NATIONAL
QUALITY FORUM

Measurement Framework to Assess Nationwide Progress related to Interoperable Health Information Exchange to support the National Quality Strategy

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DRAFT REPORT

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Contents

Executive Summary

The definition of interoperability with respect to health IT means health information technology that (1) enables secure exchange and use of electronic health information without special effort by the user; (2) allows for complete access, exchange, and use of all electronically accessible health information for authorized use; and (3) does not constitute information blocking.[1] For two systems to be interoperable, they must be able to exchange data in an agreed-upon format according to a standard and subsequently present that data in a way that a user can understand and use.

In concordance with that definition, ONC developed the Connecting Health and Care for the Nation: A Shared Nationwide Interoperability Roadmap as well as national standards as part of its certified electronic health record (EHR) technology, which provided nationwide standards for interoperability, both in the exchange of information and in its use. This provided a foundation on which disparate systems could use the appropriate formats and mechanisms to exchange data to assist providers, patients, and other stakeholders. However, true interoperability is a significant challenge to healthcare organizations for various reasons, including the lack of a common, standard framework that reconciles the differences in data as well as the varying data types. Additionally, healthcare organizations maintain incompatible products and systems, which are unable to disclose the appropriate data within the organization and with partners in its community.

As the nation moves towards increased interoperability, a measurement framework would be useful to assess its impact. At the request of the Department of Health and Human Services (HHS), the National Quality Forum (NQF) has taken on a project to develop a measurement framework and measure concepts, which can serve as a foundation for addressing the current gaps in the measurement of interoperability. As a first step towards achieving these goals, NQF conducted an environmental scan and key informant interviews and published the results in the interoperability Environmental Scan Report and the interoperability Key Informant Interview Summary Report. Additionally, NQF convened an expert, multistakeholder Interoperability Committee to provide input and guide the creation of a framework. Throughout this project, NQF solicited input from a multistakeholder audience, including NQF membership and public stakeholders.

The Committee developed the following set of guiding principles that define the key criteria when considering the measure concepts to guide their development into performance measures.

- Interoperability is more than EHR to EHR, and all sources of data should be taken into consideration.
- Various stakeholders with diverse needs are involved in the exchange and use of data, and the use of this framework and measure concepts will differ based on stakeholder perspectives
- The term “electronically exchanged information” should be used instead of “outside data” to completely fulfill the definition of interoperability.
- Interoperability needs will differ depending on the care setting.
- All critical data elements should be included in the analysis of measures as interoperability increases access to information.

The measurement framework contains essential categories (domains) and subcategories (subdomains) needed to ensure comprehensive performance measurement of interoperability. The Committee determined the following domains and subdomains that most accurately measure interoperability and its impact on health outcomes:

Domain	**Subdomain**
Exchange of Electronic Health Information	• Availability of Electronic Health Information • Quality of Data Content • Method of Exchange
Usability of Exchanged Electronic Health Information	• Relevance • Comprehensibility
Application of Exchanged Electronic Health Information	• Human Use • Computable
Impact of Interoperability	• Patient Safety • Cost Savings • Productivity • Care Coordination • Improved Healthcare Processes and Health Outcomes • Patient/Caregiver Engagement • Patient/Caregiver Experience

Using these domains and subdomains, NQF worked with the Interoperability Committee to examine and develop measure concepts based on information gathered through the literature, the key informant interviews, and the individual knowledge of each of the Committee members. Additionally, NQF examined a large group of quality measures from topics gathered through the literature to identify those that are "interoperability-sensitive" measures, which are quality-of-care metrics designed for reporting from an EHR that are potentially influenced by increased interoperability between EHRs. This framework contains two distinct sections that identify both the measure concepts and measures. Appendix A includes identified measure concepts aligned with the appropriate domains and subdomains within the report along with a timeline. The estimated timeframe states whether (1) the concepts are useful in the short-term (0-3 years); (2) the concepts will be useful in the mid-term (3-5 years); or (3) the concepts are potentially implementable in the long-term (5+ years). Appendix B shows existing measures as illustrative examples of the measure concepts created by the Committee.

Introduction

The sharing and appropriate use of information, specifically electronic information, are important aspects of healthcare.[2] Digital tools can enable providers to connect and share information with other providers and specialists to guide better decision making, improve quality of care, and increase involvement of patients in their own healthcare processes. As healthcare systems increase their adoption of health information technology (health IT), these systems collect a growing amount of data for clinical and administrative purposes within a healthcare environment. Healthcare industry performance depends on usable clinical information that freely flows, regardless of the type of system, organization, or geography. Healthcare organizations depend on efficient and secure means for computer systems and applications to communicate and exchange clinical data to support better care management for patients, preventive care, and population health management. To support these efforts, the Office of the National Coordinator for Health Information Technology (ONC) developed the Shared Nationwide Interoperability Roadmap.

The definition of interoperability with respect to health IT means health information technology that (1) enables secure exchange and use of electronic health information without special effort by the user; (2) allows for complete access, exchange, and use of all electronically accessible health information for authorized use; and (3) does not constitute information blocking.[3] For two systems to be interoperable, they must be able to exchange data in an agreed-upon format according to a standard and subsequently present that data in a way that a user can understand. In concordance with that definition, ONC developed standards for interoperability as part of its certified EHR technology, which provides national standards for interoperability, both in the exchange of information and in its use. This has created a foundation on which disparate systems can use the appropriate formats and mechanisms to exchange data to assist providers, patients, and other stakeholders. However, true interoperability is a significant challenge to healthcare organizations for various reasons, including the lack of a common, standard framework that reconciles the differences in data and varying data types; hospital infrastructures with incompatible products and systems; and the inability to disclose the appropriate data within a hospital and with partners in its community.

One of the goals in using health IT is to provide comprehensive information on patients at the point of care. This includes integrating information across different sources and sites when needed, so that the provider and patient can evaluate the most appropriate options for patients based on the effectiveness of treatments, including factors such as quality, risk, benefit, and cost. Currently, the promulgation of common data messaging standards and clinical vocabularies has increased interoperability, but they are not as effective as they could be for the seamless exchange and use of data to derive the maximum benefits of health IT. As the nation moves towards greater interoperability, a measurement framework and measures would be useful to assess its impact.

The National Quality Forum (NQF), a consensus-based entity and an experienced convener of multistakeholder groups for developing consensus around diverse and challenging topics, has taken on a project at the request of the Department of Health and Human Services (HHS) to develop a common framework and measure concepts to serve as a foundation to address the current gaps in the measurement of interoperability and its impact.

