Title of Project: Learning from Primary Care Meaningful Use Exemplars

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1. **Structured Abstract**

Purpose: To systematically identify primary care meaningful use (MU) exemplars, assess how they have achieved high performance on existing clinical quality measures (CQM), and solicit recommendations from them to inform Stage 3 MU (CQM) requirements.
Scope: Submission of CQM data is one of three major requirements for providers to receive MU incentive payments under the HITECH Act. Developing an evidence base for how practices can successfully use EHRs to achieve high performance on CQM is essential, as is identifying perspectives from exemplars on how the MU program should evolve to support high quality. We explored these issues in a national EHR based primary care practice-based research network.
Methods: Multi-method approach combining 1) cross sectional analyses of the associations between an EHR-based performance assessment in 71 practices on 21 CQM in the 2014 MU CQM set and a web-based survey of 319 providers in these practices assessing their adoption of theory-based approaches to QI using EHRs, and 2) focus groups among high 23 CQM performers to triangulate these analytic findings and provide perspectives on questions posed by the Office of the National Coordinator (ONC) related to Stage 3 MU CQMs.
Results: There was wide variability in performance among the 21 CQM among the practices. In multivariate analyses, EHR reminders were frequently associated with individual CQM performance; several EHR, practice QI, and administrative variables were associated a summary quality measure. Focus group participants agreed that CQMs should be evidence-based and focused on outcomes for high-priority conditions relevant to primary care. Limiting reporting burden, incorporating patient-generated data, accepting locally developed CQMs, and platforms for population management were viewed favorably.
Key Words: Meaningful use, clinical quality measures, electronic health records, primary care

2. Purpose

Developing an evidence base for how practices can successfully use their EHRs to achieve improvement in outcomes is essential, and may benefit from the study of exemplars, those who have successfully implemented EHRs and demonstrated high performance on CQM. Also important is input from providers to inform the further development of MU objectives under the Health Information Technology for Economic and Clinical Health (HITECH) Act. In this project, we addressed both of these needs through of a multi-method study combining an EHR-based CQM performance assessment, a provider survey, and focus groups among high CQM performers.

3. Scope

The 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act was intended to improve the quality of healthcare provided to the American public by incentivizing the meaningful use (MU) of electronic health records (EHR), defined as their use by providers to achieve significant improvements in care.(1) The legislation empowered the Secretary of Health and Human Services to develop specific MU objectives; the Centers for Medicare and Medicaid Services (CMS) in collaboration with the Office of the National Coordinator for Health Information Technology (ONC) are the federal leads for this development and implementation process. The process was designed to evolve in stages, with Stage 1 (beginning in 2011) to be focused on data capture and sharing, Stage 2 (delayed until 2014) on advanced clinical processes, and Stage 3 (delayed till 2017) on improved outcomes. For each stage, submission of data on clinical quality measures (CQM) is one of three major requirements for providers to receive MU incentive payments.

Some have argued that CQM are the most important component of MU (2), as tools that measure and track the quality of care (3) and because a focus on outcomes is a critical requirement for reengineering our healthcare system.(4) However, it has been recognized that more needs to be learned about the process of how to use EHRs in a manner to improve healthcare quality,(5) given mixed evidence that EHR use alone improves quality.(6-10) It is likely that EHR use is necessary, but not sufficient, and that organizational changes, such as team-based care, population management, and other strategies are required to achieve

improvements in quality.(11, 12) Developing an evidence base for *how* practices can successfully use their EHRs to achieve improvement in outcomes is essential, and may benefit from the study of exemplars, those who have successfully implemented EHRs and demonstrated high performance on CQM.

These exemplars are also important stakeholders in the further development of MU and may have unique insights to aid ONC in this work. In late 2012, ONC issued a Request for Comment for Stage 3 MU which included questions related to CQMs focused on ensuring that the CQM set improves the "quality of care and experience of care for providers and patients," consistent with the ultimate goal for MU.(13) In February 2013, the Agency for Healthcare Research and Quality (AHRQ), working in partnership with the ONC and CMS, solicited rapid cycle research projects to provide evidence to inform the development of Stage 3 MU objectives(14) for which a notice of proposed rulemaking (NPRM) for Stage 3 MU is expected in the fall of 2014.(15, 16)

4. Methods

Setting:
The study was conducted in PPRNet, a national EHR-based primary care practice based research network (PBRN) and Agency for Healthcare Research and Quality (AHRQ) Center for Practice-Based Research and Learning.(17) PPRNet maintains a longitudinal clinical database, derived from regular electronic data extracts from the EHRs used by participating practices. The PPRNet database is used for quality reporting and research. (18-23) Current reports provide feedback on the practice, provider, and patient level for more than 60 quality measures encompassing primary and secondary prevention, disease management, and safe medication prescribing and monitoring, as well as summary measures.(24) Twenty-one of the PPRNet measures are comparable to the 2014 CMS CQM in the eligible provider incentive program.(25)

Participating practices were recruited through a series of electronic mail messages sent in August and September 2013. PPRNet practices whose providers had attested for MU Stage 1 were eligible for the study. Those that met this eligibility requirement and that agreed to participate in the provider survey, and focus groups if invited, were enrolled. Enrolled practices that either did not submit an October 1, 2013 PPRNet data extract or failed to have a majority of their providers complete the survey were excluded from the analyses.

EHR-based CQM performance assessment:
Performance among participating practices on the 21 CQM (Table 1) was assessed as of October 1, 2013, using a method described in detail elsewhere.(26) Briefly, practices ran an extract program that generated a clinical data file for all clinical documentation since their last extract. Extracted data were posted to a secure server and added to the PPRNet database, where a longitudinal anonymized record is maintained for each patient. Data processing included matching un-coded text strings to common terminologies and standard data dictionaries (ICD-9-CM for diagnoses/problems and LOINC for laboratory results). Data tables (patient demographics, diagnoses, laboratory results, procedures, vital signs, medications) were combined across the PPRNet database using structured query language (SQL) joins to calculate a CQM. Programs searched relevant patient data to identify those eligible for the CQM, and subsequently dichotomized each patient as having met the criteria or not. For example, to identify patients eligible for "Controlling High Blood Pressure (BP) measure" the algorithm joined patient demographics with diagnoses to identify patients 18 to 85 years old who also had a diagnosis of hypertension. Those patient records were then joined with vital sign data to determine the patients with most recent systolic BP less than 140 mmHg and diastolic BP less than 90 mmHg; these patients were categorized as meeting the measure.

Practice-level performance for each CQM was determined by dividing the number of eligible patients that met the measure by the total number of eligible patients; means and standard deviations across all practices were calculated. Also calculated for each patient was the Summary Quality Index (SQUID)-CQM (24), the quotient of the number of eligible measures the patient had met and the total number of measures for which the patient was eligible. A practice-level SQUID-CQM, representing the mean SQUID-CQM for all patients in the practice, was also calculated. The practices with the 27 highest SQUID-CQMs (approximately the top tertile) were deemed "exemplar" practices.

Provider survey:
Development of the provider survey was guided by two theoretical frameworks to systematically ensure that the questions assessed a broad range of organizational factors that could impact EHR implementation. The first was the PPRNet quality improvement (QI) model Improving Primary Care through Health Information Technology (IPC-HIT)(27); the second was the Consolidated Framework for Implementation Research (CFIR).(28) Five iterative rounds of development, review and refinement by the study co-authors were completed to develop the survey. The final survey included 100 specific questions related to the 21 CQM addressing provider agreement with the CQM, staff education, use of EHR reminders, standing orders, and EHR-based patient education with 27 general questions, divided into 4 categories including practices' use of EHR functionality (including Stage 1 and 2 MU core and menu requirements), clinical QI strategies, the respondent's beliefs about the value of their EHR and QI activities and practice administrative QI strategies (Table 3).

