Title

Collaborative practice improvement for childhood obesity in rural clinics: the Healthy Eating Active Living Telehealth Community of Practice (HEALTH COP).

Permalink

https://escholarship.org/uc/item/136023px

Journal

American journal of medical quality : the official journal of the American College of Medical Quality, 29(6)

ISSN

1062-8606

Authors

Shaikh, Ulfat
Nettiksimmons, Jasmine
Joseph, Jill G
et al.

Publication Date

2014-11-01

DOI

10.1177/1062860613506252

Peer reviewed

Collaborative Practice Improvement for Childhood Obesity in Rural Clinics: The Healthy Eating Active Living Telehealth Community of Practice (HEALTH COP)

Ulfat Shaikh, Jasmine Nettiksimmons, Jill G. Joseph, Daniel Tancredi and Patrick S. Romano

What is This?

Collaborative Practice Improvement for Childhood Obesity in Rural Clinics: The Healthy Eating Active Living Telehealth Community of Practice (HEALTH COP)

Ulfat Shaikh, MD, MPH, MS,[1] Jasmine Nettiksimmons, PhD,[1] Jill G. Joseph, MD, PhD,[2] Daniel Tancredi, PhD,[1] and Patrick S. Romano, MD, MPH[1]

Abstract

This study assessed the impact of participation in a virtual quality improvement (QI) learning network on adherence to clinical guidelines for childhood obesity prevention in rural clinics. A total of 7 primary care clinics in rural California included in the Healthy Eating Active Living TeleHealth Community of Practice and 288 children seen in these clinics for well-child care participated in this prospective observational pre-post study. Clinics participated in a virtual QI learning network over 9 months to implement best practices and to exchange strategies for improvement. Following the intervention, documentation of weight assessment and counseling increased significantly. Children who received care from clinicians who led the implementation of the intervention at their clinic showed significant improvements in nutrition and physical activity. Virtual QI learning networks in geographically dispersed clinics can significantly increase clinicians' adherence to guidelines for childhood obesity and improve access to recommended care for rural and underserved children.

Residents of rural areas face multiple health disparities, including poorer access to health care, compared with residents of urban areas.[1,2] Rural populations exercise less and have higher rates of obesity, heart disease, and diabetes than their urban counterparts.[3] Clinicians in rural areas report facing professional isolation, inadequate communication with subspecialists and support services, and difficulties in obtaining continuing education.[4]

Childhood obesity and overweight are serious public health problems affecting approximately 30% of American children.[5] Obesity is even more prevalent in rural areas.[6,7] Rural children engage less in vigorous physical activity and spend more time watching television and playing video games than children in urban areas.[7] This places rural children at risk for multiple health problems, such as diabetes, hypertension, hypercholesterolemia, and depression.[8] Expert guidelines advise clinicians to evaluate growth in children at all health maintenance visits using body mass index (BMI) percentile and to provide families with nutrition and physical activity counseling.[5,9] However, the frequency with which clinicians adhere to these recommended practices is highly variable.[10-13]

Quality improvement (QI) learning networks help create a structure in which clinical teams learn from each other and from experts in topic areas in which they want to make improvements.[14] Through participation in learning sessions, team members learn how to identify goals for improvement, formulate and implement strategies to achieve goals and overcome barriers, evaluate whether strategies are successful, and use rapid cycles of change to make continuous improvement. Between learning sessions are action periods, during which clinical teams apply a variety of change strategies in consultation with experts.[14,15] A key aspect of QI learning networks is the ability to share successes and barriers with a community of peers, thereby accelerating improvement. The Healthy Eating Active Living TeleHealth Community of Practice

[1]University of California Davis School of Medicine, Sacramento, CA
[2]University of California, Davis, Sacramento, CA

