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Effect of a multicomponent intervention on achievement and improvements in quality-of-care indices among people with Type 2 diabetes in South Asia: the CARRS trial

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Abstract

Aims—To evaluate whether and what combinations of diabetes quality metrics were achieved in a multicentre trial in South Asia evaluating a multicomponent quality improvement intervention that

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Competing interests

None declared.

included non-physician care coordinators to promote adherence and clinical decision-support software to enhance physician practices, in comparison with usual care.

Methods—Using data from the Centre for Cardiometabolic Risk Reduction in South Asia (CARRS) trial, we evaluated the proportions of trial participants achieving specific and combinations of five diabetes care targets (HbA_{1c} < 53 mmol/mol [7%], blood pressure < 130/80 mmHg, LDL cholesterol < 2.6 mmol/L, non-smoking status, and aspirin use). Additionally, we examined the proportions of participants achieving the following risk factor improvements from baseline: 11-mmol/mol (1%) reduction in HbA_{1c}, 10-mmHg reduction in systolic blood pressure, and/or 0.26-mmol/l reduction in LDL cholesterol.

Results—Baseline characteristics were similar in the intervention and usual care arms. Overall, 12.3%, 29.4%, 36.5%, 19.5% and 2.2% of participants in the intervention group and 16.2%, 38.3%, 31.6%, 11.3% and 0.8% of participants in the usual care group achieved any one, two, three, four or five targets, respectively. We noted sizeable improvements in HbA_{1c}, blood pressure and cholesterol, and found that participants in the intervention group were twice as likely to achieve improvements in all three indices at 12 months that were sustained over 28 months of the study [relative risk 2.1 (95% CI 1.5, 2.8) and 1.8 (95% CI 1.5, 2.3), respectively].

Conclusions—The intervention was associated with significantly higher achievement of and greater improvements in composite diabetes quality care goals. However, among these higher-risk participants, very small proportions achieved the complete group of targets, which suggests that achievement of multiple quality-of-care goals is challenging and that other methods may be needed in closing care gaps.

Introduction

Globally, diabetes is a major and costly public health threat, with a huge impact on mortality and disability [1]. Despite evidence of improved clinical outcomes for people with diabetes who receive appropriate monitoring and treatment for risk factors (i.e. blood glucose, blood pressure and cholesterol) [2–5], many do not receive or adopt the recommended services that enable these care goals to be achieved [6].

Given evidence for targeting multiple cardiometabolic risk factors simultaneously, several organizations advocate the use of composite quality indices for diabetes care to assess quality of care [7–9]. Composite metrics, such as the D5 metric (HbA_{1c} < 53 mmol/mol [7%], blood pressure < 130/80 mmHg, LDL cholesterol < 2.6 mmol/l, tobacco-free status, and taking daily aspirin) and the ‘ABC’ goals (reductions in HbA_{1c}, blood pressure and LDL cholesterol only) in diabetes care, have been widely adopted by healthcare systems as a means of monitoring population health, improving healthcare outcomes, and lowering cost. While achievement of targets is important, several expert groups recommend using targets as a means of driving improvement rather than as goals for praise or penalty [10].

In the Centre for Cardiometabolic Risk Reduction in South Asia (CARRS) trial, we noted that, a multicomponent quality improvement intervention, comprising non-physician care coordinators and clinical decision-support software using electronic health records (EHR), led to twice the likelihood of achieving the primary outcome of better glycaemic control [HbA_{1c} < 53 mmol/mol (7%)] and either better blood pressure (< 130/80 mmHg) and/or

LDL cholesterol (< 2.6 mmol/l) control compared to usual care. In the present study, we sought to examine the effect of the CARRS quality improvement intervention on achievement of composite goals, such as the D5 metric and clinically relevant improvements in ABC goals.

Participants and methods

Data source

We conducted a *post hoc* analysis of participants in the CARRS trial. Briefly, CARRS recruited and randomized 1146 adults with Type 2 diabetes from 10 diabetes clinics in India and Pakistan. Over a median of 28 months of follow-up, usual care participants continued to be treated by their clinic physicians, while intervention participants were supported by non-physician care coordinators, and their physicians were provided with printouts from an integrated clinical decision-support EHR program that provided individualized, evidence-based diabetes treatment prompts [11]. This included tobacco cessation counselling by clinical care coordinators and clinical decision-support EHR prompts to check aspirin use.

Study setting, recruitment, intervention, data collection, analytical methods and primary trial outcomes are described in detail elsewhere [11,12].

