

Diabetes Management: Team-Based Care for Patients with Type 2 Diabetes

Task Force Finding and Rationale Statement Ratified December 2016

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Task Force Finding and Rationale Statement

Intervention Definition

Team-based care to improve diabetes control is a health systems-level, organizational intervention that incorporates a multidisciplinary team to help patients manage their diabetes. Each team includes the patient, the patient's primary care provider (not necessarily a physician), and one or more other health professionals.

Team-based care to control diabetes aims to do the following:

- Ensure patients receive appropriate tests and examinations (e.g., blood glucose level, blood pressure, lipid level, weight, eye and foot examinations)
- Manage and control patients' risk factors (e.g., blood glucose level, blood pressure, lipid level) through medications
- Educate and assist patients with self-management and adherence to treatment regimens
- Promote patients' adoption of healthy behaviors and lifestyle choices (e.g., improved diet, increased physical activity, cessation of smoking)
- Improve patients' quality of life and prevent diabetes-related complications

Task Force Finding (December 2016)

The Community Preventive Services Task Force recommends team-based care to control type 2 diabetes based on strong evidence of effectiveness. Evidence demonstrates that team-based care improves patients' blood glucose (measured using A1c levels), blood pressure, and lipid levels. Interventions also increase the proportion of patients who reach target blood glucose, blood pressure, and lipid levels.

Teams evaluated in this review included patients, their primary care providers (not necessarily physicians), and one or two additional healthcare professionals (most often nurses or pharmacists).

Rationale

Basis of Finding

The Task Force recommendation is based on evidence from a systematic review of 35 studies (search period 1960–October 2015) that evaluated the impact of team-based care on blood glucose, blood pressure, and lipids. Of the included studies, 25 were identified using the reference list of a high quality systematic review (Tricco 2012, search period 1960 – 2010), 7 were identified from a bridge search conducted using the same search terms (search period 2010 – October 2015), and 3 were identified by searching through the reference lists of included studies.

The systematic review team conducted a random effects meta-analysis to evaluate the included studies that compared team-based care interventions with usual care (absolute effectiveness, 32 studies). The team also conducted a qualitative assessment of studies that added one or more team members to existing team-based care interventions (incremental effectiveness, 4 studies). The Task Force finding is limited to people with type 2 diabetes because only one of the included studies examined intervention effectiveness for people with type 1 diabetes.

Compared with usual care, team-based care interventions improved patients' diabetic outcomes, including blood glucose level, systolic blood pressure (SBP), diastolic blood pressure (DBP), high-density lipoprotein (HDL), low-density

lipoprotein (LDL), total cholesterol, and triglycerides (Table 1). Team-based care interventions also improved patients' diabetes-related quality of life and general physical and mental health. Study participants had fewer hospitalizations and emergency department visits due to all causes.

Team-based care interventions produced greater reductions in blood glucose for patients with a baseline A1c \geq 8% (mean decrease of 0.8%, 95% CI: -1.1, -0.5; 15 studies) when compared to participants with a baseline A1c<8% (mean decrease of 0.2%, 95% CI: -0.4, 0.0; 8 studies). This difference was seen both within and between studies. Baseline A1c of 8% was a common benchmark used in the included studies to signal risk for uncontrolled diabetes.

Table 1. Overall Impact of Team-Based Care (Random Effects Meta-Analysis)

