Grant Final Report

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Standardization and Automatic Extraction of Quality Measures in an Ambulatory EHR

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Abstract

Purpose: Citizens Memorial Hospital (CMH) planned to build quality measures into an electronic health record (EHR) system, to implement an automated system for data extraction of quality measures in the ambulatory setting and to compare the completeness and accuracy of quality measure code assignment by manual coding and the automated system.

Scope: Quality measure documentation was built into the CMH EHR system used in 15 rural ambulatory clinics with 70,000 patient encounters per year.

Methods: Phase I (October 2007-September 2008) was standardizing the documentation systems and processes within the ambulatory EHR so data required for quality measurement would be available for extraction. Phase II (October 2008-December 2009) was mapping, extracting, reporting on and preparing for export using an automated data extraction system.

Results: 62 quality measures were built into the documentation and workflow in the 15 clinics studied. Automated coding was significantly more complete and accurate than manual coding for the quality measures examined. Building quality measures for automated data extraction relied heavily on the use of custom documentation queries. A toolkit including these custom queries was expanded, refined, and distributed to 53 organizations representing 2,720 health care providers for use in their EHR systems by the EHR vendor.

Key Words: Electronic medical record, EMR, electronic health record, EHR, Physicians Quality Reporting Initiative, PQRI, ambulatory quality measurement

Final Report

Purpose

The purpose of the project was to enable clinical quality measurement using electronic health record (EHR) technology.

The objectives were to:

- establish the standardization necessary for data capture of quality measures in an ambulatory EHR system,
- standardize and integrate data capture for quality of care evaluation into the routine documentation of care in an ambulatory EHR,
- implement an automated system for data extraction of quality measures in the ambulatory setting, including valid, reliable reports that provide actionable insight for the measurement and analysis of care,
- demonstrate the efficiency and accuracy of using data extraction and reporting to perform quality measurement in the ambulatory care setting, and
- address technical, organizational culture and workflow issues associated with quality data capture.

Scope

As described in a presentation made to the American Health Information Community (AHIC) on August 1, 2006, there is the "false impression that the current direction of HIT and EHR proliferation in hospitals will make measurement seamless." [Charles N. Kahn III, President, Federation of American Hospitals]. Kristine Martin Anderson, Principal, Booz Allen Hamilton, expands on that idea with this listing of the lack of standards that serve as major barriers to automated measurement of quality:

- Documentation can occur in many places in the medical record, complicating search algorithms and confusing the results
- Clinical documentation is often unstructured and uses non-standardized nomenclature
- There is insufficient active and passive encouragement of documentation that would automate quality measurement

More recently, quality measurement has garnered interest as an important aspect of "meaningful use" of health information technology. So much so, that reporting on clinical quality using EHR technology is a specific requirement for hospitals and eligible providers to qualify for incentive payments from Medicare and Medicaid.

On Feb. 17, 2009, President Obama signed the American Recovery and Reinvestment Act of 2009 (Recovery Act), a critical measure to stimulate the economy. Among other provisions, the new law provides major opportunities for the Department of Health and Human Services (DHHS), its partner agencies, and the States to improve the nation's health care through health information technology (HIT) by promoting the meaningful use of electronic health records (EHR) via incentives.

The qualification criteria for incentives (i.e., meeting specified HIT standards, policies, implementation specifications, timeframes, and certification requirements) are still in development, and will be defined through regulation and additional guidance materials. However, the Center for Medicare and Medicaid Services (CMS) generally expects that under Medicare, "meaningful EHR users" would demonstrate each of the following: meaningful use of a certified EHR, the electronic exchange of health information to improve the quality of health care, **and reporting on clinical quality and other measures using certified EHR technology**.

Context

The expected impacts of this project were to 1) establish the standardization efforts that will need to be adopted by vendors and ambulatory providers to facilitate quality measurement and 2) demonstrate the efficiency and accuracy of utilizing data extraction to automate quality measurement.

Use of an expert third party to extract, analyze and report on quality data enhances the ability of small and solo physician practices to collect, report, maintain, export and use quality measurement information. Automated data extraction should require less staff and physician time, increase accuracy, enhance the usability of the data and improve timeliness of reporting quality measures both to outside agencies and for use within the practice.

The Physician Quality Reporting Initiative (PQRI) is a pay-for-reporting program administered by CMS. The program offers an incentive payment to eligible professionals who satisfactorily report on quality measures for covered professional services provided to Medicare beneficiaries. Providers can choose from 153 quality measures that represent a variety of care settings and specialties for PQRI reporting in 2009.

Reporting for PQRI can currently take three forms. With the claims-coding method, providers can attach CPT codes to each patient encounter for a quality measure population and submit those codes to CMS on claims for payment. Successful reporting for the claims-coding method involves reporting at least 80% of the time on three quality measures. Eligible providers can also report through a PQRI-qualified registry or to CMS through a qualified EHR system.

In this study, the claims-coding method of reporting was compared to automated data extraction of quality measures.

Settings

The study was conducted in 15 physician practices that were already utilizing an ambulatory EHR. That record is linked into a community-wide EHR. Within the community-wide EHR, patient visits from the ambulatory, inpatient, home care and long term care settings are combined into one patient-centric view. Care information is maintained electronically and no paper medical records are created or maintained in these practices. The CMH EHR is known as Project Infocare.