Corresponding Author:
Ulfat Shaikh, MD, MPH, MS, Department of Pediatrics, Healthcare Quality Integration, University of California Davis School of Medicine, 2516 Stockton Blvd, Room 335, Sacramento, CA 95817.
Email: ushaikh@ucdavis.edu
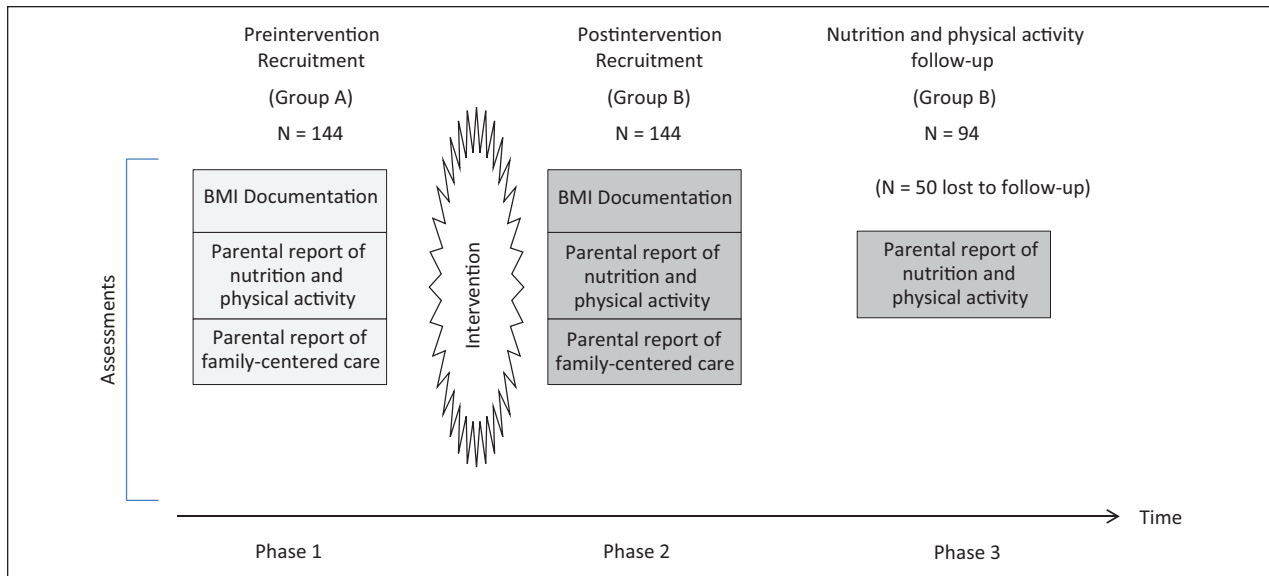
Figure 1. Study design for evaluation of the Healthy Eating Active Living Telehealth Community of Practice.
Abbreviation: BMI, body mass index.

(HEALTH COP) was a virtual QI learning network involving 7 rural clinics. Its goal was to improve childhood obesity prevention through implementation of evidence-based practices and QI strategies.

The study team hypothesized that clinicians at rural clinics participating in HEALTH COP would increase their frequency of weight assessment and counseling for nutrition and physical activity at health maintenance visits. The study team also hypothesized that children seen at participating clinics would significantly improve their short-term nutrition and physical activity behaviors. Finally, the study team assessed whether weight assessment and counseling was related to selected patient characteristics such as age, race/ethnicity, parental education, and socioeconomic status.

Methods

Design

A prospective pre-post design (Figure 1) was used to evaluate the feasibility and effectiveness of the intervention, HEALTH COP, in improving assessment of weight status, counseling on nutrition and physical activity, and short-term nutrition and physical activity behaviors in children seen at participating clinics. Approval to conduct this study was obtained from the University of California Davis Institutional Review Board.

Setting

Although all participating clinics provided care to underserved and disadvantaged patients, there was considerable diversity in the populations they served. For example, one clinic was located in Imperial County, at the California-Mexico border. This is a primarily agricultural area where 77% of residents are of Hispanic or Latino origin and only 59% of adults are high school graduates.[16] Another clinic was located in Humboldt County, near the California-Oregon border. The local economy is based on tourism, lumber, and fisheries; 78% of residents are European-American, and 85% of adults are high school graduates.[16]

Participants

Participants included 2- to 11-year-old children seen for well-child care from April to June 2010 (preintervention period) and from January to May 2011 (postintervention period). Administrative data were used to identify children who received well-child care during these 2 time periods. The study team recruited children and obtained informed consent from parents using a telephone script. The sample size calculation (n = 144) was based on 2-sided testing ($\alpha = 5\%$) and addressed the need to compare differences in outcome between each phase of the study, with at least 80% power to detect clinically significant differences (0.35 standardized units). The study team assumed a variance inflation factor of 1.20 based on the balancing effects of clustered data and improved precision from regression covariates. A priori, the study team assumed a 20% loss to follow-up between phases 2 and 3.

Intervention

Telehealth is defined as the use of electronic information and telecommunications technologies to support

long-distance clinical care, patient and professional education, and public health.[17,18] An integrated intervention delivered through telehealth was designed to help rural clinics implement strategies to increase assessment of weight and to deliver family-centered counseling. Intervention components are based on the planned care model as applied to pediatric obesity prevention and were informed by the study team's previously published survey assessing challenges to providing care for pediatric obesity in rural clinics and the utility of distance education in addressing barriers.[4,14,19] The team additionally adapted processes utilized in other successful clinic-based QI networks.[15,20]

Each clinic formed 4-person teams comprising a clinician champion, a nurse or medical assistant, an administrative staff person, and a parent advisor. Teams attended 9 monthly, 90-minute interactive learning sessions delivered by multipoint videoconferencing and had access to a Web-based toolkit of resources. The first 3 sessions focused on participants gaining knowledge and skills in pediatric obesity and basic QI methodology. These were followed by 6 interactive collaborative learning sessions, wherein teams planned and implemented practice-level changes to improve assessment of weight status and counseling.

