

***Grant Final Report***

**Grant ID: R18HS018275**

---

**Bringing High Performing Systems to Small Practices**

**Inclusive Project Dates: 09/30/09 – 07/31/13**

**Principal Investigator:**

Amanda S. Parsons, MD, MBA

**Team Members:**

Sarah Shih, MPH

Colleen McCullough

Jesse Singer, DO, MPH

Sheryl Silfen, MD

Mandy Smith Ryan, PhD

Samantha DeLeon, PhD

Alan Silver, MD, MPH

Veronica Pryor, RN

Lawrence Casalino, MD, MPH

Andrew Ryan, PhD

Tara Bishop, MD, MPH

**Performing Organization:**

New York City Department of Health and Mental Hygiene Bureau

Primary Care Information Project (PCIP)

**Federal Project Officer:**

Vera Rosenthal

**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](http://www.ahrq.gov)**

# Abstract

**Purpose:** Determine the impact of health information technology (HIT) on clinical quality measures and to what extent other factors, such as technical assistance, receipt of practice performance reports, as well as practice or physician characteristics facilitate improvement or higher performance.

**Scope:** One hundred and forty small independent practices who implemented electronic health records (EHR), 80 early adopters and 60 later adopters, and participated in pilot programs including pay-for-quality, receipt of quality reports, additional technical support, and a point of care decision support (CDS).

**Methods:** Data abstracted via manual chart review of paper records for later EHR adopters and electronic records for early EHR adopters were used to generate clinical quality measures (CQM); performance on CQM were compared across two time periods to determine possible effect of EHR on CQM. A cluster-randomized trial of primary care clinics was conducted to assess impact of incentives for increasing the delivery of cardiovascular clinical preventive services. Physicians were surveyed to assess attitudes and experience towards technical assistance, incentives, quality measurement, and use of HIT.

**Results:** Early adopters of EHR improved performance on 7 of 9 CQM in comparison to practices using paper systems (3 of 9 CQM had significant improvement) during the same time period. Effect of CDS tool is mixed; receipt of technical assistance is associated with higher performance on quality measures. Incentives resulted in modest improvements in cardiovascular processes and outcomes. Attitudes did not differ by receipt of incentives for quality measurement; incentivized practices were more likely to utilize CDS, technical assistance, and review quality reports.

**Key Words:** HIT; health information technology; quality measurement; EHR; electronic health records; quality improvement; physician experiences; clinical decision support; incentives

The authors of this report are responsible for its content. Statements in the report should not be construed as endorsement by the Agency for Healthcare Research and Quality or the U.S. Department of Health and Human Services of a particular drug, device, test, treatment, or other clinical service.

# Final Report

## Purpose

This study assesses the effects of supportive EHR implementation, clinical decision support (CDS) systems, and a randomized trial pay-for-quality program on the performance of clinical quality measures (CQM) focused on cardiovascular health – aspirin therapy, blood pressure control, cholesterol control, and smoking cessation intervention (ABCS) for 80 small independent ambulatory primary care practices that are early adopters of EHRs to 60 similar practices that are late adopters of EHRs. The project targets small community providers operating in New York City that have joined the Primary Care Information Project (PCIP), a public health bureau dedicated to integrating health information systems to improve population health. The research also assessed the attributable impact the interventions may have on improving the delivery of clinical preventive services (CPS) for the ABCS. Results will help guide future program design and policies for determining which resources to incorporate for improving cardiovascular health and maximizing the facilitative role of health information technology (HIT).

## Objectives of Study

- Determine whether practices that participated in the PCIP program experienced a more rapid rate of improvement on their quality measures than practices that did not participate.
- Determine if PCIP-participating practices are atypical in comparison to other small independent practices in New York City.
- Assess the attributable impact of each intervention: adoption of EHR, CDS, and pilot pay-for-quality program.

## 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, adequate reimbursement for CPS, shared resources to support technical needs and quality improvement coaching often

available in larger integrated care delivery systems. Attempts to boost wide adoption of health IT in small practices have been challenging, due to costs and lack of technical expertise and support. However, a majority of primary care visits occur in small practices and further highlights a need to understand what systems and resources can be implemented to improve the quality of health care.