Participants

Partners in this application have been:

- Citizens Memorial Hospital (CMH) – a public hospital district in southwest Missouri. CMH was awarded HIMSS Organizational Davies Award for 2005 for excellence in the implementation of the electronic medical record. CMH was named by Hospitals & Health Networks as a Most Wired Hospital in the Small and Rural Category for 2005-2007 and in the Most Wired Hospitals-Top 100 in 2008 and 2009.

- Institute for Health Metrics (IHM) – a non-profit organization assisting hospitals and health care providers in leveraging electronic data to improve quality. IHM works with 65 hospitals nationwide to extract, analyze and report electronic data for quality improvement efforts.

- LSS Data Systems, Inc. (LSS) – the CMH ambulatory EHR vendor, certified by CCHIT.

Population Included in this Study

There are 13 physicians and 10 nurse practitioners caring for patients in these practices. These providers deliver 70,000 patient encounters each year. As in most rural areas, the population is older and poorer than the nation at large.

Methods

Study Design

The hypotheses of this project were:

- All of the data needed for quality measurement available in an ambulatory EHR can be captured in data elements readily available for automated extraction if documentation processes are standardized.

- Automatic data extraction will be significantly more efficient and accurate when compared to the manual claims-coding method of quality measurement reporting utilized within the PQRI.

Phase I of the project (October 2007-September 2008) was standardizing the documentation systems and processes within the CMH ambulatory EHR so data required for quality measurement would be predictably available as extractable data elements without compromising physician productivity. Standardization included provider documentation templates, electronic prescribing and documentation of allergies. During this phase, CMH established and implemented a method to use the claims-coding method to report for the PQRI for comparison.

Phase II of the project (October 2008-December 2009) was mapping, extracting, normalizing, updating, reporting on and preparing for export, the PQRI measures for ambulatory care using an automated data extraction tool.

During the comparison period (October 2008 – February 2009) providers and coders utilized the claims-coding method for a set of PQRI quality measures and automated data extraction was also done for comparison.

Data Sources/Collection

Data sources for quality measures have been standardized into fields within the EHR system. In order to capture all of the data necessary for reporting the measures, these types of data fields are used: patient demographics (age, gender), billing data (ICD-9-CM diagnosis codes and CPT codes), medication lists, health maintenance items, immunization records, orders, vital signs, test results and documentation queries.

IHM extracted data nightly from the CMH LSS system via a secure VPN link. The data, transformed into an xml format, was mapped and loaded into an Oracle 10g database. Reports on patients eligible for PQRI measure populations and data compliance with the PQRI indicators were created in a secure Web application for access by CMH.

Extracted data was analyzed longitudinally for indicators requiring examination of a year's history. Certain historical tests, such as mammograms, colonoscopies and bone density (DEXA) scans, were extracted from the health maintenance section of the clinical record, where the last performed date was documented. In many cases, the last recorded date could be years prior to the current visit and from other locations outside the CMH system, such as last dates for DEXA scans and colonoscopies. PQRI indicators also require specific results for certain tests, such as Hemoglobin A1C, not just the last date performed. In those instances, laboratory data was examined for the year prior to the current visit in order to include the test results in the clinical reports.

A large part of the data necessary for PQRI compliance, particularly exclusions to quality measures, was contained within documentation queries developed by CMH. Documentation queries in the CMH EHR system are data fields with a label. Queries may be grouped together. One or many answers may be allowed for a grouping of queries. An exclusion example would be patient refusal of a recommended therapy or test. This data was also extracted and used as inclusion/exclusion criteria for reports indicating PQRI indicator compliance.

The Web application displaying monthly data for all of the PQRI indicators has the potential to provide feedback to CMH and to CMH providers on their performance. The data contained in

the Oracle database and visible in the Web application is used to build the map of data to PQRI CPT codes.

Interventions

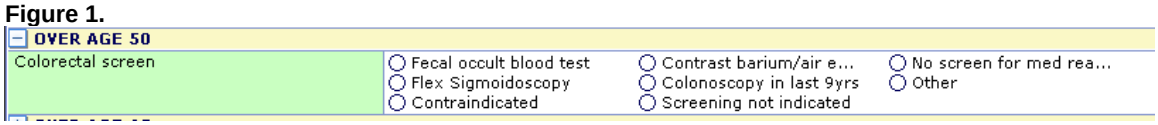
CMH and partners IHM and LSS built 62 PQRI quality measures into CMH EHR system, extracted the quality measures results and provided quality measures feedback reports to the organization.

62 measures were chosen for the study as they applied to the CMH ambulatory primary care and specialty providers.

CMH and IHM mapped the quality data fields that already existed in the CMH EHR system as extractable data fields. These included demographics, billing data, medication lists, immunization records, tests performed and test results.

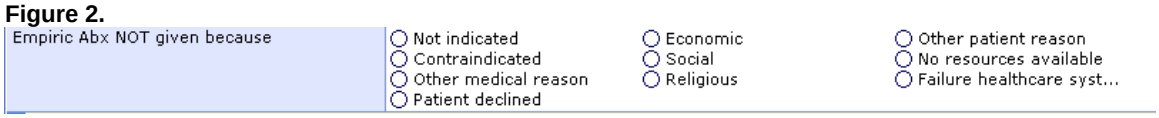
CMH created documentation queries to capture additional data within provider documentation templates. Queries included "I did it," or "I reviewed it" type queries and also included recommended screening tools in a checklist format. These queries were necessary to capture data that was previously recorded in narrative or not recorded at all.