The clinic teams set specific goals for improving obesity prevention within their clinics; implemented and tested measurable changes; shared information on outcomes with other clinics and with their leadership; shared learning about strategies, successes, and barriers to QI; and identified steps for spreading and sustaining changes locally. Clinics were supported by HEALTH COP faculty and staff through ongoing technical consultation and individualized coaching. Downloadable video recordings of sessions were made available online.

Key components of the intervention were as follows:

1. Decision support: Medical assistants and nurses were provided with Web-based calculators and BMI wheels.[21] They were trained to calculate BMI and to notify clinicians of elevated BMI. Clinicians were provided with flip charts and sample visit documentation forms containing decision-support cues for obtaining a medical history, performing an appropriate physical examination, and screening for comorbidities and psychosocial risk factors.
2. Clinical information systems: Clinics were provided training on the use of flow sheets, problem lists, and registries to assist with documenting and tracking weight status and counseling.
3. Community resources: A community resource database customized to each clinic was developed in conjunction with clinic teams. The database identified linkages to local afterschool activity programs, physical activity resources, and sources of healthy affordable foods.

4. Family management support: Clinicians and staff were trained to use nutrition and activity prescriptions and goal setting/tracking worksheets to support families using motivational interviewing and family-centered counseling. Posters containing messages about healthy nutrition and physical activity in English and Spanish were provided to clinics for their waiting and examination rooms.
5. Delivery system design: Clinics examined and reorganized their workflow to enhance assessment of weight status and counseling (eg, reassignment of roles of clinic staff and incorporation of standardized forms with cues to improve documentation of weight status and counseling). An online discussion forum was utilized to engage clinics in raising and answering questions, suggesting resources, and sharing experiences.
6. Health care system support: This component of the intervention was included to optimize reimbursement for assessment and counseling for obesity prevention by appropriate coding for clinical services. Clinic teams were provided with resources from the American Academy of Pediatrics, which included a guide to coding for obesity-related health care services as well as strategies for clinics to address denial of payment by insurance carriers.[22] It is possible that this coding information may be less relevant in the future because obesity-related counseling, which falls within preventive care, is likely to be covered by insurers under the health reform law. Standardized visit documentation forms included information to support appropriate diagnoses. Clinicians were eligible to receive up to 48 continuing education credits for participating in HEALTH COP.

Outcome Measures

Clinician assessment of weight status was evaluated by chart review. A BMI documentation score was developed as follows: 5 = correctly documented weight category[23] based on BMI percentile, 4 = correctly plotted or documented BMI percentile for age and sex, 3 = correctly documented BMI, 2 = documented height and weight, 1 = documented height or weight, 0 = neither height nor weight documented. The BMI documentation score was reviewed by 5 pediatricians in ambulatory practice and 2 biostatisticians for face validity; 1 pediatrician was a member of a committee that developed national recommendations for pediatric obesity.[24]

The study team's previous research demonstrated that parental report via the use of a questionnaire administered shortly after the visit is a better alternative than medical record documentation to evaluate nutrition and activity counseling.[25] This validated questionnaire was

used to survey parents in the present study. The study team contacted parents to administer the questionnaire by telephone on the evening of the visit. If parents were unavailable, attempts to recontact them were made up to 2 days following the visit. The questionnaire assessed whether counseling on the following topics was conducted during the visit: fruits and vegetables, outside food (restaurant, fast food, or take-out food), breakfast, family meals, sugar-sweetened drinks, television viewing, video game/computer use, and physical activity. The total number of prespecified counseling topics covered was enumerated (range = 0-8; Cronbach α = .88 at preintervention). A family-centered care composite was created by adding scores (1 to 4 scale: 1 = *never*, 4 = *always*) for the 5 questions on family-centered care (Cronbach α = .76). Parents in the postintervention phase also completed a survey about their children's nutrition and physical activity behaviors during the telephone call.[25] This survey was administered again to the postintervention group 12 to 15 weeks later to assess changes in behaviors. Difference between responses was scored as 1 = improvement, 0 = no change, or −1 = deterioration for each survey item. Then, 10 items were combined into a summary score that could range from −10 to 10: fruit and vegetable intake, duration of physical activity, consumption of restaurant food, breakfast consumption, family meal, consumption of sugar-sweetened beverages, television viewing, video/computer game use, presence of a television in the child's bedroom, and presence of a computer in the child's bedroom. For the purposes of analysis, these scores were treated as continuous variables.

