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Value of a facilitated quality improvement initiative on cardiovascular disease risk: findings from an evaluation of the Aggressively Treating Global Cardiometabolic Risk Factors to Reduce Cardiovascular Events (AT GOAL)

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Abstract

Rationale, aims and objectives—In the United States, cardiovascular disease (CVD) is the leading cause of death. The US Centers for Disease Control and Prevention contracted an evaluation of the Aggressively Treating Global Cardiometabolic Risk Factors to Reduce Cardiovascular Events (AT GOAL) programme as part of its effort to identify strategies to address CVD risk factors.

Methods—This study analysed patient-level data from 7527 patients in 43 primary care practices. The researchers assessed average change in control rates for CVD-related measures across practices, and then across patients between baseline and a patient's last visit during the practice's tenure in the programme (referred to as 'end line') using repeated measures analysis of variance and random effects generalized least squares, respectively.

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Conflict of interest

The authors declare no conflict of interest.

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Results—Among non-diabetic patients, there were significant increases in control rates for overall blood pressure (74.3% to 78.0%, $P = 0.0002$), systolic blood pressure (70.3% to 80.6%, $P = 0.0099$), diastolic blood pressure (90.1% to 92.7%, $P = 0.0001$) and low-density lipoprotein (LDL; 48.6% to 53.1%, $P = 0.0001$) between baseline and end line. Among diabetic patients, there was a significant increase in diastolic blood pressure control (59.8% to 61.9%, $P = 0.0141$). While continuous CVD-related outcomes show an overall trend between baseline and end line, patients with uncontrolled measures at baseline showed a decrease between baseline and end line relative to their counterparts who were controlled at baseline.

Conclusions—Findings from the AT GOAL evaluation support the value of a facilitated quality improvement (QI) initiative on managing CVD risk.

Keywords

cardiovascular outcomes; diabetes mellitus; patient care management; primary health care; programme evaluation; quality improvement

Introduction

Cardiovascular disease (CVD) is the leading cause of death in the United States among adults [1]. Risk factors for CVD include high blood pressure, smoking, high blood cholesterol, diabetes, overweight/obesity, physical inactivity and limited consumption of vegetables and fruit [2]. Blood pressure represents a major modifiable risk factor for CVD. About 70 million adults in the United States have high blood pressure; however, about half of these individuals do not have their blood pressure controlled [3]. There is a significant variation in the prevalence of CVD across states. The southeastern United States has a higher prevalence of high blood pressure compared with the rest of the country [4].

Quality improvement (QI) initiatives have been shown to contribute to improvement in CVD-related outcomes, especially in collaborative practice-focused initiatives [5,6]. QI is an ongoing process for improving the quality of care delivered to patients [5]. Primary care practices can be an effective setting for QI initiatives addressing CVD prevention because primary care emphasizes coordination, continuity and comprehensiveness of patient care [7]. By offering QI strategies that target primary care, doctors can monitor their performance relative to other similar practices and teams [8].

AT GOAL (Aggressively Treating Global Cardiometabolic Risk Factors to reduce Cardiovascular Events) is an example of a collaborative practice-focused QI initiative. In 2009, AT GOAL was established by the Consortium for Southeastern Hypertension Control COSEHC).[1] COSEHC is a non-profit, university medical centre affiliated organization established to address a compelling need to improve the disproportionate CVD-related morbidity and mortality throughout the Southeastern United States. AT GOAL helps health care professionals to improve hypertension, diabetes and cholesterol management in patients who are at risk for developing CVD. AT GOAL is a practice-level QI initiative that involves

[1]COSEHC is a 501c3 based in the Hypertension and Vascular Disease Center of Wake Forest University Baptist Medical Center in Winston-Salem, North Carolina.

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data auditing, feedback on quality-related metrics and provider education. AT GOAL also works with practices to promote other QI strategies at the practice level such as patient education.

The Centers for Disease Control and Prevention's Division for Heart Disease and Stroke Prevention contracted ICF International to conduct a 15-month evaluation of AT GOAL with the focus on building practice-based evidence. This is an applied evaluation study and as such the evaluation design did not impose modifications on the naturally occurring elements of AT GOAL. The purpose of this paper is to describe outcomes for a primary care QI initiative aimed at addressing CVD risk factors. Details on the development and evidence base for AT GOAL are published elsewhere [9,10].