As a first step towards achieving these goals, NQF conducted an environmental scan and key informant interviews and published the results in the interoperability Environmental Scan Report and the interoperability Key Informant Interview Summary Report. Additionally, NQF convened an expert, multistakeholder Interoperability Committee to provide input and help guide the creation of a framework. Throughout this project, NQF solicited input from a multistakeholder audience, including NQF membership and public stakeholders.

In the environmental scan, NQF reviewed over 358 references and identified 77 papers that passed a scoring threshold. These papers provided research into the use and availability of data to facilitate interoperability and the different methods of exchanging information. NQF also assessed the impact on quality measurement and then used that assessment to identify existing quality measures that aligned with the studies. Since many of these articles focus on technical aspects of interoperability rather than the potential impact of interoperability, NQF did an expanded review that included papers that focus on the use, effectiveness, or outcomes of health information exchange (HIE). The environmental scan used the ONC Roadmap as a guide to understanding the key components of interoperability including: (1) infrastructure and services needed to effectively support the capability to exchange information; (2) the flow of information from and between systems and its usage among providers, patients, and payers; and (3) how that information would have a measurable impact on the development of a learning healthcare system.

The findings from the environmental scan helped inform the development of the foundational measurement framework by providing insight into the key components necessary to develop new measures that objectively assess the ability for disparate data systems to exchange information and the use of the data to affect quality of care. Additionally, the development of domains and subdomains of the framework assisted in understanding current measures that are sensitive to interoperability that are potentially enhanced by adding data from sources outside of an electronic health record (EHR).

The key informant interviews supplemented the environmental scan and helped fill gaps related to identifying examples of the current realities of interoperability and exchange of data across disparate systems; availability of data to facilitate interoperability; use of interoperability to facilitate decision making; and the impact of interoperability on health/health-related outcomes and processes. In addition, the key informant interviewees provided recommendations for implementing a framework that would be useful from their organizational standpoint. Eight key informant interview candidates from various types of organizations—payers, health information exchanges, integrated delivery systems, health information exchange vendors, EHR/HIE vendors, informatics, and patient advocacy groups—provided information for the report. In the key informant interviews, the interviewees discussed existing measures in which interoperability affected the process or outcome of care (e.g., access to pharmacy claims data, birth outcomes, closed loop referral). In addition, interviewees provided recommendations on measure concepts affected by interoperability (e.g., care coordination, care transitions, chronic disease management). Several interviewees expressed concern that the current interoperability environment focuses solely on the exchange of information instead of availability, use, and most importantly, impact. Respondents also stressed that the measurement of interoperability should show both the extent to which data exchange and use lead to better outcomes as well as to reduced costs. This will shift the priority from merely accessing the data to using it to improve performance and achieve cost savings.

The findings from the environmental scan, the key informant interviews, and input from a multistakeholder audience provided a strong baseline to develop a common framework and measure concepts. This framework serves as a foundation to both address the current gaps in the measurement of interoperability and help assess the impact of interoperability.

A measurement framework is a conceptual model for organizing ideas that are important to measure for a topic area and for describing how measurement should take place (i.e., whose performance should be measured, care settings where measurement is needed, when measurement should occur, or which individuals should be included in measurement). Frameworks provide a structure for organizing currently available measures, areas where gaps in measurement exist, and prioritization for future measure development. The framework must be flexible to accommodate changes in data standards, data transport mechanisms, data sources, changes in settings of care, and changes in users of these systems so that it consistently provides utility for those seeking to measure and assess the effects of interoperability and its impact on quality of care.

The objective of the interoperability measurement framework is to help meet the short- and long-term objectives of the ONC Roadmap. The Roadmap has three objectives, with the first providing an ability to send, receive, find, and use interoperable data. The use of existing quality measures that are “interoperability-sensitive” and the development of new ones that fill gaps will provide a foundation to assess that ability to use interoperability to improve outcomes and processes of care. The second objective is to enhance or develop measures that integrate data from across the care continuum and could include areas such as social services and/or population health. The third objective is to develop a learning health system, which the Roadmap defines as “an ecosystem where all stakeholders can securely, effectively and efficiently contribute, share and analyze data.”[4] Although there are various interoperability-related factors that need to be addressed (i.e., a lack of vocabulary and terminology standards, unclear policy and legal governance, lack of incentives to build interoperable systems), this measurement framework seeks to identify gaps where new measures need to be developed and identify suitable existing measures.

Guiding Principles

The Committee developed a set of guiding principles that define the key criteria to guide the development of measure concepts into performance measures. The principles provide guidelines to assist in developing the concepts to measures that adequately assess and evaluate the degree to which interoperability is taking place, in addition to ensuring that future measures advance the goals and objectives of the ONC Roadmap.