Figure 1.



CMH adopted an exception model for the use of exclusion queries. With the exception model, providers are only requested to document exclusions to quality measures if they did not otherwise comply with the quality measure intent. For example, if a provider prescribes the recommended medication, no further documentation is required and the quality measure will be extracted by the automated system. If the provider does not prescribe the medication, then the provider is requested to answer an exclusion query specific to that measure indicating why the patient should be excluded from the measure. The answer to the exclusion query is then extracted for the quality measure reports.

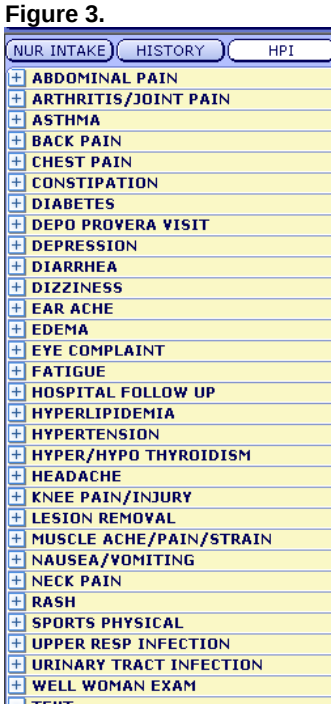
Figure 2.



CMH developed a new approach to template documentation for the organization. Historically, individual diagnosis or problem-focused templates and template sections had been utilized. To facilitate quality reporting, a comprehensive template was developed to allow providers to document care and quality measures for the top 30 presenting problems from one template. The template serves as an electronic file cabinet of the pertinent sections and queries for common presenting problems. Sections that are not used simply are not in the final document. This template is especially helpful for primary care providers where the range of presenting problems

during an individual encounter can be quite varied. The new approach was developed as a result of provider input regarding frustration with accessing and juggling multiple templates and template sections during an encounter.

Figure 3.



CMH and LSS implemented an upgraded version of the CMH EHR system to accommodate new documentation fields and extraction.

CMH implemented speech recognition to help providers use new documentation processes efficiently. Although the quality measures are documented in data or query fields, many CMH providers expressed a desire to maintain some narrative in their documentation. The use of speech recognition, typing and even transcription all merged with query and field-level documentation is used by some providers to present the "story" or "gist" of the encounter.

Providers and nurses were trained on the new documentation templates, tools and queries using online learning, classroom training and one-on-one training.

CMH introduced methods to assist providers in becoming more efficient and effective in their use of the EHR during patient encounters. With the inclusion of the additional queries and steps for quality measures, there is a perception among providers that there is simply too much to accomplish during a routine patient encounter. This intervention was based on the extensive experience and research base of two widely available proprietary methods.

- PatientBridge (MUSE) – focused on enhancing communication between the provider and patient during the patient encounter while leveraging the use of the EHR system.

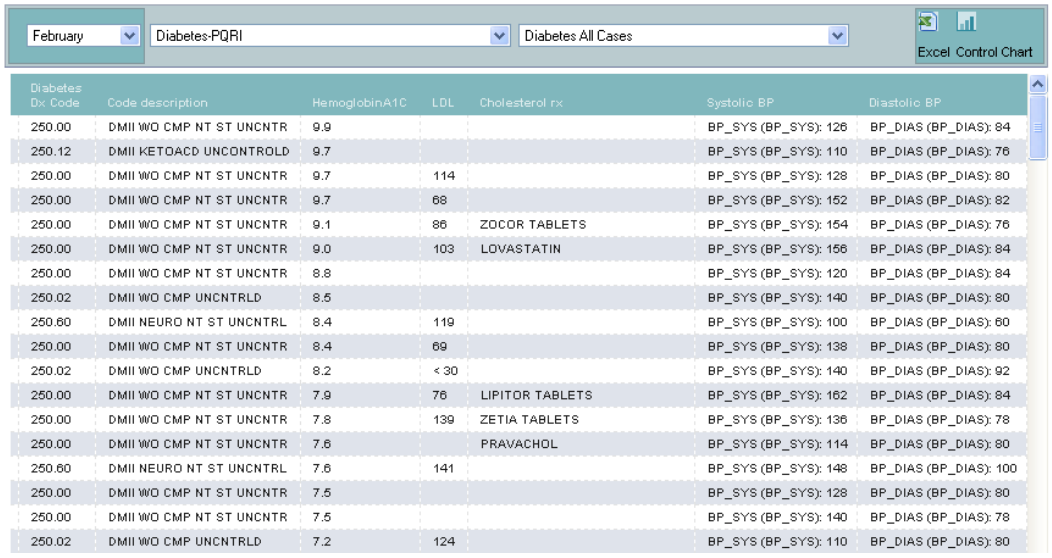
- Family Team Care – a method to improve the flow of the visit and redefine the responsibilities of the provider and medical assistant before, during and after the visit.

These methods were only introduced to providers during this project. The methods show early promise and CMH plans to fully implement them in the CMH provider practices in the future.

