Prospects for Care Coordination Measurement Using Electronic Data Sources

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Executive Summary

Care coordination, defined as the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of health care services,[1] has been recognized as a priority area for improving health care delivery in the U.S.[2] Robust measures of care coordination processes will be essential tools to evaluate, guide, and support efforts to understand and improve deficits in care coordination.

Aims

This report presents an assessment of the potential for measuring care coordination processes using data from electronic data sources, in particular from existing and emerging health information technology (IT) systems such as electronic health records (EHR), health information exchanges (HIE), and all-payer claims databases (APCD). This assessment relies on background research and input from individual and group discussions with a panel of informants with expertise in health IT systems development and use, HIEs, EHRs, APCDs, insurance plans, health data standards, and quality measurement. This effort did not aim to develop new measures of care coordination, but to synthesize the background relevant to such future work.

Advantages of Measurement Using Electronic Data

Interest in using electronic data, in particular data from health IT systems, for care coordination measurement has promising advantages over data most commonly used today to measure coordination processes (e.g., surveys, chart review). Electronic data offer:

- Minimal data collection burden. Structured data may be automatically extracted for quality measurement.
- Rich clinical context. Health IT systems populated with clinical data (e.g., information on physician orders, laboratory results, etc) offer a view of processes of care and clinical outcomes not possible from data sets based only on claims data.
- Longitudinal patient data aggregated from multiple sources over time. EHRs, HIEs and APCDs aim to aggregate information for individual patients temporally from multiple providers, settings, and payers into a single location.

Current Challenges of Measurement Using Electronic Data

Panelists identified a number of challenges in using electronic data for care coordination measurement:

- Underutilization of health IT system capabilities, such as use of structured data fields
- Clinical workflow barriers, which lead to limited attention to and documentation of coordination processes
- Lack of data standardization, in particular coding of lab results and medication information
- Limited health IT system interoperability
- Unknown clinical data quality in various electronic data sources
- Limitations in linking data
- Technical hurdles to accessing data
- Business models related to Health IT that facilitate competition rather than cooperation, especially in ways that prevent a full picture of the steps taken to care for a patient across settings and time

Key Expert Panel Recommendations to Advance the Potential for Care Coordination Measurement Using Electronic Data

Panelists also recommended a number of ways to address these key challenges.

To address underutilization of health IT system capabilities and clinical workflow barriers:

- Align structured data fields with decision support tools.
- Create protocols for non-physician clinical or support staff to enter selected information in structured fields.
- Explain and, ideally, demonstrate how and under what circumstances structured data improves care coordination, and ultimately care delivery.
- Design health IT functionality to capture coordination activities more explicitly, both to support team practice and to measure the extent of these activities.

To address lack of data standardization and limited health IT system interoperability:

- Continue to support development of standards, both in areas where standards are undeveloped and by motivating adoption of existing standards through incentive programs.
- Align measurement and payment incentive initiatives with key standards gaps, such as coding of lab results and medication information.
- Align measure specifications with existing guidelines or elements of other quality measures.
- Develop well-defined measure concepts that will give vendors, EHR users, and HIE administrators clearly defined data elements to build into systems.

To address unknown clinical data quality in various electronic data sources:

- As part of measure development efforts, include an evaluation of the reliability and accuracy of any electronic data used for quality measurement.
- Disseminate and, preferably, publish evaluations of data quality.

To address limitations in linking data:

- Communicate the value of linked data to policy makers and the public.
- Develop strategies for overcoming privacy barriers.

To address technical hurdles to accessing data:

- Consider the accessibility of data to end-users when designing health IT systems.
- Consider the resources required to extract data from health IT systems when choosing a product.
- Consider whether any additional EHR certification requirements could help improve the ease of extracting data from within EHRs.

To address business models that facilitate competition rather than cooperation:

- Support and widely disseminate projects that demonstrate the value of information sharing.
- Seek out evidence that can demonstrate any cost savings for institutions that result from information sharing or other care coordination activities.
- Bring leaders of competing health care organizations together to facilitate dialog and encourage information sharing.

Near-term Measurement Opportunities Using Electronic Data

Panelists identified opportunities for measuring care coordination using electronic data that are likely to be feasible within the next 2-to-3 years.

Near-term measurement opportunities

Measurement Approach	Data Source(s)
Use Meaningful Use measure data elements in new measures of care coordination	Certified EHRs from providers and hospitals participating in the Meaningful Use incentive program
Use CCD/CCR messages to confirm transmission of key pieces of information during care transitions	EHR or HIE* and claims data (APCD, payer files)
Use EHR data to confirm inclusion of key information from other health care settings within primary care record	EHR and claims data (APCD, payer files)
Use EHR audit files to evaluate whether information transferred from other settings is viewed by providers.	EHR audit files
Use claims data to confirm follow-up care occurred within expected time frame	APCDs, HIE* (if includes claims data) or payer files
Use claims data to examine instances of redundant testing	APCDs, HIE* (if includes claims data) or payer files Would be enhanced by addition of clinical data from EHR or HIE*

APCD – all-payer claims database; CCD – continuity of care document; CCR – continuity of care record; EHR – electronic health record; HIE – health information exchange

*HIEs are only a data source if they include a data repository that stores data rather than just transmitting it.

Next steps required to implement these care coordination measure concepts include:

- Develop methods to link clinical and claims data and examine the reliability and accuracy of the linkage.
- Investigate the validity and quality of the specific data elements used within measures.
- Assess the accuracy of data automatically extracted from EHRs, for example by comparison with manual chart review.
- Carefully specify measures, with clear definitions of numerator, denominator, and exclusions. Develop risk adjustment models where necessary.
- Elicit clinical input and synthesize evidence from published literature and evidence-based guidelines, when available, to inform measure development.

Long-term Measurement Opportunities

Panelists also discussed some measurement opportunities that are promising in the long term, but likely not feasible within the next 3 years. These opportunities and their challenges included:

- Evidence that data are being linked across sites or across providers. Using aggregation of clinical information from multiple settings as evidence of care coordination will likely require further development of interoperability infrastructure, the evolution of EHRs and how data are recorded within them, and further conceptual development around what constitutes coordinated care.

- Lack of documentation in a coordinating practice's EHR (for example, of a primary care provider or medical home) regarding health care utilization in other settings (indicator of potentially poor care coordination). A limited application of this kind of measure is likely to be feasible in some cases within the next few years, but broader application is likely more distant. To be applicable to a broad patient population, such measures would require use of APCD data for the denominator linked with documentation from an EHR for the numerator. Currently, the ability to link APCD data with outside data sources, such as EHRs, is possible in only a limited number of States that collect identified data within their APCDs and permit such linkage. In addition, confirming the absence of information about outside health care utilization will pose a significant challenge given the variability in where and how such information is documented in health IT systems today.
- Linking EHRs to patient registries would offer a potentially rich data source for quality measurement. However, panelists emphasized that near-term measurement using patient registries, with or without linking to EHRs, is not likely. Although particular registries contain some data elements that would be useful for care coordination measurement, the lack of standard design or data elements included in various registries makes it impractical to design care coordination quality measures around registry data at this time.

Conclusion

The advantages of reduced measurement burden, rich clinical context, and longitudinal data have made electronic data, in particular data from health IT systems, the target of a growing interest in measuring care coordination processes in new ways. Feedback from experts who participated in this project suggests reason for optimism about this possibility, even while recognizing many challenges that must be overcome to make such measurement feasible. The rapidity with which the health IT landscape is changing will almost assuredly help resolve many of these challenges. Indeed, our discussions with panelists and review of background materials suggest that changes likely to resolve many challenges are already underway.

Introduction

Care coordination is defined as the deliberate organization of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of health care services.[1] It has been recognized as a priority area for improving health care delivery in the U.S.[2] and is a target for efforts to improve the quality and patient-centeredness of care. Efforts to understand and improve deficits in care coordination are abundant, and robust measures of care coordination processes will be essential tools to evaluate, guide, and support these efforts.

Purpose

Recognizing that care coordination measures that do not require new data collection are of particular interest to the Agency for Healthcare Research and Quality (AHRQ) and the field, we assessed the potential for measurement using data from electronic data sources, in particular from existing and emerging health information technology (IT) systems such as electronic health records (EHR), health information exchanges (HIE) and all-payer claims databases (APCD). Relying on background research and input from experts, we aimed to provide information relevant to decisions about where to focus measure development efforts, where the most fertile ground exists for measures that rely on electronic data sources, and barriers to developing such measures.

Scope and Approach

This project aimed to understand measurement that would be feasible for a wide range of outpatient practices or hospitals that use health IT systems, not only those that are most advanced in their health IT usage. This effort did not aim to develop new measures of care coordination, but to synthesize the background relevant to such future work. To understand the potential and challenges of measuring care coordination with current and emerging technologies, we sought input from a panel of informants with expertise in health IT systems development and use, health information exchanges, electronic health records, all-payer claims databases, insurance plans, health data standards, and quality measurement. We spoke with these experts individually during 1-hour information-gathering calls, and convened two duplicative group calls (to accommodate schedules) to discuss specific measurement possibilities. For further details of methods, see Appendix A. In this report, we present themes and lessons learned through these discussions, and offer an evaluation of the most promising near-term and long-term opportunities for measuring care coordination using electronic data.

Key Terms

We define several key terms that are important for understanding the contents of this report. A complete glossary that includes these key terms and others may be found in Appendix C, and links to additional sources are available in Appendix D.

All-Payer Claims Databases (APCD) –Large-scale databases that systematically collect health care claims data (medical claims, pharmacy claims, eligibility files, provider files, and dental claims) from a variety of payer sources and that include claims from most health care providers.[i]

[i] Adapted from APCD Council All-Payer Claims Database Fact Sheet. http://www.apcdcouncil.org/sites/apcdcouncil.org/files/APCD%20Fact%20Sheet_FINAL_2.pdf. Accessed August 18, 2011.

Data Element/Field– A basic unit of information collected about anything of interest—for example, a medication name or a patient diagnosis. A data element is a unit of data for which the definition, identification, representation, and permissible values are specified by means of a set of attributes.[ii]

Electronic Health Records (EHR) – A longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. These records usually include patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports.[iii] Though often used interchangeably with the term electronic medical record (EMR), EHRs and EMRs differ in the scope of the information they contain. While EMRs contain information pertaining to a single practice or hospital, EHRs are designed to incorporate information from other providers or settings into a single record. In keeping with this broader scope, and the practice of the Office of the National Coordinator for Health IT (ONC),[iv] throughout this report we use the term EHR unless a particular comment applies specifically to the more limited EMR technology.

Health Care Entity – Discrete units of the health care system that play distinct roles in the delivery of care. Examples include individual nurses or physicians, primary care practices, multispecialty practices, or hospitals.[v]

Health Information Exchange (HIE) – Those organizations formed as an entity to provide services that focus on data exchange and sharing of patient data across disparate stakeholders at the local, State, regional and national level.[vi]

Health Information Technology (Health IT) – The application of information processing involving both computer hardware and computer software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making.[vii]

Meaningful Use (MU) –Medicare and Medicaid EHR Incentive Programs provide incentive payments to eligible professionals, eligible hospitals, and critical access hospitals as they adopt, implement, upgrade, or demonstrate Meaningful Use of certified EHR technology.[viii] The Office of the National Coordinator

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[ii] Adapted from U.S. Health Information Knowledgebase (USHIK). http://ushik.ahrq.gov/dr.ui.drOrgDataAlph?Search=All&Referer=DataElement&System=mdr&ItemDisplaySize=50. Accessed 8-21-11.

[iii] Adapted from Healthcare Information and Management Systems Society website: http://www.himss.org/asp/topics_ehr.asp. Accessed August 18, 2011.

[iv] Adapted from Office of National Coordinator Health IT Buzz: http://www.healthit.gov/buzz-blog/electronic-health-and-medical-records/emr-vs-ehr-difference/#axzz1VVLSIi5f. Accessed August 19, 2011.

[v] Adapted from *Care Coordination Measures Atlas.* McDonald KM, Schultz E, Albin L, Pineda N, Lonhart J, Sundaram V, Smith-Spangler C, Brustrom J, and Malcolm E. Care Coordination Atlas (Prepared by Stanford University under subcontract to Battelle on Contract No. 290-04-0020). AHRQ Publication No. 11-0023-EF. Rockville, MD: Agency for Healthcare Research and Quality. November 2010.

[vi] Adapted from Office of the National Coordinator homepage: http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__home/1204. Accessed August 18, 2011.

[vii] West Virginia State Medical Association Glossary of Health Information Technology Terms, http://www.wvsma.com/shared/content_objects/pdfs/glossary%20of%20hit%20acronyms%20and%20terms%20-%20revised.pdf. Accessed August 22, 2011.

[viii] Adapted from Centers for Medicaid and Medicare Services EHR Incentive Program Web page: http://www.cms.gov/ehrincentiveprograms/. Accessed August 19, 2011.

for Health IT is developing measures (Meaningful Use measures) to be used by participants in these incentive programs to demonstrate their Meaningful Use of EHR technology.

Promise for Measuring Care Coordination in the Current Health IT Environment

Two key objectives for any quality measurement effort are to reduce the burden of data collection associated with the measures and increase the ability of the measure to detect true differences in quality. To date, a majority of publicly available care coordination process measures have used time-intensive data collection methods.[3] In a previous review of the care coordination measurement landscape, we found that 70% of 84 existing care coordination measures use survey methods, while 26% use chart review and only 27% use administrative claims data (some measures use multiple data sources). Of those measures that use administrative data, fewer than one quarter relied exclusively on administrative data; most required additional data collection through chart review or surveys.[4] Since little development has occurred in the area of measures that use existing data sources, little is known about the potential to use these data to decrease measurement burden and expand the types of measures available for care coordination.