The survey was constructed using Research Electronic Data Capture (REDCap), an online survey tool (29). A pilot test by seven PPRNet members not participating in the study estimated that the survey took about 15 minutes to complete and suggested a few clarifying edits. The survey was available to respondents between November 6, 2013 and December 29, 2013. At least three emails, one fax, and one telephone reminder were sent to practice coordinators and individual clinicians in the practices to assure an adequate response rate.

Statistical Analyses:
Responses to categorical items in the survey were quantified using a scale from 0 to 100. For items with dichotomous responses (i.e. yes/no or agree/disagree), a "no" or "disagree" response was coded as 0, and a "yes" or "agree" response was coded as 100. For items with 5 possible responses, "never", "rarely", "sometimes", "mostly", and "always" were coded as 0, 25, 50, 75, and 100, respectively. A similar strategy was used for items with 3 possible responses. For practices with more than one survey respondent, scores were averaged across respondents in order to construct a single set of responses for each practice.

Descriptive statistics (means and standard deviations) were used to characterize practices' item response scores, which by design, could theoretically range from 0 to 100. One set of analyses was used to assess the degree to which survey responses in the five specific question categories (provider agreement, staff education, EHR reminders, standing orders, and EHR patient education) were correlated with the practice-level performance for the corresponding CQM. Within these analyses, bivariate (unadjusted) correlations, as well as partial (multivariate-adjusted) correlations were calculated. The partial correlations adjusted for other statistically significant ($p<0.05$) practice covariates (e.g. provider demographics, practices' patient demographic and clinical characteristic profiles), which were only selected to be included in the correlation model if they met inclusion ($p<0.1$) and exclusion ($p>0.05$) criteria within CQM-specific stepwise regression models.

A separate set of analyses was used to examine the extent to which practice responses to the general survey items were correlated with their SQUID-CQM score. Prior to calculating these correlations, a stepwise regression model revealed that among a set of patient, provider, and practice characteristics (all expressed at the level of the practice), the average number of chronic conditions among a practice's patients was the strongest independent factor correlated with a practice's SQUID-CQM score (rho = 0.60, $p<0.0001$). This variable was used as a covariate within multivariable regression models, in which the SQUID-CQM score served as the dependent variable of interest, with each of the general survey item scores serving as independent variables of interest in separate models. Partial (adjusted) correlations were calculated from these regression models, and significant ($p<0.05$) correlations were identified. All statistical analyses were conducted using SAS v9.3 (Cary, NC).

Focus groups among high CQM performers:
Lead physicians from each of the 27 designated exemplar practices were invited to participate in one of three whole day focus groups held on consecutive Saturdays in geographically separate cities in the late January and early February 2014. Standard approaches for conducting focus groups were followed, including obtaining verbal consent to participate and to record the discussions for analysis, emphasizing the importance of each person's response to each question and participation in the general discussion.(30, 31) The groups were moderated by two of the study investigators and observed by two others, who took detailed notes using an observation template to supplement the audio recordings.

The morning focus groups lasted approximately 2.5 hours and addressed participants' perspectives on the quantitative analyses. During the first 45 minutes, one of the moderators presented the overall study methods and key findings from the EHR-based CQM performance assessment, the provider survey, and the associations between them. During the remaining 1.75 hours, participants were asked for general perspectives on the overall findings and for detailed perspectives on each of the specific findings. Comments were sought both on their assessment of the validity of each finding, and for context-specific examples from their practice that supported their assessment. The process for each of the three focus groups was similar, although minor refinements were made to reflect feedback from the first group.

The afternoon focus groups also lasted approximately 2.5 hours and sought recommendations to inform the development of Stage 3 MU objectives. During a 15 minute introduction, an overview of prior and current MU CQM requirements was provided. The introductory presentation refreshed the group about the overall intent of MU CQMs to improve the quality of care. Questions from the ONC's RFC for Stage 3 MU CQM were used to guide the discussion. Participants were asked to identify which CQMs should be a high priority, discuss how to reduce the burden of CQM reporting on providers and compare the value of process versus outcome measures. The significance of incorporating patient-generated data into CQMs, the appeal of aligning MU CQMs with MU functional objectives, the feasibility and desirability of locally developed measures and the importance of population management platforms were also explored with participants. All focus group members were encouraged to respond to each question and participate in the general discussion.

Digital audio files were transferred via secure file servers for professional transcription shortly after each focus group session. Transcripts and field notes were imported into NVivo 10.0 for Windows software (QSR International, Pty, Doncaster, Australia) by the primary qualitative analyst (LN). A second investigator (AW) performed independent analyses of the field notes and transcripts. A deductive coding scheme was developed using key concepts and phrases from focus group questions, followed by an inductive process of constant comparison to identify the final themes. (32) A micro-interlocutor analysis based upon the observation template enabled us to identify areas of consensus and variation of participants' responses. (33) Extracted themes were reviewed by the two coder investigators and minor differences were resolved. (34) Review of final themes and field notes by both analysts allowed us to immerse and crystallize the findings. (35)

5. Results

Participating Practices and Identification of Exemplars:
Ninety-five PPRNet practices expressed interest in the project through response to one or more email solicitations. Seventy-eight practices consented to participate. Two of these practices did not submit data for the CQM assessment and were excluded. Five other practices failed to have the majority of their providers complete the survey and were excluded, resulting in 71 practices from 28 states for the analyses. Among these practices, there were 349 providers; 319 (92.1%) completed the provider survey. Among those completing the survey, 73% were physicians, 16% were nurse practitioners, and 11% were physician assistants. A slight majority (51%) were male, and most white (91%), and non-Hispanic (97%).

Summary data on practice performance for each of the CQM are presented in Table 1. Performance varied widely among the 21 CQM. The practice mean for tobacco use screening and counseling was 89.8%, whereas the mean for chlamydia screening was only 12.9%. Large standard deviations on most of the CQMs are indicative of wide variation among practices in measure performance. The mean SQUID-CQM across all practices was 37.4% with a standard deviation of 10.7% and a range from 17.9% to 63.1%.

The 27 practices with the highest SQUID-CQM (approximately the top tertile) came from 18 different states, and had a SQUID-CQM greater than 40%. Lead physicians from 23 of the 27 practices selected as exemplar practices attended the focus groups. Five of these physicians were female, two were Hispanic and all were White. The median age of these physicians was 56. Five physicians were general internists, two internal medicine/pediatrics physicians, and the remainder family medicine physicians. The physicians came from

practices in 18 US states. All practices reported using their EHRs for over 6 years; nine practices had been using their EHRs for 6-10 years, seven for 11-15 years, five for 16-20 years and two for more than 20 years.

Factors Associated with High CQM Performance:
Findings from the specific questions on the provider survey and their association with performance on the 21 CQM are presented in Table 2. Provider agreement was high for all of the CQM, ranging from 88.5% for depression screening to 100% for pneumococcal immunization for older adults. In the bivariate analyses, provider agreement was associated with higher performance on colorectal cancer screening, avoiding use of high-risk medications in the elderly, and chlamydia screening; the association with chlamydia screening did not persist in multivariate analyses.

