NATIONAL QUALITY FORUM

Recommended Common Data Types and Prioritized Performance Measures for Electronic Healthcare Information Systems

Foreword

Quality improvement leaders have long recognized the need for the widespread adoption of health information technology to accurately measure clinical quality, but, to date, most of the electronic health information readily available for quality measurement has been administrative, claims-based data, which include only limited clinical information. Conducting manual chart abstraction for additional clinical information is a heavy burden for healthcare providers. The lack of a set of precisely defined, universally adopted electronic measure definitions is an obstacle to automating measurement and comparing quality using electronic health information. To automatically compare performance nationally, all quality indicators need to measure the same concepts and speak the same technical language.

The National Quality Forum (NQF) Health Information Technology Expert Panel (HITEP) was charged with establishing a priority order for the current sets of AQA Alliance- and Hospital Quality Alliance-approved measures; identifying common data types from the subset of highest priority measures to be standardized for automation in electronic health records (EHRs) and health information exchanges; and developing an overarching quality measure development framework to facilitate developing, using, and reporting on quality measures from EHR systems. In this report, the panel presents its key recommendations to help provide a common road map for addressing gaps and for moving forward.

The technical and organizational approach described in this report should help define the common data quality types needed for EHR quality measurement and assist in the transition of quality measurement to EHRs.

NQF thanks HITEP for its work in helping to envision the EHR platform required for performance measurement in the future.

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Executive Summary

As described in the Institute of Medicine's (IOM's) *Crossing the Quality Chasm* report, the quality of healthcare in the United States is substantially lacking in many pivotal areas. Complex care is typically uncoordinated, and important information is frequently unavailable when needed by providers. Consequently, unexplained variations in the delivery of healthcare and the underuse, overuse, and misuse of healthcare products and services pervade the system, compromising the quality of American medicine and jeopardizing the health of its recipients.

Measuring quality is a first step toward improving American healthcare. Currently, however, collecting and reporting accurate, comparative healthcare performance data is complex and largely a time-consuming, manual process. Quality improvement leaders have long recognized that the widespread adoption of health information technology (HIT) will automate and simplify these processes by providing electronic information. Yet, to date, most of the electronic health information readily available for quality measurement has been administrative, claims-based data, which include only limited clinical information.

Electronic health record (EHR) systems have been identified as a fundamental HIT tool for collecting high-quality electronic clinical information. The federal government and private sector leaders have increased efforts to expedite and encourage the widespread adoption

of HIT by healthcare providers; yet significant barriers prevent the collection of needed quality information within the EHR. To compare performance nationally, all quality indicators need to measure the same concepts and speak the same language in order to consistently and reliably measure quality. Although there is no dearth of HIT standards, such standards do not exist when defining quality metrics (e.g., the definition of diabetes may be interpreted differently by different institutions). This lack of a set of precisely defined, universally adopted clinical definitions is an obstacle to measuring and comparing quality.

To address the need for standardization of healthcare quality measurement, the American Health Information Community (AHIC), an advisory committee to the Secretary of the Department of Health and Human Services (DHHS), established a Quality Workgroup to define how HIT can evolve to effectively support performance measurement. The workgroup recommended that an HIT expert panel be convened in order to accelerate ongoing efforts in this standardization process. The National Quality Forum (NQF) was commissioned by the Agency for Healthcare Research and Quality (AHRQ) to assemble and convene the expert panel and to provide a detailed account of its conclusions and recommendations. The NQF Health Information Technology Expert Panel (HITEP) members (Appendix A) were selected to ensure broad representation across the fields of quality measurement and HIT and of EHR vendors, health systems, and government organizations.

With the goal of achieving automated quality measurement, the panel was charged with the following tasks:

1. establish a *priority order* for the current sets of AQA Alliance- and Hospital Quality Alliance-approved measures;
2. identify *common data types* from the subset of highest priority measures to be standardized for automation in EHRs and health information exchanges; and
3. develop an overarching quality *measure development framework* to facilitate developing, using, and reporting on quality measures from EHR systems.

To prioritize measures for immediate attention, the panel used the IOM's priority conditions. Next, the panel identified the common data types (e.g., outpatient diagnosis, laboratory result, medication order) required by these high-priority measures. The panel then developed a set of criteria (e.g., level of data standardization, accuracy of data source) to assess the quality of each data type as it currently exists in EHRs. Each data type received a summary quality score from these criteria. Because measures are composed of numerous data types, the panel calculated overall scores for each measure as the average quality of its individual data types. This overall measure score can be used to assess a measure's readiness for EHR implementation and to focus efforts to improve (or replace) low-scoring measures and low-scoring data types. Although the work of HITEP was to establish an initial prioritization of measures and their associated data types, further data types should be identified as additional priorities and measures are developed.

A key product of the HITEP meetings, a list of common data types (i.e., diagnoses, laboratories, medications), was submitted to the Health Information Technology Standards Panel (HITSP) for the selection of standard terminologies, or code sets (i.e., ICD-9, LOINC, SNOMED), to express these data types. These computerized terminologies, identified in the HITSP Quality Interoperability Specification version 1.0, will support efforts for universal adoption of standardized performance measures in EHRs. Active engagement of standard development organizations by HITSP will aid in closing the gap between the quality and information technology enterprises. Additional recommendations for EHR functionality will be submitted to the Certification Commission for Healthcare Information Technology (CCHIT) for consideration in future certification criteria.

HITEP identified three broad requirements to improve the quality measurement information technology enterprise and suggested recommendations to CCHIT, HITSP, measure development organizations (MDOs), NQF, EHR vendors, and the HL7 EHR Technical Committee. First, quality measures should be designed to leverage the capabilities of EHRs. MDOs and NQF should work together to reinforce the use of high-quality data types during measure development and endorsement of measures into consensus national standards. Second, standard terminologies should be identified to code the common data types used in quality measure definitions. Finally, quality measure clinical information should be accurately captured in EHRs. Quality and information technology stakeholders should work with EHR vendors to develop functional criteria for software needed to capture the common data required for quality measurement. Key recommendations from the panel included the following:

1. NQF should evaluate the quality of data types used in measure specifications as a criterion in the endorsement of new measures, as well as in the reassessment of measures for continued endorsement.
2. A coded, interdisciplinary clinical problem list in the EHR should be used in place of billing codes to identify patient conditions, inclusion diagnoses, and exclusion diagnoses for quality measurement. It is further recommended that this problem list be accessible and utilized across care settings (e.g., inpatient, outpatient, long-term care facilities).
3. NQF should work with HITSP to develop a "reader's digest" version of a data dictionary for use by measure developers that would contain the HITEP data types and their corresponding HITSP-recommended code sets.
4. Medication allergies and side effects should be distinguished from one another and entered using standardized codes.
5. Standardized codes for summary impressions of diagnostic test results should be developed, where feasible. Quantitative results, when available, should accompany qualitative results of diagnostic studies.
6. EHR vendors should develop methods of presenting EHR medication data with external medication data from pharmacies and pharmacy networks to help providers assess patients' adherence to medication treatment plans.