While the current survey-based approach has advantages in capturing the experience of coordination and being highly adaptable to capturing care coordination activities (because survey questions are designed specifically to capture the activity of interest), it also has several disadvantages. Survey methodology is highly time-intensive and limits the number of patients or providers that can be included in a sample. In addition, sampling methodologies can be subject to selection bias and can require complex designs. Finally, survey-based measures often cannot be collected and calculated at the point of care, and thus reduce the timeliness of measurement. These issues add to the burden of a measure and potentially decrease the feasibility and usability of a measure. In addition to burden, survey-based measures often capture primarily the experience of care coordination, rather than objective measures of processes, proximal outcomes, or the ultimate outcomes achieved by a health system. This experience, while an essential aspect of care coordination, is subject to reporting bias. Additional measure types could offer the ability to create a fuller picture of care coordination by capturing supplementary objective data, in a timely and less burdensome manner.

However, in order to be a useful data source, the data must include features specific to measuring care coordination. This requires data with the ability to capture activities across the continuum of care and across settings (e.g., comprehensive longitudinal data that capture multiple loci of care). In fact, processes that occur during transitions between providers or settings are often of the greatest interest for care coordination (e.g., communication between a hospital and primary care facility). Many existing data sources, such as administrative data, pool cases according to the site of care (e.g., hospital data sets, emergency department data sets) and have limited ability to track patients longitudinally across settings. In addition, information surrounding the transitions across settings is entirely missing from these data. Our initial scan of potential data found a dearth of existing data sets with sufficient information for capturing the dynamic and inter-disciplinary nature of care coordination.

As use of health IT has expanded across the U.S. health care system, interest has grown in using electronic data from these systems as a data source for quality measurement in general (as opposed to an emphasis on assessing care coordination). This enthusiasm has centered around several advantages that health IT data may offer when technologies and their deployment are more mature:

- Minimal data collection burden. Health IT systems have the potential to provide access to structured electronic data that could be automatically extracted for quality measurement without requiring time and resource-intensive data collection efforts.
- Rich clinical context. Information stored within EMRs, EHRs or HIEs is far richer in content and detail than the claims data that have been the basis of many quality measures. This rich information could provide a view of processes of care and clinical outcomes not possible from data sets based only on claims data. For example, claims data generally lack information on physician orders, lab results, and clinical values which are more often included in EHRs. Clinical, rather than claims, data are also appealing for their ability to reflect additional context of a particular patient's clinical situation.
- Longitudinal patient data aggregated from multiple sources over time. Electronic health records and health information exchanges aim to aggregate clinical information temporally from multiple providers and settings into a single location. EHRs are intended to provide clinicians with a comprehensive view of patients' medical history and clinical status by integrating information from different settings within the health care system into a single record. (EMRs, in contrast, contain only information from a single care delivery organization). Making that vision a reality requires the ability to exchange information between locations. HIEs have been proposed as a channel to facilitate such information flow and a tool to aggregate clinical information from across the various settings where patients receive care, such as primary care and specialty clinics, hospitals, and emergency rooms. All-payer claims databases have also been suggested as potentially useful, because they aim to aggregate all health care claims associated with individual patients, and are generally backed by State-mandated reporting requirements that promise a high degree of data completeness, at least for those payers required to submit data. However, APCDs are limited in their reliance on claims data.

Quality measurement using electronic data from these systems is promising but largely untested. Through this project, we sought to understand the potential for using these sources to measure care coordination specifically, and to assess challenges associated with implementing such measurement.

Organization of This Report

The remainder of this report presents findings from our expert panel review process. This report is organized into two main sections:

1) **Challenges of Measuring Care Coordination Using Electronic Data and Recommendations to Address Those Challenges.** Our panel of experts discussed a wide range of challenges as part of their assessments of the potential for measuring care coordination using electronic data sources. We begin with this discussion because it provides important context for understanding the measurement opportunities suggested by panelists. We also synthesize information and suggestions from panelists about some ways to address these challenges.

2) **Opportunities for Measuring Care Coordination Using Electronic Data Sources.** This section outlines near-term and long-term measurement prospects identified by our expert panelists and barriers that must be overcome to bring those possibilities to fruition.

Challenges of Measuring Care Coordination Using Electronic Data and Recommendations to Address Those Challenges

Fulfilling the promise of detecting electronically how well care is coordinated requires an understanding of current challenges that our health system needs to address. Panelists identified a number of challenges in using electronic data for care coordination measurement, which we summarize into six key challenge areas:

1. Underutilization of health IT system capabilities and clinical workflow barriers
2. Lack of data standardization and limited health IT system interoperability
3. Unknown clinical data quality in electronic data sources
4. Limitations in linking data
5. Technical hurdles to accessing data
6. Business models that facilitate competition rather than cooperation

Panelists also discussed ways to address many of these challenges. At the end of each of the six challenge sections, we summarize recommendations that stem from these discussions. These recommendations are based primarily on suggestions from our panel of experts, but also include our own evaluation of promising approaches based on insight from discussion with panelists. Some recommendations are meant specifically for Federal agencies, such as AHRQ, while others are applicable to a wide range of stakeholders within this field, including researchers, measure developers, health IT systems vendors, health care delivery organizations, or systems administrators.

Key Challenge Area 1: Underutilization of Health IT System Capabilities and Clinical Workflow Barriers

Panelists noted that clinicians generally are not using EHRs to their full capacity. Although features are present in many systems that could make more data available for quality measurement, panelists felt that these are often underutilized.

Challenge 1a: Limited Availability of Structured Data

Panelists identified the predominance of unstructured data in clinical documentation as a key challenge in using information from EHRs for quality measurement. Structured data are contained within specific data fields that specify the type and format of recorded information. For example, a field for "weight" might specify that the information be recorded in kilograms. Unstructured data, in contrast, are generally recorded as free text, with no limitations in the format and often without clear specification of the type of information recorded in a particular location. Progress notes are a common example of unstructured data within EHRs.

Although some research has explored extracting information from free-text sources using a process called natural language processing, panelists agreed that quality measurement using information recorded in unstructured free-text format is not feasible at this time, nor likely to be in the near future. One panelist mentioned that his research team's attempts to extract information from free-text notes using natural language processing failed. They have turned their efforts instead towards developing standards for recording key information in a structured way.

While emphasizing the limits of unstructured data for quality measurement, panelists recognized that medical practice continues to rely heavily on unstructured data and likely will do so for some time. They attributed this to workflow practices that have not yet evolved from the traditional reliance on paper-based documentation. One panelist commented that frequently EHRs are used as elaborate text editors rather than in ways that exploit their database qualities, which is perhaps unsurprising given that clinical documentation has traditionally focused on text rather than structured data fields. Panelists also attributed continued reliance on unstructured documentation to the complexity and nuances of medical practice, which in turn requires a flexible workflow. Panelists did not discuss explicitly whether current EHR systems have abilities to capture these dynamic workflow processes in a structured form, but the absence of such examples likely means that most systems do not have such functionality at this point.

Several panelists emphasized that simply building more structured data fields into EHR systems is unlikely to increase the availability of structured data. They noted that even when structured data fields are available, they are not always used by clinicians, because entering data in a structured format requires a different workflow from entering free text, as has traditionally been done. They highlighted the need to provide incentives to motivate use of structured data fields as part of clinical workflow. Others mentioned the need to educate physicians about the utility of recording information in structured format. Panelists observed that when the advantages of recording structured data are explained—or, better yet, demonstrated—clinicians are more willing to spend the time entering data into structured fields for the sake of having better information at the point of care. In addition to quality measurement, panelists mentioned facilitating information sharing and decision support as advantages of recording structured data. The information sharing advantage also sets up an opportunity for improving care coordination, as well as measuring the presence of best practices in transmission and receipt of necessary information.

Challenge 1b: Health IT Systems Design Reflects Current Workflow

Another challenge identified by panelists was poor documentation of many processes important to care coordination. Panelists emphasized that given the many demands on clinicians' time, only information that is perceived to be critical to patient care delivery or motivated by reimbursement policy is typically recorded. No examples were provided about EHRs that support capturing documentation of coordination activities, although one panelist noted on-going efforts develop such capability within a system used by community health teams. The lack of such capability in many current systems further limits the availability of data on coordination activities. Panelists' discussions suggest that the attention to date seems to be more focused on recording clinical activities during a patient encounter, as opposed to coordination activities needed and performed by teams of clinicians and supporting staff over time and across settings.

Panelists noted that, historically, design of EHRs has been driven by requests from clinicians—primarily physicians—and that EHRs are designed to be customizable to match local workflow patterns. They noted that this is shifting somewhat with recent efforts to develop requirements for EHR certification related to Meaningful Use. However, panelists emphasized that the challenge remains in creating demand among clinicians and health IT system purchasers for features, such as structured data fields and population management functionality, that would enable easier or richer quality measurement. One panelist characterized the problem as getting health IT users to "ask for what they need."

Challenge 1c: Barriers Related to Care Plans

Much of panel's discussion of workflow barriers occurred in the context of care plans. Care plans are a particular concept of interest to care coordination measurement not only because they have been

proposed as a potential means of coordinating care (e.g., sharing information among providers in a structured way), but also because a comprehensive care plan has the potential to serve as documentation for many other aspects of care coordination that would be of interest for measurement, such as assessing needs and goals, supporting self-management goals, and establishing accountability or negotiating responsibility. Thus, data that would enable assessment of both the presence of a care plan and evaluation of care plan content are of particular interest for care coordination measurement.

While care plans are not inherent in health IT, panelists' comments often focused on the concept of care plans as it relates to care coordination. Panelists emphasized the lack of consensus in the clinical community about what constitutes a care plan. Panelists with a clinical background agreed that, in their experience, care plans are not typically used in ambulatory settings and in the inpatient setting are generally developed and used only by nurses. Several panelists noted that inpatient nurse care plans are not usually used by physicians and are not transferred out of the hospital when patients are discharged. One panelist commented that because care planning is seen in present clinical culture as a nursing task, a reframing of the concept may be necessary to get buy-in from some physicians about its importance. Others noted that evidence linking the use of care plans with improved patient outcomes would help support their use.

The panel discussed the continued ambiguity surrounding care plans, and how that ambiguity impacts the potential to measure aspects of care coordination related to care planning. Two panelists noted that although some of the data elements included on a list of care plan elements recommended by the National Quality Forum (NQF)[5] are usually contained in EHRs in structured format (e.g., medication list, problem list, follow-up appointments, and presence of an advanced directive), they would not typically be grouped in a single location within an EHR.

Using a hypothetical measure (see call agenda, Appendix B, first measure listed) as a starting place for discussion, participants debated whether the existence and documentation of various elements of a care plan within an EHR would be sufficient to indicate care coordination, or whether such elements must be grouped in a single location within the record or some other cohesive document. One panelist suggested having health IT systems pull together disparate elements to generate a care plan. In contrast, another panelist suggested that the very need to pull elements of a care plan together from scattered locations throughout a record, or from multiple records (i.e., from specialists, primary care practices (PCPs), or hospitals) rather than finding elements in a single location within a single system, would be a potential indicator of poor coordination.

There was some agreement that a more cohesive plan—one that contains deliberately collected information in a single location—was more indicative of coordination. But panelists noted that few EHRs record information in a way that reflects a discrete care plan, even though some elements of care plans might be located within the record. Panelists also noted that many elements discussed as part of a care plan are not recorded in a standard way, or in a standard location, among different EHRs. Even with a clear specification of data elements required for a care plan, one panelist with experience working for a health IT vendor noted difficulties in integrating care plans into EHRs. Typical EHR design would require creating a care plan for each problem in patients with multiple problems, a result that undermines the utility and intent of care plans for use in care coordination. Integrating patient input into care plans, an important aspect of care coordination, was noted as an additional challenge.

One panelist emphasized that a clear concept of care plans is needed within Health Level 7 (HL7) or another health IT standard in order to provide direction to vendors to create the capability of recording

care plans within EHRs. This panelist noted that HL7 has been working on this for some time in a particular work group, but as yet those efforts have not been reported.

The currently recommended Meaningful Use Stage II measure related to care plans specifies only that care plan fields (undefined beyond "treatment goals and patient instructions") be recorded, but does not require that those fields be grouped in a single location or document within the EHR. Currently, there does not appear to be clinical demand for a single care plan location or document within EHRs, suggesting that further changes in clinical practice and work flow would be needed before this would become a common feature of EHRs.

Challenge 1d: Underrepresentation of nonphysician viewpoints in health IT system design

One panelist commented that nursing and social work viewpoints are under-represented in development of EHR content, which has important implications for the kinds of coordination-related information represented in EHRs and highlighted within continuity of care messages (see section on health IT system interoperability). This panelist felt that this was particularly problematic for care coordination measurement, given that many elements of coordination, such as consideration of patient preferences and goals, social and environmental factors, and patient or family needs for support, have traditionally fallen within the scope of nursing, social work, home health, and care management practice. Another informant noted that, to date, both policy and financial support is lacking to encourage health IT-enabled collaboration between social services, case managers, and community-based support organizations with their health care professional counterparts, which further limits opportunities for interdisciplinary care coordination and availability of data on such collaborations when they occur.