## **Context and Setting**

In New York City, many of the small practices are co-located in communities with significant health disparities, e.g., higher prevalence of persons with chronic conditions and higher mortality rates. PCIP, established through a mayoral initiative and a bureau within the New York City Department of Health and Mental Hygiene (DOHMH), has been assisting small primary care practices to integrate health information systems since 2008 (AHRQ Policy Innovations Profile). PCIP also received a generous grant from the Robin Hood Foundation in 2009 to pilot a randomized trial – Health eHearts – that provided substantial monetary incentives to primary care practices and a novel pay-for-quality design: pay for delivery of ABCS and pay more for difficult to treat patients. At the same time, the EHR software in use by practices participating in the PCIP network received an upgrade to incorporate CDS (S. Amirfar 2011). In 2010, PCIP established NYC REACH, a federally designated regional extension center funded by the Office of the National Coordinator and formalized services to primary care practices adoption and meaningfully using EHR to improve health care (<http://www.nycreach.org>). As of September 2013, NYC REACH has assisted over 15,000 health care providers, include over 9,000 primary care clinicians, 1,000 specialists, and 5,000 behavioral health providers with adoption and use of HIT. The multiple con-current practice assistance programs and incentive pilot provided a unique study environment for assessing potential contributions of each successive practice intervention.

## **Participants**

Independently owned primary care practices with less than 10 physician staff were recruited for the two year pay-for-quality pilot, Health eHearts. These practices comprised the participants in this study. Two cohorts were established over the study period: early adopters that had implemented EHR prior to January 2009 and later adopters that had implemented their EHR prior to 2010 but after 2009. All participants adopted the eClinicalWorks EHR software, offered primary care services to adults (e.g., medical specialties for family, internal, general medicine, or gerontology). All practices had signed participation agreements to allow automated transmission of summarized EHR data and to participate in surveys for program evaluation purposes.

# Methods

## Study Design

A mixed methods approach was utilized across the study aims. The first study aim, utilizes data manually abstracted from practice paper or electronic records of early and later EHR adopters to calculate CQM over four time periods and compares CQM performance of two groups of practices – early and later EHR adopters from 2008 - 2009. The second study aim, employed quantitative methods of analyzing medical claims data to estimate quality measures, service utilization and costs for non-PCIP practices for comparison with PCIP practices. The third study aim incorporates quantitative analyses of EHR derived quality measures, utilization of EHR functions, and surveys completed by clinicians prior to EHR adoption, as well as after the completion of the Health eHearts Pilot.

## Data Sources and Collection

**Manual Chart Abstraction.** Practices were recruited from a pilot rewards and recognition program that included 84 practices (EHR group) that had been using an EHR for at least 6 months (adoption before January 2009) and 60 practices (non-EHR group) that adopted the EHR after July 2009. A total of 140 practices were available at the end of the Health eHearts program for inclusion; 71 practices consented to manual data review (34 early adopters, 37 later adopters). Data were manually abstracted from paper charts for the later adopters (non-EHR group) and from electronic charts (e-charts) for the early adopters (EHR group). Practices were offered a participation incentive of \$1,000 for the manual chart review. This study was approved by the DOHMH IRB (study number: 09-067)

Patient samples were obtained using the practice's EHR registry function for both early and later adopters. A random sample was generated for up to 120 patients aged 18 – 75 years who had at least one office visit during the first 18 months after the practice implemented EHR. To ensure a sufficient sample size for the later adopters (e.g., return to paper charts prior to EHR adoption), EHR registry lists for later adopters were first limited to patients that had at least one of the following conditions: current smokers, had a diagnosis of diabetes, hyperlipidemia, hypertension or ischemic cardiovascular disease.

Data abstracted from both electronic and paper charts included patient age and gender, vitals, diagnoses, lab results, medications, and the number of office visits per time period. For the electronic chart reviews, data were abstracted from pre-defined locations (lab values, vital signs, medication lists) within the EHR and free-text areas such as history of present illness and social history. For paper chart reviews, reviewers had a list of pre-defined sections to search, including free standing problem and medication lists, progress notes, lab results and initial visit intake forms. PCIP contracted with Island Peer Review Organization (IPRO) to conduct all chart reviews. Each of the eight chart reviewers was trained and tested by a standardized approach to ensure inter-rater reliability. In areas of uncertainty, a senior independent reviewer and PCIP staff member would determine whether to include the observation.