Intervention Description

AT GOAL staff members identify and enrol primary care practices located throughout the Southeastern United States to participate in the programme using multiple recruitment methods. Examples of recruitment strategies include presentations and marketing at local and regional professional conferences and announcements on the COSEHC website. Primary care practices may also be directly referred to the programme by expert faculty members or other providers. No direct financial incentives are given to primary care practices to join AT GOAL; however, providers are eligible to receive performance improvement continuing medical education (CME) credits for full participation in the programme. Figure 1 depicts the AT GOAL process, from COSEHC's efforts to recruit a practice into the programme to practice-level QI and the completion of the programme.

AT GOAL is composed of three core elements: performance monitoring, doctor education and practice-level QI.

Performance monitoring:

each enrolled practice provides AT GOAL staff with a list of patients who have International Classification of Diseases, 9th revision (ICD-9) codes for three CVD risk factors: hypertension, diabetes and high cholesterol. At the start of enrolment, AT GOAL programme staff randomly selects a minimum of 300 patients from the patient list for data collection. This sample size was determined by AT GOAL staff and is based on sample size calculations, which indicated a minimum of 263 patients per practice was needed for significance testing on outcomes between baseline and the end of the practice's participation in AT GOAL.

Next, AT GOAL staff work with the practice to extract data from this same cohort of 300 patient records for these variables of interest: sex, age (at baseline), race/ethnicity, health insurance provider, systolic blood pressure (mmHg), diastolic blood pressure (mmHg), low-density lipoprotein (LDL; mg dL^{-1}), high-density lipoprotein (HDL; mg dL^{-1}), non-HDL cholesterol (mg dL^{-1}), triglycerides (mg dL^{-1}), total cholesterol (mg dL^{-1}) and haemoglobin A1c (HbA1c) (%). AT GOAL programme monitoring is cyclical; therefore, data are extracted at baseline and four quarterly follow-up periods. AT GOAL's information technology director established queries and protocols to extract relevant data from multiple

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electronic health record (EHR) systems.[2] AT GOAL staff also review the data for integrity and troubleshoot issues in collaboration with the point of contact at each enrolled primary care practice.

Doctor education:

doctors are expected to (1) assess cardiovascular risk by understanding cardiometabolic risk factors and the importance of early assessment of these risk factors; and (2) implement evidence-based interventions for aggressively treating global cardiometabolic risk factors to therapeutic target goals. AT GOAL's doctor education component is recognized by the Accreditation Council for Continuing Medical Education. COSEHC created an evidence-based CVD risk reduction model that outlines lifestyle and treatment recommendations to guide doctor education activities. This protocol is based on evidence-based guidelines and clinical best practices for prevention, treatment and management of cardiometabolic risk factors [10–13].

AT GOAL doctor education is provided in three formats: (1) an in-person expert faculty-led education session for CME credits;[3] (2) electronic and print educational materials made available to practices; and (3) education and technical assistance provided through quarterly Webinars/conference calls.

Practice-level QI:

practices translate what they have learned in the performance monitoring and doctor education activities to implement QI interventions. AT GOAL staff provide a menu of recommended QI interventions. Examples of the recommended interventions include: implementing EHR flag systems to prompt providers according to evidence-based health management protocols, training practice staff on appropriate blood pressure measurement techniques, and increasing the use of combination medication therapies.

The actual QI interventions implemented by each practice may vary and are selected based on review of their data and the practice's specific needs and goals. This process involves (1) reviewing data reports with other providers and primary care practices staff members (e.g. nursing staff, administrative staff) to inform QI activities; (2) establishing an AT GOAL continuous quality improvement (CQI) intervention plan;[4] (3) engaging clinical and non-clinical staff, as appropriate; (4) implementing the AT GOAL CQI intervention plan through strategic QI efforts using the Plan-Do-Study-Act approach [14]; and (5) providing quality patient care according to evidence-based guidelines.

[2]When AT GOAL began in 2009, there were a number of participating practices that were not using electronic health records systems. For these, programme staff conducted manual data extraction.
[3]Through 2014, AT GOAL expert faculty provided in-person doctor education sessions. To appeal more to doctors varying schedules and reduce costs, AT GOAL is moving to providing these education sessions online.
[4]CQI is used specifically to refer to primary care practices' efforts to develop and implement their AT GOAL CQI intervention plan.

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Methods

Setting

At the time of the study, 43 primary care practices had completed AT GOAL. These practices are located throughout the southeastern United States where hypertension and diabetes have the highest prevalence relative to other regions in the United States. Most of these practices are located in rural areas/small communities and two are US federally qualified health centres. Approximately 30% are solo practices (1 – doctor practices), 50% are comprised of 3–5 doctors, and 20% had more than five doctors.

Sample

The final study sample was 7527 patients from 43 primary care practices, for which baseline and post-baseline measurements were available, that participated in AT GOAL between June 2009 and April 2014.