Challenge 1e: Clinical workflow and technology integration issues

Overall, discussions with panelists highlighted the importance of considering how EHR users interact with and use their systems when designing any measures that rely on data from such systems. They emphasized that the technological capabilities of systems are less important than their day-to-day usage. Although technological advances and improvements in data standardization may help facilitate quality measurement using health IT systems data, ultimately some evolution in clinical practice patterns, workflow, documentation habits, and demand for EHR features is likely needed before the full richness of information contained in health IT systems can be tapped for quality measurement. One panelist with both clinical and vendor background emphasized that designing EHR technology must balance meeting workflow needs of clinician users, which often requires system customization, with the need for standardizing data and workflows in order to enable additional use of clinical information, such as quality measurement, decision support, and health information exchange.

Recommendations to Address Key Challenge Area 1: Underutilization of Health IT System Capabilities and Workflow Barriers

Panelists suggested several ways to overcome the challenge of clinicians' underutilization of health IT system capabilities and, in particular, continued reliance on free text for documentation. Incorporating structured data fields into EHR systems for key clinical concepts is an important first step in addressing this challenge, but panelists agreed that building structured data fields alone is insufficient to change documentation practices. Changing clinician EHR usage practices is likely to be a slow and difficult process because it requires changes to workflow. Panelists noted that success depends on having a strong business or clinical case (e.g., clear utility of structured data at the point of care, incentives for recording structured data) for making the workflow change, and/or for the consistent commitment of health care practice leadership.

Several panelists discussed ways to motivate clinicians to use structured data fields. All agreed on the need to demonstrate the utility of structured data. Their recommendations included:

- Align structured data fields with decision support tools. When clinicians find decision support useful, they will see value in taking the time to input the structured data needed for the decision support algorithm.
- Create protocols for non-physician clinical or support staff to enter some pieces of information in structured fields. Strategies that ease the burden of work on physicians generally increase success in achieving changes in workflow practices.
- Explain—and, better yet, demonstrate—how structured data improves care coordination and ultimately care delivery. For example, through better patient monitoring and follow-up or by facilitating information exchange that provides additional information at the point of care.
- To strengthen the above recommendation, provide evidence about how care coordination improves patient outcomes or reduces costs. Evidence will help drive reimbursement of coordination activities, particularly in accountable care organizations, medical homes, and other alternative health care delivery models. It will also demonstrate to clinicians what aspects of coordination are most important to patient health, satisfaction, and quality of life.
- Make data from structured fields readily available for quality improvement evaluations. This strategy requires buy-in from clinicians that quality improvement is a priority.
- When clear coding standards are lacking, to the extent possible, align measure specifications with existing guidelines or elements of other quality measures. This will increase the utility of specific data elements, creating a stronger business case for building the data field into an EHR system and actually populating the field during clinical workflow.

Panelists also highlighted that care coordination often depends on team work and dynamic workflows by many health care professionals and that vendors and delivery systems need to design health IT functionality to capture coordination activities more explicitly, both to support team practice and to measure the extent of these activities.

Key Challenge Area 2: Lack of Data Standardization and Limited Health IT System Interoperability

Another key challenge identified by panelists is lack of standardization in how data are recorded. Standardization refers to the vocabulary or code set used to record the content of information. For example, some might record weight in kilograms, while others record weight in pounds. Even with structured data that allows querying for a particular data field such as weight (as described previously), standardization in data collection is a prerequisite for comparable information across systems. In addition to impeding reliable quality measurement, lack of standardization limits the ability to share information across systems (interoperability), which in turn limits opportunities for care coordination and coordination measurement.

Challenge 2a: Lack of Standardization

To enable quality measurement, information about particular concepts included in the measure definition (data elements) must be standardized. This ensures that a measure calculated from one site means the same thing as the measure calculated from a different site. Two levels of standardization are important to consider for quality measurement using electronic data: (1) presence of a standard code set, and (2) widespread use of the standard.

A recurring theme during discussions with panelists was inconsistency in how clinical information is coded within health IT systems. While standard code sets exist for some particular kinds of information,

panelists commented repeatedly that systems vary widely in whether or how those code sets are used, and many systems use code sets developed in-house. The result is lack of an industry standard for how many kinds of clinical information is coded.

Panelists noted several kinds of data of particular interest for measuring coordination (as well as for quality measurement of other clinical concepts) where standard code sets exist, but are not used consistently within the health IT industry today:

- Laboratory results – Several panelists commented on inconsistencies in how laboratory test and results information are coded in health IT systems. They noted that, although a standard code set exists for lab results--the Logical Observation Identifiers Names and Codes (LOINC) standard--many labs, particularly those within hospitals, continue to use alternative code sets. Many of these alternative code sets were developed in-house and are used only in a single hospital or health system. One panelist noted that this is particularly true of health care organizations that were early adopters of health IT systems, who often developed local coding schemes in the absence of well-established standards. The EHR certification requirements, established by ONC in July 2010, now require that when certified EHRs receive lab results that are coded in LOINC format, they must use LOINC codes when transmitting that information as part of other certification requirements, such as providing clinical summaries or electronic health information to patients.[6] To the extent that laboratories report results using LOINC, this new requirement should increase the availability of standardized lab data. But currently there are no requirements that labs report results using LOINC. Panelists agreed that, among systems currently in use, coding of lab results lacks uniformity.
- Medication/drug information – Several coding systems are available for recording information about medications, each with varying degrees of granularity. One panelist with experience using medication data for research explained that the inpatient setting typically codes medication information using the RxNorm code set (maintained by the National Library of Medicine), while the ambulatory setting typically uses the Food and Drug Administration's National Drug Code (NDC) Directory . However, ambulatory EHRs are expected to shift to using RxNorm in response to the Meaningful Use final rule and EHR certification standards, released in July 2010, which specify that only RxNorm may be used for certifying interoperability of EHR systems. The panelist also noted that, adding further complexity to medication information, NDC codes as used in ambulatory EHRs are not equivalent to those used in pharmacies due to different needs for drug specificity. For example, when prescribing a medication, a primary care provider would choose one of possibly many different generic versions of the drug. When submitted to the pharmacy, this order could be filled using any of the various generic choices, each with its own NDC code. Thus, the NDC code prescribed would not necessarily match the NDC code dispensed, even though the medication received was the same as that prescribed by the physician. Any attempts to link data from ambulatory systems and pharmacies will need to account for this discrepancy.
- Diagnoses and clinical observations—Variation exists in the systems used to encode clinical concepts, such as diagnoses, within health IT systems. This variation stems partially from system customization that takes place during implementation. Although panelists could not offer information on the frequency with which different code sets are used, two standards in particular were mentioned: ICD-9-CM (and the forthcoming ICD-10-CM[ix]) and SNOMED-CT. ICD-9-CM is one standard used for coding claims data, but outside of reimbursement, it is also

[ix] The conversion from ICD-9-CM to ICD-10-CM in the U.S. within the next few years is widely expected to present a challenge to health systems.

used for coding information on diagnoses in some health IT systems. SNOMED-CT is a system that allows coding of a wide variety of clinical concepts beyond diagnoses, which has been recognized as an advantage for use in point-of-care systems such as EHRs. The ONC Health IT Standards Committee has endorsed recommendations that EHR systems record clinical observations using SNOMED-CT by 2015. Currently, certified ambulatory EHR systems must record problem lists using either ICD-9-CM (or ICD-10-CM after 2013) or SNOMED-CT. ONC is continuing to develop final certification requirements.

Inconsistent coding of data requires mapping codes between systems. For example, one panelist mentioned that major lab companies often pay to have their coding systems mapped onto code sets used by major EHR vendors to enable electronic delivery of lab results. However, the cost of this mapping is eventually passed on to EHR users as part of the cost of synchronizing their system with labs. Another panelist noted that most hospitals participating in a health information exchange, particularly those that were early adopters of health IT, must map their internal lab coding system onto the standard used by the HIE. This kind of mapping requires significant time and resources, and adds an additional barrier to information exchange (see next section on interoperability). The panelist noted that depending on its extent and the level of resources committed by the local site, data mapping can take a year or more to complete. Highly accurate mapping is essential whenever exchanged information will be used at the point of care. Another panelist, who designed a database that uses information from a wide range of practices and thus a variety of EHR systems, also noted the need to map EHR data onto the coding systems used by the database. This adds an additional resource burden to sites that want to contribute data to the database. Performing such mapping often requires clinical judgment, particularly when coding systems vary significantly in their structure. This element of judgment can have important implications for interpretation of any measures based on such data.

In contrast, when variation in use of standards is restricted to a limited set of established code sets, as is the case for medication information, the resource burden associated with data mapping is not as significant. For example, cross-walks mapping many drug code sets to RxNorm are already available and the need for mapping between systems should decrease as Meaningful Use and EHR certification requirements increase standardization across health IT systems. Thus, although use of different code sets for drug information adds complexity to use of any medication information linked across systems, panelists did not suggest that this would hamper measurement using medication information.

Other concepts of interest for care coordination lack any established standard for how the information should be recorded or coded. Some examples noted by panelists include:

- Patient needs and goals
- Quality of life
- Referrals
- Care plans
- Self-management plans, goals or supports
- Mental health information, such as thoughts of suicide
- Tobacco or alcohol use
- Environmental and social factors impacting health

Although sometimes recorded as text within structured data fields, this information is most often included in EHRs as free text within notes, or not available in any documented form. As noted previously, panelists agreed that quality measurement using unstructured data is unlikely to be feasible in the near-term.

Challenge 2b: Limited Health IT System Interoperability

Whether due to incomplete use of existing standards or absence of standards, lack of standardization impacts the ability to share information across systems, termed interoperability. This lack of interoperability increases the resources required to carry out care coordination, or in some cases limits coordination altogether, and, by extension, limits the ability to measure coordination.

Panelists agreed that limited interoperability remains a major hurdle in the exchange of information across health care entities, and thus in the development of health information exchanges, patient registries, and integration of outside information into EHRs. One panelist commented that, to date, interoperability has been more of a promise than a reality. Panelists noted that a major barrier to interoperability is variation in how health IT standards are implemented.

Health Level 7 (HL7) is an international organization that focuses on developing standards for interoperability of health IT systems. While widely applied, we heard repeatedly from panelists that HL7 standards are really guidelines, designed to be highly flexible and customized to local workflows and clinical needs. While this adaptability benefits end-users who are able to customize products to match their practice patterns and workflows (thereby easing health IT adoption), it also leads to widespread variation in how standards are implemented. This variation limits interoperability. Panelists noted that this variation would likewise hamper efforts to use data elements from within EHRs because the way in which that information is coded and structured will vary for each site, even when based on the same standard. One panelist termed this the "Baskin Robbins" problem, because there are too many flavors of the same basic guideline. Another panelists commented that the ability to customize implementation (indeed, the requirement to do so in the absence of a clearly defined standard) slows the progress of standardization.

A component of the HL7 standard frequently noted as promising for care coordination measurement is the Continuity of Care Document (CCD), a standard for transferring information between health IT systems during care transitions, such as hospital discharge or transitions between outpatient practices. The CCD identifies the types of information being transmitted, such as problems or diagnoses, medications, family and social history, procedures, and a plan of care. Ideally, information contained within these and other sections of the CCD should be recognized as such by any receiving system capable of reading a CCD and then be integrated into the receiving system in the appropriate location. A related standard for information transmission, the Continuity of Care Record (CCR) developed by ASTM (formerly American Society for Testing and Materials), contains similar data fields and is used in a similar way.

Although CCD and CCR standards at their current state of implementation are promising for care coordination measurement (e.g., confirming information transfer at transitions or transfer of specific information between health care entities), panelists noted that they have several limitations of. They pointed to lack of consensus within the health IT industry about whether to use the CCD or CCR as the standard for transmitting information during transitions of care. Though very similar in content, the CCD and CCR vary in technical details, and many health IT systems are capable of sending and receiving information in only one format or the other, further limiting interoperability among health IT systems. Panelists noted that efforts are underway to harmonize the CCD and CCR standards through HL7 Clinical Data Architecture consolidation guides, but these efforts are still evolving. One panelist commented that most EHRs could not incorporate a CCD message without significant customization.

In addition to interoperability limitations, CCD and CCR standards specify the type of information transmitted between systems, but do not address how information within each section (e.g., medications) is recorded. As noted above in the discussion on data standardization, variation in how information is coded and structured is one of the core problems hampering interoperability. Furthermore, both CCDs and CCRs allow inclusion of free text, which is not readily usable for quality measurement.

Finally, one clinician noted that interoperability can also be limited within health systems due to use of distinct health IT platforms for different parts of the system. For example, separate databases and software interfaces may be used for the laboratory, radiology department, and social workers. Such duplicity further complicates interoperability within and between health systems.

Recommendations to Address Key Challenge Area 2: Lack of Standardization and Limited Health IT System Interoperability

Panelists were optimistic that standardization will improve significantly in the coming years, particularly in response to the Meaningful Use initiative. They expected that improvements in standardization of data would also improve system interoperability. Panelists agreed that leveraging the Meaningful Use initiative is the most promising way to further enhance standardization in the near term. However, they recommended a number of additional ways to address this challenge:

- Continue Federal support to develop standards, both in areas where standards are undeveloped, and by motivating adoption of existing standards through incentive programs. The ongoing development of Stage II and Stage III Meaningful Use measures provides insight into areas where more standardization is likely to emerge within the industry.
- Align other measurement and payment incentive initiatives (e.g., from accountable care organizations, medical homes, or other sources from the Centers for Medicare and Medicaid Services (CMS) with key standards gaps, such as coding of lab results and medication information.
- Use financial incentives or other means to encourage laboratories to report results using LOINC codes to align with the EHR certification requirement that systems transmit results in LOINC when they are received in this format. Such encouragement would help increase penetration of the LOINC standard throughout the health care system.
- Develop well-defined measure concepts that will give vendors, EHR users, and HIE administrators clearly defined data elements to build into systems. The NQF Quality Data Model (QDM) will be an important tool for this objective (see discussion of the QDM in Key Challenge Area 3 and Appendix D).