Interoperability Is More Than EHR to EHR

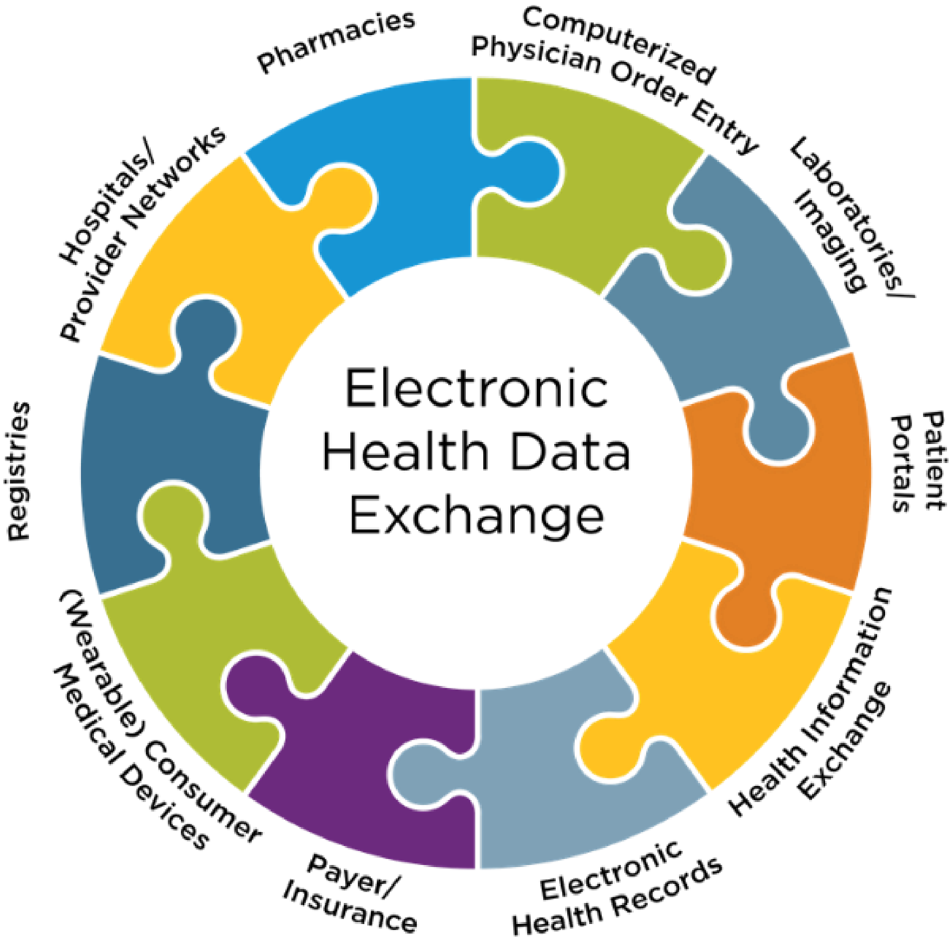
Currently, the emphasis on interoperability is moving data from one EHR system to another to advance patient care in areas such as effectiveness, patient safety, and quality. EHRs represent an individual’s patient record in a digital format. They are complex and comprehensive systems that collect information on medical histories, laboratory data, and medication data, as well as potentially assisting with billing, appointment scheduling, and referrals.[5] Because these systems serve as a significant source of patient data, the concept of interoperability often represents the exchanging of data across various EHR systems.

However, the definition of interoperability refers to the ability of a system to exchange electronic health information with and use electronic health information from other systems without special effort on the part of the user. Within the healthcare environment, various sources of patient and population data overlap in functionality with an EHR but have distinct roles and importance to the healthcare system and are critical to interoperability. A Qualified Clinical Data Registry (QCDR), for example, is population-focused and purpose driven. It is organized to collect standardized data to evaluate clinical outcomes for the specified population. Additionally, the systems meet the requirements as outlined by the Centers for Medicare & Medicaid Services (CMS) and can report quality measures to CMS for several value-based programs under the Merit-Based Incentive Payment System (MIPS). The data in these registries may come from direct data entry, through EHRs, or other data sources in which functional interoperability is essential to improve registry participation for the provider and requires limited customization to either system. Beyond registries, interoperability focuses equally on ensuring that patients, family, and caregivers have full access to view, download, and exchange their health data (often through patient portals) as well as contribute patient-generated health data to providers' EHRs. The use of mobile health devices (mHealth) have increased significantly over the past decade, with an estimated two-thirds of all individuals within the United States currently possessing a mobile device.[6] The applications for smartphone platforms exceed 200,000 and serve numerous purposes including chronic disease management, wellness and nutrition, and mental health, among others.[7] The data from these applications must be well structured and normalized to transfer from the device to an EHR. Interoperability is also a key component for research and the ability of healthcare professionals to improve results. It is a significant element to acquire data from additional sources beyond the EHR, such as clinical trial databases, practice management systems, and third-party payer databases, and can produce analysis that is reproducible and reusable. Learning health systems, such as the Precision Medicine Initiative, illustrate such interoperability among diverse systems.

Conversely, data exchanged through a fax does not fall under the definition of electronically exchanged information and is not part of this framework. These devices do not collect or analyze data, and are not functionally interoperable with other electronic data systems. It is important to use the principle of "electronically-exchanged information" with those systems capable of collecting and exchanging data electronically with other systems.

The focus of interoperability within a measurement framework must extend beyond the concept of data exchange between two EHRs into one that encompasses the diversity of data sources that capture patient and population data. Figure 1 provides an example of this.

Figure 1. The Multiple Facets of Healthcare Interoperability



Stakeholder Involvement

The use of comprehensive health data is critical to many areas in healthcare, such as quality improvement, clinical decision making, patient engagement, shared care planning, clinical and health services research, and population health analytics. A broadly accessible, interoperable system that incorporates data from various sources would potentially enable various stakeholders to participate actively in using this data. However, although the data may provide greater insight and understanding of many elements included in decision making, decisions vary based on the type of stakeholder that is involved. The impact of interoperable data affects various stakeholders in different ways, such as:

- **Patients** – An increasing body of evidence suggests the cost-effectiveness of self-care and patient engagement. Patients increasingly leverage technology platforms to access their personal data to understand their medical conditions, recommended courses of treatment, methods of self-management, and the overall price of services.[8]
- **Providers** – With the implementation of the Medicare and CHIP Reauthorization Act (MACRA), the shift to a value-based care delivery system is beginning. The use of interoperable data make

it easier for providers to make value-based decisions and deliver high-quality care by providing critical reference and decision support at the point of care.

- **Payers** – Health plans and health service companies work with communities, employers, health professionals, hospitals, and individual consumers to modernize health promotion and disease prevention initiatives that improve healthcare outcomes and lower medical care costs. The ability to gather multiple sources of data, organize and analyze it, and create actionable knowledge optimizes the decision making of both providers and patients.
- **Government** – The federal role in healthcare has expanded over recent years and is a major factor in achieving higher quality healthcare and increased value. The ability of this stakeholder to catalyze interoperability can serve as a driver for improvement in healthcare quality and value—particularly in the efforts of prevention and health promotion—and can lead to cost savings for both public and private insurance programs.

As the measurement framework is used, each of the domains should be viewed based on the stakeholder(s) it affects and what types of changes would occur based on the overall results of the measure.

Use of "Outside Data"

Interoperability is sometimes referred to as the ability of systems to gather "outside data"; that is, data that do not currently reside in the host system. The ability to acquire that data and expand the information on a patient or population within that initial system is the overall goal of interoperability. However, this concept runs counter to the definition of the term, which refers to the ability of the different information systems to exchange data accurately, effectively, and efficiently, and in a usable form. Therefore, the characterization of "outside data" only refers to the ability of a system to collect data that it currently does not possess. It does not refer to the ability to exchange data with various systems. This measurement framework discards the phrase "outside data" replaces it with the term "electronically exchanged information" which is more congruent with accepted definitions and aligns with the intent of the Shared Nationwide Interoperability Roadmap developed by ONC, which emphasizes bidirectional and multidirectional exchange among diverse information systems.

