Project Title: Best Practices for Integrating Clinical Decision Support into Clinical Workflow

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Structured Abstract

Purpose:
To determine the intensity of support that Community Health Centers (CHCs) need to better integrate clinical decision support (CDS) and clinical workflows in order to improve performance on high priority health conditions.

Scope:
This study was conducted within 12 practice sites from three CHCs that are part of a national primary care practice-based research network.

Methods:
Twelve practice sites were randomized to six months of low intensity support (the use of a CDS implementation toolkit) or high intensity support (the use of a CDS implementation toolkit with practice coaching support) with the goal of achieving increased rates of CDS use and clinical treatment outcomes for two health targets (asthma management and cardiovascular disease prevention). We used a difference in differences approach to compare the changes in CDS use and clinical treatment outcomes between the low and high intensity support groups.

Results:
The rate of asthma CDS use increased by 9.2% and 7.3% in the low and high intensity groups, respectively ($p<0.001$ for both). The rate of treatment with controller medications among those with persistent asthma did not change in the low or high intensity groups. The rate of cardiovascular disease prevention CDS use decreased by 2.3% ($p<0.001$) in the low intensity group and increased by 4.3% ($p<0.001$) in the high intensity group, resulting in a difference in differences between the groups of 7.2% ($P<0.001$). The rate of statin prescribing for patients with FRS ≥ 10% did not change in either the low or high intensity groups.

Key Words: clinical decision support, community health centers, practice coaching

Purpose

The primary objective of this study is to determine the intensity of support that Community Health Centers (CHCs) need in order to achieve the proposed Stage 3 Meaningful Use clinical decision support (CDS) objective – namely, the use of CDS to improve performance on high priority health conditions. A secondary aim of this study is to determine if and how the intensity of support needed by CHCs to more effectively integrate CDS and clinical workflows in order to improve performance on high priority health conditions varies based on the CHC's baseline chronic care and population health management infrastructure. Our hypothesis is that CHCs with lower baseline levels of chronic care and population health management infrastructure will require more intense support to achieve improvements in performance, while CHCs with higher baseline levels of chronic disease management and population health infrastructure will be able to achieve improvements in performance with lower intensity support. The two health priorities targeted in this study are asthma control and cardiovascular disease prevention. The two levels of support tested in this study are the use of a clinical decision support implementation toolkit with practice coaching support (high intensity support) or without practice coaching support (low intensity support).

Scope

Background

The Health Information Technology for Economic and Clinical Health (HITECH) Act, enacted as part of the American Reinvestment and Recovery Act (ARRA) of 2009, aims to modernize and advance the nation's health care infrastructure through supporting the meaningful use of certified electronic health records (EHRs). Through progressive stages, the Medicare and Medicaid EHR Incentive Programs seek to catalyze the use of EHRs for data capture and sharing (Stage 1), the support of advanced clinical processes (Stage 2), and the achievement of improved health outcomes (Stage 3). In response to AHRQ's request for evidence to inform the development of Stage 3 Meaningful Use objectives, we set out to determine the level of support that Eligible Providers will need to achieve the proposed Stage 3 CDS objective based on their baseline chronic care and population health management infrastructure. The Stage 3 CDS objective aims "to support higher levels of outcomes-oriented coordinated care and population health management" and is expected to start in 2017. In particular, our aim is to determine the level of support that will be required by Eligible Providers who serve populations that have historically had the worst health outcomes, including those residing in rural communities, inner city communities, low income or uninsured populations, and racial and ethnic minorities.

We start with the understanding that the meaningful use of CDS is about more than "turning on" the right technology. While many health care providers may think solely of alerts, reminders, and order sets when they think of CDS, this study is rooted in a much broader definition of CDS as "a *process* for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery."(1) This CDS definition offers a sound foundation for realizing the Stage 3 CDS objective and assessing the factors that will facilitate or impede its success. Therefore, we set out to determine what support CHCs will need not just to purchase or "turn on" CDS

interventions like alerts, order sets, or disease registries, within certified EHRs, but to ensure that CDS interventions contribute effectively to care processes and clinical workflows that are most likely to lead to meaningful improvements in the targeted quality measures and health outcomes.

Two promising approaches for supporting the more effective implementation and integration of CDS into widespread clinical care include practice coaching and the use of structured frameworks or toolkits. The evidence on the effects of practice coaching on quality improvement is strong but the resource requirements are an important limitation to its widespread use.(2, 3) The use of frameworks or toolkits is an attractive and potentially less expensive alternative to practice coaching, however the data regarding their efficacy is less well established.(4) Therefore, in this study, we compare the effects of a CDS implementation toolkit developed in conjunction with the Office of the National Coordinator (the *CDS 5 Rights*) and practice coaching on the use of CDS interventions and treatment goals targeting chronic disease management and preventive care.

