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Impact of a national collaborative care initiative for patients with depression and diabetes or cardiovascular disease☆

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ABSTRACT

Objective: The spread of evidence-based care is an important challenge in healthcare. We evaluated spread of an evidence-based large-scale multisite collaborative care model for patients with depression and diabetes and/or cardiovascular disease (COMPASS).

Methods: Primary care patients with depression and comorbid diabetes or cardiovascular disease were recruited. Collaborative care teams used care management tracking systems and systematic case reviews to track and intensify treatment for patients not improving. Targeted outcomes were depression remission and response (assessed with the Patient Health Questionnaire-9) and control of diabetes (assessed by HbA1c) and blood pressure. Patients and clinicians were surveyed about satisfaction with care.

Results: Eighteen care systems and 172 clinics enrolled 3609 patients across the US. Of those with uncontrolled disease at enrollment, 40% achieved depression remission or response, 23% glucose control and 58% blood pressure control during a mean follow-up of 11 months. There were large variations in outcomes across medical groups. Patients and clinicians were satisfied with COMPASS care.

Conclusions: COMPASS was successfully spread across diverse care systems and demonstrated improved outcomes for complex patients with previously uncontrolled chronic disease. Future large-scale implementation projects should create robust processes to identify and reduce expected variation in implementation to consistently provide improved care.

1. Introduction

There is ample evidence of large gaps between usual and evidence-based care for patients with comorbid chronic conditions, yet few examples of successful implementation of innovative care models are able to narrow this gap [1]. Evidence-driven collaborative care for patients with multiple conditions could be used as a model for the implementation of care for complex patients. To date, despite strong evidence demonstrating that the collaborative care model is effective for depression [2–4] and a growing body of evidence that it is also effective for

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other chronic diseases [4,5], collaborative care based on research outcomes is not routinely implemented outside of clinical trials.

For depression, the evidence supporting the effectiveness of collaborative care is robust, with over 80 randomized clinic trials demonstrating its value [6]. Collaborative care has been shown to increase antidepressant adherence, improve depression outcomes for 2 to 5 years, and increase patient and clinician satisfaction [2]. Some studies have also found collaborative care to be cost-saving, including Improving Mood-Promoting Access to Collaborative Treatment (IMPACT), which demonstrated a reduction of 10% in total healthcare costs over 4 years, despite the intervention lasting only 1 year [7].

For management of chronic diseases other than depression, the evidence supporting the effectiveness of collaborative care is growing. Most notably, TEAMcare demonstrated the feasibility and effectiveness of collaborative care for patients with either diabetes or heart disease in addition to depression [4]. In TEAMcare, collaborative care reduced glycolated hemoglobin (HbA1c), systolic blood pressure (SBP), low-density lipoprotein (LDL) and depression scores and disability levels while improving quality of life measures. Additional studies further support the effectiveness of collaborative care in improving diabetes [8,9] and heart disease outcomes [10].

Despite this evidence, collaborative care for multiple chronic conditions is seldom employed outside of clinical trials, in part because key components of this care are not reimbursable. Consequently, the ability to successfully implement collaborative care in a variety of healthcare systems and improve outcomes among diverse patient populations is largely unknown. To address this knowledge gap, 10 organizations across the US collaborated in a Center for Medicare and Medicaid Health Care Innovation Award-funded project to determine if collaborative care for patients with active depression plus comorbid diabetes and/or cardiovascular disease could be spread across diverse states, healthcare systems and patient populations. The Care of Mental, Physical and Substance use Syndromes (COMPASS) initiative implemented the collaborative care model in 172 clinics representing 18 healthcare systems across eight states. The goals of COMPASS were to improve clinical outcomes (namely depression as measured by the PHQ9, diabetes as measured by HbA1c and hypertension), as well as patient and clinician satisfaction. This paper reports the main findings of the COMPASS initiative.

2. Methods

2.1. Partner organizations

Partner organizations included the Community Health Plan of Washington, Kaiser Permanente Colorado, Kaiser Permanente Southern California, Mayo Clinic Health System (Minnesota, Florida), the Michigan Center for Clinical Systems Improvement, Mount Auburn Cambridge Independent Practice Association (Massachusetts), Pittsburgh Regional Health Initiative and the Institute for Clinical Systems Improvement (ICSI; Minnesota). Each partner organization was responsible for recruiting associated care systems and clinics into COMPASS, and 18 care systems and 172 primary care clinics in rural, urban and suburban settings participated. Care systems included integrated health systems, federally qualified health centers, multisite physician practices and individual practice associations. Institutional review boards for all partner organizations approved this study.

