially electronic. Percentages may be underestimates because electronic medical record use is unknown for 4.5 percent of physicians and are assumed to not use EMR.
b Required minimum features include computerized prescription ordering, computerized test ordering, electronic results and electronic physician clinical notes.
c Includes nonfederal, office-based physicians who see patients in an office setting. Excludes radiologists, anesthesiologists and pathologists.
d Significant relationship between electronic medical record (EMR) use and physician or practice characteristic based on chi-square test ($p<.01$)
e Specialty type based on categorization of physician subspecialties obtained from the American Medical Association.
* Figure does not meet standards for reliability and precision.

Patient Reports of EHR Use According to Zip Code

Finally, we report on some exploratory analyses conducted on the 2003 and 2004 NAMCS visit file by staff at the NCHS, which reflects patient visits documented over a one-week period for each physician included in the nationally representative sample of practicing physicians. Using ARF, EHR adoption was analyzed according to characteristics of the zip code in which patients lived to determine whether these area-level characteristics were associated with differential access to EHR-enhanced health care. This research found no evidence that physicians in zip codes with a higher proportion of families living in poverty, with higher concentrations of minority or Hispanic populations, with a higher proportion of individuals with lower levels of education, or with a higher proportion of households with limited English language proficiency were less likely to adopt EHRs. Nor did the analysis find significant associations between EHR use and patients' self-reported age, sex, race, ethnicity or source of insurance coverage.[67]

Looking Ahead: Building Capacity

While these data reveal no dramatic, early indications of major disparities in EHR adoption by physicians or clinics that are likely to see disproportionate numbers of underserved populations, preliminary data showing that physicians serving a greater proportion of Medicaid patients are significantly less likely to have an EHRs relative to physician practices with fewer Medicaid patients warrants further study. The critical role of targeted resources to facilitate capital investments needed to develop a functional EHRs system is also evident in the experience of community health centers and clinics in California. Overall, existing studies are far from adequate and further work is needed to identify subsets of providers who serve vulnerable patients populations, to consistently track the diffusion of HIT among these providers groups and to assess the ultimate impact on the patients they serve.

As we move forward, developing the capacity to monitor the impact of EHR adoption on the quality of care for vulnerable populations and on health disparities will require additional data collection efforts. There are two broad sets of strategies that should be employed–those related to sampling frames and those related to survey content. To a large extent, the existing information gap can be effectively addressed through sampling strategies that ensure future data collection efforts include a representative sample of providers who serve vulnerable populations. Measures of EHR adoption, prevalence of key EHR functionalities, patterns of use of these functionalities and prevalence of barriers to EHR adoption can then be compared among providers who serve vulnerable populations versus other providers. With respect to survey content, there may be a need for additional survey items or other data collection efforts that relate specifically to providers who serve vulnerable populations, including funding streams that support EHR adoption, infrastructure pertinent to a particular provider group, such as CHCs and barriers and incentives to EHR adoption. The 2006 NAMCS, currently in the field, includes a subsample of 100 CHCs and will provide excellent baseline data for measuring adoption among this group.

Developing data that allow EHR use among providers who serve vulnerable populations to be confidently determined will require complex sampling designs, including the use of disproportionate sampling techniques. A simple random sample will not produce a sample sufficient to provide reliable estimates of EHR adoption among these providers, unless that random sample is prohibitively large. Before implementing a complex sampling design, a clear, operational

definition of the variable or construct to be measured is necessary to drive the sampling strategy.

As previously mentioned, the ECP has identified racial and ethnic minority patients and low-income or publicly insured patients as the two highest priority patient populations. Strategies to identify providers who disproportionately serve these patients can be developed by using provider self-report of patient panel composition, linking provider IDs to Medicare claims to empirically assess the racial and ethnic composition of providers' elderly patient panel, or, where available, using discharge or payer-mix data to determine patient panel characteristics along key dimensions. These data can then be used to disproportionately sample providers of certain patient groups, adequately powering future EHR adoption surveys. Analytical variables such as socio-demographic characteristics of physicians, organizational characteristics of their practices and hospitals and market identifiers can also be linked to databases that contain market characteristics. This may enable richly textured descriptions of which providers serving vulnerable patients groups are achieving early and later stages of adoption.

Identifying Physicians

There are no optimal strategies for identifying physicians who play an important role in caring for vulnerable populations. One approach is to directly query providers in EHR adoption surveys. The AMA Physician Masterfile, the best source of data on physicians practicing in the United States, does not contain complete data on the race or ethnicity of physicians, case-mix or payer-mix of physician practices, or demographic profiles of physicians' patient populations. These variables could be elicited from physicians by asking them to estimate the percentage of their patients who come from different racial or ethnic groups and the payer-mix and insurance status of their patients, allowing them to be categorized according to rough proportions (e.g., low, medium or high) of vulnerable patients served. The NAMCS induction interview, for example, asks physicians to self-report their payer mix–asking them "Roughly, what percent of your patient care revenue comes from: Medicare, Medicaid, private insurance, patient payments, or other sources (including charity, research, CHAMPUS, VA)." Based on these data, physician EHR use could be profiled according to payer-mix (e.g., high Medicaid volume versus low).

While possible to query physicians about their patient mix and stratify them according to this information, the reliability of such estimates is questionable, particularly among small groups or solo practices. Large physician practices, however, may have information systems in place that enable reliable estimates of the number or proportion of minority or low-income patients served. Such information could also be enhanced through audit or validation. Studies that first validated this metric would ensure that providers did not systematically overestimate, underestimate or misclassify the proportion of their patients falling into selected categories. Systematic overestimation or underestimation would lead to erroneous assessments of EHR adoption rates among these providers and misclassification (where providers simply estimated incorrectly, sometimes overestimating and other times underestimating) would severely reduce the power of the survey to accurately estimate EHR adoption rates.

It may be possible to enhance the usefulness of data collection efforts addressing patient mix. While the NAMCS induction interview does not collect information

on the racial and ethnic composition of physicians' patient panels, it does gather empirical information about physicians' patient mix through their completion of a Patient Record Form. This part of the NAMCS survey requires physicians and their office staff to keep a listing of all patients seen over the course of an assigned week and collects data on Hispanic ethnicity, race of the patients and expected source of payment. These data may provide more accurate methods for profiling physicians' patient panels but are limited in that they are based on a one-week snapshot of patient cases. To support meaningful estimates, several years of data would need to be aggregated or the sample for this part of the NAMCS survey would need to be increased.

More robust approaches that could be used to identify providers with a high volume or high proportion of minority or publicly insured populations include linking provider information to claims data, whereby provider IDs are used to profile physicians according to volume or proportion of patients who fall into a policy-relevant category (e.g., minority, Medicaid-enrolled). Bach and colleagues,[69] for example, analyzed Medicare data on 87,803 primary care physicians and 58 million patient visits (54 million white patients and 4 million black patients) and found that 22 percent of physicians account for 80 percent of visits by black patients and 22 percent by white patients; the other 78 percent of physicians see 78 percent of white patients and 20 percent of black patients.[69]

Although not focused on EHR use, Bach's work provides a possible method for using claims data to empirically assess patient mix. With collaboration across institutions, connecting survey responses to patient data may provide insight into EHR use at the patient level. But there are two important limitations to this approach. First, Medicare claims only identify patients who are elderly or disabled and are eligible for Medicare. Whether providers who care for a high volume or proportion of elderly minorities also provide care to a high volume or proportion of non-elderly minorities is not known. It is possible that the racial and ethnic composition of the elder population in a given service area differs markedly from the racial and ethnic composition of the non-elderly population in the same service area. Second, the reliability of Medicare data on Hispanics is problematic. Medicare data are limited in their designation of Hispanic ethnicity. While more than 4 percent of America's elderly (≥ 65 years old) are Hispanic, only about 2.5 percent of Medicare enrollees were listed as Hispanic in the year 2002. The sensitivity of the Hispanic designation is about 50 percent,[70] and thus it does not identify all Hispanic-focused providers. However, the designation of someone as Hispanic in the Medicare data is highly specific[70] and should ensure that providers designated as caring for Hispanics truly do care for Hispanic populations.

Identifying physicians and physician practices that disproportionately care for Medicaid or uninsured patients using claims data would be challenging. In theory, Medicaid claims could be used in a similar fashion as in Bach's Medicare study to empirically assess the distribution of Medicaid patients throughout systems of care. But Medicaid databases are maintained at the state level and have varying capabilities for linkage with providers. While states contribute data to the State Medicaid Research Files (SMRF), federally maintained Medicaid data files that have standardized data elements across states, these data typically lag by several years and are less useful for monitoring a timely issue such as EHR adoption.

Identifying Hospitals

The American Hospital Association (AHA) annual survey can be used to identify hospitals that serve a large number of Medicaid patients or for whom Medicaid patients comprise a large proportion of their total patient revenues. This high quality survey has a very high response rate and includes data on the proportion of hospital discharges accounted for by Medicaid patients, as well as on the total number of Medicaid patients seen in a given year. These two variables can identify hospitals that care for either a high volume or a high proportion of Medicaid patients. The Medicare claims approach, described above, could also be used to identify hospitals that serve a high volume or high proportion of minority patients. Identifying hospitals that care for the uninsured is more difficult, however, as these data are not available in the AHA dataset. Several states have data on the level of uncompensated care provided by each hospital, but these data are not easily tied to assumptions about the number of uninsured patients they serve. Thus, it would be challenging to create reliable national estimates of the proportion of providers who serve a large number or proportion of uninsured patients using these data.

Conclusion

Identifying providers that disproportionately care for members of racial and ethnic minority communities or Medicaid enrollees will likely require a multi-pronged approach. While directly querying providers may be the easiest tactic, the reliability of such data remains unclear. Linking providers to claims data might identify providers that disproportionately care for minority patients, but this method would not readily identify providers who disproportionately care for Medicaid, uninsured or other vulnerable patient subpopulations. While it is relatively easy to identify hospitals that disproportionately care for Medicaid patients using links to other data sources, it will likely be more difficult to identify ambulatory providers that care for this population. Further work is needed to develop reliable data that enables policy-makers to monitor the diffusion of EHRs and HIT more generally, among providers who serve vulnerable populations compared to other providers. Ultimately, these efforts need to utilize the strength of provider-level data in combination with patient-level survey and claims data to form a comprehensive picture of EHR adoption. They also need to assess the impact of differential rates of adoption among certain providers on quality of care received, clinical outcomes and health disparities. Developing reliable and timely methods for tracking the access of vulnerable populations to EHR-enabled care should be a high priority for policy-makers and researchers at this time.