Providing clinical staff member education on specific quality goals was commonly reported for CQM, with practice scores ranging from a low of 54.7 for heart failure therapies to a high of 90.6 for influenza immunization. In the bivariate analyses, staff education was associated with performance on 11 of the CQM, however, in multivariate analyses, associations persisted only for breast cancer screening, urine protein screening for diabetes mellitus, use of anti-thrombotic medication for ischemic vascular disease, and depression screening. Focus group participants widely endorsed the notion that staff education was critical for improved performance, particularly for CQM that they could accomplish using the health maintenance (HM) reminder features of the EHR. One participant commented: "when the staff understands the clinical importance of measures it makes them more enthusiastic about getting things done and the work is already done when we walk in the door." The importance of the "how" of improvement was highlighted; accomplished by creating explicit roles and processes for staff during routine meetings and by some using morning huddles. A participant noted that there was "more direct impact when there are clear ways [for staff] to apply the education to actually improve performance." Informal competition among staff members with nominal prizes and recognition for improved group performance, rather than financial incentives, were suggested by some as important motivators.

Use of EHR reminders (e.g. flags, HM, progress note templates with prompts) as decision-support to help meet clinical quality goals was variably reported for the CQM. For cancer screening (breast, cervical, and colorectal), immunizations (influenza and pneumococcal), and tobacco use screening practice scores were above 80. For appropriate treatment of children with URI and warfarin management, scores were lower than 45. Scores for EHR reminders for other CQM were between these extremes. In the bivariate analyses, EHR reminder use was associated with higher performance on 12 of the CQM; in multivariate analyses, associations persisted for the three cancer screening CQM, urine protein screening for diabetes mellitus, heart failure therapies, chlamydia and depression screening, and immunizations. Focus group participants endorsed the strengths of their EHR for its flexibility in its ability to display deficient HM items in different ways and during various types of patient contact. In addition to display on the patient summary screen and HM section of the chart, one participant indicated that "HM out of date is pulled into every [progress] note." Another pointed out that "I can customize and embed reminders. The flexibility allows us to do this." That EHR reminder use was associated with better performance on CQM that reflect clinical processes rather than outcomes was also supported by the participants. One explained that "the EHR reminders for things that staff can't do by themselves, we don't perform nearly as well, mostly because there are more steps;" another "achieving targets is tough, more patient issues play into targets vs. process." Other participants criticized their EHR vendor for not providing automatic updates to the HM functionality based on new guidelines, and that technical savvy was required for the EHR to remain current with guidelines. One noted: "It's clunky, nerdy and I'm the best our office has, and I'm no good."

Standing order protocols were used frequently for immunization CQM but less commonly for other CQM. In bivariate analyses, use of standing orders was associated with seven CQM; however, none of these associations persisted in multivariate analyses. Focus group discussions suggested that the explanation was that standing orders were always mediated through the EHR reminder features (largely the HM reminders). Indeed several participants noted that implementing standing orders helped the practice realize significant financial gains, both directly by freeing providers to perform other clinical services and through pay for performance programs. One noted: "we are considering adding another [staff] person so that we can have them do more standing orders and that we can do our work."

Practice scores for use of EHR-based patient education to reinforce population management or public health goals ranged from 38.6 to 64.2 with no discernable pattern in the variability across the CQM. In bivariate analyses, associations were found between EHR-based patient education and hemoglobin A1C control, urine protein screening for diabetes mellitus, appropriate treatment of children with URI, and depression screening. In multivariate analyses, associations were present only for cervical cancer screening, hemoglobin A1C control, and beta-blocker therapy in heart failure. Among focus group participants, the clear consensus was that their EHR patient education resources were not very helpful; the resources were out of date and not tailored to patient needs. A variety of patient education websites were viewed as more current and were more regularly used by participants. A more substantial criticism was levied against patient education materials in general. One participant noted: "I don't think any of them have been validated, that they are useful. No one has proven that patients who have looked at these have better outcomes." Another argued for a more personalized approach to patient education, suggesting: "what should be happening is a care plan with the nurse. The patient should be deciding what would be useful for them."

Findings from the general questions on the provider survey and their association with performance on the SQUID-CQM are presented in Table 3. In the category "Use of EHR Functionality", practice means ranged from a high of 82.9 for maintaining up to date problem list to a low of 44.8 for the use of a web-based patient portal. A statistically significant correlation was found only between use of registries for population management and the SQUID-CQM. A number of the focus group participants indicated that they used the registry functionality provided by PPRNet for CQM population health management, reaching out to patients with care deficiencies. However, there was no clear consensus that they had observed an impact of these activities on CQM performance. Participants were not surprised that use of patient portals was not associated with the SQUID-CQM, noting that the purpose of portals was to improve patient access and likely impacted patient satisfaction but not CQM performance. Nor were they surprised that use of after visit summaries was not associated with performance, one participant noting: "… [summaries] can be confusing to the patient. Knowledge alone doesn't change behavior." Others pointed out the lack of actionable, individualized information and several participants shared the observation that these printed summaries were often left in the office and not taken home.

For the category "Clinical QI Strategies", practice means ranged from a high of 88.3 for medication reconciliation to 64.9 for follow-up with patients that did not complete recommended services. None of the clinical QI strategies were correlated with the SQUID-CQM. Focus group participants supported these findings. Medication reconciliation was noted as not directly tied to the CQM assessed in this study and might be more likely to impact utilization, safety or transitions of care measures. A participant also noted: "I don't think reconciliation truly correlates with compliance, getting refills." Follow-up with patients not completing recommended services was thought to be not effective for several reasons. One participant noted: "patients who are resistant are resistant." Another acknowledged that simple patient outreach, absent exploration of barriers and problem-solving, was unlikely to be effective in motivating patients to adherence with recommendations. He noted: "we don't necessarily explore barriers. Calling and just saying they need to get it done is not really effective."

For the category "Beliefs about EHR and QI Activities", practice means ranged from a high of 72.7 for EHR is helpful in achieving high quality clinical care to a low of 36.5 for finding assistance from a Regional Extension Center (36) helpful to achieve high quality clinical care. Statistically significant positive correlations were found between "EHR is helpful in achieving high quality clinical care", "EHR is customized in practice to facilitate high quality clinical care", and "Participation in PPRNet motivating to achieve high quality clinical care" and the SQUID-CQM. A statistically significant negative correlation was found between the belief that the EHR is difficult to use to achieve high quality clinical care and the SQUID-CQM. As noted above, focus group participants endorsed the view that the ability of their practice to customize their note templates and HM reminder features help improves performance across a number of CQM. Participants also noted that PPRNet activities such as reports, network meetings and site visits helped practices pinpoint areas for improvement and try new approaches to care improvement.

For the category "Practice Administrative QI Strategies", practice means ranged from a high of 77.3 for "Members working consistently to achieve improvement" to a low of 39.0 for provider incentives. Statistically significant positive correlations were found between practice member knowledge about practice improvement

priorities, members evaluating progress together, leaders seeking input from team members, regular staff meetings, and leadership commitment and the SQUID-CQM. Focus group participants emphasized that seeking input from team members was largely in reference to "what to do rather than why they should do it." Regarding provider and staff incentives, it was noted that current incentives are too small to have much impact and the feeling that their practice teams were inherently motivated to provide high quality care and did not need incentives to do so.

Recommendations to inform Stage 3 MU (CQM) requirements
The findings from this component of the focus groups have been organized into eight themes as discussed in detail below.