This study evaluates the effects of the CDS implementation toolkit and practice coaching on the use of CDS targeting two high priority areas for the Medicare and Medicaid populations –asthma management and cardiovascular disease prevention. Asthma is a prevalent chronic condition – one of the most prevalent chronic conditions of childhood.(5) Advances in evidence-based treatments have led to lower rates of asthma-related mortality and functional limitations despite rising disease prevalence.(5) Nonetheless, asthma exacerbations remain a leading cause of missed school and work days and potentially avoidable hospitalizations.(6) The highest rates of asthma prevalence and morbidity are among African-Americans, Puerto Ricans, and those with family incomes below the federal poverty level.(6) Heart disease and stroke account for one-third of U.S. deaths and are leading causes of disability.(7) Despite decreasing mortality rates for heart disease and stroke, the costs of care for both conditions continue to rise.(7) Cardiovascular disease is responsible for over 15% of all medical expenditures and nearly 30% of Medicare expenditures.(8) Heart disease and stroke are also among the most preventable medical conditions, as the better control of risk factors have been associated with about half of the decline in the incidence of cardiovascular disease.(9) Cardiovascular disease is also among the largest contributors to disparities in premature death and disability by race, ethnicity, and socioeconomic status.(10, 11) Thus, improving the control of risk factors such as smoking, high cholesterol, and high blood pressure has great potential to improve public health, reduce disparities, and curb the rising costs of health care. Importantly, the management of asthma and the prevention of cardiovascular disease are also areas with strong evidence-based guidelines.(5, 12, 13) These guidelines, however, are complex, with treatment recommendations differing based on very specific patient characteristics, and with generally low rates of adherence to the guidelines in clinical practice.(14) Given the evidence suggesting that CDS can be an effective tool to facilitate adherence to evidence-based clinical guidelines, (15-17) asthma management and cardiovascular disease prevention are exemplary targets for CDS interventions.

Setting

This study was conducted within the Alliance of Chicago Community Health Services (the Alliance), a primary care practice-based research network that includes 34 Community Health Centers, comprising

over 180 practice sites across 14 states. Since 2006, the Alliance has implemented and supported a centrally hosted EHR across member CHCs. The individual practice sites within the Alliance represent diversity not only in regards to the types of patients served but in delivery characteristics including size, setting (geographic region, rural vs. urban), and length of time using the EHR. Twelve sites from three of the Alliance's member CHCs participated in the randomized study comparing the effects of the CDS implementation toolkit and practice coaching on CDS use and the achievement of clinical treatment targets. Table 1 summarizes the key characteristics of these three CHCs.

Table 1. Demographic and Patient-Centered Medical Home Characteristics of Community Health Centers Participating in the Randomized Trial of the Effects of a CDS Implementation Toolkit vs. Practice Coaching on the Use of CDS Targeting Asthma Management and Cardiovascular Disease Prevention

	CHC A	CHC B	CHC C
GEOGRAPHIC CHARACTERISTICS	Urban	Urban	Rural
DEMOGRAPHIC CHARACTERISTICS	75% non-White race (predominantly Black), 20% Hispanic ethnicity	Predominantly Black and Hispanic	80% White race, 12% Native American, 15% Hispanic ethnicity
NUMBER OF ANNUAL PATIENT VISITS	33,000	50,000	34,000
NUMBER OF CLINICAL SITES	8	11	14
PCMH STATUS	Level 0	Level 2	Level 3

Notes for Table A: PCMH = Patient-Centered Medical Home; PCMH status was based on NCQA certification as of January 1, 2014. PCMH level 0 = PCMH certification not yet achieved. PCMH level 2 certification = able to provide team-based care; PCMH level 3 = able to provide team-based care and population health management.

Context

The Alliance has developed CDS interventions that target asthma management (asthma management CDS tool) and the prevention of cardiovascular disease (CVD prevention CDS tool), but the baseline rates of use of these tools were low as they were used in less than 20% of eligible encounters. The asthma managementCDS tool aims to improve the proportion of patients with asthma who have been appropriately assessed for disease severity and treated appropriately, including through the use of medication management and patient/family self-management support. The asthma CDS tool has the following features: point-of-care alerts regarding patients who have not had documentation of their asthma severity, control, triggers, treatment plan, or patient education within an appropriate time frame; tools to facilitate the assessment of patient's asthma control using a validated instrument, the Asthma Therapy Assessment Questionnaire (ATAQ); decision support to remind providers of guideline

appropriate treatment recommendations based on the patient's level of asthma control and severity; order sets to facilitate the prescription of guideline concordant therapy, and links to provide printed patient self-management support materials including the Asthma Action Plan. The CVD prevention CDS tool aims to increase the proportion of patients eligible for treatment with statins for the primary prevention of cardiovascular disease (CVD) who are treated with statin therapy. The CVD Prevention CDS has the following features: point-of-care alerts regarding patients who have not had documentation of CVD risk factor assessment (e.g. smoking status, cholesterol profile), automated assessment of patient's global CVD risk at the point-of-care using the 10 year risk for heart attack using the Framingham Risk Calculator, reminders for providers to consider prescribing statins for guideline-recommended patients (9, 12) with a Framingham Risk Score of ≥ 10%, order sets to facilitate the prescription of generic statins, and low-health literacy-appropriate patient health education materials.

Methods

We conducted a site-randomized trial with 12 sites from three CHCs to compare the effects of a low intensity approach (use of a CDS implementation toolkit on its own) and a higher intensity approach (use of a CDS implementation toolkit with practice coaching support) on the rates of use of the CDS tools and rates of achievement of clinical treatment targets for asthma management and cardiovascular disease prevention.

Interventions

Each of the 12 participating sites assembled a three member "CDS optimization team" consisting of a physician or mid-level provider (advanced practice nurse or physician's assistant), nurse (LPN or RN), and a medical assistant. Prior to randomization, the members of all 12 teams participated in a two hour webinar training on a CDS implementation toolkit called the *CDS 5 Rights*. During the six month intervention period, which ran from March 2014 through August 2014, each team member was expected to devote two hours a month to work on improving the targeted CDS use and clinical treatment targets using the *CDS 5 Rights* toolkit as a guide. The teams from the 6 sites randomized to the low intensity support arm were expected to work through the toolkit and work to implement desired practice improvements on their own. The teams from the 6 sites randomized to the high intensity support intervention received support from an experienced practice coach to help them work through the toolkit and to provide feedback on their planned practice improvements. Each of the 12 CDS optimization teams received monthly feedback reports on their site's performance on the targeted CDS use and treatment targets, and each of the 12 sites had access to health information technology support to help them implement desired changes to the existing CDS tools.