Chapter 5: Incentives and Barriers to HIT Adoption: Requirements for Policy Relevant Measurement

The ultimate purpose of measuring electronic health record (EHR) adoption rates is to inform policy development and, by so doing, ensure this potentially vital technology becomes readily available. Although the analysis of policy barriers to adoption is not a key goal of this report, we nevertheless think it is useful to lay out a conceptual framework upon which such policies may be based and against which they may be evaluated and assessed. Indeed, having such a framework is essential when designing data collection efforts to inform and evaluate federal efforts promoting EHR adoption.

Among the tools for addressing barriers to adoption are policy changes that have the potential to influence HIT adoption. Policy-setting bodies encompass policy-makers from both the public and private sectors. Policy-making can occur at the local, state and federal governmental levels; much policy-making occurs through private bodies such as professional societies, industry trade associations and accreditation bodies. These entities formulate and apply policies through a variety of mechanisms: financial; legal and regulatory; technological; and organizational. It is rare to find policy-making on any subject of significance in any single venue; for example, accreditation standards, licensure requirements and conditions of participation in insurance programs are quite frequently interactive. Furthermore, policy-making is dynamic, seldom involving only a single intervention, but instead relying on a combination of incentives and standards to achieve a particular outcome For example, the development of common technical standards may reduce the cost of EHR adoption, thereby easing significant barriers to interoperability by increasing the probability that purchasers will choose the correct software. These standards might be combined with a provider compensation arrangement that includes incentives for the purchase of a standard technology.

It is also important to understand that policies typically do not exert a uniform effect on the groups that are the subject of policy-making. Policies that influence adoption by small groups may not have the same implications for large academic medical centers or health care safety net providers. Effective policies should recognize differing baseline levels of capacity and infrastructure among provider subsets (e.g. community health centers, rural providers and public hospitals) and address any special needs for disseminating policies widely and effectively throughout the provider community.

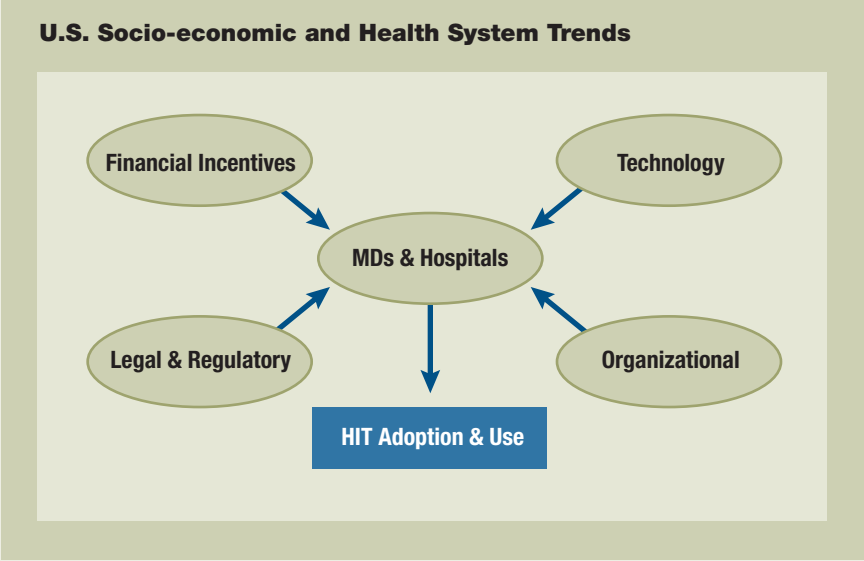
To clarify the challenges that arise in efforts to evaluate EHR adoption, this chapter sets out a policy framework to address barriers and incentives for HIT adoption and briefly reviews what is known about these barriers and incentives. The chapter also describes policy options for encouraging further HIT adoption. Then, building on our examination of the policy landscape, the chapter ends with a discussion of the quantitative and qualitative methods that might be used to evaluate these policies and their success at overcoming barriers and providing incentives for HIT adoption.

Conceptual Model of HIT Adoption

A complex interplay of barriers and incentives influence HIT adoption. The framework presented in Figure 3 outlines one possible approach to conceptualizing these barriers. Based on prior work by Institute for Health Policy staff and the HIT adoption literature,[1, 2, 5-14] this model refers to HIT generally, not just EHRs. This broader approach is justified by literature on determinants of HIT adoption, which does not single out EHRs for special consideration. We expect that the influences on EHR adoption will generally resemble those observed for other types of HIT.

As shown in Figure 3, four factors affect potential HIT adopters: (1) financial incentives; (2) legal issues; (3) the state of technology; and (4) organizational influences. These four factors are embedded in and affected by trends in the U.S. health care system generally and large socioeconomic forces both within the United States and globally.

Figure 3. **A Conceptual Model of Factors Influencing HIT Adoption**



What is Known about Barriers and Incentives?

Financial Barriers

Financial barriers have a significant influence on HIT adoption. These barriers can be best understood as "twins:" the high cost of HIT systems; and provider uncertainty regarding the value they will derive from adoption in the form of return on investment.[2, 14] Stated another way, many providers do not perceive that there is a business case for HIT acquisition and use. They argue that the absence of a business case stems from a form of market failure within the HIT sector: current dysfunctional market dynamics and incentive structures do not work efficiently and effectively to realize the societal benefits of HIT.

There are several reasons for this market failure. The first is that economic incentives in the health care industry generally do not reward good performance, reducing the motivation of self-interested health care actors to acquire HIT and compete more effectively. Often, health care compensation arrangements reward poor performance. Inefficient and sub-optimal care, for example, can generate

more visits, tests and procedures and thus more revenue for providers. At a minimum, this reduces incentives for physicians and others to invest in systems to improve performance. Making matters worse, the purchasers of HIT–mostly doctors and hospitals–would capture only a small fraction of HIT's potential economic benefits. It has been estimated that as much as 80 percent of the potential savings generated through HIT inure to insurers and health care group purchasers, including the federal government, in the form of lower premiums and enhanced worker productivity.

As part of our original project for the Office of the National Coordinator for Health Information (ONC), we collected information on barriers and incentives using focus groups composed of hospital administrators and physicians in Chicago, Boston and Denver. Participants were specifically asked about financial incentives to adopt EHRs. Those who had adopted the technology noted that the EHR simplified billing procedures and supported faster reimbursement cycles. However, any gains in efficiency were offset by reduced productivity as the technology was implemented, as well as the need to increase information technology staff to maintain the system. Overall, physicians in the focus groups did not see any financial incentives for adopting an EHR. Physicians and hospitals who had not adopted the technology reported financial disincentives, such as a decrease in productivity during the first phase of adoption and the cost of maintaining a system. Many believed that financial incentives alone would not be enough to spur adoption, and other issues such as standardization and interoperability would need to be resolved before widespread adoption would occur.

Legal Barriers

The health care system operates within a complex legal environment whose standards and requirements can both speed and impede HIT adoption. Mandates imposed through regulations, accreditation standards, or as the result of judicial liability rulings linked to the failure to incorporate new technologies into practice can push the health care industry to adopt new treatment modalities and patient safety techniques.[15] But until health care leaders recognize that the legal benefits of HIT adoption outweigh the risks, the industry's response may remain slow–even in the face of legal incentives that aim to spur adoption. The lack of response may be more notable in situations in which the business case for adoption of technology is weak, as dynamic interactions between legal and business considerations affect all industries. This is particularly true for industries where costs are high and pressure to avoid unnecessary expenditures is great.

The numerous legal issues that arise in the context of HIT fall into three categories:

- *Concern about newly created legal exposures.* Health care providers may be concerned that decisions conducive to HIT adoption may violate certain legal standards. For example, a hospital's decision to provide staff physicians with the systems necessary to prescribe electronically, in order to maintain and improve patients' quality of care, may expose both the institution and its physicians to potential liability under federal and state fraud laws. To diminish these concerns, the Centers for Medicare and Medicaid Services (CMS) and the United States Department of Health and Human Services Office of the Inspector General (OIG) in 2005 issued regulations establishing legal "exceptions" and "safe harbors" for market conduct related to the use of financial incentives to spur adoption of e-prescribing and electronic health records technology.[16] Determining the extent of the protections afforded under these exceptions and safe harbors, once interpreted and applied by the medical community and legal counsel, may influence HIT adoption rates.

- *Concern over the actual or perceived legal burden of compliance.* The use of certain technologies is associated with an actual or perceived increase in legal burdens. For example, a health professional or organization may be unwilling to adopt HIT systems in the belief that issues associated with compliance stemming from laws such as the Health Insurance Portability and Accountability Act of 1996 (HIPAA) would add to the burden and cost of practice. Non-electronic personal health information is protected by extensive federal, state and common law concepts of privacy and confidentiality; indeed, the legal duty to protect the confidentiality of patient medical records is a basic aspect of health care providers' legal obligations toward their patients.[i] Yet because of the attention given to *electronic* records, many health professionals may mistakenly believe that they are insulated from possible legal ramifications by remaining a "paper" practice.
- *Concerns regarding actual or perceived legal exposures associated with the disclosure of information.* HIT expands the accessibility of health information for governmental agencies and private parties, as well as for health professionals and health care institutions using the technology. Compelling information disclosures is not unique to electronic information but, as a practical matter, electronic information can be transmitted and reviewed more easily than information stored in paper files. Considerable attention has been focused on HIT's role in detecting health care fraud, substandard care or patterns of care and services that may violate applicable laws. While the management and integrity of health care payment systems are essential, health professionals are concerned about heightened exposure to legal scrutiny due to software systems designed to detect and measure the validity of claims on a "real time" basis. Similarly, civil liability litigation arising from allegations that involve legal violations (e.g., medical malpractice lawsuits alleging discriminatory care, where there is no privilege against having to produce certain information) may result in court-ordered production and disclosure of information ranging from medical errors to discriminatory conduct against persons with disabilities. To the extent that electronic technology makes the meaning of a medical record ambiguous, the scope of discovery could extend beyond the limits now imposed in paper medical record cases. Possible policy solutions to these barriers include immunity against liability under certain circumstances,[ii] as well as privileges against disclosure. The law also could establish safe harbors against liability if certain forms of prescribed conduct are followed.[iii] However, the privilege, immunity, or safe harbor created in these cases is likely to be narrow and apply only to select circumstances; it will not be a blanket protection against all forms of legal liability following HIT adoption. Currently, privilege rules that protect against disclosure typically are drafted narrowly to limit their reach and immunity from suit is extremely rare. The extent to which electronic health information will produce new sources of liability or demonstrative burden on health care providers remains to be seen.

i See, e.g., Doe v Medlantic Health Care Group, Inc. 814 A. 2d 939 (D.C.Ct. App., 2003). See generally,

ii For example, the Health Care Quality Improvement Act, 42 U.S.C. § immunizes health care peer review procedures against most forms of civil liability.

iii For example, federal guidance implementing language access standards governing health care providers considered federally assisted entities under Title VI of the 1964 Civil Rights Act also provide for a finding of compliance if providers can demonstrate adherence to standards set forth in the guidance.