1. CQMs should be evidence-based, focused on high priority conditions and relevant for primary care physicians.

Participants were asked to provide feedback on measures from each NQS Domain. For all domains, there was general consensus in each focus group that CQMs should be evidence-based, non-controversial and based on national guidelines when available. They also believed that the measures should be "the ambulatory sensitive ones- the ones that we can control ought to be measured in every office." Participants emphasized the need for CQMs to be flexible and rapidly evolve to reflect changes in evidence or new guidelines. For example, many participants were concerned that current CQMs regarding dyslipidemia are not concordant with the recently released ACC/AHA Guideline on the Treatment of Blood Cholesterol(37) and argued that these CQMs should be quickly updated to reflect the new guidelines. As one participant stated, "Keep it simple. Whatever you do, use things that have been vetted as indicators or results or processes that are valuable and proven they make a difference and keep the flexibility."

Participants generally agreed that CQMs in the *Clinical Process/Effectiveness* domain should reflect highly prevalent conditions with long term consequences and for which improved performance on the CQM could have considerable impact on morbidity and mortality, such as hypertension, hyperlipidemia and diabetes.

All participants believed CQMs in the *Population/ Public Health* domain should be a high priority, particularly those with broad public health implications. At one focus group, there was near unanimous consensus that CQMs should be limited to measures in this domain, while participants at the two other focus groups agreed that, while important, CQMs in other domains also reflected high priority chronic conditions and should be included. Many argued that adherence to all US Preventive Services Task Force (USPSTF) Grade A and B recommendations and recommendations from the Advisory Committee of Immunization Practices (ACIP) be included as CQMs, while others favored selecting specific USPSTF recommendations with a considerable impact on mortality. Participants universally agreed that CQMs related to hypertension, obesity and smoking cessation were of utmost importance. One participant stated, "I would put my energy into blood pressure, blood pressure, blood pressure. Smoking, smoking, smoking. Exercise, exercise, exercise."

Compared to *Clinical Process/Effectiveness* and *Population/Public Health* CQMs, there was much less enthusiasm for 2014 CQMs included in the *Patient Safety, Efficient Use of Healthcare Resources, Care Coordination or Patient/Family Engagement* domains. In general, these CQMs were not felt to have as much impact on the health of the US population as the initial two domains. The evidence supporting several measures included in the *Patient Safety* domain was questioned. For example, participants noted that there is not clear data to support the CQM *Screening for falls in the elderly*. One participant stated, "That's so frustrating that you're going to measure me on something that's one, difficult to document and two, we already have a study that shows it doesn't do any good." They were also apprehensive about the measure *Documentation of all current medications in the EHR.* First, some participants argued that this "attestation" measure required "checking boxes" on the part of provider. Second, the utility of this measure in improving care was questioned. One participant argued that listing all over the counter medications and herbal supplements in the EHR could actually have an unintended consequence and result in the provider missing an important prescribed medication due to the complexity of the list.

Participants expressed similar unease over CQMs related to *Efficient Use of Healthcare Resources.* For example, participants largely agreed with avoiding imaging for low back pain, yet they were concerned about

the ability to measure this accurately using EHR data along with the "extra work" of having to document exceptions. Participants argued that while measuring efficient use of resources was important, other types of measures would be more relevant for primary care, such as the proportion of their patients with emergency room visits or hospitalizations. Participants acknowledged that this type of measure could be difficult to assess using only ambulatory EHR data.

There was also concern that the only *Care Coordination* CQM, *Receipt of specialist report,* was a measure of coordination outside of their control and reflected EHR functionality rather than provider performance. While participants concurred that closing the loop with specialists is important for care management, there was debate about whose responsibility this was and that this measure could unfairly place additional burden on the primary care provider rather than the specialist who was receiving the revenue from providing the service. Also, as one participant stated, "My feeling is that I would rather not try to track every referral but track what are for me the high risk referrals. I don't really need to get the report back on every time I send the patient to the dietician or the physical therapist." Participants again questioned the evidence for whether adhering to this CQM improves quality.

Participants also doubted the clinical utility of CQMs included in the *Patient Engagement* domain. One participant remarked that "it was not clear how administering functional status assessments to patients makes them more engaged in their care" and again did not feel these measures were clearly supported by evidence. There was concern that current EHRs could not yet support this patient-generated data. Several participants suggested other potential patient engagement CQMs that were more useful for primary care physicians, including discussion of end of life issues, asthma control or symptoms of depression.

2. A few core CQMs focused on public health issues should be applicable to all eligible providers.

While participants at one focus group unanimously agreed that there should be a core group of CQMs for all providers regardless of specialty focused on important public health issue such as measures related to tobacco abuse and obesity, participants at the other two focus groups maintained that while a few CQMs could be applicable to all providers, there should be flexibility with CQMs tailored for both primary care physicians and specialists. According to one participant, "Why can't you have a core like smoking cessation that applies to everybody? Why can't your dermatologist say stop smoking?"

3. Focus of CQMs should largely be on outcomes.

Participants debated whether CQMs should reflect process or outcome measures, although most favored outcome measures in the context of chronic disease management. One participant favoring process measures pointed out that socioeconomic factors were more likely to impact performance on outcome measures. Another participant favoring outcome measures argued, "I think we've kind of shown that we can get the numbers on the process measures" but acknowledged that it was much harder to achieve high performance on outcome measures. There was consensus that CQMs should measure outcomes that are consistent over time; for example, hemoglobin A1C measuring blood glucose control over three months was felt to be a more important outcome than a single blood pressure value taken at one point in time.

4. Reporting of CQMs should limit burden on providers

While there were mixed opinions on the number of measures that a provider should be expected to calculate, participants in all focus groups agreed on a few important considerations. Participants consistently advocated that the focus of the CQM measure set should be on achieving improved outcomes without requiring additional work by providers. Being forced to "check boxes," as required by the 2014 core CQM *Documentation of all current medications in the EHR* was a common frustration expressed at all focus groups. Participants repeatedly stated that accurate calculation of measures should not require additional steps outside the routine workflow. One participant cited the "tremendous provider burden" currently placed on the provider for current measure calculations. Another participant stated, "I should not require a full time information technology (IT) person to meet these goals." There was general agreement that the measures should be meaningful to providers and beneficial for patients. A few participants believed that the number of measures should differ by specialty. The majority of participants agreed that if CQMs were both meaningful and calculated automatically without additional burden, increasing the number of measures would not be problematic. According to one participant, "If the burden was eliminated where it was automated, I think we wouldn't have a lot of pushback." Participants all concurred that functional MU objectives, such as those related to clinical decision support, should be aligned with CQMs.

Participants agreed that improved EHR capabilities including integrated immunization registries and synchronization between billing and documentation services could reduce burden on providers to duplicate documentation for measure requirements. As one participant stated, "There should not be a measure for which you have to manually go get other data just so that you can make your report." Another participant agreed, "Why do we have to click a box to say that we did medication reconciliation? When we opened the medication list or we made a couple of changes in medications, shouldn't that be automatically recorded?"

5. Consider performance thresholds for some CQMs

The concept of requiring providers to reach performance thresholds on some CQMS was also discussed. Participants agreed that if thresholds for quality measures were required in future MU requirements, then the number of measures should definitely be limited. One participant suggested that requiring only a select group of three or four core measures, each with thresholds to reach, could be "more valuable than having lots of measures with no threshold." Another participant was opposed to a threshold requirement and instead believed those goals should be achieved through pay for performance programs rather than the MU programs.