Data was extracted from the CMH EHR system by IHM. Data was validated by IHM by comparing extracted data elements and case volumes against internal CMH reports and data residing in the CMH EHR system.

Web-based reports were created demonstrating compliance with PQRI indicators by displaying clinical data relevant to each indicator. The example displays the clinical data related to a diabetes indicator; patient and provider identifying data is not shown below but is displayed to the left of the diagnosis code data in the web-based interface.

Figure 4.



Diabetes Dx Code	Code description	HemoglobinA1C	LDL	Cholesterol rx	Systolic BP	Diastolic BP
250.00	DMII WO CMP NT ST UNCNTR	9.9			BP_SYS (BP_SYS): 126	BP_DIAS (BP_DIAS): 84
250.12	DMII KETOACD UNCONTROLD	9.7			BP_SYS (BP_SYS): 110	BP_DIAS (BP_DIAS): 76
250.00	DMII WO CMP NT ST UNCNTR	9.7	114		BP_SYS (BP_SYS): 128	BP_DIAS (BP_DIAS): 80
250.00	DMII WO CMP NT ST UNCNTR	9.7	68		BP_SYS (BP_SYS): 152	BP_DIAS (BP_DIAS): 82
250.00	DMII WO CMP NT ST UNCNTR	9.1	86	ZOCOR TABLETS	BP_SYS (BP_SYS): 154	BP_DIAS (BP_DIAS): 76
250.00	DMII WO CMP NT ST UNCNTR	9.0	103	LOVASTATIN	BP_SYS (BP_SYS): 156	BP_DIAS (BP_DIAS): 84
250.00	DMII WO CMP NT ST UNCNTR	8.8			BP_SYS (BP_SYS): 120	BP_DIAS (BP_DIAS): 84
250.02	DMII WO CMP UNCNTRLD	8.5			BP_SYS (BP_SYS): 140	BP_DIAS (BP_DIAS): 80
250.60	DMII NEURO NT ST UNCNTRL	8.4	119		BP_SYS (BP_SYS): 100	BP_DIAS (BP_DIAS): 60
250.00	DMII WO CMP NT ST UNCNTR	8.4	69		BP_SYS (BP_SYS): 138	BP_DIAS (BP_DIAS): 80
250.02	DMII WO CMP UNCNTRLD	8.2	< 30		BP_SYS (BP_SYS): 140	BP_DIAS (BP_DIAS): 92
250.00	DMII WO CMP NT ST UNCNTR	7.9	76	LIPITOR TABLETS	BP_SYS (BP_SYS): 162	BP_DIAS (BP_DIAS): 84
250.00	DMII WO CMP NT ST UNCNTR	7.8	139	ZETIA TABLETS	BP_SYS (BP_SYS): 136	BP_DIAS (BP_DIAS): 78
250.00	DMII WO CMP NT ST UNCNTR	7.6		PRAVACHOL	BP_SYS (BP_SYS): 114	BP_DIAS (BP_DIAS): 80
250.60	DMII NEURO NT ST UNCNTRL	7.6	141		BP_SYS (BP_SYS): 148	BP_DIAS (BP_DIAS): 100
250.00	DMII WO CMP NT ST UNCNTR	7.5			BP_SYS (BP_SYS): 128	BP_DIAS (BP_DIAS): 80
250.00	DMII WO CMP NT ST UNCNTR	7.5			BP_SYS (BP_SYS): 140	BP_DIAS (BP_DIAS): 78
250.02	DMII WO CMP UNCNTRLD	7.2	124		BP_SYS (BP_SYS): 110	BP_DIAS (BP_DIAS): 80

IHM applied to be a registry for the purposes of this grant so data could be uploaded in an HL7 format. However, IHM was not accepted as a registry. EHR vendors were able to upload data as part of a pilot project in 2009; however, any such uploads were not eligible for the incentive payment. Due to rapidly changing regulation on which entitites will be allowed to upload and the data transmission format, CMH and IHM have not been able to demonstrate this functionality as part of this project.

Measures

- Number of measures of ambulatory quality as defined by PQRI that could be captured in extractable data formats from the EHR.

- Accuracy and completeness of reporting quality measures compared between the manual claims-coding method and automated data extraction.

Limitations

Coders were unable to code all charts for the 62 quality measures within the PQRI program that apply to CMH provider specialties. Even with additional coding staff, they were not able to code all of the measures that could be utilized for each specialty. To limit the scope of coding required, coders were instructed to code for three measures for each provider. Those measures were used for comparison to the automated data extraction method.

Coders were unable to accurately track detailed additional time associated with coding for PQRI.

CMH's data extraction partner, IHM was not recognized as registry or EHR vendor for automated reporting. A quality data extraction service did not appear to be contemplated in the PQRI program.

Results

Principal Findings

All 62 measures of ambulatory quality as defined by PQRI that apply to CMH provider specialties could be captured in extractable data formats from the EHR. For 50 of the measures used in this study, the information used to determine if a patient encounter was eligible for inclusion and quality reporting as per the PQRI measure specifications was already available in demographic, diagnosis and/or procedure codes within the EHR system.

Twelve measures have additional eligibility requirements that determine if a patient is included for reporting. One additional requirement was found in the medication list. The other eleven required the creation of a documentation query.

Table 1.