7. Quality and information technology stakeholders should work together to define additional EHR functional requirements that support quality measurement.

Although many stakeholders agree on the need to transition the healthcare quality measurement enterprise toward EHRs, there has been no common road map for moving forward. There will clearly be a transition period, with reliance on clinically enriched claims data as a path toward quality measurement built on EHRs. This initial HITEP work focused on envisioning the EHR platform required for performance measurement in the future. The technical and organizational approach described in this report should assist in the transition of quality measurement to EHRs. HITEP's work provides important building blocks for this effort, including the common data quality types needed for quality measurement and a new method to assess data quality that should help the movement toward a more rational approach to measure development and endorsement.

Recommended Common Data Types and Prioritized Performance Measures for Electronic Healthcare Information Systems

Introduction

As described in the Institute of Medicine's (IOM's) *Crossing the Quality Chasm* report, the quality of healthcare in the United States is substantially lacking in many pivotal areas. Complex care is typically uncoordinated, and important information is frequently unavailable when needed by providers. Consequently, unexplained variations in the delivery of healthcare and the underuse, overuse, and misuse of healthcare products and services pervade the system, compromising the quality of American medicine and jeopardizing the health of its recipients.[1,2]

Measuring quality is a first step toward improving American healthcare. Currently, however, collecting and reporting accurate, comparative healthcare performance data is complex and largely a time-consuming, manual process. Quality improvement leaders have long recognized that the widespread adoption of health information technology (HIT)[3] could potentially automate and simplify these processes by providing electronic information.[4,5,6] To date, most of the

[1] Institute of Medicine (IOM), *Crossing the Quality Chasm: A New Health System for the 21st Century,* Washington, DC: National Academy Press; 2001.

[2] Agency for Healthcare Research and Quality, *Improving Healthcare Quality Fact Sheet.* Available at www.ahrq.gov/consumer/qntlite. Last accessed June 2007.

[3] HIT is used to manage and exchange patient health information electronically.

[4] National Quality Forum (NQF), *Information Technology and Healthcare Quality: A National Summit,* Washington, DC: NQF; 2003.

[5] IOM, *Fostering Rapid Advances in Health Care: Learning from System Demonstrations,* Washington, DC: National Academies Press; 2002.

[6] National Committee on Vital and Health Statistics, *Information for Health: A Strategy for Building the National Health Information Infrastructure,* Washington, DC: Department of Health and Human Services; 2001.

electronic health information readily available for quality measurement has been administrative, claims-based data. Recent quality improvement initiatives from the AQA Alliance and Hospital Quality Alliance (HQA) have included claims-based measures. However, most experts agree that clinical performance is more accurately characterized by clinical information, which is rarely available in electronic format.

Electronic health record (EHR) systems[7] have been identified as a fundamental HIT tool for collecting high-quality electronic clinical information. The federal government and private sector leaders have increased efforts to expedite and encourage the widespread adoption of HIT by healthcare providers; yet significant barriers prevent the collection of needed quality information within the EHR. To compare performance nationally, all quality indicators need to measure the same concepts and speak the same language in order to consistently and reliably measure quality. Although there are coding standards for many clinical data, consistent definitions for which data elements should be used in calculating quality measures do not exist (e.g., the definition of diabetes may be interpreted differently by different institutions). The lack of a set of precisely defined, universally adopted clinical definitions is an obstacle to measuring and comparing quality.

To address the need for standardization of healthcare quality measurement, the American Health Information Community (AHIC), an advisory committee to the Secretary of the Department of Health and Human Services (DHHS), established a Quality Workgroup to define how HIT can evolve to effectively support performance measurement. The workgroup recommended that a HIT expert panel be convened in order to accelerate ongoing efforts in this standardization process. The National Quality Forum (NQF) was commissioned by the Agency for Healthcare Research and Quality (AHRQ) to assemble and convene the expert panel and to provide a detailed account of its conclusions and recommendations.

The NQF Health Information Technology Expert Panel (HITEP) members were selected to ensure broad representation across the fields of quality measurement and HIT and of EHR vendors, health systems, and government organizations (Appendix A). With the goal of achieving automated quality measurement, the panel was charged with the following tasks:

1. establish a *priority order* for the current sets of AQA Alliance- and HQA-approved measures;
2. identify *common data types* from the subset of highest priority measures to be standardized for automation in EHR and health information exchanges; and
3. develop an overarching quality *measure development framework* to facilitate developing, using, and reporting on quality measures from EHR systems.

[7] Although definitions vary for electronic health records and electronic medical records (EHRs and EMRs), depending on the source, the framework discussed in this report applies to all electronic record systems of longitudinal patient health information. This report refers to this broader definition of systems as an EHR.

This final report is organized into three sections, with supporting appendices. The first section summarizes HITEP's major work, with detailed analysis and discussion of the following areas: the priority order used for measure selection, the common data categories and types, the quality score for common data types, the prioritization framework for measure quality, the identification of high- and low-yield common data types, and an organization analysis for moving forward in the quality domain. The second section focuses on recommendations from the panel for a wide variety of potential users of the report, including the Health Information Technology Standards Panel (HITSP),[8] the Certification Commission for Health Information Technology (CCHIT),[9] EHR vendors, quality measure developers, and NQF. The final section focuses on the potential for future work for HITEP.

Expert Panel Analysis

Priority Order for Measure Selection

The panel began by identifying high-priority conditions and associated AQA Alliance and HQA quality measures. The clinical importance of the health conditions served as the initial lens through which the panel assessed these measures. The IOM criteria for prioritization of clinical conditions were applied as a filter to the full list of more than 100 AQA Alliance and HQA measures. These criteria include:

1. **impact:** the magnitude of the individual and societal burden imposed by a clinical condition, including disability, mortality, and economic costs;
2. **improvability:** the extent of the gap between current and evidence-based best practices, and the likelihood that the gap can be closed and conditions improved through changes in clinical processes, as well as the opportunity to achieve improvements in the six IOM quality aims;[10] and;
3. **inclusiveness:** the relevance of a condition to a broad range of individuals with regard to a) age, gender, socioeconomic status, and race/ethnicity; b) the generalizability of associated quality improvement strategies across the spectrum of healthcare conditions; and c) the capacity for change across a range of healthcare settings and providers.

Through the application of these criteria, IOM identified 20 healthcare areas upon which national quality improvement efforts should be focused: care coordination (cross-cutting), self-management/health literacy (cross-cutting), asthma, evidence-based cancer screening (focusing on colorectal and cervical cancers), children with special healthcare needs, diabetes, end-of-life care (focusing on congestive heart failure and chronic obstructive pulmonary disease), frailty associated with old age (i.e., preventing falls and pressure ulcers), hypertension,

[8] HITSP is a cooperative partnership between the public and private sectors for the purpose of achieving a widely accepted set of performance standards to enable widespread interoperability among healthcare software applications.

