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Title

Improving risk factor management for patients with poorly controlled type 2 diabetes: A systematic review of healthcare interventions in primary care and community settings

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Abstract

Objectives: Poorly-controlled type 2 diabetes mellitus (T2DM) is a major international health problem. Our aim was to assess the effectiveness of healthcare interventions, specifically targeting patients with poorly-controlled T2DM, which seek to improve glycaemic control and cardiovascular risk in primary care settings.

Design: Systematic review.

Setting: Primary care and community settings.

Included studies: Randomised controlled trials (RCTs) targeting patients with poor glycaemic control were identified from Pubmed, Embase, Web of Science, Cochrane Library and SCOPUS. Poor glycaemic control was defined as HbA1c over 68mmol/ mol (7.5%).

Interventions: Interventions were classified as organisational, patient-oriented, professional, financial or regulatory.

Outcomes: Primary outcomes were HbA1c, blood pressure and lipids. Two reviewers independently assessed studies for eligibility, extracted data, and assessed study quality. Meta-analyses were undertaken where appropriate using random-effects models. Subgroup analysis explored the effects of intervention type, baseline HbA1c, study quality and study duration. Meta-regression analyses were undertaken to investigate identified heterogeneity.

Results: Thirty-eight RCTs were identified, including 10,407 patients with most undertaken in the USA. In general studies had low risk of bias. The main intervention-types were patient-directed (48%) and organisational (48%). Overall, interventions reduced HbA1c by -0.34% (95% CI; -0.46%, -0.21%) but meta-analyses had high statistical heterogeneity. Subgroup analyses suggested that organisational interventions, interventions on those with baseline HbA1c over 9.5% and studies of longer duration had better improvements in HbA1c. Meta-regression analyses suggested that only interventions on those with population HbA1c over 9.5% were more effective. Interventions did not improve blood pressure or lipids, although

baseline levels of control were generally good.

Conclusions: This review suggests that interventions for T2DM, in primary care, are better targeted at individuals with very poor glycaemic control and that organisational interventions may be more effective.

Article summary:

'Strengths and limitations of the study'

- This systematic review adds to the evidence regarding the effectiveness of healthcare interventions, which specifically target patients with poor glycaemic control of Type 2 Diabetes Mellitus, in community settings.
- There is no specific definition for 'poor control' diabetes in the literature, but by including all studies that had patients with a HbA1c > 59 mmol/mol (7.5%), we captured the full range of poor glycaemic control and also examined other key risk factors such as blood pressure and lipids.
- Data were pooled from 38 studies across four continents, enhancing the generalisability of the findings.
- We did not account for medication use in the studies, but given that all included studies were RCTs, which would balance out delivery of medications, we think that differences relating to underlying medication usage relate to how different interventions types promote the intensification of medications.
- An individual patient data meta-analysis may answer further questions not possible in this review.

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Competing interests statement:

Nil

Author's contributions:

All authors contributed to the drafting of the paper. MEM, MB and RG independently assessed studies for eligibility, extracted data, and assessed study quality. Decisions or disagreements were brought to SMS. SMS, TF and FB provided methodological and statistical support to the paper. All authors contributed to the writing of the paper.

Main text

Introduction

Worldwide, type 2 diabetes mellitus (T2DM) is rising in prevalence and will exceed 4.4% of the world's population, or 366 million by 2030 (1). Despite a wealth of evidence regarding the importance of risk factor control in T2DM, many patients continue to have poor control of HbA1c, blood pressure and lipids. Up to 60% of patients fail to meet target HbA1c levels (2). Similarly over one third of patients with T2DM have inadequate blood pressure control (3). Poorly-controlled T2DM - and its associated microvascular and macrovascular complications - is associated with higher morbidity, higher mortality, poorer quality of life and substantial economic burden (4).

Several systematic reviews have examined interventions designed to support the delivery of diabetes care in the community to improve glycaemic and cardiovascular risk factor control (5-10). A 2011 review of community-based interventions including all patients with T2DM, comprising sixty-eight studies, showed that only one third had a statistically significant improvement in one of the relevant clinical outcomes for diabetes: HbA1c, blood pressure or lipids (8). The majority of included studies targeted all patients with T2DM without focussing on those with poor control. Although no overall effect was noted, combining organisational with professional (multifaceted) interventions was concluded to be more beneficial than single interventions and the highest quality multifaceted randomised controlled trials (RCTs) tended to include decision support interventions and elements. A 2013 review looked at 48 cluster RCTs, assessing the effectiveness of Quality Improvement (QI) strategies on the management of diabetes (both type 1 and 2) (11). It suggested that QI interventions, which intervened at a system level on diabetes management, were associated with the largest benefits in glycaemic control and that the effectiveness of interventions targeting healthcare practitioners varied with baseline glycaemic control; being more effective with patients with worse control (11). A 2016 review, of type 1 or type 2 diabetes in primary care, looked at the effects of Clinician Education, Clinician Reminders, Team Changes, Case Management,

Electronic Patient Registry, Telemedicine and Audit and Feedback (10). Including thirty studies, it concluded that multifaceted interventions on multidisciplinary teams were most effective. Interventions targeting family physicians were only effective if computerised feedback on insulin prescribing was provided.

Four large RCTs from North America and the UK have investigated the effects of intensive management of hyperglycaemic and cardiac risk factors on mortality in T2DM across all settings (12-17). Uncertainty remains regarding intensive glycaemic management for all patients with T2DM, with concerns about aggressive reductions in HbA1c (18). Targeted reductions in cardiovascular and glycaemic risk factors in certain vulnerable populations (cognitively impaired, disabled and frail) have been advocated (19). Interventions that specifically target those with very poor control of risk factors may be more beneficial than those targeting all patients, achieving the benefits of cardiovascular and glycaemic control, but without the potential risks of intensively lowering HbA1c in all persons with T2DM. The effect of interventions specifically targeting patients with poorly controlled T2DM in primary care is unknown.

Our aim was to assess the effectiveness of healthcare interventions delivered in primary care and community settings, targeting poorly-controlled T2DM, which seek to improve glycaemic control, blood pressure and lipids.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to standardise the conduct and reporting of the research and the protocol was registered on PROSPERO (20).

Data Sources and Searches

We searched articles in all languages from the Cochrane Library, Pubmed, Embase, Web of Science and SCOPUS from 1990 to 31st December 2015. Reference lists of all included papers were searched. Secondary searching of all references from included studies was also conducted. *Appendix 1* outlines the search string.

Study Selection

We considered randomised controlled trials (RCTs), controlled clinical trials (CCTs), controlled before and after studies (CBAs) and interrupted time series analyses (ITS) meeting the Cochrane Effective Practice and Organisation of Care (EPOC) quality criteria (21). Studies published in all languages were eligible.

Population:

Individuals with 'poorly controlled' T2DM were our population of interest. Though there is a broad consensus about the importance of achieving good glycaemic control for the reasons described, there are no validated cut-offs, which define 'poor-control' of T2DM for targeted interventions. Poorly controlled T2DM has been defined based upon elevated glycated haemoglobin levels in the literature, with different thresholds of HbA1c described, from over 59 mmol/mol (7.5%), over 64 mmol/mol (8.0%) to over 75 mmol/mol (9.0%) (22-24). A recent definition from 2015 of 'persistently poorly controlled diabetes' as a HbA1c over 75 mmol/mol (9.0%) for over one year (25). In this review, we considered participants to have poorly controlled T2DM if their HbA1c was over 59 mmol/mol (7.5%) (or if over 80% of the population in a study had a HbA1c over 59 mmol/mol). Similarly there is no defined cut off as to what defines 'poorly-controlled' blood pressure. We identified studies primarily based on poor glycaemic control but also included participants in these

studies who had uncontrolled hypertension or elevated cholesterol/ lipids, if the risk factor level was above that of an accepted international target, as designated by the study authors. Where studies included patients with 'poor control' based upon a range of risk factor profiles, for consistency, we only included a study if 80% of the population had a HbA1c over 59 mmol/mol (7.5%).

Interventions:

We included interventions delivered by healthcare professionals (HCPs) specifically aiming to target patients with poor control of T2DM, based in primary care or community settings. The primary healthcare setting was defined as providing "integrated, easy to access, health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained and continuous relationship with patients, and practicing in the context of family and community" (26). We excluded drug trials though interventions could have involved treatment intensification. Interventions were defined as simple if they had one identifiable component and multifaceted if they had more than one element. We excluded trials performed within the hospital or the hospital-outpatient setting. The Cochrane EPOC taxonomy of interventions was utilised and the predominant intervention type was defined using five categories including organisational, patient-centred, regulatory, financial and professional (*Appendix 2*) (21):

Comparison:

Comparison groups were included if they received usual care in that setting for T2DM. Controls were also included if they received minor enhanced elements of care, such as education leaflets, which the study authors believed did not go beyond usual care in most settings.

Outcome measures:

Primary outcomes included glycaemic control (HbA1c), blood pressure (systolic or diastolic) and lipid levels, but if studies did not include HbA1c they were excluded. Secondary outcomes included patient reported outcome measures (PROMs) (for example health related quality of life), utilisation of health services, behavioural

outcomes such as medication adherence, provider behaviour, acceptability of service to patients and providers, economic outcomes and adverse events.