Key Challenge Area 3: Unknown Clinical Data Quality in Electronic Data Sources

Panelists noted that since few measures to date have relied on clinical data extracted from EHRs or other health IT sources, the quality of these data—including the accuracy of the information itself, as well as the process for extracting the data from electronic records—have not yet been fully assessed. Another panelist noted that the quality of clinical data, whether obtained from an electronic or paper medical record, is generally not considered as robust as inpatient claims data because there is no auditing of clinical data. However, a different panelist commented that because clinical data are used in providing patient care, there is an important incentive to maintain accuracy, even without auditing. Another panelist reported that within an HIE, they found the greatest accuracy in attributing patients to

particular primary care providers when using both claims and clinical data. When providers were given lists of patients who had been attributed to them using an algorithm that relied on both data sources, providers agreed with the attributions about 90% of the time. Having the ability to attribute patients is fundamental to measuring coordination between the primary care provider and other providers or settings (such as a specialist or hospital). It is also critical for care coordination measurement (or any quality measurement) at the provider level.

Over the course of discussions with panelists, we supplemented their commentary by consulting sources they mentioned that have investigated the accuracy of information extracted automatically from EHRs compared to traditional chart review extraction methods.[7-11] Although none of these studies assessed measures directly related to coordination of care, they demonstrate some successes using Health IT in quality indicator construction. However, they also highlight that inadequate documentation of measure exclusions (i.e., patients who should be excluded from the numerator or denominator) is a key challenge in such endeavors. Information needed for measure exclusions was typically recorded as unstructured data, which was captured during manual chart review but not when data were automatically extracted, resulting in lower measure performance when using automatically extracted data. Until such information is regularly captured in structured fields, this limitation in EHR data is likely to impact many measures of care processes that rely on data automatically extracted from EHRs, including measures of care coordination.

Any use of health IT data for quality measurement will need to be accompanied by an assessment of data accuracy, reliability, and quality. NQF has developed a Quality Data Model that provides a framework for assessing the quality of data elements. This framework provides a useful starting place for such evaluation (see Appendix D for links to additional sources).

The completeness of data also must be considered. For example, few HIEs today have participation from all providers or hospitals in a particular region. Information on care or services received at non-participating sites will be missing, which will impact the reliability of any quality measurement using that data source, and is particularly salient to assessments of coordination of care across settings. Panelists noted that the problem of incomplete data should improve as HIEs mature and more data sources are linked (e.g., APCDs and EHRs). However, this development will take time.

Recommendations to Address Key Challenge Area 3: Unknown Clinical Data Quality in Electronic Data Sources

The gaps identified by panelists in knowledge about the quality of clinical data contained in health IT systems, in particular data pertaining to coordination processes, suggest the need to include an evaluation of the reliability and accuracy of any health IT data as part of measure development for any indicators based on information from health IT systems. Although the investigations of health IT system data noted by panelists do not pertain directly to care coordination processes, they suggest that particular attention should be paid to documentation of measure exclusions, as evidence suggests that current documentation structures and practices within EHRs are inadequate for many of the quality measures that have been tested using health IT data. Support for data quality investigations and dissemination of those results, would further quality measurement using health IT data.

Key Challenge Area 4: Limitations in Linking Data

Data sources, such as all-payer claims databases or health information exchanges, that link data from multiple sources provide a key advantage for care coordination measurement because they provide a view of care received across the health care system, rather than focusing on care at a particular site or

setting. In addition, they offer insight into the various care transitions that patients experience, including the care received before, during, and after each of those transitions. Panelists commented that linking claims data with clinical data would provide a particularly rich picture of service use and clinical context, while linking data from multiple providers or settings (e.g., hospitals, primary care practices, multispecialty clinics, behavioral health centers, long-term care, and home health) would provide a view of interactions with a wide range of health care providers.

Panelists identified policies limiting collection or use of identified data in response to privacy concerns as an ongoing challenge in linking data across sources, whether clinical data from EHRs or claims data from hospitals, pharmacies and ambulatory care settings. Such policies complicate, and in some cases seriously limit, the ability to link data across sources. Though the Federal Health Information Portability and Accountability Act (HIPAA) and other privacy regulations allow data sharing for treatment, payment, and operations, the complicated nature of privacy statutes requires careful planning, operational structures (e.g., written business agreements or data use agreements), and technological protections (e.g., encryption, data security) prior to sharing protected information. Adding to the complexity, each State has its own privacy laws, further complicating any data linkage efforts that cross State boundaries.

One panelist commented that privacy policies and regulations limiting exchange of patient information pose a challenge for the execution of care coordination, and, by extension, measurement of coordination processes. Nevertheless, panelists noted that the value of linked data is becoming widely recognized, which is lowering policy barriers to this process.

Overall, panelists anticipated that comprehensive data sets linking clinical and claims data will become more widely available in the future, but to date such sets are available from only a limited number of States or regions. A recent report on APCDs states that currently, five States with existing or developing APCDs are collecting patient identifiers that would allow linking the dataset to other outside data sources, such as clinical data from EHRs or an HIE, four States do not currently allow patient identifiers to be collected, and five States are either examining the issue legislatively or are unable to disclose whether or not they are collecting patient identifiers.[12] Panelists noted that established HIEs and APCDs where these challenges have been overcome can serve as models to ease creation of new linked datasets in other regions or States.

Panelists also noted limitations in the completeness of data contained within linked data sources such as APCDs and HIEs. For example, even well-established HIEs typically cover only a particular region or a subset of providers within a State. Similarly, APCDs vary in the percent of the patient population included, both with respect to patients with commercial insurance (e.g., only patients covered by insurers with a minimum number of lives covered, or that cover a certain share of a particular market), and also with respect to entire groups of patients (e.g., the uninsured; Medicare beneficiaries; and patients with other Federal health coverage such as through the Department of Veterans Affairs, the military, or Indian Health Services). This has implications for implementation of denominator definitions for any quality measures that use such a data source, as well as potential measures' utility and interpretation.

Recommendations to Address Key Challenge Area 4: Limitations in Linking Data

Panelists emphasized that efforts should be made to communicate the value of linked data to policy makers and the public. They also highlighted the importance of developing, demonstrating, and sharing strategies for overcoming privacy barriers. They noted that established health information exchanges

and States and regions that allow collection of identified patient information within APCDs will be well-positioned to provide such demonstrations.

Key Challenge Area 5: Technical Hurdles to Accessing Data

Several panelists noted that it can be very difficult and costly for practices to extract data from their EHRs for use in quality measurement or quality improvement. One panelist with extensive experience extracting data from different EHRs noted that much site-specific work is required to identify and extract the necessary data elements and that often how information is recorded varies by patient condition within single practices. This would create a significant challenge if trying to scale up to measures of care coordination applicable across a wide range of conditions, rather than disease-specific measures. Another panelist estimated that extracting data for a single quality report might cost $100,000. Yet another panelist characterized EHRs as "data sinks," rather than data repositories.

In one example of the problems in extracting data, a panelist noted that at a five-physician practice using a single EHR, they discovered 136 combinations of where and how colorectal cancer screening was documented within the EHR. This variation resulted from differences in terminology used (i.e., lack of standardization in how information was coded or recorded) and differences in where within the EHR the information was stored (i.e., lack of structured data fields, as well as variation in the clinical workflow and use of EHR technology). Panelists emphasized that identifying all of the ways and locations in which a single piece of information can be recorded and developing algorithms to extract and normalize that data require considerable health IT resources, which is why many practices currently have trouble using or simply are unable to use data from their EHR systems for quality improvement or quality reporting. The logical extension of this problem is that it may be indicative of the challenge to a practice in actually coordinating care (e.g., right care delivered at right time in right setting) in the current health care environment, much less assessing whether the constellation of activities required occurred in the most efficient way possible.

Our panel of experts included several involved in the design or administration of databases that use information from EHRs. Approaches to obtaining that data varied across these systems. One database uses third-party companies to extract data directly from the databases that underlie EHR systems. This administrator noted that the difficulty in extracting data varies considerably by the EHR system. Another panelist explained that a software program designed to aggregate information across patient encounters relies on individual health care sites to export data from their EHRs, which are then integrated into the software and standardized. When possible, the software maker offers some guidance to sites on how to identify and export data, but the burden of data extraction falls on the individual practices, which often then turn to the EHR vendor for help extracting data. Another panelist noted that even when data are compiled from users of products from a single vendor, the high degree of customization performed when implementing EHRs at individual sites complicates data extraction. The ability to efficiently coordinate and measure care may depend partly on finding an appropriate balance between system customization, which may help improve coordination by adapting technology to meet local needs, and standardization, which facilitates comparative measurement.

HIEs have been suggested as potential data sources for care coordination measurement because they aggregate information across many different parts of the health care system. However, panelists emphasized that HIEs themselves do not typically store data. Many are just channels for transmitting information with all the data housed in the original systems (e.g., the ambulatory clinic EHR or hospital EHR). Panelists emphasized that without a data repository or underlying database that stores

information from the various health care entities that participate in an exchange, an HIE is not a data source. One panelist with experience working with an HIE noted a cultural challenge in having the need recognized for such a repository underlying HIEs.

Recommendations to Address Key Challenge Area 5: Technical Hurdles in Accessing Data

Discussions with panelists led us to the following recommendations for improving the ease of access to data within health IT systems:

- Consider the accessibility of data to end users when designing systems. Panelists emphasized that vendor design is highly responsive to user demand, highlighting the importance of having users and purchasers understand the need for easily accessible data and of communicating that need to health IT vendors.
- Carefully consider the resources required to extract data from health IT systems when choosing a product.
- As demonstrated by the Meaningful Use incentive program, vendors are also highly responsive to certification requirements and incentive programs because such programs drive demand among users and purchasers who benefit from those incentives. ONC and its health IT committees may wish to consider whether any additional EHR certification requirements could help improve the ease of extracting data from within EHRs.
- Some data elements of potential interest may be extracted from health IT systems using a free, open source software service from ONC, called the popHealth tool. The popHealth tool is designed to help EHR vendors and health care providers extract data elements required to inform all 44 Meaningful Use Stage I quality measures from their Continuity of Care records (CCD or CCR). It is geared toward simplifying the standardization process for EHR users and is designed to assist users that do not have programs in place to extract the necessary data elements themselves. More information on the popHealth tool is available in Appendix D.

Expanding the popHealth tool to facilitate extracting data elements for Stage II, and eventually Stage III, measures (when those measures use data elements not required in Stage I) would further increase the availability of health IT data for quality measurement, particularly if new quality measures are developed using Meaningful Use data elements. Eventually incorporating other key data elements into popHealth or similar data extraction tools would further facilitate access to health IT data, to the extent that standard definitions of concepts critical for a wide range of quality measures are developed (see Recommendations to Address Key Challenge Area 2a, above.

Key Challenge Area 6: Business Models That Facilitate Competition Rather Than Cooperation

Another challenge noted by several panelists as limiting HIE development and exchange of clinical information in general is the fact that exchanging information among competing health care institutions and health IT vendors runs counter to current business models. Makers of health IT products are generally reticent to share information about the design of proprietary software, complicating efforts to achieve interoperability and standardization across the health IT sector. In addition, health care delivery entities may be wary about sharing information with their competitors. Some use EHR deployment strategically, such as a hospital supporting installation of their vendor's EHR system into primary care practices within their market reach, so that these physicians have a workflow incentive to refer their patients to the hospital with a compatible information system. One panelist observed that good care coordination often means less money for health care institutions. For example, ordering a repeat test generates revenue, while obtaining results from a test performed at another institution does not.

Indeed, the resources required to obtain results from an outside source (whether through institutional investment in an HIE or time spent by individual providers to seek out information from other sites) and to integrate them within the receiving EHR (ranging from scanning documents to developing mapping algorithms that recode lab results from one system to another) generally increase non-reimbursable costs for a health care entity. Another panelist commented that hospitals will have to rethink their business models to maintain financial stability if hospital admissions decline as a result of improved care coordination or other health reforms. Thus, although from the patient and societal perspectives any activities, such as care coordination, that are expected to decrease hospital admissions are seen as valuable, organizations delivering care have disincentives for spending resources implementing changes that may undermine their current business models.

Despite these challenges, one panelist with experience administering an HIE was optimistic about the prospects for increased information sharing. He noted that, at a meeting of leaders of competing institutions who are participating in an HIE, discussion focused around the realization that information sharing that helped one institution ultimately helped others as well. He emphasized that helping stakeholders realize the mutual benefits of information sharing will be key to overcoming the obstacles of a competitive health care marketplace, and pointed to the example set by successful HIEs as an important demonstration of those benefits.

The ability to share information across health systems has important impacts on the ability to coordinate care, and by extension to measure coordination. Similarly, barriers such as business models that impede information sharing also often impede the standardization necessary for quality measurement using health IT data.

Recommendations to Address Key Challenge Area 6: Business Models That Facilitate Competition Rather Than Cooperation

To address some of these business model barriers, panelists suggested supporting and widely disseminating projects that demonstrate the value of information sharing. They also highlighted the need for evidence that can demonstrate any cost savings for institutions that result from information sharing or other care coordination activities. In addition, panelists emphasized the importance of bringing leaders of competing health care organizations together to facilitate dialog and encourage information sharing. Finally, some expressed optimism that financial incentives will become better aligned between payers and health care providers as alternative models of health care delivery and payment evolve, particularly through initiatives related to accountable care organizations and patient centered medical homes. Supporting such initiatives may help overcome some business model barriers that have hindered information sharing and care coordination and by extension make data about coordination more readily available for measurement purposes.