The researchers worked with AT GOAL staff to obtain existing data from patient records for baseline and four to five follow-up periods, collected as part of the AT GOAL performance monitoring component. COSEHC supplied a de-identified dataset comprised of 27 128 patients of practices that participated in AT GOAL 2009–2014 in a comma separated value file format for this study.

The researchers further refined the dataset to account for patient age and data completeness. The sample was restricted to patients between the ages of 18 and 85 years (resulting $n = 26\,370$). The sample was further restricted to patients with non-missing data on each of the covariates of interest (discussed below) at any data collection period during their practice's tenure with AT GOAL (resulting $n = 10\,263$). To assess change over time, patients must have had baseline and at least one post-baseline measurement for each of the CVD-related measures of interest (for a final sample of 7527 patients from 43 primary care practices for which baseline and post-baseline measurements were available).

Data collection/measures

Outcome measures of interest included systolic blood pressure, diastolic blood pressure, LDL and HbA1c. Since this is an applied evaluation project with collaborative input from AT GOAL staff, it was especially critical to mirror the priorities of the programme. As such, researchers were primarily interested in the proportion of patients at 'control' for these outcome measures as defined according to AT GOAL's criteria for control. AT GOAL criteria are based on guidelines as specified by the Joint National Commission (JNC) 7, the Adult Treatment Panel III and the American Diabetes Association. Control for systolic blood pressure was defined as less than 130 mmHg for diabetic patients and less than 140 mmHg for non-diabetic patients. Control for diastolic blood pressure was defined as less than 80 mmHg for diabetic patients and less than 90 mgHg for non-diabetic patients.[5] LDL control

[5]In 2013, the American Diabetes Association guidelines and JNC 7 guidelines changed the definition for blood pressure control for individuals with diabetes to less than 140/90 mmHg, unless the patient has chronic kidney disease. While AT GOAL updated their definitions upon release of the new guidelines, because the sample for the study included patients from practices that participated in AT GOAL prior to the release of the new guidelines, the researchers used the previous guidelines for blood pressure control in diabetic patients as described here.

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was defined as less than 100 mg dL^{-1} for both diabetic patients and non-diabetic patients [15]. HbA1c control was only assessed in diabetic patients and was defined as less than 7% [16]. Covariates of interest included diabetes diagnosis, sex, race, age at baseline, health insurance provider, and body mass index (BMI; determined by patient height and weight).

Statistical analyses

The researchers used Stata (version 12.0, Stata Corp., College Station, TX, USA) for all statistical analyses. The researchers stratified analyses by diabetic status and CVD-related measures because of statistically significant differences in outcomes between diabetic and non-diabetic patients. Descriptive statistics summarized the sample. The researchers assessed the average change in control rates for the CVD-related measures across practices using repeated measures analysis of variance. The researchers used random effects generalized least squares to assess the average change in the percent of patients' with controlled blood pressure, HbA1c and LDL rates between baseline and their last recorded measure post-baseline (referred to as end line).

The researchers used random effects generalized least squares for continuous measures of blood pressure, LDL, and HbAlc.The researchers further investigated the change in the CVD-related measures between baseline and end line for patients uncontrolled at baseline using one-sample *t*-tests. Finally, to assess the association between blood pressure, cholesterol and HbAlc control rates and patient characteristics, the researchers used generalized estimating equations logit-link models, which account for the correlation between repeated visits for patients. Two-tailed tests with *P*-values ≤ 0.05 indicated statistical significance.

Results

At the time of practice enrolment in AT GOAL, most of the 7527 patients in the final study sample were female, White and older than 51 years of age (Table 1). Most were overweight or obese according to their BMI, and nearly two-thirds of these patients had a diabetes diagnosis. A majority of patients had some form of health insurance, which included both public (e.g. Medicare and Medicaid) and private (e.g. United Healthcare, Aetna, etc.) payer sources. Diabetic and non-diabetic patients in the sample had similar characteristics; however, non-diabetic patients tended to be younger with a slightly higher proportion of these patients between the ages of 18 and 50 years at the time of their practices' enrolment in AT GOAL.

Table 2 presents practice-level and patient-level average control rates between baseline and end line. Among practices' non-diabetic patients, control rates for overall blood pressure increased by 3.6 percentage points from 72.7% to 76.3% between baseline and end line ($P = 0.0200$). Also, among practices' non-diabetic patients, control rates for diastolic blood pressure from 89.4% to 91.9% ($P = 0.0028$). Among practices' diabetic patients, while overall blood pressure, systolic blood pressure and diastolic blood pressure rates increased between baseline and end line, these changes were not statistically significant. Among practices' diabetic patients, LDL increased significantly between baseline (47.8%) and end

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line (52.3%, $P = 0.0009$). Of note, control rates for HbA1c declined over the period from 63.2% to 52.9% ($P = 0.0114$).