Outcome	Summary Effects
<p>Blood glucose, measured using A1c levels (25 studies)</p> <p>Stratified by baseline A1c:</p> <p> \geq8% (15 studies)</p> <p> <8% (8 studies)</p>	<p>Grand Mean*: decrease of 0.5% (95% CI: -0.7, -0.3)</p> <p>Prediction Interval, 95%†: -1.4, 0.3</p> <p>p < 0.01</p> <p>I² = 85.7% (95% CI: 80.1%, 89.8%)</p> <p>Mean: decrease of 0.8% (95% CI: -1.1, -0.5)</p> <p>Mean: decrease of 0.2% (95% CI: -0.3, 0.0)</p>
<p>Blood pressure</p> <p>Systolic (18 studies)</p> <p>Diastolic (17 studies)</p>	<p>Grand Mean: decrease of 5.5mmHg (95% CI: -8.1, -3.0)</p> <p>Prediction Interval, 95%: -15.4, 4.3</p> <p>p < 0.01</p> <p>I² = 81.3% (95% CI: 71.4%, 87.8%)</p> <p>Grand Mean: decrease of 3.2mmHg (95% CI: -4.8, -1.5)</p> <p>Prediction Interval, 95%: -9.3, 3.0</p> <p>p < 0.01</p> <p>I² = 81.1% (95% CI: 70.7%, 87.8%)</p>

Outcome	Summary Effects
Lipids	
HDL (9 studies)	Grand Mean: increase of 0.7mg/dL (95% CI: -0.8, 2.2) Prediction Interval, 95%: -3.4, 4.8 p = 0.35 I ² = 50.9% (95% CI: 0%, 77%)
LDL (14 studies)	Grand Mean: decrease of 8.0mg/dL (95% CI: -11.8, -4.3) Prediction Interval, 95%: -18.5, 2.4 p < 0.01 I ² = 42.2% (95% CI: 0%, 69.2%)
Total cholesterol (12 studies)	Grand Mean: decrease of 7.4mg/dL (95% CI: -13.9, -0.9) Prediction Interval, 95%: -28.0, 13.2 p = 0.02 I ² = 63.3% (95% CI: 31.6%, 80.3%)
Triglycerides (7 studies)	Grand Mean: decrease of 13.3mg/dL (95% CI: -38.4, 11.8) Prediction Interval, 95%: -82.6, 56.0 p = 0.30 I ² = 70% (95% CI: 10.7%, 82.9%)

BP: blood pressure; SBP: systolic blood pressure; DBP: diastolic blood pressure; HDL: high density lipoprotein; LDL: low density lipoprotein

***Grand mean:** the weighted average of study results on a common outcome (e.g. blood glucose). Meta-analysis uses special methods to assign weight to each study's result.

†Prediction interval, 95%: Assumes each study in the analysis is observing (with some error) a unique intervention effect due to the variation in setting, population, and delivery. It also assumes these true effects are normally distributed around the grand mean. The 95% prediction interval means that when team-based care is implemented in similar ways and in similar settings to those included in this review, in 95 out of 100 cases the true effect will fall inside the interval.

‡I²: the proportion of the observed variance that is due to between-studies differences. This value explains what is driving the spread of the data but does not describe how much spread exists.

Compared with usual care, team-based care interventions increased the proportion of patients who reached blood glucose, blood pressure, and lipid targets (Table 2). Authors of the included studies set these targets based on American Diabetes Association (ADA) guidelines available at the time and may not reflect current standards. ADA sets targets based on the most current evidence and has gradually moved from standardized goals intended for all patients with diabetes to individualized goals specific to each patient. The latest guidelines (ADA, 2017; Sections 6 and 9) outline blood glucose, blood pressure, lipids and weight goals, but emphasize the importance of modifying goals based on patients'

characteristics, such as life expectancy, past history of hypoglycemic events, presence or absence of advanced microvascular or macrovascular complications, extensive comorbid conditions, or time since diabetes diagnosis.