The CDS implementation toolkit used for this study is the *CDS 5 Rights* toolkit, which consists of the *CDS 5 Rights* Framework and corresponding worksheets.(18) It was developed by the CDS Collaborative for Performance Improvement in conjunction with the Office of the National Coordinator. The worksheets that are part of this toolkit provide a systematic way for care teams to analyze current target-focused workflows and information flows in order to highlight inefficiencies and improvement opportunities for key performance measures. In particular, the *CDS 5 Rights* Framework emphasizes that the achievement

of CDS-supported improvements in desired health outcomes relies on 1. the communication of the *right information:* evidence-based, suitable to guide action, pertinent to the circumstance; 2. to the *right person:* considering all members of the care team, including clinicians, patients, and their caretakers; 3. in the *right CDS intervention format:* such as an alert, order set, or reference information to answer a clinical question; 4. through the *right channel:* for example, a clinical information system such as an electronic health record, personal health record, or a more general channel such as the Internet or a mobile device; 5. at the *right time in workflow:* for example, at time of decision or action.(19)

Outcomes

The effects of applying the *CDS 5 Rights* toolkit alone (low intensity support) versus *CDS 5 Rights* toolkit plus practice coaching (high intensity support) were assessed by CDS intervention use and clinical treatment outcomes for the cardiovascular disease prevention and asthma management CDS interventions as outlined in Table 2.

Table 2: CDS Use Outcomes and Clinical Treatment Outcomes

GENERAL TARGET	ASTHMA	CVD PREVENTION
USE OF CDS	Assessment of asthma severity	Estimation of CVD Risk using the Framingham Risk Score
CLINICAL TREATMENT OUTCOME	Controller medication prescribed for patients with persistent asthma	Statin prescribed for patients with Framingham Risk Score ≥ 10%

Patients were eligible for the asthma management CDS use and treatment outcomes if they were ages 5-40 with a diagnosis of asthma and had at least one visit to the practice site during the 6 month study period (March 1, 2014, and August 31, 2014). Patients were eligible for the CVD prevention CDS use and treatment outcomes if they had no known coronary heart disease or coronary heart disease equivalent (stroke, carotid atherosclerosis, peripheral arterial disease), no known diabetes mellitus, were men ages 35 to 75 or women ages 45-75, and had at least one visit to the practice site between March 1, 2014, and August 31, 2014.

Study Sites and Randomization

This study was conducted among 12 sites from three CHCs that are members of the Alliance. To assess whether the intensity of CHC support needed varies based on the health center's chronic disease management and population health infrastructure at baseline, randomization of the participating sites was stratified by CHC, as the CHC's differed in regards to baseline NCQA Patient-Centered Medical Home Certification level (Table 1). Two practice sites from each of the three CHCs were randomized to the low intensity support intervention, and two practice sites from each of the three CHCs were randomized to the high intensity support intervention.

CHC A is a federally-qualified health center in an urban center that serves a population that is predominantly Black or Hispanic. CHC A serves over 33,000 patients annually across 8 separate sites. The

surrounding community is characterized by large concentrations of public housing and abandoned residential buildings. Over 50% of the CHC's patients are uninsured, 40% have Medicaid coverage, and 96% live below 200% of federal poverty level. CHC A has a strong commitment to quality improvement and community engagement but had not yet achieved PCMH certification at the start of this study. The four largest CHC A primary care practice sites participated in this study.

CHC B is a federally-qualified health center that serves a predominantly Black and Hispanic population in an urban area. CHC B serves over 34,000 patients annually across 11 separate sites. This health center had achieved PCMH Level 2 certification by the start of this study. The four largest CHC B primary care practice sites participated in this study.

CHC C is a federally-qualified health center in rural and suburban areas that serves nearly 50,000 patients annually across 14 separate sites. Approximately 30% of the population is a racial or ethnic minority, with 15% identifying as Hispanic and 12% American Indian/Alaskan native. Nearly 20% of the CHC's patients are uninsured, 31% have Medicaid coverage and 11% have Medicare. Nearly 89% of the patients live at or below 200% of poverty. Four CHC C primary care practice sites participated in this study.

Our hypothesis is that CHCs with a strong chronic disease and population health management infrastructure will be able to achieve high levels of CDS intervention use as well as improvements in clinical treatment targets with relatively low-intensity implementation support strategies (e.g. introductory webinar and use of *CDS 5 Rights* toolkit) while practices with weaker chronic disease and population health management infrastructure will require higher-intensity support strategies (e.g. practice coaching) to achieve high levels of CDS intervention use and improvements in clinical treatment outcomes.

Analysis

Due to the differences in the baseline rates of CDS use between the low intensity support and high intensity support groups (despite randomization), we used a difference in differences approach to compare the change in CDS use and clinical treatment outcomes between the sites randomized to the low versus high intensity support interventions. We compared the baseline (December 2013 – February 2014) and follow up (June 2014 – August 2014) rates of asthma severity assessment, prescription of asthma controller medications for patients with persistent asthma, cardiovascular disease risk assessment, and prescription of statins for patients with Framingham Risk Score of 10% of higher. For each outcome, we used a direct two sample proportion test, which tests the difference in the change of proportions between the two groups. This method allowed us to account for the number of patients in each practice site during each measurement period.

Other data collection

We surveyed the CDS optimizations teams from each of the 12 practice sites to determine their prior quality improvement training and experience as well as their perceptions of their health center's practice environment, organizational culture, and quality improvement culture. We surveyed the staff

at each of the three CHCs to determine the usability of the asthma management and cardiovascular disease prevention CDS tools. We also interviewed members of the CDS optimization teams to gain further insight into strengths and weaknesses of the interventions.