Data Extraction and Quality Assessment

Two reviewers (MEM and RG) read the titles and/ or abstracts of the identified references and eliminated irrelevant studies. Studies that were deemed eligible for inclusion were read in full and their suitability for inclusion in the systematic review was independently determined by two reviewers. Disagreements were managed by a third, independent reviewer (SMS). The following information was extracted: a) Details of intervention, b) Participants, c) Clinical setting, d) Study design, e) Outcomes, f) Author Information. We contacted authors for missing data.

Risk of bias in articles was assessed using the Cochrane Handbook for systematic reviewing and EPOC criteria (27). Two review authors independently assessed the risk of bias of each included study against the criteria described in the Cochrane risk of bias tool. We explicitly judged each of these criteria using: low risk of bias, high risk of bias or unclear risk of bias (either lack of information or uncertainty over the potential for bias). We resolved disagreements by consensus and consulted a third review author to resolve disagreements if necessary. An overall assessment of a study's risk of bias was determined using EPOC guidance, with judgement and consensus reached between two reviewers (MEM and SMS) (27).

Data Analysis

For continuous data we calculated the treatment effect using mean differences (MD) and 95% confidence intervals (CI). No binary outcomes were included. Revman software was used to perform the analysis, determine heterogeneity and produce forest plots to illustrate pooled estimates (21). Stata version 13 was used to investigate publication bias by creating funnel plots and using Egger's test to assess funnel plot asymmetry (28). A random-effects analysis was applied and heterogeneity across the studies was quantified using the I^2 statistic. If the I^2 statistic was >50%, it was deemed that there was significant heterogeneity between the studies.

Subgroup analyses were performed for primary outcomes based on a priori assumptions, as per the PROSPERO protocol (20). For HbA1c we explored the possible effects of subgroups; a) the type of intervention based upon the EPOC taxonomy (*Appendix 2*); b) study quality and c) baseline HbA1c in the study populations (HbA1c 7.5% - 9.4%, or ≥ 9.5%). After reviewing the included studies we also included study duration as a subgroup (< 12 months or ≥ 12 months), as a wide range in study duration was found. Subgroup analyses for systolic blood pressure (SBP) and diastolic blood pressure (DBP) explored the effects of intervention-type based upon the EPOC taxonomy.

When important heterogeneity was identified, we investigated its causes using meta-regression. Meta-regression is an extension to subgroup analysis that allows the effect of continuous, as well as categorical, characteristics to be investigated (29). Meta-regression was performed to explore the effects of; a) study quality (using the overall assessment risk of bias); b) study population characteristics (e.g. gender, age and baseline HbA1c and SBP); c) intervention type (EPOC taxonomy); and d) study duration on the primary outcomes (29). Random effects meta-regression was performed using Stata 13 (28).

Results

Overall 15,130 titles were screened and 38 full text articles met the inclusion criteria (*Figure 1*: PRISMA Flow diagram). All 38 studies were RCTs, encompassing 45 interventions in total, comprising 10,407 patients (22-25, 30-63). No other eligible study designs were identified.

Characteristics of studies

Twenty-nine of the 38 studies were conducted in the United States, six in Europe, two in Australia and one in Israel. Follow-up of outcomes in the studies varied in length from 3 (53) to 36 months (46). The mean HbA1c across all studies was 9.5% (95% CI; 9.2%, 9.8%). The mean age of patients in the studies varied from 49.6 (47) to 63.2 (64); partly reflecting different inclusion criteria (*Table 1*). Twenty-six studies explicitly defined their study population as "poorly controlled", "complicated" or "persistently poorly controlled", whereas the other twelve had poorly controlled T2DM with HbA1c ≥ 59 mmol/mol (7.5%) as per the review inclusion criteria. Twenty-four of the 38 studies reported SBP results (22-25, 30-36, 38, 39, 41, 45, 46, 48-51, 54, 58, 59, 61) and of these, twenty reported DBP (22-25, 31, 32, 34-36, 38, 39, 41, 45, 46, 48, 49, 51, 54, 58, 61). Seventeen of the studies reported a lipid outcome (23, 24, 30-32, 35, 36, 38, 39, 41, 45, 46, 48, 51, 56, 58, 61). All of the 38 studies reported at least one secondary outcome. Two studies were excluded from primary outcome analysis due to lack of appropriate data, despite efforts to contact authors (31, 60).

Interventions were all complex with multiple components. Studies were categorised based on the predominant intervention element using the EPOC taxonomy. The included interventions were categorised as predominantly patient-centred (n=18, 47%); organisational (n=18, 47%), financial (n=1, 3%) or professional (n=1, 3%). One study (Long et al. 2012) comprised two intervention arms with a patient-centred and financial intervention (included as a patient-centred predominant intervention in our analysis). Descriptions of the interventions are outlined in *Table 1.*

The eighteen patient-centred interventions in our review included four telephone-

(34, 41, 56, 58), four computerised/ mobile phone based- (32, 36, 52, 60), one video-based- (51), four peer-support- (30, 38, 44, 49), three self-monitoring-based (37, 50, 63) and two-culturally-supportive self-management interventions (39, 45). The 18 organisational interventions included five pharmacist interventions performing case management (35, 40, 47, 48, 57), six nurse case management interventions (23, 31, 46, 53, 55, 59), three web-based/ telemedicine/ telephone case management interventions (24, 25, 62), two new-clinic-based interventions (43, 54), one community health-worker intervention (61) and one psychological intervention (22). More detailed descriptions of the interventions are outlined in *Appendix 3*.

Risk of bias

All 38 studies were RCTs, with six being cluster RCTs. Overall, 22 studies were classified as having a predominant low-risk of bias (58%) (22-24, 32-36, 39, 41, 42, 45, 46, 51, 53-55, 58-60, 62, 63), twelve studies had an unclear-risk (32%) (25, 30, 31, 37, 38, 40, 44, 47, 49, 56, 57, 61) and four RCTs were classified as having a high-risk of bias (10%) (43, 48, 50, 52) (*Appendix 4*). Blinding of outcome assessment was classified as low-risk in all studies. Attrition bias was evident in seven studies. *Appendix 5* outlines the summary judgements for both overall risk of bias and predominant intervention type, which were used in the meta-regression analysis.

There was no evidence of publication bias in the studies included in the HbA1c (p =0.41) or DPB analysis (p=0.29). However, there was some evidence of publication bias in the studies included in the SBP analysis (p <0.01). See *Appendix 6*.

Primary outcomes

HbA1c

Overall 36 of the 38 studies were included in a meta-analysis, which found a mean difference (MD) in HbA1c of -4 mmol/mol (-0.34%) (95% CI; -0.46%, -0.21%) favouring intervention groups, but with statistical heterogeneity (I^2 = 68%). *Figure 2(a)* outlines the overall effect of interventions on HbA1c, across EPOC categories.

Subgroup analyses were performed based upon the predominant organisational

type (*Figure 2(a)*), the baseline HbA1c level (*Figure 2(b)*), study quality (*Figure 2(c)*) and study duration (*Figure 2(d)*). These analyses suggested that organisational interventions (MD in HbA1c of -5 mmol/mol (-0.48%) (95% CI; -0.73%, -0.23%); I^2 = 80%) (more than patient-centred interventions), on those with baseline HbA1c over 80mmol/mol (9.5%) (MD in HbA1c of -7 mmol/mol (-0.60%) (95% CI; -0.84%, -0.36%)); I^2 = 74%) and studies of longer duration (MD in HbA1c of -4 mmol/mol (-0.38%) (95% CI; -0.57%, -0.20%); I^2 = 74%) had better improvements in HbA1c. Studies with a low-risk of bias appeared to have a smaller reduction in HbA1c compared to unclear- and high-risk studies (MD in HbA1c of -3 mmol/mol (-0.28%) (95% CI; -0.42%, -0.21%); I^2 = 57%).

As the overall results showed statistical heterogeneity, meta-regression analysis was also conducted to explore the components of this heterogeneity. As with the meta-analyses, higher baseline HbA1c was associated with a greater reduction in HbA1c (β-Coefficient -0.32 (95% CI; -0.47, -0.18), p<0.001). The predominant-intervention type, risk of bias and study-duration were not associated with improved glycaemic control.

Blood pressure

Overall SBP did not improve in the twenty-three interventions included in the meta-analysis (MD SBP – 0.76 mmHg (95%; CI -2.00, 0.47)) with moderate heterogeneity (I^2 = 40%) () (22-25, 30-36, 38, 39, 41, 45, 46, 48-51, 54, 58, 59, 61). DBP improved modestly in the nineteen studies included in the meta-analysis (MD DBP – 1.21mmHg (95%; CI -2.24, -0.18)) with moderate heterogeneity (I^2 = 48%) (*Appendix 7*) (22-25, 31, 32, 34-36, 38, 39, 41, 45, 46, 48, 49, 51, 54, 58, 61).