Technology Related Barriers

As is the case with many other technological advances, HIT is in a constant state of evolution. Findings from our focus groups suggest that concerns about ease of use and obsolescence were second only to financial barriers as a primary reason for not adopting this new technology. Participants reported that current systems are unwieldy and difficult to use. Those who had not adopted expressed concerns about investing in a system, only to have it become obsolete through mergers on the supplier side or technology upgrades.

Aspects of technology that affect ease and value of use can facilitate or impede adoption. Reliable, transparent and simple hardware and software lowers the cost of adoption, maintenance and use while simultaneously increasing the likelihood that providers will purchase and employ them. Widespread adoption of sophisticated handheld devices and the development of technologies and systems for making interoperability simple, straightforward and reliable will increase the attractiveness of HIT among physicians and hospitals. Finally, federal efforts currently under way to promote standardization and certification should accelerate adoption. An example of such efforts is the Certification Commission for Health Information Technology (CCHIT) charged with developing criteria and evaluation processes for certifying EHRs and interoperability components. These criteria include the ability of EHRs to protect health information, standards by which EHRs must share health information and clinical features that improve patient outcomes.

As previously noted, these technological changes operate to some extent through financial mechanisms, reducing the effective cost of a given level of technology or increasing its quality and thus its benefits. But this does not lessen the psychological barriers to adoption. As we found in our focus groups, some physicians in solo and small practices, for example, fear being stuck with a failing EHR system, no access to a paper record and a full waiting room. Overcoming this anxiety through technological improvements and consensus around the best practices for HIT adoption would hasten implementation.

Organizational Barriers

Organizational factors, attributes of the organizations in which care is provided, also influence HIT adoption. Existing evidence, for example, suggests that large physicians practices are more likely to adopt HIT than small practices.[6, 9] This finding also holds true for hospital adoption of computerized physician order entry (CPOE) and likely is a reflection of their greater capital and human resources.[5] Payer-mix, including the proportion of uninsured or Medicaid patients, directly affects financial resources and thus providers' ability to acquire HIT. Health care safety net providers often labor under strained financial circumstances owing to their uncompensated care missions, their disproportionate dependence on Medicaid and their comparatively limited ability to generate other sources of patient revenues. Research is needed to further define the barriers to HIT adoption among safety net providers and the best way to ensure that they do not lag behind.

Other organizational factors affecting HIT acquisition include the size of provider organizations and whether they are part of an integrated care system. For lack of a better term, we call this latter attribute the provider's "system attributes." Solo or small groups of physicians and small hospitals are less likely to have the resources required to adopt HIT. However, even small providers have better adoption levels when they are part of systems of care. Those systems provide financial support, technical assistance and legal protection to small physician groups.

Finally, many studies, including our focus group research, have shown that organizational leadership–or lack thereof–has a major effect on HIT adoption. Organizations such as Intermountain Health System in Salt Lake City, Utah, are pioneers in HIT acquisition because their leaders decided it was the right thing to do. Surveys of hospital executives suggest that hospitals with CPOE frequently were driven to adopt HIT by leaders who placed the organization's mission above its financial considerations. Although this is not a realistic approach for all health care organizations, clearly the values, vision and capacity of organizational leaders influence decisions about whether to invest substantial resources in HIT systems.

Policies that Affect HIT Adoption

The barriers discussed above serve as a guide to potential policies for spurring HIT adoption. To be effective, these policies must address the critical barriers currently faced by providers. In Table 7, we list possible policy options related to each of the major barriers identified in Figure 3.

Table 7. **Policies Influencing HIT Adoption and Applicable Market Sectors**

Domain	Barrier	Policy
Financial incentives	Lack of a business case for performance	■ Pay for performance: practices and hospitals that adopt EHRs to improve quality would receive a higher reimbursement rate from third-party payers ■ Public reporting of performance: information on the level of EHR adoption among providers and hospitals would be made publicly available
	Lack of a business case for HIT	■ Pay for use of HIT: practices and hospital that adopt EHRs would receive a higher reimbursement rate from third-party payers ■ Grants to providers, including AHRQ implementation grants ■ Loans to providers to cover the costs of acquisition, training and/or maintenance ■ In kind assistance ■ Performance standards/certification (reduces the risk of wasting funds on substandard equipment/software) ■ Interoperability standards (reduces risk of lost investment due to poor choice of IT solution)
Legal/ Regulatory	Fraud and abuse related to HIT adoption, including "Stark Law"	■ Modifications and exemptions
	Privacy and security obligations under HIPPA electronic health information standards	■ Clarification
	Liability exposure from more and more accessible, health information	■ Greater liability protection
State of Technology	Lack of interoperability	■ Standards for interoperability
	Lack of interconnectedness	■ Support for regional health information organizations (RHIOs)
Organizational	Lack of accountability for quality	■ Internal reporting requirements
	Lack of workforce skills	■ Workforce training/certification
	Leadership	■ Training of health care leaders
	System attributes	■ Providing incentives for practices to form networks and negotiate contracts
	Size	■ Assistance to small providers
	Organizational Surplus/Capital Availability	■ Assistance to safety net providers

Financial Incentives

Although policies that offer financial incentives for HIT adoption take several forms, all aim to reduce HIT's costs and increase the return to providers on their technology investments. Changing payment policies to reward good health care performance, for example, creates a non-specific incentive for providers to improve their quality and reduce costs of care. If HIT delivers on its promise, this should lead many providers to invest in information technology to improve their performance.

Other policies focus on reducing the costs of HIT acquisition or increasing revenues associated with the system's use, such as: reimbursing providers for using HIT in clinical care, providing grants or low-interest loans to providers

who purchase HIT systems, providing equipment or software free of charge and reducing uncertainty about software performance. This last intervention involves certification and standardization of HIT products. It assures buyers that they will acquire products to meet their needs and expectations, thus lowering HIT's effective price (or improving its effective quality). The Wired for Health Care Quality Act of 2005 (Senate Bill 1418), which passed the Senate unanimously on November 18, 2005, included a number of these policy options. Policies addressing the unique infrastructure and financing challenges faced by safety net providers will likely be necessary to facilitate widespread HIT acquisition and use–and consequently its benefits–among this group of institutions. Safety net providers disproportionately serve poor, minority, publicly insured and uninsured patients. They lack the margins necessary to allow large capital investments without support from grants, loans or augmented reimbursement policies. Thus, HIT adoption initiatives may have the unintended consequence of widening the health disparities gap in the U.S. health care system unless targeted policies addressing the needs of these provider groups are developed.

Technological Policies

There are a variety of approaches that could be used to reduce technological obstacles to HIT adoption. CCHIT is pursuing one important option: providing the equivalent of a "Good Housekeeping" seal of approval to particular HIT applications by certifying them as compliant with certain federal or other standards. This approval assures potential purchasers that the products in question are state of the art and provide the essential functionalities required of HIT applications. Another approach, also part of HHS' current portfolio of activities, is to create standards that, once incorporated into HIT systems, will enable them to communicate or inter-operate effectively. Finally, government and private sector organizations at multiple levels are trying to stimulate the creation of local health care stakeholder networks that use HIT to develop local mechanisms for health information exchange. The networks, called regional health information organizations (RHIOs), aim to help providers overcome technical barriers, thus enabling them to communicate about common patients.

Organizational Policies

It is difficult to develop policies that directly affect how providers of care organize themselves, even when it is clear that larger and more integrated groups of providers may facilitate HIT adoption. Policies that explicitly favor one type of organizational form over another are likely to be fiercely opposed by doctors and hospitals disadvantaged by such interventions. In some cases and settings, such as rural areas, the promotion of larger groups of doctors and the development of integrated systems may be inherently more difficult than in other areas.

Nevertheless, pertinent options exist. Many observers believe that forcing providers to be more transparent about their performance, through public reporting of efficiency and quality data, may stimulate doctors and hospitals to join larger groups and integrate into systems. This is because small and disorganized providers will have more trouble meeting these requirements. Another approach is to provide centralized training opportunities for doctors and hospitals that lack the resources to do such training themselves. Finally, for organizations that face systematic barriers to HIT adoption, such as safety net facilities, direct subsidies may be required.

Critical, Policy-Relevant Questions

The next major consideration in evaluating EHR interventions is: What do policy-makers want to know about the interventions? While we can only speculate about policy-maker's information needs as they seek to spur the adoption of this technology, several critical questions are likely to arise.

These questions come in two basic forms. The first asks: *Did the policy work?* That is, did it affect the adoption or use of EHRs and, if so, how much? The second asks: *Why or/how did it work or not work?* While the first question addresses outcome, the second question addresses the process or mechanism of change–critical information for improving policy development in the future. Tables 8 and 9 summarize other questions that are likely to arise in these two areas.