6. EHRs should have capabilities to capture patient generated data which could be incorporated into CQMs

Participants gave many examples of current uses of patient-generated data, including home blood pressure measurements, blood glucose logs and food diaries, and generally agreed that these types of data would be easier to use for clinical care purposes if they could be directly imported into the EHR through a portal. Examples of possible EHR-enabled CQMs using patient-generated data suggested by clinicians were measures related to dementia or cognitive impairment, exercise, tobacco use or end of life care. Many participants agreed that there should be a review queue to ensure clinician recognition of patient-reported data, along with a way to differentiate patient-generated data from office-generated data in the EHR. One participant stated, "If it's patient-generated data, it's going to have to come in some kind of format so it doesn't create an error." Providers also emphasized that there should be evidence that collecting this type of data improves outcomes before CQMs are developed.

7. Locally developed CQMs can encourage innovation

The majority of participants believed that allowing locally developed CQMs would foster innovation and promote the development of new measures that could be relevant and useful for primary care physicians. However, participants conceded that each EP should only be permitted to submit one locally developed CQM and that there should be some certification process including a submission form describing the evidence that the supports the measure. There were mixed opinions about whether development of local CQMs should be limited to larger organizations such as Accountable Care Organizations or professional societies, with some concern that larger systems or professional societies might not share the same interests as individual providers. According to one provider, "Meaningful use ought to be using the EHR in a way that allows the providers to really figure out what they are doing with their patients and get the feedback on it. It really isn't sending something off to Congress so that two years from now you don't get a penalty."

8. Population management tools are vital to improving quality

There was unanimous agreement on the importance of health IT tools for population management. All exemplars participating in these focus groups receive regular performance reports on CQMs including patient level registries as part of their routine participation in PPRNet, and many stated that the registries were one of the most useful tools they had for improving the health of the patients in their practices.

Participants felt that tools that assisted with case management and calculated risk scores (i.e. FRAX, Framingham, ACC/AHA 10-year atherosclerotic cardiovascular disease estimate) should be present in a basic CQM population management platform. Others suggested adding utilization information, including ER visits and hospitalizations. Participants agreed that there was a business case for their use of these tools; several described using registries to reach out to patients due for specific services. Others pointed out that the business case for use of these tools is enhanced in a pay for performance environment.

Discussion:
Several pertinent findings emerged from this multi-method study. First, this study of *how* practices can successfully use their EHRs to achieve improvement in outcomes ("meaningful use" in its optimal sense) is interesting to clinicians. Indeed a large majority of PPRNet practices with clinicians that had certified for MU by the third quarter of 2013 agreed to participate in the study, and the survey response rate among clinicians in practices completing the study was 92.1%. Second, it is clear that use of an EHR does not assure high performance on CQM, even when the CQM are widely endorsed by clinicians. The mean practice SQUID-CQM for measures supported by almost 90% of clinicians across this group of practices, all of which used an EHR, was only 37.4%. Third, practices are using theoretically sound improvement strategies (27) for many CQM, such as staff education, EHR reminders, standing orders, and EHR-based patient education, though there was great variability in their use among practices and by CQM. Practices also widely reported use of many EHR functions including those required for Stage 1 or 2 MU, and a majority had favorable beliefs about the potential impact of EHR on quality. Fourth, although there was some variability by CQM and for eight CQM no measured strategies were associated with higher performance, use of EHR reminder functions seemed to be the most effective strategy. That a number of bivariate associations between standing orders and staff education did not persist after adjusting for other variables suggests that these interventions were operationalized through the use of EHR reminders. Fifth, although we found correlations between the SQUID-CQM and several beliefs about EHR and quality initiatives and practice administrative QI activities, the only correlation with EHR functionality was for registry use for population management. Several requirements for Stage 1 and/or 2 MU, including maintaining problem lists, providing after visit clinical summaries and patient portal functionalities were not associated with the SQUID-CQM.

Finally, the exemplar's specific recommendations on how MU CQMs could be improved to achieve improved outcomes may help policymakers in their rulemaking for Stage 3 MU. To date, the progression of MU CQM requirements from 2011 to 2014 largely does not reflect the recommendations from these exemplars. Participants advocated that CQMs be evidence-based and reflect high priority conditions, yet many of the CQMs added to the 2014 measure set do not meet these criteria. For example, 2014 CQMs for adults include several new measures that our participants did not feel were evidence-based, such as *Functional status assessment for complex chronic conditions* and *Screening for future fall risk.* In fact, while participants advocated for adhering to USPSTF recommendations, the USPSTF has concluded that the likelihood of benefit for routinely performing an in-depth fall risk assessment in adults aged 65 years or older is small and therefore not recommended.(38) Other new CQMs, such as *Documentation of current medications in EHR* require attestation which was viewed by participants as creating additional burden. In addition, while participants recommended required core CQMs, during the transition from initial CQMs introduced in 2011 to the current 2014 set, required core CQMs were eliminated.

The study has several prominent strengths. To our knowledge it is the first study assessing the association between measured CQM performance and organizational factors related to EHR implementation in a broad set of primary care practices. A recent national study suggesting that physicians using EHRs that meet MU criteria, particularly those with longer EHR experience, have improved clinical care was based on survey, not clinical data (39), as was an earlier study finding no association between EHR use and quality. (40) Other studies examining the associations between EHR use and quality have been limited to one primary care practice (41), one state (9, 42), and by use of administrative data to assess quality.(9, 42, 43) The current study is likely to be more representative, since it included a relatively large number of primary care practices, all of whose physicians had sufficient enough experiences with EHR to be certified for MU. In addition, the physicians participating in the focus groups had years of experience using EHR in their practices and their perspectives on MU may have unique salience.

The study also has several notable weaknesses. It reflects findings among users of only one EHR, and all the participants were all members of PPRNet, a learning and research organization with a mission to improve health care. The magnitude of the statistically significant associations between CQM performance and the survey variables were low to modest, indicating that there are other determinants of quality other than those assessed in the study. Although all associations assessed were specified in advance, the large number of them suggests that some of the statistically significant associations may have occurred by chance. As with any study of EHR CQM performance, the findings are dependent on the accuracy of the data in the EHR and the fidelity by which these data were extracted and incorporated into CQM, an issue noted in a recent

report.(44) Since one of the frameworks used in the survey design (IPC-HIT) was developed in PPRNet practices, it may be that the observed associations are unique to this population of clinicians. Finally, focus group participants were from exemplar practices; and their perspectives about MU may differ from other primary care clinicians.

Despite these limitations, our findings support the conclusion that among clinicians who have certified for MU, organizational factors related to EHR implementation, such as purposeful use of EHR functionality coupled with staff education in a milieu where QI and the EHR are valued and supported, are associated with higher performance on primary care-relevant CQM. High quality care requires more than MU certification.