Assessment of practice-level factors associated with use of CDS interventions

To determine the practice-level characteristics that may help to identify CHCs and other safety net primary care practices that may benefit the most from interventions or support to increase their success in achieving the Stage 3 Meaningful Use CDS objective, we examined the association between factors such as practice size, practice setting (rural vs. urban), healthcare provider model (physician vs. nurse practitioner model), and chronic care management infrastructure (PCMH certification level) with the rate of use of CDS interventions targeting asthma management and cardiovascular disease prevention and the rate of appropriate medication prescribing for both of these conditions. Twenty-one of the Alliance's member CHCs contributed data to this cross-sectional assessment of the association between practice-level factors and CDS use.

Results

Principal Findings

- The rate of CDS use for asthma management, measured by the documentation of asthma severity, increased in the low and high intensity groups, but there was no difference in the rate of increase between the groups randomized to low versus high intensity support.
- The clinical treatment outcome for asthma, the rate of the prescription of controller medications for patients with persistent asthma, did not change in either the low intensity or high intensity groups.
- The rate of CDS use for CVD prevention, measured by documentation of cardiovascular disease risk assessment using the Framingham Risk Score (FRS), decreased by 2.8% in the low intensity group and increased by 4.3% in the high intensity group, resulting in a difference in differences in the rate of cardiovascular disease risk assessment of 7.2% between the groups (all p-values <0.001).
- The clinical treatment outcome for CVD prevention, the rate of statin prescribing for those with high cardiovascular disease risk, did not change in either the low or high intensity groups.

Outcomes

CDS Optimization Team Characteristics

Fifty-six percent (20/36) of CDS optimization team members completed the *CDS 5 Rights* Team Survey. Of the respondents, 65% reported no or little prior training in quality improvement methodologies, 53% reported no or little prior experience working on quality improvement interventions, and 47% had worked at the health center for 3 or fewer years. The characteristics of the team survey respondents are summarized in Table 3.

Table 3. Characteristics of CDS Optimization Team Survey Respondents

RESPONDENT CHARACTERISTICS	N (%)
COMMUNITY HEALTH CENTER	N=16
CHC A	6 (38)
CHC B	5 (31)
CHC C	5 (31)
JOB POSITION	N=17
PHYSICIAN, PHYSICIAN'S ASSISTANT, OR NURSE PRACTITIONER	10 (59)
REGISTERED NURSE OR LICENSED PRACTICAL NURSE	4 (23)
MEDICAL ASSISTANT	3 (18)
DURATION OF EMPLOYMENT AT HEALTH CENTER	N=17
<1 YEAR	2 (12)
1-3 YEARS	6 (35)
4-5 YEARS	3 (18)
6-9 YEARS	2 (12)
10 OR MORE YEARS	4 (23)
PRIOR QUALITY IMPROVEMENT TRAINING	N=17
NONE	8 (47)
A LITTLE	3 (18)
A MODERATE AMOUNT	4 (23)
A LOT	2 (12)
PRIOR QUALITY IMPROVEMENT EXPERIENCE	N=17
NONE	3 (18)
A LITTLE	6 (35)
A MODERATE AMOUNT	5 (29)
A LOT	3 (18)

Community Health Center's Practice Environment and Organizational Culture

The team members' perceptions of their health center's practice environment, organizational culture, and quality improvement culture differed modestly by health center. However, health centers with higher levels of PCMH certification did not consistently score higher on measures of health center environment and culture. Table 4 summarizes how each of the health centers were rated in regards to practice environment, organizational culture, and quality improvement culture.

Table 4. CDS Optimization Team Ratings of Practice Environment, Organizational Culture, and Quality Improvement Culture Stratified by Community Health Center

	CHC A	CHC B	CHC C
PROFESSIONAL PRACTICE ENVIRONMENT SCORE (RANGE 6-30)	18.3	22.0	19.8
ORGANIZATIONAL CULTURE SCORE (RANGE 8-40)	26.9	30.8	30.8
QUALITY IMPROVEMENT CULTURE SCORE (RANGE 10-50)	34.7	34.2	33

Notes for Table 4: The Professional Practice Environment Score was based on a six item subset of the Professional Practice Environment Scale.(20) The Organizational Culture Score was based on an eight item subset (Domain 1) of the Quality Improvement Maturity Tool.(21) The Quality Improvement Culture Score was based on a 10 item subset (Domain 4) of the Quality Improvement Maturity Tool.(21) Each item was scored on a 5 point Likert scale (1 = strongly disagree, 5 = strongly agree), and the mean scores for each item were added to create the total score. Higher scores indicate better ratings in each domain.

Ratings of CDS 5 Rights Implementation Toolkit

While team members expressed an appreciation for the concepts and framework of the *CDS 5 Rights* Implementation Toolkit, the *CDS 5 Rights* Implementation Toolkit was rated poorly by most team members in regards to ease of use. Only 18% of respondents agreed or strongly agreed that the toolkit was easy to use while 76% agreed or strongly agreed that the toolkit was unnecessarily complex. Seventy-six percent of respondents agreed or strongly agreed that they would need the support of a practice coach or other quality improvement expert in order to be able to effectively use the toolkit.

Usability of CDS Tools

Ninety-nine staff members from the three participating CHCs responded to the staff survey regarding usability of the asthma management and CVD prevention CDS tools. In general, the CDS tools were rated favorably, but opportunities for improving the integration between CDS and clinic workflow were identified.