Table 8: **Questions Related to Policy Intervention Outcomes**

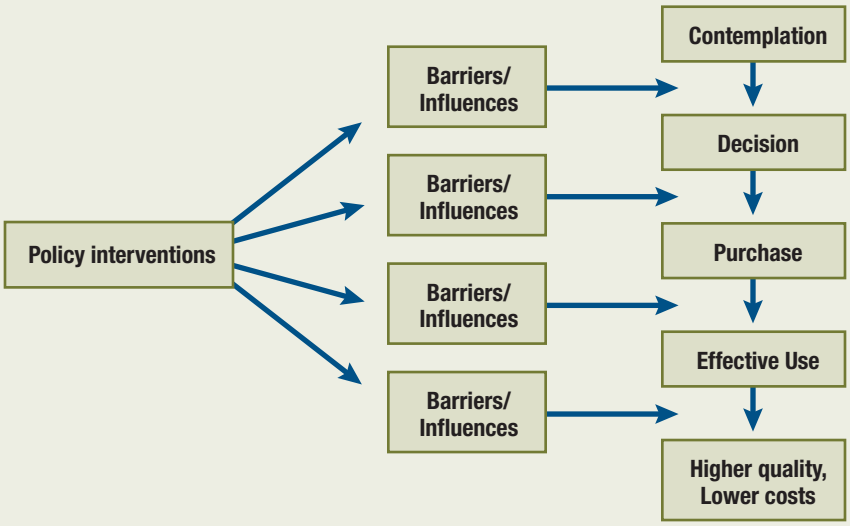
1. Did the policy affect adoption of EHRs in physician offices and in hospitals as indicated by:	■ The number of physicians with access to EHRs in their office practice? ■ The number of physicians that use EHRs in their office practice? ■ The number/type of EHR functionalities used by physicians in their office practice? ■ The number/type of office-based decisions in which computerized decision support plays a role? ■ The number of hospitals with access to EHRs? ■ The number/proportion of physician staff at these hospitals that use EHRs for inpatient care? ■ The number/type of EHR functionalities used by physicians for inpatient care? ■ The number/proportion of physicians' inpatient decisions in which computerized decision support plays a role?
2. Did the policy affect the level of interoperability in the health care system as indicated by:	■ The number of physicians who report that their practices' EHRs communicate with EHRs at the hospitals where they admit patients? ■ The number of physicians reporting that their practices' EHRs communicate with: other physicians to which they refer, pharmacies, imaging facilities, laboratories, home care services and insurance companies? ■ The number of hospitals reporting that their EHRs communicate with: referring physicians, pharmacies, independent imaging facilities and laboratories, other hospitals and insurance companies? ■ The number of patients who communicate electronically with health care providers?
3. Did the policy affect the cost and/or quality of care in inpatient or office-based settings as indicated by:	■ Physicians' perceptions of cost and quality of care? ■ Nurses' perceptions of cost and quality of care? ■ Patients' perceptions of cost and quality of care? ■ Objective indicators of cost and quality of care as demonstrated by: ● Administrative data obtained from payers such as Medicare and private insurers? ● Quality measures reported to CMS, Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and state data repositories on various procedures and rates of safety problems?

Table 9: **Questions Related to Mechanisms/Processes of Policy Effect**

1. Did the policy affect providers' decision to acquire an EHR?	
If so, how?	■ By reducing the cost of the product? ■ By improving the reliability of the product? ■ By increasing availability of technical support?
If not, why?	
2. Did the policy affect the EHR purchase process?	
If so, how?	■ By reducing the price of the product? ■ By increasing the understandability of the product? ■ By making comparative data on the performance of alternative products available? ■ By providing technical support?
If not, why?	
3. Did the policy affect providers' use of an existing EHR?	
If so, how?	■ By improving reliability of the product? ■ By increasing understandability of the product? ■ By providing technical support? ■ By increasing financial rewards for product use? ■ By increasing financial rewards for meeting quality/cost targets?
If not, why?	

In thinking about questions related to process of change, it is useful to consider the mechanisms by which policies affect the behavior of doctors and hospitals towards EHRs. As noted above, policy interventions typically affect EHR adoption by working through a specific type of influence and/or reducing a particular barrier to acquisition and use. Figure 4 makes the manner in which policies affect barriers and influences more explicit and thereby influence the process of adoption. By breaking down the process of adoption, it shows that barriers and influences may exert their effect at several points in the acquisition process. Thus, this model lays out the "life cycle" of EHR adoption and the points at which different policies come to bear on it. While the adoption process is not always linear and sequential, this model approximates the steps providers take from contemplating HIT adoption to its effective use and integration in clinical care.

Figure 4. **Sequence of HIT Adoption**



Assessing the Impact of Policy Changes on HIT Adoption

Methods for evaluating policy interventions must be customized to the experimental context, the intervention and the questions under study. While it is not feasible to provide a detailed description of methods for approaching every possible question and policy intervention related to HIT adoption, certain generic considerations can be summarized. In the next section, we describe the types of data that are likely to be useful and alternative methodologies for collecting data. Then, using two examples, we illustrate how these can be brought to bear for evaluating policy interventions.

Generic Considerations

The first generic consideration is the recognition that policy interventions of interest will rarely be the subject of well-designed, controlled studies. Evaluations typically are natural experiments, with control groups constructed post-hoc or completely lacking. Thus, these evaluations rely heavily on statistical methods to control for confounding variables.

Second, the natural experiments take place in complex and changing environments where many potential influences on EHR adoption are operating at the same time. It is likely that multiple policy interventions will occur simultaneously. This complexity reduces evaluators' ability to arrive at clear and convincing conclusions about the effects of any one policy.

Third, methodologies are likely to vary with the unit of analysis and questions of interest. ONC, for example, has expressed an interest in measuring dissemination and use of EHRs among physicians in solo, small and large groups and among hospitals. Each of these providers constitutes a different unit of analysis, which may vary depending on the perspective taken to evaluate their adoption of EHRs. Levels of adoption and use among specific providers, for example, can be approached from a national or local perspective (e.g., regions, states or local markets) or among policy-relevant groups of providers (e.g., safety net providers or rural providers), depending on the question at hand. The desired outcome also needs to be specified; investigating policy effects on levels of use (an outcome variable) will differ significantly from understanding mechanisms of policy effect.

Data Necessary to Evaluate Policy Interventions

Primary or secondary data collected de novo by evaluators or derived from pre-existing data sources and quantitative or qualitative data can be used for evaluating policy interventions. Primary, quantitative data can be used to evaluate EHR policy interventions and include the following:

1. Surveys of relevant adopter populations (physicians, hospitals administrators, pharmacists, home health workers, etc.);
2. Surveys of patients who are affected by or witness the use of EHRs, which is relevant for understanding the extent to which EHRs facilitate patient communication with physicians and the use of EHRs to build personal health records;
3. Chart reviews to assess the quality of care provided with and without EHRs;
4. Direct observation of the care process in health care institutions/physician offices with and without EHRs (including time motion studies, error documentation and communication measures);
5. Focus groups of providers and other relevant populations;
6. Case studies of particular provider institutions or markets; and
7. One-on-one interviews with providers and other relevant individuals.

Similarly, a variety of secondary data also may be useful for evaluating policy interventions. These include:

1. Administrative data from public and private third parties;
2. Survey data collected by public and private vendors, including:
    a. National Ambulatory Medical Care Survey (NAMCS)
    b. National Hospital Ambulatory Medical Care Survey (NHAMCS)
    c. National Health Interview Survey (NHIS)
    d. The Medical Expenditure Panel Survey (MEPS)
    e. U.S. Census data
    f. Data collected by provider associations: American Medical Association (AMA), American Hospital Association (AHA) and Medical Group Management Association (MGMA)
    g. Data collected by private foundations: Robert Wood Johnson Foundation, Commonwealth Fund and Kaiser Family Foundation (among the most interesting data sources on EHR adoption among physicians are surveys by Stephen M. Shortell and colleagues at the University of California, Berkeley and the Center for the Study of Health System Change–both of which were supported by the Robert Wood Johnson Foundation)
3. Reports on quality of care from CMS, JCAHO and state governments; and
4. Other standard government data sets including the Area Resources File (ARF).

Surveys are likely to be a key data collection methodology, and can be conducted cross-sectionally or longitudinally depending on the questions to be addressed. Longitudinal surveys, which can use both cross-sectional and time-dependent controls, are most useful for before- and after-study designs. Cohorts also can be followed over time, in combination with multiple cross-sectional surveys. Alternatively, a multiple cross-sectional design can be used. Which approach is used depends on the resources available, questions of interest, timing and nature of interventions, among other considerations.

Administrative data and quality reports made to public and private authorities are useful when they can be linked to institutions or physicians variably affected by policy interventions. In such cases, an intervention's effect on HIT adoption can be associated with the ultimate outcomes of interest: cost and quality of care. However, establishing links between data on EHR use and administrative and quality data may be difficult as there are no publicly available data on EHR acquisition and use that permit identification of specific providers. Without knowing their identities, and obtaining their permission, such linkages might come only with increased public reporting (through Leapfrog and other initiatives).

Qualitative approaches to data collection can provide texture and validation to quantitative findings, filling in cases where quantitative findings are hampered by a lack of available data. Focus groups and interviews with groups affected by policies promoting EHR adoption may generate new hypotheses and help to confirm or refute these hypotheses.

Study Design

Several methodological approaches can be used to evaluate the policy interventions of interest. Given the complexity of natural experiments, the ideal study designs are likely to be multi-method or use different methodologies to collect several types of data.

Study design involves the following critical steps:

1. Choice of policy intervention to be studied
2. Choice of questions of interest
3. Choice of unit of analysis
4. Identification of experimental situation
5. Characterization of the policy intervention and its timing
6. Choice of key dependent and independent variables
7. Identification of possible data sources
8. Design of data collection methods
9. Design of analytic methods

The policy intervention, questions of interest, and unit of analysis will, to some degree, be defined by policy-makers. In an ideal experimental situation, possible control groups include unaffected institutions or practices within the same geographic area or in a different geographic area (for example, different states or regions), or groups that are affected at different points in time. This way the

behavior of cohorts experiencing the intervention early can be compared to those that have not yet experienced it (but will later on). The affected population can also serve as the control group, if baseline data is available from the same cohort or a comparable group.

Once experimental and control groups (if any) are identified, the next step is to characterize the intervention and its timing: what precisely happened and when? This can be challenging as policy interventions often do not occur at a precise moment in time. Instead, they are telegraphed ahead of time, leading providers to change their behavior in anticipation of a new policy. They also are phased in gradually, triggering change over an extended period.