Practice characteristics, including number of providers, number of fulltime equivalent (FTE) positions, estimated number of patients seen per year, and percentage of patients with Medicaid or uninsured were self-reported by practices on a survey when they joined PCIP. Additional

practice milestones, such as dates of EHR implementation, were obtained from an operations database maintained by PCIP staff.

Delivery of nine clinical preventive services (CPS) was calculated using data abstracted from patient records and estimates for four time points – early 2008, late 2008, early 2009, and late 2009. CPS included: antithrombotic prescription for appropriate patients, BMI recorded, smoking status recorded, smoking cessation intervention offered, hemoglobin A1c testing, cholesterol testing, blood pressure control, hemoglobin A1c control, cholesterol control (Exhibit 1). Measure rates of CPS were compared between EHR and non-EHR practices; population rates were calculated for each preventive service and each time period (i.e., sum numerators across all practices, divided by sum of denominators across all practices).

Simple frequencies and descriptive statistics were generated to calculate practice and patient sample characteristics. All statistical tests were conducted using SAS 9.2 analytical software (SAS), and a two-tailed test result with a p-value of <0.05 was considered statistically significant. Chi-square tests were generated to compare rates between EHR and non-EHR practices and within each group across time periods, and plotted population level performance rates for each preventive service (Exhibit 1). Performance rates were calculated using Microsoft Access Structured Query Language, and graphs were created in Microsoft Excel.

**Medical Claims Data.** Two separate medical claims data sources were obtained. PCIP received paid claims data from the 32BJ Health Fund who manages the health benefits for members of the 32BJ SEIU labor union and their dependents. Claims were restricted to members who had at least one outpatient primary care visit within New York City from 2008 to 2010 with a primary care physician (ie, family practice, geriatrics, general practice, internal medicine, nurse practitioner, obstetrics & gynecology, and preventive medicine). Claims for adult members of the 32BJ union were considered; all dependents, regardless of age, were excluded from the study. Attribution to PCIP practices were based on whether members received 100% of their outpatient primary care with any provider enrolled in the PCIP, and members were attributed to the non-PCIP group if 100% of their primary care visits were with any provider not enrolled in the PCIP. About 6000 members were assigned to the PCIP group and about 22,000 members were assigned to the non-PCIP group, with approximately 9,000 unassigned members.

Total volume of health care service utilization and costs were calculated per patient and calendar year across all providers who rendered health services to the patient. This included specialty care, hospital outpatient, hospital inpatient, and emergency department services regardless of location or facility. Hospital inpatient services include all surgical procedures and treatments, with the potential for multiple claims per inpatient visit. Total health care costs were calculated as the total amount reimbursed to the provider(s) by the 32BJ Health Fund. Total volume of health care services and costs per patient were stratified into yearly time periods to assess the impact of the program over time. DOHMH IRB approval was obtained for this portion of the study (study number: 10-086).

The academic study partners at Weill Cornell Medical College obtained a data set from the New York Quality Alliance data set for calendar years 2007–10. The data set includes outpatient quality of care measures based on Healthcare Effectiveness Data and Information Set specifications from thirteen private insurers (including some managed Medicare and Medicaid plans) for physicians in New York City, Long Island, the Hudson Valley, the state's capital region (surrounding Albany), and western New York State. We tested whether physicians in the project improved the quality of outpatient care more than a set of matched comparison

physicians in New York State who did not participate in the project. We examined whether the effect of participation in PCIP was greater for physicians who received more technical assistance from the program. This study encompasses the time period before, and up to two years after, EHR implementation for participating physicians (Ryan 2012).

**Provider Surveys.** Two provider surveys administered for program evaluation purposes were utilized for this study. One of the survey was administered prior to practices going “live” on the EHR and was developed by PCIP staff to measure providers’ comfort with computer tasks (e.g., typing, printing) and expectations about EHRs (e.g., the EHR will improve medication safety, the EHR will disrupt workflow). The survey also solicited demographic data (e.g., how long the provider had been in practice, provider gender), their comfort level with computers, and their attitudes about EHRs. Additional provider characteristics (provider work load, type of provider, provider specialty) for both survey responders and non-responders were incorporated from PCIP’s contacts relationship management database, Salesforce©.