Table 2. Proportion of Participants Who Reached Diabetes Control Targets

Outcome	Summary Effects
<p>Blood glucose, measured using A1c levels</p> <p>Reached below 7.0% (7 studies)</p> <p>Reached below 7.5% (1 study)</p>	<p>Median increase of 15.1 percentage points (IQI: 2.0 to 27.9)</p> <p>Increase of 18 percentage points</p>
<p>Blood pressure</p> <p>Blood pressure reached below 130/80mmHg (10 studies)</p> <p>SBP reached below 130mmHg (3 studies)</p> <p>DBP reached below 80mmHg (3 studies)</p>	<p>Median increase of 15.0 percentage points (IQI: 6.0 to 27.2)</p> <p>Median increase of 4.4 percentage points (Range: -1.2 to 40)</p> <p>Median decrease of 1 percentage point (Range: -1 to 5.9)</p>
<p>Lipid</p> <p>HDL*</p> <p>Reached above 35mg/dL (1 study)</p> <p>Reached above 40mg/dL (1 study)</p> <p>Reached above 43mg/dL for males or above 50mg/dL for females (1 study)</p> <p>LDL reached below 130mg/dL (5 studies)</p> <p>Total cholesterol reached below 200mg/dL (1 study)</p>	<p>3.2 percentage point decrease</p> <p>0.6 percentage point increase</p> <p>2 percentage point increase</p> <p>Median increase of 16.7 percentage points (IQI: 5.7 to 21.8)</p> <p>14 percentage point increase</p>

* An increase in HDL is considered favorable.

IQI = interquartile interval

SBP: systolic blood pressure

DBP: diastolic blood pressure

HDL: high density lipoprotein

LDL: low density lipoprotein

Team-based care interventions vary greatly in team composition and operation and in care delivery. Stratified analyses were performed using random effects meta-analysis to examine the influence of these factors on patients' blood glucose and blood pressure. The main findings are stated below; for detailed results, see the Stratified Analysis). Not enough studies reported on the other outcomes to conduct random effects meta-analysis.

Most of the included studies formed a team by adding a nurse (19 studies) or a pharmacist (13 studies) to the patient-primary care provider relationship; only one study added a nurse and a pharmacist. Greater reductions in patients' blood glucose levels were reported when pharmacists rather than nurses were added to the team, though the addition of either led to improved blood glucose levels.

In the included studies, patients' medication regimens could be changed in one of three ways:

- Primary care providers made all medication changes;
- Team members proposed medication changes that required approval from primary; or
- All qualified team members made changes to medication as appropriate.

Programs that allowed team members to make suggestions with primary care provider approval (4 studies) led to greater reductions in diastolic blood pressure than did programs that only allowed primary care providers to make medication changes (11 studies). Only 2 studies evaluated programs that allowed all qualified team members to make medication changes.

Team communication was categorized as either explicit or implicit. Through explicit communication, team members actively exchanged information during team meetings or other formal interactions and communication channels. Through implicit communication, team members shared information passively. Examples of this could include leaving notes in patients' health records or leaving status updates in primary care providers' folders. Studies with explicit communication (15 studies) showed more favorable blood pressure outcomes than studies with implicit communication (4 studies).

Studies that allowed all team members access to patients' medical records (21 studies) showed more favorable reductions in blood glucose when compared to studies that did not (3 studies).

Added team members interacted with patients face-to-face, remotely (e.g. telephone, email), or both in-person and remotely. Studies showed that patients experienced greater reductions in blood glucose levels when services such as education, counseling, and follow-up were delivered both in-person and remotely (10 studies), rather than just in-person (12 studies) or remotely (3 studies).

Applicability and Generalizability Issues

Intervention settings

Most included studies evaluated interventions in the United States (25 studies). Remaining studies were conducted in Canada (3 studies), the United Kingdom (2 studies), Hong Kong, the Netherlands, Switzerland, Taiwan, and United Arab Emirates (1 study each location). Nearly two-thirds of the studies evaluated team-based care interventions implemented in clinics (22 studies). The other studies evaluated interventions in hospitals (5 studies), pharmacies (4 studies), or Veterans Affairs facilities (4 studies). Most of the included studies examined interventions in urban settings (22 studies). Other interventions were implemented in mixed (urban/suburban/rural; 8 studies), suburban (1 study), or rural settings (1 study). Team-based care was effective across these settings.