Choosing the key dependent and independent variables is critical to translating the policies and questions of interest into measurable variables that accurately indicate behaviors of interest and a policy's influence on these behaviors. Confounding variables need to be controlled for in the analysis, and understanding them is critical to choosing the independent variables. This is especially true in cases where the control groups are not comparable to experimental groups. Descriptive and multivariate approaches that are designed to control for confounding variables will be used in the analysis. Advanced statistical methods, such has hierarchical modeling and instrumental variables, may be necessary to account for nested data sources and a lack of adequate controls.

Measuring the policy-relevant effects of efforts to influence HIT adoption is an extremely challenging task. However, measurement will be enhanced by a sound understanding of the influences on HIT adoption, the barriers to its spread, and the basic principles of research design discussed above.

Chapter 6: Survey Guidelines: Improving What We Know About EHR Adoption

This chapter recommends general methodological guidelines for use by the Office of the National Coordinator for Health Information Technology (ONC) and by other agencies and organizations seeking to apply principles of best survey practice to the measurement of electronic health record (EHR) adoption in the United States. It is not intended to be a comprehensive guide to designing and conducting surveys or to provide detailed and comprehensive standards for federal surveys. This information is available from other sources, such as the recently released version of the Office of Management and Budget (OMB) guidance on the conduct of surveys for the federal government,[1-3] which summarizes issues in survey development, design, testing, conduct and analysis.

The measurement of EHR adoption is a complex and occasionally vexing methodological problem, and high quality surveys are needed to improve the data available to inform policy-making. As stakeholders' priorities for the cost, quality and timeliness of quantitative data about EHR adoption vary, we have presented guidelines for data collection of the highest quality while acknowledging that practical issues may lead some stakeholders to choose different survey methods.

Approaching Methodological Guidelines

Several investigative and analytic approaches were considered for measuring the adoption of EHRs, each of which has strengths and weaknesses. Not all of these approaches involved surveys. The methods we assessed included:

- analyzing measures in existing surveys using meta-analytic techniques;
- evaluating non-survey data from vendors, certification processes or registries;
- expanding existing surveys to include new or improved measures; and
- designing and conducting surveys to meet specified objectives.

The project team chose to focus on improving survey methods and measurement, which is at the center of three of these four approaches.

An expert panel was convened to evaluate the use of meta-analysis or summary descriptive analysis to estimate current levels of EHR adoption. However, as discussed in Chapter 3, prior surveys were found to vary widely with respect to the functionalities they measure, respondents they target, and clinical settings they examine–as well as the quality of their methodology. This heterogeneity led the Expert Consensus Panel (ECP) to conclude that meta-analysis is not an appropriate approach, as it may not be possible to obtain reliable and valid estimates of critical parameters by combining data from existing sources.

As further input into the guideline development process, we commissioned RTI International, an independent scientific research and technology development institute, to conduct focus groups and case study interviews. Hospital and group practice health care providers, health information technology professionals, and key trade association and e-health collaborative leaders were included in focus groups and interviews in three market areas: Denver, Colo., Chicago, Ill., and Framingham/Natick, Mass. This research gave us insight into the best way to measure EHR adoption rates and learn about the factors that positively or negatively influence adoption. These findings are discussed in detail in Chapter 5.

Survey Design

Specify Objectives

Developing annual national estimates (and standard errors for those estimates) of EHR adoption for three populations–solo and small physician groups, large physician group practices and hospitals–is essential to informing policies that aim to increase HIT adoption. As part of this process, it is critical to detect variations in adoption rates among health care providers in different geographic locations and specialties, and among those serving populations of diverse race, ethnicity, insurance status, and socioeconomic status. Further, the ECP recommended that margin of error estimates be approximately the same (+/- 3 percent) for data collected on the experience of vulnerable populations and for data collected on the population as a whole.

Specify Populations and Respondents of Interest

Determining the appropriate unit or units of analysis is essential to valid, reliable measurement. Because our research focused on measuring adoption in three groups–solo and small physician practices, large groups and hospitals–our recommendations largely pertain to measuring adoption among these providers. In future reports, we are likely to extend our recommendations to other groups, including consumers. While it is relatively straightforward to define the population of interest for individual physicians and hospitals, physician groups and ambulatory practices are highly variable in organizational structure and are not licensed or accredited in a way that facilitates this process. This variability makes identifying and locating respondents for physician groups somewhat more problematic.

Once the populations of interest are identified and defined, the next challenge is to select the appropriate respondent within each population. Individual physicians are likely to be the preferred respondent for solo physician practices and small groups. The respondent (or respondents) most able to provide valid and reliable information about the adoption of EHRs and their component functionalities within larger physician group practices and hospitals must be identified, and could include a medical or nursing director, practice administrator, technology officer, chief executive, or financial officer. As respondents' perspectives–and their reliability–are likely to vary, it may be desirable to gather data from multiple respondents within an organization. Survey procedures should allow flexibility to identify the most knowledgeable respondents, and survey pre-testing and development should focus on the best way to get valid and reliable estimates.

Although our current focus is on a selected group of providers, an important and likely future population of interest is patients or individual health care consumers. The ultimate goal of EHRs is to improve the quality and effectiveness of patient care. Thus, research designs that collect patient data eventually will provide a valuable perspective on EHR use. Data collection from patients and consumers also should help policy-makers anticipate the effect of EHR adoption on diverse patient populations.

Survey and Sampling Design

Many factors shape the selection of survey and sample design, including the target population, available sample frame, key measures, desired response rate, mode of data collection, budget, and time until data are needed.

Survey Design

Surveys can be cross-sectional, conducted at one point in time, or longitudinal, allowing for the same questions to be asked at two or more points in time. Many

EHR adoption studies are one-time, cross-sectional surveys. While valuable for measuring use at a point in time, they do not provide repeated, comparable measures of EHR adoption.

Longitudinal designs–trend, cohort and panel studies–are intended to collect repeat measures. Repeat uses of the same survey over time can provide trend data, insofar as the samples are randomly selected and comparable in terms of their demographic characteristics. Cohort studies can be used to measure changes in specific groups (people who belong to a given profession, organization or location) over time. They are used when the aggregate group characteristics are of interest, as the individuals surveyed might change. Panel studies enroll a sample of respondents and ask the same question(s) to the same individuals or organizations over time. These studies have become increasingly expensive, due to the challenge of maintaining panels and response rates, and trend or cohort designs are likely to be the favored approach.

Sampling

Sampling design describes the procedures used to select a survey's sample population, which consists of the individuals or organizations selected randomly from a sample frame to represent the target populations of interest. Ideally, the sample frame is the same as the target population (e.g., if the target population is all U.S. physicians, the ideal sample frame is a complete and accurate listing of all physicians). In practice, however, there are often differences between sample frames and target populations, resulting in both insufficient sample coverage and excess sample coverage. Sample coverage, a term used to describe the extent to which the sampling frame resembles the target population, is complete when the sampling frame is identical to the target population.

There are several major types of probability samples–simple random, systematic random, stratified (proportionate and disproportionate), and area or cluster probability–and multiple sampling stages are often required to identify the respondent(s) of interest. For example, surveys of a target population might begin by identifying geographical areas to conduct survey fieldwork and, in further stages, hospitals selected from these geographical areas, followed by physicians from those hospitals, and then randomly selected patients from the physician's practice. At each stage, there is a selection procedure and an associated probability of selection.

Disproportionate Sampling

There are simple and complex approaches to sampling. For example, in the case of sampling physicians nationally, approaches range from selecting a random sample from a list of all U.S. physicians and collecting data from those providers, to selecting physicians and physician practices within an area probability sample of the U.S. population and collecting data on randomly selected patient visits to those physicians (as done by the National Ambulatory Medical Care Survey (NAMCS)).[4] Complex sampling designs are often necessary to answer policy questions about subsets of providers. In our case, we want to know whether providers serving vulnerable populations are developing HIT capacity at the same rate as other providers and, if not, what impact this is having on quality of care and health disparities.

We identified racial and ethnic minority patients and low-income or publicly insured patients as high priority patient populations. A simple random sample is not sufficient to provide reliable estimates of HIT adoption among those

providing care to these populations. As discussed in greater detail in Chapter 4, provider subgroups can be identified through self-report of patient panel composition, linking provider IDs to Medicare claims to assess the racial and ethnic composition of elderly patient panels, and using discharge data or payer-mix data to determine patient panel characteristics along key dimensions. Disproportionate sampling based on these data should adequately power HIT adoption estimates for these subgroups.

Special attention must be given to understanding design effects and survey weights that adjust estimates by the probability of subject selection, as disproportionate sampling impacts estimation and standard errors. Complex sampling designs that rely on public use data, and data being interpreted in organizations where appropriate methodological staff or consultant help is not available, may pose challenges to getting accurate estimates and standard error calculations.

Sampling Frames

The sampling frames that have the best sample coverage and quality for drawing probability samples of solo physicians and small groups, large physician groups, and hospitals are listed below. In all surveys, it is important to understand sample coverage and its determination; the source of the data; the age of the data; the proportion of incomplete, missing, or inaccurate data elements; and the methods of updating and validating data elements.

Solo and Small Group Physicians

The preferred source of data on physicians in solo practice and small groups is the American Medical Association (AMA) Masterfile. The AMA Masterfile includes current and historical data on physicians residing in the United States who have met the educational and credentialing requirements to practice medicine. Records include the physician's name, medical school and year of graduation, gender, birthplace, and birth date, as well as residency training, state licensure, board certification, geographical location and address, type of practice, present employment, and practice specialty. There is one caveat: the time between a physician's change in practice status and its notation in the Masterfile record can be substantial. Also, it does not contain complete data on physician race or ethnicity, practice case-mix, or payer-mix, or on the patient population's demographic profile.[5, 6]

Large Physician Group Practices

The Medical Group Management Association currently has the most comprehensive information on medical groups composed of three or more physicians in the United States, with a database that includes about 35,000 groups. It was created by a merger of MGMA's database of members, past members, and customers, with the FIRSTMARK commercial database, AMA medical group data file, and Veterans Health Administration medical group file. A current MGMA effort to identify physician practices in Colorado that serve vulnerable populations could suggest novel strategies for identifying such groups and also inform sampling frame development to ensure their representation in national samples.

