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COMPARATIVE EFFECTIVENESS OF COALITIONS VERSUS TECHNICAL ASSISTANCE FOR DEPRESSION QUALITY IMPROVEMENT IN PERSONS WITH MULTIPLE CHRONIC CONDITIONS

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Significance: Prior research suggests that Community Engagement and Planning (CEP) for coalition support compared with Resources for Services (RS) for program technical assistance to implement depression quality improvement programs improves 6- and 12-month client mental-health related quality of life (MHRQL); however, effects for clients with multiple chronic medical conditions (MCC) are unknown.

Objective: To explore effectiveness of CEP vs RS in MCC and non-MCC subgroups.

Design: Secondary analyses of a cluster-randomized trial.

Setting: 93 health care and community-based programs in two neighborhoods.

Participants: Of 4,440 clients screened, 1,322 depressed (Patient Health Questionnaire, PHQ8) provided contact information, 1,246 enrolled and 1,018 (548 with ≥ 3 MCC) completed baseline, 6- or 12-month surveys.

Intervention: CEP or RS for implementing depression quality improvement programs.

Outcomes and Analyses: Primary: depression (PHQ9 < 10), poor MHRQL (Short Form Health Survey, SF-12 < 40); Secondary: mental wellness, good physical health, behavioral health hospitalization, chronic homelessness risk, work/workloss days, services use at 6 and 12 months. End-point

regressions were used to estimate intervention effects on outcomes for subgroups with ≥ 3 MCC, non-MCC, and intervention-by-MCC interactions (exploratory).

Results: Among MCC clients at 6 months, CEP vs RS lowered likelihoods of depression and poor MHRQL; increased likelihood of mental wellness; reduced work-loss days among employed and likelihoods of ≥ 4 behavioral-health hospitalization nights and chronic homelessness risk, while increasing faith-based and park community center depression services; and at 12 months, likelihood of good physical health and park community center depression services use (each $P < .05$). There were no significant interactions or primary outcome effects for non-MCC.

Conclusions: CEP was more effective than RS in improving 6-month primary outcomes among depressed MCC clients, without significant interactions. *Ethn Dis.* 2018;28(Suppl 2):325-338; doi:10.18865/ed.28.S2.325.

Keywords: Depression; Quality Improvement; Chronic Conditions; Coalition Intervention

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INTRODUCTION

Depression is associated with high morbidity, health care costs and worse outcomes for chronic conditions such as diabetes.¹⁻⁶ Chronic medical conditions disproportionately affect individuals with depression and other serious mental illness, contributing to earlier morbidity, premature mortality,^{7,8} and higher costs of care. Quality improvement (QI) programs for depression in primary care based on the collaborative care model are effective among primary care patients, including those with chronic medical conditions.⁹⁻¹⁶ Depressed patients in under-resourced communities have lower rates of access to quality care and worse outcomes.¹⁷⁻²¹ Evidence suggests that implementing QI for

depression improves mental health outcomes as much or more for racial/ethnic minority compared with White populations.^{16,22-25} In under-resourced communities, depressed persons may receive services in alternative community sectors addressing social risk factors, such as homelessness.²⁶⁻²⁸ Public and private health insurance plans and health care systems increasingly seek to integrate addressing social determinants of health with health care to improve outcomes for patients with comorbid medical and mental disorders (eg, high-risk beneficiaries). One such strategy may be implementing QI for depression, including for clients with multiple medical comorbidities, across health and community-based sectors.²⁹ However, such integrated, community-wide approaches are under-studied.³⁰

Community Partners in Care³¹ (CPIC), a group-randomized trial, compared two approaches to implement evidence-based QI for depression across health and social-community sectors in under-resourced communities: 1) coalition support (Community Engagement and Planning, CEP) and 2) individual program technical assistance (Resources for Services, RS). Depressed participants were largely African American or Latino (90.8%) with income below federal poverty (73.7%). The study was implemented using Community-Partnered Participatory Research (CPPR).³² CEP, compared with RS, at 6 months significantly reduced the likelihood of having poor mental health-related quality of life (MHRQL), a primary outcome, but not depression by PHQ9; and improved community-

prioritized outcomes, including increased likelihood of mental wellness and reduced likelihood of chronic homelessness risk and any behavioral health hospitalization.³¹ Over a 12-month period, there was evidence of reduced likelihood of poor MHRQL and of behavioral health hospitalization.³³ More than half the participants reported ≥ 3 chronic medical conditions,³¹ and evidence of effectiveness in this subgroup might inform efforts to develop integrated coalition approaches for complex patients. Intervention effects in this subgroup have not previously been reported. A Cochrane Review³⁴ identified CPIC as a main study of the added value of coalitions over an alternative to affect the health of minorities. Accordingly, this study provides a secondary analysis of CPIC intervention effects for depressed participants with multiple chronic medical conditions (MCC) as the main focus.

Objective

Our objective was to explore whether CEP relative to RS conferred similar benefits to participants with MCC as the overall sample, for primary and community-prioritized outcomes and secondary services use. Prior literature⁹⁻¹⁶ suggests that an effective implementation strategy for depression QI may benefit depressed individuals with MCC; but a coalition approach might not be as effective for MCC clients if it diffuses a clinical focus for a group with complex medical needs. We were also interested in exploring effects of interventions for clients without MCC and differential intervention effects by MCC status to inform future research, but

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the study has fewer non-MCC than MCC clients and was not specifically designed to test this interaction.

METHODS / DESIGN

We provide secondary data analyses of CPIC intervention effects^{28,31,33,35,36} for participants with and without MCC and explore effects of interactions of intervention and MCC status. Design and interventions are described elsewhere.^{31,33,36} CPIC was a group-level randomized comparative effectiveness trial comparing two interventions to implement an expanded model of depression collaborative care or QI programs in under-resourced communities. The CPIC protocol is published as an appendix to the 12-month outcomes article by Chung et al.³³ Funded in 2007 prior to mandated registration of health services trials, the study was registered post-enrollment at ClinicalTrials.gov (NCT01699789). The human subject protocol was approved by IRBs of RAND and institutions requiring separate review.