Demographic characteristics

The 35 included studies provided demographic information on 15,472 study participants. Overall, study participants had a mean age of 58.4 years (31 studies) and were 52.2% female (34 studies). Only 9 studies reported participants' income or employment, and 7 of these studies were implemented among low-income or underserved populations. Seventeen studies reported on level of education, and slightly more than half of the participants had less than high school education (median of 51.3%; 8 studies).

Of the 25 U.S. studies, 20 reported on race. The study population included white (median 61.5%; 15 studies), African Americans (median 16.5%; 12 studies), Hispanic/Latino (median 19.2%; 8 studies), Asian American (median 2.9%; 3 studies), American Indian/Alaskan Native (median 2.9%; 3 studies), and other (median 3.8%; 5 studies). Five studies targeted specific races or ethnicities, including black (3 studies), Samoan (1 study), and Hispanic (1 study) populations.

Only one study examined within-study difference of effectiveness by gender and found that more males had a $\geq 1\%$ decrease in blood glucose. Two studies stratified results based on race/ethnicity. One study found that interventions were effective for both white and non-white patients. One study added a community health worker to an existing team to provide self-management education and support to patients, and found that more Latinos achieved blood pressure ($<130/80$ mmHg) and LDL (<100 mg/dL) targets than African Americans and Non-Hispanic whites. Studies that targeted racial or ethnic minorities reduced blood glucose levels (4 studies). Studies that targeted low-income populations improved blood glucose, blood pressure, and lipids (3 studies). Studies that targeted African Americans with low-income found reductions in blood glucose and diastolic blood pressure (3 studies).

Intervention characteristics

Services delivered:

The components of care delivered varied between studies. Of the 35 included studies, almost all reported an initial education component (33 studies) and a continued education/counseling component (32 studies). A majority of the studies included regular testing and monitoring (29 studies) and medication modification (24 studies). About one-third of the studies included patient goal setting and development of an action plan to achieve those goals (16 studies). Studies that included goal setting for patients were less effective at reducing blood glucose levels than studies that did not offer this service.

Intervention duration:

Team-based care interventions ranged in duration from less than 6 months to more than 36 months; these differences did not influence intervention effectiveness.

Team composition and operation:

Similar improvements in patient outcomes were reported when teams added one or two members to the patient-primary care provider relationship. Studies recruited additional team members by hiring new people (22 studies) or expanding the roles of existing staff (6 studies). The type of recruitment method did not influence intervention effectiveness.

Data Quality Issues

All included studies were classified as having greatest suitability of design with good (7 studies) or fair (28 studies) quality of execution. Studies were either individual randomized control trials (28 studies) or group randomized control trials (7 studies).

The systematic review team conducted the meta-analysis based on a few considerations. The body of evidence had all randomized control trials, and all studies reported health outcomes using standardized measurements. Heterogeneity existed, however, with between-study differences accounting for a high proportion of the observed variance for all outcomes (A1c: $I^2 = 85.7\%$, SBP: $I^2 = 81.3\%$, DBP: $I^2 = 81.1\%$). This heterogeneity should be expected, as team-based care varied in delivery of care, team composition, team operation, and the population receiving care.

When faced with high heterogeneity, the focus should be on the spread of the data and the causes of the dispersion through stratified analysis. Random-effects meta-analysis accounts for the spread of the data which is best captured by the 95% prediction interval. The 95% prediction interval means that when team-based care is implemented in similar ways and in similar settings to those included in this review, in 95 out of 100 cases the true effect will fall inside the interval. For all outcomes in Table 1, the prediction intervals lie almost entirely in the favorable direction, indicating that the vast majority of team-based care interventions would be expected to improve outcomes.

The heterogeneity that existed in this body of evidence allowed the review team to examine the impact of various factors on intervention effectiveness. Stratified analyses were performed to explore the sources of the heterogeneity. The results are briefly discussed above, and detailed results are available from [Stratified Analysis](#).

Other Benefits and Harms

No additional benefits or harms were identified in the included studies or in the broader literature.

