Grant Final Report

Grant ID: R18HS17059

Bringing Quality Measurement to the Point of Care

Inclusive Dates: 09/30/07 – 09/29/10

Principal Investigator:
Winfred Wu, MD, MPH (project years 2 and 3)
Farzad Mostashari, MD, MSc (project years 1 and 2)

Team Members:
Sarah Shih, MPH[*]
Colleen McCullough[*]
Amanda Parsons, MD, MBA[*]
Jesse Singer, DO, MPH[*]
Sheryl Silfen, MD[*]
Mandy Smith Ryan, PhD[*]
Samantha DeLeon, PhD[*]
Samantha Catlett[*]
Maryam Khan[*]
Alan Silver, MD, MPH[†]
Veronica Pryor, RN[†]
George Hripsack, MD, MS[‡]
David Kauffman, PhD[‡]
Neil Calman, MD, MPH[§]
Kwame Kitson, MD[§]
Michelle Pichardo, MPH[§]
Jonah Pisack[§]
Lara Angelo[§]

[*] PCIP, NYC DOHMH
[†] IPRO (medical chart review collection)
[‡] Columbia University (CDSS usability design)
[§] Institute for Family Health (comparison EHR system)

Performing Organization:
New York City Department of Health and Mental Hygiene, Primary Care Information Project

Project Officer:
John White, Angela Lavenderos (close out period), Matthew Quinn (project years 2 and 3), Marybeth Farquar (project year 1)

Submitted to:
The Agency for Healthcare Research and Quality (AHRQ)
U.S. Department of Health and Human Services
540 Gaither Road
Rockville, MD 20850
www.ahrq.gov

Abstract

Purpose: To assess the impact and challenges of introducing health IT tools to assist small primary care practices in quality measurement and reporting.

Scope: This study focuses on a subset of small independent practices implementing an upgrade to their electronic health record with features to support quality of care measurement, capability to search across patients for specific clinical information, and a point of care decision support.

Methods: Electronic record review and abstraction was conducted pre and post implementation of an EHR software upgrade. Data elements and their specific location in the EHR were collected to determine whether automated reporting fully captured practice performance. Provider interviews and surveys were conducted to capture attitudes and experience towards quality measurement and challenges in improving the delivery of recommended clinical preventive services.

Results: Across 56 practices and reviews of over 6,100 patient records, most practices did not have prior quality measurement experience or engage in quality improvement activities prior to adoption of an EHR. Though most quality measures selected for this study showed improvement post CDSS implementation, many of the practices would under report their performance if using automated EHR-derived quality reporting. Providers found some documentation tasks within the EHR to be easier while other data entry processes pose challenges which have downstream effects for quality measurement and reporting.

Key Words: HIT, quality measurement, EHR, quality improvement, automated quality reports

Final Report

Purpose

This study assesses the impact and challenges of introducing health IT tools to assist primary care providers in small practices, settings with ten or fewer physicians, to measure the quality of care. In collaboration with an electronic health record (EHR) vendor, the Primary Care Information Project (PCIP) deployed new functionality that allows clinicians to view 'real time' measures of the delivery of clinical preventive services. In addition, the EHR also provides patient specific alerts and 'one click' options to act on potentially missed opportunities for follow-up care or recommended preventive services. Providers using these systems were given substantial technical support and training to use these tools. This study describes the reliability of automated quality measurement and challenges in documentation that have implications for future quality measurement and reporting.

Objectives of Study (original study aims):

1. Design a simple and intuitive point of care quality measurement and decision support user interface

2. Validate a set of automated clinical quality measures that address priority public health issues

3. Characterize provider attitudes and measure provider satisfaction with performance indicators

4. Determine the impact of the quality dashboard on the accuracy of and provider satisfaction with EHR derived quality measures

5. Disseminate findings though national measurement consensus organizations (e.g., National Quality Forum's "Standardizing Ambulatory Care Performance Measures" project), through EHR vendors participating in this project, and through peer reviewed publications

Scope

Background

Despite the evidence base for reducing morbidity and mortality, delivery of clinical preventive services has stagnated in the adult primary care setting. In particular, small, independent practices are challenged by the absence of integrated information systems, incorporation of timely and actionable information at the point of care, and adequate

reimbursement for CPS. Attempts to boost wide adoption of health IT in small practices have been challenging, due to costs and lack of technical expertise and support. Furthermore, most 'off the shelf' software for electronic health records focuses on billing, appointment scheduling, and entering information that does not allow for searching or generating patient lists or measuring the practice's progress on priority clinical preventive services. New software development was needed to address the specific needs and limited resources common in the primary care setting so that timely and usable information would be made available at the point of care.

Context and Setting

PCIP, a bureau of the New York City Department of Health and Mental Hygiene (DOHMH), has been bringing integrated care delivery systems to small primary care practices since 2008.Through a request for proposal process, eClinicalWorks™, a fully integrated EHR system, was selected as the software product that would be subsidized by the city for deployment in primary care practices serving Medicaid and uninsured populations. Some of the key features of eClinicalWorks system include flexibility of customizing the user interface (templates) and availability of structured fields for capturing clinical information (minimizing free text). eClinicalWorks was also the most selected EHR by primary care providers in a Massachusetts demonstration project for its ease of use and lower costs.[1] In addition, eClinicalWorks was willing to redesign large portions of the software to incorporate actionable patient reminders and distribute the new design features free of charge as part of existing licenses.

Participants

In order to assess the impact of the EHR changes and whether they facilitated quality measurement, practices for this study were recruited based on their adoption of EHR prior to January 2009. This would ensure practices had at least 200 patients already recorded in the EHR and had some experience using the EHR. Practices recruited were enrolled in a privately funded pilot recognition and pay-for-quality program, Health eHearts, because they had adopted an EHR prior to 2009 and through the incentive program, would be focusing on quality measurement. Of the 84 practices that were participating in Health eHearts, 56 practices, representing 154 providers, agreed to electronic record review and abstraction. Interviews were conducted, and two sets of provider surveys were administered across providers that adopted an EHR through the PCIP program.