Interventions

Both interventions were designed to implement evidence-based QI toolkits across health and community-based services sectors. Toolkits were available online and included manuals and flashdrives with tools for clinician assessment and medication management, individual and group Cognitive Behavioral Therapy for Depression, depression case management and health worker outreach and team management (<http://www.communitypartnersincare.org/>

community-engagement-and-planning/).^{27,37-40} Resources for Services (RS) offered a prespecified number of webinars by interdisciplinary experts and one site visit to each primary care site, plus outreach by a community-engagement specialist. Community Engagement and Planning (CEP) invited program administrators to 10-12 biweekly meetings using participatory planning³² to adapt toolkits and develop training capacity, followed by oversight of training and program implementation for a year. The number of trainings offered and percentage of staff participating were greater in CEP than RS.³⁶

Sampling

Programs from health care (primary care, public health, mental health, and substance abuse) and social-community sectors (homeless and social services, faith-based, park community centers, hair salons, exercise or other program) were identified from agency lists and community nominations in South Los Angeles and Hollywood-Metro LA. Sixty agencies were invited to participate; 133 of 194 programs within those agencies were potentially eligible (ie, served at least 15 clients per week, at least one staff member and did not focus exclusively on psychotic disorders or home services). Within each community, programs or clusters were paired based on geographic location, service sector, population served, services offered, and funding sources.

One of each pair was randomized to CEP and the other to RS. Following site visits to finalize enrollment, 93 programs from 50 consenting agencies were enrolled (45 RS and 48

CEP). Staff blinded to intervention status approached clients in waiting rooms (consecutively), group meetings or lines (randomly), with 4,649 adults (aged ≥ 18 years) approached over 2-3 days per program; 4,440 (95.5%) agreed to screening. Eligibility was limited to clients providing contact information and scoring ≥ 10 on a modified 8-item Patient Health Questionnaire (PHQ-8).^{31,41} Of 4,440 adults screened, 1,322

Our objective was to explore whether Community Engagement and Planning relative to Resource Services conferred similar benefits to participants with medical chronic conditions as the overall sample, for primary and community-prioritized outcomes and secondary services use.

were eligible, 1,246 enrolled and 1,018 completed baseline or 6- or 12-month follow-up telephone surveys conducted by staff blinded to intervention status. MCC status was identified by a baseline measure listing 18 common chronic medical conditions; having ≥ 3 was classified

as MCC. Of 1,018 in the analytic sample, 548 had MCC (270 RS, 278 CEP) and 470 did not (non-MCC) (234 RS, 236 CEP). The CONSORT diagram is presented elsewhere.^{31,33}

Study Variables

Baseline measures included age, sex, education, race/ethnicity, current marital and work statuses, health insurance coverage, family income, MCC status, meeting federal criteria for family poverty, 12-month major depressive or dysthymic disorder from the MINI,⁴² and alcohol abuse or use of illicit drugs in past 12 months.

Pre-specified primary outcomes were: poor mental health quality of life (MHRQL), using a standard cut-point on the mental health subscale of the Short Form Health Survey (SF-12, MCS-12 \leq 40)⁴³ over the previous four weeks; and depression by a standard cut-point for mild/moderate depression on the Patient Health Questionnaire (PHQ) (9-item for outcome; 8-outcome for baseline, each \geq 10)⁴¹ in the past two weeks. Following community priorities for outcome, we selected items from existing measures to develop five indicators as secondary outcomes: 1) mental wellness in the prior four weeks based on responding to “all of the time, or most of the time, or a good bit of the time” on any of three items (feeling calm and peaceful, having energy, being happy)³¹; 2) good physical health⁴⁴ based on a response to any of five items: a) health not limited at all in daily moderate activities; b) climbing stairs; c) at least fairly physically active in work and leisure time; d) in the prior 4 weeks, health not limited in the kind of work or

other activities you do as a result of your physical health; e) not accomplishing less than what one would like; 3) chronic homelessness risk, defined as currently homelessness or living in a shelter or having \geq 2 risk factors for future homelessness from life events measures in the past 6 months;⁴⁵ 4) any behavioral health hospitalization (and for sensitivity analysis, \geq four hospital nights) in the past 6 months;³¹ and 5) any work for pay and if employed, number of work-loss days in the prior 30 days.

Outpatient services in the prior 6 months included: number of visits to health care agencies for “depression” (primary care services for depression or emotional health (ie, assessment, referral, medication, counseling); emergency or urgent care visits for alcohol, drug, or mental health; mental health specialty outpatient visits; and substance abuse program visits with depression services as defined above; number of mental health specialty outpatient visits with advice about medication or with counseling for depression/mental health. We included number of visits to social-community sectors with depression services in the prior 6 months (ie, social services, faith-based programs, parks and recreation community centers, telephone hotlines, and other); and any antidepressant medication use.^{31,37}

Statistical Methods

Our analytic sample included 1018 individuals completing any baseline, 6-, or 12-month survey. We compared baseline characteristics by intervention status overall and stratified by MCC status. We

used item-level imputation for missing data and wave-level imputation for missing surveys to adjust findings to the observed analytic sample,⁴⁶⁻⁴⁹ which for each period included clients not known to have died or withdrawn participation (1,018 for 6 months; 1,013 for 12 months). We used weights to account for non-enrollment and attrition (ie, enrolled, but not completing any surveys).^{50,51} The technical documentation for weighting and multiple imputation is presented elsewhere.^{33,36} Variance estimation is based on Taylor Series Linearization Method SUDAAN version 11.0.1 (<http://www.rti.org/sudaan/>), accounting for clustering (clients within programs), weighting, and multiple imputations.

We conducted intention-to-treat analyses using logistic regression for dichotomous variables, or Poisson regression for count outcome variables, estimated MCC-by-intervention (CEP relative to RS) interaction model. With attrition noted as a limitation by a Cochrane Review,³⁴ we present end status at each follow-up for primary analyses, which permits using multiple imputation and attrition weights. Consistent with recommendations for group-level randomization trials,⁵² all models adjust for baseline status of the dependent variable, age, race/ethnicity, education, 12-month depressive disorder, and community. For PHQ-9 as outcome, we used modified PHQ-8 as covariate, given no suicide item at screening. Comparisons focused on effects of interventions within subgroups (MCC, non-MCC), but including interaction tests.