People living with diabetes may experience hypoglycemia when they go on treatment regimens. The systematic review team examined whether team-based care could lead to medication over-prescription, resulting in more hypoglycemic events. Seven of the included studies examined this issue and found that hypoglycemic events were very rare, and there were no differences in rates of these events between intervention and control groups.

Considerations for Implementation

Evidence from included studies shows that team-based care, implemented with people who have type 2 diabetes, produces clinically and statistically significant reductions in a wide range of diabetes indicators including blood glucose, blood pressure, and lipids.

A larger reduction in blood glucose levels was observed for patients with baseline A1c $\geq 8\%$, though team-based care was also effective for patients with baseline A1c $< 8\%$. A widely cited, long-term cohort study of people with type 2 diabetes suggested that for every 1% reduction in A1c level there was a corresponding 35% reduction in the risk of microvascular complications and 25% reduction in diabetes-related death, irrespective of baseline A1c (UK Prospective Diabetes Study Group, 1998). Based on this estimation, the A1c reductions found in this review have important clinical implications.

Team-based care is patient-centered care delivered by a team of healthcare professionals from different medical disciplines. In most included studies, care was tailored to reflect each patient's knowledge of diabetes, ability to adopt behavior modifications to control diabetes, severity of diabetes indicators, and diabetes-related complications. Evidence from the current review demonstrated that team-based care improved patients' quality of life and overall physical and mental health and slightly increased their satisfaction with care. There was also a reduction in all-cause hospitalization and emergency department (ED) use for study participants. This may be because team-based care interventions allow for more frequent and regular interactions between patients and healthcare professionals, which gives them more opportunities to address health concerns.

Team-based care has been implemented for various populations in different settings, and with different team composition and operation procedures. While each team is unique with its own purpose, setting, patient needs, and resource availability, there are some overarching principles for building effective teams. Five principles of team-based care identified in the broader literature include: shared goals between the team and the patient; clear roles and expectations for all team members; mutual trust among team members; effective communication; and measurable processes and outcomes (Mitchell et al., 2012).

Stratified analysis of the current body of evidence suggests that team-based care with active, explicit communication between team members is more effective than team-based care with less formal and less active communication channels. In these more effective programs, team members communicated through various channels, such as face-to-face meetings, telephone conferences, email exchanges, or submissions of reports through electronic health record systems with feedback from team members. Advancement in mobile technology may allow even easier and timelier communication.

Evidence suggests that a combination of face-to-face and remote interactions between patients and added team members result in greater reduction in blood glucose levels than either face-to-face or remote interactions alone. Studies included in the stratified analysis only used telephones for remote communication, but other mobile technologies can also be used, such as text messaging, web portals, and apps.

Evidence indicates that composition of effective teams can be flexible. Team-based care was shown to be effective with one or two added team members, either nurses or pharmacists, who were recruited as new hires or who were existing staff with expanded roles. Teams that added a pharmacist did show more improvement in blood glucose when compared to teams that added a nurse. Team-based care with an added pharmacist tends to focus more on medication adherence and modification, which could explain the difference in effectiveness. This finding is consistent with results from a previous Community Guide review on [team-based care to control blood pressure for people with cardiovascular disease](http://www.thecommunityguide.org/findings/cardiovascular-disease-team-based-care-improve-blood-pressure-control) [www.thecommunityguide.org/findings/cardiovascular-disease-team-based-care-improve-blood-pressure-control] (Proia et al., 2014).

The current body of evidence only included studies that provided enough resources to establish team-based care interventions for a short duration. Three studies examined the impact of intervention duration on effectiveness and reported favorable reductions in blood glucose early in the intervention (at 3 months) that were sustained through continued care (last follow-up at 36 months).

Outside of research settings, team-based care interventions can face challenges such as limited resources or lack of knowledge on how to transition to patient-centered care or form a functional and effective multidisciplinary team. A list

of resources to guide interested health teams through implementing team-based care is available at the end of this document.