The main predictor variables were scores on three indices: comfort with computers, positive attitudes about EHRs, and negative attitudes about EHRs. The comfort with computers index consisted of five questions assessing providers’ comfort completing the following tasks: email, printing, restarting a computer, typing, and searching on the internet. Each question was recoded to a three point scale: uncomfortable, comfortable, and very comfortable. A mean comfort score was computed based on the answers to these five questions.

The positive attitudes about EHRs index consisted of responses to the following five statements: 1) an EHR will improve my access to patient information when I need it, 2) an EHR will improve my ability to make decisions about patient care, 3) an EHR will improve my ability to provide preventative care, 4) an EHR will reduce medication errors and adverse drug events, and 5) I think the benefits of adopting an EHR will outweigh the challenges I have to overcome. Each question was coded on a three point scale: disagree, unsure, agree. A mean score was calculated based on the answers to these five questions.

The negative attitudes about EHRs scale consisted of responses to the following seven statements: 1) using an EHR will decrease the amount of time I can spend talking with patients, 2) using an EHR will cause disruptions to my workflow, 3) using an EHR will cause a patient visit to last longer, 4) the use of the computer in the exam room will interfere with the patient visit, 5) an EHR will generate too many alerts and reminders during the patient visit, 6) using an EHR will limit my discretion as a primary care provider, and 7) using an EHR will make it more difficult to protect patient privacy. Each question was coded using the same three point scale as the positive attitude score, but for this scale a high score equated to strong negative attitudes about the EHR.

The other survey was administered at the end of the Health eHearts program. The Health eHearts follow-up survey consisted of a total of 33-items (29 items in the control group version) was administered to a lead clinician from each practice. The instrument was developed in collaboration with Health eHearts program evaluators from University of California San Francisco (UCSF). The instrument focused on: clinicians’ experiences and attitudes toward the selected quality measures (ABCS), training on use of EHR or achievement of ABCS, Quality Improvement visits, tracking patients for preventive services using the EHR, quality reports, incentive payments (incentive group only), recognition programs in general, and demographics. Topics identified as barriers included: accuracy and regularity of reports relevant to the practice’s patient population, measurement targets that were meaningful to the practice

population, availability of training or assistance to conduct QI activities, and use of practice tools, such as the EHR, to identify patients and document for quality measurement reports.

**Summarized Clinical Data derived from HER.** Data on measures of EHR use and clinical quality measures were transmitted directly from the EHRs to PCIP on a monthly basis. An office visit was defined as an encounter in which the provider recorded that the patient both checked in and checked out. Four measures of EHR use generated: 1) the percentage of visits with a documented blood pressure, 2) the percentage of visits where medications were reviewed, 3) the percentage of visits with allergy information entered into a structured field, and 4) the percentage of visits with a prescription generated and the prescription was electronically prescribed. Outcome measures were calculated for the 12 month time period after EHR implementation. The ABCS were also generated through summarized clinical data (Exhibit 2).

## Interventions

All primary care practice participants received support and training on using the EHR for tracking and documenting CQM. As part of the Health eHearts pilot, practices received quarterly reports on their performance on the ABCS. Half of the practices (70 out of 140) were randomized to receive incentive payments for achieving patient goals (control of blood pressure, control of cholesterol) or delivering cardiovascular preventive services, e.g., aspirin therapy, smoking cessation intervention (Bardach 2013).

## Measures

The following tables describe the measures used in the study.

**Table 1. Description of Quality Measures Abstracted from Medical Records (electronic and paper)**

Measure	Eligible patients	Patient goal
Antithrombotic therapy	Patients 18+ with ischemic vascular disease (IVD) or 40+ with diabetes (DM)	Taking aspirin/other antithrombotic therapy
Blood pressure control	Patients 18-75 with hypertension with or without DM	Without DM: Systolic<140, Diastolic<90 With DM: Systolic<130, Diastolic<80
Body mass index recorded	Patients 18+	BMI recorded in past 24 months
Cholesterol control	General population: Male (35+) or female (45+) patients with no prior diagnosis of DM or IVD and total cholesterol and/or LDL tested in the past 5 years  High risk: Patients 18-75 with hyperlipidemia and (IVD or diabetes) and LDL tested in the past 12 months	General population: LDL<160 or total cholesterol<240  High risk: LDL<100
Cholesterol testing	General population: Male (35+) or female (45+) patients with no prior diagnosis of DM  High risk: Patients 18-75 with hyperlipidemia and (IVD or diabetes)	General population: LDL or total cholesterol test recorded in past 60 months  High risk: LDL test recorded in past 12 months
Hemoglobin A1c	Patients 18-75 with DM	Hemoglobin A1c test recorded in the past