In the subgroup analysis, intervention-type did not appear to differentially affect SBP (*Appendix 7*). With DBP however, organisational interventions appeared to improve DBP modestly (MD DBP – 2.66mmHg (95%; CI -4.27, -1.05) (I^2 = 36%)) compared to patient-centred interventions (*Appendix 8*). Meta-regression analysis was not conducted for SBP or DBP as significant heterogeneity was not present.

Lipids

Seventeen of the 38 studies reported total cholesterol, LDL-cholesterol, HDL-cholesterol or triacylglicerides (23, 24, 30-32, 35, 36, 38, 39, 41, 45, 46, 48, 51, 56, 58, 61). Statistically significant improvements in lipids were only demonstrated in four of these 17 studies (31, 32, 45, 48). Baseline lipid levels were generally not reported. Eight of the seventeen studies reported data relating to total cholesterol. Meta-analysis was undertaken on these studies, which indicated no difference in MD (MD Total Cholesterol – 2.19 mg/dl (95% CI -6.5, 2.11); I^2 = 0%) (*Appendix 9*) (35, 36, 38, 41, 45, 46, 58, 61).

Secondary outcomes

All but one the 38 included studies reported at least one of the eligible secondary outcomes (*Appendix 10*). Overall, interventions had very limited effect on secondary outcomes. Twenty-three studies reported other physical outcomes (e.g. BMI, and estimated glomerular filtration rate). Of the twelve studies that reported on weight or BMI, only one showed significant improvement (56). Seven studies reported mental health outcomes (25, 36, 38, 41, 45, 58, 63) with one showing a significant improvement in the Change Mental Component Summary Score (63). Twenty-five studies reported PROMs, ten showing an improvement with the intervention. Nine studies reported medication adherence outcomes, two showing improvement. Sixteen studies reported utilisation outcomes with four improving processes of care.

Discussion

Statement of principle findings

Healthcare interventions have positive, albeit modest, effects on HbA1c in poorly controlled T2DM. Interventions targeting those with a higher baseline HbA1c (≥ 80 mmol/mol (9.5%)) show the greatest effects. There was no evidence of a significant impact on blood pressure or lipids, though baseline control of these risk factors was generally good or of an effect on secondary outcomes. Our results suggest that a targeted approach to T2DM management, focussing on individuals with very poor glycaemic control, may represent a prudent strategy for future management.

Strengths and weaknesses of the study

The methodology of our systematic review addresses key credibility issues (65, 66). The research question was sensible, our search of the literature was exhaustive and our results are outlined clearly for primary and secondary outcomes. The effect of baseline HbA1c was consistent across studies, biologically plausible and was an a priori hypothesis (66).

We performed meta-regression to explore the heterogeneity, which also confirmed the increased effectiveness of interventions on those with HbA1c ≥ 80 mmol/mol (9.5%). However, a major limitation is that meta-regression is usually underpowered to detect anything but very large associations. Though we do not believe the subgroup findings occurred by chance, there remained high heterogeneity and we explored between-study comparisons rather than within-study comparisons (66). An individual patient data meta-analysis would answer further questions not possible in this review. There was some evidence of publication bias in the SBP analysis, but this was not present for the twenty studies reporting DBP.

This study will inform researchers regarding the range of interventions that have been deployed to target patients with poorly controlled T2DM. There is no specific definition for 'poor control' of T2DM in the literature, but by including all studies

that had patients with a HbA1c > 59 mmol/mol (7.5%), we captured the full range of poor glycaemic control. Studies examining poor control of HbA1c possess a risk of regression towards the mean. However, all included studies were RCTs with control groups, which should have accounted for this. Targeted interventions in poorly controlled T2DM need to be distinguished from interventions, which are designed to intensively reduce HbA1c in all patients. Though persons with very poor glycaemic control are also at risk of the adverse effects of hypoglycaemic agents, targeting this population is more likely to reach the right balance of reducing harms of overtreatment and maximising potential benefits (18). The relative importance of targeting glycaemic or cardiovascular risk has been debated in the literature (17). We did not account for medication use in the studies, but given that all included studies were RCTs, which would balance out delivery of medications, we think that differences relating to underlying medication usage relate to how different interventions types promote the intensification of medications.

Comparison with other studies

The existing literature examining healthcare interventions to improve glycaemic control has focussed on a range of approaches. There have been systematic reviews of interventions including QI initiatives, education, self-management support, case-management, adherence to medication and professional interventions, though as outlined previously most have not specifically targeted patients with poor glycaemic control (8, 10, 11).

A synthesis of 27 systematic reviews and 347 randomised controlled trials identified the cost-effectiveness of self-management interventions in T2DM. in all patients with T2DM (67). This overview included studies that targeted all patients with T2DM and found very good evidence that education improves blood glucose control in patients with T2DM in the short term (less than 12 months) and that behavioural and psychological interventions are associated with modest improvements in blood glucose control (HbA1C) (67, 68).. A review of computer-based diabetes self-management interventions to manage T2DM reported a small beneficial effect on blood glucose control (MD of -0.2%) (69). Another recent systematic review of 118

self-management interventions found improvements in HbA1c in 62% of studies. The overall mean effect was to reduce HbA1c by -0.57%, although patients with persistently elevated HbA1c over 9 had greater improvements (70). In our review, patient-orientated interventions, such as self-monitoring of blood glucose and self-management interventions, seemed to be less effective than organisational interventions.

Case management by nurses and other professionals and case management in socially disadvantaged have been shown to be beneficial when targeted at all patients with T2DM and our review supports this conclusion for poorly-controlled populations (5, 71-73). Pharmacist-based interventions have been studied, mainly in outpatient settings or in US primary care, and have been found to be effective and cost-effective (74, 75). The five pharmacist interventions in our review, targeting patients with poorly-controlled T2DM, showed mixed results, but overall had predominantly positive effects on HbA1c.

Attention to, and reporting of, intensification of anti-diabetic medications and patient's adherence to treatment regimens are needed to achieve optimal glycaemic control (76, 77). Evidence regarding adherence in T2DM is mixed. A previous systematic review of twenty one studies that included fourteen RCTs to enhance T2DM treatment adherence in community and hospital settings found that few studies measured or assessed adherence and that interventions to improve adherence did not show benefits or harms (78). A review by Farmer et al. found limited evidence of effect for interventions promoting the monitoring of medication use and brief messaging to support medication adherence in patients with T2DM, though the included studies did not specifically target patients with poorly controlled diabetes (64). Only nine of the 38 included studies in our review looked at adherence to medications as an outcome and only two of these nine studies had a statistically significant effect on adherence (49, 61). The baseline level of adherence varied considerably and studies used different scale ranges.

Our review identified only one professional-based interventions in poorly controlled T2DM, through a physician decision aid (42). Two systematic reviews have examined

the impact of clinical decision support systems (CDSS) on the management of T2DM in primary care - between them looking at twenty eight trials, with varying results but none of these CDSS interventions were designed to promote intensification of prescribing in persons with poor glycaemic control (79, 80).

Future research

There is a need for further research examining professional-based interventions in poorly controlled T2DM, such as CDSS, which promote intensification of medications (76). Studies from jurisdictions outside North America on poorly controlled populations would also be welcome. It is likely that most successful interventions have their impact as a result of intensification of medicines and/ or improving adherence to medicines (76). As adherence was not measured in most of the studies and intensification poorly documented, it is important that future interventions report on these findings. Furthermore organisational interventions could incur significant costs to a health system so cost-effectiveness analyses on future interventions should be undertaken to ensure the modest improvements in HbA1c are beneficial for the health systems.

In conclusion, clinicians and policy makers, when considering organisation of care for T2DM should focus their effects on those patients with very poor glycaemic control (≥80 mmol/mol (9.5%)). Prioritising interventions that emphasise structured organisation of care, which can include intensification and adherence to medications, also seem more likely to deliver optimal results in terms of glycaemic control for T2DM patients.