Statistical Analysis

All analyses were performed using survey data analysis procedures or mixed-effects linear regression models to account for design effects arising from the multilevel structure of the data (visits nested within clinicians nested within clinics).[26] To control for unmeasured clinic differences and correlation between visits with the same clinician, the study team specified clinics as strata and clinicians as clusters in the survey analysis methods; for the mixed-effects models, the team specified random intercepts for clinicians and fixed effects for clinic. Data from 2 participating clinics with similar characteristics and a small number of participants in the preintervention phase were combined to increase the stability of estimates. Participant and visit characteristics were compared between preintervention and postintervention groups using survey-adjusted χ^2 statistics and survey-adjusted linear regression models.

Separate multiple linear regression models were fit for each of the 3 primary outcomes. Covariates chosen for regression models were clinician type, clinician champion, BMI percentile or weight category, age, race/ethnicity, parental education, birth order, and whether the child utilized more medical services than other children, as reported by the parent. Variables that changed the estimate of pre-post change by more than 10% were included in models. Demographic variables with statistically significant differences between the preintervention and postintervention groups were also included in models of clinician behavior.

Secondary analyses were performed to evaluate changes in clinicians' behaviors with regard to individual documentation and counseling measurements using prevalence ratios, which reflect the change in frequency of each behavior.[27] Models of individual behaviors included the same covariates as the corresponding overall model. Although age was not found to be a confounder in the overall counseling score model, it was included in the individual counseling topic models because some topics might be age specific (eg, video games). All analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC).

Results

Demographic Characteristics of Participating Children, Parents, and Clinicians

Table 1 summarizes child and clinician characteristics. Children were primarily Hispanic and approximately half were female. There were minimal differences in patient and clinician characteristics between the preintervention and postintervention periods, with the exception of parental education and clinician type. Approximately 50% of parents included in the preintervention period had some college education. During the postintervention period, 57% of parents had completed high school. The postintervention period had a larger proportion of children seen by pediatricians compared with the preintervention period. Because of low frequencies, nurse practitioners and physician assistants were combined for multivariable analyses. For the same reason, underweight children were combined with healthy weight children.

Clinicians' Documentation of Weight Assessment

Approximately 16% of children were overweight, and 22% were obese. Figure 2 compares documentation of weight assessment between preintervention and postintervention periods. Following the intervention, the mean raw documentation score increased from 3.5 to 4.6 (1-5 scale). There were significant improvements in all documentation behaviors, with the largest improvements seen in documentation of BMI percentile and weight category.

Table 1. Patient and Clinician Characteristics.[a]

Category	Level	Preintervention Mean	Postintervention Mean	P Value
Patient number		144	144	—
Age	Years	4.9	5.1	.58
Sex	Female	47%	54%	.14
Child requires more health care services	Yes	11%	10%	.83
First child	No	54%	53%	.32
	Yes	41%	38%	
	Not applicable	5%	9%	
Education	<High school	24%	43%	.01
	High school/GED	28%	24%	
	Postsecondary school	49%	33%	
Race/Ethnicity	Non-Hispanic white	38%	29%	.18
	Hispanic white	48%	62%	
	Other	14%	10%	
Weight category	Underweight	6%	4%	.49
	Healthy weight	58%	56%	
	Overweight	17%	15%	
	Obese	19%	25%	
Clinician number		34	34	—
Clinician type	Family physician	14%	17%	.04
	Pediatrician	57%	71%	
	NP	16%	4%	
	PA	13%	7%	
	Other[b]	1%	0%	
Clinician champion		43%	47%	.26

Abbreviations: GED, general equivalency diploma; NP, nurse practitioner; PA, physician assistant.
[a]P values for categorical variables come from Rao-Scott χ^2 tests stratified by clinic and clustered by clinician. P values for continuous variables come from linear regression models with fixed effects for clinic and random effects for clinicians nested within clinics.
[b]Excluded from χ^2 tests.

## Parental Report of Counseling on Nutrition and Physical Activity

Figure 2 compares parental report of clinician counseling between the preintervention and postintervention periods. The total counseling score significantly increased by 0.8 points (0-8 scale). Clinicians covered, on average, 0.8 more topics per visit after the intervention than before. Analysis of individual counseling topics demonstrated the largest increase in counseling on television. There was a significant increase in counseling on sugary drinks and video games. Counseling on fruits and vegetables, breakfast, and family meals also increased, although these changes were not statistically significant.

Factors Associated With Weight Assessment and Counseling in Multivariate Analyses

Table 2 summarizes results for the 3 main multivariable regression models. Parents educated beyond high school received counseling on fewer topics related to nutrition and activity than parents with a high school diploma. Parental assessment of family-centered care did not differ significantly between the preintervention and postintervention periods. Nurse practitioners and physician assistants had significantly higher scores for family-centered care compared with pediatricians, although the small number of visits for these clinicians suggests that these results should be interpreted with caution.