testing		6 months
Hemoglobin A1c control	Patients 18-75 with DM and hemoglobin A1c tested in the past 6 months	Hemoglobin A1c<7
Smoking cessation intervention	Patients 18+ with a "current smoker" smoking status	Smoking cessation intervention (Rx or Counseling) received in the past 12 months
Smoking status recorded	Patients 18+	Smoking status recorded in the past 12 months

**Exhibit 2. Description of ABCS Quality Measures used in Health eHearts**

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

## Results

### Principal Findings and Outcomes

- Early EHR adopters (representing practices that were receiving support from PCIP) were more likely to show significant improvement on seven of the nine CQM in comparison to later adopters (representing practices that were not receiving support from PCIP) during the same time period; improvement rates differed by CQM (Exhibit 3).
- Using medical claims data from a private payer, PCIP affiliated practices have younger patients and lower prevalence of chronic conditions such as diabetes, hypertension, high cholesterol, or cancer compared to non-PCIP affiliated practices. From 2008 to 2010, members who had a major chronic disease and whose primary care providers participated in the PCIP had decreased utilization of potentially costly inpatient services (De Leon 2013).
- Using claims derived clinical quality measures from a multi-payer database, PCIP practices were more likely to be smaller (fewer providers), practice in a zip code with a higher proportion of poverty, and less likely to be affiliated with a corporate parent organization; comparison of quality measures derived from claims data did not differ between PCIP and non-PCIP practices (not shown). However, PCIP practices that

received eight or more technical assistance visits were associated with higher performance on selected quality measures (Ryan 2013).

- With the exception of length of time on EHR and patient centered medical home recognition (PCMH) status, practice characteristics such as size, number of providers, type, were not associated with increased rates of clinical preventive services (Wang 2013). In addition, practices with PCMH status had higher increases on some measures than practices without PCMH status (Wang, Accepted)
- Pay-for-quality had a modest effect (5 – 8 percentage points) on increasing delivery of ABCS (Bardach 2013); Clinicians in both incentive and control groups reported positive experiences with Health eHearts, no differences were detected between groups regarding agreement with selected clinical measures or their relevance to patient population. However, clinicians in the incentive group were more likely to review quarterly performance reports and access quality improvement visits. (Begum, in press).
- Prior to EHR adoption providers had positive expectations for how the EHR would affect their delivery of patient care. Even with positive attitudes, however, almost a third of providers had concerns about the EHR - particularly about whether it would decrease their time with patients. Contrary to the hypothesis that provider comfort with computers and attitudes (both positive and negative) prior to adoption would predict measures of EHR use after implementation, no significant relationship between attitudes prior to implementation and EHR use were observed (Bishop, under review).
- Utilizing a indicator-level fixed effect model to evaluate the association between exposure of the EHR, clinical decision support, technical assistance, and financial incentive on improved performance on select CQM:
  - Practice exposure to EHR was not associated with increased performance on CQM;
  - Practice exposure to technical assistance was not associated with increased performance on ABCS but associated with increased performance on non-ABCS measures;
  - Practice exposure to CDS was not associated with increased performance on ABCS or non-ABCS measures;
  - Practice exposure to financial incentives was significantly associated with increased performance on ABCS measures.

Adoption of EHR alone and CDS does not necessarily lead to increased performance on ABCS measures. However, use of incentives and technical assistance could lead to improvement on ABCS and non-ABCS measures (Ryan, Draft).

## Significance and Implications

With the American Reinvestment and Recovery Act, patients accessing small primary care practices in New York City are more likely to receive clinical preventive services that could reduce their risk of disability or death from cardiovascular disease. Practices adopting and using EHRs may observe some immediate increase in select process clinical quality measures. However, practices will not likely to see substantial gains without continued technical assistance and/or incentives. Combined assistance from a regional extension center or quality improvement initiative can potentially sustain 5 – 10 percentage point improvements over 2 years several areas of preventive services. Policy makers looking to accelerate or further maximize the HIT infrastructure investment may need to consider payment models coupled with technical support resources to accelerate improvements in areas of preventive care that are underutilized or need improvement.