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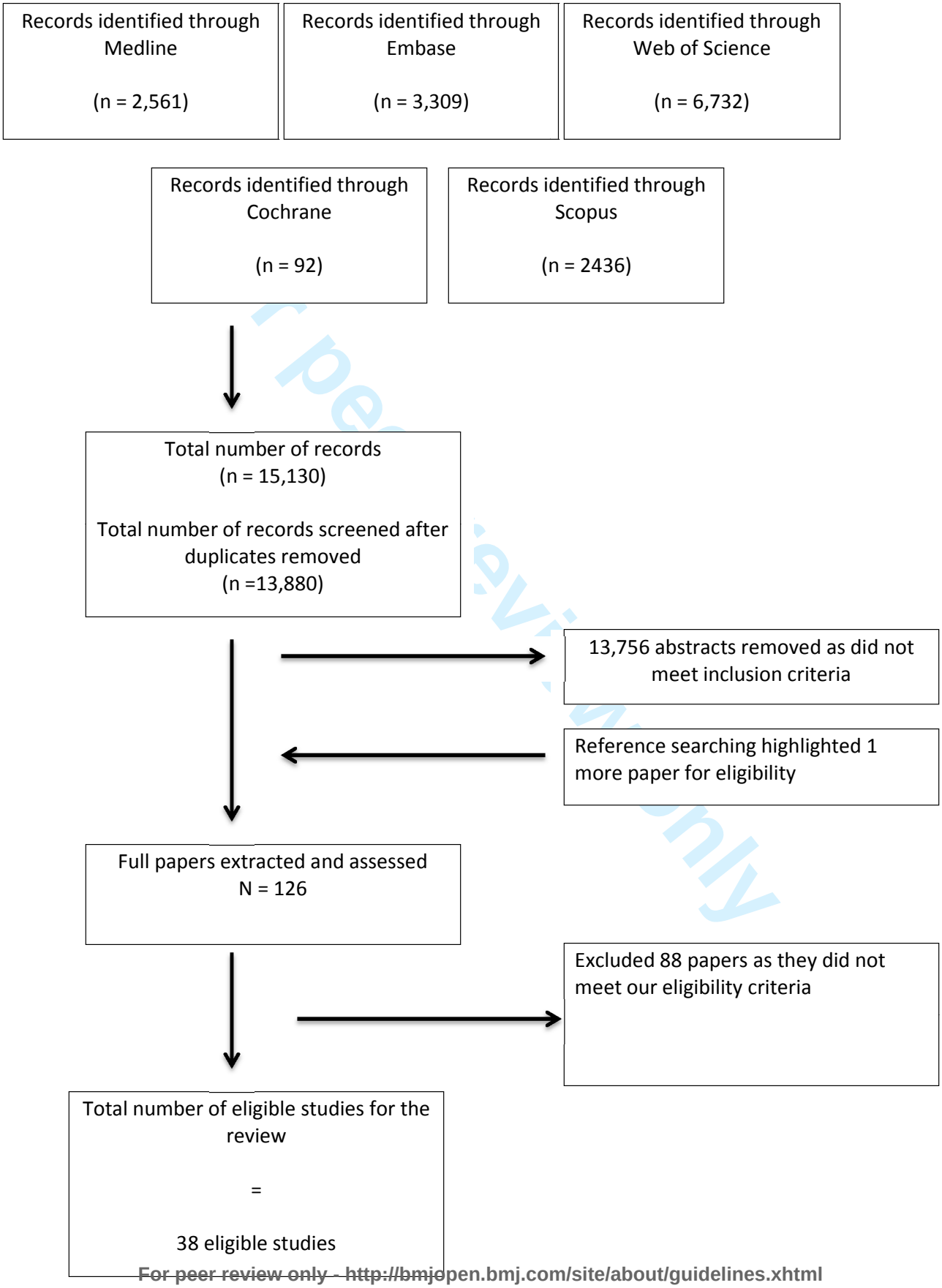
Figure 1: PRISMA Flow Sheet



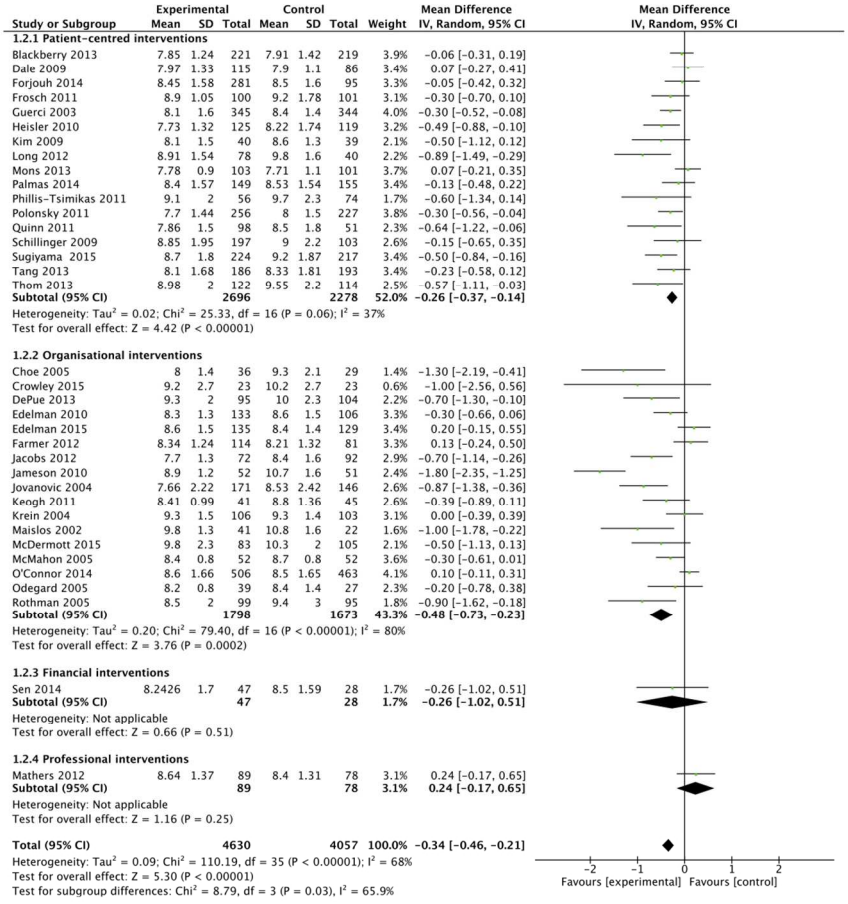


Figure 2a. Effects of interventions on HbA1c, with intervention-type subgroups

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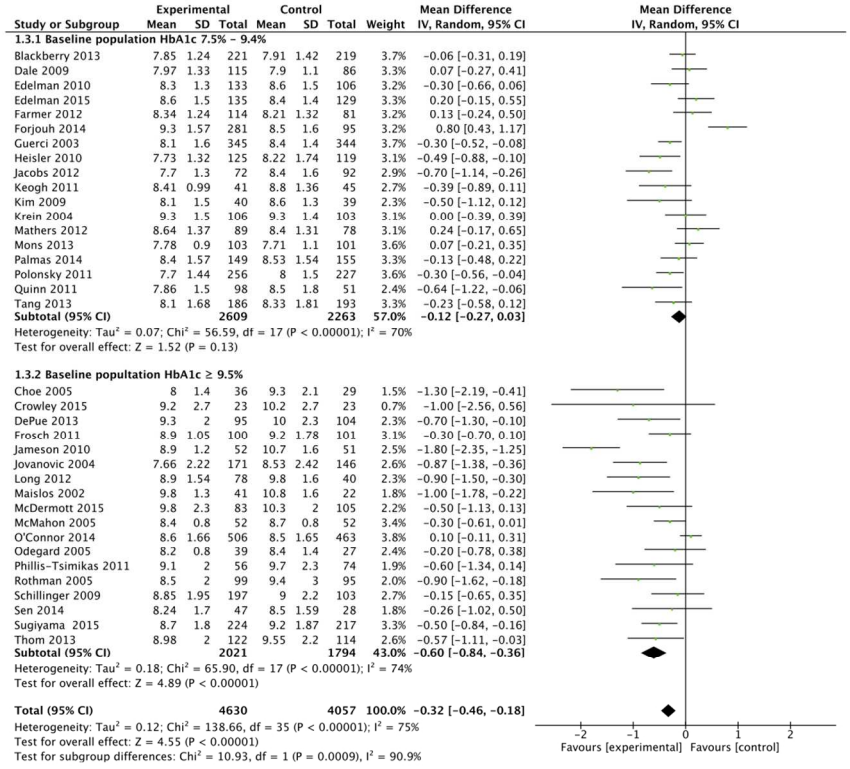

Figure 2b. Effects of interventions on HbA1c, with baseline HbA1c subgroups

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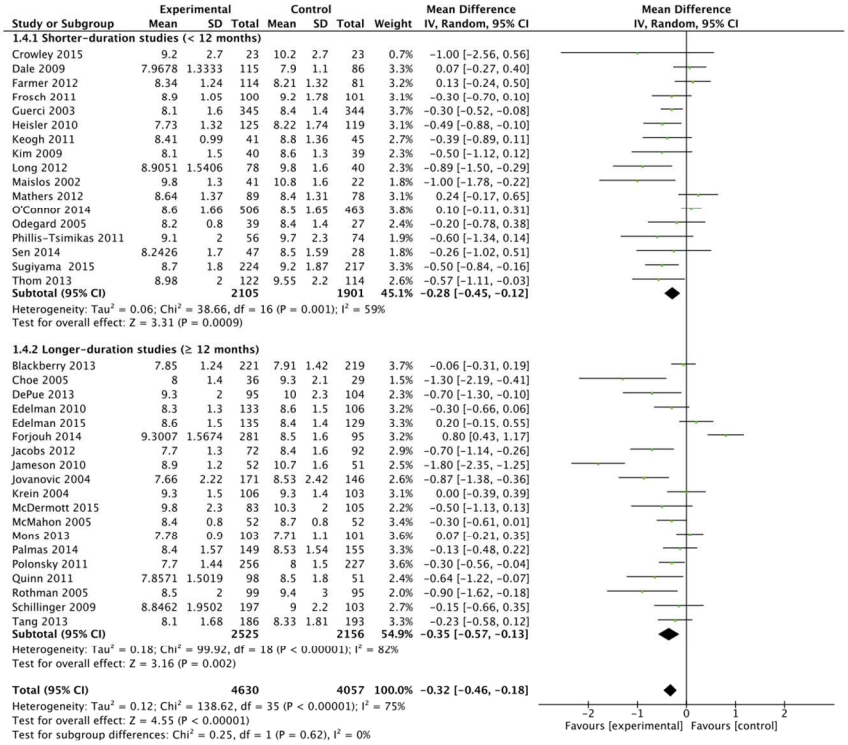