Opportunities for Future Measurement of Care Coordination with Electronic Data

Although panelists identified many challenges associated with using data from health IT systems for care coordination measurement, they also identified several promising opportunities. In reviewing these opportunities, we differentiate between near-term opportunities—those that panelists expected could potentially be implemented in at least a pilot phase in the next 2-to-3 years—from long-term opportunities, which might be 3 or more years in the future. These timeframes are not concrete and are based on what panelists estimated, as well as whether or not the foundation for making use of a given health IT tool for measurement is in place at the time of this report.

Near-term Opportunities

In this section, we discuss measure concepts that panelists suggested would be feasible to develop and at least pilot test, if not fully implement, over the next 2-to-3 years. We also discuss specific obstacles that must be overcome to implement such measures.

Aligning Measures With Meaningful Use Data Elements

The measurement strategy recognized by almost all panelists as the most promising in the near-term is developing care coordination measures using data elements from the Meaningful Use Health IT incentive program measures.

The Meaningful Use incentive program, offered by CMS, has already garnered much attention in the health care industry, and in particular among users and potential adopters of EHR systems. The influence of the Meaningful Use program on implementation of health IT is expected to grow over the coming years, as more hospitals and outpatient providers begin participating in the program.

The expected widespread participation in Meaningful Use is likely to drive further standardization within the industry, at least with respect to data elements required for the Meaningful Use measures. Tables 1, 2, and 3 list Stage I and Stage II Meaningful Use measures that contain data elements that may be useful for care coordination measurement. These data elements should become widely available, most in a structured format, within EHR systems as participation in the Meaningful Use program grows. Although the data elements identified here may be used in a wide variety of ways, we highlight some of the ways in which they are most likely to be useful for measuring care coordination processes. Specifically, we note elements that are likely to be useful for calculating numerators or identifying denominator populations and point to specific care coordination activity domains from the *Care Coordination Measures Atlas* framework that the data element might help measure.[3]

The Stage I Meaningful Use measures are divided into two sets: core measures that must be met, and menu set measures, from which participants may choose five measures in order to fulfill the Stage I requirements. Because they are required for all participants in the Meaningful Use program during their first year of participation, data elements from the Stage I core measures will be the most widely available the soonest (Table 1).[x]

[x] Eligible providers, hospitals, and critical access hospitals may begin participating in Meaningful Use in 2011.

Table 1. Meaningful Use Measures With Data Elements Potentially Useful for Care Coordination Measurement: Stage I Core Measures

Measure	Data Elements of Interest	Potential Use*	Comments
Stage I Core Measures			
Maintain an up-to-date problem list of current and active diagnoses: >80% of all unique patients (seen by EP or admitted to EH/CAH) have at least 1 entry or an indication that no problems are known for the patient recorded as structured data	Structured list of current and active diagnoses	Useful in identifying denominator population	ONC EHR certification requirements specify use of ICD-9-CM or SNOMED-CT to code current or active diagnoses as structured data
Maintain active medication list: >80% of all unique patients (seen by EP or admitted to EH/CAH) have at least 1 entry (or an indication that the patient is not currently prescribed any medication) recorded as structured data	Structured list of active medications	Useful as a numerator element, particularly pertaining to Medication Reconciliation or Information Transfer	Measure does not specify format or coding of drug information
Maintain active medication allergy list: Maintain active medication list: >80% of all unique patients (seen by EP or admitted to EH/CAH) have at least 1 entry (or an indication that the patient has no known medication allergies) recorded as structured data	Structured list of medication allergies	Useful as a numerator element, particularly pertaining to Medication Reconciliation or Information Transfer Also useful for measure exclusions and risk adjustment	Measure does not specify format or coding of allergy information
Clinical summaries provided to patients for >50% of all office visits within 3 business days	Elements of clinical summaries potentially of use: • Problem list • Diagnostic/lab test orders and/or results • Medication list • Medication allergy list • Reason for visit • Procedures • Immunizations • Time/location next visit	If captured in EHRs in a structured way, elements of clinical summaries may be useful in the numerator of measures of many different care coordination processes, including Information Transfer, Facilitate Transitions Across Settings, Proactive Plan of Care, and Establish Accountability/Negotiate Responsibility	Specifications do not require data be provided in a structured format, but do require that any of the specified elements that are captured by certified EHRs be included in the clinical summary

CAH – critical access hospital; CPOE – computerized physician order entry; EH – eligible hospital; EHR – electronic health record; EP – eligible provider; MU – Meaningful Use; ONC – Office of the National Coordinator; PCP – primary care provider

*See the *Care Coordination Measures Atlas* for a list of activities hypothesized to be important for coordinating care.[3] These activities are contained with the care coordination measurement framework.

In addition to the core measures, during Stage I, participants in the Meaningful Use program must also choose five measures to report from among the Stage I menu set. Thus, data elements from these menu set measures may not be as widely available as those from the core set, but many likely will still be in use (Table 2).

Table 2 Meaningful Use Measures with Data Elements Potentially Useful for Care Coordination Measurement: Stage I Menu Set Measures

Measure	Data Elements of Interest	Potential Use*	Comments
Stage I Menu Set Measures			
>40% of all clinical lab test results (ordered by EP or authorized provider of EH/CAH during the EHR reporting period) whose results are either in a positive/negative or numerical format are incorporated into certified EHR technology as structured data	Clinical lab test results	Useful as a numerator element, in particular for measures of Information Transfer Also useful for measure exclusions and risk adjustment.	Specifications do not require use of a particular code set, but ONC EHR certification requires use of LOINC version 2.27, when such codes were received within an electronic transaction from a laboratory, for the entry of structured data into a certified EHR.
EP/EH/CAH performs medication reconciliation for >50% of transitions of care in which the patient is transitioned into the care of the EP or admitted to the EH/CAH	Documentation that medication reconciliation was performed	Useful as a numerator element, particularly pertaining to Medication Reconciliation and/or Facilitate Transitions Across Settings.	Likely relies on provider attestation. A more robust measure would use other data providing evidence of reconciliation, but such data likely do not exist at this time.
EP/EH/CAH who transitions or refers their patient to another setting of care or provider of care provides a summary of care record for >50% of transitions of care and referrals	Patients undergoing transition of care or receiving referral Summary of care record	Data identifying transitions of care or referrals useful as a denominator data element Summary of care record useful as numerator data element, particularly for measures pertaining to Establish Accountability/Negotiate Responsibility, Information Transfer, Facilitate Transitions Across Settings, and/or Proactive Plan Of Care	No guidance is provided regarding content of a summary of care record. Current measure recommendations indicate this is under development for Stage II. Measure specifications do not require use of structured data within the summary of care record, which would be desirable for use as a quality measure data element.

CAH – critical access hospital; CPOE – computerized physician order entry; EH – eligible hospital; EHR – electronic health record; EP – eligible provider; LOINC - Logical Observation Identifiers Names and Codes; MU – Meaningful Use; ONC – Office of the National Coordinator; PCP – primary care provider

*See the *Care Coordination Measures Atlas* for a list of activities hypothesized to be important for coordinating care.[3] These activities are contained with the care coordination measurement framework.

Stage I of Meaningful Use also requires reporting of Clinical Quality Measures using EHR data. These measures focus on performance of specific clinical processes, such as mammography screening, asthma assessment, and appropriate therapy for colorectal and breast cancer. Their focus on specific diseases and conditions and clinical processes makes them less useful for assessing coordination processes. However, the expected widespread availability of elements required for these measures within EHR systems as structured data offers another set of data elements available to review for care coordination measurement development and testing. Guidance for calculating the Clinical Quality Measures, all of which predate the Meaningful Use program, is available using the NQF Quality Data Model format, which seeks to enable quality measurement using electronic data (see Appendix D).

Data elements listed in Table 3 are likely to be widely available as more Meaningful Use participants reach Stage II. Although these measures currently are recommendations, it is expected that the final set of measures will be very similar to these recommendations. Note that the ONC Health IT Policy Committee recommended that implementation of Stage II Meaningful Use be delayed until 2014 for those sites that attest to Stage I Meaningful Use in 2011. Thus, although specification of Stage II Meaningful Use elements will be available much sooner (final rule to be released in June 2012), actual implementation and availability of these data elements will not generally be available until late 2013 and early 2014. Specifications should be sufficient to begin measure development prior to the full implementation of Stage II Meaningful Use, but empirical testing may be limited to advanced sites until 2014, when wider implementation is underway.

Table 3 Meaningful Use Measures With Data Elements Potentially Useful for Care Coordination Measurement: Stage II Recommended Measures

Measure	Data Elements of Interest	Potential Use*	Comments
Stage II Recommended Measures			
At least 1 lab order uses CPOE for 60% of unique patients who have at least 1 lab test result	Lab orders (recorded as structured data through CPOE)	Lab orders could serve as a denominator for measures pertaining to Information Transfer or Monitor, Follow-up and Respond to Change	This is one element of a measure addressing CPOE for medication, lab, and radiology orders.
Hospital labs provide structured electronic lab results to outpatient providers for ≥40% of electronic orders received, and use LOINC where available	Structured electronic lab results coded using LOINC	Useful for numerator of measures pertaining to Information Transfer and/or Facilitate Transitions Across Settings	Specifications note that further guidance is needed on where LOINC codes are available.
Clinical summaries provided to patients for >50% of all office visits within 24 hours (pending information should be available within 4 days of becoming available to EP)	Elements of clinical summaries potentially of use: • Problem list • Diagnostic/lab test orders and/or results • Medication list • Medication allergy list • Reason for visit • Procedures • Immunizations • Time/location next visit	If captured in EHRs in a structured way, elements of clinical summaries may be useful in the numerator of measures of many different care coordination processes, including Information Transfer, Facilitate Transitions Across Settings, Proactive Plan of Care, and Establish Accountability/Negotiate	As with the related Stage I Core measure, this does not specify recording or transmission of information in a structured way.

		Responsibility. In addition, evidence of timely transfer of clinical summaries may also be useful for measures related to Information Transfer and Facilitate Transitions Across Settings, even if data are not structured.	
Record and provide summary of care record for >50% of transitions of care for referring EP or EH; record care plan fields (goals and instructions) for 10% of patients; record team member (including PCP, if available) for 10% of patients; for EH, 10% of all discharges have care summary (including care plan and care team, if available) sent electronically to EP or post-acute care provider	Summary of care record Care plan fields Team member (in particular PCP) Care summary	Summary of care record and care summary may be useful for numerator of measures related to Information Transfer, Facilitate Transitions Across Settings, and Proactive Plan Of Care. Care plan fields may be useful for numerator of measures pertaining to Proactive Plan Of Care and Assess Needs and Goals. Specification of team member, in particular PCP, may be useful for denominator of any measure that requires attribution of patients to a particular provider, or numerator of measures pertaining to Establish Accountability/Negotiate Responsibility	More guidance is needed regarding content of a summary of care record. Current measure recommendations indicate this is under development. Measure specifications do not require use of structured data for any of these elements (including team member), which would be desirable for use as quality measure data elements. Care team members may be required as structured data in Stage III (coded using National Provider Identifier) A dynamically maintained shared care plan may be considered for Stage III.

CAH – critical access hospital; CPOE – computerized physician order entry; EH – eligible hospital; EHR – electronic health record; EP – eligible provider; LOINC - Logical Observation Identifiers Names and Codes; MU – Meaningful Use; ONC – Office of the National Coordinator; PCP – primary care provider

*See the *Care Coordination Measures Atlas* care for a list of activities hypothesized to be important for coordinating care.[3] These activities are contained with the care coordination measurement framework.

The Meaningful Use measures will enable further care coordination measurement using data from EHRs to the extent that the Meaningful Use incentive program stimulates capture of structured data for all patients. Capturing structured data for only a percent of the patient population, for example the minimum thresholds specified in the Stage I and Stage II measures, would be insufficient to facilitate broader quality measurement. Likewise, health care entities may meet the Meaningful Use requirements of some measures by demonstrating use of some structured data elements without structuring all elements of a particular data field, which would be insufficient for broader quality measurement. For example, in Stage I, only one entry on an active medication list is required to be structured, but to be useful as a data element for broader quality measurement, all entries on a

medication list should be recorded as structured data. However, it is expected that improvements in the design and use of EHRs in order to fulfill the Meaningful Use measures will stimulate usage beyond the minimum standards established by the Stage I and II measures.

The Meaningful Use measures provide a starting place for developing new measures of care coordination processes that rely on EHR data. Further development is needed for some data elements, in particular specification of information to be included in and coding systems used for clinical summaries, summary of care records, care summaries, and a plan of care. Such specifications will likely emerge, and open up new possibilities for measurement efforts, as the Meaningful Use measures are widely adopted and implemented. For example, specifications are currently under development through the Transitions of Care Initiative to facilitate transfer of summary of care records, including standard definitions of data elements and which elements must at a minimum be exchanged. Additional information is available in Appendix D.

Measuring Information Transfer

Several additional near-term measurement opportunities identified by panelists focused on confirming transmission of information during care transitions. For all these measure concepts, although evidence of information transfer alone is insufficient to establish that care is well coordinated, it provides insight into one important step in care coordination.