Because the 2 data collection phases did not occur in the same calendar months, the study team performed sensitivity analyses focusing on temporal patterns. Two models restricted to only the preintervention or postintervention phases found no such trends for the primary outcomes. Estimates also were very similar between the reported models and models restricted to the calendar months common to both study phases. Also, 5 children were enrolled in both the preintervention and postintervention phases, and sensitivity analyses confirmed that including these children did not substantively affect results.
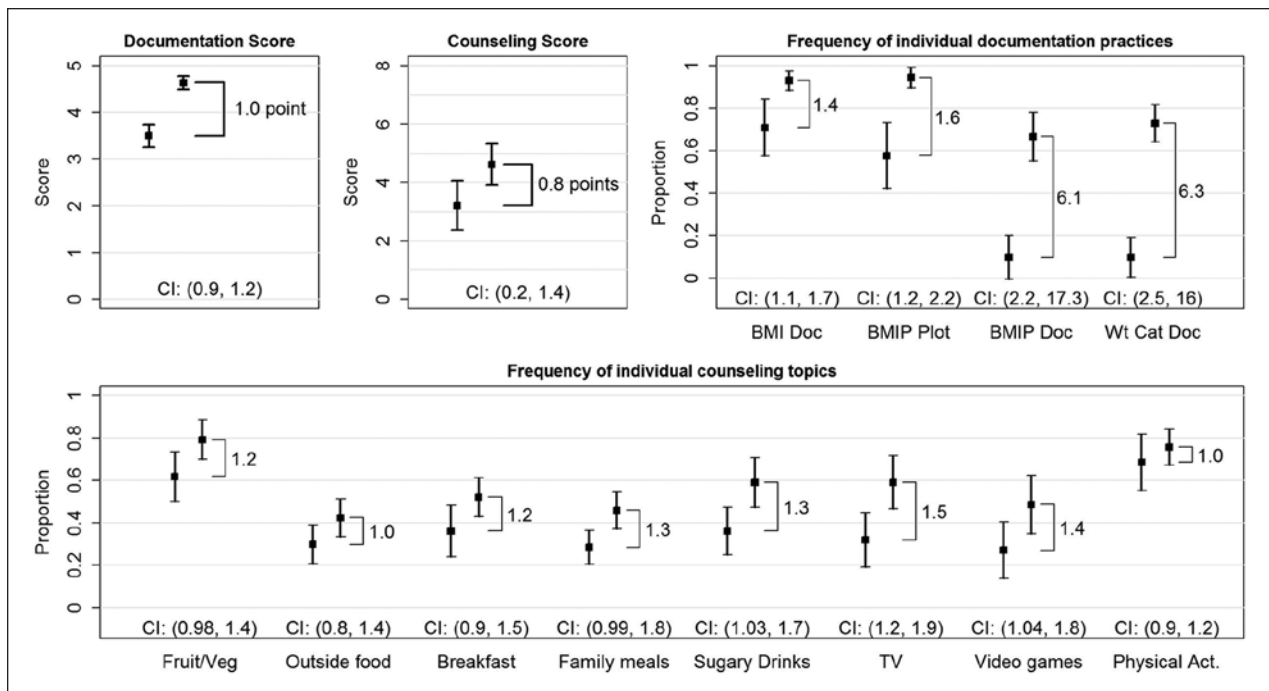
Figure 2. Summary of study measures before and after the intervention.[a]

[a]Unadjusted means and 95% CIs are plotted. Adjusted estimates of pre-post change and associated 95% CIs are shown in text on the figure. The documentation summary score had a possible range of 0 to 5, the counseling summary score had a possible range of 0 to 8, and change is shown in the original point scale. The frequency of individual documentation and counseling practices are shown as proportions, and adjusted change estimates are given as prevalence ratios.

Abbreviations: CI, confidence interval; BMI, body mass index; BMIP, body mass index percentile; Doc, documentation; Wt Cat, weight category.

Change in Nutrition and Physical Activity Behaviors

A total of 92 participants from the postintervention phase were followed up by telephone 3 months later. The unadjusted nutrition and physical activity change score was 0.3 (95% CI = [−0.2, 0.8]). During secondary analyses, heterogeneity was assessed by examining bivariate relationships between the change score and the set of candidate covariates used in previous analyses. Higher parental education and provision of care by clinician champions were both significantly associated with improvement in nutrition and physical activity behaviors and were combined in a single multivariate model (overall model F test P value = .01). Individual change scores for all 6 combinations of these variables are reported in Table 3.

Discussion

Participation in HEALTH COP, a virtual QI learning network, significantly increased rural clinicians' adherence to guidelines for childhood obesity prevention. There were significant improvements in documentation practices related to weight assessment. Counseling on television, sugary drinks, and video games significantly

increased, along with an overall increase in the number of counseling topics. Less-educated parents received more counseling. Increased discussions on weight, nutrition, and physical activity did not negatively affect parental perception of care. In fact, trends suggest that parental perception of family-centered care improved following the intervention.