Methods

Aim 1: Design a Simple and Intuitive Point of Care Quality Measurement and Decision Support User Interface

Study Design and Data Sources. Review of the literature and meetings with clinician advisory councils (CACs) established by PCIP helped to identify design elements incorporated

into the development of the quality measurement and decision support user interface. Based on usability testing conducted by the Department of Biomedical Informatics at Columbia University (DBMI), principles of clinical informatics were applied to the interface design and programming (e.g., non-disruptive alerts, minimal "clicks", group data entry locations natural to clinical workflow, critical or key items highlighted through color or bolded/underlined text, etc).

Intervention and Limitations. New software development and testing were conducted in collaboration by eClinicalWorks and PCIP staff. All new development with eClinicalWorks through PCIP was made available to other users of the eClinicalWorks EHR software, regardless of geographic location or affiliation with PCIP. Deployment of new EHR functionality was limited to practices that had already adopted the eClinicalWorks software prior to January 2009.

Aim 2: Validate a Set of Automated Clinical Quality Measures that Address Priority Public Health Issues

Study Design and Data Source. Software programming was generated to "hard code" 34 measures displayed in the practice's EHR and easily accessible by the provider. Though intended to be a one-time development and validation cycle, several issues were identified in the deployment process that led to further testing and additional revisions to the software programming codes residing at the practices. Practices received several upgrades and patches from eClinicalWorks throughout the study period. Instead of a one-time software validation process across practices as originally proposed, validation of quality measure reports and the clinical decision support tool became an ongoing process requiring constant review and validation on a practice by practice basis.

Quality measure reports were monitored throughout the study period and the content of automated transmission were analyzed across practices. In addition, the PCIP development team conducted visits to practices (either through WebEx or in person) to test the quality measurement calculation results. To test the "reasonableness" of data, PCIP staff would review the practice denominator and determine whether the counts or rates appeared to be unusually low by comparing what is expected for similar providers or speaking with the suspect practice's PCIP field staff to see if similar patterns were observed (e.g., if the provider is pediatrician, a low denominator for hypertension diagnosis may be appropriate). Low numerators (e.g., a value of zero or one) were also investigated for general population screening measures, as it was hypothesized that these measures were typically acted upon and low rates (e.g., < 5%) or numerators were an indication that providers either had a system configuration issue or were not using the EHR. In addition, a separate analytic team compared the monthly data collected from the quality measures against other data sources (e.g., encounter data, provider FTE, potential rise of symptoms related to infectious disease – syndromic surveillance) available within the health department. Inconsistent transmissions of data from month to month from various practices were observed. For example, a practice's denominator would drop from 15 – 20 patients to 0 or less than 5 patients, or the converse (i.e., a sudden rise in patients). In some cases, the practice was legitimately not entering data (e.g., closed for vacation); in other cases, the practice may have had a system issue or change in usability patterns. For the sudden increases, the provider may have hired a new provider or clinical assistants to increase productivity. These changes in practice transmissions of summarized data provided clues to whether changes in the practices

were due to system issues or general events that were explainable once a PCIP staff contacted the practice to verify the trends.

Measures. The NYC health department has been proactively measuring the health of its residents through indicators established by the agency in 2004. "Take Care New York," (TCNY) the city's health policy agenda, was established to monitor the top ten priority health areas that present the greatest disease burden to New Yorkers and are amenable to evidence-based intervention and improvement. These areas include cardiovascular health, diabetes, smoking, establishing a regular health care provider, HIV testing and treatment, cancer screening, immunizations, depression screening and treatment, alcohol and substance abuse screening and treatment, and appropriate treatment of asthma. For a full description, go to: http://www.nyc.gov/html/doh/downloads/pdf/public/dohmhnews3-02.pdf.

The TCNY policy was the basis for the the quality measure selection embedded in the EHR in use by primary care practices and supported by PCIP's program. A total of 34 TCNY adult primary care prevention reminders were programmed into the EHR upgrade, eClinicalWorks version 8.0, sometimes referred to as the "TCNY build." In addition, to further focus providers on key actions, a core set of cardiovascular care measures (ABCS) was established as the city's highest priority for improvement (Exhibit 1). These core measures were selected based on projections of 500 providers consistently delivering clinical preventives services to 80% of their eligible patient population for a decade across the ABCS measures, which would potentially avert 5,000 deaths from heart attack and stroke. The ABCS measures address some of the same priority areas cited by the Institute of Medicine. In addition, addressing performance on the ABCS measures would have significant impact on reducing the known top contributors to death and morbidity in the city. This includes ischemic vascular disease (estimated to be over 80,000 per year), followed by other chronic disease conditions, such as hypertension and diabetes, as well as underlying causes of death and disease by smoking. Definitions for all embedded quality measures were based on those available in the National Quality Forum (NQF) repository, and some were slightly modified to be deployed in the EHR setting. In one measure, recorded body mass index (BMI), PCIP drafted and submitted a measure for endorsement by NQF as no measure existed for BMI at the time of the development process.