Study outcomes

We evaluated achievement of the D5 metric over time in the intervention and usual care groups. Given that the CARRS trial was initiated in 2011, the D5 metric for the present study was based on prevailing treatment guidelines at that time: HbA_{1c} <53 mmol/mol (7%), blood pressure <130/80 mmHg, LDL cholesterol <2.6 mmol/l, non-smoking status, and aspirin use. Based on more recent recommendations, we examined change in the D4 metric (without aspirin use).

We further evaluated whether there were clinically significant improvements in ABC metrics from baseline, defined as: reductions from baseline in HbA_{1c} > 11 mmol/mol [1%], systolic blood pressure (SBP) > 10 mmHg, and LDL cholesterol >0.26 mmol/l. Lastly, we examined whether smaller improvements from baseline were observed in HbA_{1c} [no reduction, reduction up to 6.5 mmol/mol (0.5%), reduction between 6.5 and 11 mmol/mol (0.5–0.99%)], SBP (no reduction, reduction up to 5 mmHg, reduction between 5 and 9.9 mmHg), diastolic blood pressure (no reduction, reduction up to 5 mmHg, reduction between 5 and 9.9 mmHg), and LDL cholesterol (no reduction, reduction up to 0.13 mmol/l, reduction between 0.13 and 0.25 mmol/l) by treatment group.

Statistical analysis

We used an intention-to-treat approach. The analysis was performed using STATA (15.0) [13]. First, we examined the proportions of participants in each group achieving individual and combinations of care targets at baseline, 12 months post-randomization, and at the end-of-study visits. We then used log binomial models with generalized estimating equations to analyse outcomes observed across all time points to estimate achievement of individual and

combinations of targets over the course of the study by intervention group. The model included treatment, time, treatment $\times$ time interaction, baseline value, and site.

Second, we examined rates of achieving clinically meaningful improvements in the three ABC indicators, HbA_{1c}, SBP and/or LDL cholesterol, defined as reduction from baseline in HbA_{1c} of > 11 mmol/mol (1%), change in SBP of > 10 mmHg, and change in LDL cholesterol of > 0.26 mmol/l. Outcomes were classified as no reduction in HbA_{1c}, SBP and/or LDL cholesterol, reduction in any one, any two, or in all three, and reported by group and at each study time point. Log binomial models were used to estimate improvements in these indices over the course of the study, reporting both absolute difference-in-differences (95% CI) and relative differences (95% CI) between groups. Finally, for each ABC indicator, we examined ranges of smaller improvements (described above) and compared these proportions among groups at 12 months and end of study.

Ethics

The institutional ethics committees at each participating site and the coordinating centres (Public Health Foundation of India, New Delhi, India, and Emory University, Atlanta, Georgia) approved the trial.

Results

A description of baseline characteristics is published elsewhere [11]. At trial end, compared to usual care, higher proportions of participants in the intervention group achieved the composite D5 quality metric [2.2% vs 0.9%; relative risk 3.2 (95% CI 1.2, 8.2)]. In an analysis of D4 (without aspirin use), achievement of goals in the intervention and usual care groups was 7.9% and 2.4%, respectively [relative risk 3.4 (95% CI 2.1, 7.2); Table 1].

Overall, a significantly larger proportion achieved improvements in all three ABC indices in the intervention group compared to the control group [relative risk 1.8 (95% CI 1.5, 2.3)]. By the end of the study, 32.4% of intervention participants had achieved meaningful improvements in all three targets [reduction of > 11 mmol/mol (1%) in HbA_{1c}, > 10 mmHg in SBP, > 0.26 mmol/l in LDL cholesterol] vs 17.1% in the control group [relative risk 1.9 (95% CI 1.5, 2.4); Table 2].

In adjusted estimates, over half of participants in the intervention group achieved a > 11 -mmol/mol (1%) reduction in HbA_{1c} (59.5%), > 10 -mmHg reduction in SBP (56.8%), or > 0.26 -mmol/l (56.8%) reduction in LDL cholesterol by 12 months that was sustained until the end of study. By comparison, 42.7% of participants in the control group achieved a > 11 -mmol/mol [1%] reduction in HbA_{1c}, 51.7% achieved > 10 -mmHg reduction in SBP, and 50.3% achieved a > 0.26 -mmol/l reduction in LDL cholesterol at 12 months (Fig. 1).