Measures developed from concepts illustrated in this report and existing "interoperability-sensitive" measures should not be developed or used based on considerations of gathering "outside data," but rather the ability to obtain and exchange data electronically with those systems providing information necessary for the measures. Although the measurement framework does not explicitly refer to the concept of information blocking, it is an obstacle to the effective exchange of information, and measures assessing its impact on the acquisition and exchange of data between systems align with many of the concepts within the framework. Measures developed for information blocking should evaluate the limits such blocking imposes on both the efficiency of data exchange and the benefits of exchange accrued by multiple stakeholders.[9]

Differences Due to Setting

Like the diverse uses of data from interoperable networks based on the stakeholders involved, the use of interoperable data also varies based on the setting. A large hospital network that relies on care teams would use interoperability to coordinate care between those caregivers involved in the patient's care. A nursing home or post-acute care setting would use interoperability to facilitate care transitions for elderly patients who move between their primary places of care to a hospital or other care settings. The uses of exchanged data vary based on both the setting and its individualized needs. As such, the importance of certain measures will depend on how specific care settings will use them. Large health systems that have implemented an EHR, exchange data with other entities, and can report metrics electronically on quality, population health, and other areas may be interested in concepts that align with usability or impact because their systems and use are mature enough to exchange and aggregate data from multiple sources.

The success of interoperability may be measured on how it is affecting the way these organizations measure health outcomes and healthcare processes. A smaller practice that has implemented an EHR may not have the same level of maturity as a larger practice. The less sophisticated organizations could measure their interoperability success on the availability of data to exchange and whether the functionality and capability exist to exchange data to and from multiple sources. The interest of smaller practices may align with concepts from either of those specific domains. Moreover, across the nation, nonclinical providers and settings are working to exchange health information electronically among diverse sectors—such as housing, jails, schools, and social services—in recognition that social and environmental determinants of health are likewise critical to better healthcare and better health outcomes. The utility of the measure concepts depends on the care setting, as well as its capability and experience with interoperability, and the measures developed for each setting should reflect that.

Various Data Types

There are a number of data types within EHRs and other healthcare systems that are important in their representation of patients and populations. Some of the data types used for community or population health come from nonclinical sources (e.g., social determinants of health data, which can derive from systems that collect and analyze data on economic stability, education, food, and physical environment). These data reside across multiple systems and in some cases, cannot be exchanged to an EHR or other clinical information system in a manner that its content and meaning are not compromised. The significance of these data is critical in both understanding and serving diverse populations with complex needs. As the use of EHRs and other systems expand beyond providing information about a single patient at the point of care to accounting for communities and populations, it is important that critical data elements are included within that analysis. Thus, as the development of measures from the measure concepts illustrated within this framework commences, an accounting of the types of data and potential methods of standardization that facilitates exchange and provides the needed information to conduct the appropriate analysis is essential.

Domains and Subdomains

After consideration of the information gathered through the environmental scan and key informant interviews, the Interoperability Committee determined that a four-domain model provided the best combination of utility, simplicity, and accuracy in identifying and covering the main components of interoperability. A domain is a categorization/grouping of high-level ideas and measure concepts that further describes the measurement framework. Along with developed high-level measurement domains, the Committee defined more in-depth subdomains that further delineate the measures and measure concepts. This model helped to frame the Committee's ideas about the measurement and evaluation of key interoperability elements. The domains and subdomains encompass both the short- and long-term goals of the ONC Roadmap.

The table below lists the domains and subdomains from the Committee:

Domain	**Subdomain**
Exchange of Electronic Health Information	• Availability of Electronic Health Information • Quality of Data Content • Method of Exchange
Usability of Exchanged Electronic Health Information	• Relevance • Comprehensibility
Application of Exchanged Electronic Health Information	• Human Use • Computable
Impact of Interoperability	• Patient Safety • Cost Savings • Productivity • Care Coordination • Improved Healthcare Processes and Health Outcomes • Patient/Caregiver Engagement • Patient/Caregiver Experience

Exchange of Electronic Health Information

The first domain focuses on the exchange of electronic health information, which creates the ability for a system to collect data it currently does not possess. A core aspect of interoperability is the availability of electronic health information when needed and the ability to move that information electronically. Without the availability of key electronic health data for key stakeholders/users to exchange information efficiently, no other aspects of interoperability are achievable. Measures in this domain revolve around how stakeholders along the care continuum can electronically send, receive, find, and use data. This domain is divided into the three subdomains: availability of electronic health information, quality of data content, and method of exchange.

Availability of Electronic Health Information

This subdomain measures the amount of healthcare data that is available and ready for electronic exchange to stakeholders/users. This would include measures and/or measure concepts addressing the ability of systems to electronically view, download, and transmit health information, who is involved in exchanging information, and addressing staff training.

Quality of Data Content

This subdomain measures the extent to which appropriate information (e.g., precision and specificity) is electronically exchanged. This includes measures and/or measure concepts addressing electronically exchanged data content that was valid, accountable, and directly related to the patient.

Method of Exchange

This subdomain measures the amount of information and in what format (i.e., structurally recognized standard) the electronic health data are being exchanged. This includes measures and/or measure concepts addressing adherence to messaging and vocabulary standards.

Usability of Exchanged Electronic Health Information

While the first domain focuses on the ability to exchange information amongst stakeholders, the second domain of usability of exchanged electronic health information focuses on the ability of the stakeholder to acquire and use the data when needed. Exchanged electronic health information should be made available to the stakeholder in a timely manner with content and format that is appropriate to support a healthcare decision. Measures and/or measure concepts in this domain serve as indicators of the degree to which the right information is available at the right time for decision making or other actions. This domain is divided into the following subdomains: relevance and comprehensibility.

Relevance

This subdomain measures the extent to which the content of the exchanged information is current, available, and meets the needs or expectations of that stakeholder to support a healthcare decision. The relevance of exchanged electronic information measured in this domain refers to clinical data. This includes measures and/or measure concepts addressing timeliness, accessibility, and clinical completeness of the data.

Comprehensibility

This subdomain measures the ability of stakeholders to understand the exchanged information. This includes measures and/or measure concepts addressing the presentation format.