Figure 2c. Effects of interventions on HbA1c, with study quality subgroups

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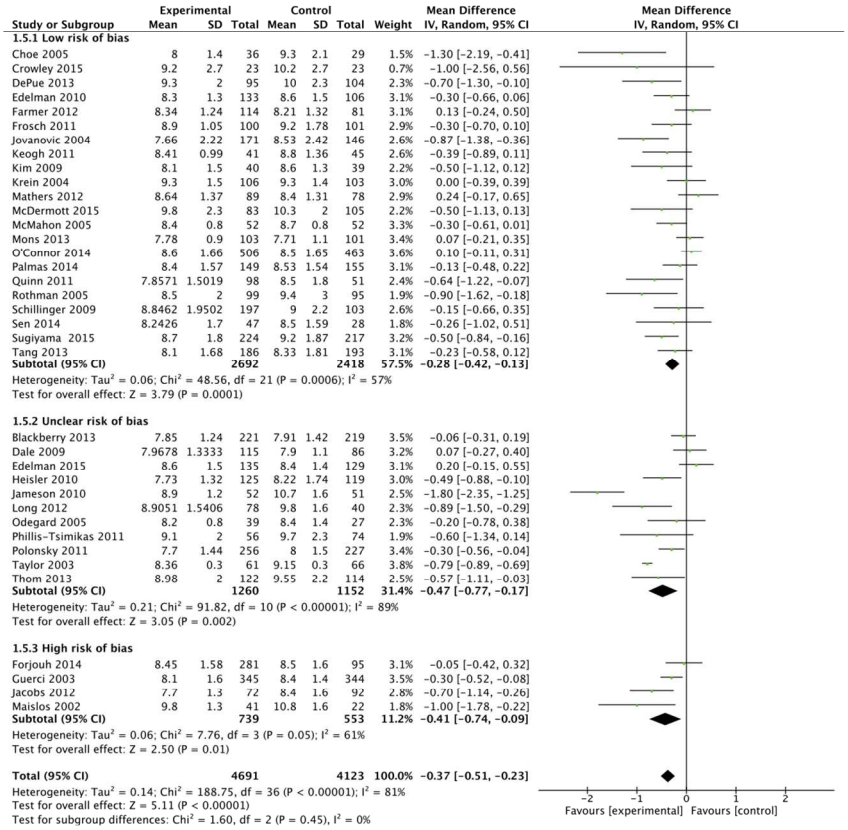

Figure 2d. Effects of interventions on HbA1c, with study duration subgroups

215x279mm (150 x 150 DPI)

Table 1: Characteristics of included studies

Study ID Author, Year Country	**Patient participants** Total patients (n) Intervention (n) Control (n) Age (mean, unless stated) Gender (% male, unless stated) HbA1c cutoff of 'poor control' Baseline HbA1c level (mean) Baseline BP (mean) % on insulin at baseline Diabetes duration: (years) **Practitioner and practice participants**	**Brief Intervention description**	**Predominant Intervention type**	**Outcomes:** **Primary** **Secondary**	**Study duration Months**
Blackberry 2013 Victoria, Australia	**Patient participants** 473 Patients (236 Intervention and 237 Control) Mean age: 62.8 % male: 57% T2DM with HbA1c > 7.5% Mean HbA1c: 8.06 Mean BP: NR % insulin baseline: 27% Mean diabetes duration 10 (5-14 range) **Practitioner and practice participants** 59 practices Practice-based nurses	Telephone coaching by nurses to support diabetes management and self monitoring	Patient-centred	Primary outcomes: HbA1c at 18 months Secondary outcomes: Lipid and TAG profile; eGFR and urine ACR; BP; BMI; waist circumference; smoking status; Quality of Life; Diabetes Self efficacy; Diabetes support; Depression status; Intensification of diabetes. Others: Health service utilization; Physical activity, Nutrition	18 months
Capozza 2015 USA	**Patient participants** 93 patients (58 Intervention; 35 Control) Mean age: 58.7 % male: 35.5% T2DM with HbA1c > 8% Mean Baseline HbA1c 9.1% Mean Baseline BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Recruited from 18 primary clinics	Text-message based behavioural intervention for T2DM	Patient-centred	Primary outcome: Change in HbA1c from day 0 to day 180 Secondary outcomes: Patient interaction and satisfaction (CSQ8) with the program	6 months
Choe	**Patient participants** 80 patients (41 Intervention and 39 Control)	Pharmacist case management	Organisational.	Primary outcome: HbA1c level at 12 months	12 month intervention

2005 USA	Age: 51.0 (all less 70) % male: 46% HbA1c ≥ 8.o% Mean HbA1c 10.1 Mean BP: NR % insulin baseline: 30% Diabetes duration: NR **Practitioner and practice participants** • 1 clinic • 1 pharmacist case manager			Secondary outcomes: Rates of diabetes process measures (LDL, dilated retinal examination, urine ACR or use of ACE Inhibitors, monofilament testing for diabetic neuropathy, by chart review over 24 months); Rate of HbA1c measurement.	with primary outcome reporting at 12 months and a further 24 month follow up.
Crowley 2015 USA	**Patient participants** 50 patients (25 Intervention and 25 Control) Age: 60 % male: 24% HbA1c > 9% Definition: Yes, defined as 'persistently poor diabetes' Mean HbA1c 10.5% Mean SBP: 127/ 80 % insulin baseline: NR Diabetes duration: 12 **Practitioner and practice participants** Patients all receiving care by Durham VA primary care and endocrinology	Intensive telemedicine intervention for veterans	Organisational	Primary outcome: HbA1c Secondary outcomes: Diabetes self-management (Self-care inventory revised); Depression (PHQ-9); Self reported medication adherence (Morisky medication adherence); BP; Adverse events; Telephone encounters	6 months
Dale 2009 England Exploratory RCT	**Patient participants** 231 (90 (PS) Intervention 1, 44 (NS) Intervention 2 and 97 Control) Age: No mean age provided, but wide spectrum of ages from below 50 to over 70 in each of the intervention and control groups. % male: 57% HbA1c ≥7.5% Mean HbA1c: 8.6% Mean BP: NR % insulin baseline: 0% Diabetes duration: No mean, but between 1- 15 years mostly. **Practitioner and practice participants** 29 practices Peer coaching or diabetes specialist nurse delivered	Two intervention telecare groups: a) Peer-support telecare intervention b) Diabetic specialist nurse telecare support	Patient-centred.	Primary outcome: Self efficacy (DMSES) Secondary outcomes: HbA1c; Cholesterol; BMI. Diabetes distress (PAID)	6 months

DePue 2013 U.S. Territory of America Somoa Cluster RCT	**Patient participants** 268 patients (104 Intervention and 164 Control) Age: 55 % male: 38% Intervention did not target poor control per se, mean baseline HbA1c of 9.6% (SD of 2.1%) was deemed eligible for inclusion Mean HbA1c 9.8 Mean BP: 133/ 84 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Cluster RCT based upon twelve village units Nurse care managers	Nurse–Community Health Worker Team in American Somoa	Organisational.	Primary outcome: HbA1c Secondary outcomes: BP; BMI; Dietary intake; Medication adherence; Physical activity; Adapted measures of diabetes beliefs	12 months
Edelman 2010 North Carolina and Virginia, USA.	**Patient participants** 239 patients (133 Intervention and 106 Control) Age: 61.9 % male: 96% T2DM HbA1c >7.5 AND (SPB > 140 DBP > 90) Mean HbA1c: 9.2% Mean BP: 152/ 84 % insulin baseline: unclear Duration of diabetes: NR **Practitioner and practice participants** 2 VA centres A care team involving internist, pharmacist, a nurse and educator	Enrollment into a general medical clinic (GMC) with an internist, pharmacist and a nurse or educator that met seven times over 12 months	Organisational.	Primary outcomes: HbA1c Secondary outcomes: Systolic blood pressure; Adherence to medications; Self-efficacy; Adverse events through structured self report and medical record review; Health utilization; Cost data	12 months
Edelman 2015 USA	**Patient participants** 377 patients (193 Intervention and 184 Control) Age: 58.7 % male: 45.4% HbA1c ≥ 7.5 (and HTN) Mean HbA1c 9.1% Mean BP: 142.2/ 80.7 % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants**	Nurse case management	Organisational	Primary outcome: HbA1c Secondary outcomes: BP; Weight; Physical activity; Self-efficacy; Health literacy; Medication adherence (via self report)	24 months