One suggested measure concept involves using CCD/CCR messages to confirm that information was transferred from the discharging hospital to the primary care clinic at the time of patient discharge. Presence of a CCD/CCR message from the hospital within a primary care clinic EHR would indicate a basic level of information transfer. If more detail were desired about the kinds of information transmitted, for example, a medication list or problem list, the section headings within a CCD/CCR message could be used to confirm that that information was included with the transmission. These measure ideas would not attempt to evaluate the contents of CCD/CCR messages, but rather confirm that certain categories of information were transmitted between particular participants in a patient's care (e.g., hospital and primary care provider) at key care transitions. Health information exchanges that contain a data repository could be used to identify CCD/CCR messages, or EHR data could be used to examine CCD/CCR messages received.

Given that use of CCD/CCR messages is still evolving, panelists also suggested looking for any information about outside care within a primary care EHR as evidence of information transfer and a basic level of coordination. For example, panelists suggested that, if a patient is known to have visited the emergency room but the primary care EHR contains no information on that visit within a certain amount of time, this indicates poor coordination. Such measurement would require clear specification of the kinds of outside information of interest, such as discharge summaries, clinical summaries, transition of care records, CCD/CCR messages, or lab or imaging results from an outside system. Given the heterogeneity in how such information is stored within EHR systems, each clinic would likely need to develop their own algorithm for identifying it. However, broadening the scope of information format beyond CCD/CCR messages may be more feasible in the current health IT environment.

An important limitation in such measures of information transfer noted by some panelists is that they fail to measure whether or how information is used, an important consideration in understanding if care coordination has been achieved. One measure concept suggested to address this was use of audit files to evaluate whether information transferred from other settings is viewed by primary care providers. In order to comply with privacy regulations, EHRs typically contain an auditing feature that tracks which

users access which information at particular times. These audit files could be used to confirm that someone within a primary care practice opened a discharge summary within a certain amount of time after it was received, or that a clinical summary from a specialist visit was viewed prior to or at the time of a follow-up visit. Although they suggested measurement using audit files is feasible, our panelists were not aware of any efforts to use them for quality measurement to date, and emphasized that methods would need to be developed to extract the necessary information from audit files (likely requiring IT system administration assistance) and to assess the accuracy of information within audit files for quality measurement purposes. One potential problem brought up by a panelist was accuracy of information about the origin of transitions documents (provenance), such as discharge summaries, that are integrated into an EHR. The provenance of documents forwarded through multiple systems or providers would be important to understand.

In all the measures suggested that focus on information transfer at the time of patient transitions, claims data would be needed to identify those transitions. For example, claims data would be needed to identify when patients were discharged from the hospital or readmitted or when they visited an outpatient specialty provider. Health information exchanges, when they include a data repository and incorporate claims data, would be a particularly useful source for such measures because they include clinical information from EHRs and claims data in a single source. All-payer claims databases are also particularly attractive for this purpose because they contain data from all health care settings, an essential tool for identifying a wide range of patient transitions. However, linking APCD data with EHRs is currently only possible within the limited number of States that collect identified patient information within their APCD. Privacy issues would need to be resolved before such linkage could be achieved. For patients with commercial insurance, payer files would also likely contain sufficient information to identify most care transitions. However, transitions to and from services not covered by the payer, such as behavioral health services for payers with mental health benefit carve-outs, would not be reflected in single-payer data.

A further consideration for any measures that focus on transmission of information to or from the primary care clinic or a patient-centered medical home is the ability to attribute a patient to a particular primary care provider or home. Panelists emphasized that most EHRs do not identify a PCP for patients because they use an encounter-based model that does not easily capture those kinds of longitudinal care concepts. But panelists with experience attributing patients to PCPs emphasized that this is not an insurmountable obstacle to such quality measure concepts. One panelist with experience administering an HIE provided information about the algorithm developed to attribute patients to PCPs within the exchanges' data repository and reported that the method had a high degree of accuracy (approximately 90% agreement between the algorithm and primary care providers themselves). Thus, although attention must be paid to this issue during measure development, it is unlikely to hamper use of such measures. Another informant suggested that, in the long-term, issues of attribution would be less problematic if future EHR standards would encourage or require capture of longitudinal care concepts, such as designation of a PCP or medical home.

Using Claims Data for Measurement

Panelists suggested several ways in which claims data, particularly from all-payer claims databases, could be used to evaluate care coordination. Because claims data focus on services received (events) rather than processes of care, these measure suggestions focused on intermediate outcomes that might be indicative of poor coordination.

One concept suggested is presence of follow-up appointments within an expected time frame of a particular event, such as discharge from the hospital or performance of a particular surgical procedure. Another concept suggested was evaluation of redundant testing. For example, claims for the same imaging study or lab test from different facilities or ordered by different providers within close proximity to one another might indicate failure to share test results across settings. Any such measures would likely need to be limited to particular tests within specific instances, such as repetition of a particular imaging study within a set timeframe surrounding an inpatient admission for a specific diagnosis, or a particular lab test performed at both a primary care and specialty clinic during a timeframe within which the results would not be expected to change. One panelist noted that an important limitation in such measures is ambiguity in claims data about which provider or institution performs a test vs. which bills for the test. This issue would need to be investigated during measure development.

All-payer claims databases would be particularly useful for such measures because they aggregate claims for care received in most settings of the health care system. Health information exchanges with a data repository and that include claims data might also be used for such measures. In both cases, completeness of the data source must be carefully considered. For example, an HIE that contains claims data from only 50% of ambulatory care providers would not be sufficient to confirm that a follow-up appointment occurred.

If these measures relied on only claims data, they would be limited by lack of clinical context. Panelists emphasized that the ability to link claims data to clinical information from within EHRs, whether by linking EHRs with APCDs or through an HIE that contains claims data, would greatly enhance such measures. The additional clinical context was seen as particularly important for ensuring face validity among clinicians. Issues of patient matching would need to be resolved in attempting to link claims with clinical data, but these challenges have already been addressed in some HIEs. Privacy concerns and other regulatory hurdles that limit use of identified patient data pose a greater challenge in the near-term, but panelists agreed that these barriers are also likely to be overcome in the next few years as the need for linked data is more widely recognized.

Panelists also discussed measures related to what care coordination is expected to achieve or influence positively. For example, other ideas suggested for claims-based care coordination measurement included hospital readmissions, adherence to guidelines for episodes of care where well-established and fairly standard processes of care exist, and adherence with guidelines for pharmacotherapy of certain chronic conditions. Such measures would not directly capture coordination processes, but rather would provide an indirect view of coordination through events potentially related to adequacy or inadequacy of coordination and thus might be considered proxy measures of coordination processes. The focus of this report, however, is on electronic data source opportunities for measuring coordination processes directly, so further detail on these ideas from panelists is not covered in this report.

Summary of Near-term Measure Opportunities

Table 4 summarizes the measure opportunities identified by panelists as likely feasible in the next 2-to-3 years. A common thread among most near-term measurement possibilities is a focus on the transfer of information. Panelists agreed that potential exists to measure documentation and transmission of some kinds of information that is likely to be useful in coordinating care, but that other dynamic processes of care coordination, such as interpersonal communication or some supports for self-management, are not likely to be measurable with health IT data sources because they are not well documented or easily captured as part of care encounters.

Table 4. Near-term Measure Opportunities

Measurement Approach	Specific Measure Concepts	Data Source(s)
Use Meaningful Use measure data elements in new measures of care coordination	See Tables 1, 2, and 3 for lists of data elements	Certified EHRs from providers and hospitals participating in the Meaningful Use incentive program
Use CCD/CCR messages to confirm transmission of key pieces of information during care transitions	CCD/CCR transmitted following hospital discharge or referral to specialist CCD/CCR sections for the medication list, problem list, lab results included among information transmitted. Contents of CCD/CCR not examined)	Numerator: EHR or HIE* Denominator: claims data (APCD, HIE* [if includes claims data], payer files)
Use EHR data to confirm inclusion of key information from other health care settings within primary care record	Primary care EHR contains information on hospitalization (e.g., discharge summary) or specialist visits (e.g., clinical summary) that occurred outside the primary care clinic system	Numerator: EHR Denominator: claims data (APCD, HIE* [if includes claims data], payer files)
Use EHR audit files to evaluate whether information transferred from other settings is viewed by providers.	Discharge summary received from hospital is opened by PCP or nurse within certain timeframe. Clinical summary from specialist consult is viewed before or during follow-up visit.	Numerator and denominator: EHR audit files
Use claims data to confirm follow-up care occurred within expected time frame	Percent of patients discharged from the hospital with certain conditions who have a visit with an outpatient provider within a certain timeframe	Numerator and denominator: APCDs or HIE* (if includes claims data) or payer files
Use claims data to examine instances of redundant testing	• Repetition of a particular imaging study within a set timeframe: surrounding an inpatient admission for a particular diagnosis. • -ordered by different outpatient providers at visits with the same principal diagnosis.	Numerator and denominator: APCDs or HIE* (if includes claims data) or payer files Would be enhanced by addition of clinical data from EHR or HIE*

APCD – all-payer claims database; CCD – continuity of care document; CCR – continuity of care record; EHR – electronic health record; HIE – health information exchange

*HIEs are only a data source if they include a data repository that stores data rather than just transmitting it.

Although these measures represent the most promising opportunities identified from our panel review, they still require some additional efforts. To implement several of these measure concepts, methods must first be developed to link clinical and claims data and the reliability and accuracy of any such linkage examined. Because many of the data elements needed for these suggested measures have not been used in prior quality measurement efforts (to our knowledge), the validity and quality of the specific data elements used would also need to be investigated. For example, it would be necessary to examine whether information needed from claims data is routinely collected by all payers and what level of specificity for document types, provenance, and viewer are typically included within EHR audit

files. The accuracy of data automatically extracted from EHRs must also be assessed, for example, by comparison with manual chart review. The published literature may contain some information on validity, reliability, and accuracy of some data elements or sources, but in the absence of published literature, new investigations would be required. Finally, as with all measure development efforts, measures must be carefully specified with clear definitions of numerator, denominator, and exclusions. In some cases, risk adjustment would also be needed. Clinical input is essential during such development, as well as evidence from published literature and evidence-based guidelines, when available.

Long-term Opportunities

Because the health IT field is developing rapidly and care coordination measurement is still in its infancy, estimates of long-term prospects for measuring care coordination using health IT data are likely to change within the next few years. Nevertheless, our discussions with panelists revealed a number of possible avenues for such measurement which, though likely not feasible in the near-term, present a promising possibility as both fields further develop. These approaches are necessarily less well defined than the near-term opportunities identified in the previous section.

During one of the group calls, panelists discussed the challenge in assessing whether care is coordinated as an intermediate outcome rather than measuring discrete actions or processes that are believed to be important for coordinating care, but may not individually be sufficient to achieve coordinated care. Evidence that data are being linked across sites or across providers was suggested as one potential structural indicator related to care coordination. Although panelists debated where to look for such evidence of linkage, there was some agreement that aggregated information from multiple sources should be located within whatever entity is primarily responsible for coordinating care, whether that is in the EHR of a primary care provider, long-term care facility, or the registry of another responsible entity such as an insurance provider. However, there was no agreement among panelists about where within an EHR this information might be found or how it might be structured. Overall, using aggregation of clinical information from multiple settings as evidence of care coordination will likely require further development of interoperability infrastructure, the evolution of EHRs and how data are recorded within them, and further conceptual development around what constitutes coordinated care. Dovetailing efforts to improve coordination and simultaneously record and measure related activities is part of the promise of health IT, which to date has been focused more on clinical processes (e.g., preventive screening) and less on management processes (e.g., patient and information flow) that support clinical activity.

Another idea suggested as an indicator of poor coordination is lack of documentation in a coordinating practice's EHR (e.g., of a primary care provider or medical home) regarding health care utilization in other settings. The specific example was provided of a patient with multiple visits to outside specialists about which no information can be found in the PCP's EHR. This concept could also be applied to evaluate a PCP's awareness of patients' hospital admissions, ED visits, or behavioral health visits. The denominator of such a measure would be based on knowledge about what health care services individual patients have used, requiring claims data or other information on health care utilization from across settings.

A limited application of this kind of measure is likely to be feasible in some cases within the next few years (see near-term opportunities section), but broader application is likely more distant. For example, to be applicable to a broad patient population, such measures would require use of APCD data for the

denominator, rather than claims data from a single payer or from a particular HIE. (Only mature HIEs that include a data repository and incorporate claims data would be sufficient for use in the denominator). Currently, the ability to link APCD data with outside data sources, such as EHRs, is possible in only a limited number of States that collect identified data. Issues of patient matching patients across claims and EHR data would pose a challenge, but one panelist noted that matching is done regularly by many health plans to enable patient outreach by clinicians.

Furthermore, given the wide variation in how outside information is integrated into current EHR systems, near-term measurement would likely be restricted to specific information types and formats, such as a CCD/CCR message or a hospital discharge summary. Given that there is currently no usual location where outside information is stored within EHRs, and the possibility that information might be present within text-based notes that could not be assessed through automatic data extraction, confirming the absence of information about outside health care utilization will pose a significant challenge. As industry standards evolve for incorporating discharge summaries, clinical summaries, outside lab and imaging results, pharmacy data, and transition of care documents, it may be feasible to capture a wider range of data integration (and lack thereof) within such measures.