Application of Exchanged Electronic Health Information

The previous domains measure the electronic exchange of data and whether the data contain the pertinent information for making health decisions. Beyond the exchange of usable data that are relevant for a clinical decision, another major objective of interoperability is to ensure effective use of exchanged electronic health information. Measures in this domain will assess whether exchanged electronic health information is used to inform, to participate directly in decision making, to participate in algorithms which support decision making, and to provide data for aggregation within and outside of EHRs for use in matters related to population health and other actions. This domain is divided into the following subdomains: human use and computable.

Human Use

This subdomain measures the human use of exchanged electronic health information including viewing, interpreting, and applying the data to decisions or other actions. This includes measures and/or measure concepts that address the extent to which the exchanged electronic health information supports clinical reasoning and decision making.

Computable

This subdomain measures the use of exchanged information for computational tasks including clinical decision support, calculation of quality metrics, and other data analytics. This includes measures and/or measure concepts addressing the level of processing that can occur due to the presence of exchanged electronic health information.

Impact of Interoperability

The fourth domain focuses on the impact of interoperability, which represents how interoperability affects the healthcare system. Measures in this domain will serve as indicators that interoperability made an impact and improved care. This domain assumes the other three domains are functioning. In other words, there is exchanged of electronic health information, usability of exchanged electronic health information, and application of exchanged electronic health information. The Committee divided this domain into seven separate subdomains: patient safety, cost savings, productivity, care coordination, improved healthcare processes and health outcomes, patient/caregiver engagement, and patient/caregiver experience.

Patient Safety

This subdomain addresses patient safety issues, which are impacted by the availability of electronically exchanged health information. This includes measures and/or measure concepts addressing adverse drug events, appropriate medication management, medication reconciliations, and cumulative radiation exposure.

Cost Savings

This subdomain addresses the ability to reduce spending and increase value that is affected by the availability of electronic health information. This includes measures and/or measure concepts addressing duplication and redundancy in labs, imaging, and other services.

Productivity

This subdomain addresses enhanced productivity that is facilitated by available exchanged electronic health information. This includes measures and/or measure concepts addressing time spent manually searching or collecting the information needed to appropriately take care of the patient (e.g., rework and waste).

Care Coordination

This subdomain addresses care coordination between different providers, different care settings, and with the patient/family/caregiver that is affected by the availability and use of electronic health information. This includes measures and/or measure concepts addressing closed loop referrals to providers, access to longitudinal care plans, and communication of patient information to another provider.

Improved Healthcare Processes and Health Outcomes

This subdomain addresses the ability for exchanged data to demonstrate a positive impact on healthcare processes and health outcomes. This includes measures and/or measure concepts addressing readmissions and appropriately recommended screenings/tests/images.

Patient/Caregiver Engagement

This subdomain addresses patients' and caregivers' access to and use of personal electronic health information and electronic health tools and their ability and desire to be active partners in their own health or the health of someone under their care. This includes measures and/or measure concepts addressing patients'/caregivers' increased electronic access to health information and impact with shared decision making, adherence to treatment, and change of health behaviors.

Patient/Caregiver Experience

This subdomain addresses patients' and caregivers' experience with their contribution to an exchange through access and use of personal electronic health information and electronic health tools (i.e., not bringing chart, sharing of data with provider, and others), as well as general satisfaction with a system that has high interoperability.

Measures and Measure Concepts

NQF worked with the Interoperability Committee to examine and develop measure concepts based on information gathered through the literature, the key informant interviews, and the individual knowledge of each of the Committee members. Additionally, NQF examined a large group of quality measures based on the topics gathered through the literature to identify those that would be "interoperability-sensitive"; that is, a quality-of-care metric designed for reporting from an EHR and capturing any potential effects of EHRs. Within this framework, there are two distinct sections that identify the measure concepts and measures.

A measure concept is an idea for a measure that includes a description of the measure, including a planned target and population. The findings from the environmental scan, the key informant interviews, and the Committee in-person meeting informed the development of measure concepts by providing insight into the key components necessary to develop new measures that objectively assess the ability for disparate data systems to exchange information and the use of the data to affect quality of care. Appendix A identifies the measure concepts with the appropriate domains and subdomains along with an estimated timeframe. The estimated timeframe states whether (1) the concepts are useful in the short-term (0-3 years); (2) the concepts will be useful in the mid-term (3-5 years); or (3) the concepts are potentially implementable in the long-term (5+ years). Given the rapid advancements in EHR systems and the goals and objectives of the ONC Roadmap, it is important to assess the applicability of measure concepts based on the current and future state of interoperability to prioritize measure development. The measure concepts contain interdependencies within their domains that affect their eventual implementation and use (e.g., you must have access to the data for exchange before appropriately evaluating usability). In developing measures from the concepts, it is important to understand the dependencies when evaluating interoperability and which domains are critically important, and which differ across stakeholders and organizations.

A measure is a fully developed metric that includes detailed specifications and may have undergone scientific testing. NQF replicates the methodology used by Kern, Pincus et al. that focused on the examination of ambulatory care quality metric sets that were sensitive to improvements in quality facilitated by healthcare interoperability. NQF expanded this methodology to include hospital-based metrics and reviewed over 600 electronic clinical quality measures, evaluating them based on data applicability, data availability, data timeliness, and data accuracy. NQF and the Committee conducted both the review and evaluation.

Appendix B shows existing measures to represent illustrative examples of the measure concepts created by the Committee. This set of measures may not be susceptible to the guiding principles, in that they cannot always deviate based on stakeholder or setting and thus may not be good, independent markers as to the progress and use of interoperable systems. Additionally, the measures themselves may be sensitive to the data captured within an EHR and other secondary systems, but may not provide a metric that discerns whether interoperability provided any benefit, or whether the benefits came from other factors, such as better data collection strategies. Thus, the measures represent examples of the measure concepts so that future measure development can adjust or expand those measures to reflect the domains and subdomains of the framework, as well as adhere to the guiding principles.

It is also important to note that ONC convened a national community of practice (CoP) addressing exchange and interoperability measurement in early 2015. A final report entitled, "Measuring Nationwide Progress: Interoperability and Exchange of Health information," documents the current state of exchange measurement in three domains: (1) capability for interoperable exchange; (2) information flow and usage of interoperable information; and (3) impacts of exchange and interoperability on improved healthcare. Additionally, the ONC report documents the types of interoperability-specific measures that are in current use, and a discussion of the cross-cutting challenges that are associated with measuring progress in exchange and interoperability.[10] These measures serve as additional examples of the measure concepts and are available in a spreadsheet online that captures the proposed measures, what area of interoperability they assess and evaluate, and how their overall usability.