	9 primary care practices in Duke.				
Farmer 2012 UK	**Patient participants** 211 patients (126 Intervention and 85 Control) Age: 63.2 % male: 65% HbA1c ≥ 7.5% Mean HbA1c: 8.3% Mean BP: 136.9/ 78.2 % insulin baseline: NR Mean diabetes duration: 6.8 years **Practitioner and practice participants** 13 practices Practice nurses	Nurse-led, multilevel intervention to support medication adherence	Organisational	Primary outcome: % days over a 12 week period on which the correct number of doses of main glucose lowering medication was taken each day as prescribed. Secondary outcomes: Hba1c at 0 and 20 weeks (from protocol); Functional status as per SF 12 Physical and SF 12 Mental; Diabetes treatment satisfaction and satisfaction with nurse; MARS Self reported adherence (range 5-25); % reporting hypoglycaemia	12 weeks (intervention was 8 weeks into a 20 week trial)
Forjouh 2014 USA	**Patient participants** 376 patients (101 Intervention 1 (CDSMP), 81 Intervention 2 (PDA), 99 Intervention 3 (PDA, CDSMP and 95 Control) Age: 57.6 % male: 44.0% HbA1c >7.5% Mean HbA1c: 9.3 Mean BP: 134.8/ 77 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 7 practices involved Technology intervention	Three intervention groups, reflecting the individual and combined effects of a behavioural and technology intervention; a chronic Disease Self-Management Program (CDSMP) and a diabetes self-care software on a personal digital assistant (PDA).	Patient-centred	Primary: HbA1c Secondary: BMI; BP; Self management behavioural measures (e.g. foot care)	12 months
Frosch 2011 USA	**Patient participants** 201 patients (100 Intervention and 101 Control) Age: 55.5 % male: 51.5% HbA1c > 8.0 Mean HbA1c: 9.6% Mean BP: 127.7/ 74.0 % insulin baseline: NR Mean diabetes duration: 9.5 **Practitioner and practice participants** 3 academic primary care practices and 1 community based safety net clinic Nurse educators	A video behavioural support intervention by nurse educators with a workbook followed by 5 sessions of telephone coaching.	Patient-centred	Primary: HbA1c Secondary: LDL Cholesterol; BP; BMI; Prescribed medications; Diabetes knowledge (23 point Diabetes knowledge test); Self-care behaviours (SDSCA)	Unclear, possibly over 6 months

Guerci 2003 France	**Patient participants** 988 patients (510 Intervention and 478 Control) Age: 60.6 % male: 53.7% HbA1c ≥ (7.5 and 11) diabetes. Mean HbA1c 8.95% Mean SBP: 139.6, 80.4 % insulin baseline: 0% Mean diabetes duration months: 96.6 **Practitioner and practice participants** 265 GPs involved, uncertain number of practices	A self-monitoring of blood glucose intervention Auto-Surveillance Intervention Active (ASIA) study.	Patient-centred	Primary: HbA1c Secondary: Changes in fasting glucose; Symptomatic hyoglycaemia; BP; Weight; Diet; Drugs; Adverse drug event	6 months
Heisler 2010 USA	**Patient participants** 244 patients (126 Intervention and 119 Control (NCM)) Age: 62.0 % male: 100% HbA1c > 7.5% Mean HbA1c 7.98 Mean BP: 138.4/ 76.5 % insulin baseline: 56% Diabetes duration: NR **Practitioner and practice participants** Two VA facilities Nurse and peer case managers	Reciprocal peer support	Patient-centred	Primary HbA1c 6 months Secondary: Medication adherence; Diabetes emotional distress; Diabetes specific social support; Medication changes Attendance at clinics	6 months
Jacobs 2012 USA	**Patient participants** 396 patients (195 Intervention and 201 Control) Age: 62.9 % male: 50% HbA1c > 8.0% Mean HbA1c 9.35 Mean BP: 138.7/ 78.9 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 5 pharmacists, patients came from practices of 66 primary care physicians.	A pharmacist assisted medication program intervention	Organisational	Primary No specific primary outcome given or sample size: Secondary: HbA1c < 7%; LDL Cholesterol < 100mg/dl; BP < 130/ 80mmHg	12 months

Jameson 2010 USA	**Patient participants** 104 patients (52 Intervention and 52 Control) Age: 49.6 % male: 49% HbA1c ≥ 9.0% (two of the population had T1DM) Mean HbA1c: 10.8% Mean BP: NR % insulin baseline: 49.6% Mean diabetes duration: NR **Practitioner and practice participants** 1 pharmacist.	A pharmacist collaborative management intervention	Organisational	Primary: HbA1c Secondary: % of patients with a 1.0% decrease in HbA1c.	12 months
Jovanovic 2004 USA	**Patient participants** 362 patients (186 Intervention and 172 Control) Age: 57.0 % male: 23.8% HbA1c > 7.5 Mean HbA1c: 9.65% Mean BP: 135/ 79 % insulin baseline: NR Mean diabetes duration: 11.1 **Practitioner and practice participants** Unclear number of case managers and practices	Diabetes case management by a nurse or dietician	Organisational	Primary: HbA1c Secondary: % participants achieving HbA1c goals medication usage; BP ; Lipids; BMI; Frequency of hypoglycaemia	36 months
Keogh 2011 Ireland	**Patient participants** 121 patients (60 Intervention and 61 Control) Age: 58.6 % male: 64% HbA1c ≥ 8.0% Median HbA1c: 9.2 Mean BP: 138.8/ 76.8 % insulin baseline: 52% Mean diabetes duration: 9.4 **Practitioner and practice participants** One practice One psychologist	Psychological family intervention	Organisational	Primary outcome: Hba1c Secondary outcomes: Illness perceptions (Brief illness Perception Questionnaire); Psychological wellbeing (12-item Well-Being questionnaire); BP; BMI; Diabetes self management (Summary of Diabetes Self-care Activities Questionnaire); Self Efficacy (UK version Diabetes Self-Efficacy Scale); Family support (Diabetes Family Behaviour Checklist).	6 months
Kim 2009 USA	**Patient participants** 83 patients (41 Intervention and 42 Control) Age: 56.4 % male: 55.4% HbA1c ≥ 7.5%	A Community-based, culturally tailored behavioral intervention	Patient-centred	Primary: HbA1c Secondary: Diabetes knowledge test (DKT)' Self efficacy (Stanford Chronic Disease Self-Efficacy scale); Self care	30 weeks (7 months) 6 month intervention

	Mean HbA1c: 9.25% Mean BP 132.1/ 79.3 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Uncertain number practices Community nurse delivered			(Diabetes self care activitiis (SDSCA); Depression (Kim Depression Scale for Korean Americans); Quality of Life (Diabetes Quality of Life Measure (DQOL); Lipids; BP; BMI	
Krein 2004 USA	**Patient participants** 246 patients (123 Intervention and 123 Control) Age: 61 % male: 97% HbA1c ≥7.5% Mean HbA1c 9.25 Mean BP: 145/ 86 % insulin baseline: 59% Mean diabetes duration: 11 **Practitioner and practice participants** One VA centre, unclear number of practices Two nurse case managers	Case management by nurse practitioners	Organisational	Primary: HbA1c Secondary: LDL; Cholesterol; BP; Health status; Patient satisfaction; Inpatient and outpatient encounters, pharmacy and laboratory use; Semi structured interviews also done.	18 months
Long 2012 USA	**Patient participants** 118 patients (38 Intervention 1 (PM), 40 Intervention 2 (FI) and 39 Control) Age: 60 % male: 94% HbA1c > 8.0% (two patients may have had T1DM) HbA1c Mean: 9.7 Mean BP: NR % insulin baseline: 74% Mean diabetes duration: NR Diabetes over 10 years: 58% **Practitioner and practice participants** Unclear number of practices Peer mentors	Two interventions: Peer mentoring Financial incentivisation of patients	Patient-centred	Primary: Hba1c Secondary: Patient recollection of hypoglycaemic event	6 months
Maislos 2002 Israel	**Patient participants** 82 patients (48 Intervention and 34 Control) Age: 60.5 % male: 29.5% HbA1c ≥ 10% Mean HbA1c 11.35 Mean BP: NR	A mobile clinic providing interdisciplinary care	Organisational	Primary: Decrease of HbA1c of 0.5% at six months Secondary: Compliance with study protocol at six months	6 months

	% insulin baseline: 20% Duration diabetes: 10 **Practitioner and practice participants** 2 practices involved via 1 mobile clinic				
Mathers 2012 UK Cluster RCT	**Patient participants** 175 patients (95 Intervention and 80 Control) Age: 64 % male: 54% HbA1c ≥ 7.5 Mean HbA1c: 8.7% Mean BP: NR % insulin baseline: NR Duration diabetes: 7.8 **Practitioner and practice participants** 49 practices involved GPs and nurses from practices delivered intervention	Patient decision aid to improve decision quality and glycaemic control	Professional	Primary: HbA1c Secondary: Decisional conflict scale score- indicator of decision quality; Knowledge and realistic expectations of the risks and benefits; Regret scale	6 months
McDermott 2015 Australia Cluster RCT	**Patient participants** 213 patients (113 Intervention and 100 Control) Age: 47.9 % male: 37.6% HbA1c ≥ 8.5 (69mmol/mol) Mean HbA1c 10.7 Mean BP: 131/ 79.3 % insulin baseline: 44.4% Diabetes duration: NR **Practitioner and practice participants** 12 remote communities in north Queensland.	Community-based health-worker led case management approach to the care of Indigenous adults with poorly controlled type 2 diabetes in primary care services in remote northern Australia	Organisational	Primary outcome: HbA1c level at 18 months Secondary outcomes: BP BMI Lipids Medications ACR eGFR Test of Functional Health Literacy for Adults (TOFHLA) Assessment of Quality of Life (AQoL) instrument Implementation Fidelity	18 months
McMahon 2005 USA	**Patient participants** 104 patients (52 Intervention and 52 Control) Age: 63.5 % male: 99% HbA1c ≥ 9% Mean HbA1c: 10.0% Mean BP: 140/ 81 % insulin baseline: 54% Duration diabetes: 12.3 years **Practitioner and practice participants** Practice number unclear	Web-based care management	Organisational	Primary: HbA1c Secondary Systolic BP Diastolic BP TAG LDL Cholesterol HDL Cholesterol	12 months