One panelist noted that linking EHRs to patient registries would offer another potentially rich data source for quality measurement. This not only would improve care at the point of care—for example, information on immunizations obtained at a public health fair might be available to the primary care physician—but could also provide more comprehensive data for quality measurement. However, panelists emphasized that near-term measurement using patient registries, with or without linking to EHRs, is not likely. They noted that although particular registries contain some data elements that would be useful for care coordination measurement, the lack of standard design or data elements included in various registries makes it impractical to design care coordination quality measures around registry data at this time. Looking forward, an ongoing project funded by AHRQ aims to develop a Registry of Patient Registries (RoPR), similar to clinicaltrials.gov, which would provide searchable information about the focus, content, design, and stewardship of many patient registries in the country (see Appendix D for more information). This project is still in development, but in the future may help facilitate integration of registry data with other data sources, such as EHRs, by making it easier for users to identify relevant registries, and encouraging use of standardized core data elements across registries.

Summary of Measurement Opportunities

Panelists recognized that the demands for quality measurement have grown substantially in recent years and noted the challenge in keeping up with quality measurement initiatives that are not always synchronized. This has put considerable measurement burden on clinicians and systems administrators, and, increasingly, health IT vendors, who must keep pace with a dynamic measurement field in order to facilitate measurement using their products. Panelists encouraged harmonizing measurement efforts as much as possible to ease this burden. Aligning new measures of care coordination with data elements required for Meaningful Use measures is one example of this strategy. In the field of care coordination specifically, supporting research investigating how coordination activities relate to key outcomes would also help reduce measurement burden by focusing measurement efforts around a limited number of processes or concepts known to be important. Finally, one panelist summed up his recommendations in this way: “Don’t ask for too many measures, don’t make them too complex, incrementally increase the kinds of data needed for quality measures.”

Conclusion

The advantages of reduced measurement burden, rich clinical context, and longitudinal data have made electronic data, in particular data from health IT systems, the target of a growing interest in supporting and measuring care coordination processes in new ways. In this report, we provide an assessment of the potential for such measurement, based on input from experts. Their insight suggests much reason for optimism about the possibility of measuring care coordination using electronic data sources, albeit tempered by the reality of many challenges that must be overcome to make such measurement feasible. A key observation from our discussions with these experts is the rapidity with which the health IT landscape is changing. That rapid change will almost assuredly help resolve many of challenges in the current health IT environment, but does introduce its own challenge in predicting what will and will not be possible in the future. Even recommendations pertaining to near-term measurement opportunities identified in this report may become outdated before they are fully implemented.

Many of the challenges with using health IT data for care coordination measurement identified by the panelists are indicative of a field still in the early stages of growth. While well-defined datasets and definitions of data elements are generally not available today, our discussions with panelists and review of background materials suggest that much improvement in this area is already underway. Thus, the opportunity for measure development must respond to and take advantage of this dynamic environment. Even beyond measure development, monitoring existing indicators in light of this environment will be essential as new data developments may pave the way for indicator improvements.

Our findings suggest a need for continued dialog with a wide range of experts at local, regional, and national levels. We hope this report offers a starting point for that discussion, and further identification of opportunities for focusing on operational mechanisms that are important to producing highly coordinated patient-centered care. Measurement offers one such operational mechanism, but finding exactly what can be measured well locally and then compared regionally or nationally to motivate improvements in performance is an ongoing process. The rich opportunities likely to be feasible with the growth of electronic data are both exciting and daunting. Directing attention to measuring coordination processes has the potential to bring together many health care stakeholders and ultimately deliver on these opportunities.

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Appendix A: Methods of Seeking Input About the Potential for Measuring Care Coordination Using Electronic Data Sources

Our primary means for exploring how care coordination might be measured in novel ways using data from electronic data sources was through discussion with a panel of experts. Details of the panel selection process and discussions are outlined below. We also investigated additional sources that panelists suggested would help inform our discussion, and consulted with additional informants who provided background information and feedback on conclusions from the panel review. We synthesized information learned from all these sources and present results and conclusions in this report.

Panelist Selection

The project team sought to assemble a panel of experts in electronic data sources that might be used today or in the near future to measure care coordination. To identify these experts, we first sought the input of AHRQ, which has an extensive research portfolio in health IT. We received a list of AHRQ-recommended individuals and began our outreach with these potential participants. As we progressed through initial calls and learned of additional potential avenues to explore, we grew the list of individuals we sought to engage in the panel. These additional means of identifying potential panelists included:

- Association with reports, workgroups, or other materials reviewed as part of our background research
- Referrals from other panelists
- Referrals from individuals we contacted, but who were unable to participate in the panel themselves
- Web research for individuals associated with organizations of interest

The following individuals participated in our expert panel review and have agreed to have their names appear in this report.

Table A-1. Expert Panelists and Affiliations

Panelist	Position	Affiliation
Hunt Blair	Deputy Commissioner, Division of Health Reform & State Health Information Technology Coordinator	Department of Vermont Health Access
Carmella Bocchino	Executive Vice President	America's Health Insurance Plans
Keri Christensen, M.S.	Senior Policy Analyst, Performance Improvement	American Medical Association
Joanne Cuny, R.N., M.B.A.	Director, PCPI Measure Testing and Quality Improvement	American Medical Association
Aaron N. Cutshall, M.S.C.I.S.	Senior Data Architect	Indiana Health Information Exchange
Floyd Eisenberg, M.D., M.P.H., FACP	Senior Vice President for Health Information Technology	National Quality Forum
J. Michael Fitzmaurice, Ph.D., FACMI	Senior Science Advisor for Information Technology, Office of the Director	Agency for Healthcare Research and Quality
Valerie Fong, R.N., M.S.N.	Senior Manager, Care Delivery Transitions	Kaiser Permanente
Craig Jones, M.D.	Director	Vermont Blueprint for Health

Panelist	Position	Affiliation
Melanie P. Mastanduno, B.S.N., M.P.H.	Director, Population Health Measurement	The Dartmouth Institute of Health Policy and Clinical Practice
Patrick Miller, M.P.H.	Research Associate Professor; Co-Chair, All-Payer Claims Database Council	New Hampshire Institute for Health Policy and Practice
Jon D. Morrow, M.D.	Senior Medical Leader, Clinical Data Services	GE Healthcare
Wilson D. Pace, M.D., FAAFP	Professor, Green-Edelman Chair for Practice-based Research	University of Colorado School of Medicine
L. Greg Pawlson, M.D., M.P.H.	Executive Director of Quality Innovations	BlueCross BlueShield Association
Fred Rachman, M.D.	CEO	Alliance of Chicago Community Health Services
Elizabeth Schofield, B.S.N., M.B.A.	Clinical Product Specialist	Siemens Medical Solutions
Claudia Steiner, M.D., M.P.H.	Research Medical Officer	Agency for Healthcare Research and Quality
Paul Tang, M.D., M.S.	Chief Innovation and Technology Officer	Palo Alto Medical Foundation
Charlene S. Underwood, M.B.A., FHIMSS	Senior Director, Government and Industry Affairs	Siemens Healthcare

*One individual who was unable to be publicly affiliated with this work represented an additional health IT solutions vendor perspective. Additional panelists who do not appear above represent a payer perspective and national-level involvement and expertise with Meaningful Use.

Conference Calls

The expert panel review process consisted of individual calls held over approximately 3 months, followed by two group panel discussions.

We held 19 individual calls with panelists during the period of April through July 2011. Each call was between 30 and 60 minutes in length. The team spoke with a total of 21 panelists through these initial calls. These calls were geared toward information gathering and were tailored to each individual's area of expertise. Information we sought from most individuals included:

- Feasibility of measuring care coordination processes using electronic data
- Anticipated time horizon for care coordination measurement using electronic data
- Most promising possibilities (near-term and long-term) for care coordination measurement using electronic data
- Challenges in using electronic data for care coordination measurement
- Data elements typically available in health IT systems
- Format (structured vs. unstructured) and accessibility of key data elements
- Standards for coding or capturing key data elements within health IT systems

The project team convened two 2-hour group conference calls in July 2011. Each call had unique participants with an identical agenda that included background material (Appendix B). A project team member moderated the calls guided by the call agenda and the particular comments and discussion of each call. The distribution and participation of panelists across the two calls was based solely on the panelists' availability. A total of 14 individuals participated in one of the two group calls.

Limitations

We assembled our panel of experts by soliciting recommendations from AHRQ based on a list of desired expertise areas, then used a "snowball" technique to identify additional informants by asking each panelist we spoke with for recommendations of other experts or organizations to contact. While effective in covering our desired expertise areas, this method is limited in its reliance on personal contacts. Although not within scope of expertise sought, additional perspectives from provider organization operations, finance administrators, and front-line clinicians may have supplemented our findings in useful ways.

Appendix B: Group panel call agenda

The following material was distributed to all group call participants in advance of the calls, in order to stimulate and support the discussion.

Hypothetical Care Coordination Measure Concepts

For Discussion of Data Issues and Opportunities

Background:
Our goal is to assess the potential of measuring care coordination processes using data from various health IT systems, such as electronic health records (EHR), health information exchanges (HIE), and other sources such as all-payer claims databases. We are interested in your thinking about measurement that would be feasible for a wide range of practices or hospitals, not only those that are most advanced in their use of health IT systems, although we are also interested in possibilities from leaders in health IT implementation.

Although we are not developing specific measure concepts at this time, as a foundation for our group discussion, we developed two hypothetical measure concepts. We will use these as concrete launching points to discuss issues and opportunities related to particular kinds of information needed, corresponding data elements, identification of denominator populations, standardization of data, and feasibility. We are not interested in debating the merits of particular measure concepts, but rather wish to focus on how data from health IT systems or other sources could be used to measure concepts such as these. The hypothetical measures are derived from preferred practices highlighted in a National Quality Forum report on care coordination measurement,[i] but to our knowledge are not proposed as measures by any organization.

Below, we list general questions to guide the discussion.

Questions for Discussion:

- Which aspects of the hypothetical measures are the most feasible to implement currently using data from health IT systems or other sources? Which are least feasible?
- What potential issues are there in identifying the denominator populations?
- What barriers or challenges currently exist in measuring these concepts?
- What needs to happen to overcome those challenges?
- What might be possible in another 2-3 years, given the current rate of IT system implementation and expected developments for other data sources?

Hypothetical Measure 1: Percent of practice patients with chronic disease for whom a plan of care is documented in the patient record.

Based on NQF Preferred Practice 6: Health care providers and entities should have structured and effective systems, policies, procedures, and practices to create, document, execute, and update a plan of care with every patient.

The plan of care should be jointly created and managed by the patient, caregiver, and care provider according to their preferences and the accountable provider. Elements of the plan of care should include, but not be limited to:

- Patient's diagnosis or problem;
- Updated list of medications;
- Appointments for follow-up care;
- Environmental or social factors that may contribute to the problem;
- Other known factors that may contribute to the problem, including assets and strengths;
- Plan of care to address the diagnosis or problem, including preventive care;
- Documentation of the surrogate decision-maker for patient care;
- Self-management training and/or skills identified by the patient;
- Evaluation of participation and level of engagement in activities of daily living;
- Existence of advance directives.

Measure Numerator: Presence of a care plan that includes the above elements in the patient record. The elements must be grouped together in a single location within the record, such as a care plan document or template.

Measure Denominator: Patients with a visit to the primary care practice within the last 3 years with at least 3 encounters with any diagnosis of congestive heart failure (CHF), asthma, diabetes, advanced coronary artery disease, chronic kidney disease or chronic liver disease, or patients seen within the practice within the last 3 years who have been hospitalized within 12 months with a principal diagnosis of one of these diagnoses.

Hypothetical Measure 2: Percent of practice patients whose referral to a specialist physician was accompanied by core transition data elements.

Based on NQF Preferred Practice 22: Data elements should accompany the patient during all transitions of care and should be appropriate to the type of transition and accessible throughout the transition. These core data elements should include, but not be limited to:

- Medical diagnosis and significant health problems;
- Clinical status;
- Medication lists;
- Treatments/procedures completed within the setting;
- All treatments (durable medical equipment [DME], medications, therapies) including post-transitions treatments;
- Relevant past medical history;
- Functional status;
- Communication skills;
- Patient and caregiver priorities for care;
- Preferences relevant to the transition;
- Advance directive status.

Measure Numerator: Presence of the above elements in information or documentation sent by the primary care provider to a specialist when referring a patient for a specialist consult. Documentation

must exist that the information was transmitted to the specialist electronically or in hard copy within one week of referral, or no later than the date of the specialist visit, whichever is sooner.

Measure Denominator: Patients referred from the primary care practice to a non-practice specialist physician within the last 12 months.

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[i] National Quality Forum (NQF). *Preferred Practices and Performance Measures for Measuring and Reporting Care Coordination: A Consensus report.* Washington, D.C.: NQF; 2010.

Appendix C: Glossary and abbreviations

Accountable Care Organization (ACO) – A group of health care providers who give coordinated care and chronic disease management, and thereby improve the quality of care patients get. The organization's payment is tied to achieving health care quality goals and outcomes that result in cost savings.[1]

All-Payer Claims Database (APCD) – Also known as an All-Payer, All-Claims Database. Large-scale databases that systematically collect health care claims data from a variety of payer sources that include claims from most health care providers. Statewide APCDs are databases, typically created by a State mandate, that generally include data derived from medical claims, pharmacy claims, eligibility files, provider (physician and facility) files, and dental claims from private and public payers. In States without a legislative mandate, there may be voluntary reporting of APCD data.[2]

Care Plan – Outlines the patient's current and longstanding needs and goals for care and/or identifies coordination gaps. The plan is designed to fill gaps in coordination, establish patient goals for care, and, in some cases, set goals for the patient's providers. Ideally, the care plan anticipates routine needs and tracks current progress toward patient goals.[3] (Also sometimes referred to as a nursing care plan or plan of care.)