The Interoperability Measurement Framework represents a significant step in advancing interoperability within a diverse set of both healthcare settings and systems. The development of the ONC Roadmap illustrated a series of short- and-long term objectives to move to national interoperability between numerous clinical and nonclinical systems. This framework provides an objective and independent assessment as to whether those objectives are reachable and what areas need improvement. The measure concepts developed through the Committee are wide reaching to cover large number of stakeholders and care settings, each of which could benefit from interoperability in both the provision of individual care as well as for populations. It is a framework that is accessible, usable now and in the future, and provides a foundation on which to advance and evaluate interoperability for years to come.

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Appendix A: List of Measure Concepts

Domain	Subdomain	Measure Concept	Estimated Timeframe
Exchange	Availability of Electronic Health Information	Were the clinical staff trained on accessing data?	Short-Term
Exchange	Availability of Electronic Health Information	Type of health information exchanged per month per patient and to what stakeholder	Short-Term
Exchange	Availability of Electronic Health Information	Relevant clinical and nonclinical care providers who could electronically view, download, and transmit health information from their own site	Short-Term
Exchange	Availability of Electronic Health Information	Picture Archiving and Communication Systems (PACS) images that were sent or accessible between electronic health record systems.	Short-Term
Exchange	Availability of Electronic Health Information	Data elements that were captured electronically but not exchanged between at least two entities	Short-Term
Exchange	Availability of Electronic Health Information	Available structured elements that were electronically exchanged per patient	Short-Term
Exchange	Availability of Electronic Health Information	Number of EHR systems generating Continuity of Care Documents (CCD) or Continuity of Care Record (CCR) to exchange	Short-Term
Exchange	Availability of Electronic Health Information	Number and type of users participating in exchange by role (i.e., doctors, nurses, care coordinators, etc.)	Short-Term
Exchange	Availability of Electronic Health Information	Number and type of users actively exchanging electronic information	Short-Term

Domain	**Subdomain**	**Measure Concept**	**Estimated Timeframe**
Exchange	Availability of Electronic Health Information	Amount of health data exchange done through application programming interfaces (APIs) conforming to nationally certified standards through the Department of Health and Human Services (HHS)	Short-Term
Exchange	Availability of Electronic Health Information	How often patient’s experience includes increased electronic access to their health information, which increases their participation in shared decision making with the clinical care team	Short-Term
Exchange	Availability of Electronic Health Information	How often patient’s experience includes increased electronic access to their health information as well as electronic tools to improve health behaviors.	Short-Term
Exchange	Quality of Data Content	Percentage of available, electronically exchanged data elements that were valid and related directly to the patient	Short-Term
Exchange	Quality of Data Content	Available, electronically exchanged data elements received from the sender that were related directly to the patient	Short-Term
Exchange	Method of Exchange	Percentage of applicable standards recommended by the US Department of Health and Human Services (DHHS) that are implemented	Short-Term
Exchange	Method of Exchange	Number of systems adopting certified messaging and vocabulary standards recommended by the U.S. Department of Health and Human Services (HHS) for diagnoses, procedures, medications, lab orders, and results	Short-Term

Domain	Subdomain	Measure Concept	Estimated Timeframe
Exchange	Method of Exchange	Number of data elements that could not be parsed or interpreted by a receiving system	Short-Term
Exchange	Method of Exchange	The use of nationally recognized standards and clinical vocabularies within a clinical environment to communicate with nonclinical systems	Long-Term
Usability	Completeness	Reduction of provider identified errors in the patient's medical record	Short-Term
Usability	Relevance	Frequency of electronically exchanged information that has been viewed	Short-Term
Usability	Relevance	Users who had an available, relevant minimum data set that were electronically exchanged for the decision/action	Short-Term
Usability	Relevance	Electronically exchanged structured elements present for a given decision/action	Mid-Term
Usability	Relevance	Number of times a complete and current medical record was accessible to a patient and a provider during a clinical encounter	Short-Term
Usability	Relevance	Amount of time a provider had to spend searching for available information	Short-Term
Usability	Relevance	Number of clicks and/or sign-ons a provider has to do when accessing available information	Short-Term
Usability	Relevance	How often information accessed by a provider was out of date	Short-Term
Usability	Relevance	Amount of provider time spent searching for information that could have been available electronically (e.g., allergies, immunizations)	Short-Term

Domain	Subdomain	Measure Concept	Estimated Timeframe
Usability	Comprehensibility	How often information was difficult to understand because of formatting	Short-Term
Usability	Comprehensibility	How often information was difficult to understand for other reasons (reasons should be defined)	Short-Term
Application	Computable	Data could not be parsed or interpreted by a receiving system	Short-Term
Application	Computable	Data could not be used by the provider or members of the care team in the provision of care	Short-Term
Application	Computable	Percentage and frequency of quality metrics generated with electronically exchanged discrete data	Short-Term
Application	Computable	Number of medication discrepancies among different medication lists (i.e., pre-admission list, home medication list, etc.)	Short-Term
Application	Human Use	Frequency of reconciliation/incorporation of electronically exchanged information	Short-Term
Application	Human Use	Frequency of electronically exchanged discrete data used in a clinical decision	Long-Term
Impact	Care Coordination	Number of longitudinal care plans that both patients and clinicians use in the delivery of care	Long-Term
Impact	Care Coordination	Number of closed loop referrals to providers	Short-Term
Impact	Cost Savings	Presence of duplicate labs/imaging	Mid-Term
Impact	Cost Savings	Number of duplicated/reduction of labs and imaging over time on provider and payer side	Mid-Term

Domain	Subdomain	Measure Concept	Estimated Timeframe
Impact	Patient/Caregiver Engagement	How often patient’s experience includes increased electronic access to their health information and electronic tools, which increases the frequency they set and track their individual health goals	Short-Term
Impact	Patient/Caregiver Engagement	How often patient’s experience includes increased electronic access to their health information and electronic tools, which increases the frequency that they review and follows their clinical care team’s instructions for treatment or care	Short-Term
Impact	Patient/Caregiver Engagement	Number of care plans that include the patient’s personal health goals, personal health concerns, and family caregivers	Mid-Term
Impact	Patient/Caregiver Engagement	Impact of patients’ use of their health information (e.g., shared decision making, medication adherence, patient activation, change of health behaviors)	Mid-Term
Impact	Patient/Caregiver Experience	Patient/caregiver satisfaction with the transfer of personal electronic health information from provider to provider	Mid-Term
Impact	Patient/Caregiver Experience	Patient/caregiver satisfaction with provider care due to provider having personal electronic health information from another provider	Mid-Term
Impact	Patient Safety	Number of instances a medication was not given for patient who came from outside healthcare facility	Mid-Term