Table 1. Primary Care Relevant 2014 Centers for Medicare and Medicaid Services (CMS) Clinical Quality Measures Included in Performance Assessment

Measure Title	Measure Description	Mean % among Practices	Standard Deviation
Clinical Process / Effectiveness			
Anti-depressant Medication Management	% of patients 18 years of age and older who were diagnosed with major depression and treated with antidepressant medication, and who remained on antidepressant medication treatment	59.9	8.7
Asthma: Use of Appropriate Medications	% of patients 5-64 years of age who were identified as having persistent asthma and were appropriately prescribed controller medication	48.0	9.8
Blood Pressure (BP) Control	% of patients 18-85 years of age with a diagnosis of hypertension and whose BP was <140/90mmHg	69.9	10.7
Breast Cancer Screening	% of women 50-75 years of age who had a mammogram to screen for breast cancer	60.2	15.6
Cervical Cancer Screening	% of women 21-64 years of age who received one or more Pap tests to screen for cervical cancer	48.5	16.3
Colorectal Cancer Screening	% of adults 50-75 years of age who had appropriate screening for colorectal cancer	54.2	16.7
Diabetes: Hemoglobin A1c Poor Control	% of patients 18-75 years of age with diabetes without a recent hemoglobin A1C or hemoglobin A1c > 9.0%	40.7	12.9
Diabetes: LDL-C Management	% of patients 18-75 years of age with diabetes whose LDL-C was <100 mg/dL	62.1	10.2
Diabetes: Urine Protein Screening	% of patients 18-75 years of age with diabetes who had a nephropathy screening test or evidence of nephropathy	78.4	11.0
Heart Failure (HF): ACE Inhibitor or ARB Therapy	% of patients aged 18 years and older with a diagnosis of heart failure (HF) who were prescribed ACE inhibitor or ARB therapy	55.4	11.9
Heart Failure (HF): Beta-Blocker Therapy	% of patients aged 18 years and older with a diagnosis of heart failure (HF) who were prescribed beta-blocker therapy	57.9	14.0
Ischemic Vascular Disease (IVD): Use of Aspirin or Another Antithrombotic	% of patients 20-79 years of age and older with diagnosis of ischemic vascular disease (IVD) who had documentation of use of aspirin or another antithrombotic	50.1	19.5
Ischemic Vascular Disease (IVD): LDL control	% of patients 20-79 years of age and older with diagnosis of ischemic vascular disease (IVD) whose LDL-C was < 100 mg/dl	65.4	8.5
Efficient Use of Healthcare Resources			
Appropriate Treatment for Children with Upper Respiratory Infection (URI)	% of children 3 months-18 years of age who were diagnosed with upper respiratory infection (URI) and were not dispensed an antibiotic prescription on or three days after the episode.	62.5	26.0
Patient Safety			
Use of High-Risk Medications in the Elderly	Percentage of patients 66 years of age and older who were not ordered high-risk medications	80.1	6.6
Warfarin Time in Therapeutic Range	Average % of time in which patients aged 18 and older with atrial fibrillation on warfarin therapy have INR in the past 45 days within the therapeutic range	38.8	17.7
Population / Public Health			
Chlamydia Screening for Women	% of women 16- 24 years of age who were identified as sexually active and who had at least one test for chlamydia	12.9	15.0
Depression Screening	% of patients aged 18 years and older screened for clinical depression	36.3	27.1
Influenza Immunization	% of patients aged 6 months and older seen for a visit in the last year who received an influenza immunization or who reported previous receipt of an influenza immunization	29.5	12.3
Pneumococcal Immunization for Older Adults	% of patients 65 years of age and older who have ever received a pneumococcal vaccine	63.0	20.9
Tobacco Use Screening and Cessation Intervention	% of patients aged 18 years and older who were screened for tobacco use within 24 months and who received cessation counseling intervention if identified as a tobacco user	89.8	8.7

Table 2. Practice Clinician Survey Scores for Specific Questions and Associations with Clinical Quality Measure Performance

	Measure	Agreement: Mean (SD)	Staff Education: Mean (SD)	EHR Reminders: Mean (SD)	Standing Orders: Mean (SD)	EHR Patient Education: Mean (SD)
Clinical Process / Effectiveness	Anti-depressant Medication Management	90.9 (18.3)	63.1 (23.8)	50.8 (26.8)	N/A	46.1 (23.5)
	Asthma: Use of Appropriate Medications	97.0 (8.9)	59.0 (22.6)	53.1 (26.2)	N/A	50.0 (23.8)
	Blood Pressure (BP) Control	96.5 (13.8)	79.0 (20.3)	74.6 (22.6)	N/A	59.5 (23.4)
	Breast Cancer Screening	97.2 (10.1)	89.2*† (15.6)	88.0*† (14.8)	69.7* (36.9)	61.0 (24.3)
	Cervical Cancer Screening	98.0 (7.8)	83.4* (19.2)	83.6*† (19.4)	39.7* (38.6)	56.4† (25.7)
	Colorectal Cancer Screening	99.8*† (1.1)	85.9* (17.1)	88.2*† (14.5)	51.0* (40.6)	60.2 (24.5.)
	Diabetes: Hemoglobin A1c Poor Control	90.4 (16.2)	78.2 (22.8)	74.2 (25.9)	63.7 (40.5)	64.2*† (22.3)
	Diabetes: LDL-C Management	91.6 (16.6)	63.4 (24.2)	68.0 (23.6)	55.5 (41.1)	64.2 (22.3)
	Diabetes: Urine Protein Screening	92.8 (20.2)	74.9*† (22.0)	80.2*† (23.2)	64.6* (39.8)	64.2* (22.3)
	Heart Failure (HF): ACE Inhibitor or ARB Therapy	96.0 (14.5)	54.7 (22.1)	59.0*† (27.0)	N/A	48.0 (24.8)
	Heart Failure (HF): Beta-Blocker Therapy	96.5 (13.9)	54.7 (22.1)	56.2*† (27.2)	N/A	48.0† (24.8)
	Ischemic Vascular Disease (IVD): Use of Aspirin or Another Antithrombotic	98.2 (7.5)	64.4*† (23.9)	75.8*† (23.8)	N/A	54.4 (23.3)
	Ischemic Vascular Disease (IVD): LDL control	94.0 (11.7)	62.4 (24.6)	64.0 (23.2)	48.3 (41.2)	54.5 (23.3)
Efficient Resource Use	Appropriate Treatment for Children with Upper Respiratory Infection (URI)	89.8 (21.6)	63.2* (27.1)	36.5*(27.9)	N/A	38.6* (26.5)
Patient Safety	Use of High-Risk Medications in the Elderly	91.7*† (18.9)	56.8 (22.0)	69.2 (20.8)	N/A	43.5 (24.9)
	Warfarin Time in Therapeutic Range	97.3 (13.7)	76.8* (23.0)	43.2 (29.2)	N/A	49.3 (27.5)
Population / Public Health	Chlamydia Screening for Women	89.3*(25.1)	65.7* (24.6)	64.0*† (29.8)	30.7* (35.7)	45.4 (26.8)
	Depression Screening	88.5 (23.2)	69.1*† 26.6)	67.7*† (29.5)	41.2* (42.2)	50.2* (29.7)
	Influenza Immunization	97.9 (7.1)	90.6* (14.5)	88.2*† (14.7)	82.0 (29.2)	62.7 (25.1)
	Pneumococcal Immunization for Older Adults	100.0 (0.0)	88.0* (17.2)	87.0*† (16.0)	72.0* (35.0)	62.3 (24.5)
	Tobacco Use Screening and Cessation Intervention	98.3 (8.5)	86.2 (16.7)	83.5 (17.7)	N/A	62.6 (25.4)

SD: Standard deviation

* Significantly ($p<0.05$) correlated with corresponding quality measure in bivariate (unadjusted) analysis

† Significantly ($p<0.05$) correlated with corresponding quality measure in multivariate (adjusted) analysis

Table 3: Mean Practice Clinician Survey Scores for General Questions and Associations with Summary Quality Index (SQUID)-Clinical Quality Measure Performance