Discussion

The present findings suggest that a low-cost, multicomponent quality improvement strategy involving non-physician care coordinators and clinical decision-support EHR software for physicians was associated with higher achievement of composite quality goals as well as

improvements in diabetes care indices (without meeting the target threshold) for people with high-risk, poorly controlled diabetes in outpatient diabetes clinics in India and Pakistan. However, overall, the proportion of participants achieving all D5 or D4 metrics was very low. That said, almost one in three participants in the intervention arm achieved clinically significant improvements in all three ABC goals, which was nearly twice the number doing so in the usual care arm. This combination of findings suggest that the ‘additional’ targets of non-smoking status and aspirin use may have been differentiating factors in achieving some vs the full composite of quality targets[11].

Our analysis adds to the growing body of literature that multicomponent strategies which target both participants and clinicians can have greater effects on meeting composite score metrics than usual care [14,15]. Several previous population health quality improvement studies using clinical decision-support tools and team-based care, including the RAMP-DM trial in Hong Kong and the Swedish National Diabetes Registry project, reported similar improvements in achievement of the ABC goals [16,17]; however, in these previous studies, the proportion of participants achieving all quality metrics was also small, suggesting the need for interventions beyond the patient and clinician level. This may involve more nuanced segmentation of how participants and healthcare professionals respond to behavioural prompts [18]. More careful segmentation would allow exploration beyond the averages of large populations. Emerging machine-learning technologies, for example, may allow optimization so that higher care goal achievement can be reached.

Using composite scores to evaluate the quality of diabetes care has limitations. First, measures are usually weighted equally; for example, simple process measures are weighted equally to clinical outcome control measures [19]. We addressed this by limiting the composite score to clinical outcomes only. However, because we limited our analysis to diabetes risk factor outcomes, we do not capture important structures and processes of care. Yet, by looking beyond glucose control and incorporating other risk factors, we get a more complete picture of diabetes care, as these are critical risk factors that must be controlled to prevent diabetes complications [20].

Our analysis shows promising results for the implementation of a low-cost team-based intervention to improve diabetes composite indices. The results also highlight the challenges in improving multiple indices. Globally, diabetes care is suboptimal [10], but reframing care targets as an opportunity for clinically meaningful improvements in cardiometabolic risk factor control is important. The broader policy implication of the present study is that utilizing a multicomponent team-based approach can yield promising improvements, especially in low-resource settings. Further studies are needed to examine the scalability and sustainability of multicomponent quality improvement interventions for diabetes care and their broader application to other chronic health conditions.

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What's new?

- Quality improvement interventions targeting multiple risk factors in diabetes can lower the risk of disabling complications.
- In this *post hoc* analysis of the Centre for Cardiometabolic Risk Reduction in South Asia (CARRS) randomized controlled trial, the multicomponent quality improvement intervention (comprising non-physician care coordinators and clinical decision-support electronic health records) was associated with higher achievement of composite diabetes quality targets and clinically significant improvements in cardiometabolic indices; however, only small proportions of these participants with poor glycaemic control achieved the complete group of five targets.
- Multicomponent quality improvement can improve achievement of diabetes quality targets, and perhaps more importantly, can lead to improvements in care indices that may mitigate complications for people with diabetes.

FIGURE 1.

Improvements in mean 'ABC' goals from baseline to 12 months and baseline to end of study. Estimated proportions of participants with a reduction in mean HbA_{1c}, systolic blood pressure, diastolic blood pressure and LDL cholesterol from baseline to 12 months and from baseline to end of study. *P* values obtained from generalized estimating equation models to show differences between groups. EOS, end of study.

Effect of the CARRS quality improvement intervention on achievement of D5 diabetes targets