Sixty-one percent of respondents agreed or strongly agreed that the asthma management CDS tools helped them to improve the health of patients with asthma, while 68% agreed or strongly agreed that the CVD prevention CDS tools helped them to improve the health of patients at risk for cardiovascular disease. In regards to the compatibility of the CDS tools with the health center's mission and workflows, 84% of respondents agreed or strongly agreed that the asthma management CDS tools fit with their health center's mission and 82% of respondents agreed or strongly agreed that the CVD prevention CDS tools fit with their health center's mission, but only 62% of respondents agreed or strongly agreed that the asthma management CDS tools were compatible with existing clinic workflows and only 61% of respondents agreed or strongly agreed that the CVD prevention CDS tools were compatible with existing clinic workflows. The survey included 15 items from the 20 item Health IT Usability Evaluation Scale.(22) Each item was scored on a 5 point Likert scale from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating more positive ratings of the CDS tool. The mean score across the 15 items was 3.5 for the asthma management tools and 3.8 for the CVD prevention CDS tools.

RCT Results

The asthma management CDS use outcome, the rate of asthma severity assessment, increased by 9.2% ($p<0.001$) and 7.3% ($p<0.001$) in the practice sites randomized to low and high intensity support, respectively. The change in the rate of asthma severity assessment, did not differ between the low and high intensity groups (difference in differences 1.9%, $p=0.50$). The asthma clinical treatment outcome, the rate of treatment with controller medications among those with persistent asthma, did not change

in the practice sites randomized to either low or high intensity support. The CVD prevention CDS use outcome, the rate of cardiovascular disease risk assessment using the Framingham Risk Score (FRS), decreased by 2.3% ($p<0.001$) in the practice sites randomized to low intensity support and increased by 4.3% ($p<0.001$) in the practice sites randomized to high intensity support, resulting in a difference in differences between the groups of 7.2% ($p<0.001$). The CVS prevention CDS use outcome, the rate of statin prescribing for patients with FRS ≥ 10%, did not change in the practice sites assigned to either the low or high intensity support arms. The baseline and follow up rates of CDS use and treatment targets are summarized in Tables 5. The results of the difference in differences analyses are summarized in Table 6.

Table 5. Baseline and Follow-up Rates of CDS Use and Treatment Goals for Asthma Management and CVD Prevention CDS Tools for Practice-sites Randomized to Low vs. High-Intensity Support

	Low Intensity Support n/N (%)		High Intensity Support n/N (%)		Baseline Difference (%)	p-value for baseline difference
	Baseline Period (December 2013 – February 2014)	Follow-up Period (June 2014 – August 2014)	Baseline Period (December 2013 – February 2014)	Follow-up Period (June 2014 – August 2014)		
CDS Use Outcomes						
Assessment of asthma severity	336/1130 (30)	500/1284 (39)	158/815 (19)	239/895 (27)	10%	p<0.001
Estimation of 10 year CVD risk	794/5173 (15)	680/5459 (13)	1584/5589 (28)	1650/5055 (33)	13%	p<0.001
Clinical Treatment Outcomes						
Controller medications prescribed for patients with persistent asthma	245/248 (99)	346/348 (99)	115/117 (98)	158/164 (96)	0	p=0.7
Statin medication prescribed for patients with Framingham Risk Score ≥ 10%	388/828 (47)	364/862 (42)	387/847 (46)	308/731 (42)	4	p=0.63

Table 6. Pre-post Differences in the Rates of CDS Use and Treatment Goals for Asthma Management and CVD Prevention CDS Tools for Practice-sites Randomized to Low vs. High-Intensity Support

	Low Intensity Support Pre-Post Difference (final% - baseline %)	High Intensity Support Pre-Post Difference (final% - baseline %)	Difference in Differences
CDS Use Outcomes			
Assessment of asthma severity	9.2%*	7.3%*	1.9%
Estimation of 10 year CVD risk	-2.8%*	4.3%*	7.2%*
Clinical Treatment Outcomes			
Controller medications prescribed for patients with persistent asthma	0.6%	1.9%	-2.6%

Statin medication prescribed for patients with Framingham Risk Score ≥ 10%	-4.7%	-3.6%	1%

*Table 6 Notes: * p<0.001*

As noted in Figures 1 and 2, we did not observe consistent differences in the overall results when the outcomes were stratified by Community Health Center.