ICSI led the overall initiative and facilitated partner organization collaboration, administration of the grant award, and implementation of the COMPASS care model. Participants from each partner organization attended a 2-day train-the-trainer session, followed by customized onsite 3-day trainings at each site. Following these trainings, partner organizations provided different levels of coaching and booster trainings. The content and frequency of these sessions were determined by each partner, with input from ICSI and other partners, taking into account outcomes and fidelity measures, regular inperson or phone observation of systematic case reviews by ICSI staff, coaching and networking calls and requests from sites themselves. In addition, ICSI facilitated monthly Webinars with the care managers and later hosted a second train-the-trainer event. The Advancing Integrated Mental Health Solutions (AIMS) Center at the University of Washington helped develop the COMPASS model and provided technical assistance for its implementation, including making its care management tracking system (CMTS) available for use. HealthPartners Institute led the monitoring, performance reporting and assessment of the initiative's implementation and outcomes.

2.2. Patients

Potential participants with active depression and diabetes and/or cardiovascular disease were enrolled in COMPASS between February 2013 and March 2015. Patients were identified in varying ways across clinics and medical groups, including recruitment of patients during primary care appointments, clinician referrals and electronic medical record queries. Patients who were recruited into COMPASS were typically not adequately responding to usual care.

Patients were eligible for COMPASS if they had active depression (PHQ9>9) and poorly controlled diabetes or cardiovascular disease. Initially, an additional eligibility criterion was having Medicare or Medicaid insurance; however, due to challenges with enrollment of sufficient patients and implementation in clinics with multiple payers, all insurance types were later accepted, which ultimately improved COMPASS's generalizability.

A total of 3854 patients were enrolled in COMPASS. For purposes of analysis, the following exclusion criteria were applied to ensure that patients actually received COMPASS care: 89 patients were excluded because they had no documented contact with COMPASS care managers after enrollment, 143 because less than a month elapsed between first contact and discharge from COMPASS and 13 because they were enrolled less than a month before COMPASS ended. The final analytic sample included 3609 patients.

2.3. Intervention

The COMPASS care model is described in detail in a related publication [11]. Briefly, COMPASS care was based broadly on the chronic care model [12,13] and more specifically on the collaborative care management model [2,14] as refined by the IMPACT [3] and TEAMcare [4] trials and the DIAMOND (Depression Improvement Across Minnesota–Offering a New Direction) [15] project. The key components of this model are intensive case management using rigorous treat-to-target guidelines for depression, diabetes and cardiovascular disease delivered by a care management team. Each team consisted of a care manager who had direct contact with the patient, as well as a consulting primary care physician and psychiatrist. Teams were expected to meet weekly for systematic case reviews, where they were tasked with (a) reviewing the initial care plan for all patients; (b) reviewing all patients not improving and making treatment adjustments as indicated; and (c) agreeing on discharge and follow-up plans for patients who achieved disease goals and were ready to transition out of COMPASS. Processes of care and patients outcomes were monitored using an electronic CMTS, and aggregated and site-specific quality improvement reports were routinely reported to each site. Laboratory, vital signs and healthcare services utilization information were abstracted from the CMTS.

2.4. Patient and clinician surveys

Patients who agreed to have their personal information sent to a central evaluation center were contacted to participate in a phone survey about their satisfaction with care before beginning COMPASS care and again 1 year after enrollment. Of the 3854 patients enrolled in COMPASS, contact information for 1762 (46%) patients was provided to the central survey center. Of these 1762 patients, 1133 were able to be contacted, 751 were screened and 663 (38% of 1762) were eligible

Table 1
Depression improvement and remission among $N=3363$ patients with PHQ9>9 at treatment initiation