There's also one caveat with respect to the MGMA database: the individual, merged databases used to create it contain errors. MGMA has taken steps improve the reliability of the database.[7] However, in light of problems with the MGMA database, the best strategy for understanding EHR adoption in physician group practices may be to sample physicians and then elicit information about group

size and organization in order to assure adequate data on groups. This would enable surveys to generate conclusions about EHR adoption by physicians practicing in groups. If desired, this strategy could be expanded to sample the groups identified by physicians and to survey relevant respondents in those groups. Such a strategy would produce data that represented adoption of EHRs by groups in which physicians practice in the United States. Though not ideal, this approach is recommended in part due to concerns about the accuracy and currency of the available lists of group practices and the lack of a definitive source for all medical groups in the United States. Short of this revised approach, the MGMA database is the preferred database.

Inpatient Hospitals

The American Hospital Association (AHA) maintains a database of more than 6,000 U.S. hospitals with information on approximately 700 characteristics, including bed size, location, teaching status, and region. Although declining response rates have affected the database's quality, it is updated annually for 85 percent of hospitals nationwide and considered the best available source of hospital sample data in the United States. AHA data is also linked to Centers for Medicare and Medicaid Services (CMS) and financial data.[2] This, in combination with geographical data, might enable sample selection to target hospitals that serve a disproportionate share of vulnerable patients.[8] The AHA database is the preferred sampling frame for acute care hospitals in the U.S.

Sample Size, Survey Weights, and Modes and Methods

Sample Size

The desired precision of estimates for key analytic variables and the desired analytic power for statistical comparisons should drive sample size calculations. Working with sampling and survey methodology experts, these estimates should take into account the specific measures of interest, estimates of the population proportion reporting on this measure, information on anticipated survey response rates, and effects of complex sample designs. The margin of sampling error, which will vary both with the size of the total sample, or sample subgroup, as well as the response frequency for any analytic variable, can be measured and controlled in probability sample surveys. Surveys measuring EHR adoption should have sample sizes sufficient to provide estimates with margins of error no greater than +/- 3 percent, as defined by the ECP.

Survey Weights

Probability samples might under- or over-represent some elements of the population. Thus, weights should be assigned to each respondent case and used to adjust the overall results to more closely conform to the known characteristics of the total population. (Failing to weight data can result in biased or imprecise estimates and should be avoided.)

Modes and Methods in Data Collection

The recent OMB advisory summarizes the advantages and disadvantages of different data collection modes, including personal interviews, telephone (voice, interactive voice response, or facsimile), mail, and Web-based surveys. Factors that should be considered when choosing a sample mode include: availability of contact information, cost of contacting respondents, time to administer the survey, length of the questionnaire, speed with which data are needed, respondent burden to perform survey tasks, complexity of the survey instrument, question type (open

or closed ended and need for visual aids), question sensitivity, need for computer-assisted interviewing, desired response rate, possibility of interviewer bias, and need to control survey completion by respondent or other proxy or substitute.

Facsimile numbers and e-mail addresses are not widely available for physician, medical group, and hospital samples. As a result, reliance on these modes will have a negative impact on sample coverage and increase selection bias. Although researchers may be tempted to collect data for information technology surveys online, initial contacts should be made in a mode common to all potential subjects, and the survey should allow for multiple modes of response. Web administration might not be an option for some respondents, and surveys that rely on this approach may result in biased data as those with Web access may be more likely to have EHRs in their practice.

Physician surveys initiated by mail, with an honorarium check enclosed, have the highest response rates, according to recent studies.[9] Group practice and hospital data quality and response rate rely on reaching the most knowledgeable respondent–specific physicians, practice administrators, executives, and information technology professionals. Finally, survey response rates have declined in recent years, making repeated attempts to contact eligible respondents and the ability to conduct surveys in multiple modes necessary.

Practice and Market

To understand how adoption rates may vary across provider groups, it is essential to collect information about those providers that will allow detection of such variation and its potential causes.

One of our policy concerns is to learn the ways in which EHRs affect the quality of care and health outcomes of vulnerable populations including the poor, uninsured, racial and ethnic minorities, and Medicaid beneficiaries. Accurate measurement of practice and market characteristics nationally will help researchers to examine differential adoption rates among providers who serve vulnerable populations relative to other providers. These analyses can highlight the need for policy development in specific areas and motivate the development and adoption of relevant interventions.

Physician Characteristics

The NAMCS survey includes data on payer-mix, provider demographics (including age, gender, ethnicity and race), year of graduation from medical school, specialty, number and type of locations where the physician sees patients, number of office visits per week, group membership states, and number of providers in the physician's medical group. NAMCS also collects extensive information about patients at the visit level including, race, ethnicity, expected source of payment, reason for visit, diagnosis, and services provided. These physician and practice level characteristics would allow for the analysis of EHR adoption by subgroups. Analyses of NAMCS data will assist in determining if different subgroups of the provider population are adopting the technology at differential rates.[4]

As discussed in Chapter 4, the ECP has recommended that racial and ethnic minorities and low-income patient populations be the highest priority groups with respect to tracking access to EHRs and their potential implications for health disparities. This suggests that the following subdomains are essential to capture important information about a physician's practice environment and

could be added to the NAMCS survey instrument to supplement the data that is currently collected:

- urban/rural status (MSA/non-MSA) and
- socio-economic status of the local population.

Concerns about survey length and respondent burden might lead to the use of other analytic techniques to capture data on market characteristics. Geocoding, for example, can link respondents' zip codes to demographic information.

Medical Group Practices

The MGMA survey also collects information on the type of practice, number of full-time equivalent physicians, number of full-time equivalent non-physician providers, and majority owner of the practice. In order to fully understand the diffusion of EHRs among physician group practices, the ECP suggested adding the following sub-domains:

- payer mix;
- zip code;
- years of operation;
- form of physician compensation;
- membership in a network;
- rural/urban location of practice;
- socio-economic profile of the local market;
- level of hospital/medical competition in the market area; and
- ethnic/racial composition of the patient panel.

As with physician characteristics, these items could be added to the MGMA survey, although researchers must be mindful of the survey length. Geocoding could again be used to capture information about a practice's geographic area.

Hospital Characteristics

There are no ongoing hospital surveys that examine EHR use in the inpatient environment. As discussed above in relation to solo physicians and group practices, understanding the characteristics of hospitals that do and do not adopt EHRs will further our understanding of the adoption process and the diffusion of the technology among different hospital subgroups. In order to ensure an adequate understanding of these subgroups, the following sub-domains could be included in a hospital survey:

- racial and ethnic composition of the patient population;
- hospital characteristics: size, payer-mix, location, membership in multi-hospital system;
- financial status, public vs. private;
- market characteristics: rural/urban, SES profile of the market area, level of hospital/medical competition; and
- safety net vs. non-safety net.

The annual AHA hospital survey provides a useful model for the type of information that can be collected from hospitals. While the AHA survey does not include measures of EHR adoption, barriers, or incentives, it does collect extensive data on hospital financing, beds, utilization, and staffing. Creating new survey content to capture EHR adoption data that could be linked to existing AHA data might be an efficient way to collect the necessary information without burdening respondents with a lengthy list of hospital characteristics.

Fielding the Survey

Survey errors, including both non-response and response errors, can threaten researchers' ability to obtain valid and reliable estimates and to accurately calculate their precision. Non-response errors occur when only some of those sampled respond to a survey. In order to measure their impact on data quality, it is important to understand differences in survey response between those sampled and those who complete the survey. (AMA and AHA samples describe respondent characteristics; other sample sources make it difficult to evaluate non-response error). Response errors include problems with question wording, questionnaire design flaws, item non-response, interviewer effects, respondent selection, and mode of interview effects. These errors can be minimized by carefully developing and testing survey instruments, but response errors that occur during the field period can also have impacts.

Survey errors arise in part from the logistical challenges of administration–training interviewers and research staff, constructing quality checks at each stage, and maximizing response rates. To overcome these challenges and minimize errors, using a professional survey research organization with established fieldwork procedures is desirable. Achieving acceptable response rates in busy professional and organizational settings can require months of data collection, and efforts to maximize cooperation are critical to survey quality. Many organizations faced with the time and cost demands of careful data collection choose to compromise their methods, but this decision results in biased estimates where the bias is not measurable or even detectable.

Statistical Analysis and Reporting

The use of appropriate, valid statistical methods and consultation is essential for analyzing survey data about EHR adoption, and these methods should be reported along with the results of such surveys. Analyses should take into account the sample size of the relevant subgroup, and the adequacy of power and sampling design needed to support those analyses. Data analyses should include design or response weights appropriate to the survey and sampling design; estimates should include standard errors. All analytic reports should include disclosure information in accordance with the guidelines presented in this chapter.

Confidentiality and Disclosure

Survey researchers should adhere to the full code of professional ethics and practices for survey research, including protecting the confidentiality of respondents and disclosing the full details about the survey's methodology. Maintaining confidentiality is essential to ensure that respondents are willing to participate in future survey research. Transparency of methods will allow end users of the data to have confidence in the validity and reliability of the results.

Confidentiality

An essential element of best survey practice is protecting research subject confidentiality. Data should be reported in the aggregate and great care should be taken to limit information about respondent identifiers to those with a need to know, and Institutional Review Boards (IRBs) should review procedures to ensure compliance with human subject protection guidelines. The following steps should be taken in order to ensure respondent confidentiality:

- data should be reported in the aggregate form;
- respondent identifiers should be removed from any data that is publicly available; and
- researchers should consider limiting the data that is publicly available when it may be possible for analysts to determine a given respondent's identity based on demographic information (for example, when there is only one hospital in a particular zip code with a given demographic profile).