[9] CCHIT was created by the DHHS Office of the National Coordinator for HIT (ONCHIT) to oversee private sector certification of HIT products.

[10] IOM's six quality aims are that healthcare should be safe, effective, patient centered, efficient, equitable, and timely.

immunization, ischemic heart disease, major depression, medication management, nosocomial infections, pain control in advanced cancer, pregnancy and childbirth, severe and persistent mental illness, stroke, tobacco dependence treatment, and obesity.[11]

The AQA Alliance and HQA measures were categorized by both the IOM priority conditions and by NOF-endorsement status into three tiers (Table 1).

The panel unanimously approved this measure prioritization scheme and further agreed to limit initial EHR data type identification to three clusters within the first tier: diabetes, ischemic heart disease (coronary artery disease, acute myocardial infarction, and heart failure), and medication management. Of note, these three clusters represented nearly half of the AQA Alliance and HQA measures. At the second meeting, analysis was completed on all 84 first-tier, high-priority measures (Appendix B). This prioritization schema was used to set the framework for the current HITEP efforts. The NQF-convened National Priorities Partnership will conduct further work on national priorities and goal setting.

Common Data Categories and Types

To incorporate these measures into EHRs, measures must be encoded using standard code sets. Before these standards can be proposed, the panel's first step was to identify common types of information contained in the 84 high-priority measures. Measure specifications were collected and entered into a database, including numerator, denominator, and exclusion criteria, as well as the logic, or algorithm, required to calculate the measure. Each numerator, denominator, and exclusion was divided into broad data *categories* (e.g., laboratories, diagnoses, medications) and then into more specific data *types* (e.g., laboratory result, laboratory order). At a more detailed level, measures are composed of specific *elements* (e.g., laboratory result of *cholesterol*, diagnosis of *diabetes*); however, it was beyond the scope of the panel's charge and limited time to enumerate all these individual data elements. Therefore, the panel identified broad data *categories* and *types* that are common in all measures. The panel identified 11 categories and 38 types directly from the AQA Alliance/HQA measures, each accompanied by a date/time stamp—that is, the date and

Table 1—Prioritization Tiers for AQA Alliance and HQA Measures

MEASURE PRIORITY TIER	NQF ENDORSED®	IOM PRIORITY CONDITION
First *(highest)*	●	●
Second	●	
Third		

[11] IOM, *Priority Areas for National Action: Transforming Health Care Quality,* Washington, DC: National Academies Press; 2003.

time the element was recorded. These categories and types were submitted to HITSP, which recommended standardized terminologies in its Interoperability Specifications for Quality version 1.0.[12]

The panel proposed three additional data types (not found in the measure set) required to assess disparities, including patient ethnicity/race, language, and payment source. The need for these patient demographics and for identifying the patient's primary care provider raised the important issue of the dividing line between practice management systems and overall EHR systems. Although these data may exist in the practice management systems, they may or may not be incorporated into EHRs. The final list included 11 categories and 38 data types (Table 2).

Table 2—Categories and Types of Data Common to High-Priority AQA Alliance/HQA Measures

DATA CATEGORY	DATA TYPES	
Adverse Drug Event	allergy	intolerance
Communication	provider-provider	provider-patient
Diagnostic Study	order	result
Diagnosis	outpatient (billing) outpatient (problem list)	inpatient
History	behavioral (smoking) birth care classification (CMO[13]) death enrollment trial ethnicity/race	language payment source primary care provider sex symptoms
Laboratory	order	result
Location	source/current/target	transfer type
Medication	discontinue order inpatient administered inpatient order	outpatient duration outpatient order outpatient order filled
Opt-out	other reason	
Physical Exam	vitals (blood pressure)	
Procedure	inpatient end inpatient start order	outpatient past history consult result

[12] HITSP Interoperability Specifications for Quality, "IS 06." Available at www.hitsp.org.

[13] Comfort Measures Only: care classification focusing on providing care, interventions, and medications that are focused on symptom management, often near the end of life.

Quality Score for Common Data Types

These data types vary in their quality and availability in EHRs. The panel proposed a framework to assess the quality of each data type as it currently exists in EHRs. This framework is an important and new dimension through which to examine the electronic data required for quality measurement. Specifically, the data quality framework provided an initial assessment of the availability and quality of a given data type, as well as the validity and reliability of data stored and retrievable from EHR systems. The panel proposed that these quality criteria be measured using a five-point scale, weighted to account for qualitative differences in their perceived importance to data quality (Table 3).

The authority and accuracy of data are often inter-related (e.g., laboratory results coming from a laboratory interface are both authoritative and accurate). Although there are examples of data from an authoritative source (e.g., clinician) that are not always accurate (e.g., subjective historical findings) and vice versa, both authority and accuracy were considered in aggregate because they both assess the soundness of the data source. For data sources with low authority or accuracy, efforts can be made to identify and improve these characteristics.

Identifying data standards and gaps, where there are no existing standards, is a critical step toward the end goal of interoperable and comparable quality measurement across settings and time. For data types with multiple standards or without an existing standard, HITSP can recommend optimal standards and identify the need for new standards by standard development organizations.

In order for quality data to be recorded at the point of care by authoritative sources, they need to fit into the clinical workflow. For example, it is of little benefit to have the capability of capturing certain patient symptoms if recording the data requires five clicks and three screens during

Table 3—Evaluation Criteria for Common Data Types[a]

DATA QUALITY CRITERIA	DESCRIPTION	SCALE	WEIGHT
Authoritative/Accurate Source	Is the entry in the EHR from an authoritative data source? What is the accuracy of the data element in EHRs?	1-5	5
Data Standards	Is the data element coded in a structured format using a nationally accepted terminology standard?	1-5	5
Workflow Fit	Does capture of the data element by the most appropriate healthcare professional fit the typical EHR workflow for that user?	1-5	4
Availability in EHRs	Is the data element currently available within EHRs?	1-5	4
Auditable	Can the data be tracked over time to assess accuracy?	1-5	2

[a] The data quality scores (Appendix C) are weighted sums of the individual criterion. For example, if a data type was scored 4, 5, 3, 3, and 3 for authority/accuracy of source, data standards, workflow fit, availability in EHRs, and auditable, respectively, the quality score would be (4*5) + (5*5) + (3*4) + (3*4) + (3*2) = 75. The maximum quality score is 100.

a busy clinical encounter, because the end result likely will be missing data. For data types that do not fit smoothly into the clinical workflow, vendors can improve their software to allow for their easy capture.

The availability of data in an EHR can help triage measures that are more appropriate for immediate implementation in an EHR. Measure developers may choose to construct future measures with readily available data or signal to the vendor community when critical data types should be made available in the EHR. Finally, the degree to which data types can be audited provides transparency for EHR public reporting or accreditation.