	N (%) or M (S.D.)	% Response (PHQ9 decreased by at least 50%)	% Remission (last PHQ9<5)	Response (PHQ9 decreased by at least 50%)		Remission (last PHQ9<5)	
				OR (95% CI)	p	OR (95% CI)	*P*
All patients		16%	24%				
Age	60 (13)			model *P*<.001			
18–49	715 (21%)	15%	17%	0.75 (0.58–0.96)	0.02	0.63 (0.50–0.79)	<.001
50–69	1936 (58%)	17%	24%	ref		ref	
70+	708 (21%)	17%	32%	1.16 (0.91–1.48)	0.24	1.59 (1.29–1.94)	<.001
not reported	4 (<1%)						
Sex				model *P*=.56			
Male	1199 (36%)	16%	25%	0.90 (0.74–1.10)	0.31	1.01 (0.85–1.20)	0.95
Female	2153 (64%)	17%	24%	ref		ref	
not reported	11 (<1%)						
Race				model *P*=.01			
Black	310 (9%)	14%	18%	0.73 (0.51–1.04)	0.08	0.57 (0.41–0.80)	<.001
White	2315 (69%)	17%	26%	ref		ref	
Other, Multiple	298 (9%)	15%	20%	0.97 (0.65–1.44)	0.86	0.86 (0.60–1.22)	0.40
Not reported	440 (13%)						
Hispanic ethnicity				model *P*=.61			
No	2634 (78%)	17%	24%	ref		ref	
Yes	488 (15%)	14%	29%	0.89 (0.65–1.22)	0.47	1.06 (0.83–1.37)	0.63
Not reported	241 (7%)						
Insurance coverage				model *P*<.001			
Medicaid	747 (22%)	17%	17%	0.82 (0.64–1.05)	0.12	0.50 (0.39–0.63)	<.001
Medicare	1605 (48%)	17%	27%	ref		ref	
Commercial	940 (28%)	15%	25%	0.86 (0.68–1.09)	0.21	0.79 (0.65–0.96)	0.02
Self-pay	66 (2%)	23%	21%	1.29 (0.69–2.42)	0.43	0.69 (0.38–1.28)	0.37
Not reported	5 (<1%)						
PHQ9 score				model *P*<.001			
10–14	1605 (48%)	10%	30%	ref		ref	
15–19	927 (28%)	21%	21%	2.12 (1.68–2.69)	<.001	0.70 (0.58–0.86)	<.001
20–27	834 (25%)	24%	16%	2.41 (1.90–3.06)	<.001	0.57 (0.46–0.71)	<.001
Months in care				model *P*<.001			
0–3 months	312 (9%)	7%	11%	ref		ref	
3–6 months	510 (15%)	13%	19%	2.28 (1.37–3.81)	.002	2.33 (1.51–3.58)	<.001
6–9 months	565 (17%)	15%	29%	3.32 (2.02–5.47)	<.001	4.19 (2.77–6.33)	<.001
9–12 months	562 (17%)	20%	26%	4.54 (2.78–7.42)	<.001	4.10 (2.70–6.24)	<.001
12–15 months	479 (14%)	16%	24%	3.48 (2.09–5.80)	<.001	3.82 (2.48–5.87)	<.001
15–18 months	441 (13%)	22%	25%	6.29 (3.78–10.5)	<.001	5.00 (3.22–7.77)	<.001
18–21 months	297 (9%)	18%	32%	5.26 (3.04–9.09)	<.001	6.51 (4.12–10.3)	<.001
21+ months	197 (6%)	17%	25%	3.92 (2.17–7.10)	<.001	4.21 (2.54–6.99)	<.001

and completed baseline surveys. At 1 year, 456 patients completed follow-up surveys (69% follow-up rate; 26% overall completion rate).

A total of 1554 primary care clinicians were eligible to enroll patients into COMPASS and were invited to complete a Web-based survey. The survey asked about physician satisfaction with available resources for care of complex patients at the start of COMPASS and after 1 year. In all, 709 of 1554 eligible clinicians (46%) completed baseline surveys, and 689 of 1244 (55%) completed 1-year surveys.

2.5. Outcome measures

Depression severity was assessed and monitored using the PHQ9 [16], with a PHQ9 score (range: 0–27) obtained at most contacts by care managers. Following clinical guidelines, depression remission was defined as a PHQ9 score<5, while depression response was defined as a follow-up PHQ9 score that decreased by at least 50% compared to baseline [16,17]. A patient with diabetes was considered at goal when his/her HbA1c was <8.0% [18], and a patient with hypertension was considered at goal if his/her SBP was <140 mmHg and diastolic blood pressure (DBP) was <90 mmHg [19]. All outcomes were patients' last observed outcomes during the project. Blood pressure was used as the sole indicator of the impact of COMPASS on cardiovascular disease due to changes in the national guidelines for cholesterol management and treatment that were released during COMPASS [20], making it difficult to use cholesterol as an outcome measure.

2.6. Analyses

Descriptive statistics, such as means and standard deviations for continuous variables and frequencies and percentages for dichotomous variables, characterized patients included in the analytic sample ($n=3609$). At enrollment, 93% ($n=3363$) of patients had a PHQ9>9, indicating active depression. These patients were retained in analyses of depression remission and response. In addition, 46% ($n=1666$) of patients in the analytic sample were documented as having diabetes and HbA1c≥8.0% at enrollment, and 13% ($n=462$) were documented as having cardiovascular disease and blood pressure≥140/90 mmHg at enrollment. These subgroups of patients were included in analyses of HbA1c and blood pressure control, respectively.