**Figure 1. Comparison of Early and Late EHR adopter performance on Nine Clinical Quality Measures**

Comparing performance across groups:  
 \*p<0.05 \*\*p<0.01  
 Compared to performance in early 2008,  
 performance in late 2009: <sup>1</sup>p<0.05 <sup>2</sup>p<0.01

— EHR practices  
 - - - non-EHR practices

Vertical axis for each graph is Rate of Delivery (%) of Clinical Preventive Service

**Figure 1a. Antithrombotic therapy**

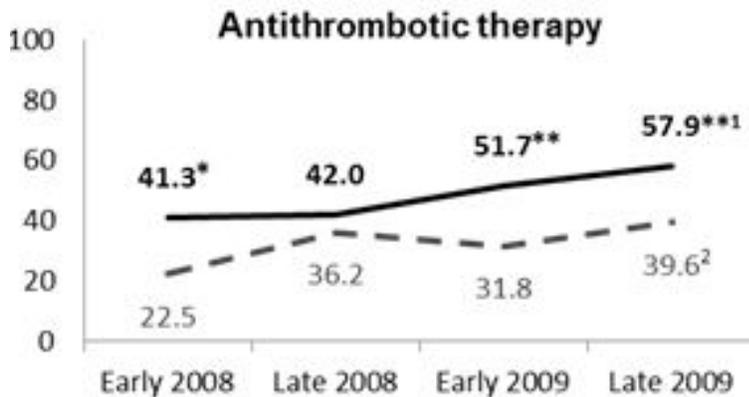


Figure 1b. Blood Pressure Control

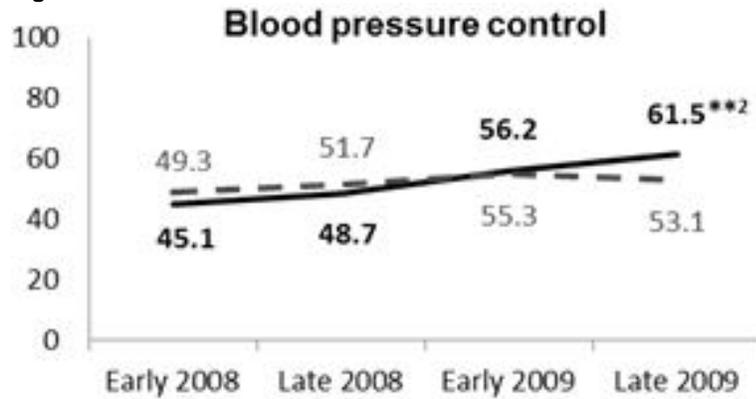


Figure 1c. Hemoglobin A1c testing

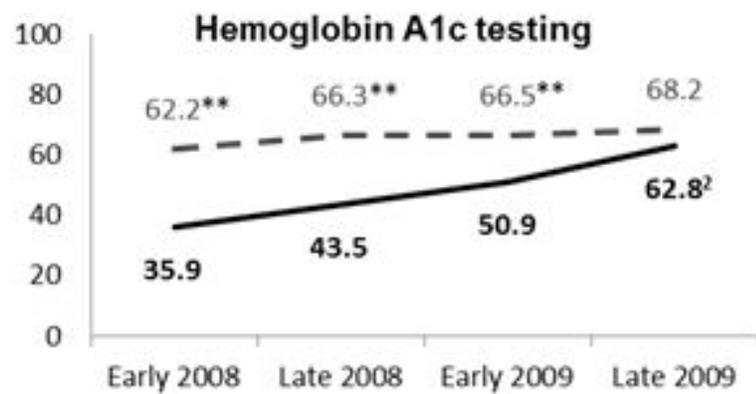


Figure 1d. Body mass index recorded

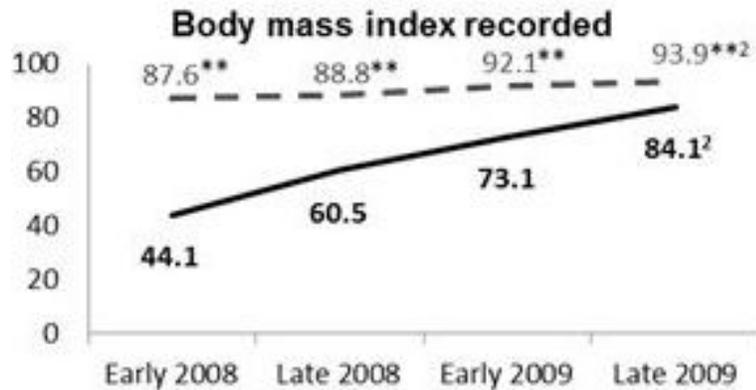


Figure 1e. Cholesterol control

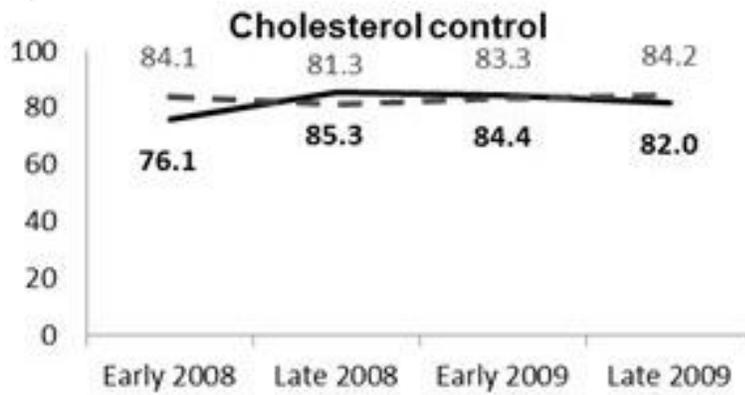


Figure 1f. Smoking status recorded

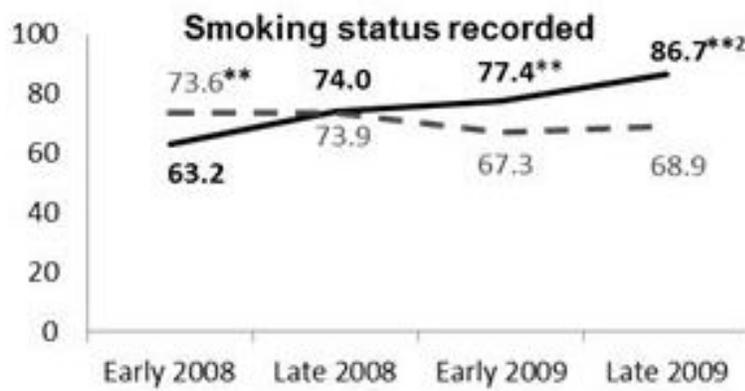


Figure 1g. Smoking cessation intervention

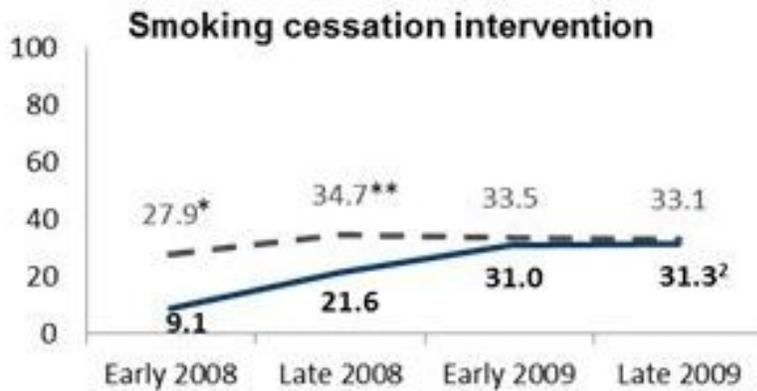


Figure 1h. Cholesterol testing

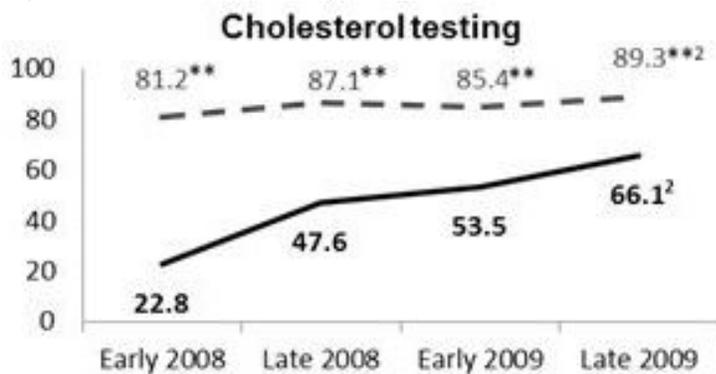
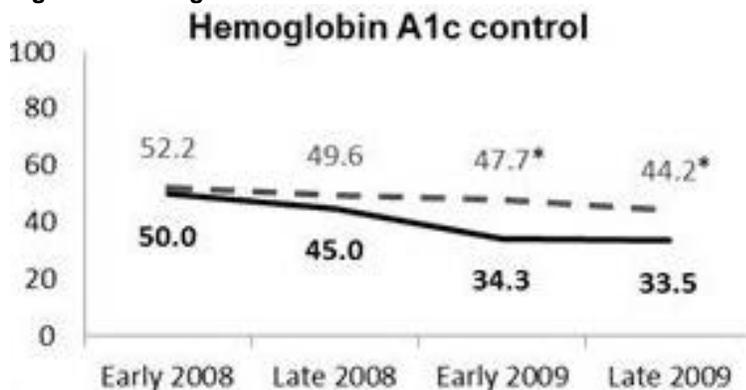


Figure 1i. Hemoglobin A1c control