The panel achieved consensus regarding the data type quality framework and the weighting scheme. When assigning data quality scores to each of the data elements, the panel assumed that it was dealing with a comprehensive EHR system that was being used effectively by its clinical users. There was additional agreement that the patient should be included as an authoritative data source for certain aspects of care related to symptoms and medication usage. When the only source of clinical data is historical, the EHR should have the capability of capturing these data with an attribute of "patient reported." There was general agreement on the subjective data quality scores from the broad stakeholder representatives of HITEP. Appendix C displays the data types and their weighted quality scores calculated from Table 3.

The panel chose these criteria to provide an initial assessment of the soundness of each quality data type. The development and implementation of measures with data types of high quality are encouraged. However, the interpretation of low quality scores is subjective. The low-quality data scores should serve as an indicator for further discussion. For example, the panel agreed that the low-quality "diagnosis-outpatient (billing)" data should be replaced with the higher-quality "diagnosis-outpatient (problem list)," with respective scores of 47/100 and 82/100. Conversely, the data type "diagnostic study-result," for example, left-ventricular ejection fraction, scored low, yet is both clinically critical to key heart failure measures and is not available from a higher-quality data type; therefore, efforts should be focused on improving the quality of this data type.

Prioritization Framework for Measure Quality

The data quality of a measure is a function of the quality of its individual data types (Table 2) and their respective sources. The quality of each measure was defined as the average data quality score for the individual data types required by the measure. To assess this cumulative measure quality, a matrix was constructed to identify the numerator, denominator, and exclusion data types for the 84 measures (Appendix D). The measures (vertical axis) are sorted by their average quality score, and the data types (horizontal axis) are sorted by data quality score. Additionally, the matrix displays the frequency with which individual data types are utilized in the set of 84 measures.

Of note, measures designed for the ambulatory setting may contain inpatient data types. For example, in the diabetes measures, the denominator includes "patients who had two face-to-face encounters with different dates of service in an ambulatory setting or non-acute inpatient setting, or one face-to-face encounter in an acute inpatient or emergency room setting during the measurement year with a diagnosis of diabetes." This example highlights the inherent (and often requisite) complexity of quality measure data requirements.

Measures with high quality scores are ready for EHR implementation. Measures with low quality scores should be targets for one of the following:

a. modification to replace low-quality data types with higher-quality data types;
b. improvement of the existing low-quality data types (e.g., left ventricular ejection fraction); or
c. retirement or replacement with a more appropriate, high-quality measure.

Measure developers are encouraged to utilize high-quality data types. For example, "laboratory-result" is a high-quality data type with a score of 91/100, yet it is used in only 13 percent of these 84 high-priority measures. This discrepancy is a consequence of past measures utilizing claims data, in which laboratory results often are not available. This highlights the need for a transition strategy to move from measures that rely exclusively on claims data, to measures that enrich the claims data with clinical data, to the final state of measures that rely heavily on clinical data from EHRs.

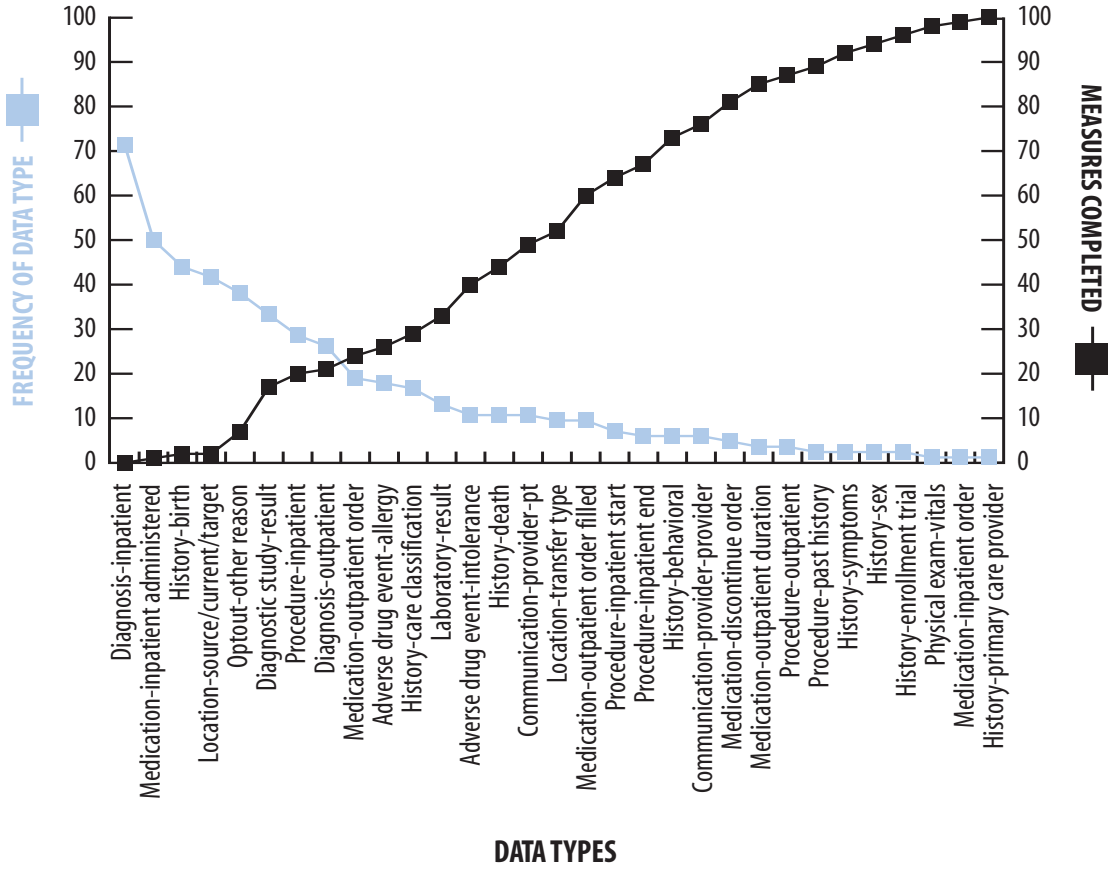
Identification of High- and Low-Yield Common Data Types

Each of the 84 high-priority measures is composed of a subset of 38 data types. To identify whether particular data types have been used more frequently and thus represent a potential target for further adoption, Pareto curves were constructed. For the Pareto analysis, the 38 data types were sorted according to their frequency of use in all of the 84 measures. Beginning with the most frequently used data type, and progressing through each data type, the percentage of measures that could be calculated was calculated with the addition of each data type. A measure can be calculated only if all of its data types are provided. See Figure 1.

The Pareto analyses demonstrated that there is currently no "80/20 rule" for a parsimonious collection of data types. The committee discussed the potential advantage of leveraging high-quality data types derived from EHRs in the future. Such a strategy would not only lead to more accurate and reliable comparative quality measures, but also would reuse data types that are efficiently captured in EHRs as a byproduct of care. To identify the relative influence of data types on exclusion criteria, a second Pareto curve was calculated using exclusion criteria only. See Figure 2.