For depression outcomes, patients achieved depression remission if their most recent PHQ9<5. If they did not meet criteria for depression remission, they achieved depression response if their most recent PHQ9 decreased by at least 50% compared to their baseline PHQ9. For diabetes and hypertension, two dichotomous outcome measures were used for analyses: diabetes control (yes if most recent HbA1c<8.0%, no otherwise) and hypertension control (yes if most recent SBP<140 and last DBP<90, no otherwise). The associations of patient characteristics with these outcomes are presented as odds ratios and 95% confidence intervals (CIs) estimated using separate multilevel logistic regressions. Dependence in outcomes among patients in the same medical group, due to being treated under the same care model, was accounted for by clustering patients within medical group to reduce estimation bias for

Table 2
HbA1c Improvement among $N=1666$ patients with diabetes and A1c≥8 at treatment initiation

	N (%) or M (S.D.)	% last HbA1c<8	OR (95% CI)	*P*-value
All patients		23%		
Age	58 (13)		model *P*<.001	
18–49	421 (25%)	16%	0.64 (0.47–0.87)	<.004
50–69	981 (59%)	24%	ref	
70+	264 (16%)	30%	1.32 (0.97–1.79)	.08
Gender			model *P*=.34	
Male	595 (36%)	25%	1.12 (0.88–1.42)	0.34
Female	1066 (64%)	22%	ref	
Not reported	5 (<1%)			
Race			model *P*=.02	
Black	174 (10%)	20%	0.63 (0.41–0.95)	0.03
White	1091 (65%)	25%	ref	
Other, multiple	179 (11%)	18%	0.63 (0.40–1.0)	0.05
Not reported	222 (13%)			
Ethnicity			model *P*<.001	
Not Hispanic	1215 (73%)	24%	ref	
Hispanic	359 (22%)	19%	0.55 (0.40–0.75)	.0002
Not reported	92 (5%)			
Insurance coverage			model *P*<.001	
Medicaid	371 (22%)	18%	0.59 (0.42–0.82)	.002
Medicare	697 (42%)	29%	ref	
Commercial	563 (34%)	19%	0.54 (0.41–0.71)	<.001
Self-pay	33 (2%)	21%	0.83 (0.35–1.97)	0.67
not reported	2 (<1%)			
Baseline HbA1c			model *P*<.001	
8.0–<8.5	357 (21%)	38%	ref	
8.5–<9.0	253 (15%)	33%	0.84 (0.59–1.20)	0.34
9.0–<9.5	241 (14%)	20%	0.43 (0.29–0.64)	<.001
9.5+	815 (49%)	14%	0.27 (0.20–0.37)	<.001
Months in care			model *P*<.001	
0–3 months	173 (10%)	6%	ref	
3–6 months	252 (15%)	16%	3.04 (1.46–6.32)	0.003
6–9 months	307 (18%)	29%	6.63 (3.31–13.3)	<.001
9–12 months	270 (16%)	28%	6.33 (3.14–12.8)	<.001
12–15 months	237 (14%)	23%	5.03 (2.46–10.3)	<.001
15–18 months	209 (13%)	25%	6.08 (2.94–12.6)	<.001
18–21 months	135 (8%)	23%	4.87 (2.25–10.5)	<.001
21+ months	83 (5%)	31%	9.10 (4.01–20.5)	<.001

fixed parameters. Using the most recently documented measures as outcomes was driven by the infeasibility of imposing consistency in the number and timing of observations in this demonstration project. Associations with outcomes should be interpreted as point-in-time estimates as the data do not support inferences about relationships between duration of care and likelihood of outcomes. Patient and clinician satisfaction were reported using descriptive statistics. Odds ratios and 95% CIs for changes in ratings over time were also estimated via multilevel regression to account for dependence in outcomes due to repeated measures. All analyses were done using Statistical Analysis System Version 9.4 (SAS Institute, Inc.)

3. Results

3.1. Study participants

The average patient age was 60 years, with 57% of patients aged 50 to 69. Nearly two thirds of patients were female. Seventy-nine percent of patients were white, and 14% were Hispanic. Approximately half of patients were insured by Medicare. The largest groups of patients were from Minnesota, California and Pennsylvania. Patients were enrolled for an average of 11 months, with a range of 1 to 26 months.

3.2. Depression

Depression findings are shown in Table 1. At enrollment, 48% of patients had moderate depression (as self-reported on the PHQ9), 28% moderate to severe and 25% severe. In total, 24% of patients experienced depression remission, while 16% experienced response. Patients who were younger than 50 were less likely to obtain depression remission (odds ratio (OR)=0.63, 95% CI: 0.50–0.79) or response (OR=0.75, 95% CI:0.58-0.96) than were patients aged 50–69, while patients who were older than 69 were more likely to achieve depression remission (OR=1.59, 95% CI: 1.29–1.94). Patients who were Black were less likely to achieve depression remission than were white patients (OR=0.57, 95% CI: 0.41–0.80). Those who were insured by Medicaid (OR=0.50, 95% CI: 0.39–0.63) or commercial insurance (OR=0.79, 95% CI: 0.65–0.96) had lower rates of depression remission compared to those insured by Medicare. Patients with moderately severe or severe depression were less likely to obtain depression remission and more likely to achieve depression response than those with moderate depression. Depression remission and response rates were generally lower in patients who were enrolled 3 months or fewer compared to patients enrolled for longer periods (remission rates of 11% and response rates of 7% in those enrolled 0–3 months vs. remission rates of 19–32% and response rates of 13–22% in those enrolled 6–21+ months, model *P*<.001).