At the patient level, also shown in Table 2, changes in control rates between baseline and end line varied substantially between non-diabetic and diabetic patients. Among non-diabetic patients, there were statistically significant increases in control between baseline and end line for overall blood pressure (74.3% to 78.0%, $P = 0.0002$), systolic blood pressure (73.8% to 80.6%, $P = 0.0099$), diastolic blood pressure (90.1% to 92.7%, $P = 0.0001$) and LDL (48.6% to 53.1%, $P < 0.0001$).

Among diabetic patients, there were statistically significant increases in control between baseline and end line for diastolic blood pressure (59.8% to 61.9%, $P = 0.0141$). There were also increases in control between baseline and end line for overall blood pressure (35.2% to 36.2%), systolic blood pressure (44.6% to 46.1%) and LDL (62.6% to 63.6%); however, none of these changes were statistically significant. Results also showed a statistically significant decrease in HbA1c control between baseline and end line for diabetic patients (58.2%% to 55.2%, $P = 0.0001$).[6]

Table 3 displays the average rate of decline for blood pressure, LDL and HbA1c by baseline control status adjusted for patient characteristics: age, gender, race, health insurance status and diabetes status. While the overall trend shows minimal increases in systolic blood pressure, diastolic blood pressure, LDL and HbA1c between baseline and end line, patients with uncontrolled measures at baseline showed a decrease between baseline and end line relative to their counterparts who were controlled at baseline: −3.43 mmHg (95% CI: −3.61, −3.25) for systolic blood pressure, −2.07 mmHg (95% CI: −2.19, −1.95) for diastolic blood pressure and −5.24 mg dL^{-1} (95% CI: −5.51, −4.98) for LDL. Among diabetic patients with uncontrolled HbA1c at baseline, there was a decrease of 0.13% (95% CI: −0.15, −0.12) between baseline and end line compared with diabetic patients with controlled HbA1c at baseline.

Table 4 presents results of one-sample *t*-tests focused specifically on the subsets of patients ($n = 2507$) that had uncontrolled clinical measures at baseline. Among non-diabetic patients with uncontrolled systolic blood pressure at baseline ($n = 657$), there was a statistically significant decrease of 14.9 mmHg in systolic blood pressure from baseline to end line ($P < 0.0001$). Among non-diabetic patients with uncontrolled diastolic blood pressure at baseline ($n = 298$), there was a statistically significant average decrease of 11.3 mmHg in diastolic blood pressure from baseline to end line ($P < 0.0001$). Finally, among non-diabetic patients with uncontrolled LDL at baseline ($n = 1552$), there was a statistically significant decrease of 14.8 mg dL^{-1} ($P < 0.0001$) for LDL from baseline to end line.

Similar findings were found among diabetic patients with uncontrolled metrics at baseline for systolic blood pressure, diastolic blood pressure and LDL as noted in Table 3. Further,

[6]Note: 44% of the diabetic patients in this analysis fall into the age range of 65–85. Recently, a goal of <7% for A1c is being questioned for elderly patients (older than 65), for whom both the risk of hypoglycaemic events and associated adverse CV events is heightened, and the benefits of tight glucose control less evident. Emerging guidance indicates older adults A1c range can be between 7.5% to 8.0% (see American Diabetes Association (2013) Standards of medical care in diabetes – 2013. *Diabetes Care*, 36 (Suppl 1), 11–S66).

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among diabetic patients with uncontrolled HbA1c at baseline ($n = 1719$), there was a statistically significant decrease of 0.2% for HbA1c from baseline to end line ($P < 0.0001$).

Finally, Table 5 presents adjusted odds ratios (aORs) for associations between patient characteristics and control at end line for blood pressure, LDL and HbA1c. At end line, patients had greater odds of control for overall blood pressure (aOR = 1.03, 95% CI: 1.01, 1.04), diastolic blood pressure (aOR = 1.03, 95% CI: 1.01, 1.04), systolic blood pressure (aOR = 1.04, 95% CI: 1.02, 1.05) and LDL (aOR = 1.03, 95% CI: 1.04, 1.04) when accounting for patient characteristics of interest. For diabetic patients, the results confirm a decreasing trend in control rates for HbA1c when accounting for covariates of interest (aOR = 0.97, 95% CI: 0.96, 0.99).