Table 1. Description of ABCS quality measures

Area	Description
Anti-thrombotic Therapy	Ages 18 years or older with Ischemic Vascular Disease or ages 40 years or older with Diabetes on aspirin or another anti-thrombotic therapy
Blood Pressure Control	Patients 18-75 years of age with Hypertension, without Ischemic Vascular Disease or Diabetes who have a BP < 140/90
Blood Pressure Control	Patients 18-75 years of age with a diagnosis of Diabetes AND Hypertension with the most recent BP below 130 systolic and 80 diastolic
Blood Pressure Control	Patients 18-75 years of age with a diagnosis of Ischemic Vascular Disease AND Hypertension without Diabetes with a BP below 140 systolic and 90 diastolic
Cholesterol Control	Male patients >= 35 years of age and female patients >=45 years of age without Ischemic Vascular Disease or Diabetes who have a total cholesterol < 240 or LDL < 160 measured in the past 5 years
Cholesterol Control	Patients 18-75 years of age with a diagnosis of Ischemic Vascular Disease or Diabetes and Lipoid disorder who had a LDL < 100 in the past 12 months
Smoking Cessation	Patients ages 18 years or older identified as current smokers who received cessation interventions or counseling

Aim 3: Characterize Provider Attitudes and Measure Provider Satisfaction with Performance Indicators

Study Design. Two separate sets of surveys were administered to providers. The first set of surveys was administered only to small practices participating in the Health eHearts pilot pay-for-quality program. The second set of surveys were administered to all providers participating in PCIP, including those practicing in community health centers (CHC) and hospital affiliated outpatient settings. Both sets of survey were designed to establish baseline attitudes and experiences and allowed for re-measurement of selected attitudes or experiences at a later time point.

Data Collection. Key informant interviews were conducted in June to August of 2008, to refine an item set for assessing provider experience and attitudes towards quality measurement and pay-for-performance. In April 2009, surveys were administered to all clinicians that were recruited for the Health eHearts pilot pay-for-quality program, implemented an EHR prior to 2009, had at least 200 patients with a diagnosis of hypertension, diabetes, or dyslipidemia, and self-identified as practicing family, internal, or geriatric medicine. A follow-up survey was administered to this same group in September 2010.

A broader survey was administered to all providers enrolled in PCIP, including those practicing in community health centers or hospital affiliated outpatient clinics. Surveys were administered at two time points: the first, prior to their EHR adoption, and the second, six months post EHR use (pre-EHR adoption survey administration began in March 2008). Responses to the survey were analyzed to identify common facilitators and barriers that impact the use of HIT for quality measurement or delivery of clinical preventive services. Simple frequencies or descriptive statistics were generated from the survey responses collected.

Aim 4: Determine the Impact of the Quality Dashboard on the Accuracy of and Provider Satisfaction with EHR Derived Quality Measures

Study Design. Practices enrolling in the Health eHearts program (N=84) were recruited to participate in a two by three factor randomized trial. Half of the practices were randomized to receive monetary incentives for each patient that that achieved the ABCS measures. Incentives were higher for patients with either a co-morbid condition or priority insurance type such as Medicare or uninsured. In combination, practices were also randomized to receive CDSS versions that either aligned with the ABCS measures that were tied to the incentives, not tied to incentives (non-ABCS), or all reminders for the 34 TCNY measures. The hypothesis of the 2X3 way design was that practices with both incentives and reminders for ABCS would have the fastest improvement and highest achievement rates on the ABCS measures. Practices with no incentives and no reminders on the ABCS would have the slowest improvement and lowest performance on the ABCS. Those with incentives but all reminders would have moderate improvement and performance. We also hypothesized that practices with incentives would consistently have faster improvement and higher performance on the ABCS than those without incentives. However, due to software bugs within eClinicalWorks, the randomization of the CDSS reminders were not maintained according to assignment and practices received a mixture

of reminders, without any discernable grouping to allow for testing the interaction between incentives and CDSS. An intention-to-treat analysis is in progress to assess impact of incentives and reminders on improving the documentation and performance on the ABCS measures.

Data Collection. Despite the failure of randomization, the study continued with electronic record review and abstraction with 56 practices to assess the documentation and location of necessary data elements for calculating ten automated quality measures before and after the implementation of CDSS (see Exhibit 2 for a description of the measures). The manual chart review abstraction identified whether a necessary element for quality measurement was present for a patient pre and post CDSS and where the clinical information was documented. The presence and location of clinical information allowed us to assess whether providers were more likely to document in the locations captured by the automated reporting pre and post implementation of CDSS.

Table 2. Description of quality measures abstracted from electronic record reviews

Quality Measure	Eligible patients	Patient Goal
Body Mass Index	Patients 18+	BMI recorded in past 24 months
Breast Cancer Screen	Female patients 40+	Mammogram conducted within past 24 months
Smoking Status	Patients 18+	Smoking status recorded in the past 12 months
Aspirin	Patients 18+ with ischemic vascular disease or 40+ with diabetes	Taking Aspirin/other Antithrombotic therapy
Blood Pressure Control	Patients 18-75 with hypertension with or without diabetes	Without diabetes: Systolic <140, Diastolic <90 With diabetes: Systolic <130, Diastolic <80
Cholesterol Control	General population: Male (35+) or female (45+) patients with no prior diagnosis and total cholesterol and/or Low Density Lipids (LDL) tested in the past 5 years	General population: LDL <160 or total cholesterol <240
Cholesterol Control	High risk: Patients 18-75 with dyslipidemia and (IVD or diabetes) and LDL tested in the past 12 months	High risk: LDL<100
Hemoglobin A1c Screen	Patients 18-75 with diabetes	A1c test recorded in the past 6 months
Hemoglobin A1c Control	Patients 18-75 with diabetes and A1c tested in the past 6 months	A1c level <7
Smoking Cessation	Patients 18+ with a "current smoker" smoking status	Smoking cessation intervention (Rx or Counseling) received in the past 12 months
Influenza Vaccination	Patients 50+	Patient received flu shot from the most recent September 1

For each practice, 120 patients age 18-75 years with at least one established patient visit in the past year were randomly sampled for data abstraction. Chart reviewers were instructed to look for the presence or absence of data elements necessary to determine whether a patient was eligible for the quality measure and if eligible, met the treatment or prevention goal. In addition, the location of each data element was recorded, along with dates of services.