Significance of comparisons was assessed using contrasts among re-

Table 1. Baseline characteristics of depressed clients in outcomes analysis, by intervention^a

	Overall, N=1018		with MCC, n=548		without MCC, n=470	
	RS, n=504	CEP, n=514	RS, n=270	CEP, n=278	RS, n=234	CEP, n=236
Age, mean (SD), y	44.9 (12.4)	46.6 (13.2)	48.2 (11.0)	50.4 (11.6)	40.9 (12.8)	41.9 (13.6)
Female, n (%)	286 (54.8)	309 (59.1)	151 (54.0)	166 (58.8)	135 (55.9)	143 (59.5)
Race/Ethnicity, n (%)						
Latino	194 (38.8)	215 (43.1)	88 (32.9)	99 (37.3)	106 (45.8)	116 (50.1)
African American	239 (46.9)	249 (45.0)	135 (49.6)	149 (49.7)	104 (43.7)	100 (39.4)
Non-Hispanic White	45 (9.7)	41 (8.8)	30 (11.9)	23 (9.0)	15 (7.0)	18 (8.6)
Other	26 (4.6)	9 (3.1)	17 (5.5)	7 (4.0)	9 (3.5)	2 (1.9)
Married or living with partner, n (%)	116 (22.6)	115 (22.6)	55 (20.0)	57 (20.7)	61 (25.8)	59 (25.0)
< High school, n (%)	221 (43.7)	224 (43.5)	115 (42.4)	112 (40.1)	106 (45.3)	113 (47.5)
No health insurance, n (%)	286 (57.3)	259 (51.1)	151 (56.4)	127 (46.8)	135 (58.4)	132 (56.4)
Income < poverty level, n (%)	373 (74.5)	377 (73.0)	198 (73.6)	199 (70.9)	175 (75.5)	178 (75.6)
Any work for pay now, n (%)	105 (20.6)	100 (19.4)	42 (15.2)	50 (18.0)	63 (27.0)	49 (21.1)
Chronic homelessness risk, n (%) ^b	283 (58.0)	255 (50.4)	168 (63.7)	136 (49.8)	116 (51.2)	119 (51.2)
12-month depressive disorder, n (%)	311 (62.4)	318 (61.4)	189 (70.5)	180 (65.1)	122 (52.8)	138 (56.9)
Alcohol abuse or use of illicit drugs, 12 months, n (%)	180 (36.3)	218 (42.2)	91 (34.2)	108 (38.7)	89 (38.9)	110 (46.4)
Poor mental health-related quality of life, n (%) ^c	271 (53.8)	275 (52.7)	157 (57.5)	155 (54.5)	114 (49.4)	120 (50.5)
Mental wellness, n (%) ^d	200 (39.2)	207 (40.1)	89 (32.7)	101 (36.0)	111 (47.0)	106 (45.1)
Good physical health, n (%) ^e	380 (75.2)	378 (73.4)	179 (66.6)	177 (63.8)	201 (85.4)	201 (85.2)
PHQ-8, mean (SD) ^f	15.1 (4.2)	14.9 (4.1)	15.8 (4.1)	15.5 (4.2)	14.2 (4.0)	14.1 (3.8)

a. Data were multiply imputed and weighted for eligible sample for enrollment; Chi-square test was used for a comparison between the two groups accounting for the design effect of the cluster randomization; P > .10 except homelessness risk within MCC, for which P=.052.
 b. Homeless or living in a shelter, or at least two risk factors of four (at least two nights homeless, food insecurity, eviction, financial crisis)
 c. Mental Health Composition Score of SF-12 (MCS12) ≤ 40; one standard deviation below population mean.
 d. At least good bit of time on any of three items: feeling peaceful or calm, being a happy person, having energy.
 e. On any of five items: health not limited in daily activities, climbing stairs, kind of work or other activities from physical health, not accomplishing less than one would like, fairly physically active in work and leisure past 4 weeks.
 f. 8-item Personal Health Questionnaire Depression Scale (0 to 24, higher more distress).
 RS, resources for services or individual program technical assistance; CEP, community engagement and planning; MCC, medical chronic conditions, defined as presence of 3 or more chronic conditions (among 18 conditions).

gression coefficients. Results are presented from logistic regression models as odds ratios (OR) and from Poisson models as incidence rate ratios (IRR) with 95% CIs. We supplement adjusted models with unadjusted raw data to assess robustness.

We conducted sensitivity analyses for intervention effects adjusted for baseline only or without covariates, with no change in conclusions. We include unweighted longitudinal models as sensitivity analyses (Tables 2, 3, 6, 7). For primary outcomes, we applied a Bonferroni adjustment considering two primary outcomes for 2 time periods, ie, P<.0125.⁵³

RESULTS

Baseline

Baseline demographic characteristics among those with and without MCC are similar for those in CEP and RS. Most participants were African American or Latino and had family income below federal poverty level (Table 1). Relative to those without MCC, participants with MCC were older, in worse mental and physical health, less likely to be working for pay, and race-ethnicity distribution differed with a higher percentage of African American (each P<.05, Table 2). For the whole

sample, the distribution of specific chronic conditions is given in Table 3, with no significant differences at P<.05 by intervention status.

Primary Outcome

CEP relative to RS was associated with a lower likelihood of poor MHRQL and depressive symptoms (PHQ-9) at 6-months among MCC participants (Table 4); with no significant 12-month intervention effects. MHRQL remained significant at 6 months after Bonferroni adjustment. There were no significant intervention effects within non-MCC clients, with trends suggesting