3.3. Diabetes

Table 2 presents the findings for HbA1c control. Twenty-two percent of patients in the HbA1c analysis were of Hispanic ethnicity, and nearly half of patients with diabetes and an elevated baseline HbA1c had very elevated HbA1c levels of 9.5% or higher. For patients with diabetes who had a baseline HbA1c of at least 8.0%, 23% went on to achieve an HbA1c<8.0%. Patients were less likely to achieve HbA1c goals if they were Black (OR=0.63, 95% CI: 0.41–0.95) compared to their white counterparts; Hispanic (OR=0.55, 95% CI: 0.40–0.75) compared to people not of Hispanic ethnicity; insured by Medicaid (OR=0.59, 95% CI= 0.42–0.82) or commercial insurance (OR=0.54, 95% CI: 0.41–0.71) compared to Medicare; or had a baseline HbA1c level of at least 9.0 (HbA1c 9.0– < 9.5: OR=0.43, 95% CI=0.29–0.64; HbA1c≥9.5: OR= 0.27, 95% CI: 0.20–0.37) compared to a lower baseline HbA1c of 8.0 to<8.5. Patients who were enrolled for less than 3 months tended to achieve an HbA1c<8% at lower rates than patients enrolled for longer periods (0–3 months: 6%; 3–21+ months: 16–31%; model *P*<.001).

3.4. Cardiovascular disease

Hypertension findings are presented in Table 3. The majority (72%) of patients had Stage 1 hypertension (defined as SBP=140–159 or DBP=90–99), while 28% had Stage 2 hypertension (SBP≥160 or DBP≥100). In all, 58% of patients achieved hypertension control. Hypertension control rates were generally higher for patients who were enrolled more than 3 months compared to patients enrolled in COMPASS for shorter periods (0–3 months: 19%; 3–21+ months: 47–79%; model *P*<.001).

3.5. Differences across sites

Table 4 describes many differences between sites, including variations in implementation strategies. Clinics were located in a variety of settings, and partner sites each involved varying numbers of clinics with wide-ranging numbers of primary care clinicians. The number of patients enrolled per medical group ranged from 51 to 620 patients. In general, systematic case reviews occurred weekly and most often in person, although teleconferences were also used by some clinics. The clinical backgrounds of care managers varied considerably, with care managers having nursing, physician assistant, social work and medical assistant degrees. Just over half of care managers were located in primary care clinics and met with patients both in person and by phone, while the remaining care managers were located in a central location and did all of their outreach via phone. Types of registries varied between the AIMS CMTS, electronic medical record (EMR)-based CMTS and custom electronic CMTS.

Table 3
Blood pressure improvement among *N*=462 with heart disease and SBP≥140 or DBP≥90 at treatment initiation

	N (%) or M (S.D.)	% last BP<140/90	OR (95% CI)	*P*-value
All patients		58%		
Age	64 (12)		model *P*=.81	
18–49	52 (11%)	56%	0.96 (0.53–1.76)	0.90
50–69	261 (56%)	57%	ref	
70+	149 (32%)	60%	1.13 (0.75–1.71)	0.55
Gender			model *P*=.30	
Male	176 (38%)	55%	0.82 (0.56–1.20)	0.30
Female	286 (62%)	59%	ref	
Race			model *P*=.12	
Black	53 (11%)	70%	1.93 (1.03–3.61)	0.04
White	334 (72%)	54%	ref	
Other, multiple	31 (7%)	58%	1.16 (0.55–2.44)	0.70
Not reported	44 (10%)			
Ethnicity			model *P*=.15	
Not Hispanic	396 (86%)	57%	ref	
Hispanic	36 (8%)	44%	0.60 (0.30–1.20)	0.15
Not reported	30 (6%)			
Insurance coverage			model *P*=.71	
Medicaid	82 (18%)	59%	1.11 (0.67–1.82)	0.69
Medicare	287 (62%)	56%	ref	
Commercial	83 (18%)	63%	1.31 (0.79–2.17)	0.29
Self-pay	10 (2%)	50%	0.78 (0.22–2.77)	0.70
Baseline BP category			model *P*=.15	
Stage 1 HTN: SBP140–159 or DBP 90–99	331 (72%)	60%	ref	
Stage 2 HTN: SBP 160+ or DBP 100+	131 (28%)	53%	0.74 (0.49–1.11)	0.15
Months in care			model *P*<.001	
0–3 months	42 (9%)	19%	ref	
3–6 months	62 (13%)	47%	3.81 (1.51–9.60)	<.001
6–9 months	68 (15%)	62%	6.75 (2.70–16.9)	<.001
9–12 months	83 (18%)	55%	5.36 (2.20–13.1)	<.001
12–15 months	75 (16%)	59%	6.23 (2.52–15.4)	<.001
15–18 months	63 (14%)	68%	9.67 (3.75–25.0)	<.001
18–21 months	43 (9%)	79%	17.63 (5.99–51.9)	<.001
21+ months	26 (6%)	77%	13.82 (4.15–46.0)	<.001