	Questionnaire Item	Item Score Mean (SD) Across Practices	Adjusted* Correlation with SQUID-CQM
Use of EHR Functionality	EHR-based update form for patients to review their status on CQM	49.8 (28.2)	0.20
	Registries for population management	60.1 (24.6)	0.32†
	Web portal for patients to reinforce their clinical quality goals	44.8 (32.1)	-0.11
	After visit summary to educate patients about their progress on CQM goals	69.4 (21.7)	0.19
	Maintain up to date problem lists	82.9 (13.6)	0.14
Clinical QI Strategies	Medication reconciliation at each patient visit	88.3 (12.8)	0.13
	Medication refill protocol	77.6 (20.1)	-0.04
	Point of care laboratory tests	74.5 (20.7)	-0.05
	Request patients have laboratory tests in advance of visits	66.6 (18.9)	0.14
	Follow up with patients who do not complete recommended services	64.9 (16.8)	0.21
Beliefs about EHR and QI Activities	EHR is helpful in achieving high quality clinical care	72.7 (14.1)	0.29†
	EHR is customized in practice to facilitate high quality clinical care	71.4 (14.9)	0.34†
	EHR is difficult for you to use to achieve high quality clinical care	58.6 (15.5)	-0.25†
	Practice has financial burdens using EHR to achieve high quality clinical care	47.1 (18.2)	0.07
	Participation in PPRNet motivating to achieve high quality clinical care	63.6 (22.1)	0.26†
	Assistance from REC helpful to achieve high quality clinical care	36.5 (18.5)	0.12
Practice administrative QI Strategies	Members review CQM performance reports	71.2 (19.2)	0.17
	Members know the practice's improvement priorities	74.7 (16.3)	0.30†
	Members work consistently to achieve improvement	77.3 (14.6)	0.16
	Members evaluate progress together	70.5 (17.7)	0.28†
	Leaders seek team members assistance and input regarding decisions	63.5 (21.2)	0.29†
	Staff incentivized towards higher performance	52.4 (22.7)	0.14
	Providers incentivized with rewards from achieving high performance	39.0 (24.3)	0.07
	Regular staff meetings with entire team to discuss rationale for decisions	72.1 (21.1)	0.34†
	Leadership show commitment to improving meaningful use of EHR	77.2 (18.4)	0.33†
	Test a variety of approaches using EHR to achieve high quality clinical care	58.5 (16.0)	0.07

CQM: Clinical Quality Measures; REC: Regional Extension Center.

* The correlations presented are partial correlations between practices' mean survey item responses and their SQUID-CQM scores; the correlations are adjusted for the mean number of chronic conditions among the practices' patients.

† $p<0.05$

6. List of Publications and Products.

Submitted manuscripts:

- Ornstein SM, Nemeth LS, Nietert PJ, Jenkins RG, Wessell AM, Litvin CB: Learning from Primary Care Meaningful Use Exemplars. Submitted to the Journal of the American Board of Family Medicine, July 2014.
- Litvin CB, Ornstein SM, Wessell AM, Nemeth LS: “Meaningful” Clinical Quality Measures for Primary Care Physicians. Submitted to the Journal of the American Medical Informatics Association, July 2014.

Presentations:

- Ornstein S: “Learning from Primary Care Meaningful Use Exemplars.” North American Primary Care Research Group Practice Based Research Network Meeting. Bethesda, MD, July 1, 2014.
- Nemeth L: “Measuring Practice Transformation.” North American Primary Care Research Group Practice Based Research Network Meeting. Bethesda, MD, July 1, 2014.
- Litvin C: “Learning from Meaningful Use "Exemplars": Relevant Clinical Quality Measures for Primary Care.” Accepted for oral presentation at the North American Primary Care Research Group Annual meeting, New York, New York, November 2014.

Project Summary References:

1. Blumenthal D, Tavenner M. The "meaningful use" regulation for electronic health records. New England Journal of Medicine. 2010;363(6):501-4. doi: NEJMp1006114 [pii]10.1056/NEJMp1006114. PMID: 20647183.
2. Zaroukian MH. American College of Physicians comment letter on stage 3 meaningful use, Jan. 14 2013.
3. Clinical Quality Measures (CQMs): Centers for Medicare & Medicaid Services; [cited 2013 2-18]. Available from: http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/ClinicalQualityMeasures.html.
4. Hoffman A, EJ. E. Reengineering us health care. JAMA. 2013;309(7):661-2. doi: 10.1001/jama.2012.214571.
5. 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;32(1):53-62. doi: 10.1377/hlthaff.2012.0742. PMID: 23297271.
6. Chaudhry B, Wang J, Wu S, Maglione M, Mojica W, Roth E, Morton SC, Shekelle PG. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. Ann Intern Med. 2006;144(10):742-52. PMID: 16702590.
7. Goldzweig CL, Towfigh A, Maglione M, Shekelle PG. Costs and benefits of health information technology: new trends from the literature. Health Aff (Millwood). 2009;28(2):w282-93. doi: 10.1377/hlthaff.28.2.w282. PMID: 19174390.
8. Linder JA, Ma J, Bates DW, Middleton B, Stafford RS. Electronic Health Record Use and the Quality of Ambulatory Care in the United States. Archives of Internal Medicine. 2007;167(13):1400-5. PMID: 17620534.
9. Zhou L, Soran CS, Jenter CA, Volk LA, Orav EJ, Bates DW, Simon SR. The relationship between electronic health record use and quality of care over time. J Am Med Inform Assoc. 2009;16(4):457-64. doi: 10.1197/jamia.M3128. PMID: 19390094; PMCID: 2705247.
10. Reed M, Huang J, Graetz I, Brand R, Hsu J, Fireman B, Jaffe M. Outpatient electronic health records and the clinical care and outcomes of patients with diabetes mellitus. Ann Intern Med. 2012;157(7):482-9. doi: 10.7326/0003-4819-157-7-201210020-00004. PMID: 23027319.
11. Margolius D, Bodenheimer T. Transforming primary care: from past practice to the practice of the future. Health Aff (Millwood). 2010;29(5):779-84. doi: 10.1377/hlthaff.2010.0045. PMID: 20439861.
12. Cusack CM, Knudson AD, Kronstadt JL, Singer RF, Brown AL. Practice-Based Population Health: Information Technology to Support Transformation to Proactive Primary Care (Prepared for the AHRQ National Resource Center for Health Information Technology under Contract No. 290-04-0016.). Rockville, MD: Agency for Healthcare Resarch and Quality.
13. Bergstrom G, Bjelle A, Sorensen LB, Sundh V, Svanborg A. Prevalence of rheumatoid arthritis, osteoarthritis, chondrocalcinosis and gouty arthritis at age 79. J Rheumatol. 1986;13(3):527-34. PMID: 3735273.
14. Beriwal S, Demanes DJ, Erickson B, Jones E, De Los Santos JF, Cormack RA, Yashar C, Rownd JJ, Viswanathan AN. American Brachytherapy Society consensus guidelines for interstitial brachytherapy for vaginal cancer. Brachytherapy.11(1):68-75. doi: S1538-4721(11)00349-7 [pii] 10.1016/j.brachy.2011.06.008. PMID: 22265440.
15. Bergquist S, Frantz R. Pressure ulcers in community-based older adults receiving home health care. Prevalence, incidence, and associated risk factors. Adv Wound Care. 1999;12(7):339-51. PMID: 10687554.
16. Tagalicod R, Reider J. Progress on Adoption of Electronic Health Records: Centers for Medicare and Medicaid Services; 2013 [updated December 13, 2013; cited April 16 2014]. Available from: http://www.cms.gov/eHealth/ListServ_Stage3Implementation.html.
17. AHRQ Centers for Primary Care Practice-Based Research and Learning 2012 [10-29-2012]. Available from: http://www.ahrq.gov/research/rescenters.htm.
18. Ornstein S, Jenkins RG, Nietert PJ, Feifer C, Roylance LF, Nemeth L, Corley S, Dickerson L, Bradford WD, Litvin C. A multimethod quality improvement intervention to improve preventive cardiovascular care: a cluster randomized trial. Ann Intern Med. 2004;141(7):523-32. PMID: 15466769.
19. Rose HL, Miller PM, Nemeth LS, Jenkins RG, Nietert PJ, Wessell AM, Ornstein SM. Alcohol screening and brief counseling in a primary care hypertensive population: a quality improvement intervention. Addiction. 2008;103(8):1271-80. PMID: 18422825; PMCID: PMID: 18422825.