Table 2. Baseline characteristics of depressed clients by MCC status^a

	Overall, N=1018	Participants with MCC, N=548	Participants without MCC, N=470	P
Age, mean (SD), y	45.8 (12.9)	49.4 (11.3)	41.4 (13.2)	<.001
Female, n (%)	595 (57.0)	317 (56.4)	278 (57.7)	.749
Race/ethnicity, n (%)				.003
Latino	409 (41.0)	186 (35.2)	223 (48.0)	
African American	488 (46.0)	284 (49.7)	204 (41.5)	
Non-Hispanic White	86 (9.2)	54 (10.4)	32 (7.8)	
Other	35 (3.8)	23 (4.7)	12 (2.7)	
Married/living with partner, n (%)	231 (22.6)	112 (20.3)	120 (25.3)	.071
< High school, n (%)	446 (43.6)	227 (41.2)	219 (46.4)	.102
Income < poverty level, n (%)	750 (73.7)	397 (72.2)	353 (75.6)	.313
Any work for pay now, n (%)	205 (20.0)	92 (16.7)	113 (24.0)	.017
Chronic homelessness risk, n (%) ^b	538 (54.1)	303 (56.5)	235 (51.2)	.149
No health insurance, n (%)	545 (54.1)	278 (51.4)	267 (57.4)	.109
12-month depressive disorder, n (%)	629 (61.9)	369 (67.7)	260 (54.9)	<.001
Alcohol abuse or use of illicit drugs, 12 months, n (%)	398 (39.3)	199 (36.5)	200 (42.7)	.157
Poor mental health-related quality of life, n (%) ^c	546 (53.2)	312 (56.0)	234 (49.9)	.069
Mental wellness, n (%) ^d	407 (39.7)	190 (34.4)	217 (46.0)	<.001
Good physical health, n (%) ^e	759 (74.3)	357 (65.1)	402 (85.3)	<.001
PHQ-8, mean (SD) ^f	15.0 (4.1)	15.6 (4.2)	14.2 (3.9)	<.001

a. Data multiply imputed; percentages and means weighted for enrollment and survey response; Chi-square test for comparing MCC status accounting for cluster-randomized design.

b. Homeless or living in a shelter, or at least two risk factors of four (at least two nights homeless, food insecurity, eviction, financial crisis).

c. Mental Health Composition Score of SF-12 (MCS12) ≤ 40; one standard deviation below population mean.

d. At least good bit of time on any of three items: feeling peaceful or calm, being a happy person, having energy.

e. On any of five items: health not limited in daily activities, climbing stairs, kind of work or other activities from physical health, not accomplishing less than one would like, fairly physically active in work and leisure past 4 weeks.

f. 8-item Personal Health Questionnaire Depression Scale (0 to 24, higher more distress).

RS, Resources for services or individual program technical assistance; CEP, Community engagement and planning; MCC, medical chronic conditions, defined as presence of 3 or more chronic conditions (among 18 conditions).

small effects (for MHRQL, $P=.064$) but no significant interactions.

Community-prioritized Outcomes

Among MCC participants at 6 months, CEP relative to RS increased the likelihood of mental wellness and reduced the likelihood of chronic homelessness risk, having ≥4 hospital nights (any hospitalization, $P=.07$) and work-loss days if working (any work for pay, not significant). At 12 months, CEP relative to RS increased the likelihood of having good physical health. Among non-MCC participants, there were no significant

intervention effects, with trends suggesting smaller effects. There were no significant interactions of intervention effect by MCC status.

Outpatient Services

At 6-month follow-up, MCC participants in CEP relative to RS reported greater mean visits to faith-based programs for depression/emotional health services ($P=.014$). Among those with any faith-based participation, the number of faith-based depression/emotional visits was significantly higher for CEP (mean 1.7, SD 6.0) than RS (mean .8, SD 2.5) ($P=.024$). Participants in CEP relative to RS had a higher

likelihood of any park community center depression service ($P=.004$). There were no significant intervention effects on service use variables at 12 months among those with MCC. Among non-MCC, CEP relative to RS was associated at 6 months with significantly fewer specialty medication visits ($P=.003$) and more visits with depression services in faith-based and any community sector; and at 12 months with reduced likelihood of antidepressant use (each $P<.05$). At 6 months, a significant interaction suggests greater increase in CEP vs RS in having a park depression/emotional health service in MCC than non-MCC. (Table 5)

Table 3. Percentage of specific chronic conditions at baseline, N=1018^a

Chronic condition	Overall (N=1018)	RS (N=504)	CEP (N=514)	P
Asthma	223 (21.5%)	111 (21.6%)	112 (21.4%)	.963
Diabetes	191 (19.0%)	108 (21.5%)	84 (16.7%)	.217
Hypertension	384 (38.9%)	189 (38.6%)	195 (39.2%)	.892
Arthritis	375 (37.5%)	170 (34.1%)	205 (40.7%)	.076
Physical disability	143 (14.7%)	72 (14.8%)	70 (14.5%)	.874
Trouble breathing caused by emphysema or chronic lung disease	182 (17.8%)	87 (17.1%)	96 (18.4%)	.672
Cancer diagnosed, excluding skin cancer	35 (3.4%)	17 (3.2%)	18 (3.6%)	.791
Neurological condition	69 (6.5%)	33 (6.5%)	36 (6.6%)	.97
Stroke	83 (8.2%)	40 (7.9%)	43 (8.4%)	.799
Angina, heart failure or coronary artery disease	80 (8.3%)	38 (7.7%)	42 (8.8%)	.591
Chronic back problems	365 (36.5%)	190 (38.3%)	175 (34.7%)	.282
Stomach ulcer	161 (16.3%)	85 (17.1%)	76 (15.4%)	.528
Chronic liver disease	90 (9.3%)	44 (9.1%)	46 (9.4%)	.932
Migraine or other chronic severe headaches	367 (35.3%)	186 (36.8%)	181 (33.9%)	.463
Chronic problems urinating or bladder infections	148 (15.3%)	70 (14.5%)	78 (16.0%)	.597
Chronic gynecologic problems or women's health problems, N=595	170 (28.0%)	78 (26.8%)	92 (29.1%)	.544
HIV	83 (8.3%)	35 (6.8%)	48 (9.8%)	.647
Other chronic pain condition	199 (19.9%)	96 (19.1%)	104 (20.6%)	.645
3 or more chronic conditions	548 (54.8%)	270 (54.4%)	278 (55.1%)	.889
Number of chronic conditions, mean (SD)	3.3 (2.6)	3.3 (2.6)	3.4 (2.7)	.829

a. Data were multiply imputed; percentages and means were weighted to account for enrollment and survey response; Chi-square test was used for comparing two groups accounting for the design effect of the cluster randomization.