Diabetes status had statistically significant associations with control at end line for overall blood pressure, systolic blood pressure, diastolic blood pressure and LDL, when accounting for covariates of interest. Patients with diabetes had lesser odds for control at end line for overall blood pressure (aOR = 0.18, 95% CI: 0.17, 0.19), systolic blood pressure (aOR = 0.23 , 95% CI: 0.21, 0.24) and diastolic blood pressure (aOR = 0.15, 95% CI: 0.14, 0.17) compared with patients without diabetes. However, those with diabetes had 66% greater odds of LDL control at end line compared with patients without diabetes (aOR = 1.66, 95% CI: 1.53, 1.79). The results pertaining to associations between other patient characteristics and outcomes of interest varied across outcome and characteristic (see Table 5).

Discussion

The researchers observed statistically significant improvements in CVD-related outcomes at the primary care practice level and the patient level. The findings are particularly promising for patients that had uncontrolled CVD-related risk factors as baseline. Patients with uncontrolled measures at baseline showed a decrease between baseline and end line relative to their counterparts who were controlled at baseline. Further, non-diabetic patients had a statistically significant decrease in systolic blood pressure and a decrease in diastolic blood pressure from baseline to end line. Non-diabetic patients also had a statistically significant decrease for LDL from baseline to end line. Diabetic patients with uncontrolled metrics at baseline for systolic blood pressure, diastolic blood pressure and LDL also showed improvements. These reductions have important health implications since reducing average population systolic blood pressure by only 12–13 mmHg could reduce stroke by 37%, coronary heart disease by 21% and cardiovascular disease mortality by 25% and all-cause mortality by 13% [17].

Tracking control rates was of particular interest to AT GOAL. In terms of control rates for the key outcome measures, among non-diabetic patients, there were statistically significant increases in control rates for overall blood pressure, systolic blood pressure, diastolic blood pressure and LDL between baseline and end line. Among diabetic patients, there were also improvements in control rates for overall blood pressure, systolic blood pressure, diastolic blood pressure and LDL between baseline and end line; however, the increase was only found to be statistically significant for diastolic blood pressure. Among diabetic patients, HbA1c control rates decreased between baseline and end line.

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Findings from the AT GOAL evaluation support the value of a facilitated, coordinated practice-focused QI initiative on managing CVD risk. Our results are particularly noteworthy because they can inform similar practice-level QI initiatives on attainable improvement goals especially when focusing on patient populations with a high degree of CVD risk. Also, with the compelling need to improve the disproportionate CVD-related morbidity and mortality throughout the southeastern United States, the results of AT GOAL are especially promising.

AT GOAL practices engage doctors and use benchmarking to direct and motivate practice change and to help practices determine 'where they are' before determining future directions and areas for improvement. Our results are comparable with other QI studies aimed at promoting cardiovascular health. In a systematic review of 44 QI studies, Walsh and colleagues [18] found that QI that involved doctor education, audit and feedback had a median absolute decrease of 3.5 in the proportion of patients with controlled systolic blood pressure (defined as the proportion of patients in whom systolic blood pressure was in a certain range depending on the study). Our evaluation results suggest an increasing trend in control for systolic blood pressure; however, this increase was statistically significant for non-diabetic patients only. Walsh *et al.* [18] also found a median absolute increase of 2.0 in the proportion of patients with controlled diastolic blood pressure, which is consistent with the results in our evaluation. Other studies have shown practice-focused QI is effective for improving patient outcomes [19–23].

As QI initiatives are increasingly expected to demonstrate improvement in terms of rapid response, AT GOAL is an important contribution to the evidence base due to its relatively short intervention period of approximately 12 months. Through a systematic process of performance monitoring, tailored education, and promotion of primary care practice-level QI activities, AT GOAL enhances doctors' knowledge and skills to provide quality care to patients at risk for CVD. Our evaluation findings suggest that a combination of multiple QI strategies that includes performance monitoring, doctor education and practice-level QI can support primary care doctors in the promotion of cardiovascular health.

While the evaluation design contained many strong features, the findings of this evaluation should be viewed in light of certain limitations. First, participation by practices in AT GOAL was voluntary; therefore the findings may not be generalizable to all primary care practices. Nonetheless, the study sample did consist of a diverse patient population representing a range of practice types including for profit and not for profit primary care practices, federally qualified health centres, private practices and solo practitioners, and practices associated with large doctor groups and medical centres. The findings may be relevant to a range of primary care settings. Another limitation is the study lacked a control group; therefore, unmeasured events cannot be omitted as potential explanations of the findings. It was not feasible to recruit practices as controls and expect them to share performance data with no benefit for participation nor would it have been ethical to withhold evidence-based guidelines that could improve patient care from control practices. Finally, the extent to which practice-level QI efforts affected the observed outcomes could not be accounted for in this evaluation because of the limited availability of consistent data on practices' selection and implementation of AT GOAL CQI intervention plans. The researchers also conducted

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interviews with providers in practices that participated in AT GOAL. While these interviews provided insight into the practices' implementation efforts, further study is needed to understand the extent to which implementation of the plans contributed to improvement in clinical outcomes.