Figure 1. Use of Asthma Management CDS by Health Center

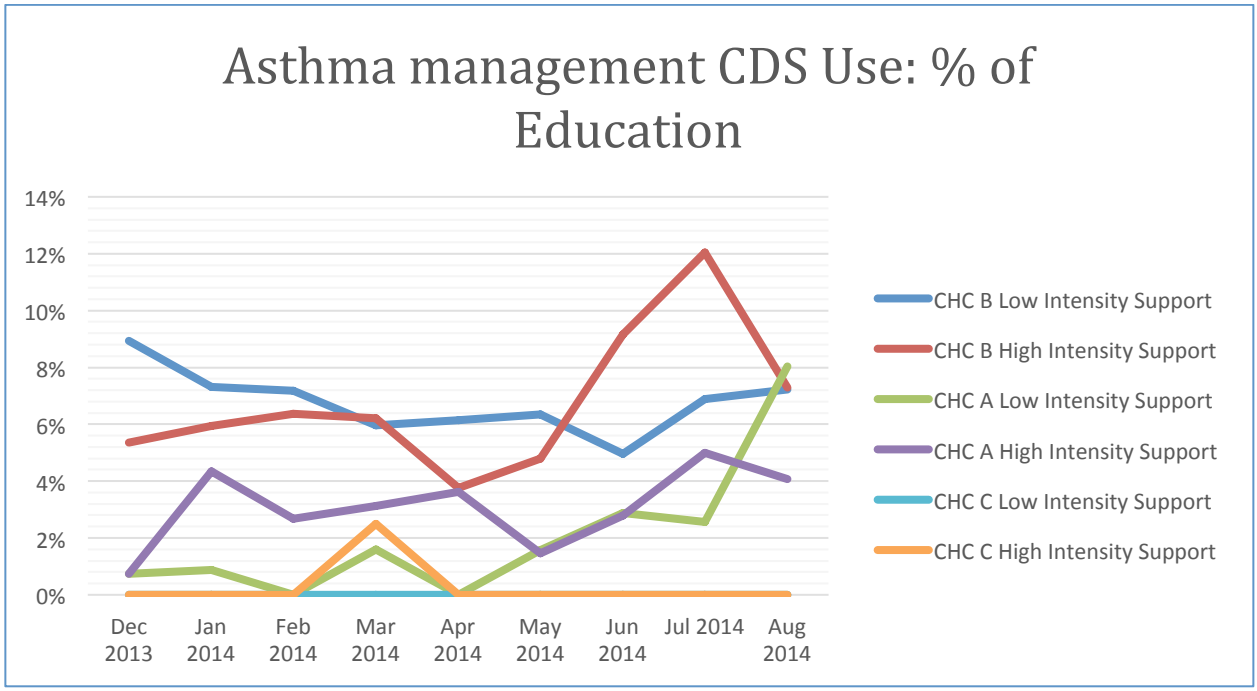
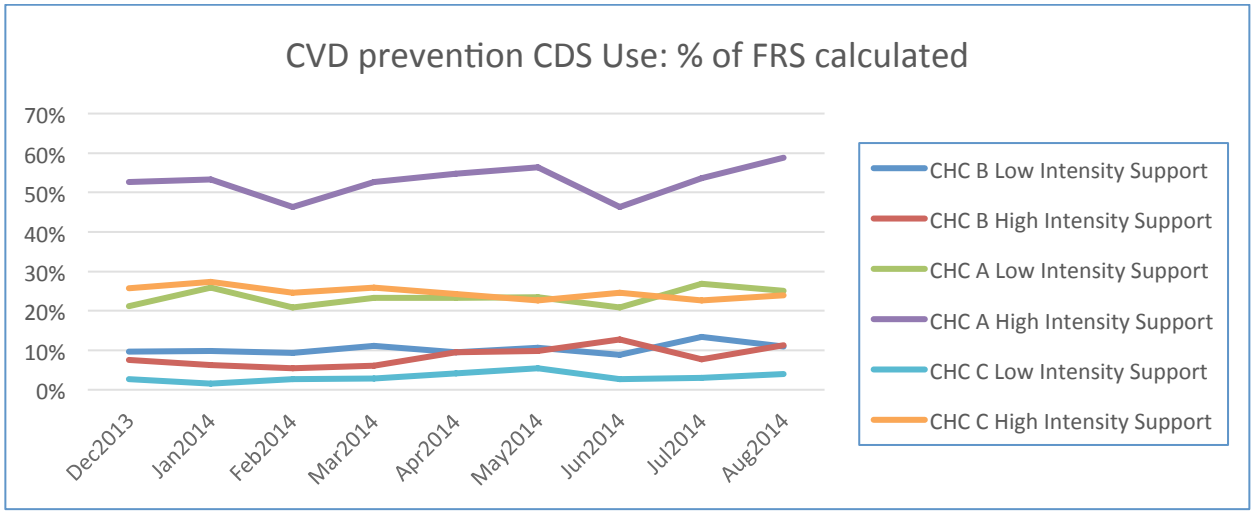


Figure 2. Use of Cardiovascular Disease Prevention CDS by Health Center



Opportunities for Improving CDS and Clinical Workflow Integration by the Teams

Based on a review of the worksheets completed by each CDS optimization team while working through the CDS implementation toolkit, the following opportunities for improving the integrating CDS and clinical workflow were identified. 1. Teams recognized the importance of leveraging the full care team. Team members identified that data entry and counseling components of the CDS tools were heavily dependent on the highest level providers (MDs, PAs, APNs) and that some of these activities could be done by other team members (including patients). 2. Teams aimed to leverage care opportunities outside of traditional patient-clinician office visits. In particular, the teams noted that existing CDS was often limited to the traditional office visit with limited opportunities for other team members to contribute to or interact with the CDS for pre-visit preparation, inter-visit outreach, or through patient portals.

Assessment of practice-level factors associated with use of CDS interventions

Twenty-one of the Alliance's member CHCs contributed data to the cross-sectional assessment of the association between practice-level factors and CDS use. The characteristics of these sites are summarized in Table 7.

Table 7. Characteristics of 21 Community Health Centers Participating in the Assessment of the Association between Practice-Level Factors and CDS Use

CENTER CHARACTERISTICS	N = 21
URBAN/RURAL STATUS	
- **URBAN**	15 (71.4)
- **RURAL**	5 (23.8)
- **BOTH**	1 (4.8)
MD VS NP MODEL	
- **MD**	14 (66.7)
- **NP**	7 (33.3)
PCMH STATUS	
- **NO**	10 (47.6)
- **YES**	10 (47.6)
- **PURSUING**	1 (4.8)
QI LEAD	
- **YES**	14 (66.7)
- **NO**	7 (33.3)
% OF UNINSURED, MEAN (SD)	28.0 (26.0)
% OF AT OR BELOW 200% POVERTY, MEAN (SD)	77.4 (23.5)
% OF NON-WHITE, MEAN (SD)	48.0 (26.6)
% OF HISPANIC, MEAN (SD)	30.9 (30.1)
% OF AGE UNDER 18, MEAN (SD)	26.4 (18.8)
% OF AGE OVER 65, MEAN (SD)	5.0 (5.1)
% OF NON-ENGLISH PRIMARY LANGUAGE, MEAN (SD)	23.1 (23.7)
# OF SITES, MEAN (SD)	6.3 (5.7)