RS, Resources for Services or individual program technical assistance; CEP, Community Engagement and Planning

Sensitivity Analyses

Unweighted longitudinal models indicated similar patterns of intervention effects on outcomes. The CEP intervention took place during the 12 months post-baseline. As a sensitivity analysis, we conducted a longitudinal analysis using all waves of data (baseline, 6 months, 12 months) with three-way interactions (time, intervention, MCC status) without response weights, adjusting for the same set of baseline covariates as in the primary analysis. Initial explorations of 3-level, random-effects models using the SAS GLIMMIX procedure failed to converge for some variables. As a result, we utilized a generalized estimating equation (GEE) framework with logistic regression models for binary outcomes and Poisson models for count data us-

ing the SAS GENMOD procedure, specifying exchangeable correlation at the program level. From the estimated model, we developed a contrast involving a linear combination of coefficients to test intervention effects at each end point (baseline, 6 months, 12 months) and tested differences between intervention groups in change from baseline to 6 months, and 12 months within MCC and nonMCC groups and interaction of intervention by MCC status at each time point. The results of sensitivity analyses are presented in Tables 6 and 7.

DISCUSSION

This secondary analysis was designed to explore whether CPIC intervention findings for the full sample^{31,36}

were confirmed among participants having depression and MCC, an important clinical and policy group, viewed by stakeholders as vulnerable and prioritized for subanalyses. This comparison has potential implications for innovative health insurance and health care programs seeking to integrate clinical and social services to address social determinants of health for complex clients. Consistent with prior studies suggesting that depression collaborative care is effective in medically ill patients,⁹⁻¹⁶ we found that the CEP relative to RS was associated with greater improvements at 6 months among MCC participants in both primary outcomes of MHRQL and depression, which for MHRQL would survive formal correction for multiple statistical comparisons. We previously reported that interven-

Table 4. Intervention effects on primary and community-prioritized outcomes at 6 and 12 month follow-up

	Unadjusted estimates ^a				Adjusted analysis ^{b,c}					
	with MCC		without MCC		with MCC		without MCC		Interaction	
	RS	CEP	RS	CEP	CEP vs RS test (95% CI)	P	CEP vs RS test (95% CI)	P	P	
6-month follow-up										
Primary outcomes	n/N (%)	n/N (%)	n/N (%)	n/N (%)	OR		OR			
Poor mental health quality of life	119/194 (61.3)	78/181 (43.1)	67/159 (42.1)	66/154 (42.9)	.54 (.36, .81)	.005	1.06 (.65, 1.71)	.816		.064
PHQ-9 ≥10	157/194 (80.9)	119/182 (65.4)	83/159 (52.2)	85/151 (56.3)	.60 (.40, .90)	.015	1.01 (.49, 2.11)	.968		.125
Community-prioritized (secondary)										
Mental wellness	51/195 (26.2)	75/182 (41.2)	69/159 (43.4)	79/154 (51.3)	1.94 (1.25, 3.01)	.004	1.51 (.80, 2.84)	.184		.473
Good physical health	131/195 (67.2)	133/182 (73.1)	136/159 (85.5)	125/154 (81.2)	1.49 (.97, 2.29)	.068	.81 (.47, 1.40)	.438		.063
Chronic homelessness risk	97/195 (49.7)	49/182 (26.9)	42/158 (26.6)	45/153 (29.4)	.47 (.30, .72)	.001	.85 (.36, 2.02)	.675		.175
Any behavioral health hospitalizations	16/195 (8.2)	8/182 (4.4)	13/159 (8.2)	8/154 (5.2)	.51 (.24, 1.06)	.071	.52 (.19, 1.40)	.184		.967
≥4 hospital nights for behavioral health	11/195 (5.6)	3/182 (1.6)	4/159 (2.5)	4/154 (2.6)	.28 (.10, .77)	.015	.46 (.09, 2.27)	.313		.595
Work for pay now	33/195 (16.9)	42/182 (23.1)	54/159 (34.0)	45/154 (29.2)	1.38 (.76, 2.51)	.269	.86 (.46, 1.60)	.606		.229
	mean (SD)	mean (SD)	mean (SD)	mean (SD)	IRR		IRR			
Work days missed last 30 days, if working	8.4 (10.3)	2.9 (4.5)	3.4 (5.7)	4.2 (7.0)	.41 (.22, .74)	.005	1.03 (.44, 2.43)	.934		.105
12-month follow-up										
Primary outcomes	n/N (%)	n/N (%)	n/N (%)	n/N (%)	OR		OR			
Poor mental health quality of life	106/189 (56.1)	87/177 (49.2)	66/143 (46.2)	62/147 (42.2)	.82 (.55, 1.21)	.296	.77 (.48, 1.23)	.258		.836
PHQ-9 ≥ 10	149/192 (77.6)	124/177 (70.1)	72/145 (49.7)	77/150 (51.3)	.88 (.56, 1.38)	.580	1.01 (.57, 1.79)	.973		.704
Community-prioritized (secondary)										
Mental wellness	71/194 (36.6)	72/179 (40.2)	84/145 (57.9)	84/151 (55.6)	1.16 (.71, 1.88)	.542	.97 (.61, 1.54)	.897		.509
Good physical health	121/193 (62.7)	125/179 (69.8)	126/145 (86.9)	128/150 (85.3)	1.55 (1.04, 2.29)	.031	1.25 (.68, 2.30)	.448		.542
Chronic homelessness risk	77/192 (40.1)	63/178 (35.4)	30/144 (20.8%)	46/149 (30.9%)	1.05 (.62, 1.77)	.855	1.29 (.75, 2.23)	.344		.598
Any behavioral health hospitalizations	10/194 (5.2)	8/179 (4.5)	4/145 (2.8)	8/150 (5.3)	.74 (.34, 1.62)	.447	1.01 (.31, 3.24)	.992		.684
≥4 hospital nights for behavioral health	7/193 (3.6)	7/179 (3.9)	1/145 (.7%)	2/150 (1.3)	.87 (.36, 2.09)	.756	.88 (.13, 6.09)	.894		.993
Work for pay now	28/193 (14.5%)	38/178 (21.3%)	49/144 (34.0%)	39/149 (26.2%)	1.62 (.78, 3.38)	.171	.77 (.47, 1.26)	.299		.068
	mean (SD)	mean (SD)	mean (SD)	mean (SD)	IRR		IRR			
Work days missed last 30 days, if working	6.3 (7.8)	6.5 (8.7)	2.9 (4.6)	4.7 (8.7)	1.13 (.55, 2.31)	.719	1.59 (.74, 3.42)	.220		.443

a. Raw data without weighting and imputation.

b. Intervention-by-MCC interaction models used multiply imputed data, weighted for eligible sample for enrollment; logistic regression models for binary variables (presented as odds ratio, OR) or Poisson regression models for count variables (presented as incidence rate ratios, IRR), interacted of intervention condition by MCC status adjusted for baseline status of the dependent variable, age, education, race/ethnicity, 12-month depressive disorder, and community and accounted for the design effect of the cluster randomization.

c. A sensitivity analysis for "Work days missed last 30 days, if working" based on generalized negative binomial regression models using STATA (svy: gnbreg) provided similar results.