Continuity of Care Document (CCD) – A joint effort of HL7 and ASTM[4] to foster interoperability of clinical data to allow physicians to send electronic medical information to other providers without loss of meaning, which will ultimately improve patient care.[5]

Continuity of Care Record (CCR) – A proposed standard for exchanging basic patient data between one care provider and another to enable this next provider to have ready access to relevant patient information. The standard is proposed by the E31 Committee on Healthcare Informatics of ASTM, an American National Standards Institute (ANSI) standard development organization.[6]

Data Element/Field – A basic unit of information collected about anything of interest—for example, a medication name or a patient diagnosis. A data element is a unit of data for which the definition, identification, representation, and permissible values are specified by means of a set of attributes.[7]

Data Repository – A database acting as an information storage facility. Although often used synonymously with data warehouse, a repository does not have the analysis or querying capabilities of a warehouse.[8]

Electronic Health Records (EHR) – A longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. Though often used interchangeably with the term electronic medical record (EMR), EHRs and EMRs differ in the scope of the information they contain. While EMRs contain information pertaining to a single practice or hospital, EHRs are designed to incorporate information from other providers or settings into a single record. The EHR automates and streamlines the clinician's workflow. The EHR has the ability to generate a complete record of a clinical patient encounter as well as supporting other care-related activities directly or indirectly via interface including evidence-based decision support, quality management, and outcomes reporting.[9]

Electronic Medical Records (EMR) – An application environment composed of the clinical data repository, clinical decision support, controlled medical vocabulary, order entry, computerized provider order entry, pharmacy, and clinical documentation applications. This environment supports the patient's electronic medical record across inpatient and outpatient environments, and is used by health care practitioners to document, monitor, and manage health care delivery within a care delivery organization (CDO). The data in the EMR is the legal record of what happened to the patient during their encounter at the CDO and is owned by the CDO.[10] Though often used interchangeably with the term electronic health record (EHR), EMRs and EHRs differ in the scope of the information they contain. While EMRs contain information pertaining to a single practice or hospital, EHRs are designed to incorporate information from other providers or settings into a single record.

Health Care Entity – Discrete units of the health care system that play distinct roles in the delivery of care. Examples include individual nurses or physicians, primary care practices, multispecialty practices, or hospitals.[11]

Health Information Exchange (HIE) – Those organizations formed as a corporate entity to provide services that includes core services focused on data exchange and sharing of patient data across disparate stakeholders at the local, State, regional and national level. Health Information exchange organizations require an organizational, financial, and business structure that supports a sustainable service offering that supports a broad range of stakeholder participation.[12]

Health Information Technology (Health IT) – The application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making.[13]

Health Insurance Portability and Accountability Act (HIPAA) – A Federal law intended to improve the portability of health insurance and simplify health care administration. HIPAA sets standards for electronic transmission of claims-related information and for ensuring the security and privacy of all individually identifiable health information.[14]

Health Level Seven International (HL7) – A messaging standard that is widely used in messaging across health care applications. That is, it is used to send structured, encoded, data from one application (such as the laboratory system) to another (such as the EHR).[15]

International Classification of Diseases, 9th Edition/Revision, Clinical Modification (ICD-9-CM) – The official system of assigning codes to diagnoses and procedures associated with hospital utilization in the United States. The ICD-9-CM is used to code and classify mortality data from death certificates.[16]

International Classification of Diseases, 10th Edition/Revision, Clinical Modification (ICD-10-CM) – The tenth revision of the International Classification of Diseases, Clinical Modification. ICD-10-CM will affect coding for everyone covered by the Health Insurance Portability and Accountability Act (HIPAA), not just those who submit Medicare claims.[17]

Interoperability – The ability of software and hardware on multiple pieces of equipment made by different companies or manufacturers to communicate and work together.[18]

Logical Observation Identifiers Names and Codes (LOINC) – Used to identify individual laboratory results (e.g. hemoglobin values), clinical observations (e.g., discharge diagnosis), and diagnostic study observations (e.g., chest x-ray impression). LOINC is most widely used in laboratory systems.[19]

Meaningful Use (MU) – The American Recovery and Reinvestment Act of 2009 specifies three main components of Meaningful Use: (1) The use of a certified EHR in a meaningful manner, such as e-prescribing. (2) The use of certified EHR technology for electronic exchange of health information to improve quality of health care. (3) The use of certified EHR technology to submit clinical quality and other measures. Simply put, "Meaningful Use" means providers need to show they're using certified EHR technology in ways that can be measured significantly in quality and in quantity.[20]

National Drug Code (NDC) Directory – The Drug Listing Act of 1972 requires registered drug establishments to provide the Food and Drug Administration (FDA) with a current list of all drugs manufactured, prepared, propagated, compounded, or processed by it for commercial distribution. (See Section 510 of the Federal Food, Drug, and Cosmetic Act (Act) (21 U.S.C. § 360)). Drug products are identified and reported using a unique, three-segment number, called the National Drug Code (NDC), which serves as a universal product identifier for human drugs. FDA publishes the listed NDC numbers and the information submitted as part of the listing information in the NDC Directory.[21]

Office of the National Coordinator (ONC) for Health Information Technology – Organizationally located within the Office of the Secretary for the U.S. Department of Health and Human Services (HHS). ONC is the principal Federal entity charged with coordination of nationwide efforts to implement and use the most advanced health information technology and the electronic exchange of health information.[22]

Patient Registry – A database of confidential patient information that can be analyzed to understand and compare the outcomes and safety of health care. The data may originate from multiple sources, including hospitals, pharmacy systems, physician practices, and insurance companies.[23]

Patient Centered Medical Home (PCMH) – The AHRQ defines a medical home as an organizational model for primary care that delivers the core functions of primary health care. The medical home is patient-centered, provides clear access to comprehensive and coordinated care, and employs a system-based approach to quality and safety. Health information technology plays a central role in implementing the medical home. AHRQ also recognizes the need for significant workforce development and fundamental payment reform to provide the hallmark accessibility, affordability, and high quality of the patient centered medical home.[24]

Primary Care Physician/Practice (PCP) – The Institute of Medicine defines primary care as the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community.[25]

RxNorm – RxNorm provides normalized names for clinical drugs and links its names to many of the drug vocabularies commonly used in pharmacy management and drug interaction software, including those of First Databank, Micromedex, MediSpan, Gold Standard Alchemy, and Multum. By providing links between these vocabularies, RxNorm can mediate messages between systems not using the same software and vocabulary.[26]

Quality Data Model (QDM) – An "information model" that clearly defines concepts used in quality measures and clinical care and is intended to enable automation of electronic health record (EHR) use. Developed by the National Quality Forum, the QDM provides a way to describe clinical concepts in a standardized format so individuals (i.e., providers, researchers, measure developers) monitoring clinical performance and outcomes can clearly and concisely communicate necessary information. The QDM describes information so that EHR and other clinical electronic system vendors can consistently interpret and easily locate the data required.[27]

Standards and Interoperability (S&I) Framework – The Standards and Interoperability Framework is a set of integrated functions, processes, and tools being guided by the healthcare and technology industry to achieve harmonized interoperability for healthcare information exchange. The Standards and Interoperability Framework is an investment by the country in a set of harmonized interoperability specifications to support national health outcomes and healthcare priorities, including Meaningful Use, the Nationwide Health Information Network, and the ongoing mission to create better care, better population health and cost reduction through delivery improvements.[28]

Systematized Nomenclature of Medicine—Clinical Terms (SNOMED CT) – One of a suite of designated standards for use in U.S. Federal Government systems for the electronic exchange of clinical health information; is also a required standard in interoperability specifications of the U.S. Healthcare Information Technology Standards Panel.[29]

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[3] Adapted from *Care Coordination Measures Atlas.* McDonald KM, Schultz E, Albin L, Pineda N, Lonhart J, Sundaram V, Smith-Spangler C, Brustrom J, and Malcolm E. Care Coordination Atlas (Prepared by Stanford University under subcontract to Battelle on Contract No. 290-04-0020). AHRQ Publication No. 11-0023-EF.
[4] American Society for Testing and Materials
[5] Health Level Seven, Inc., http://www.hl7.org/documentcenter/public_temp_0F4E7D58-1C23-BA17-0CD957B03BBCC0CB/pressreleases/20070212.pdf. Accessed August 18, 2011.
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[9] Healthcare Information and Management Systems Society, http://www.himss.org/asp/topics_ehr.asp. Accessed August 18, 2011.
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[12] Office of the National Coordinator for Health Information Technology, http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__home/1204. Accessed August 18, 2011.

[13] West Virginia State Medical Association Glossary of Health Information Technology Terms, http://www.wvsma.com/shared/content_objects/pdfs/glossary%20of%20hit%20acronyms%20and%20terms%20-%20revised.pdf. Accessed August 22, 2011.
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[17] Adapted from Centers for Medicare and Medicaid Services, https://www.cms.gov/icd10/. Accessed August 23, 2011.
[18] West Virginia State Medical Association Glossary of Health Information Technology Terms, http://www.wvsma.com/shared/content_objects/pdfs/glossary%20of%20hit%20acronyms%20and%20terms%20-%20revised.pdf. Accessed August 22, 2011.
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[29] U.S. National Library of Medicine—National Institutes of Health, http://www.nlm.nih.gov/research/umls/Snomed/snomed_main.html. Accessed August 18, 2011.

Appendix D: Additional Sources

This appendix includes links to sources with additional information about key data sources, concepts, or standards discussed in the report.

All-payer claims databases (APCD)
The APCD Council is a federation of government, private, non-profit, and academic organizations focused on improving the development and deployment of State-based all payer claims databases. Their website contains useful information on active and developing APCDs, projects related to APCDs, and standardization related to APCDs. Available at: http://www.apcdcouncil.org/

Continuity of Care Document (CCD)
The Continuity of Care Document is a standard for transferring information between health IT systems during care transitions. The CCD standard was developed by the Health IT Standards Panel to harmonize the Clinical Data Architecture interoperability standard developed by Health Level 7 (HL7) with the Continuity of Care Record developed by ASTM (see next entry). Background on the CCD standard, as well as additional technical details, are available from HL7 at:
http://wiki.hl7.org/index.php?title=Product_CCD

Continuity of Care Record (CCR)
The Continuity of Care Record is a standard for transferring information between health IT systems during care transitions. The CCR is related to the CCD, but was developed by ASTM (formerly American Society for Testing and Materials). Information about the CCR standard is available from ASTM at:
http://www.astm.org/Standards/E2369.htm

Health IT Standards Panel
Although the HIT Standards Panel formally concluded in April 2010, the HITSP website contains a wealth of information about current health IT standards for interoperability, including **continuity of care documents (CCD)**, EHR lab results reporting, and consultations and transfers of care. Available at:
http://www.hitsp.org/default.aspx

Meaningful Use Incentive Program
The Centers for Medicare and Medicaid Services provides an overview of the Meaningful Use incentive program and links to the program requirements and measures, available at:
https://www.cms.gov/ehrincentiveprograms/30_Meaningful_Use.asp

Guidance for calculating the Clinical Quality Measures required for the Meaningful Use program is available at: http://www.cms.gov/QualityMeasures/03_ElectronicSpecifications.asp#TopOfPage

National Quality Forum (NQF) Quality Data Model
Information about the NQF Quality Data Model is available at:
http://www.qualityforum.org/Projects/h/QDS_Model/Quality_Data_Model.aspx#t=1&s=&p=

Office of the National Coordinator (ONC) for Health IT
The Office of the National Coordinator for Health Information Technology (ONC) is the central coordinating entity for Federal health IT development efforts. The ONC website has a wealth of

information about health IT standards, initiatives, and the Meaningful Use Incentive Program: http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__home/1204

Of particular interest is the Health IT Policy Committee (HITPC), which includes workgroups focused on Meaningful Use, certification and adoption of Health IT, and information exchange, among others. The HITPC website is available at: http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__health_it_policy_committee/1269

Also of interest is the Health IT Standards Committee (HITSC) which is charged with making recommendations to the National Coordinator for Health IT on standards, implementation specifications, and certification criteria for the electronic exchange and use of health information. The HITSC website is available at: http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__health_it_standards_committee/1271

popHealth

The popHealth tool is designed to help EHR vendors and health care providers extract data elements required to inform all 44 Meaningful Use Stage I quality measures from their Continuity of Care records (CCD or CCR). A summary of the popHealth tool is available at: http://projectpophealth.org/

After creating an account, users may download the programs through the website in order to run popHealth software, available at: http://projectpophealth.org/download.html

Registry of Patient Registries (RoPR)

The Agency for Healthcare Research and Quality is developing a Registry of Patient Registries (RoPR), similar to clinicaltrials.gov, to provide searchable information about the focus, content, design, and stewardship of many patient registries in the country. Information about RoPR is available at: http://www.effectivehealthcare.ahrq.gov/index.cfm/search-for-guides-reviews-and-reports/?pageaction=displayproduct&productid=690

Standards and Interoperability (S&I) Framework

The S&I Framework is a federal initiative to harmonize interoperability efforts within the health IT field. A wealth of information about the framework, its objectives, on-going work, and how to participate, is available at: http://wiki.siframework.org/

A useful starting place for understanding the S&I Framework is the Introduction and Overview, available at: http://jira.siframework.org/wiki/display/SIF/Introduction+and+Overview

An S&I framework initiative of particular interest for care coordination is the Transitions of Care Initiative, which aims to facilitate transfer of summary of care records. Information on the initiative is available at: http://wiki.siframework.org/Transitions+of+Care+%28ToC%29+Initiative

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