Data Field for Quality Measure Results	# of Measures
Immunization	2
Medication	16
Query	31
Test	11
Test or Medication	2
Total	62

For the quality measure results, the data could be found in an existing field for 31 of the 62 measures. Queries were built to capture the other 31 results. Many queries were standard or evidence-based assessment tools.

All of the quality measure exclusions as defined in the PQRI quality measures specifications were built as queries. Three standard exclusion reasons were built and could be reused for multiple measures. An additional twelve queries were built for other exclusion reasons. Examples of non-standard exclusion reasons are a patient with normal left ventricular function or a patient with no history of urinary incontinence.

Table 2.

Exclusion Reasons	# measures
Medical Reason	28
Patient Reason	13
System Reason	9
Other "Documented" Reason	12
None	21
1 reason	29
2 reasons	3
3 reasons	9

An important component addressed while building the quality measures documentation was to determine where within a routine visit the documentation would normally occur.

Table 3.

Routine Visit Elements	# of PQRI Results
Disease Management	6
Exam	12
Past Medical, Family, Social History	2
Health Maintenance	13
Nurse Intake	6
Nurse Intake & Plan	1
Letters	1
Plan	5
Medication List & Prescriptions	16
Grand Total	62

CMH used this information to place queries in the area of the EHR system where the recording provider or nurse would be documenting when the information was available during the encounter. Initially, the software did not allow for test result entry or multiple answer queries to be utilized in the health maintenance or disease management areas of the system. The vendor added this functionality.

Automated data extraction was more complete than coders at identifying the eligible populations and more accurate in reporting the quality measure results as recorded in data fields. This result is qualified by a low compliance rate for manual claims coding of the quality measures as described below.

Manual Coding Process

CMH utilizes a centralized coding model. CMH utilizes centralized coding for these ambulatory care practices. Although providers can code their own encounters, most providers indicate a diagnosis and a coder validates the diagnosis and applies the evaluation and management level or procedure code.

Coders were instructed to assign the relevant PQRI CPT codes for three measures for each provider beginning in the last calendar quarter of 2007. The coders were provided with instructions, specifications and resources from the CMS PQRI website and related websites. By

design, no further instruction or feedback was given to the coders regarding their success or compliance with quality measure coding. The coders and their supervisors were aware of the fact that there was an ongoing allocation of their salaries to what they referred to as the "PQRI grant" through the comparison period which ended in February, 2009.

There was no financial incentive provided for CMH providers. CMH rural health clinic providers are not eligible for the PQRI bonus. Rural health clinic claims are processed through the CMS Part A program and not per the Part B Provider Fee Schedule. CMH rural health providers and coders were aware that there was no financial incentive for PQRI submissions. CMH would have been eligible for the incentive payment for the CMH specialists, but that bonus would not have been shared with the CMH specialist providers under the current contract arrangements between CMH and those specialists.

CMH coding completeness was very low. Even where eligible, CMH would not have qualified for the incentive payments because of the low completeness of the coding. Whereas the incentive payment is based on successful reporting 80% of the time on three measures per provider, the coding for PQRI in the CMH system was never over 50% for any measure in a 6 month reporting period. Although not typical, failure to successfully report for PQRI is common even among those providers attempting successful reporting. CMS reported in November, 2009 that more than 162,800 professionals participated in the PQRI reporting program in 2008 and that more than 85,000 (52%) of those professionals satisfactorily reported data and qualified for an incentive payment. At CMH, almost any change (coder turnover, provider turnover, supervisor turnover) appears to have interrupted the coding of PQRI measures.

One coder, coding for two providers, did continue coding throughout the comparison period. That case was used for the analysis. That coder's completeness was also very low contributing to a dramatic difference between the completeness of manual and automated coding methods.

For this case, the coder coded three diabetes measures (PQRI measures 1, 2, and 3). Measure 1 is a hemoglobin A1C result. Measure 2 is low density lipoprotein (LDL) result. Measure 3 is the systolic and diastolic blood pressure (while two CPT codes are applied, both codes are reported as a single measure). Coders assigned these CPT codes for patients with diabetes for two physicians.

The following PQRI codes are defined for the following values:

Table 4.

Measure	Value	PQRI CPT
Systolic BP value	<130	3074F
Systolic BP value	130-139	3075F
Systolic BP value	>=140	3077F
Systolic BP value	Not done	2000F-8P
Diastolic BP value	<80	3078F
Diastolic BP value	80-89	3079F
Diastolic BP value	>=90	3080F
Diastolic BP value	Not done	2000F-8P
Hemoglobin A1C value	<7	3044F
Hemoglobin A1C value	7-9	3045F
Hemoglobin A1C value	>9	3046F
Hemoglobin A1C value	Not done	3046F-8P

Table 4. (continued)

Measure	Value	PQRI CPT
LDL value	<100	3048F
LDL value	100-129	3049F
LDL value	>129	3050F
LDL value	Not done	3048F-8P

The coder coded only 20% of the eligible cases and applied only 16% of the eligible codes to those cases. Four codes could have been assigned to each case. From October 2008 through February 2009, 311 encounters were eligible for PQRI diabetes coding. 63 (20%) of these cases were identified correctly by the coder. 1,244 total possible codes could have been assigned to the 311 encounters. 201 (16% of those possible) codes were assigned by the coder to cases identified.

Table 5.