Domain	**Subdomain**	**Measure Concept**	**Estimated Timeframe**
Impact	Patient Safety	Number of Adverse Drug Events with newly prescribed drugs where offending other drug not in prescriber’s EHR	Mid-Term
Impact	Productivity	Number of times that a look-up is done for prior outside imaging studies, lab orders, or medications, before ordering a new imaging study, labor order, or prescription	Long-Term

Appendix B: List of Existing Measures

Domain	Subdomain	Relevant Measure Concept	Existing Measure
Exchange	Availability of Electronic Health Information	Number of longitudinal care plans that both patients and clinicians have access to and use in the delivery of care	MU/ACI objective on coordination of care through patient engagement: percentage of transitions of care and referrals where the receiving provider has never encountered the patient before and requests and incorporates the patient's electronic summary of care record into the EHR
Exchange	Availability of Electronic Health Information	The patient's experience includes increased electronic access to their health information, which increases their participation in shared decision making with the clinical care team.	MU/ACI objective on coordination of care through patient engagement: Percentage of patients where patient- generated health data is incorporated into the CEHRT
Exchange	Availability of Electronic Health Information	Percentage of available, electronically exchanged data elements that were valid and related directly to the patient	MU/ACI objective on coordination of care through patient engagement: percentage of patients where data from a nonclinical setting is incorporated into the CEHRT
Exchange	Availability of Electronic Health Information	The patient's experience includes increased electronic access to their health information, which increases their participation in shared decision making with the clinical care team.	MU/ACI measure for patient access: percentage of patients (or patient authorized representatives) who are provided timely access to view online, download, and transmit his or her health information; and the patient's health information is available to access using any application of their choice that is configured to meet the technical specifications of the application programming interfaces (API) in the provider's CEHRT
Exchange	Availability of Electronic Health Information	Were the clinical staff trained on data exchange?	CPC+ Regional Learning Faculty training record for care coordination milestone

Domain	Subdomain	Relevant Measure Concept	Existing Measure
Exchange	Method of Exchange	Percentage of business agreements (BA) between trading partners to exchange data that were not completed, improperly executed, or became inactive.	Public Reporting of Direct Trust aggregated HISP statistics
Impact	Care Coordination	Number of instances a medication was not given for patient who came from outside healthcare facility	Venous thromboembolism (VTE) diagnosis and treatment: percentage of patients with any of these diagnosis—VTE, PE, DVT—indicating a complete list of medications was communicated to the next clinician of service when the patient is referred or transferred to another setting, service, practitioner, or level of care within or outside the organization
Impact	Care Coordination	Frequency of reconciliation/incorporation of electronically exchanged information	Pressure ulcer prevention and treatment protocol: percentage of patients with documentation in the medical record that communication of a transfer/discharge plan for patients with a pressure ulcer(s) took place addressing skin status and the pressure ulcer prevention plan when transferring patient care to another care provider

Domain	Subdomain	Relevant Measure Concept	Existing Measure
Impact	Care Coordination	Frequency of reconciliation/incorporation of electronically exchanged information	Oncology: percentage of patients, regardless of age, with a diagnosis of cancer who have undergone brachytherapy or external beam radiation therapy who have a treatment summary report in the chart that was communicated to physician(s) providing continuing care and to the patient within one month of completing treatment
Impact	Care Coordination	Percentage of users who had an available, relevant minimum data set that were electronically exchanged for the decision/action (completeness)	Emergency department transfer communication: percentage of patients transferred to another healthcare facility whose medical record documentation indicated that all the relevant elements were communicated to the receiving hospital within 60 minutes of discharge
Impact	Care Coordination	Percentage of available, electronically exchanged data elements that were valid and related directly to the patient	Adult depression in primary care: percentage of patients with major depression or persistent depressive disorder whose primary care records show documentation of any communication between the primary care clinician and the mental healthcare clinician
Impact	Improved Healthcare Processes and Health Outcomes	Number of medication discrepancies among different medication lists (i.e., pre-admission list, home medication list, etc.)	Use of appropriate medications for people with asthma: percentage of patients 5 to 64 years of age during the measurement year who were identified as having persistent asthma and who were appropriately dispensed medication during the measurement year

Domain	Subdomain	Relevant Measure Concept	Existing Measure
Impact	Improved Healthcare Processes and Health Outcomes	Percentage of Picture Archiving and Communication Systems (PACS) images that were sent between systems	Prostate cancer: percentage of patients, regardless of age, with a diagnosis of prostate cancer at low risk of recurrence receiving interstitial prostate brachytherapy, OR external beam radiotherapy to the prostate, OR radical prostatectomy, OR cryotherapy who did not have a bone scan performed at any time since diagnosis of prostate cancer
Impact	Improved Healthcare Processes and Health Outcomes	Number of EHR systems generating Continuity of Care Documents (CCD) or Continuity of Care Record (CCR) to exchange	Preventive services for adults: percentage of patients ages 50 to 75 years who have one or more of the following screenings: colonoscopy in past 10 years, flexible sigmoidoscopy in past five years, and fecal occult blood test (FOBT) annually
Impact	Improved Healthcare Processes and Health Outcomes	Number of EHR systems generating Continuity of Care Documents (CCD) or Continuity of Care Record (CCR) to exchange	Preventive services for adults: percentage of female patients age 45 years and older who have lipid screening every five years
Impact	Improved Healthcare Processes and Health Outcomes	The patient's experience includes increased electronic access to their health information and electronic tools, which increases the frequency they set and track their individual health goals.	Prevention and management of obesity for adults: percentage of patients with a BMI greater than or equal to 25 who received education and counseling for weight management strategies that include nutrition, physical activity, lifestyle changes, medication therapy, and/or surgical considerations