Our evaluation provides important insights into the role of performance monitoring, provider education and practice-level QI initiatives in managing CVD risk factors. To further understand the relationships between QI strategies, primary care practice and patient outcomes, future research should focus on identifying the contextual factors associated with primary care practice and the specific components of QI interventions that contribute to improved CVD outcomes. By examining contextual factors (e.g. health care system and practice characteristics, baseline capacity for practices to engage in QI, composition and involvement of multidisciplinary teams in QI), researchers could refine/clarify those elements that support enhanced practice-level QI efforts. Further study on specific QI activities at the primary care practice level can help elucidate which strategies are effective in which settings to impact CVD-related outcomes. Finally, such interventions should also be studied for their long-term impact on health care delivery and patient-level outcomes.

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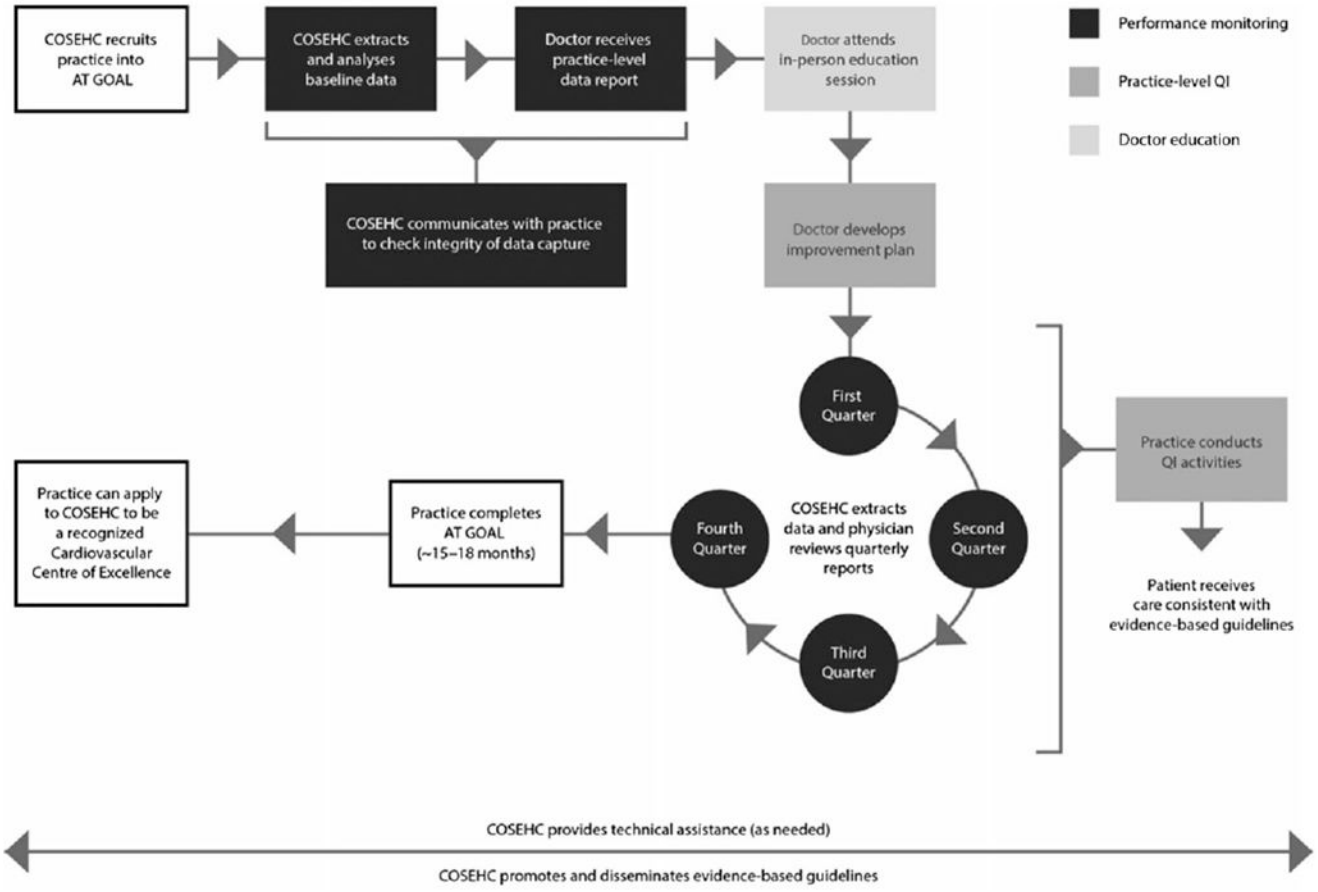

Figure 1.
The AT GOAL programme model.