Disclosure

Surveys reported in the public domain should make methodology information available for review, including survey questionnaires or other relevant sections of the survey. Researchers and organizations also must be prepared to report response rate information in accordance with professional standards and to conduct quality checks at every phase. Meta-analysis will require incorporating survey data that rates the quality of existing surveys. The American Association of Public Opinion Research (APPOR) recommends disclosure of the following elements:

- who sponsored the survey, and who conducted it;
- exact wording of questions asked, including explanatory text;
- a definition of the population under study, and a description of the sampling frame used to identify this population;
- a description of the sample design that indicates the method used to select respondents;
- sample sizes and, where appropriate, eligibility criteria, screening procedures, and response rates computed according to AAPOR standard definitions;
- a discussion of the findings' precision, including estimates of sampling error, and a description of any weighting or estimating procedures used;
- which results are based on parts of the sample, rather than on the total sample, and the size of such parts; and
- method, location and dates of data collection.

Modifying existing national surveys

As discussed in previous chapters, both the NAMCS and MGMA survey contain useful items on EHR adoption. However, based on our research, we believe that new content–either for these surveys or for new surveys–must be developed to accurately measure adoption among all provider groups.

As discussed in Chapter 2, the NAMCS contains a list of EHR functionalities. However, the survey does not allow for a full understanding of EHR adoption as the "use" measures lack precision (see Chapter 2 for a full discussion of this issue). Moreover, the survey does not include items that adequately cover EHR acquisition and installation, and barriers and incentives to adoption; also, the validity of the patient race and ethnicity data has not been assessed.

Similarly, the MGMA survey does not include items on all of the domains necessary to measure adoption. In addition, as discussed earlier in this chapter, the MGMA sampling frame has significant drawbacks that may cast doubt on the reliability of any findings. Thus, it may be necessary to supplement the MGMA sample in order to ensure that it is representative of physician groups nationwide.

In both surveys, respondents may either be physicians or practice managers. For solo or small groups, physicians are the appropriate respondents. However, for large groups, both individual physicians and practice managers have limitations as respondents. The surveys assume that respondent physicians will be completely familiar with all of the functions of their EHR system. However, unless they have received significant training or are highly motivated to learn the system, physicians are not likely to be aware of functions that they do not use but may be available in an organization's EHR. Practice managers and CIOs may be a more appropriate respondent for questions that focus on EHR capabilities, and researchers should carefully track who the respondent is within each practice. However, these respondents may not know what functionalities physicians actually employ.

When developing any new survey content, survey researchers should be mindful of the differences, not only between respondents within a care setting, but also differences across care settings. At this time, the AHA's annual survey does not include measures of EHR adoption. As NHAMCS only focuses on hospital emergency and ambulatory care department, there will likely be a need to develop survey content specific to the inpatient setting. Adoption issues may differ significantly between inpatient and outpatient care settings, and surveys need to reflect the need for separate content. Also, it is important that hospital EHR adoption surveys focus at both the departmental and the hospital-wide level.

Next Steps and Summary

Our focus has been on the best approaches to generating annual national measures of EHR adoption by physicians and hospitals in a timely way. As meta-analysis of existing data from multiple surveys was not found to be a viable approach, our attention has turned to the expansion of existing surveys to include new content or samples and the development of entirely new surveys.

Discussions about expanding surveys and conducting new probability sample surveys of physicians, physician group practices, and hospitals raised several critical issues. In consultation with the ECP and in accordance with best survey practices, we have concluded the following:

- Defining units of analysis and appropriate respondents is likely to be a challenge. Our core interest is in whether electronic health records have been adopted–acquired, installed and used–in the patient-provider encounter. Although our current objective is to develop measures of adoption among physicians and hospitals, patient-level visit data is expected to be of value too.
- Surveys of physicians and hospitals are best conducted using samples drawn from AMA and AHA databases.
- Group practice and hospital EHR adoption surveys may have to be approached in more than one phase, with surveys of a first respondent to elicit organizational information followed by a second phase of surveys to gather data from knowledgeable respondents. It is also likely that critical information will need to be elicited from more than one knowledgeable respondent within a practice or organization. Necessary adjustments for probabilities of selection

can be made between phase one and two to allow additional stratification or oversampling for organizational size, understanding of vulnerable patient populations, or other factors. Finally, survey measure and method testing will be key to obtaining valid and reliable EHR adoption estimates.

- EHR acquisition, installation, and use, and key functionalities will be difficult to assess solely through the use of existing surveys. Thus it is likely that new content and new data collection efforts will be necessary.
- NAMCS could serve as a useful framework for additional data collection efforts on physician practices and groups, both through content or sample expansions. An annual survey, it provides both physician and physician practice level data and is linked to patient-encounter information, thus meeting many of our defined objectives. NAMCS already includes content on EHR adoption, and a preliminary meeting with National Center for Health Statistics (NCHS) representatives was held April 26, 2006, to discuss the opportunities for collaboration.
- While it might be possible to add new content to the 2007 NAMCS survey, major content or method changes are unlikely until 2008, given the need for testing and development, OMB clearance, and the time to publish preliminary and final estimates.
- Further analyses will be necessary to determine whether current NAMCS data is sufficient to understand access to EHRs in practices serving vulnerable populations and whether, working in collaboration with NCHS, needed estimates will be available in a suitable time frame for the ONC and ECP.
- AHA's annual survey has a high response rate and is currently the best source of hospital data. Although the survey is already extensive, preliminary discussions suggest that AHA is willing to include a limited number of new data elements to estimate hospital EHR adoption. More extensive content would likely need to go in stand-alone surveys of a similar population.
- Adding content to existing surveys raises many challenges that need to be addressed in order to ensure the timeliness of collaborative estimates and their validity and reliability as specified by the ECP, especially for providers serving vulnerable populations. Our content guidelines, for example, established specific data collection objectives, many of which would not be achievable given the cost and respondent burdens of existing questionnaires. Current surveys serve many important public purposes other than ascertaining rates of EHR adoption, and incorporating additional content could threaten those purposes. Further, it is unlikely that existing national surveys will have the space or scope to explore broader questions, such as the incentives and barriers to adoption and other policy-relevant issues. Thus, it is possible that new surveys that collect and disseminate policy-making data and meet ECP and ONC objectives might still be necessary.

In the prior chapter, we discuss general recommendations for improving what is known about EHR adoption through surveys of physicians, group practices and hospitals. This chapter focuses on specific recommendations for improving existing, ongoing national surveys, and for new survey efforts where these are required to meet the needs of policy-makers concerned with EHR adoption. In addition, we make further recommendations for surveys of providers and hospitals serving vulnerable populations. Last, we lay out a research agenda for studying both the effect of EHRs on the provision of care and the use of EHRs to capture quality data efficiently.

Our recommendations have several central goals. The first is to ensure that policymakers and managers have the information they need to maximize the speed and effectiveness with which EHRs become available to U.S. health care providers. The second goal of our recommendations is to make certain that the information developed, and the policies and decisions undertaken, recognize and address inequities that may arise as EHRs diffuse through our health care system. If the past is a prelude, the risk that the spread of vital new health information technologies, such as EHRs, will sustain or even increase disparities in health and health care is substantial. The advent of health information technology creates an opportunity to avoid perpetuating the history of unequal treatment for vulnerable groups of U.S. citizens. To seize this opportunity requires a careful but relentless search for data documenting the existence of disparities and suggesting policies to overcome them.

1. Improving estimates of EHR adoption among physicians using existing, ongoing national surveys

1.a. The National Ambulatory Medical Care Survey (NAMCS)

NAMCS, an annual survey of patient visits to physicians in the United States, is a high quality national survey that meets many critical needs for information on health care services in the United States. It offers the potential to use a well-designed federal survey to measure EHR adoption. Moreover, its patient-level data could provide some information about the affect of EHR availability on patterns of care among sampled physicians. However, the survey's sample size is currently not adequate to track adoption on an annual basis within the accuracy levels specified by the Expert Consensus Panel (ECP). In the past, most NAMCS EHR adoption estimates were made by combining several years of survey data, which somewhat reduced the survey's ability to meet the need for annual estimates of EHR adoption rates. However, in 2005, researchers at the National Center for Health Statistics (NCHS) made significant efforts to increase NAMCS' response rate and effectively increased their sample. However, it is too early to assess whether the sample size is adequate to meet the ECP's standards for accuracy in examining differential patterns of adoption among providers disproportionately serving vulnerable populations.

Should the federal government provide additional funding, there are several possible scenarios for expanding NAMCS to track EHR adoption among physicians and meet the central goals outlined above.

1.a.1. Supplement the NAMCS sample to ensure an adequate number of providers serving vulnerable populations are surveyed

The NAMCS sample could be supplemented so that it includes both a national, random sample of physicians (as it now does) and an adequate oversample of physicians serving vulnerable populations. According to ECP recommendations, surveys should be designed and sufficiently powered to detect variations of approximately +/- 3 percent in adoption rates among health care providers who serve vulnerable populations, the same margin of error that the ECP recommends for estimates of adoption rates among all health care providers. In the case of NAMCS, the sample could supplement its current, nationally representative sample of 1,200 physicians with an additional oversample of 1,000 physicians serving vulnerable populations. This would yield a margin of error of +/- 3 percentage points for the national sample and approximately +/- 3 percentage points for the subgroup of providers serving vulnerable populations.

However, there are two drawbacks to supplementing the NAMCS sample. First, supplementing the sample without additional content will not meet several data collection needs. NAMCS contains only a limited number of questions about EHR functionalities. It does not contain any questions on other domains of interest: rates of EHR acquisition and installation (as opposed to use), and incentives and barriers to adoption. Second, the physician induction interview, which contains questions about EHR use, is fielded throughout the year. Thus, survey data is generally not available until the middle of the following data collection year–limiting its usefulness for making timely, annual estimates of EHR adoption. We should note, however, that NAMCS is working hard to make data available in a more timely fashion.

1.a.2. Create a new survey module for EHR adoption that could be added to the current NAMCS survey

This option offers several of the same advantages as the prior one, including the NAMCS survey's high response rate and an inherent link to patient-level data. In addition, creating a new survey module would allow researchers to gain a much fuller understanding of EHR adoption by allowing them to ask multiple questions in each survey domain. This data could be combined with NAMCS patient-level data to determine if subgroups of patients have differential access to EHRs.

However, given the limited sample size, researchers would not be able to conduct additional analyses on providers serving vulnerable populations. Moreover, the timeliness issue would also apply to this option and may be exacerbated by adding a large amount of new content to the survey that would have to be approved by the Office of Management and Budget (OMB), a process generally lasting nine months. This would significantly delay data the first time the new module was fielded and have serious implications for timely annual estimates of EHR adoption in the short term.