Table 1

	Proportions attaining D5 quality targets										Longitudinal absolute risk difference	Longitudinal relative risk* (95% CI)
	Baseline		12 months		End of study		Overall		Usual care	Intervention		
	Intervention N=575	Usual care N=571	Intervention N=497	Usual care N=246	Intervention N=571	Usual care N=575						
HbA _{1c} <53 mmol/mol (7%)	0	0	19.1	11.8	23.5	11.6	21.5	11.1	10.4 (6.8,14.0)	1.9 (1.5, 2.5)		
Blood pressure <130/80 mmHg	16.2	20.3	45.6	42.6	56.7	47.5	51	45	6.0 (1.6,10.4)	1.1 (1.0,1.3)		
LDL cholesterol <2.6 mmol/l	27	24.2	53.2	43.5	57.8	52.5	56.4	47.1	9.3 (5.1,13.4)	1.2 (1.1,1.3)		
Non-smoking	93.4	92.5	95.5	93.1	95.6	95.2	95.7	94.6	1.1 (−0.6,2.8)	1.8 (0.9,3.9) [‡]		
Aspirin: yes	38.6	37.8	43.1	43.8	44.2	46.2	43.8	44.2	−0.4 (−5.0,4.2)	1.0 (0.7,1.3) [‡]		
D5												
Any 1	36.3	36.3	15.3	16.2	9.9	15.2	12.3	16.2	−3.9 (−7.3,−0.5)	0.7 (0.6, 1.0)		
Any 2	41.4	42.7	31.7	40.8	28.5	35.7	29.4	38.8	−9.4 (−13.9,−5.0)	0.7 (0.6, 0.9)		
Any 3	16.4	15.2	36.6	28	36.8	34.8	36.5	31.6	4.9 (0.5,9.2)	1.2 (1.0, 1.4)		
Any 4	0	0	15.3	12.3	22.3	12.5	19.5	11.3	8.3 (4.7,11.9)	1.8 (1.4, 2.3)		
All 5	0	0	1.2	0.5	2.4	0.9	2.2	0.8	1.4 (0.2,2.6)	3.2 (1.2, 8.2)		
D4 [‡]												
All 4	0	0	5.1	2.2	9.9	2.9	7.9	2.4	5.5 (3.5,7.6)	3.4 (2.1, 7.20)		

Overall relative risks were obtained via log binomial models using generalized estimating equations.

* Estimates combine all non-missing values collected at baseline, months 12, 24, and end-of-study.

[‡]D4 (without aspirin use, in accordance with the treatment guidelines prevailing when the CARRS Trial was initiated in 2011);

[‡]Where the log-binomial model did not converge we used logistic model for the estimates and have reported odds ratio (95% CI).

Effect of CARRS quality improvement intervention on 'ABC' (HbA_{1c}, blood pressure and LDL cholesterol) risk factors

Table 2

	Participants achieving specified reductions since baseline		
	At 12 months, % (95% CI)	At end of study, % (95% CI)	Overall, % (95% CI)
No reductions*			
Usual care	10.2 (7.6,12.9)	7.3 (4.9,9.6)	8.7 (7.10.4)
Intervention	6.1 (4.8,2)	4.6 (2.8,6.5)	5.5 (4.7)
Relative risk (95% CI)	0.6 (0.3,0.9)	0.6 (0.4,1.1)	0.7 (0.5,0.9)
<i>P</i>	0.02	0.09	0.02
Difference in difference [†]	-4.1 (-7.4,-0.7)	-2.6 (-5.6,0.3)	-3.1 (-5.4,-0.9)
At least one reduction*			
Usual care	39.9 (35.6,44.2)	30.9 (26.7,35.0)	34.9 (31.9,38.0)
Intervention	29.4 (25.4,33.3)	23.9 (20.1,27.6)	26.8 (23.8,29.8)
Relative risk (95% CI)	0.7 (0.6,0.9)	0.77 (0.6,1.0)	0.8 (0.7,0.9)
<i>P</i>	<0.01	0.02	<0.01
Difference in difference [†]	-10.4 (-16.2,-4.6)	-7 (-12.5,-1.4)	-8.1 (-12.4,-3.9)
At least two reductions*			
Usual care	39.2 (34.9,43.5)	44.6 (40.1,49)	41.8 (38.7,44.9)
Intervention	43 (38.7,47.4)	38.8 (34.5,43.1)	40.8 (37.6,44.0)
Relative risk (95% CI)	1.1 (1.0,1.27)	0.87 (0.8,1.0)	1.0 (0.9,1.1)
<i>P</i>	0.22	0.07	0.62
Difference in difference [†]	3.8 (-2.3,9.9)	-5.8 (-12,0.4)	-1 (-5.5,3.4)
All three reductions*			
Usual care	10.7 (8.13,4)	17.1 (13.8,20.5)	14.4 (12.1,16.8)
Intervention	21.9 (18.3,25.5)	32.4 (28.3,36.6)	27 (23.9,30.1)
Relative risk (95% CI)	2.1 (1.5,2.8)	1.9 (1.5,2.4)	1.8 (1.5,2.3)
<i>P</i>	<0.01	<0.01	<0.01
Difference in difference [†]	11.3 (6.8,15.9)	15.4 (10.0,20.7)	12.6 (8.7,16.4)

SBP, systolic blood pressure.

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11 mmol/mol (1%) HbA_{1c}, 10-mmHg SBP, 0.26 mmol/L LDL cholesterol reduction.
*
† Difference between intervention and usual care groups, rounded to the nearest 10th.