	Number	%
Total cases for this indicator	311	
Cases identified correctly by coders	62	20%
Cases not identified by coders	248	80%
Total possible codes for this indicator	1244	
Total codes assigned by coders	201	16%
Codes not assigned by coders	1043	84%

The coder was accurate 95.5% of the time for the cases coded. Out of 201 codes assigned to 63 cases, there were 9 errors, for an error rate of 4.5%. 5 errors were duplicate codes assigned for blood pressure values based on previous visits and 4 errors were incorrect codes (e.g. coding for a diastolic blood pressure less than 80 when the blood pressure value was between 80 and 89).

Eligible population identification. The code definition of a diabetes encounter for the indicator selected for manual coding is:

- Patients aged 18 through 75 years on date of encounter; **AND**

- Diagnosis for diabetes (line-item ICD-9-CM): 250.00, 250.01, 250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 250.40, 250.41, 250.42, 250.43, 250.50, 250.51, 250.52, 250.53, 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 250.90, 250.91, 250.92, 250.93, 357.2, 362.01, 362.02, 362.03, 362.04, 362.05, 362.06, 362.07, 366.41, 648.00, 648.01, 648.02, 648.03, 648.04; **AND**

- Patient encounter during reporting period (CPT or HCPCS): 97802, 97803, 97804, 99201, 99202, 99203, 99204, 99205, 99212, 99213, 99214, 99215, 99304, 99305, 99306, 99307, 99308, 99309, 99310, 99324, 99325, 99326, 99327, 99328, 99334, 99335, 99336, 99337, 99341, 99342, 99343, 99344, 99345, 99347, 99348, 99349, 99350, G0270, G0271

The coder also performed unnecessary work by assigning diabetes measures codes to 39 cases that were not eligible for these measures indicating that the complexity of even selecting the eligible population manually was challenging.

Due to the unexpectedly low rate of completeness using the manual coding method, the completeness of coding for all patients with diabetes seen by these two physicians in 2008 was also examined. For the 257 patients with their first encounter during the first three quarters of 2008 (the first encounter would be the one used for PQRI measurement), 75 cases (26%) were coded for A1C and 71 cases (28%) were coded for LDL. The A1C coding completeness was significantly better for the first nine months of 2008 cases compared to the study period (mid-P exact test, two tailed, 95% CI, p=.006). The LDL coding completeness was significantly better for the first nine months of 2008 cases compared to the study period (mid-P exact test, two tailed, 95% CI, p<.000007).

In addition, the completeness for systolic and diastolic blood pressure for the first nine months of 2008 was compared to the study period. These items are coded for each encounter, with the most recent encounter during the reporting period used for PQRI measurement. For the 649 encounters during the first three quarters of 2008, 184 cases (28%) were coded for systolic blood pressure and 185 cases (28%) were coded for diastolic blood pressure. The systolic blood pressure coding completeness was no different for the first nine months of 2008 cases compared to the study period (mid-P exact test, two tailed, 95% CI, p=.025). The diastolic blood pressure coding completeness was significantly better for the first nine months of 2008 cases compared to the study period (mid-P exact test, two tailed, 95% CI, p=.00002).

These levels of completeness, although better than during the study period, still would not have qualified the providers for the PQRI bonus. The drop in completeness as time passed for three of four codes suggests that PQRI coding may have become less important without feedback and financial incentive.

Automated Data Extraction

Electronic case identification and coding. Using electronic case identification, IHM identified 1,550 cases eligible for diabetes quality measure reporting during the study period from October 1, 2008 through February 28, 2009. These cases include all 15 practices in the study.

Table 6. IHM analysis (total encounters: 1550)

	Visit only	Within Past year
Number of cases with systolic BP documented	1485, 95.8%	
Number of cases with diastolic BP documented	1485, 95.8%	
Number of cases with A1C documented	313, 20.2%	657, 42.4%
Number of cases with LDL documented	196, 12.6%	448, 28.9%
(Denominator below is number performed for each item)		
Number of case with BP controlled (Systolic <139 and Diastolic <90)	946, 63.7%	
Number of cases with A1C<7	188, 60.1%	355, 54.0%
Number of cases with LDL<100	79, 40.3%	184, 41.1%

Through the use of automated data extraction and analysis, IHM was able to determine that:

- 95.8% of eligible cases had systolic and diastolic blood pressure documented.
- 42.4% of cases had a hemoglobin A1C performed and
- 28.9% had an LDL test performed.

Currently participation in the PQRI program only requires reporting of CPT codes and does not specify performance goals for appropriate control of blood pressure, A1C or LDL. It is expected that eventually the PQRI measures will be reported and performance goals or national comparisons will be available. For cases in the study period, analysis showed these levels of performance:

- 63.7% of patients with a blood pressure measurement had their blood pressure controlled (systolic blood pressure <140 and diastolic blood pressure <90),
- 54% of patients who had a hemoglobin A1C performed had a value <7%, and
- 41.1% of patients who had an LDL performed had a value<100 mg/dl.

Actionable and timely feedback has been shown to improve guideline compliance [Guzek et al Am J Med Qual. 2009 Sep 17; Guldberg et al BMC Fam Pract. 2009 May 6;10:30.]. Further research on the impact of feedback reporting on provider utilization of quality measure queries and on their performance relative to historical performance or performance goals warrants further evaluation.