In bivariate analyses, no factors were consistently associated with higher rates of use of the asthma management or CVD prevention CDS tools. The factors examined included geographic area (rural versus

urban), practice model (physician versus nurse practitioner led), achievement of PCMH certification, presence of a quality improvement leader at the health center, number of practice sites, % population served that is uninsured, poor, nonwhite, pediatric, senior, or with limited English proficiency. In multivariate analyses, no factors were significantly associated with CDS use (Tables 8a and 8b).

Table 8a. Multivariate Assessment of Factors Associated with Use of Asthma Management CDS

% ASTHMA SEVERITY ASSESSED	COEF.	P-VALUE	[95% CI]	
URBAN	0.052	0.718	-0.363	0.467
PCMH	-0.044	0.573	-0.267	0.179
QI-LEADER	0.264	0.157	-0.183	0.712
NUMBER OF SITES	-0.011	0.159	-0.030	0.008
MD	-0.159	0.417	-0.698	0.379
% UNINSURED	0.166	0.449	-0.443	0.775
% BELOW 200% POVERTY	-0.009	0.956	-0.484	0.466
% NON-WHITE	-0.090	0.543	-0.511	0.330
% HISPANIC	0.479	0.366	-0.955	1.913
% UNDER 18	0.568	0.067	-0.073	1.209
% OVER 65	-0.124	0.92	-3.747	3.499
% NON-ENGLISH-PRIMARY	-0.834	0.228	-2.590	0.922

Table 8b. Multivariate Assessment of Factors Associated with Use of CVD Prevention CDS

% FRS CALCULATED	COEF.	P-VALUE	[95% CI]	
URBAN	-0.018	0.897	-0.420	0.384
PCMH	0.060	0.444	-0.156	0.276
QI-LEADER	0.041	0.783	-0.392	0.474
NUMBER OF SITES	-0.007	0.293	-0.025	0.011
MD	0.012	0.946	-0.509	0.534
% UNINSURED	0.061	0.762	-0.528	0.651
% BELOW 200% POVERTY	-0.029	0.854	-0.489	0.431
% NON-WHITE	0.069	0.625	-0.338	0.477
% HISPANIC	0.134	0.779	-1.255	1.523
% UNDER 18	-0.272	0.258	-0.893	0.349
% OVER 65	-0.533	0.662	-4.042	2.976
% NON-ENGLISH-PRIMARY	-0.234	0.692	-1.934	1.467

Discussion

This study demonstrated that safety net primary care practices can achieve modest improvements in the rates of CDS use over a short (6 month) time period with the support of a CDS implementation toolkit and/or practice coaching. However, there were no changes in the rates of clinical treatment outcomes –

the rate of treatment with controller medications for patients with persistent asthma or the rate of treatment with statins for patients at high risk for CVD who are eligible for primary prevention. The improvement in the rates of use for the asthma management CDS are encouraging, but there are several aspects of the results that merit discussion.

1. The rate of use of the asthma management CDS tool increased to a similar extent in the practice sites assigned to both the low and high intensity support arms, but the rate of use of the CVD prevention CDS tool increased only slightly in the sites assigned to high intensity support and decreased in the sites assigned to low intensity support. What could account for these differences?

The CVD prevention CDS examined in this study targeted the primary prevention of cardiovascular disease with statins for high risk patients and was based upon use of the Framingham Risk score and ATPIII guidelines. (12) The new American College of Cardiology/American Heart Association (ACC/AHA) cholesterol treatment guidelines, the first major revision to the cholesterol treatment guidelines in a decade, were released in November 2013, one month after funding for this study began.(23) The ACC/AHA guidelines were a marked departure from prior cholesterol treatment guidelines in that they advocated for a different method to assess individual's 10 year risk for major CVD events (the ASCVD pooled risk equations rather than the Framingham Risk equations), lower thresholds for starting statin therapy, and the elimination of LDL treatment targets. Moreover, there has been concern about the accuracy of the ASCVD pooled risk equations and controversy about the 2013 ACC/AHA cholesterol treatment guidelines.(24, 25) We believe that the publication of the 2013 ACC/AHA guidelines likely impacted the CVD prevention CDS outcomes in our study as the new guidelines may have led to provider unwillingness to use the Framingham Risk calculator, provider uncertainty about how to assess CVD risk, and provider uncertainty about when to recommend statin therapy for primary prevention. These factors may have led to the observed decrease in the rate of CVD risk assessment using the Framingham Risk score in the low intensity support sites and may have contributed to the only small rate of increase in the use of the CVD risk assessment tool in the high intensity support sites. It is possible that the high intensity support sites may have been better able to address the controversy and confusion caused by the release of the new guidelines. After a somewhat long and contentious approval process through the health centers' quality committees, the option to estimate patient's CVD risk using the ASCVD pooled risk equations with decision support facilitating adherence to the 2013 ACC/AHA guidelines was added to the CVD prevention CDS, but the updated CDS did not go into effect until September 2014, after the data collection period of this study was completed.

2. No improvements in the clinical treatment outcomes for asthma management or CVD prevention were observed in the low or high intensity support groups. What factors may explain this?