Table 3. Items abstracted from the medical records and location searched in the record

Data elements abstracted from records	Location of data elements in the record
Diagnoses: diabetes, hypertension, IVD, dyslipidemia **Vitals**: BMI, BP **Labs**: A1c, LDL, HDL, total cholesterol **Smoking status** **Diagnostic:** mammogram	Problem list Vitals Medical/social history Medication lists Lab tests Procedures Diagnostic imaging Smart form

Data elements, along with the location in which they were documented within the patient chart, were used to calculate actual versus EHR-derived rates in the delivery of clinical preventive services. The software currently relies on specific structured fields within the EHR, such as the problem list for diagnoses, smart form for smoking status, and the demographics section for age and gender, to determine whether a patient is eligible for a quality measure or prevention. The patients meeting the preventive service goal of the automated quality measure are also determined by only a limited set of structured fields. For example, for smoking cessation intervention, documentation of a patient's smoking status for the denominator must be located within the smart form and the intervention must be documented as counseling, a prescription, or referral to the NYS Fax-to-Quit program. However, providers have documented the status and interventions in locations of the EHR (e.g., Social history, preventive medicine, patient documents) that will not be recognized by the automated quality measurement software.

For each patient visit per time period, a binary score was created to indicate whether the patient was eligible for a specific quality measure and if the patient received the appropriate intervention. For example, patients with hypertension would receive "1" for eligibility, which would later be summarized for the denominator for the blood pressure control measure. Patients with hypertension and a blood pressure reading of less than 140/90 would receive a "1" for achieving the recommended goal, which would be summarized for the numerator of the blood pressure control measure. Binary scores per patient by chart review period for ten quality measures were calculated using Microsoft Access SQL queries.

Aim 5: Disseminate Findings Though National Measurement Consensus Organizations (E.G., National Quality Forum's "Standardizing Ambulatory Care Performance Measures" Project), Through EHR Vendors Participating in This Project, and Through Peer Reviewed Publications

PCIP staff have received invitations to present at national conferences and have also sought out venues to submit abstracts to disseminate preliminary findings. In addition, findings or issues identified through the study were regularly communicated to staff at eClinicalWorks at weekly meetings.

Results

Aim 1: Design a Simple and Intuitive Point of Care Quality Measurement and Decision Support User Interface

Principal Findings. The monthly Clinical Advisory Committee meetings defined a wide range of functionality that was desirable to providers. However, not all requested items could be incorporated in the new version. PCIP discussed with eClinicalWorks software limitations and feasibility issues to narrow down the features of interest and prioritize critical elements for inclusion in the software upgrade. The development and testing of the quality measurement and clinical decision support tool took longer than originally anticipated. Though the roll out was intended for early 2008, the actual deployment did not begin until a year later. Deployment of the upgrades to practices that had already implemented an EHR took over six months. Practices were advised to apply the changes to their software after hours to avoid disruption and that the upgrade could take a couple of hours. Because the software needed to be applied to individual practices, the upgrades depended on availability of the practice's schedules and coordination with eClinicalWorks. With the delayed deployment of the software upgrades, a no-cost extension was requested in order to conduct the data collection and assess the impact of the new features on quality measurement, and perception of the system features.

New features of the EHR that focus on quality measurement and reporting included:

- Enhanced Registry: a robust searching tool across patient records allowing providers to identify groups of patients by most structured fields entered in the EHR (e.g., diagnoses, drugs, labs, demographics, service dates)

- Clinical Decision Support System (CDSS): a non-disruptive clinician reminder feature located in the right pane of the screen available at the point of care and specific to each patient. CDSS allows providers to take appropriate action to meet recommended clinical preventive care guidelines, or remove the patient from the measurement cohort due to valid exclusions or contraindications. This feature was intended to help providers "do the right thing at the right time" for their patients. CDSS displays all the preventive service opportunities for a specific patient at the time of the visit in a side panel and then are suppressed when addressed (e.g., patient has diagnosis of hypertension and blood pressure doesn't meet recommended guideline goals, review if drugs are already prescribed, once prescribed, reminder disappears. The reminder for blood pressure control will reappear if the levels remain above recommended guideline levels).

- Comprehensive Order Sets: one-click ordering of recommended preventive services and display of best practice recommendations (e.g., generic medications, laboratory tests, referral for diagnostics or procedure, patient education)

- Measure Reports: real time reports within the EHR that display a provider's overall performance on quality measures derived from the CDSS preventive service reminders (e.g., number of patients with hypertension and blood pressure controlled to goals according to recommended guidelines)

Screenshot or demonstrations of these features can be arranged by request (www.nyc.gov/PCIP).

Discussion. By August 2009, most providers were using a version of eClinicalWorks with the quality measurement and clinical decision support tools. All providers adopting an EHR post January 2009 have these features. Nearly all practices that adopted prior to 2009 accepted the software upgrade. In very few cases, several practices did not upgrade to the new version because their existing software required considerable reconfiguration that would be been severely disruptive to the practice.

The approach for Health IT adoption by PCIP has resulted in a 95% success rate in EHR implementation. Success was measured by number of practices still using the EHR adopted through PCIP after the initial two years of the software subsidy provided by city. Approximately half of the practices that have graduated from the city subsidy have joined the regional extension center to pursue Meaningful Use incentives from the Centers of Medicare and Medicaid Services. All components of PCIP were developed with an emphasis on integrating evidence based prevention guidelines into Health IT so that providers can focus on delivering "health care as if health mattered."[2]

Implications. Recognizing that technology alone would not transform the delivery of primary care, PCIP offered additional support, apart from this study, to assist in quality improvement. Practices that upgraded their EHR to eClinicalWorks version 8.0 received extensive on-site training in using the CDSS and quality reporting tool as well as bimonthly in-person visits from quality improvement specialists to help practices fully utilizes the functions through workflow redesign. Practices also received guides with step-by-step instructions for running registry reports, coding for billing, using CDSS to better manage patients, interpreting quality measurement reports, and applying for patient centered medical home recognition.