There was a robust discussion of the issues related to measure exclusions. Although the purpose of exclusions is to avoid penalizing an individual's performance score, when in fact a guideline recommendation is not clinically appropriate for an individual patient, the opportunity costs

Figure 1 – Pareto Analysis of Data Types in Numerator, Denominator, and Exclusion Criteria

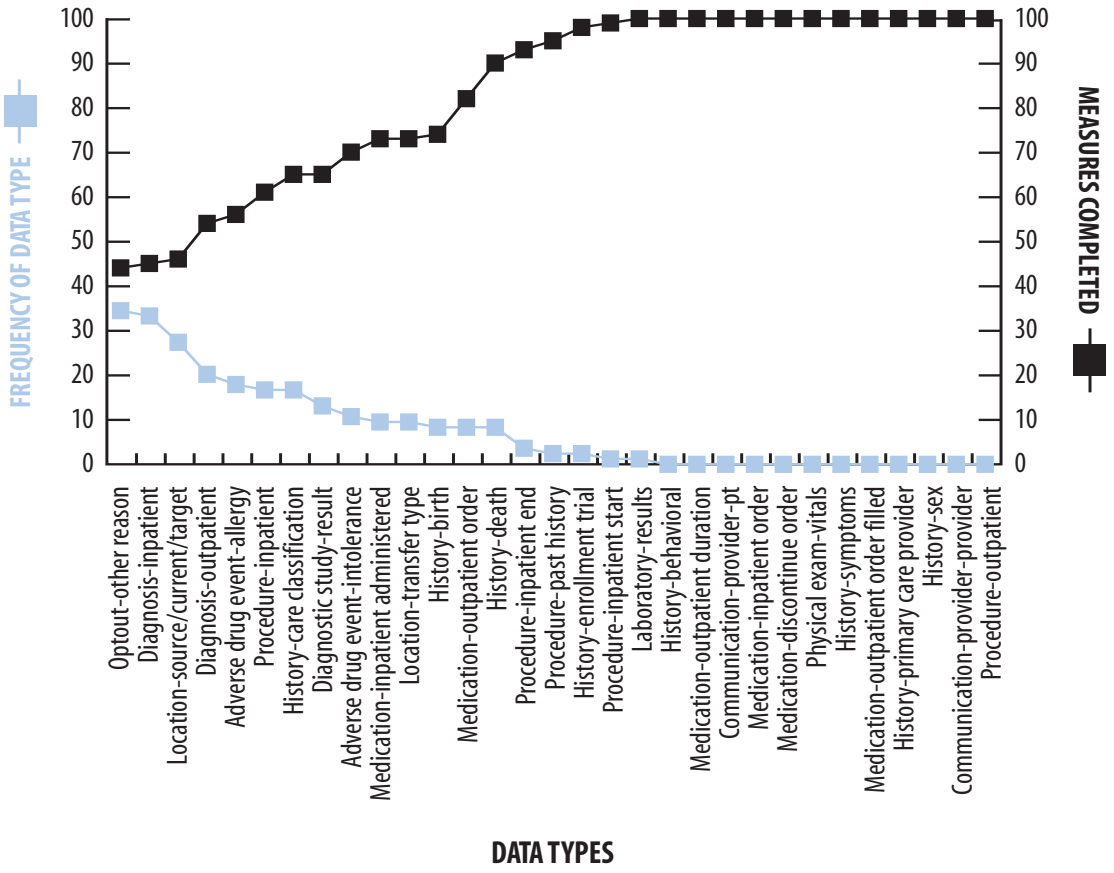


of acquiring the exclusion data should be considered. There were questions about how this approach to exclusions could be operationalized. A suggestion was made that measure developers could specifically assess the additive impact and burden of additional exclusions. At Caregroup in Boston, a committee decides whether to add a data element based on the following:

1. **Impact Factor:** how many doctors, patients, and staff will be affected?
2. **Quality/Compliance:** will it improve quality or is it required for compliance?
3. **Return on Investment:** will it generate more revenue/reduce costs?
4. **Workflow:** what is the impact on workflow (i.e., the time-cost of data collection stakeholders)?

Discussion ensued regarding the role of statistical performance adjustment, rather than exclusions, as a reasonable approach to risk adjustment. The current approach of

Figure 2 – Pareto Analysis of Data Types in Exclusion Criteria Only



many measures that use broad exclusion categories also was discussed, with concern expressed that there was no mechanism to electronically audit the exclusions at this time. Ultimately, the panel recommended that measure developers conduct sensitivity analyses to ensure that each exclusion criterion's contribution to the quality score is commensurate with the number of patients affected and the costs of acquiring the information. The addition of each exclusion criterion increases the administrative burden of collecting, calculating, and auditing quality measures. There was consensus that NQF should work with measure developers to limit exclusions, where possible, to make them more appropriate for inclusion in EHRs.

Quality Domain Organizational Analysis

HITEP discussed the importance of delineating the roles of the various entities involved with quality measurement and HIT to ensure coordination of efforts and

alignment of goals and objectives. The panel analyzed organizational roles and the critical interfaces and connections that would be required to advance performance measurement within EHRs.

The panel discussed the role of guideline developers and their relation to specialty societies and measure developers. There was a discussion of the need to influence "upstream" guideline and measure development processes, so that measures being submitted for NQF endorsement meet the criteria set to increase the comparative value of quality scores and minimize the effort required to acquire and report out the quality scores in an EHR. This would be an important consideration for those who gather evidence for clinical guidelines and decision support systems.

The payers, both public and private, influence the process through reporting mechanisms that influence their payment. There also was discussion of the role of the American Medical Association/National Committee for Quality Assurance/EHR Vendors Association Collaborative. The current work of the collaborative focuses on a standard approach to implementing and updating quality measures in EHRs. CCHIT certification plays an important ongoing role by influencing EHR functionality. The certification criteria become more comprehensive each year. Finally, there was discussion of the panel's potential leverage points.

Expert Panel Recommendations

Based upon its discussion and deliberations, HITEP identified three broad gaps and requirements in the quality measurement information technology enterprise and suggested eight recommendations to CCHIT, HITSP, measure development organizations, NQF, EHR vendors, and the HL7 EHR Technical Committee.

GAP: Quality measurement specifications are not designed to leverage EHR systems.

RECOMMENDATION 1. NQF should evaluate the quality of data types used in measure specifications as a criterion in the endorsement of new measures, as well as in reassessment of measures for continued endorsement.

NQF should encourage the use of high-quality data elements for newly submitted measures and gradually retire endorsed measures that rely on poor-quality data elements (e.g., reliance on billing data for diagnosis codes). Through its Consensus Development Process, NQF could require sensitivity analyses that would examine the marginal benefit of additional exclusions. This analysis could assess both the complexity of the submitted measure as well as the costs/benefits to the exclusion and inclusion criteria. NQF will work with measure developers to determine how these sensitivity analyses can be performed at the time of measure submission.