CMH and IHM were able to achieve 100% coding completeness using automated data extraction. Automated coding accuracy for blood pressure documentation was 100% for data documented in a query or field-level data within the EHR system.

Initial automated coding accuracy for A1C results was 99.4% accurate and for LDL results was 98.5% accurate. Inaccuracies for the test result coding were due to test results reported as "<30" rather than an integer. Based on this review, the coding algorithms were revised to provide 100% accuracy for lab results.

Any documentation recorded in a narrative field type and test results from outside the CMH system that were scanned and not entered into data fields were not included in the study. Instead, a field for each element was identified or created and users were instructed to utilize those fields to get "credit" for the data during quality measurement.

Comparison of Coder Performance and Automated

Comparison of coder performance and automated data extraction/coding performance was highly significant ((mid-P exact test, two tailed, 95% CI, p<.00000001) for case identification accuracy and coding accuracy for the blood pressure, A1C and LDL data elements. There is further discussion below on some limitations of this finding.

Outcomes

- Automated data extraction, analysis and reporting were demonstrated for 62 quality measures.

- Automated data extraction, analysis and reporting were found to be more complete and accurate than manual coding for quality measures.

- Automated data extraction relied heavily on the use of custom documentation queries. One half of the 62 measures required a custom query for accurate quality measurement. Eleven of twelve additional eligibility requirements required a query and all quality measure exclusions required queries

- A standard documentation toolkit including quality measures queries was delivered to 53 LSS clients. The measures were based on those developed by CMH. They were expanded to include the ambulatory specialties not covered in the CMH study and validated by Zynx Health, Inc. The toolkit includes the ability to use the queries with the manual coding method or with automated data extraction.

Discussion

CMH coder compliance using manual coding methods was extremely low.

- Coders had no direct incentive to add the quality measures codes to these cases. Even though additional time was budgeted and allowed for this additional coding, the connection between the extra time and extra tasks did not serve as a direct incentive.

- Providers were also not provided with a financial incentive to assure that the PQRI codes were applied consistently. For the CMH rural health clinics, the providers were not eligible for the PQRI incentive payment. For the CMH specialty clinics, any incentive payment would have been paid to the organization and would not have been shared with providers under the typical terms of the employment contract utilized at CMH.

- By design no feedback was provided to the coders on their level of completeness during the study period. Feedback to providers was also not available until the automated data extraction reports were created and validated.

Use of the quality measures documentation that requires the use of new documentation queries has, so far, been low among providers at CMH.

- EHR documentation to enable capture of all PQRI data elements was implemented during this project. So far, however, provider documentation of PQRI data elements, especially for documenting measure exclusions, has been low. As intended, no feedback was given to providers on their use of the documentation queries or on their performance on the quality measures during this study.

- Strategies to improve use of the quality measurement queries may include feedback, workflow enhancements and training:

    - Feedback: As part of this project, IHM created a Web based report for CMH with the ultimate goal of providing feedback on aggregate performance. These reports were used to assist the data validation process but were not yet used for provider feedback. Feedback reports were beyond the scope of this project, but their use could increase future compliance.

    - Workflow enhancements: Within this project, documentation templates were redesigned and speech recognition was implemented. Additional training on methods to increase the efficiency and effectiveness of the use of an EHR within the context of a visit could further improve providers' use of the queries specific to quality measurement.

    - Training: Advanced training for providers and nurses on the quality measures and on the effective use of the EHR system are also indicated as methods to improve use of quality measure queries.

Using an automated method of extracting data, quality measures could be extracted and reported without providers using quality measure documentation queries at all.

- Measure exclusions. Since the measure exclusions are all captured in queries, those would not be captured and providers would simply fail to comply with the measure if they failed to document using the exclusion query – but would still succeed in reporting the measure.

- Other queries. Other queries include the "action" (for example, the results for measures, screening result or the documentation that an action was completed). Again, if the provider failed to use the queries, they would fail to comply with the measure – but would succeed in reporting the measure.

- Further evaluation on the use of quality measure queries and exclusions with timely feedback and financial incentives for performance is suggested.

- Standardization of exclusion queries and assessment documentation queries would be beneficial.

In 11/2009, the National Quality Forum (NQF) published a report titled Health Information Technology Automation of Quality Measurement: Quality Data Set and Data Flow. The study was also funded under a contract from the Agency for Healthcare Research and Quality.

In the study, the NQF Health Information Technology Expert Panel (HITEP) recommends a Quality Data Set (QDS). The QDS includes quality data standard categories, data types, sources, recorders, settings and health record fields. The recommendations serve as a framework for defining quality measures in a way that will facilitate quality measurement as a by-product of care documentation.

To accommodate the current PQRI measures, HITEP might consider including a reporting period and a performance period. Those periods are a dimension of the PQRI measures that add challenge and could be identified and refined in quality measure definitions.

The PQRI measures currently include data actions using terminology different from the QDS terminology. For example 14 PQRI measures require that something is "documented," one measure requires that the medication list is "verified," four measures look for something to be "reviewed" and another measure requires something to have been "previously received." In addition, PQRI measures include terms such as "classified," "characterized," or "interpreted." Mapping the PQRI terminology to the proposed QDS framework during quality measure definition could provide improved quality measure standardization that could facilitate quality measure documentation and automated data extraction.