This study demonstrates that QI learning networks are an effective strategy to improve preventive care for childhood obesity. Moreover, it is feasible to use virtual learning networks in delivering such QI interventions to clinicians in underserved rural clinics. This intervention enhanced rural clinicians' access to continuing education in childhood obesity and QI methodology and enabled peer support. An example of peer support that was facilitated by the online discussion forum was in the area of parent education materials. Clinics shared and provided feedback to each other on parent education handouts that they had adapted and implemented at their sites. Clinic participation, in turn, improved access to recommended care for rural and underserved children at high risk for obesity.

Formulating guidelines is necessary but not sufficient to change clinical practice.[28] Reducing variation in care and increasing adherence to recommended practices is an important aspect of QI. The most feasible and effective

Table 2. Multivariate Model Results for Primary Outcomes (Fixed Effects for Clinics Not Shown).

Effect	Levels	Estimate	$P > |t|$	95% CI	
Documentation score: multivariate analysis					
Preintervention adjusted mean		3.4	<.0001	3.0	4.5
Intervention		1.0	<.0001	0.9	1.2
Clinician type	Family physician	−0.3	.13	−0.7	0.1
	NP/PA	−0.2	.40	−0.6	0.2
	Pediatrician	(Reference)	—	—	—
Parental education	<High school	0.2	.17	−0.1	0.4
	High school	(Reference)	—	—	—
	>High school	0.1	.32	−0.1	0.3
Counseling score: multivariate analysis					
Preintervention adjusted mean		3.8	.002	1.5	6.1
Intervention		0.8	.01	0.2	1.4
Clinician type	Family physician	−0.5	.56	−2.1	1.1
	NP/PA	−0.2	.78	−1.7	1.3
	Pediatrician	(Reference)	—	—	—
Parental education	<High school	0.4	.38	−0.4	1.2
	High school	(Reference)	—	—	—
	>High school	−1.2	.001	−2.0	−0.5
Family-centered care: multivariate analysis					
Preintervention adjusted mean		16.6	<.0001	15.1	18.1
Intervention		0.5	.09	−0.1	1.1
Clinician type	Family physician	0.2	.68	−0.9	1.3
	NP/PA	1.0	.04	0.04	2.0
	Pediatrician	(Reference)	—	—	—
Parental education	<High school	0.3	.39	−0.4	1.1
	High school	(Reference)	—	—	—
	>High school	−0.3	.38	−1.0	0.4
Weight category	Healthy/Underweight	(Reference)	—	—	—
	Overweight	0.4	.33	−0.4	1.1
	Obese	0.5	.12	−0.2	1.2
Clinician champion		0.5	.31	−0.5	1.4
First child		0.0	.88	−0.6	0.5

Abbreviations: CI, confidence interval; NP, nurse practitioner; PA, physician assistant; —, no value.

Table 3. Change in Children's Nutrition and Physical Activity Behaviors 3 Months Following the Intervention, Stratified by Parental Education and Clinician Participation Levels.[a]

	Parental Education		
Clinician Participation	Less Than High School	High School/GED	More Than High School
Clinician champion	0.4 (−0.5, 1.3)	1.6 (0.9, 2.4)	0.6 (−0.4, 1.6)
Clinician nonchampion	−0.4 (−1.1, 0.2)	0.8 (−0.1, 1.7)	−0.2 (−1.6, 1.2)

Abbreviation: GED, general equivalency diploma.
[a]Scores with 95% confidence intervals are presented. A score of 0 represents no change, a score significantly greater than 0 represents positive change, and a score significantly lower than 0 represents negative change.

strategies utilize a multifaceted systems approach.[29,30] Components of effective interventions may include clinician-level interventions (eg, clinician education, educational outreach, counseling algorithms) and system-level interventions (eg, office staff assistance, work flow modifications, tools to enhance data collection and counseling, reminder systems).[30-34] Systematic and routine screening for risk factors may increase behavioral counseling, as demonstrated by trials of tobacco cessation interventions, which found that establishing a system to document tobacco use tripled the odds of clinician intervention.[35]

The present study adds to the recent literature on the effectiveness of QI learning networks in enhancing health care delivery at the practice level and adds new information on the effectiveness of virtual QI learning networks. Young et al[36] described clinics in Utah that improved their delivery of pediatric preventive services, including documentation of BMI, after participating in a learning network. Margolis et al[37] reported that continuing medical education and training in QI methods in primary care clinics in North Carolina resulted in significant improvement in the delivery of preventive services compared with clinics that received only continuing medical education. However, this intervention did not affect self-reported parent knowledge or behavior.[38] Schonlau et al[39] reported that QI education and coaching significantly improved process measures of asthma care. However, patients did not show an increase in asthma-related knowledge, and the intervention did not improve patient-level outcome measures. Cloutier et al[40] found that an asthma management program increased adherence to national guidelines at urban primary care clinics and resulted in significant reductions in hospitalizations and acute visits for children with asthma.