GAP: Quality measurement specifications rely heavily on administrative data rather than on clinical data.

RECOMMENDATION 2. A coded, interdisciplinary clinical problem list in the EHR should be used in place of billing codes to identify patient conditions, inclusion diagnoses, and exclusion diagnoses for quality measurement. It is further recommended that this problem list be accessible and utilized across care settings (e.g., inpatient, outpatient, long-term care facilities).

Based on HITEP's review of quantitative data quality scores for each proposed data element for the prioritized conditions, the panel concluded that the target population for performance measures could be more accurately identified by using diagnoses on the patients' clinical problem lists than by using the currently employed billing code abstraction methodology. Further adoption and utilization of problem lists by clinicians should be encouraged.

Although the panel unanimously agreed on the use of problem list diagnoses, it acknowledged that the identification of a code set capable of accurately capturing problem list diagnoses is paramount to the success of this recommendation. The panel recommended that HITSP identify an appropriate standard for encoding problem list diagnoses. In the short term, the panel acknowledged that ICD-9 CM has a number of limitations, which cause organizations to create "dummy diagnoses" to supplement the current codes. ICD-10 CM addresses a number of the limitations of ICD-9 CM, but still suffers from being a statistical classification system rather than a diagnosis coding system. HITSP should consider the SNOMED terminology set as another option for coding problem list diagnoses.

RECOMMENDATION 3. NQF should work with HITSP to develop a "reader's digest" version of a data dictionary for use by measure developers that would contain the HITEP data types and their corresponding HITSP-recommended code sets.

GAP: Clinical information required for quality measurement is not adequately captured in EHRs.

RECOMMENDATION 4. Medication allergies and side effects should be distinguished from each other and entered using standardized codes.

The panel recommended that HITSP identify relevant standards, if available, or encourage their development. The panel recommended that EHR vendors develop efficient methods for the healthcare professional user to differentiate clearly between hypersensitivity reactions to a medication versus an anticipated side effect or drug intolerance. CCHIT should include this functionality as a requirement for its certification.

RECOMMENDATION 5. Standardized codes for summary impressions of diagnostic test results should be developed, where feasible. Quantitative results, when available, should accompany qualitative results of diagnostic studies.

Clinical guidelines, and their related quality measures, often refer to results of diagnostic tests (e.g., echocardiograms, radiologic procedures, angiograms). Most diagnostic test results are dictated in free text, making the results of these tests uninterpretable by the computer. Similarly, summary results of specialty consults (e.g., results of diabetic retinal eye examinations) also may need to be encoded. The panel recommended that HITSP assess current

standards development activities in this area and identify mature standards, promising developments, and gaps that require further attention by standards development organizations. The panel recommended that EHR vendors develop functionality that facilitates the efficient entry of these coded summary results by healthcare professionals interpreting diagnostic tests or conducting specialty consults. CCHIT should include this functionality as a requirement for its certification.

In addition to providing qualitative summary impressions, quantitative results should be provided. For example, an echocardiogram result would contain both the quantitative left ventricular ejection fraction, "30 percent," and the qualitative interpretation, "severe left ventricular systolic dysfunction."

RECOMMENDATION 6. EHR vendors should develop methods of presenting EHR medication data with external medication data from pharmacies and pharmacy networks to help providers assess patients' adherence to medication treatment plans.

RECOMMENDATION 7. Quality and information technology stakeholders should work together to define additional EHR functional requirements that support quality measurement.

For example, if a measure requires information from discharge instructions, these requirements should be specified and communicated to EHR vendors to develop functionality, in order to automatically capture the issuance of discharge instructions regarding specific conditions. EHR vendors should consider data requirements for quality measurement and efficient capture of the data elements within the clinical workflow.

Future Work

The results of the meeting will be submitted to CCHIT, HITSP, and the HL7 EHR Technical Committee and will ultimately support NQF in its collaborative efforts with measure developers to identify common conventions for measure specifications that align with EHR data elements and functional capabilities.

Should further funds be made available, the panel also would be in an excellent position to build on current efforts by focusing on clinical workflow as outlined in the AHIC Quality Workgroup recommendation 2.1.

Acknowledgment

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Appendix A
Expert Panel Members and Project Staff

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Appendix B

Institute of Medicine Priority Area, AQA Alliance/HQA, Nation Quality Forum-Endorsed Measures

Institute of Medicine Priority Area, AQA Alliance/HQA, NQF-Endorsed Measures*

ISCHEMIC HEART DISEASE CLUSTER

CORONARY ARTERY DISEASE

1. CAD Pts with Diabetes and/or LVSD Prescribed ACE-I/ARB Therapy (AQA)
2. Drug Therapy for Lowering LDL Cholesterol (AQA)
3. Antiplatelet Therapy (AQA)
4. Lipid Profile (AQA)

ACUTE MYOCARDIAL INFARCTION

5. Emergency Medicine - Aspirin at Arrival for AMI (AQA)
6. Emergency Medicine - EKG Performed for Non-Traumatic Chest Pain (AQA)
7. Emergency Medicine - Fibrinolytic Therapy Ordered Within 20 Minutes of ECG for AMI (AQA)
8. Beta-Blocker Treatment after Heart Attack (AQA)
9. Beta-Blocker Therapy - Post MI (AQA)
10. Beta-Blocker Therapy - Prior MI (AQA)
11. AMI - ACE-I/ARB for LVSD (HQA)
12. AMI - Aspirin at Arrival (HQA)
13. AMI - Aspirin Prescribed at Discharge (HQA)
14. AMI - Beta-Blocker at Arrival (HQA)
15. AMI - Beta-Blocker Prescribed at Discharge (HQA)
16. AMI - Primary PCI Received within 120 Minutes of Hospital Arrival (HQA)
17. AMI - Thrombolytic Agent Received within 30 Minutes of Hospital Arrival (HQA)
18. AMI - 30-Day Mortality (HQA)

HEART FAILURE

19. HF Pts with LVSD Prescribed ACE-I/ARB Therapy (AQA)
20. HF Pts with LVSD Prescribed Beta-Blocker Therapy (AQA)
21. LVF Assessment (AQA)
22. HF Pts with Atrial Fibrillation Prescribed Warfarin Therapy (AQA)
23. HF - LVF Assessment (HQA)
24. HF - ACE-I/ARB for LVSD (HQA)
25. HF - Discharge Instructions (HQA)
26. HF - 30-Day Mortality (HQA)

DIABETES CLUSTER

27. HbA1C Measurement (AQA)
28. HbA1C Control (AQA)
29. Blood Pressure Management (AQA)
30. LDL Cholesterol <130 (AQA)
31. Lipid Measurement (AQA)
32. Eye Exam (AQA)
33. Diabetic Retinopathy: Documentation of Presence or Absence of Macular Edema and Level of Severity of Retinopathy (AQA)