Domain	**Subdomain**	**Relevant Measure Concept**	**Existing Measure**
Impact	Improved Healthcare Processes and Health Outcomes	Impact of patients' use of their health information (e.g., shared decision making, medication adherence, patient activation, change of health behaviors)	Pressure ulcer prevention and treatment protocol: percentage of inpatients with pressure ulcer(s) whose medical record contains documentation of a comprehensive patient assessment and thorough wound evaluation.
Impact	Improved Healthcare Processes and Health Outcomes	Percentage of available relevant structured elements that were electronically exchanged per patient	Major depressive disorder (MDD): percentage of medical records of patients aged 18 years and older with a diagnosis of MDD and a specific diagnosed comorbid condition (diabetes, coronary artery disease, ischemic stroke, intracranial hemorrhage, chronic kidney disease [stages 4 or 5], ESRD or congestive heart failure) being treated by another clinician with communication to the clinician treating the comorbid condition
Impact	Improved Healthcare Processes and Health Outcomes	Type of health information exchanged per month per patient and to what stakeholder	Lipid management in adults: percentage of patients with established atherosclerotic cardiovascular disease (ASCVD), or 10-year CHD risk greater than or equal to 10%, or diabetes and on lipid-lowering medication who have a fasting lipid panel within 24 months of medication prescription

Domain	Subdomain	Relevant Measure Concept	Existing Measure
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of electronically exchanged discrete data used in a clinical decision	Lipid management in adults: percentage of patients with established ASCVD, or a 10-year CHD risk greater than or equal to 10%, or diabetes on lipid-lowering medication and most recent LDL greater than 100 mg/dL, who are prescribed a maximal recommended dose of a potent statin (such as simvastatin, pitavastatin, rosuvastatin, or atorvastatin)
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of electronically exchanged discrete data used in a clinical decision	Heart failure: percentage of patients aged 18 years and older with a diagnosis of heart failure with a current or prior LVEF less than 40% who were prescribed beta-blocker therapy either within a 12-month period when seen in the outpatient setting or at each hospital discharge
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of reconciliation/incorporation of electronically exchanged information	Heart failure: percentage of patients aged 18 years and older with a diagnosis of heart failure with a current or prior left LVEF less than 40% who were prescribed ACE inhibitor or ARB therapy either within a 12-month period when seen in the outpatient setting or at each hospital discharge
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of electronically exchanged discrete data used in a clinical decision	Heart failure in adults: percentage of patients with heart failure diagnosis who have a follow-up appointment with their primary care clinician within seven days of hospital discharge

Domain	**Subdomain**	**Relevant Measure Concept**	**Existing Measure**
Impact	Improved Healthcare Processes and Health Outcomes	Percentage of Picture Archiving and Communication Systems (PACS) images that were sent between systems	Diagnostic imaging: percentage of patients undergoing a screening mammogram whose information is entered into a reminder system with a target due date for the next mammogram
Impact	Improved Healthcare Processes and Health Outcomes	Percentage of Picture Archiving and Communication Systems (PACS) images that were sent between systems	Diagnostic imaging: percentage of imaging studies for patients aged 18 years and older with shoulder pain undergoing shoulder MRI, MRA, or a shoulder ultrasound who are known to have had shoulder radiographs performed within the preceding 3 months based on information from the radiology information system (RIS), patient-provided radiological history, or other healthcare source
Impact	Improved Healthcare Processes and Health Outcomes	Percentage of users who had an available, relevant minimum data set that were electronically exchanged for the decision/action (completeness)	Diagnosis and management of chronic obstructive pulmonary disease (COPD): percentage of COPD patients who require hospital admission/readmission for COPD-related exacerbations in one month
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of reconciliation/incorporation of electronically exchanged information	Comprehensive adult diabetes care: percentage of patients 18 to 75 years of age with type 1 or type 2 diabetes who had an eye exam (retinal) performed
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of reconciliation/incorporation of electronically exchanged information	Care for older adults: percentage of adults 66 years and older who had a medication review during the measurement year

Domain	Subdomain	Relevant Measure Concept	Existing Measure
Impact	Improved Healthcare Processes and Health Outcomes	Percentage, frequency of electronically exchanged information that has been viewed	Cardiac care: percentage of patients with early complications after permanent pacemaker (PP) implantation
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of reconciliation/incorporation of electronically exchanged information	Cancer screening: percentage of women aged 51 to 74 years who have had at least one mammogram performed during the measurement year or the year prior to the measurement year
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of reconciliation/incorporation of electronically exchanged information	Cancer screening: percentage of individuals aged 50 to 74 years who had a fecal occult blood test (FOBT) performed during the measurement year or a colonoscopy during the previous nine years (including the measurement year)
Impact	Improved Healthcare Processes and Health Outcomes	Frequency of reconciliation/incorporation of electronically exchanged information	Breast cancer: percentage of patients who made progress toward goals by the end of the 12-month period after completing the final component of the treatment plan
Impact	Improved Healthcare Processes and Health Outcomes	Percentage, frequency of electronically exchanged information that has been viewed	Breast cancer: percentage of patients who had documentation of follow-up care (recommendations) during the 12-month period after completing the final component of the treatment plan for breast imaging, coordination of care, LVEF assessment, and pelvic exam

Domain	Subdomain	Relevant Measure Concept	Existing Measure
Impact	Improved Healthcare Processes and Health Outcomes	Type of health information exchanged per month per patient and to what stakeholder	All-cause readmissions: the number of acute inpatient stays during the measurement year that were followed by an acute readmission for any diagnosis within 30 days and the predicted probability of an acute readmission, for patients 18 years of age and older
Impact	Patient Safety	Percentage of times that a look-up is done for prior outside imaging studies before ordering a new imaging study	Search for Prior Computed Tomography (CT) Studies through a Secure, Authorized, Media-free, Shared Archive
Impact	Patient Safety	Number of Adverse Drug Events with newly prescribed drugs where offending other drug not in prescriber's EHR	Potentially harmful drug-disease interactions in the elderly: percentage of Medicare patients 65 years of age and older who have evidence of an underlying disease, condition, or health concern and who were dispensed an ambulatory prescription for a potentially harmful medication, concurrent with or after the diagnosis
Impact	Patient Safety	Number of medication discrepancies among different medication lists (i.e., pre-admission list, home medication list, etc.)	Medication reconciliation post-discharge: percentage of discharges from January 1 to December 1 of the measurement year for patients 66 years of age and older for whom medications were reconciled on or within 30 days of discharge
Impact	Patient Safety	Percentage of times that a look-up is done for prior outside imaging studies before ordering a new imaging study	Computed Tomography (CT) images available for patient follow-up and comparison purpose

Appendix C: Interoperability Committee Roster and NQF Staff

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