Patient outcomes varied considerably between medical groups. In considering outcomes for medical groups that enrolled at least 10 patients with the referent condition, depression remission rates ranged from 5% to 41%, and depression response rates ranged from 6% to 26%, while HbA1c control was achieved by as few as 7% of patients in one medical group and as many as 33% of patients in another. Similarly, hypertension outcomes varied widely by medical group, ranging from 27% to 76%. In general, there were no clear associations between medical group characteristics and patient outcomes. One exception to this was frequency of systematic case reviews, as the one group that met infrequently had the lowest rates of depression remission and response of all 18 medical groups. In addition, the two medical groups that used custom registries (as opposed to the AIMS CMTS or an electronic medical record CMTS) had the two lowest rates of depression remission and response. Otherwise, as a result of many unmeasured and unmeasurable internal and external contextual differences, it was difficult to ascribe outcome differences to any of the more discrete factors included in this table.

3.6. Patient and clinician satisfaction

Overall, patients and clinicians expressed satisfaction with COMPASS. Patients tended to rate their care as "excellent" more often after experiencing COMPASS care (44.6% at 1 year vs. 38.6% at baseline), although this result did not reach statistical significance (OR=1.29, 95% CI: 0.99–1.67). The percent of patients who rated their care as excellent at 1 year at individual medical groups ranged from 0% to 86%. There was significant improvement in depression care satisfaction, with 49.7% of patients "very satisfied" with their depression care at 1 year compared to 35.2% at baseline (OR=1.87, 95% CI: 1.42–2.46). There were no differences between baseline and 1 year in satisfaction with general primary medical care, ability to get medical appointments as soon as desired or the ability to get questions answered by phone or email. At 1 year, 55.8% of patients stated that they were "very satisfied" with COMPASS care (item not asked at baseline).

Clinicians were more likely to be "very satisfied" with resources at 1 year compared to baseline (21.7% vs. 17.4%; OR=1.33, 95% CI; 1.02–1.75). "Very satisfied" care ratings in individual medical groups ranged from 7% to 57% of clinicians at 1 year.

4. Discussion

This large collaborative care initiative for complex patients with multiple chronic diseases was able to successfully spread a new care model to diverse care systems across the United States that was associated with improved disease outcomes in patients with poorly controlled depression and comorbid diabetes, cardiovascular disease or both. All 18 medical groups remained engaged in COMPASS throughout the project, but as is true with any such initiative, there was significant variation in approach to implementation as well as in outcomes achieved. Overall, of patients who had not been at goal at enrollment, 40% achieved depression remission or response, while 23% achieved HbA1c goals and 58% achieved blood pressure goals within a mean enrollment of 11 months. Patients rated their care highly, and clinicians were satisfied with COMPASS resources.

Comparing COMPASS results to randomized clinical trials of collaborative care is challenging, not only given differences in study design but also differences in outcome measures. While most studies report mean changes in depression scores or SBP or HbA1c levels, we instead report

Table 4
Differences by medical group

Medical group	Setting (urban (U), rural (R) and/or suburban (S))	#PCPs (small=20–100, medium=101–200, large=201–1000)	#Clinics (small=1–5; medium=6–10; large=11–24)	Systematic case review meetings	Care manager degree; location	CMTS type	Total # patients enrolled	Patients with PHQ9>9 at treatment initiation	% patients achieving depression remission/ response [ab]	Patients with initiation SBP≥140 or DBP≥90	% patients achieving BP <140/90 [c]	Patients with A1c≥8 at treatment initiation	% patients Achieving A1c<8 [d]	Patients completing 1-year survey	% patients rating care as "excellent" at 1 year	Clinicians completing 1-year survey	% clinicians "very" satisfied with resources at 1 year
							N	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%[b]
All patients							3609	3363	24/16%	462	58%	1666	23%	456	45%	689	22%
1	R,S,U	Large	Large	Weekly Webinars	RN, LPC; Central	EMR	309	301	17/14%	33	64%	149	17%	89	31%	127	12%
2	S,U	Large	Large	Weekly Webinars	NP, PA; Central	EMR	418	416	29/14%	26	46%	342	30%	35	54%	143	23%
3	R,S,U	Medium	Medium	Weekly In person	RN; Clinic	AIMS	629	619	30/20%	91	65%	344	16%	91	42%	94	24%
4	S,U	Small	Large	Weekly In person	RN; Central	AIMS	488	444	23/26%	107	52%	75	25%	46	39%	27	33%
5	S	Medium	Medium	Weekly In person	RN; Clinic	EMR	146	122	20/17%	40	70%	41	27%	33	53%	22	41%
6	R,S	Small	Small	Infrequently	RN; Clinic	Custom	48	44	5/7%	13	54%	10	20%	6	83%	7	14%
7	U	Small	Large	Weekly In person	BSW, BA; Clinic and Central	AIMS	94	60	20/13%	14	57%	43	30%	2	0%	28	29%
8	U	Small	Medium	Weekly In-person	RN, MSW, LSCW, MA, LMHC; Clinic	Custom	121	107	8/16%	9	89%	35	9%	10	56%	27	7%
9	S,U	Small	Large	Weekly In person	CMA, RN; Clinic	AIMS	203	179	25/9%	6	67%	49	20%	31	50%	43	21%