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Table 1

Sample characteristics (n = 7527)

Characteristic	All patients (n = 7527) n (%)	Non-diabetic patients (n = 3021) n (%)	Diabetic patients (n = 4506) n (%)
Gender			
Male	3277 (43.5%)	1298 (43.0%)	1979 (43.9%)
Female	4250 (56.5%)	1723 (57.0%)	2527 (56.1 %)
Race			
White	4893 (65.0%)	1901 (62.9%)	2992 (66.4%)
Black/African American	2155 (28.6%)	794 (26.4%)	1361 (30.2%)
Other	479 (6.4%)	326 (10.8%)	153 (3.4%)
Age at baseline			
18-50 years	1315 (17.5%)	599 (19.8%)	716 (15.9%)
51-64 years	3024 (40.2%)	1227 (40.6%)	1797 (39.9%)
65-85 years	3188 (42.4%)	1195 (39.6%)	1993 (44.2%)
Have health insurance	6575 (87.4%)	2569 (85.0%)	4006 (88.9%)
Body mass index (BMI)			
Underweight (<18.5)	21 (0.3%)	11 (0.4%)	10 (0.2%)
Normal (18.5–24.9)	879 (11.7%)	452 (15.0%)	427 (9.5%)
Overweight (25.0–29.9)	2094 (27.8%)	1005 (33.3%)	1089 (24.2%)
Obese (30.0 or more)	4533 (60.2%)	1553 (51.4%)	2980 (66.1%)

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Table 2

Percent of patients with controlled CVD-related measures at baseline and end line at the practice level and patient level (n = 43 practices, 7527 patients)

	Practice-level mean for non-diabetic patients (n = 29)			**Practice-level mean for diabetic patients (n = 40)**		
Clinical measure	**Baseline mean (SD)**	**End line mean (SD)**	***P*-value**	**Baseline mean (SD)**	**End line mean (SD)**	***P*-value**
Overall blood pressure	72.7% (9.4%)	76.3% (9.2%)	**0.0200**	34.4% (13.7%)	34.6% (13.2%)	0.9215
Systolic blood pressure	76.6% (8.7%)	79.0% (8.1%)	0.1015	44.4% (14.0%)	45.2% (14.4%)	0.7300
Diastolic blood pressure	89.4% (7.7%)	91.9% (6.8%)	**0.0028**	60.9% (17.5%)	62.7% (17.7%)	0.2789
LDL	62.1% (16.5%)	65.2% (14.0%)	0.2787	47.8% (9.7%)	52.3% (9.0%)	**0.0009**
HbA1c *				63.2% (18.7%)	52.9% (15.6%)	**0.0114**
	Non-diabetic patients (n = 3021)			Diabetic patients (n = 4506)		
Clinical measure	Baseline mean (SD)	End line mean (SD)	*P*-value	Baseline mean (SD)	End line mean (SD)	*P*-value
Overall blood pressure	74.3% (43.7%)	78.0% (41.4%)	**0.0002**	35.2% (47.8%)	36.2% (48.1%)	0.2542
Systolic blood pressure	78.3% (41.3%)	80.6% (39.5%)	**0.0099**	44.6% (49.7%)	46.1% (49.9%)	0.1026
Diastolic blood pressure	90.1% (29.8%)	92.7% (26.1%)	**0.0001**	59.8% (49.0%)	61.9% (48.6%)	**0.0141**
LDL	48.6% (50.0%)	53.1% (49.9%)	<**0.0001**	62.6% (48.4%)	63.6% (48.1%)	0.1831
HbA1c *				58.2% (49.3%)	55.2% (49.7%)	**0.0001**

* HbA1c calculated for the diabetic patient population only (n = 4091).

Values in bold are significant at the 5% level.