	Care manager available				
Mons 2013 Germany	**Patient participants** 204 patients (103 Intervention and 101 Control) Age: 67.5 % male: 61% HbA1c > 7.5% Mean HbA1c: 8.1% Mean BP: 137.5/ 80 % insulin baseline: NR Duration diabetes: NR **Practitioner and practice participants** 10 GP practices Practice nurses	Supportive telephone counseling	Patient-centred	Primary HbA1c Secondary Systolic BP; Diastolic BP; Cholesterol; Health related quality of life (Short Form General Health Survey: SF-12); Symptoms of depression: Geriatric depression scale	18 months
O'Connor 2014 USA **Cluster RCT**	**Patient participants** 1102 patients (569 Intervention and 533 Control) Age: 43% ≥ 65 years. ~ 61 mean % male: 51.3% HbA1c ≥ 8% Mean HbA1c: 9.8% Mean BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Large medical groups in California. Clusters defined on their linkage to primary care physicians.	Telephone Outreach to Improve Medication Adherence and Metabolic Control in Adults With Diabetes	Organisational	Primary Outcome: Medication adherence (at least one prescription fill within 60 days of prescription date). Secondary Outcomes: Medication persistence (two or more prescription fills within 180 days); HbA1c; BP; Lipids	6 months
Odegard 2005 USA	**Patient participants** 77 patients (43 Intervention and 34 Control) Age: 51.8 % male: 57% HbA1c ≥ 9.0% Mean HbA1c: 10.4% Mean BP: NR % insulin baseline: 32% Duration diabetes: 7.6 **Practitioner and practice participants** 7 primary care clinics Pharmacists: Unclear number	A pharmacist intervention care management intervention	Organisational	Primary HbA1c 12 months Secondary: Medication appropriateness (Medication Appropriate Index/ MAI); Self reported adherence by questionnaire	6 month intervention but HbA1c at 12 months

Palmas 2014 USA	**Patient participants** 360 patients (181 Intervention and 179 Control) Age: 57.6 % male: 38% HbA1c ≥ 8.0% Mean HbA1c: 8.7% Mean BP: 136/ 81 % insulin baseline: NR Duration diabetes: NR **Practitioner and practice participants** Unclear number GP practices Two community health workers	Community health worker (CHW) intervention in an Hispanic population	Patient-centred	Primary: HbA1c Secondary: Systolic BP; Diastolic BP; LDL Cholesterol; Medication adherence; Dosage and intensity; Physical activity; Diet; Depression	12 months
Phillis-Tsimikas 2011 USA	**Patient participants** 207 patients (104 Intervention and 103 Control) Age: 50.7 % male: 29.5% HbA1c > 8.0% Mean HbA1c: 10.4% Mean BP: 122.6/75 Duration diabetes: NR % insulin baseline: NR **Practitioner and practice participants** Unclear number GP practices participating Peer educators	Peer-led diabetes education programs in high-risk Mexican Americans	Patient-centred	Primary: HbA1c Secondary: Lipids; BP; BMI; Self management behaviours and Depression (in separate publication)	10 months Intervention was 4 months and primary outcome was 6 months after this.
Polonsky 2011 USA Cluster RCT	**Patient participants** 499 patients (256 Intervention and 227 Control) Age: 55.8 % male: 53.2% HbA1c > 7.5% Mean HbA1c: 8.9 Mean BP: NR % on insulin: 0% Duration diabetes: 7.6 **Practitioner and practice participants** 34 GP practices participating	Self blood glucose monitoring	Patient-centred	Primary: Hba1c Secondary: Treatment intensification; Total number of visits with medication or lifestyle modifications; Time to the first treatment change; Frequency of SMBG; GWB from WHO-5 Well-Being Index	12 months
Quinn 2011	**Patient participants** Cluster trial, 3 intervention groups, 1 control 163 patients (Intervention 1 (CO) 23,	Mobile phone-based treatment/ behavioural coaching intervention	Patient-centred	Primary: HbA1c	12 months

USA Cluster RCT	Intervention 2 (CPP) 22, Intervention 3 (CPDS) 62 and Control 56) Age: 52.9 (weighted average) % male: 52.5% (weighted average) HbA1c ≥ 7.5% Mean HbA1c: 9.4 Mean SBP: 131/ NR % insulin baseline: NR Duration diabetes: 8.2 **Practitioner and practice participants** 26 GP practices participating			Secondary: PHQ-9 questionnaire for depressive symptoms; Self completion patient outcome instrument; Diabetes Distress Scale; BP; Lipids; Hypoglycaemic events; Hospitalisations and ED visits	
Rothman 2005 USA	**Patient participants** 217 patients (112 Intervention and 105 Control) Age: 55.5 % male: 44% HbA1c ≥ 8.0% Mean HbA1c: 11 Mean BP: 138.5/ 81 % insulin baseline: 39% Duration diabetes: 8.5 **Practitioner and practice participants** Three pharmacists	A primary care-based disease management program delivered by trained pharmacists.	Organisational	Primary: HbA1c Secondary: BP; Aspirin; Lipids; Diabetes knowledge Satisfaction (Diabetes Treatment Satisfaction Questionnaire); Use of clinical services; Adverse events; Process measures (time spent with patients and medication changes)	12 months
Schillinger 2009 USA	**Patient participants** 339 patients (112 intervention 1 (ATSM), 113 intervention 2 (GVC) and 114 Control) Age: 56.1 % male: 41 % HbA1c ≥ 8.0% Mean HbA1c: 9.5% Mean BP: 140/ 77.3 % insulin baseline: 38% Duration diabetes: 9.5 **Practitioner and practice participants** Uncertain number GPs- in a safety net health system	Two interventions: Self-Management Support via 1/ Automated telephone self management support (ATSM) and 2/ Group medical visits (GMVs).	Patient-centred	Primary: Self management behaviour Secondary: Patient assessment of chronic illness care (PACIC); Diabetes Quality Improvement Program; Interpersonal Processes of Care for Diverse Populations (IPC) instrument; Self management behavior (Foods, diets, exercise, self monitoring); SF-12 instrument for QoL; Functional status- likert scale; HbA1c; SBP; DBP; BMI	12 months
Sen 2014	**Patient participants** 75 patients (21 Intervention 1 (low), 26 Intervention 2 (high) and 28 Control) Age: 54.3	Financial incentives for home based monitoring- two interventions	Financial	Primary: Adherence over three months Secondary: HbA1c	12 weeks

USA	% male: 36% HbA1c ≥ 7.5% (90-95% had T2DM from personal correspondence with author) Mean HbA1c 9.5% Mean BP: 132.9/ 86.1 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 1 practice				
Sugiyama 2015 USA	**Patient participants** 516 patients (258 Intervention and 258 Control) Age: 63 % male: 30% HbA1c ≥ 8.0% Mean HbA1c: 9.7 Mean BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Participants were recruited from senior centers, churches, community clinics, and Los Angeles County Community and Senior Service Centers	Diabetes self management education by trained health educators.	Patient-centred	Primary: HbA1c Secondary: Change Mental Component Summary Score (MCS-12) from the SF-12; Social support score from the Diabetes Care Profile	6 months
Tang 2013 USA	**Patient participants** 415 patients (203 Intervention and 213 Control) Age: 54 % male: 60% HbA1c ≥ 7.5% Mean HbA1c: 9.3 Mean BP: 126.6/ 72.7 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Uncertain number practices	Online disease management of diabetes	Patient-centred	Primary: HbA1c Secondary: SBP; DBP; LDL; 10 year Framingham risk; Satisfaction; Psychosocial wellbeing; Healthcare utilization	12 months
Taylor 2003 USA	**Patient participants** 169 patients (84 Intervention and 85 Control) Age: 55.2 % male: 52.7% HbA1c > 10.0% Mean HbA1c: 9.5%	Nurse care management (NCM)	Organisational	Primary: % of patients in 'target' HbA1c Secondary: Total cholesterol; HDL Cholesterol; LDL cholesterol; TAGs; Glucose; Microalbuminuria; SBP; DBP; Processes of care (foot, eye, dental exam and flu shot);	12 months