MEDICATION MANAGEMENT CLUSTER

34. Appropriate Treatment for Children with URI (AQA)
35. Appropriate Testing for Children with Pharyngitis (AQA)
36. Empiric Antibiotic for CAP (AQA)
37. Pneumonia - Initial Antibiotic Received within 6 Hours of Hospital Arrival (HQA)
38. Pneumonia - Appropriate Initial Antibiotic Selection (HQA)
39. Surgical Care - Timing of Prophylactic Antibiotics – Ordering Physician (AQA)
40. Surgical Care - Timing of Prophylactic Antibiotics – Administering Physician (AQA)
41. Surgical Care - Selection of Prophylactic Antibiotics – 1st or 2nd Generation Cephalosporin (AQA)
42. Surgical Care - Discontinuation of Prophylactic Antibiotics (Non-Cardiac Procedures) (AQA)
43. Surgical Care - Discontinuation of Prophylactic Antibiotics (Cardiac Procedures) (AQA)
44. Preoperative Beta-Blockade for Cardiac Surgery Pts (AQA)
45. Duration of Antibiotic Prophylaxis for Cardiac Surgery Pts (AQA)
46. Timing of Antibiotic Administration for Cardiac Surgery Pts (AQA)
47. Selection of Antibiotic Administration for Cardiac Surgery Pts (AQA)

Appendix C
HITEP Data Category Types and Associated Criteria Scores

HITEP Data Category Types and Associated Criteria Scores

Quality Concept (first meeting)	Data Category-Type (second meeting)	Data Source	Data Stds	Accur -acy	Feasible Workflow	Version Control	In EHR	Criteria Score
Admission time (hospital)	location-source/current/target	admin	5	5	5	5	5	**100**
	history-birth	admin	5	5	5	5	5	**100**
Time of surgery (incision)	procedure-inpt_start	admin	5	5	5	5	5	**100**
Inhospital death	history-death	admin	5	5	5	5	5	**100**
Surgery end time	procedure-inpt_end	admin	5	5	5	5	5	**100**
Procedure code (OP)	procedure-outpt	billing	5	5	4	5	5	**96**
Vital signs (BP)	physical exam-vitals	EHR	5	4	5	5	5	**95**
	history-sex	admin	5	4	5	4	5	**93**
Procedure code (IP)	procedure-inpt_start	billing	5	5	3	5	5	**92**
Clinical lab result	laboratory-result	EHR	4	5	4	5	5	**91**
Arrival time (ED)	location-source/current/target	admin	5	3	5	5	5	**90**
EHR encounter diagnosis	diagnosis-outpatient active	EHR	5	3	5	5	5	**90**
	location-transfer type	admin	5	4	5	1	5	**87**
Inpatient billing codes	diagnosis-inpt	billing	5	3	4	5	5	**86**
Med administered (IP)	medication-inpatient administered	EHR	3	5	3	5	5	**82**
Arrival time (hospital)	location-source/current/target	admin	5	3	3	5	5	**82**
Problem list diagnosis	diagnosis-outpatient (problem list)	EHR	4	4	4	3	5	**82**
Medication ordered (IP)	medication-inpatient order	EHR	3	5	4	5	4	**82**
Clinical lab order	laboratory-order	EHR	2	5	4	5	5	**81**
	history-behavioral	EHR	3	4	4	3	5	**77**
	procedure-past history	EHR	2	5	4	3	5	**77**
Active medication (OP)	medication-outpatient order	EHR/rx	3	3	4	5	5	**76**
Active medication (OP)	medication-outpatient order filled	EHR/rx	3	3	4	5	5	**76**
Past medication	medication-discontinue order	EHR/rx	3	3	3	5	5	**72**
Consult ordered	procedure-ordered	EHR	1	5	4	4	4	**70**
Diagnostic test order	diagnostic study-ordered	EHR	2	3	4	3	5	**67**
	history-ethnicity/race	admin	3	3	3	1	5	**64**
Allergies	adverse_drug_event-allergy	EHR	2	3	4	1	5	**63**
Discharge instructions given	communication-provider-pt	EHR	1	4	3	4	4	**61**
Diabetic retinopathy exam	diagnostic study-result	result	1	4	3	3	4	**59**
Diagnostic test result	diagnostic study-result	result	1	4	3	3	4	**59**
Imaging results (e.g., LVEF)	diagnostic study-result	result	1	4	3	3	4	**59**
Imaging order (e.g., MRI)	diagnostic study-ordered	EHR	2	3	4	3	3	**59**
	history-primary care provider	EHR	1	3	3	3	5	**58**
	history-payment source	admin	1	1	5	3	5	**56**
Consult results (eye exam)	diagnostic study-result	result	1	4	3	3	3	**55**
	history-language	admin	1	4	3	1	4	**55**
	history-care classification	EHR	1	4	5	2	1	**53**
Outpatient billing codes	diagnosis-outpatient (billing)	billing	5	2	3	0	0	**47**
Drug intolerance	adverse_drug_event-intolerance	EHR	1	3	4	1	1	**42**
MD-MD communication	communication-provider-provider	EHR	1	2	3	1	2	**37**
	history-enrollment trial	EHR	1	4	1	1	1	**35**
Active medication duration	medication-outpatient duration	EHR/rx	2	1	2	3	1	**33**
	history-symptoms	EHR	1	2	2	1	1	**29**
	opt out-other reason	EHR	1	1	1	1	1	**20**

Appendix D
Measure and Data Type Scoring Matrix

APPENDIX D: Measure and Data Type Scoring Matrix

D = data type in measure **denominator**
N = data type in measure **numerator**
X = data type in measure **exclusions**