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Table 3

Change in cardiovascular disease-related quality measures between baseline and end line controlling for patient characteristics* (n = 7527)

	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)	LDL (mg dL^{-1})	HbA1c† (%)
	Coeff. (95% CI)	Coeff. (95% CI)	Coeff. (95% CI)	Coeff. (95% CI)
Constant	**119.01 (118.09, 119.94)**	**74.94(74.37, 75.51)**	**78.86 (76.9, 80.82)**	6.44 (6.32, 6.56)
Trend (change between baseline and end line)	**1.12 (1, 1.23)**	**0.36 (0.3, 0.42)**	**1.86(1.69, 2.04)**	**0.07 (0.06, 0.08)**
Trend (change between baseline and end line) × uncontrolled at baseline	**−3.43 (−3.61, −3.25)**	**−2.07 (−2.19, −1.95)**	**−5.24 (−5.51, −4.98)**	**−0.13 (−0.15, −0.12)**

*Controlling for: age, gender, race, health insurance status, diabetes and body mass index.

†HbA1c calculated for the diabetic patient population only (n = 4091).

Values in bold are significant at the 5% level.

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Table 4

Mean change in CVD-related measures between baseline and end line among patients uncontrolled at baseline ($n = 2507$)

	Non-diabetic patients			Diabetic patients		
Clinical measure	***n***	**Mean change (SD)**	***P*-value**	***n***	**Mean change (SD)**	***P*-value**
Systolic blood pressure (mmHg)	657	−14.9 (18.2)	<**0.0001**	2496	−8.1 (18.5)	<**0.0001**
Diastolic blood pressure (mmHg)	298	−11.3 (9.5)	<**0.0001**	1812	−6.3 (10.4)	<**0.0001**
LDL (mg dL^{-1})	1552	−14.8 (32.3)	<**0.0001**	1684	−14.3 (33.5)	<**0.0001**
HbA1c(%)				1709	−0.2 (1.7)	<**0.0001**

Values in bold are significant at the 5% level.

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Table 5

Adjusted odds ratios (aOR) for associations between patient characteristics and controlled CVD-related measures at end line (n = 7527)

Characteristic	Overall blood pressure OR (95% CI)	Systolic blood pressure OR (95% CI)	Diastolic blood pressure OR (95% CI)	LDL OR (95% CI)	HbA1c* OR (95% CI)
Trend	**1.03** (1.01, 1.04)	**1.03** (1.01, 1.04)	**1.04** (1.02, 1.05)	**1.03** (1.02, 1.04)	**0.97** (0.96, 0.99)
Gender					
Male	Reference	Reference	Reference	Reference	Reference
Female	**0.93** (0.87, 1.00)	**0.91** (0.85, 0.97)	**1.13** (1.05, 1.22)	**0.62** (0.57, 0.67)	**1.16** (1.04, 1.3)
Race					
White	Reference	Reference	Reference	Reference	Reference
Black/African American	**0.63** (0.59, 0.69)	**0.70** (0.65, 0.75)	**0.54** (0.5, 0.59)	**0.75** (0.69, 0.82)	**0.81** (0.72, 0.92)
Other	**0.83** (0.72, 0.96)	**0.84** (0.73, 0.98)	0.92 (0.76, 1.10)	0.91 (0.77, 1.07)	1.11 (0.83, 1.49)
Age at baseline					
18–50 years	Reference	Reference	Reference	Reference	Reference
51–64 years	0.99 (0.9, 1.09)	**0.76** (0.69, 0.84)	**1.59** (1.44, 1.77)	**1.44** (1.29, 1.6)	**1.28** (1.09, 1.5)
65–85 years	**0.92** (0.84, 1.02)	**0.59** (0.53, 0.65)	**3.05** (2.73, 3.4)	**2.17** (1.93, 2.43)	**1.74** (1.47, 2.04)
Health insurance					
Yes	Reference	Reference	Reference	Reference	Reference
No	**1.15** (1.04, 1.28)	**1.20** (1.08, 1.33)	0.92 (0.82, 1.03)	**0.88** (0.78, 0.99)	**0.80** (0.67, 0.97)
Diabetes diagnosis					
No	Reference	Reference	Reference	Reference	
Yes	**0.19** (0.17, 0.2)	**0.24** (0.22, 0.25)	**0.14** (0.12, 0.15)	**1.65** (1.52, 1.79)	
Body mass index					
Underweight/normal (up to 24.9)	Reference	Reference	Reference	Reference	Reference
Overweight (25.0–29.9)	**0.87** (0.79, 0.97)	**0.85** (0.77, 0.95)	**0.87** (0.76, 1)	0.97 (0.88, 1.07)	**0.85** (0.74, 0.98)
Obese (30.0 or more)	**0.70** (0.63, 0.77)	**0.72** (0.65, 0.8)	**0.68** (0.6, 0.77)	0.96 (0.86, 1.06)	**0.66** (0.57, 0.77)

*HbA1c calculated for the diabetic patient population only (n = 4091).

Values in bold are significant at the 5% level.