In identifying and creating the sources for the data elements for quality data extraction, CMH and IHM noted these aspects of the PQRI measures that were challenging even within a fully implemented EHR system. Addressing these characteristics of the PQRI measures may serve to increase adoption and use of the measures.

- Population identification**.** Populations based on ICD9 and CPT codes are not standardized. For example, in the Diabetes indicators, five different base populations were used for different clinical measures. While some variation in eligible populations may exist, there seems to be marginal benefit for different populations defined by ICD9 and CPT codes for Foot examination and Footwear evaluation. The varied populations could be utilized within the automated approach, but complicate the implementation and maintenance of the automated system. In addition, the subtle differences in populations make it difficult for providers to know what patients have which requirements – information they may need during the process of delivering care. Within disease management systems, use of varied populations complicates not only the application of the requirements, but may complicate the user view of the results.

- Additional eligibility requirements. Twelve of the measures used in this study included additional eligibility conditions beyond age, gender, ICD9 and CPT codes. Some of these criteria are not standard medical practice documentation, such as first use of medication or no prior medical visit for back pain within the past four months. Elimination of these, where possible, could enhance use of those measures.

- Reporting periods. 42 of the 62 measures utilized in this project are required to be reported "once per reporting period." With the use of manual coding, this may be intended to decrease the effort to comply. With manual coding, it proved difficult for the CMH coders to track that they had or had not already reported a measure for a particular patient sometime previously in the reporting period. With the use of automated data extraction, it would be possible to report only once per period for each patient, but it also would not be a burden to report with every encounter

- Complex compliance requirements. 15 of the 62 PQRI measures used in this study have a result that includes two actions. For example, a result was documented and reviewed, the BMI was calculated and a plan documented, and the medication list was documented and

verified. Another 7 measures included an option for compliance. For example, a test was ordered or a medication was prescribed.

For medication verification (PQRI Measure #130), the following complicated responses are specified, each with a separate G-code:

- Current Medications with Dosages AND Verification Documented—G8427: List of current medications with dosages (includes prescription, over-the-counter, herbals, vitamin/mineral/dietary [nutritional] supplements) and verification with the patient or authorized representative documented by the provider; **OR**

- Current Medications with Dosages not Documented, Patient not Eligible—G8430: Provider documentation that patient is not eligible for medication assessment; **OR**

- Current Medications with Dosages Documented, Patient Verification not Documented, Patient not Eligible—G8507: Provider documentation that patient is not eligible for patient verification of current medications; **OR**

- Current Medications with Dosages Documented, Patient Verification not Documented, Reason not Specified—G8428: Provider documentation of current medications with dosages (includes prescription, over-the-counter, herbals, vitamin/mineral/dietary [nutritional] supplements) without documented patient verification; **OR**

- Current Medications with Dosages not Documented, Reason not Specified
  G8429: Incomplete or no provider documentation that the patient's current medications with dosages (includes prescription, O, herbals, vitamin/mineral/dietary [nutritional] supplements) were assessed

Currently, some measures are so complicated to implement that they end up being online checklists, instead of quality care data that can then be extracted as a by-product of routine care documentation.

Some PQRI measures have been simplified since the introduction of the program in 2007. The ePrescribing measure previously included four complicated responses, but will include only one response for 2010. Where measures like these above can be likewise simplified without compromising clinical accuracy and evidence based practice, the use and reporting of the measures could be increased.

Conclusions

Automated data extraction and analysis identified the eligible populations for PQRI measures better than coders were able to do so.

Automated data extraction was more accurate than manual coding for reporting quality measurement results.

Automated data extraction relied heavily on documentation queries, or data fields, for additional requirements, results and measure exclusions.

Without incentives and feedback, providers may not use of the documentation queries that are needed for accurate quality measurement.

Without provider use of those queries, quality measurement can be done, but may not be reflect the care provided.

Modifications and further standardization of the measures could improve use and measurement.

Significance

These results demonstrate that the use of a data extraction from an EHR system multiplies the ability to do quality measurement and reporting. While only 52% of providers who reported to PQRI successfully reported on three quality measures in 2009, CMH and IHM were able to extract and report on 62 measures.

The results validate that quality reporting from an EHR system is more complete and accurate than manual coding.

The results show that a large number of quality measures rely on documentation queries.

Implications

Data extraction services, which are not registries according to current definition, might be considered as another category for reporting for purposes of PQRI.

A repository of quality measure documentation queries and data fields (exclusions, additional requirements, and evidence-based assessments) would be helpful to vendors and ambulatory providers, particularly if there would be a mechanism to keep those queries and fields updated as the quality measures evolve.

Future studies are indicated on the use of quality measure queries, data fields and assessments within an EHR system. Targeted feedback, workflow enhancement and training are methods to be considered for further research.

List of Publications and Products

"Capturing PQRI Data: Lessons Learned from an AHRQ Grant" Online presentation by Denni McColm of project findings on November 12, 2009 to an audience of 105 health care professionals and clinical researchers.

"Selecting PQRI Indicators: Lessons Learned from an AHRQ Grant" Online presentation by Anita Karcz scheduled for December , 2009

The recordings of these presentations will be posted for download at the Institute for Health Metrics Web site for public access.

Journal article submissions are in progress.