1.a.3. Supplement the NAMCS sample and create a separate survey module on EHR adoption

Supplementing the sample by including an oversample of physicians serving vulnerable populations and creating a new module focused on EHR adoption would give researchers a full understanding of adoption among the general provider population as well as provider subgroups. While costly, this new survey effort would build on an established, high quality survey and thus give researchers a high

level of confidence in the data's quality. As with the other options, data timeliness would remain an issue as modifications of this magnitude require OMB approval.

As discussed above, using the NAMCS survey offers several advantages, among them its high response rate. However, the timeliness of the data remains a significant drawback. The ECP has recommended yearly data collection. In order to be useful to policy-makers, data on EHR adoption, a rapidly evolving phenomenon, should be collected and disseminated as quickly as possible without jeopardizing its quality. This need may preclude the use of NAMCS, at least in the first and second years of the data collection effort. A major modification of the NAMCS survey, such as those discussed in the first and second options, would require OMB submission in January 2007, and generally takes nine months to receive clearance. The survey would then be fielded in January 2008, with publicly available data released in the spring of 2009.

2. Improving estimates of EHR adoption among physician group practices

As discussed in the prior chapter, there currently is no reliable sample of physician group practices in the United States. In light of this limitation, the preferred way to obtain data on physician group practices would be to start with a national random sample of physicians or build off an existing physician survey and use this sample to create a sample of groups. Researchers could design a survey module for practice managers that includes questions on size of practice, region, multi or single specialty, multi- or single- site location, and market integration. In addition, practice managers could be surveyed about any assistance their practice might need in order to adopt EHRs.

One possible design would be to obtain the names of practice heads. These could then be matched against the AMA database and other commercially available lists, such as the MGMA database, that include the names of practice managers. For practices missing this information, researchers could follow up the physician survey by telephone to obtain practice manager names and confirm addresses. With weighting based on the number of physicians in the group, this design would allow researchers to generalize to physicians that practice in groups of a particular size and with specific characteristics.

It is possible to use NAMCS to generate estimates based on group practices. However, the sample size is not adequate to obtain estimates for a given year with desired accuracy, and all NAMCS group practice estimates must be combined over several years of data. To obtain an adequate sample size, the NAMCS sample would have to be supplemented.

3. Improving estimates of EHR adoption among hospitals

3.a. National Hospital Ambulatory Medical Care Survey (NHAMCS)

NHAMCS is a nationally representative survey of hospital emergency and ambulatory care departments that provides high quality data on a range of vital health care matters. Should the federal government wish to provide additional funding for NHAMCS, there are several options for supplementing it to further our understanding of EHR adoption among hospitals. The current NHAMCS design only includes hospital outpatient departments and emergency rooms. Any changes to the NHAMCS design should expand the sample to include the inpatient environment, as EHR adoption issues may vary between inpatient and outpatient settings.

3.a.1. Supplement the NHAMCS sample to ensure an adequate number of providers serving vulnerable populations are surveyed

Similar to the options for expanding NAMCS, the NHAMCS sample could be supplemented to ensure that it includes an adequate number of hospitals disproportionately serving vulnerable populations. The oversample should be sufficient to allow for estimates of hospitals serving vulnerable populations with the same or similar margin of error as estimates based on the national sample.

Building on NHAMCS offers several advantages. It would allow researchers to have a high level of confidence in the reliability of the data, as NHAMCS questions have been cognitively tested, the sampling method is rigorous, and the response rate is excellent. However, as with the NAMCS, the timeliness of the data–which would only be available to the public in the spring of 2009–is an issue. In addition, interviewing in the inpatient setting would require a major modification of this federal survey. It is likely that these changes would require lengthy development work to identify correct respondents and obtain OMB approval, a process that could add approximately one year to the project timeline, with data available in 2010.

3.a.2. Create a new survey module for inpatient hospital EHR adoption that could be added to the current NHAMCS survey

The current NHAMCS survey contains a limited number of survey items related to EHR adoption. A new survey module would allow researchers to gain a fuller understanding of EHR use in the inpatient setting, as it could ask about a number of items in each of the survey domains. This data could be combined with patient level NHAMCS data to understand differences in EHR adoption among different patient groups.

However, NHAMCS' sample size may not be adequate for comparisons between hospitals that disproportionately serve vulnerable populations and those that do not. (NHAMCS estimates are generally made using data combined over several years to increase their precision).

3.b. The American Hospital Association (AHA) Annual Survey

The AHA conducts an ongoing, annual survey of inpatient hospitals. The survey currently does not include any questions on EHR adoption, but it provides a very useful potential platform for administering such questions. Adding a limited set of items to this survey may be possible and would offer the advantages of a high response rate survey. However, it is unlikely that the AHA would consider adding more than a very small number of items. The survey currently serves many important purposes for the nation's hospitals and policy-makers, providing information about staffing, utilization and other critical matters. Adding a substantial module about EHRs would greatly add to the respondent burden and could jeopardize the traditional purposes of the survey.

3.c. Conducting a new hospital survey in cooperation with the AHA

Creating a new hospital survey in cooperation with the AHA may be the best way to fully understand EHR adoption in the inpatient environment. The survey could include a nationally representative sample of hospitals, with an oversample of facilities disproportionately serving vulnerable populations. It may be possible to build on other existing work supported by the Robert Wood Johnson Foundation to identify these hospitals.

The survey would require a considerable amount of development work to:

- identify hospitals serving vulnerable populations;
- identify the correct respondents;
- develop effective questions; and
- assure an adequate response rate.

As discussed in the prior chapter, this design may need to include multiple respondents within each hospital in order for researchers to understand the process of adoption, as well as the functionalities that are actually used by health care providers in the hospital.

Creating a new survey instrument in cooperation with the AHA offers several advantages. First, partnering with the AHA may help to improve the survey's response rate. While the AHA annual survey has a response rate in the 80 percent to 85 percent range, the majority of other hospital surveys only achieve response rates in the 30 percent range. In addition, creating a new survey would ensure that the data needs of policy-makers and managers are met, as it would be able to include questions in all domains of interest. In addition, creating a new survey may produce data more quickly than either adding to the AHA annual survey or modifying the NHAMCS survey.

Summary Recommendations

- Building on NAMCS and NHAMCS to study the rate of EHR adoption offers the possibility of using high quality surveys with excellent response rates. However, the timeliness of these data may limit somewhat the value of relying on these existing, ongoing national surveys, particularly in the first and second years of the monitoring effort.
- NHAMCS would require significant design changes in order to survey the inpatient environment.
- Policy-makers should explore the possibility of conducting independent surveys of physicians and group practices in order to produce more timely data.
- Researchers surveying physicians and physician group practices could field their own data collection efforts and, at the same time, work with the National Center for Health Statistics to supplement the NAMCS sample and create additional survey modules. Ideally, the two data collection efforts would use identical survey modules to allow for trending the data over time.
- New survey efforts should have sample sizes that are sufficient to detect variations within subgroups at approximately +/- 3 percentage points.
- New surveys of physician group practices should start with a national random sample of physicians, or build off an existing physician survey, and use this sample to create a sample of groups. Researchers could design a survey module for practice managers that includes questions on practice size, region, multi or single specialty, multi- or single-site location and market integration.
- Researchers designing new hospital survey efforts should consider partnering with the AHA.

4. Improving estimates of EHR adoption among providers serving vulnerable populations

As discussed in the preceding chapters, the HIT health disparities workgroup identified a range of policy-relevant patient subgroups (e.g., defined by racial, ethnic, socioeconomic, geographical, insurance states, and English proficiency) who stand to benefit from information on the use of EHRs to direct their medical care. The ECP has identified racial and ethnic minority patients and patients who have low-incomes or are publicly insured as high priority patient populations.

Strategies to identify providers who disproportionately serve these patients could be developed in a number of ways. Physicians could be asked to report on the composition of their patient panels, for example. However, the reliability of these estimates is unknown. Surveys relying on self report should conduct an audit on a randomly selected subsample of respondents to verify the reliability of their estimates. Linking provider identification to Medicare claims data would provide more reliable data than self-report for empirically assessing the racial and ethnic composition of providers' patient panels. The primary drawback of this approach is that it would provide data on the elderly population only. Investigators relying on Medicare claims data should conduct supplementary research to determine whether the distribution of elderly patients from racial and ethnic subgroups among health care providers is similar to that of non-elderly populations.

The two approaches discussed above could also be used to determine the racial and ethnic characteristics of a hospital's patient population. In addition, discharge data could be used to the extent that individual hospitals accurately collect and record patient racial/ethnic data. Surveyors choosing to rely on discharge data should conduct an audit on a randomly selected sub-sample of hospitals in order to verify the data's reliability. Payer-mix also could be determined using self-report for individual providers and group and discharge data for hospitals. Researchers using self report on payer-mix will need to determine the correct respondent for these questions at the level of the individual provider, practice and hospital.

Recommendations

Identifying providers that disproportionately care for vulnerable populations will likely require a multi-pronged approach.

- Directly querying providers may be the easiest choice; however, the reliability of such data is unclear.
- Linking providers to Medicare claims data would provide reliable information on the elderly population but not the non-elderly.
- Payer-mix would be a good choice for hospitals; however, it may be of limited usefulness for individual providers.
- In order to clearly understand if differential rates of EHR adoption are contributing to disparities in health care, further research is needed to reliably identify providers serving vulnerable populations.

Conclusions

If, as many predict, the advent of HIT generally, and EHRs in particular, constitutes a revolutionary change in the organization of our health care system and the practice of medicine, tracking the adoption of these technologies and understanding their impact on the health care system are vital to effective policy development. Interested stakeholders have a valuable foundation to build on in this regard, consisting of public and private surveys of providers conducted by various agencies and groups. These existing data collection efforts should be supported and continued. But to provide the information that policy-makers need and, especially, to avoid recapitulating past inequities associated with the introduction of new technologies, new data collection initiatives will be required. In future reports, we hope to be able to summarize what has been learned from a new wave of investigations that will keep stakeholders fully informed of what the HIT revolution means for our changing health care system.

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Chapter 2

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