Aim 2: Validate a Set of Automated Clinical Quality Measures that Address Priority Public Health Issues

Principal Findings. The validation issues encountered throughout the study have been substantial and have made it difficult to ascertain practice performance. Despite these challenges, a semi-automated extraction process was developed (i.e., sending a person to each practice to extract summarized data and calculate the practice's quality measures) and used to confirmed the observed trend that most practices are improving their performance on quality measures, as well as increasing the number of patients entered in the EHRs. The semi-automated extraction also assisted in detecting whether practices were either not fully using the EHR or had substantial configuration issues (e.g., a multi-physician practice had fewer than 10 patients with hypertension per year). Below is a summary of issues identified throughout the study and impacts to the validity of automated measure reporting across practices.

- Documentation for assigning the primary care provider (PCP) or primary care giver (PCG). These designations are used to assign patients to providers in the CDSS and quality reporting tools. Not all providers followed the same assignment conventions. In cases of solo practices, if a patient is not assigned, they will not appear on CDSS and hence will not be reported in the automated measures.

- Mapping of data elements or structured fields for automated quality reporting. Some practices receiving the software upgrade required manual mapping of data entered by providers to the program logic that derives the quality measure or reminders. Not all practices had their software appropriately mapped and the vendor has identified solutions to resolve the mapping differences across a handful of practices.

- Differing interpretation and implementation of time intervals. PCIP and eClinicalWorks had different interpretations of the reporting and application of recommended guidelines that determined the allowable window of time when a service should be delivered. Some examples include:

    - Anchoring clinical goal or target to most recent encounter: measurement intent was to assess for the most recent encounter whether a patient had met a recommended treatment guideline. However, the programming calculated if a patient ever met the target in the past or prior to the most recent encounter within the reporting period. This would potentially overestimate the numerator for patients seen by a provider more than once in a reporting period.

    - "Look-back" period (time interval suggested by care guideline of when providers could have met and treated patients): patients were not assessed based on the time period between their most recent encounter and the look-back period. Rather only encounters meeting numerator and denominator definitions were counted within the last six months of the reporting period, thus setting the look back period as 6 months from the end of the reporting period for all measures. This may undercount patients that have met the target during the first six months of any one year reporting period or patients that met the numerator criteria prior to the reporting period but within the "look-back" period.

- Variation in the definition of an "office visit." All quality measures assumed that an office visit was based on a physical encounter (in-person visit) with the provider in order to be eligible for the measurement denominator. However, the data in the EHR for scheduling could potentially include no-shows or canceled visits depending on how a practice coded or customized their appointment flags. These types of visit were included as encounters and potentially inflated the denominator for some practices.

- Other system bugs or usability issues:

    - Not including a specific diagnosis group in the denominator (cholesterol control for patients with diabetes or ischemic vascular disease)

    - Vitals or lab results entered by practice after the visit were not kept or saved into the record

    - Opening and closing forms would inadvertently meet measure numerator criteria (e.g., patients were automatically considered numerator compliant for smoking cessation intervention if the provider opened and closed the form without any further action).

Discussion. The attempts to validate a set of automated clinical quality measures were challenging, and nearly impossible given the architecture in place for deriving quality measures across hundreds of disparate practices and in effect, systems. Though all practices in this study were using eClinicalWorks, the flexibility of the software to allow user customization introduced variation in the data entry and subsequent automated extraction for quality measurement and reporting. In addition, not all software patches were applied to every practice, as some refused the patches or no issues were reported requiring a patch. The heterogeneity of the software configurations across practices contributed to the complexity of validating the quality measures and reports originating from practices.

Implications. Iterative patching and upgrades, as well as applying fixes to correct EHR system issues introduced variability in the practice's ability to report consistently on selected measures as certain features of the EHR had to be corrected or "debugged" to appropriately reflect practice performance on quality measures. In consultation with eClinicalWorks, programming codes used to derive measures were revised and re-deployed. However, given this architecture, future attempts to modify programming to automate quality reporting would be cumbersome, disruptive to practices, and not scalable (Note: the study focused on upgrading and patching 84 independent practices that took nearly six months; currently, PCIP is supporting over 500 independent practices using an EHR). The process of upgrades and patches led to the unintended consequence that practices became reluctant and had many reservations in accepting future upgrades to their software. An alternative architecture that would be less disruptive to the practice's systems is undergoing testing and is projected to be widely adopted by 2012. The new architecture does not require the practice to have the corrected programming for extracting information for quality measurement reporting. Rather, queries will be built and sent to the practices for extraction over a secure portal, and only summarized information (e.g., counts of patient with diabetes) would be retrieved. This avoids the requirement of having the corrected quality measurement queries embedded at the practice's EHR.

Aim 3: Characterize Provider Attitudes and Measure Provider Satisfaction with Performance Indicators

Principal Findings. A strong impetus of bringing measurement to small practices is to increase the delivery of key clinical preventive services. Several reports have indicated that having access to timely information and measurement may not be enough to motivate or sustain provider engagement on priority preventive services, especially in an environment where reimbursement is substantially higher for treating the sequelae of a chronic condition. Providers participating in the Health eHearts program were surveyed regarding their experience and attitude toward quality measurement for improvement, reporting for health plan accountability and incentive purposes.

Key informant interviews indicated that providers were motivated and concerned with:

- clinical relevance of measures (agree with guidelines but difficult or infeasible with their patient population)
- data integrity (distrust with external data sources historically used, inaccurate lists of patients)

- perceived benefits of measuring quality ("what's in it for the practice?")

- perceived burdens/challenges to measuring quality (time and effort needed to collect data, verify information to health plans)

- physician control over attaining quality targets (rewards sound nice but it is up to the patients)

Across the informants, those that were more engaged with quality improvement saw the benefits and importance of quality measurement, where as those less experienced with quality improvement perceived measurement as an issue of compliance and a necessary operational hassle.