## 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 indicates that 59.8% of patients are minority race/ethnicity and 17.9% live below the Federal poverty line.

## References

Amirfar S, Taverna J, Anane S, Singer J. Developing public health clinical decision support systems (CDSS) for the outpatient community in New York City: our experience. *BMC Public Health*. 2011 Sep 30;11:753.

AHRQ Health Care Innovations Profiles.  
<http://www.innovations.ahrq.gov/content.aspx?id=3825>

Bardach NS, Wang JJ, De Leon SF, Shih SC, Boscardin WJ, Goldman LE, Dudley RA. Effect of pay-for-performance incentives on quality of care in small practices with electronic health records: a randomized trial. *JAMA*. 2013 Sep 11;310(10):1051-9.

De Leon SF, Pauls L, Shih SC, Cannell T, Wang JJ. Early assessment of health care utilization among a workforce population with access to primary care practices with electronic health records. *J Ambul Care Manage*. 2013 Jul-Sep;36(3):260-8.

Ryan AM, Bishop TF, Shih S, Casalino LP. Small physician practices in New York needed sustained help to realize gains in quality from use of electronic health records. *Health Aff (Millwood)*. 2013 Jan;32(1):53-62.

Wang JJ, Sebek KM, McCullough CM, Amirfar SJ, Parsons AS, Singer J, Shih SC. Sustained improvement in clinical preventive service delivery among independent primary care practices after implementing electronic health record systems. *Prev Chronic Dis*. 2013