The "holy grail" of Meaningful Use 3 is not just to increase rates of CDS use but to actually improve clinical outcomes. Since it was unrealistic to be able to observe changes in the most meaningful clinical outcomes (rates of asthma exacerbations or rates of first CVD events) within the tight timeline of this study, we included clinical treatment outcomes (use of controller medications and use of statin therapy) that are closely linked with the target clinical outcomes. It is likely that the 6 month period of active site

team support (through use of the CDS implementation toolkit with or without practice coaching support) was too short of a time frame to observe meaningful differences. Based on a review of the team worksheets, they spent the first three months outlining existing workflows and brainstorming ideal workflows. It was not until the fourth month that the CDS implementation teams started to implement their desired CDS or workflow changes and even at the end of the 6 month period, the majority of planned changes had not yet been implemented.

In regards to the asthma treatment outcomes, the ceiling effect may have been at play: while the rates of asthma severity assessment were low at baseline, the rates of treatment with controller medications were very high among those with documented persistent asthma, with little room for improvement. We did, however, also examine the change in the rate of prescriptions for controller medications among those with documented persistent asthma *or* with no documentation of asthma severity and found no change in the rate.

3. For three of the four study outcomes, there were no differences between the practice sites assigned to low intensity versus high intensity support. What factors may account for this?

It is possible that the CDS implementation toolkit was structured enough that there truly was no additional benefit to practice coaching support, but given the feedback received from CDS optimization team members regarding the complexity of the *CDS 5 Rights* toolkit, we doubt that this fully accounts for the lack of difference between the sites assigned to low versus high intensity support. In fact, due to requests for clarification on how to begin work using the toolkit, the practice coaches provided monthly written feedback to the worksheets submitted by the teams assigned to the low-intensity intervention. Thus the true difference in intensity between the low and high support groups was not as great as originally intended. (The sites assigned to the high intensity support group received one hour of meeting time with the practice coaches each month in addition to detailed written feedback on their submitted worksheets and practice improvement plans). A simplified version of the worksheets included in the *CDS 5 Rights* toolkit is now available but was not used for our study.

The short study time frame may also have contributed to the lack of observed difference between the study sites. As previously noted, since most practice sites did not have time to implement the bulk of their planned workflow changes during the course of this study, it is likely that the simplest changes (i.e. those that practices may be able to implement on their own with little practice coaching support or quality improvement expertise) were implemented across most sites. The changes that might take more practice coaching support to design and implement were likely not implemented at any site, irrespective of their assigned level of support, thus there may not have been enough time to observe any differences that may have become apparent between the two study arms with more time.

Other study limitations include the lack of a true control group. We cannot say for sure how much the changes observed in the low and high intensity support arms would have differed from a “no support” arm; however, we did not find evidence of any increase in the use of the asthma management or CVD

prevention tools across the sites that did not participate in the randomized controlled trial portion of this study.

In conclusion, our study found that the use of a relatively low intensity, publicly and freely available CDS implementation toolkit may help community health centers to increase and improve their use of CDS targeting high priority health conditions over a relatively short time period. Studies of longer duration may be needed to determine whether this type of support may also lead to improvements in the rates of achieving clinical outcomes.

We have identified the following policy implications based on our study.

1. Health centers can benefit from structured support to improve the integration between their clinical decision support and clinical workflows.

The *CDS 5 Rights* toolkit enabled care teams to move beyond a limited perspective on CDS (i.e. one emphasizing alerts and order sets) to a more robust and effective approach. That is, study CHC teams now see CDS more sharply as a process for optimizing target-related information flow and workflow by leveraging the full care team and all opportunities to support key decisions and actions - including those outside the traditional patient-clinician office visit. Results from this study validate that CMS resources, such as the a meaningful use tip sheet "CDS: More than just 'alerts'"(26) and ONC's "Resources for Improving Care with CDS,"(18) can be useful. Simplified versions of the *CDS 5* Rights toolkit have also been developed in response to team members' feedback on the complexity of the original toolkit. However, access to the resources alone will not be sufficient to accelerate progress toward MU3's CDS-enabled goals for improved healthcare outcomes. The care teams required significant time and feedback to feel comfortable applying the principles they learned by working through the toolkit and struggled to find time to work on the CDS optimization teams given their heavy clinical loads. It is possible that local teams may need less support with the simplified version of the *CDS 5 Rights* toolkit, local teams may be more successful if they are made up of members with more quality improvement experience, or that local teams may be more successful if team members routinely have dedicated time and officially recognized roles that include attention to quality improvement and workflow optimization.

2. The adoption and use of CDS is more likely to lead to improved performance on high priority health conditions if it is explicitly linked with changes in clinical workflow that promote proactive chronic disease management and population health management. Having the right people and processes is as important as having the right technology and CDS capabilities.

The current MU3 CDS objectives provide explicit recommendations regarding the CDS intervention capabilities, but do not provide explicit recommendations or guidance regarding the care processes that can optimize the impact of those CDS capabilities. CMS should consider directly incentivizing validated quality improvement processes that are important for the delivery of high quality preventive care and chronic disease management, and not just the technology (CDS) that is needed. The meaningful use objectives will be unlikely to promote improved performance on high priority conditions if other health care financing trends do not strongly incentivize chronic disease management and population health

management. PCMH initiatives may be one way of supporting practices to focus not only on the technology, but also on the people and processes needed to advance health outcomes. If a health center does not have the care management infrastructure in place to support the effective use of CDS to improve performance on a small number of high priority conditions, adding more CDS tools targeting other conditions is unlikely to be helpful. Focusing on directly incentivizing Eligible Professionals to demonstrate improvement on a small number of conditions rather than incentivizing weak use of multiple CDS interventions may be more productive in the long run.

List of Publications and Products

None

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