A 30 item survey was administered; 95 providers from 65 small practices (71% of 134 providers and 84 small practices) responded to the baseline survey in April 2009. Respondents served largely lower income populations; 66% of practices had 30% or higher patient populations that were Medicaid or Uninsured. Across the respondents, receipt or use of quality reports were the least frequent type of quality improvement; nearly 28% reported never engaging in quality improvement activities. The reasons most frequently selected by respondents for not engaging in improvement activities were "I don't have the staff needed to do it" (77%), followed by "I don't have the tools needed to do it" (37%), and "I don't know how to do it" (35%). Further confirmation of the resource impact on quality measurement and improvement was that 78% of solo offices did not engage in any QI activities compared with 22% of practices with 2 or more providers. The most frequently selected barrier for achieving the "ABCS" quality targets was patient noncompliance, followed by "agree with recommendation but forget to apply." Regression analysis suggests that practice size, previous experience with quality measurement, and having conducted quality improvement on any of the four "ABCS" are associated with active engagement in quality measurement and reporting. Additional analyses are being conducted to assess if small provider practices were actively using the tools from the EHR to assess gaps in care for their patient population.

A 20 item follow-up survey was administered to providers in September 2010. Data collection continued after the end of the grant period to improve the response rate, and the latest count included 42 completed surveys out of 93 of control group participants (45% response rate) and 65 completed surveys out of 118 of incentive group participants (55% response rate), resulting in a total of 107 responses (51% response rate). A total of 93 completed surveys were available for inclusion in this report: 39 from non-incentivized practices and 54 from incentivized practices. Responses from the surveys are being entered and tabulated for items that correspond with the baseline survey. Additional items, not included in the baseline survey, addressed provider experience with different components of the Health eHearts program (e.g., quality reports, clinical decision support system alerts, additional on-site visits with quality improvement specialists; incentives and payment report – only for incentivized practices). Early results from practices receiving monetary incentives suggest that providers found the payment reports were the most useful and positive in experience (79.2%), whereas access to a quality improvement specialist was the least frequently selected response choice (22.2%). For the non-incentivized practices, clinical decisions support system alerts (74.4%) was the most frequently selected program feature that was useful in improving the practice's achievement on the ABCS quality measures. In comparing available program features to both incentive and non-

incentivized practices, access to a quality improvement specialist was ranked higher by the non-incentivized practices (43.6%) than by incentivized practices (22.2%).

Through a general provider survey collection process, a total of 674 surveys were collected from practices joining PCIP for the pre-EHR implementation period and 445 responses for the 6-month post-EHR implementation period. Response rates varied depending on the collection cycle and can range between 35% – 67%. Average overall response rate for the pre-EHR implementation survey was 57% and 51% for the 6-month post-EHR implementation survey. Roughly half (54%) of the respondents in the pre-EHR implementation survey were from small independent practices. A majority of respondents (71%) for the 6-month post-EHR implementation was from small primary care practices. Smaller practices had higher response rates as a few CHC or hospital clinics have declined to participate in surveys.

Providers in the pre-survey generally expressed positive attitudes in anticipating EHR functionality (Exhibit 4). Most had had previous experience using automated chart documentation (70.2%), orders of prescriptions (68.1%), results reporting (65.6%), and other order entry (61.7%). Providers had less experience with referral orders (41.1%), tracking (28.0%), and decision support tools (29.1%). Providers were also asked about their satisfaction with their current processes (e.g., "indicate your level of satisfaction with the way you currently complete the following tasks"). Of the respondents, more than half (61%) expressed dissatisfaction with their current method of tracking recommended preventive services for their patients.

Table 4. Attitudes towards tasks prior to EHR adoption (674 respondents)

Table 4a. Functionality where more than 50% of respondents were dissatisfied or very dissatisfied with their current methods

Functionality	%
Making a list of patients based on diagnosis or history	70.7%
Contacting patients to remind them of care for which they are due	65.2%
Keeping track of preventive health services	61.9%
Reviewing referral information from sub-specialists	60.0%
Monitoring patient medication adherence	58.3%
Communicating referral information to sub-specialists	57.9%
Assisting patients in self-management activities	54.4%

Table 4b. Functionality where about 50% of respondents were dissatisfied or very dissatisfied with their current methods

Functionality	%
Keeping medication lists	53.1%
Monitoring medication safety at the point of prescribing	51.2%
Keeping problem lists	49.4%
Documenting CPT and ICD-9 codes for billing purposes	44.3%

Table 4c. Functionality where less than 50% of respondents were dissatisfied or very dissatisfied with their current methods

Functionality	%
Reviewing laboratory and radiology tests	33.5%
Applying clinical practice guidelines	29.2%
Writing prescriptions	28.0%
Ordering laboratory and radiology tests	26.0%
Documenting histories	24.7%
Documenting physical exams	23.4%
Documenting allergies	19.2%

In the post-EHR implementation survey, providers were asked about their attitudes and experience towards tasks at least 6 months after using the EHR (e.g., "Compared to previous routines, how has the EHR changed the performance of the following tasks?"). More than 60% of respondents reported that tasks were generally easier, with the exception of assisting patients in self-management activities (e.g., goal setting, patient education), communicating referral information to sub-specialists, reviewing information from sub-specialists, and monitoring patient medication adherence (see Exhibit 5). In addition, a quarter of respondents reported that certain tasks were more difficult after EHR adoption: contacting patients to remind them of care for which they are due (e.g., postcards, phone calls, emails) and ordering appropriate preventive care services (e.g., mammograms or flu shots) during the visit. Additional analyses matching practice responses across the surveys are underway and will also adjust for provider and practice characteristics.

Similar to other reports in the literature, providers reported that the EHR increased the amount of time needed to see the same number of patients (54.4%) and did not decrease the amount of time spent talking to patients (64.1%). However, most found that the EHR was "useful for my job" (94.5%), easier to access patient information from outside the office (71.1%), and improved their ability to provide preventive care (68.9%). Additional subgroup analyses will be conducted to assess whether there are experiential differences for practices that received CDSS as part of their initial EHR software package vs. practices that had to upgrade to receive CDSS after several months using the EHR.