This review, in conjunction with the Community Guide review of team-based care to improve blood pressure control, demonstrates that team-based care is effective in managing diabetes and hypertension. Team-based care may be a platform to successfully treat other chronic conditions or patients with multiple chronic conditions.

Evidence Gaps

Additional research and evaluation are needed to answer the following questions and fill existing gaps in the evidence base.

- What are intervention effects on diabetes-related complications and healthcare use?
- How effective are interventions with the following populations?
 - People with type 1 diabetes
 - Younger people with diabetes
 - Uninsured people with diabetes
 - People with diabetes living in rural settings
- How do team composition and operation affect intervention outcomes?
 - What services (e.g. education, counseling, goal setting, medication modification) are provided by team members?
 - How do team members communicate? Do teams use electronic records or meetings or other means of communication?
 - Do programs provide protocols to delineate the team roles and responsibilities?
 - Who is the team lead? The primary care provider, or the team member providing the majority of services?
 - Who is the primary contact for the patients? The primary care provider, the team member providing majority of the services, both, or someone else?

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Additional Resources

- CDC, Division of Diabetes Translation: [Team Care Approach for Diabetes Management](http://www.cdc.gov/diabetes/ndep/pdfs/ppod-guide-team-care-approach.pdf) [www.cdc.gov/diabetes/ndep/pdfs/ppod-guide-team-care-approach.pdf]. This brief document walks through how to set up team-based care.
- Agency for Healthcare Research and Quality: [Creating Patient-Centered Team-based Primary Care](http://pcmh.ahrq.gov/page/creating-patient-centered-team-based-primary-care) [pcmh.ahrq.gov/page/creating-patient-centered-team-based-primary-care]. This is a white paper on how to create a patient-centered team-based primary care
- Improving Chronic Illness Care: [Primary Care Team Guide](http://www.improvingchroniccare.org) [www.improvingchroniccare.org]. This organization is a pioneer in the field of implementing the chronic care model, offers an extensive collection of resources and researches.
- American Medical Association: [Creating Strong Team Culture](http://www.stepsforward.org/modules/create-healthy-team-culture) [www.stepsforward.org/modules/create-healthy-team-culture]. This webpage provides step-by-step tools on creating a strong team culture
- [Interprofessional Education Collaborative](http://ipecollaborative.org/Resources.html) [ipecollaborative.org/Resources.html]. This website provides educational materials to promote interprofessional learnings for enhanced team-based care.
- NIH, National Institute of Diabetes and Digestive and Kidney Diseases: links to resources on preventing and managing diabetes:
 - [Practice Transformation for Physicians and Health Care Teams](http://www.niddk.nih.gov/health-information/health-communication-programs/ndep/health-care-professionals/practice-transformation/Pages/resourcedetail.aspx) [www.niddk.nih.gov/health-information/health-communication-programs/ndep/health-care-professionals/practice-transformation/Pages/resourcedetail.aspx]. This webpage provides step-by-step guidance on transforming medical practices to improve diabetes care
 - [Redesigning the Health Care Team: Diabetes Prevention and Lifelong Management](http://www.niddk.nih.gov/health-information/health-communication-programs/ndep/health-care-professionals/team-care/Pages/publicationdetail.aspx) [www.niddk.nih.gov/health-information/health-communication-programs/ndep/health-care-professionals/team-care/Pages/publicationdetail.aspx]. This webpage provides detailed information on why use team-based care and how to form a high-functioning team
- The Primary Care Team Guide: [Building a Primary Care Team](http://www.improvingprimarycare.org/team) [www.improvingprimarycare.org/team]. This free online learning tool guides people on how to establish an effective team for team-based care.

Disclaimer

The findings and conclusions on this page are those of the Community Preventive Services Task Force and do not necessarily represent those of CDC. Task Force evidence-based recommendations are not mandates for compliance or spending. Instead, they provide information and options for decision makers and stakeholders to consider when determining which programs, services, and policies best meet the needs, preferences, available resources, and constraints of their constituents.

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