20. Ornstein S, Nemeth LS, Jenkins RG, Nietert PJ. Colorectal cancer screening in primary care: translating research into practice. Med Care. 2010;48(10):900-6. doi: 10.1097/MLR.0b013e3181ec5591. PMID: 20808257.
21. Litvin CB, Ornstein SM, Wessell AM, Nemeth LS, Nietert PJ. Use of an Electronic Health Record Clinical Decision Support Tool to Improve Antibiotic Prescribing for Acute Respiratory Infections: The ABX-TRIP Study. J Gen Intern Med. 2012. doi: 10.1007/s11606-012-2267-2. PMID: 23117955.
22. Nemeth LS, Ornstein SM, Jenkins RG, Wessell AM, Nietert PJ. Implementing and evaluating electronic standing orders in primary care practice: a PPRNet study. J Am Board Fam Med. 2012;25(5):594-604. PMID: 22956695. doi: 10.3122/jabfm.2012.05.110214. PMID: 22956695.
23. Wessell AM, Ornstein SM, Jenkins RG, Nemeth LS, Litvin CB, Nietert PJ. Medication Safety in Primary Care Practice: Results From a PPRNet Quality Improvement Intervention. Am J Med Qual. 2012. doi: 10.1177/1062860612445070. PMID: 22679129; PMCID: PMID: 22679129.
24. Nietert PJ, Wessell AM, Jenkins RG, Feifer C, Nemeth LS, Ornstein SM. Using a summary measure for multiple quality indicators in primary care: the Summary QUality InDex (SQUID). Implement Sci. 2007;2:11. doi: 10.1186/1748-5908-2-11. PMID: 17407560; PMCID: 1852570.
25. Centers for Medicare & Medicaid Services. 2014 Clinical Quality Measures. http://go.cms.gov/1mASXFA Accessed February 18, 2013.
26. Ornstein S, Nietert PJ, Jenkins RG, Wessell AM, Nemeth LS, Rose HL. Improving the translation of research into primary care practice: results of a national quality improvement demonstration project. Jt Comm J Qual Patient Saf. 2008;34(7):379-90. PMID: 18677869; PMCID: PMID: 18677869.
27. Nemeth LS. Synthesizing Lessons Learned Within a Practice-Based Research Network (PPRNet). 26th Annual Conference of the Southern Nursing Research Society; 25February; New Orleans, LA2012.
28. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci. 2009;4:50. doi: 10.1186/1748-5908-4-50. PMID: 19664226; PMCID: 2736161.
29. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81. doi: 10.1016/j.jbi.2008.08.010. PMID: 18929686; PMCID: 2700030.
30. Krueger R, Casey MA. Focus Groups. 3rd ed. Thousand Oaks, CA: Sage Publications; 2000.
31. Morgan DL. Focus Groups. Annual Review of Sociology. 1996;22:129-52.
32. Strauss A, Corbin J. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. 2nd ed. Thousand Oaks, CA: Sage Publications, Inc.; 1998.
33. Ownwuegbuzie AJ, Dickinson WB, Leech NL, Zoran A, G. A qualitative framework for collecting and analyzing data in focus group research. International Journal of Qualitative Methods. 2009;8(3):1-21.
34. Combs JP, Ownwuegbuzie AJ. Describing and illustraing data analysis in mixed research. International Journal of Education. 2010;2(2):1-23.
35. Borkan J. Immersion/Crystallization. In: Crabtree BF, Miller WL, editors. Doing Qualitative Research. Thousand Oaks: Sage Publications, Inc.; 1999. p. 177-94.
36. Maxson E, Jain S, Kendall M, Mostashari F, Blumenthal D. The regional extension center program: helping physicians meaningfully use health information technology. Ann Intern Med. 2010;153(10):666-70. doi: 10.7326/0003-4819-153-10-201011160-00011. PMID: 21079224.
37. Stone NJ, Robinson J, Lichtenstein AH, Bairey Merz CN, Lloyd-Jones DM, Blum CB, McBride P, Eckel RH, Schwartz JS, Goldberg AC, Shero ST, Gordon D, Smith SC, Jr., Levy D, Watson K, Wilson PW. 2013 ACC/AHA Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Journal of the American College of Cardiology. 2013. doi: 10.1016/j.jacc.2013.11.002. PMID: 24239923.
38. Moyer VA, Force USPST. Prevention of falls in community-dwelling older adults: U.S. Preventive Services Task Force recommendation statement. Annals of internal medicine. 2012;157(3):197-204. doi: 10.7326/0003-4819-157-3-201208070-00462. PMID: 22868837.
39. King J, Patel V, Jamoom EW, Furukawa MF. Clinical benefits of electronic health record use: national findings. Health Serv Res. 2014;49(1 Pt 2):392-404. doi: 10.1111/1475-6773.12135. PMID: 24359580.
40. Linder JA, Ma J, Bates DW, Middleton B, Stafford RS. Electronic health record use and the quality of ambulatory care in the United States. Arch Intern Med. 2007;167(13):1400-5. doi: 10.1001/archinte.167.13.1400. PMID: 17620534.

41. Samal L, Wright A, Healey MJ, Linder JA, Bates DW. Meaningful use and quality of care. JAMA internal medicine. 2014. doi: 10.1001/jamainternmed.2014.662.
42. Poon EG, Wright A, Simon SR, Jenter CA, Kaushal R, Volk LA, Cleary PD, Singer JA, Tumolo AZ, Bates DW. Relationship between use of electronic health record features and health care quality: results of a statewide survey. Med Care. 2010;48(3):203-9. doi: 10.1097/MLR.0b013e3181c16203. PMID: 20125047.
43. Kern LM, Barron Y, Dhopeshwarkar RV, Edwards A, Kaushal R, Investigators H. Electronic health records and ambulatory quality of care. J Gen Intern Med. 2013;28(4):496-503. doi: 10.1007/s11606-012-2237-8. PMID: 23054927; PMCID: 3599037.
44. Kern LM, Malhotra S, Barron Y, Quaresimo J, Dhopeshwarkar R, Pichardo M, Edwards AM, Kaushal R. Accuracy of Electronically Reported "Meaningful Use" Clinical Quality Measures: A Cross-sectional Study. Ann Intern Med. 2013;158(2):77-83. doi: 10.7326/0003-4819-158-2-201301150-00001. PMID: 23318309.