Table 5. Provider attitudes towards tasks after 6 months of EHR (445 respondents)

	% of Respondents: Easier	% of Respondents: No Change	% of Respondents: More Difficult
Monitoring medication safety at the point of prescribing (e.g., drug-allergy, drug-drug interactions)	81.2	5.9	12.9
Keeping medication lists updated	80.1	12.8	7.0
Keeping problem lists updated	80.0	9.4	10.6
Renewing prescriptions	79.8	6.4	13.8
Documenting CPT and ICD-9 codes for billing purposes	77.7	14.1	8.2
Making a list of patients based on diagnosis or history	77.4	5.6	17.0
Documenting physical exams	73.8	20.0	6.1
Writing prescriptions	71.8	13.2	15.0
Documenting allergies	69.1	12.7	18.2
Contacting patients to remind them of care for which they are due (i.e. postcards, phone calls, emails)	68.9	4.2	27.0
Reviewing laboratory and radiology tests	68.1	18.4	13.5
Documenting histories	64.8	25.2	10.0
Ordering laboratory and radiology tests	62.0	25.1	12.9
Ordering appropriate preventive care services (e.g., mammograms or flu shots) during the visit	60.9	10.3	28.8
Assisting patients in self-management activities (e.g., goal setting, patient education)	59.0	3.7	37.3
Communicating referral information to sub-specialists	54.6	7.6	37.7
Reviewing information from sub-specialists	48.7	9.5	41.8
Monitoring patient medication adherence	42.9	4.4	52.7

Discussion. Provider surveys have generated a rich source of information in understanding the impact of the software changes and challenges encountered by practices. However, the

survey administration to achieve reasonable response rates requires a substantial effort and is perceived as an additional burden by providers (e.g., concerns of survey fatigue). Because of the constant changes with health IT and requirements, "shadowing" a sample of practices or conducting repeated in-depth interviews over the course of may be more appropriate in this study setting.

Implications. To understand which practice and provider characteristics are associated with high performance and improvement on the ABCS, further analyses are being conducted to associate provider attitudes and experiences with performance on the ABCS.

Aim 4: Determine the Impact of the Quality Dashboard on the Accuracy of and Provider Satisfaction with EHR Derived Quality Measures

Principal Findings. A total of 154 providers from 56 practices, with a full time equivalent of 89.2 were recruited to participate in electronic record review and abstraction. Collectively, over 90,000 patients between the ages of 18 and 75 were seen by the participating practices. Using the practices' registry function, 57.4% (51,848) of the patients served were female and 11.3% (10,186) were ages 65 years or older. The majority of participating practices were solo or two person practices (74.1%) with at least 1 full time equivalent clinician; 96.4% had only one practice site. Nearly half (42.7%) of the practices saw 1,500 to 5,000 patients per year. The earliest practice adopted an EHR in August 2007, and the latest in November 2008. The average practice had implemented an EHR for 11.0 months (range of 1.9 to 37.1 months) prior to upgrading to a version with the CDSS. Of the patients sampled, 58.8% were female and 55.8% were age of 45 years or older. The predominant diagnoses were hypertension (34.5%) and dyslipidemia (30.9%). The average number of visits per patient was 3.5 in time period 1 and 2.7 in time period 2. Over 6,100 patient electronic records were reviewed and used to derive actual vs. EHR automated quality measures pre and post the EHR software upgrade.

Automated, EHR-derived quality measures were compared with the electronic record review[a] performance for ten quality measures. Preliminary results indicate that little difference exists for measuring performance on antithrombotic therapy, blood pressure control, body mass index recorded, and smoking cessation intervention. However, there are substantial documentation differences for breast cancer screening, hemoglobin A1c screening and control, cholesterol screening and control, and documented smoking status. Measures with the least under reporting due to automation of calculated rates from EHR typically had 99% or higher documentation in structured fields (e.g., vitals section, problem lists for diagnoses, and medication lists). Measures with the most under reporting due to automation of calculated EHR could be categorized into system integration issues or provider workflow preferences that led to documentation as free text or other structured fields not currently captured with the software programming.

An example of a system integration issue is the laboratory interface, a component of the EHR for computerized orders of laboratory diagnostics and receipt of results to be auto-populated in

[a] The actual performance on a quality measure at a practice is calculated using the presence of clinical information anywhere in the medical chart review. The EHR derived performance on a quality measure is limited to structured fields referenced in the software program.

structured fields. Many practices with lower volumes of patients have had difficulty establishing an interface with laboratory vendors, as there are costs and technical supports necessary to properly map software elements to be transferred and incorporated into a practice's EHR. Practices with an established interface can easily order labs, but may have trouble receiving results as structured data. Lab results returned as a scanned document or via fax require additional data entry and often are not incorporated into structured fields. Similar issues have been identified for mammograms which are typically not conducted at the primary care facility. Preliminary results in estimating the loss of information due to incomplete capture for quality measure for laboratory tests averages around 40%.

Discussion. Nearly all practices participating in PCIP showed trends in improving their performance on quality measures across the ABCS. Trends were validated from the electronic record reviews. Analyses of the overall practice performance showed significant increases from pre to post EHR software upgrade for A1c Screening, antithrombotic therapy, blood pressure control, body mass index recorded, influenza vaccination, and smoking status recorded. With the exception of influenza vaccination, increases ranged from 5 – 20 percentage points per measure (Exhibit 6). No significant changes were observed for A1c control, cholesterol control, and smoking cessation intervention. Additional analyses are being conducted to incorporate practice level characteristics to determine if there are other potential effects contributing to the increase in performance (e.g., technical assistance from PCIP, use of specific CDSS measures, incentives from Health eHearts). However, the impact of each individual effect may not be distinguishable as the randomization of CDSS reminders was not kept. A manuscript summarizing these results is in progress, with a target submission date in early 2011.