RS, Resources for services or individual program technical assistance; CEP, Community engagement and planning; MCC, medical chronic conditions, defined as presence of 3 or more chronic conditions (among 18 conditions).

Table 5. Intervention effects on service utilization at 6 and 12 month follow-up

	Unadjusted estimates ^a				Adjusted analysis ^{b,c}				
	with MCC		without MCC		with MCC	P	without MCC	Interaction	
	RS	CEP	RS	CEP	CEP vs RS test (95% CI)		CEP vs RS test (95% CI)	P	P
6-month follow-up	mean (SD)	mean (SD)	mean (SD)	mean (SD)	IRR		IRR		
Health care sector visits for depression	11.2 (19.1)	12.2 (25.0)	13.4 (35.0)	12.4 (27.9)	.99 (.45, 2.18)	.987	.90 (.53, 1.54)	.699	.783
Mental health specialist visits received advice about medication	4.2 (9.5)	3.5 (5.1)	6.0 (25.3)	2.5 (7.8)	.59 (.33, 1.07)	.079	.35 (.18, .68)	.003	.130
Mental health specialist visits received counseling	7.2 (14.1)	5.7 (10.4)	8.6 (29.0)	5.3 (11.7)	.77 (.38, 1.57)	.421	.57 (.30, 1.07)	.078	.429
Community sector visits for depression	4.2 (20.0)	3.8 (15.7)	.8 (2.3)	3.8 (18.8)	1.20 (.57, 2.50)	.630	2.87 (1.14, 7.21)	.027	.160
Faith-based visits with depression service	.5 (2.1)	1.0 (4.8)	.3 (1.1)	.5 (3.9)	2.65 (1.22, 5.74)	.014	3.31 (1.32, 8.28)	.011	.661
Any park services for depression	n/N (%)	n/N (%)	n/N (%)	n/N (%)	OR		OR		
	4/195 (2.1)	12/182 (6.6)	9/159 (5.7)	3/154 (1.9)	4.15 (1.60, 10.77)	.004	.60 (.14, 2.52)	.464	.014
Took antidepressant	89/195 (45.6)	81/181 (44.8)	51/159 (32.1)	38/154 (24.7)	.81 (.42, 1.58)	.517	.60 (.23, 1.61)	.249	.567
12-month follow-up	mean (SD)	mean (SD)	mean (SD)	mean (SD)	IRR		IRR		
Health care sector visits for depression	10.4 (23.1)	10.3 (22.2)	7.5 (20.0)	6.9 (15.8)	.86 (.55, 1.36)	.513	.99 (.53, 1.86)	.982	.656
Mental health specialist visits received advice about medication	3.6 (11.4)	4.2 (10.6)	2.2 (6.1)	1.8 (5.1)	1.05 (.64, 1.74)	.838	.98 (.46, 2.11)	.960	.850
Mental health specialist visits received counseling	5.1 (12.9)	4.5 (10.2)	3.7 (8.0)	2.6 (7.0)	.86 (.53, 1.41)	.541	.88 (.48, 1.59)	.657	.948
Community sector visits for depression	2.1 (8.6)	3.4 (18.0)	1.5 (7.3)	3.5 (17.9)	1.61 (.64, 4.07)	.310	2.33 (.63, 8.64)	.184	.652
Faith-based visits with depression service	1.2 (8.1)	.9 (6.6)	1.2 (7.1)	.9 (3.8)	.79 (.24, 2.58)	.681	1.24 (.39, 3.96)	.710	.613
Any park services for depression	n/N (%)	n/N (%)	n/N (%)	n/N (%)	OR		OR		
	5/194 (2.6)	4/179 (2.2)	1/145 (.7)	5/149 (3.4)	.88 (.24, 3.24)	.844	3.12 (.57, 16.93)	.181	.239
Took antidepressant	75/194 (38.7)	68/179 (38.0)	43/145 (29.7)	26/149 (17.4)	.87 (.51, 1.48)	.592	.53 (.32, .87)	.015	.153

a. Raw data without weighting and imputation.

b. Intervention-by-MCC interaction models used multiply imputed data, weighted for eligible sample for enrollment; logistic regression models for binary variables (presented as odds ratio, OR) or Poisson regression models for count variables (presented as incidence rate ratios, IRR), interacted of intervention condition by MCC status adjusted for baseline status of the dependent variable, age, education, race/ethnicity, 12-month depressive disorder, and community and accounted for the design effect of the cluster randomization.

c. A sensitivity analysis for count variables based on generalized negative binomial regression models using STATA (svy: gnbreg) provided similar results.