In the present study, the study team noted that parents of children seen during the preintervention period had significantly higher educational levels compared with those seen during the postintervention period. One possible explanation is the lower volume of patients seen for well-child care in the postintervention phase (which coincided with winter months) in clinics located in more northern and mountainous regions of California, possibly because of inclement weather and a higher volume of acute visits. Parental education in these particular clinics was higher than parental education in the other clinics, which may increase the likelihood of unmeasured confounders.

The present study was conducted at 7 rural clinics that volunteered to participate in HEALTH COP, thereby limiting generalizability. It is possible that leadership at these clinics was especially concerned about the burden of obesity, perceived a need to change their clinical practice, and was motivated to improve care. The scale utilized to evaluate BMI documentation may be considered another limitation because it was only assessed for face validity.

Although the sample size did not permit a complete analysis of the difference in change between clinician champions and nonchampions, the study team noted that in clinics with multiple clinicians, clinic champions showed greater improvements in care delivery. The fact that all clinics volunteered to participate suggests that most clinicians had some level of interest in the intervention. Future studies may need greater emphasis on specific strategies for dissemination of innovations to other clinicians at the same clinic.

The results of this study demonstrate that there are opportunities to substantially improve clinical care delivery related to weight assessment, and nutrition and activity counseling using QI learning networks such as HEALTH COP. Use of telehealth technology to facilitate virtual QI learning networks in geographically dispersed clinics demonstrates results comparable with more resource-intensive face-to-face learning networks.

Declaration of Conflicting Interests

Funding

References

1. Merwin E, Snyder A, Katz E. Differential access to quality rural healthcare: professional and policy challenges. *Fam Community Health*. 2006;29:186-194.

2. Eberhardt MS, Pamuk ER. The importance of place of residence: examining health in rural and nonrural areas. *Am J Public Health*. 2004;94:1682-1686.

3. US Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. *The Health and Well-being of Children in Rural Areas: A Portrait of the Nation*. Rockville, MD: US Department of Health and Human Services; 2005.

4. Shaikh U, Nettiksimmons J, Romano P. Pediatric obesity management in rural clinics in California and the role of telehealth in distance education. *J Rural Health*. 2011;27:263-269.

5. Institute of Medicine. *Preventing Childhood Obesity: Health in the Balance*. Washington, DC: National Academies Press; 2005.

6. Lutfiyya MN, Lipsky MS, Wisdom-Behounek J, Inpanbutr-Martinkus M. Is rural residency a risk factor for overweight and obesity for U.S. children? *Obesity (Silver Spring)*. 2007;15:2348-2356.

7. Child and Adolescent Health Measurement Initiative. National survey of children's health. http://childhealthdata. org/browse/survey. Accessed October 18, 2011.

8. Must A, Strauss RS. Risks and consequences of childhood and adolescent obesity. *Int J Obes Relat Metab Disord*. 1999;23(suppl 2):S2-S11.

9. Davis MM, Gance-Cleveland B, Hassink S, Johnson R, Paradis G, Resnicow K. Recommendations for prevention of childhood obesity. *Pediatrics*. 2007;120(suppl 4):S229-S253.

10. Shaikh U, Nettiksimmons J, Joseph JG, Tancredi DJ, Romano PS. Clinical practice and variation in care for childhood obesity at seven clinics in California. *Qual Prim Care*. 2012;20:335-344.

11. Klein JD, Sesselberg TS, Johnson MS, et al. Adoption of body mass index guidelines for screening and counseling in pediatric practice. *Pediatrics*. 2010;125:265-272.

12. Patel AI, Madsen KA, Maselli JH, Cabana MD, Stafford RS, Hersh AL. Underdiagnosis of pediatric obesity during outpatient preventive care visits. *Acad Pediatr*. 2010;10:405-409.

13. Huang TT, Borowski LA, Liu B, et al. Pediatricians' and family physicians' weight-related care of children in the U.S. *Am J Prev Med*. 2011;41:24-32.

14. Institute for Healthcare Improvement. *The Breakthrough Series: IHI's Collaborative Model for Achieving Breakthrough Improvement*. Boston, MA: Institute for Healthcare Improvement; 2003.

15. Polacsek M, Orr J, Letourneau L, et al. Impact of a primary care intervention on physician practice and patient and family behavior: keep ME Healthy: the Maine Youth Overweight Collaborative. *Pediatrics*. 2009;123(suppl 5):S258-S266.