Table 6. Average practice performance on quality measures pre and post CDSS

Total Number of Practices = 54	Practice Average % of Patients meeting quality goal: Pre CDSS	Practice Average % of Patients meeting quality goal: Post CDSS	Practice Average % of Patients meeting quality goal: Difference
A1c Control	29.4	29.1	-0.3
A1c Screening	45.1	64.9	19.8*
Aspirin Therapy	45.3	52.7	7.4*
Blood Pressure Control	45.9	54.8	8.9*
Body Mass Index recorded	64.9	77.7	12.8*
Breast Cancer Screening	21.4	31.3	9.9*
Cholesterol Control	76.3	77.4	1.1
Influenza Vaccination	19.3	22.4	3.1*
Smoking Cessation Intervention	32.1	31.2	-0.9
Smoking Status recorded	77.9	84.3	6.4*

* T-test, p-value <0.05

Implications. Because automated quality measurement reporting requires the capture of structured data fields to calculate accurate numerators and denominators, measures that are highly dependent on practice workflows will be most susceptible to accurate data capture. For example, when capturing a patient's smoking status (current, former or never smoker), for the eClinicalWorks software, this information must reside within the smart form that is often conducted as part of the intake process for an annual exam. However, if patients quit smoking or become smokers, clinicians will now need to find the form to revise the patient's status. This

type of workflow is less intuitive for most clinicians and cumbersome. Other EHR systems may be exploring natural language processing for similar sections of the record to make the data entry more consonant with medical training and lessen the data entry tasks. Alternatively, additional interviews and usability studies can be used to identify provider's natural workflow tendencies and influence the design of quality measures and data element capture in future software upgrades and revisions. Additional analyses are being conducted to understand common patterns and the variations of documentation across practices.

The current results are limited to the eClinicalWorks system. Additional data have been collected and are being analyzed for the EPIC system. This work is being conducted in collaboration with the Institute of Family Health, led by Neil Calman and his team.

Aim 5: Disseminate Findings Though National Measurement Consensus Organizations (E.G., National Quality Forum's "Standardizing Ambulatory Care Performance Measures" Project), Through EHR Vendors Participating in This Project, and Through Peer Reviewed Publications

The interview guide and surveys described in this report are available on the Agency for Healthcare Research and Quality's Health IT Tools website (http://healthit.ahrq.gov). As additional analyses are being conducted, results of the documentation issues with vendors and national measurement bodies have been shared with regional extension centers. In addition, several senior staff from PCIP have been in direct communication with the Office of the National Coordinator and advisory bodies that select measures and their design. Though the final results have yet to be published in a peer-reviewed journal, manuscripts are in process with plans to submit them in early 2011.

Inclusion of AHRQ Priority Populations

PCIP began extending EHRs for the primary goal of improving the delivery of recommended clinical preventive services. As an early EHR extension program, PCIP was supported by a combination of city, state, federal and private funds. Program operations of PCIP support the adoption and use of EHRs among primary care providers in neighborhoods with the greatest health disparities – East and Central Harlem, the South Bronx, and Central Brooklyn. An analysis of the zip codes of participating practices mapped to census tracks s indicates that 59.8% of patients are minority race/ethnicity and 17.9% live below the Federal poverty line. Nearly 80 of the 154 participating providers are spread over 20 sites where over 30% of patients live below the poverty line and nearly 85% are minority. As a regional extension center for New York City, all software based interventions described in this grant have been deployed to over 2,200 providers representing nearly 500 independent practices, including small primary care practices with less than 10 providers, community health centers, and outpatient clinics associated with hospitals. All practices serve a minimum of 10% of patients with Medicaid insurance or self-pay (uninsured).

References

1. Mostashari F, Tripathi M, and Kendall M. A Tale Of Two Large Community Electronic Health Record Extension Projects. Farzad Mostashari, Micky Tripathi, and Mat Kendall, *Health Aff* March 2009 28:2345-356

2. Frieden TR, Mostashari F. Healthcare as if health mattered. *JAMA*. 2008 Feb 27;299(8):950-2

List of Publications and Products

Drafts of manuscripts are in progress. The manuscripts will address the following three areas as a result of the grant:

- Rapid increase in documented of clinical preventive services in small independent urban practices after EHR adoption
- Using EHR for documenting and capturing quality measures – which measures can reliably report on provider performance?
- Provider experiences pre and post EHR implementation and impact on quality measurement

Presentations

Poster presentation at the AHRQ Grantee Conference, June 2-4, 2010: Bringing Population Health Measurement to Small Practices (C McCullough, S. Shih, A. Parsons, W. Wu)

Oral presentation at the Academy Health Annual Research Meeting, June 27-29th, 2010: Trends in utilization of preventive services in medically under-served communities among small urban practices that have recently adopted health IT (S. De Leon, S. Shih)

Poster presentation at the Academy Health Annual Research Meeting, June 27-29th, 2010: Do small practices that implement at the start of a citywide EHR subsidy program differ from practices that join at the later portion of the program? (S. De Leon, S. Shih)

Poster presentation at the Academy Health Annual Research Meeting, June 27-29th, 2010: Orienting Small, Urban Practices in Poorer Neighborhoods towards Healthcare Quality: Providers' Perceptions and Experiences with Quality Measurement and Pay-for-Quality (M Smith Ryan, S. Shih, N. Bardach, R. A. Dudley)

Panel presentation at the Academy Health Annual Research Meeting, June 27-29th, 2010: Health Information Technology Policy and Evaluation From the City and State Perspective (R. Block, R. Kaushal, and S. Shih)

Oral presentation at the 9th Annual International Society for Disease Surveillance Conference, December 1-2nd: Where's the Data? Accuracy of Automated EHR Reporting (C. McCullough, S. Catlett, S