Measures 1-42

	IOM Priority Area- Measure Name	AQA HQA	Avg Data Quality Score	Min Data Quality Score	# Types	Frequency in Measures, %	Data Type Quality Score	history-birth	history-death	procedure-inpatient	procedure-inpatient_end	procedure-inpatient_start	procedure-outpatient	physical_exam-vitals	history-sex	laboratory-result	location-source/current/target	location-transfer_type	diagnosis-inpatient	medication-inpatient_administered	medication-inpatient_order	history-behavioral	procedure-past_history	medication-outpatient_order	medication-outpatient_order_filled	medication-discontinue_order	adverse_drug_event-allergy	communication-provider-pt	diagnostic_study-result	history-primary_care_provider	history-care_classification	diagnosis-outpatient	adverse_drug_event-intolerance	communication-provider-provider	history-enrollment_trial	medication-outpatient_duration	history-symptoms	optout-other_reason
						100	94	100	11	100	30	96	6	96	7	95	1	93	2	91	13	91	42	87	10	86	73	82	50	82	1	77	6	77	2	76	19	76	10
1	**Cancer**-Cervical CA screen	A	97	93	4	D		X			N		D																									
2	**AMI**-30d mortality	H	95	86	3	X	N										D																					
3	**Heart Failure**-HF, 30d mortality	H	95	86	3	D	N										D																					
4	**Med Manage**-Surgery pre-op BB	A	95	82	4	D		D		N									N																			
5	**CAD**-lipids, checked	A	92	86	3	D								N			D																					
6	**Med Manage**-Surgery abx, CT duration	A	91	72	8	D		D	XN	X						X		X	X														N					
7	**Med Manage**-pharyngitis, test + abx	A	90	82	4	D								N			D		D																			
8	**Stroke**-Antiplatelet	A	89	82	3	D											D		N																			
9	**Tobacco**-Tobacco use	A	89	77	3	D										D												N									
10	**Pregnancy**-Anti-D for Rh-neg	A	88	76	4			D							D		D																N					
11	**Cancer**-Breast CA screen	A	88	58	4	D		X					D																					N				
12	**AMI**-PCI 120min	H	86	58	6	X		DN								DNX		D	X															D				
13	**Med Manage**-Surg abx, before incision 1h	H	85	47	8	D		DX		N						X		X	XN														X					
14	**Med Manage**-Surg VTE, received	A	84	20	8	D		DX	X	N						X		X	N																			
15	**Stroke**-Radiology findings	A	84	58	4	D										D		D															DN					
16	**AMI**-thrombolytic 30m	H	83	58	5	X										DNX		D	DN														D					
17	**Med Manage**-Surgery abx, selection	H	83	47	7	D		DNX								XN		X	XN														X					
18	**Med Manage**-Surgery VTE, ordered	A	83	20	7	D		DX	X							X		X	N																			
19	**Cancer**-Colorectal CA screen	A	82	47	6	D		X			N				N																		N					
20	**Heart Failure**-HF, D/C instruct	H	82	53	6	X		X								X		D														N		X			
21	**Med Manage**-Surgery abx, d/c 24h	H	82	47	8	D		DX								X		X	X														X					
22	**Heart Failure**-LVEF, checked 1	A	81	58	3	D												D															N					
23	**Heart Failure**-LVEF, checked 2	A	81	58	3	D												D															N					
24	**Tobacco**-Heart failure smoking cessation	H	81	61	4	X												D				D										N					
25	**Immunization**-Pneumococcal vaccine	H	80	53	8	DX	X										X	DX	N					N								X		X			
26	**Immunization**-Influenza vaccine	H	80	53	8	DX	X										X	DX	N					N								X		X			
27	**Med Manage**-URI w/o abx	A	80	47	4	D										D			N																D			
28	**Diabetes**-BP, checked	A	80	47	6	D						N						DX						D	D										DX			
29	**Med Manage**-Surgery abx, ordered	A	80	20	5	D		D		N									N																			
30	**Med Manage**-Surgery abx, received	A	80	20	5	D		D		N									N																			
31	**Tobacco**-Advising smokers to quit	A	79	61	3	D																D										N					
32	**Diabetes**-HbA1C, checked	A	79	47	6	D									N			DX						D	D										DX			
33	**Diabetes**-HbA1C, at goal	A	79	47	6	D									N			DX						D	D										DX			
34	**Diabetes**-Lipids, at goal	A	79	47	6	D									N			DX						D	D										DX			
35	**AMI**-ASA, discharge	H	79	53	6	X										X		D	XN																			
36	**Heart Failure**-LVEF, checked 3	H	78	53	7	X		X								X		D															N	N		X		
37	**Tobacco**-AMI smoking cessation	H	78	53	6	X										X		D				D										N			X		
38	**Tobacco**-Pneumonia smoking cessation	H	78	53	8	D	X										X	X				D										N	X		X		
39	**Pregnancy**-HIV screening	A	78	20	5			D							N	N		DX																			
40	**CAD**-antiplatelet	A	77	42	6	D										X		DX	N																			
41	**Stroke**-Rehab	A	77	20	4	D		N										D																			
42	**Heart Failure**-LVSD, ACEI/ARB 1	H	76	20	11	X	X	X								X	X	DX	N														D		X			

	IOM Priority Area- Measure Name	18	11	33	1	17	26	11	5	2	4	2	39
1	**Cancer**-Cervical CA screen												
2	**AMI**-30d mortality												
3	**Heart Failure**-HF, 30d mortality												
4	**Med Manage**-Surgery pre-op BB												
5	**CAD**-lipids, checked												
6	**Med Manage**-Surgery abx, CT duration												
7	**Med Manage**-pharyngitis, test + abx												
8	**Stroke**-Antiplatelet												
9	**Tobacco**-Tobacco use												
10	**Pregnancy**-Anti-D for Rh-neg												
11	**Cancer**-Breast CA screen			N									
12	**AMI**-PCI 120min			D									
13	**Med Manage**-Surg abx, before incision 1h						X						
14	**Med Manage**-Surg VTE, received												X
15	**Stroke**-Radiology findings			DN									
16	**AMI**-thrombolytic 30m			D									
17	**Med Manage**-Surgery abx, selection						X						
18	**Med Manage**-Surgery VTE, ordered												X
19	**Cancer**-Colorectal CA screen			N			X						
20	**Heart Failure**-HF, D/C instruct		N			X							
21	**Med Manage**-Surgery abx, d/c 24h						X						
22	**Heart Failure**-LVEF, checked 1			N									
23	**Heart Failure**-LVEF, checked 2			N									
24	**Tobacco**-Heart failure smoking cessation		N										
25	**Immunization**-Pneumococcal vaccine			X		X							
26	**Immunization**-Influenza vaccine			X		X							
27	**Med Manage**-URI w/o abx						D						
28	**Diabetes**-BP, checked						DX						
29	**Med Manage**-Surgery abx, ordered												X
30	**Med Manage**-Surgery abx, received												X
31	**Tobacco**-Advising smokers to quit		N										
32	**Diabetes**-HbA1C, checked						DX						
33	**Diabetes**-HbA1C, at goal						DX						
34	**Diabetes**-Lipids, at goal						DX						
35	**AMI**-ASA, discharge	X				X							
36	**Heart Failure**-LVEF, checked 3		N	N		X							
37	**Tobacco**-AMI smoking cessation		N			X							
38	**Tobacco**-Pneumonia smoking cessation		N	X		X							
39	**Pregnancy**-HIV screening												X
40	**CAD**-antiplatelet	X						X					
41	**Stroke**-Rehab												N
42	**Heart Failure**-LVSD, ACEI/ARB 1	X		D		X							X

The National Quality Forum (NQF) is a private, nonprofit, open membership, public benefit corporation whose mission is to improve the American healthcare system so that it can be counted on to provide safe, timely, compassionate, and accountable care using the best current knowledge. Established in 1999, NQF is a unique public-private partnership having broad participation from all parts of the healthcare industry. As a voluntary consensus standard-setting organization, NQF seeks to develop a common vision for healthcare quality improvement, create a foundation for standardized healthcare performance data collection and reporting, and identify a national strategy for healthcare quality improvement. NQF provides an equitable mechanism for addressing the disparate priorities of healthcare's many stakeholders.

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