RS, Resources for services or individual program technical assistance; CEP, community engagement and planning; MCC, medical chronic conditions, defined as presence of 3 or more chronic conditions (among 18 conditions).

tion effects on depression were not significant in the overall sample.^{31,36}

Further, we found significant effects of CEP over RS for at least one time point among MCC participants for community-prioritized outcomes, ie, mental wellness, homelessness risk

factors, ≥ 4 behavioral health hospitalizations, and work-loss days among employed. The sample without MCC was smaller, and we did not observe significant intervention effects on primary or community-prioritized outcomes. For non-MCC clients, we

found a pattern under CEP relative to RS of fewer specialty medication visits at 6 months, less use of antidepressants at 12 months, but more faith-based visits and any community visit for depression at 6 months. Most intervention-by-MCC interac-

Table 6. Longitudinal analyses for alternative modeling of intervention effects on primary and secondary outcomes ^a

	Participants with MCC				Participants without MCC				Interaction P
	CEP vs RS at specific time		CEP vs RS in change from baseline		CEP vs RS at specific time		CEP vs RS in change from baseline		
	Test (95% CI)	P	Test (95% CI)	P	Test (95% CI)	P	Test (95% CI)	P	
Primary outcomes									
Poor mental health quality of life									
	OR		OR		OR		OR		
Baseline	.95 (.68, 1.32)	.764			1.05 (.74, 1.48)	.8			.696
6-month follow-up	.54 (.36, .83)	.007	.57 (.34, .95)	.032	1.01 (.62, 1.64)	.969	.96 (.54, 1.71)	.901	.085
12-month follow-up	.78 (.55, 1.11)	.164	.82 (.51, 1.32)	.41	.80 (.51, 1.25)	.318	.76 (.44, 1.31)	.324	.935
PHQ-8 ≥10									
Baseline	2.16 (.26, 17.95)	.472			1.15 (.42, 3.16)	.781			.599
6-month follow-up	.59 (.39, .90)	.014	.27 (.03, 2.23)	.224	1.02 (.50, 2.05)	.957	.88 (.25, 3.12)	.845	.119
12-month follow-up	.82 (.55, 1.22)	.328	.38 (.04, 3.23)	.374	1.03 (.57, 1.85)	.914	.89 (.29, 2.72)	.843	.506
Community-prioritized									
Mental wellness									
Baseline	1.11 (.79, 1.55)	.543			.94 (.64, 1.39)	.773			.499
6-month follow-up	1.84 (1.20, 2.83)	.007	1.66 (1.04, 2.66)	.035	1.48 (.81, 2.71)	.183	1.57 (.79, 3.13)	.187	.491
12-month follow-up	1.19 (.74, 1.92)	.453	1.07 (.60, 1.93)	.802	.96 (.61, 1.49)	.846	1.01 (.58, 1.76)	.963	.401
Good physical health									
Baseline	.89 (.62, 1.28)	.539			.97 (.58, 1.64)	.914			.812
6-month follow-up	1.42 (.95, 2.12)	.086	1.59 (.95, 2.67)	.08	.83 (.47, 1.47)	.514	.85 (.44, 1.68)	.645	.094
12-month follow-up	1.46 (.97, 2.19)	.066	1.63 (1.03, 2.60)	.038	1.28 (.71, 2.33)	.399	1.32 (.63, 2.76)	.453	.709
Chronic homelessness risk									
Baseline	.58 (.37, .93)	.023			.98 (.63, 1.51)	.913			.073
6-month follow-up	.43 (.28, .65)	<.001	.73 (.46, 1.17)	.194	.81 (.38, 1.74)	.553	.83 (.38, 1.80)	.616	.127
12-month follow-up	.92 (.56, 1.51)	.742	1.58 (.88, 2.83)	.12	1.23 (.71, 2.13)	.457	1.26 (.67, 2.38)	.475	.446
Any behavioral health hospitalizations									
Baseline	1.41 (.83, 2.38)	.198			1.53 (.73, 3.18)	.256			.863
6-month follow-up	.54 (.27, 1.09)	.085	.38 (.17, .88)	.024	.55 (.22, 1.34)	.182	.36 (.12, 1.11)	.075	.983
12-month follow-up	.83 (.36, 1.90)	.659	.59 (.26, 1.34)	.205	1.13 (.37, 3.40)	.828	.74 (.19, 2.81)	.648	.68
≥4 hospital nights for behavioral health									
Baseline	1.40 (.82, 2.40)	.222			1.53 (.75, 3.10)	.24			.833
6-month follow-up	.30 (.11, .78)	.014	.21 (.07, .64)	.006	.51 (.12, 2.24)	.359	.34 (.07, 1.68)	.174	.54

a. Intervention-by-MCC interaction models used all waves of multiply imputed data (baseline, 6 months, 12 months). A generalized estimating equation logistic regression model was used for a binary variable (presented as odds ratios) and Poisson regression model was used for a count variable (presented as incidence density ratios), adjusted age, education, race/ethnicity, 12-month depressive disorder, and community. RS, Resources for Services; CEP, Community Engagement and Planning; MCC, medical chronic conditions, defined as presence of 3 or more chronic conditions (among 18 conditions)

tions were not significant. Findings were fairly consistent in unweighted longitudinal sensitivity analyses.

The overall pattern suggests that findings for clients with MCC at 6 months were generally consistent with that of the overall sample, favoring CEP relative to RS for MHRQL and some community-prioritized

outcomes.^{31,33} Reduced effects at 12 months may partly be due to lower exposure over time to depression services in the assigned intervention.⁵⁴ Future research is needed to understand mechanisms underlying initial benefits of CEP relative to RS and reduced effects over time, to inform research on determining how to sustain effects.

Limitations

The study has important limitations. The MCC indicator was based on 18 specific conditions, all measures were self-reported and community-prioritized outcomes while using items from standard measures were newly constructed indicators to match stakeholder concepts. The

Table 7. Longitudinal analyses for alternative modeling of intervention effects on primary and secondary outcomes ^a