10	U	Large	Small	Weekly In person	RN; Clinic	AIMS	93	87	17/13%	4	25%	27	7%	20	45%	9	33%
11	S,U	Small	Large	Weekly In person	RN, LPN, MA, CHW; Clinic	AIMS	184	172	20/12%	29	62%	68	28%	17	44%	21	35%
12	S	Small	Small	Weekly In person	RN, CMA, RD; Clinic	AIMS	61	51	24/22%	2	100%	23	30%	14	75%	30	20%
13	S,U	Medium	Medium	Monthly In Person; Weekly Other	RN; Clinic	EMR	209	187	14/11%	22	27%	72	14%	10	60%	13	38%
14	R,S,U	Large	Small	Weekly In person	PA, RN, NP; Central	EMR	208	208	41/14%	21	76%	148	32%	16	38%	17	12%
15	S,U	Large	Small	Weekly In person	RN; LCSW; Central	EMR	114	109	24/21%	3	33%	95	20%	17	53%	45	11%
16	S,U	Medium	Medium	Weekly In person	LCSW; Central	EMR	69	68	28/12%	2	50%	58	33%	7	86%	10	10%
17	R,S	Small	Medium	Monthly In person; Weekly Webinar	RN; Clinic	AIMS	78	77	19/6%	16	44%	35	11%	5	20%	14	57%
18	R	Small	Small	Weekly In person	RN; Central	AIMS	137	112	22/20%	24	46%	52	29%	7	29%	11	27%

PCPs = primary care providers; A1c = glycated hemoglobin.
[a] Last observed PHQ9 < first observed PHQ9*.5.
[b] Last observed PHQ9<5.
[c] Last observed SBP<140 and DBP<90.
[d] Last observed A1c<8.

what we consider to be a more clinically meaningful outcome for clinicians and patients: the percent of patients who achieved disease outcome goals. An exception to this clinical trial reporting is found in TEAMcare, which reported that at 1 year, 37% of intervention patients were at goal for a combined primary outcome (HbA1c<7.0% or decrease ≥0.5%; SBP<130 or decrease ≥10 mmHg; and LDL<100 or decrease ≥15%), compared to 22% of usual care patients (P=.024) [4]. In addition, 60% of patients in TEAMcare achieved depression response (defined as a ≥50% decrease in Symptom Checklist-20 score [21]) at 12 months, compared to 30% of patients receiving usual care (P<.001). In COMPASS, 23% of patients achieved HbA1c goals (HgA1c<8.0%), and 58% achieved blood pressure goals (SBP<140 and DBP<90 mmHg) during an average follow-up of 11 months. In addition, 40% of COMPASS patients achieved either depression remission (PHQ9<5) or response (PHQ9 decrease of at least 50%). Although we acknowledge that (a) we do not present a similar composite score; (b) our HbA1c and BP outcomes differ somewhat from TEAMcare; and (c) our average patient follow-up is a month shorter, our results are highly encouraging, particularly given that this initiative was implemented outside of a randomized clinical trial and involved patients who had largely failed treatment as usual.

As COMPASS involved 18 medical groups and 172 clinics, it required flexibility in putting the model into practice while also making substantial efforts to maintain the fidelity to the collaborative care model necessary to achieve desired patient outcomes. As a result, there were notable differences in implementation between medical groups and often even between different clinics within the same medical group. Given this, it is not unexpected that there were significant differences in outcomes between medical groups. When examining medical groups that enrolled at least 10 patients with the outcome of interest (Table 4), the best:worst ratios by medical group were 3:1 in hypertension outcomes (76% in medical group 14 vs. 27% in medical group 13), over 4:1 in HbA1c outcomes (33% in medical group 16 vs. 7% in medical group 10) and depression response (26% in medical group 4 vs. 6% in medical group 17), and 8:1 in depression remission (41% in medical group 14 vs. 5% in medical group 6). Moreover, there was often greater variation in outcomes across clinics within medical groups than between the medical groups themselves (clinic-level results not shown). Notably, the highest- and lowest-performing clinics were not consistently in the same medical groups across outcomes, and some clinics did well with one disease outcome while poorly with another.