Wang JJ, Cha J, Winther CH, McCullough CM, Parsons AH, Singer J, and Shih SC. Patient-Centered Medical Home and Quality Measurement in Small Practices. *AJMC* (Accepted)

## List of Publications and Products

AHRQ Health Care Innovations Profiles.

<http://www.innovations.ahrq.gov/content.aspx?id=3825>

Bardach NS, Wang JJ, De Leon SF, Shih SC, Boscardin WJ, Goldman LE, Dudley RA. Effect of pay-for-performance incentives on quality of care in small practices with electronic health records: a randomized trial. *JAMA*. 2013 Sep 11;310(10):1051-9.

Begum R, Smith Ryan M, Winther CH, Wang JJ, Bardach NS, Parsons AH, Shih SC, and Dudley RA. Small Practices' Experience with EHR, Quality Measurement, and Incentives. *AJMC* (in press).

Bishop TF, Smith Ryan M, McCullough CM, Shih SC, Casalino LP, and Ryan AM. Do provider attitudes about electronic health records predict future electronic health record use? (under review, *BMC Online*)

Ryan AM, McCullough CM, Shih SC, Wang JJ, Smith Ryan M, and Casalino LP. The intended and unintended consequences of technical assistance, clinical decision support and financial incentives on quality of care in a community based electronic health record implementation project. (Draft)