	Participants with MCC				Participants without MCC				Interaction P
	CEP vs RS at specific time		CEP vs RS in change from baseline		CEP vs RS at specific time		CEP vs RS in change from baseline		
	Test (95% CI)	P	Test (95% CI)	P	Test (95% CI)	P	Test (95% CI)	P	
12-month follow-up	.99 (.40, 2.47)	.981	.71 (.30, 1.67)	.429	1.21 (.20, 7.46)	.834	.79 (.12, 5.16)	.806	.844
Any work for pay now									
Baseline	1.07 (.60, 1.92)	.813			.71 (.38, 1.32)	.277			.206
6-month follow-up	1.23 (.70, 2.17)	.452	1.15 (.65, 2.03)	.623	.76 (.42, 1.37)	.341	1.07 (.56, 2.05)	.842	.21
12-month follow-up	1.33 (.71, 2.48)	.353	1.24 (.61, 2.52)	.523	.71 (.44, 1.14)	.156	1.00 (.55, 1.82)	1	.054
Work days, N, missed in last 30 days, if working									
IRR									
Baseline	.16 (-.78, 1.11)	.72			-.03 (-1.20, 1.13)	.952			.741
6-month follow-up	-4.48 (-7.67, -1.28)	.006	-4.64 (-7.68, -1.60)	.003	.31 (-3.00, 3.62)	.844	.34 (-2.47, 3.16)	.804	.049
12-month follow-up	.90 (-2.48, 4.28)	.593	.74 (-3.05, 4.53)	.69	2.01 (-1.49, 5.50)	.25	2.04 (-1.80, 5.88)	.283	.594
Services utilization									
Health care visits for depression (N)									
Baseline	1.03 (.75, 1.43)	.848			.81 (.52, 1.27)	.355			.236
6-month follow-up	1.00 (.48, 2.08)	.99	.96 (.47, 2.00)	.915	.81 (.45, 1.43)	.444	.99 (.54, 1.83)	.987	.547
12-month follow-up	.90 (.58, 1.41)	.651	.87 (.56, 1.37)	.555	.89 (.46, 1.72)	.718	1.10 (.51, 2.38)	.807	.962
MH outpatient visits with medication (N), advice(N)									
Baseline	1.27 (.77, 2.12)	.348			1.10 (.58, 2.06)	.775			.732
6-month follow-up	.63 (.34, 1.15)	.128	.49 (.24, 1.01)	.053	.32 (.17, .63)	.001	.30 (.14, .62)	.002	.047
12-month follow-up	1.16 (.68, 1.99)	.577	.91 (.52, 1.60)	.751	.95 (.45, 2.00)	.895	.87 (.32, 2.33)	.773	.597
MH outpatient visits with counseling (N)									
Baseline	1.14 (.77, 1.70)	.501			1.19 (.66, 2.13)	.567			.911
6-month follow-up	.79 (.40, 1.58)	.472	.69 (.35, 1.36)	.256	.54 (.28, 1.05)	.067	.46 (.24, .89)	.021	.336
12-month follow-up	.94 (.56, 1.58)	.811	.82 (.47, 1.43)	.477	.86 (.48, 1.56)	.616	.73 (.36, 1.48)	.371	.784
Community sector visits for depression (N)									
Baseline	1.26 (.72, 2.21)	.419			.74 (.35, 1.60)	.449			.244
6-month follow-up	1.20 (.55, 2.61)	.644	.95 (.41, 2.22)	.911	2.65 (1.00, 7.01)	.05	3.56 (1.05, 12.07)	.042	.225
12-month follow-up	1.55 (.59, 4.05)	.369	1.23 (.37, 4.09)	.735	2.28 (.62, 8.37)	.2	3.06 (.67, 14.02)	.144	.657
Religious services for depression									
Baseline	1.18 (.64, 2.20)	.591			.41 (.18, .90)	.026			.033
6-month follow-up	2.53 (1.17, 5.49)	.019	2.14 (1.00, 4.55)	.049	2.71 (1.12, 6.56)	.027	6.69 (2.05, 21.85)	.002	.896
12-month follow-up	.68 (.18, 2.56)	.558	.58 (.15, 2.25)	.414	1.01 (.33, 3.04)	.991	2.48 (.63, 9.79)	.193	.688
Any park community center services for depression									
OR									
Baseline	.81 (.45, 1.46)	.48			.96 (.43, 2.15)	.928			.722
6-month follow-up	3.57 (1.46, 8.73)	.006	4.41 (1.47, 13.23)	.009	.54 (.13, 2.20)	.373	.56 (.12, 2.55)	.445	.011
12-month follow-up	.63 (.20, 1.98)	.428	.78 (.26, 2.34)	.655	2.26 (.51, 10.06)	.279	2.35 (.49, 11.22)	.28	.164
Use antidepressant									
Baseline	1.15 (.75, 1.77)	.513			1.41 (.83, 2.42)	.205			.457
6-month follow-up	.99 (.54, 1.80)	.96	.85 (.49, 1.48)	.556	.80 (.37, 1.70)	.522	.56 (.27, 1.19)	.12	.627
12-month follow-up	1.01 (.60, 1.71)	.975	.87 (.54, 1.41)	.574	.69 (.41, 1.17)	.167	.49 (.28, .85)	.012	.247

a. Intervention-by-MCC interaction models used all waves of multiply imputed data (baseline, 6 months, 12 months). A generalized estimating equation logistic regression model was used for a binary variable (presented as odds ratios) and Poisson regression model was used for a count variable (presented as incidence density ratios), adjusted age, education, race/ethnicity, 12-month depressive disorder, and community. RS, Resources for Services; CEP, Community Engagement and Planning; MCC, medical chronic conditions, defined as presence of 3 or more chronic conditions (among 18 conditions)

study was limited to two Los Angeles communities. Response rates were moderate for agencies, high for programs and clients enrollment, with moderate client nonresponse at follow-up. Randomization was within community so there could be cross-intervention exposure, a conservative bias limiting observed effects.

...we found that the CEP relative to RS was associated with greater improvements at 6 months among MCC participants in both primary outcomes of MHRQL and depression...

This subanalysis was exploratory. The non-MCC group had a smaller sample size and the study was not designed to have power for interactions. There was no usual-care control.

CONCLUSION

Given policy and health care system interest in integrated approaches such as community health homes and accountable communities,^{55,56} the findings, despite study limitations, suggest that a coalition model relative to program technical assistance to implement collaborative care for depression, holds prom-

ise for improving at least short-term outcomes among ethnically diverse groups having both depression and multiple chronic medical conditions.

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Conflict of Interest

No conflicts of interest to report.

AUTHOR CONTRIBUTIONS

Research concept and design: Aoki, Chung, Dixon, Johnson, F Jones, Landry, Ngo, Sherbourne, Whittington, Williams, Miranda, Belin, L Jones, Wells; Acquisition of data: Aoki, Dixon, Lizaola, Mtume, Pulido, Lucas Wright, Zhang, Miranda, Gilmore, L Jones, Wells; Data analysis and interpretation: Springgate, Tang, Ong, Chung, Johnson, F Jones, Lizaola, Pulido, Sherbourne, Whittington, Zhang, Miranda, Belin, Gilmore, Wells; Manuscript draft:

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