These variations in approach to implementation and outcomes across medical groups provide a unique opportunity to learn how they might be associated. This is particularly germane because previous research has shown that the greater the fidelity to the collaborative care model, the better patient outcomes, at least when considering depression [22,23]. Although systematic case review teams were encouraged and expected to meet weekly, one medical group met infrequently, and this group had the lowest depression remission and response rates of all 18 medical groups. Regarding CMTS use, two medical groups used private vendors to build custom electronic CMTS, and these groups had poor depression outcomes, and one had poor diabetes outcomes as well. In contrast, there were no clear correlations between disease outcomes and method of systematic case review meetings or location of care managers. It is of course possible that many of these implementation variations reflected unmeasured organizational characteristics such as leadership support or organizational culture that ultimately contributed to the implementation and effectiveness of COMPASS. Some of these variations in implementation and engagement are reflected in the widely varying numbers of patients enrolled by each medical group, ranging from only 51 patients in one medical group to 684 patients in another. In the end, having a systematic case review meet infrequently was associated with the poorest depression remission rates for one medical group, and using a custom electronic CMTS was associated with poor depression and diabetes outcomes for two medical groups, but otherwise, there were few medical group variations that were consistently associated with outcomes. Some medical groups were in the top three of 18 for more than one medical outcome, and some were in the bottom three for more than one medical outcome, but it was much more common for a medical group to perform well or poorly on one measure and in the middle of the pack on the rest.

An important finding of COMPASS is that patient outcomes did not vary according to care manager degree or background. This has important implications for future implementations of this evidence-based collaborative care model, as it has direct bearing on workforce availability and the potential costs of providing this care model. Our preliminary data indicate that the frequency of care manager contact with patients is a strong predictor of patient outcomes, and we will explore this in a subsequent paper. Other COMPASS data suggest that when care managers had been employed longer or had more contact with consulting physicians outside of the scheduled systematic case reviews, their patients had better diabetes outcomes, while when care managers had larger panel sizes, more time allocated to COMPASS or a higher comfort level treating depression, their patients had better depression outcomes [24].

Patients expressed satisfaction with COMPASS care in general and with depression care specifically. These are important findings, as it has been established that satisfaction with care predicts greater adherence and improved outcomes in patients with chronic disease [25]. Satisfaction is also important for achieving what has now been called *the quadruple aim* (improving quality, patient experience, healthcare costs and clinician satisfaction). In COMPASS, multiple resources were in place to provide increased support to patients and primary care clinicians, including care managers to monitor patients and disease parameters, care registries to prompt care manager attention for patients not achieving goals and systematic case reviews to facilitate discussions of patients not progressing as expected. All of this culminated in increased outreach to patients with chronic disease, likely leading to increased patient satisfaction with care and increased clinician satisfaction with these additional resources. Interestingly, patient and clinician satisfaction did not consistently correlate with chronic disease outcomes. For example, one medical group had some of the best patient depression, diabetes and hypertension outcomes but one of the lowest patient satisfaction ratings. Conversely, one medical group had some of the poorest patient depression, diabetes and hypertension outcomes but one of the highest rates of patient and clinician satisfaction. There were no apparent correlations between patient satisfaction with primary care and the ability to get appointments or answers to questions, areas where we would have expected to see some improvement given the nature of the collaborative care model, which should have provided access to care managers to help facilitate patient appointments or answer patient questions. It is possible that this finding reflects a misunderstanding by patients about the role of the care managers, or it may truly reflect less accessibility to care managers than the COMPASS model should have allowed.

One limitation of this initiative was that data were collected as part of a demonstration project, not as a randomized controlled trial, so there were neither control groups nor detailed measures of the degree of implementation at partner sites. Data were collected by care managers as part of ongoing patient care, rather than a more scheduled collection that might have occurred within a randomized trial. There were many unmeasured factors that may have contributed to patient outcomes, including changes in diet, exercise or social supports or engagement in psychotherapy for which we cannot account. Patients enrolled in COMPASS had largely failed usual care, which may have biased our results towards the null, and these results therefore may not be generalizable to the larger primary care population. There may have been selection bias present, with patients more motivated to address their depression, diabetes or cardiovascular disease more likely to enroll in COMPASS, which may have biased our results away from the null. While some may view the patient and clinician survey rates as somewhat low, potentially limiting the validity and generalizability of these

data, we submit that the survey rates are reasonably high for a nonresearch real-life evaluation, particularly for one where local operational personnel were recruiting patients and clinicians for the survey. Overall, we believe that any potential limitations of COMPASS are balanced by the rich opportunity to examine a collaborative care initiative for complex patients with multiple chronic conditions in a real-world setting in diverse populations across the country.

COMPASS demonstrates that a complex initiative can be successfully implemented and executed by a wide range of care systems and serve as a model for spreading improved care for medically complex patients. Large-scale spread projects should expect variation in implementation and preemptively create robust processes to identify and reduce this variation and assure that desired care is consistently provided to further improve patient outcomes.

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