16. US Census Bureau. United States Census 2010. http://www.census.gov/2010census. Accessed September 1, 2013.

17. US Department of Health and Human Services, Health Resources and Services Administration. Telehealth. http://www.hrsa.gov/telehealth/. Accessed January 23, 2007.

18. Epstein LH, Gordy CC, Raynor HA, Beddome M, Kilanowski CK, Paluch R. Increasing fruit and vegetable intake and decreasing fat and sugar intake in families at risk for childhood obesity. *Obes Res*. 2001;9:171-178.

19. Glasgow RE, Orleans CT, Wagner EH. Does the chronic care model serve also as a template for improving prevention? *Milbank Q*. 2001;79:579-612.

20. National Initiative for Children's Healthcare Quality. Medical home learning collaboratives. http://www.nichq.org/medical_home.html. Accessed September 1, 2013.

21. Dunlop AL, Leroy Z, Trowbridge FL, Kibbe DL. Improving providers' assessment and management of childhood overweight: results of an intervention. *Ambul Pediatr*. 2007;7:453-457.

22. Hassink SG. *Pediatric Obesity: Prevention, Intervention, and Treatment Strategies for Primary Care*. 1st ed. Washington, DC: American Academy of Pediatrics; 2006.

23. Centers for Disease Control and Prevention. About BMI for children and teens. http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html. Accessed March 10, 2013.

24. Barlow SE; Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics*. 2007;120(suppl 4):S164-S192.

25. Shaikh U, Nettiksimmons J, Bell RA, Tancredi D, Romano PS. Accuracy of parental report and electronic health record documentation as measures of diet and physical activity counseling. *Acad Pediatr*. 2012;12:81-87.

26. Korn EL, Graubard BI. *Analysis of Health Surveys*. New York, NY: Wiley Interscience; 1999.

27. Spiegelman D, Hertzmark E. Easy SAS calculations for risk or prevalence ratios and differences. *Am J Epidemiol*. 2005;162:199-200.

28. Grimshaw JM, Eccles M, Tetroe J. Implementing clinical guidelines: current evidence and future implications. *J Contin Educ Health Prof*. 2004;24(suppl 1):S31-S37.

29. Grimshaw JM, Shirran L, Thomas R, et al. Changing provider behavior: an overview of systematic reviews of interventions. *Med Care*. 2001;39(8, suppl 2):II2-II45.

30. Søndergaard J, Hansen DG, Aarslev P, Munck AP. A multifaceted intervention according to the Audit Project Odense method improved secondary prevention of ischemic heart disease: a randomised controlled trial. *Fam Pract*. 2006;23:198-202.

31. Hinchman J, Beno L, Dennison D, Trowbridge F. Evaluation of a training to improve management of pediatric overweight. *J Contin Educ Health Prof*. 2005;25:259-267.

32. Ockene IS, Hebert JR, Ockene JK, Merriam PA, Hurley TG, Saperia GM. Effect of training and a structured office practice on physician-delivered nutrition counseling: the Worcester-Area Trial for Counseling in Hyperlipidemia (WATCH). *Am J Prev Med*. 1996;12:252-258.

33. Davis D, O'Brien MT, Freemantle N, Wolf FM, Mazmanian P, Taylor-Vaisey A. Impact of formal continuing medical education: do conferences, workshops, rounds, and other traditional continuing education activities change physician behavior or health care outcomes? JAMA. 1999;282:867-874.

34. Pelto GH, Santos I, Goncalves H, Victora C, Martines J, Habicht J-P. Nutrition counseling training changes physician behavior and improves caregiver knowledge acquisition. *J Nutr*. 2004;134:357-362.

35. Fiore MC, Bailey WC, Cohen SJ. *Treating Tobacco Use and Dependence: A Clinical Practice Guideline*. Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2000.

36. Young PC, Glade GB, Stoddard GJ, Norlin C. Evaluation of a learning collaborative to improve the delivery of preventive services by pediatric practices. *Pediatrics*. 2006;117:1469-1476.

37. Margolis PA, Lannon CM, Stuart JM, Fried BJ, Keyes-Elstein L, Moore DE Jr. Practice based education to improve delivery systems for prevention in primary care: randomised trial. *BMJ*. 2004;328:388.

38. Rosenthal MS, Lannon CM, Stuart JM, Brown L, Miller WC, Margolis PA. A randomized trial of practice based education to improve delivery systems for anticipatory guidance. *Arch Pediatr Adolesc Med*. 2005;159:456-463.

39. Schonlau M, Mangione-Smith R, Chan KS, et al. Evaluation of a quality improvement collaborative in asthma care: does it improve processes and outcomes of care? *Ann Fam Med*. 2005;3:200-208.

40. Cloutier MM, Hall CB, Wakefield DB, Bailit H. Use of asthma guidelines by primary care providers to reduce hospitalizations and emergency department visits in poor minority, urban children. *J Pediatr*. 2005;146:591-597.