	Mean BP: 127.5/ 72.8 % insulin baseline: NR Mean diabetes duration NR **Practitioner and practice participants** Uncertain number practices Nurse care managers			Psychosocial (SF 26 for QoL and Duke Activity Status); Patient and physician satisfaction; Medical utilization (physician visits)	
Thom 2013 USA	**Patient participants** 299 patients (151 Intervention and 148 Control) Age: 55.2 % male: 47.8% HbA1c ≥ 8.0% Mean HbA1c: 10.0 Mean BP: 143.2/ NR % insulin baseline: 55% Mean diabetes duration: 8.9 **Practitioner and practice participants** 6 practices included Peer coaches	Peer health coaching	Patient-centred	Primary: HbA1c Secondary: % patients whose HbA1c dropped 1%; % patients with a HbA1c less 7.5; LDL; SBP; BMI	6 months

Glossary of abbreviations:

ACR (albumin-creatinine ratio), AQoL (assessment of quality of life), ATSM (automated telephone self management support) , BMI (body mass index), BP (blood pressure), CDSMP (chronic disease self-management program) , CO (coach-only), CPDS (coach primary care provider portal with decision support), CPP (coach primary care physician portal), CSQ8 (client satisfaction scale 8), DBP (diastolic blood pressure), DMSES (diabetes management self efficacy scale) , DQOL (diabetes quality of life measure), ED (emergency department), eGFR (estimated glomerular filtration rate), FI (financial incentivisation), GMV (group medical visits), GWB (blobal well being), LDL (low density lipoproetin), MAI (medication appropriate index), MARS (medication adherence rating scale), MCS-12 (mental component summary score), NR (not recorded), PACIC (Patient assessment of chronic illness care), PAID (problems areas in diabetes scale), PDA (personal digital assistant), PHQ-9 (patient health questionnaire 9), PM (peer mentoring), SBP (systolic blood pressure), SDSCA (summary of diabetes self-care behaviours scale), SF-12 (short Form general health survey), T2DM (type 2 diabetes mellitus), TOFHLA (test of functional health literacy for adults), VA (veteran's affairs), WHO (World Health Organisation).

Appendix 1: Search String

Pubmed/ Medline

Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled

AND

Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin

AND

primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR OR health care provider OR case manager OR “case management” OR “care management”

(((primary care[Title/Abstract] OR primary health[Title/Abstract] OR (family physician[Title/Abstract] OR family physicians[Title/Abstract]) OR (general practicability[Title/Abstract] OR general practice[Title/Abstract] OR general practice,[Title/Abstract] OR general practices[Title/Abstract] OR general practician[Title/Abstract] OR general practicians[Title/Abstract] OR general practicioner[Title/Abstract] OR general practicioners[Title/Abstract] OR general practictioner[Title/Abstract] OR general practictioners[Title/Abstract] OR general practiioners[Title/Abstract] OR general practioner[Title/Abstract] OR general practioners[Title/Abstract] OR general practionner[Title/Abstract] OR general practionners[Title/Abstract] OR general practise[Title/Abstract] OR general practises[Title/Abstract] OR general practitioner[Title/Abstract] OR general

practitioner's[Title/Abstract] OR general practitioners[Title/Abstract] OR general practitionner[Title/Abstract] OR general practitionners[Title/Abstract] OR general practive[Title/Abstract]) OR (family practice[Title/Abstract] OR family practices[Title/Abstract] OR family practioner[Title/Abstract] OR family practise[Title/Abstract] OR family practitioner[Title/Abstract] OR family practitioners[Title/Abstract]) OR outpatient?[Title/Abstract] OR clinic?[Title/Abstract] OR ambulatory[Title/Abstract] OR health centre?[Title/Abstract] OR health centre?[Title/Abstract] OR office[Title/Abstract] OR veterans[Title/Abstract] OR pharmacist[Title/Abstract] OR nurse[Title/Abstract] OR doctor[Title/Abstract] OR psychologist[Title/Abstract] OR health care provider[Title/Abstract] OR case manager[Title/Abstract] OR "case management"[Title/Abstract] OR "care management"[Title/Abstract]) AND ("1990/01/01"[PDAT] : "2014/11/26"[PDAT])) AND ((Lipid[Title/Abstract] OR cholesterol[Title/Abstract] OR blood pressure[Title/Abstract] OR hypertension[Title/Abstract] OR cardiovascular risk[Title/Abstract] OR glycaemic[Title/Abstract] OR glycemic[Title/Abstract] OR HbA1c[Title/Abstract] OR A1c[Title/Abstract] OR (HbA[Title/Abstract] AND 1c[All Fields]) AND Title/Abstract[All Fields] OR haemoglobin[Title/Abstract] OR hemoglobin[Title/Abstract]) AND ("1990/01/01"[PDAT] : "2014/11/26"[PDAT]))) AND ((Diabetes[Title/Abstract] OR T2D$[Title/Abstract] OR NIDDM[Title/Abstract] OR MODY[Title/Abstract] OR Non-insulin dependent[Title/Abstract] OR Insulin[Title/Abstract] OR IDDM[Title/Abstract] OR Poorly-controlled[Title/Abstract]) AND ("1990/01/01"[PDAT] : "2015/12/31"[PDAT])) AND ("1990/01/01"[PDAT] : "2015/12/31"[PDAT])

WoS search

TS = (Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled)

AND

TS = (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin)

AND

TS = (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office)

TI = (Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled) AND TS = (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin) AND TS = (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office)

Indexes=SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH Timespan=1990-2015

SCOPUS

lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk

OR glycaemic OR glycemic OR hba1c OR a1c OR (hba AND (1c)) OR haemoglobin OR hemoglobin AND diabetes OR t2d$ OR niddm OR mody OR non-insulin dependent OR insulin OR iddm OR poorly-controlled AND primary care OR primary health OR family physician* OR general practi* OR family practi* OR outpatient? OR clinic? OR ambulatory OR health centre? OR health centre? OR office AND (EXCLUDE (SUBJAREA , "DENT") OR EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "DENT") OR EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "ARTS") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "ENGI") OR EXCLUDE (SUBJAREA , "BUSI") OR EXCLUDE (SUBJAREA , "ECON") OR EXCLUDE (SUBJAREA , "VETE") OR EXCLUDE (SUBJAREA , "MATE") OR EXCLUDE (SUBJAREA , "COMP") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "EART") OR EXCLUDE (SUBJAREA , "PHYS"))

1990- 2015 Title abstract

Embase

(primary care OR primary health OR family physician* OR general practi* OR family practi* OR outpatient? OR clinic? OR ambulatory OR health centre? OR health centre? OR office OR veterans OR pharmacist OR nurse OR doctor OR psychologist OR OR health care provider OR case manager OR case management OR care management):ab,ti

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(Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled):ab,ti

Cochrane Library = 74

(Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled)

AND

(Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin)

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(primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR health care provider OR case manager OR case management OR care management)

(Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled) AND (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin) AND (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR health care provider OR case manager OR case management OR care management) in Title, Abstract, Keywords in Cochrane Reviews

Appendix 2

Appendix 2: Cochrane Effective Practice And Organisation of Care Review Group taxonomy of interventions:	
Professional interventions	For example; distribution of educational materials to healthcare professional, or educational meetings, or audit and feedback.
Organisational interventions	For example; Revision of professional role (e.g. community pharmacist providing case management for patient with diabetes) or skill mix changes (changes in numbers, types or qualifications of staff). Included telemedicine interventions with predominant organisational elements.
Patient-orientated interventions	For example; patient education, peer support or support for self management. Including telephone and telemedicine interventions with predominant patients elements (with focus on self-management)
Financial interventions	For example; Fee-for-service for provider or a penalty for the patient.
Regulatory interventions	For example; changes to local or national regulations designed to alter care delivery to improve outcomes.

Appendix 3: Detailed description of study interventions

N	Study	Brief intervention description	Intervention description
N.	Author Year Country	Brief Intervention description	Intervention description (detailed) Length intervention Predominant Intervention type Comparison
1	Blackberry 2013 Victoria, Australia	Telephone coaching by nurses to support diabetes management and self monitoring	The PEACH study: GP based nurse led telephone coaching; dealing with lifestyle issues, medication adherence and dosing, self monitoring of their disease, how to take greater initiative in the therapeutic alliance with their doctor, facilitating appropriate intensification of medications to achieve treatment goals. Nurses did not have prescribing rights. Length: In the first six months there were five telephone-coaching sessions at intervals of six weeks in the first six months, a coaching session at 8 and 10 months, a face-to-face coaching session at 12 months and a final coaching session at 15 months. Predominant EPOC intervention type: Patient-centred Comparison: Usual general practice care
2	Capozza 2015 USA	Text-message based behavioural intervention for T2DM	Receipt of 1-7 test diabetes-related messages per day, depending on the choices they made at enrolment. The content of the text messages were reviewed by certified diabetes educators and patients had control over the types and frequency of the messages. Users could turn off the program by texting the word 'stop'. The core messages related to diabetes education and health improvement (medication reminders, glucose testing reminders, BP measurement reminders and encouraging weight loss). Patients could reply to messages to get feedback. Length: 6 months of text messages

			Predominant EPOC intervention type: Patient Comparison: Usual care
3	Choe 2005 Michigan, USA	Pharmacist case management	The case manager was a clinical pharmacist who was already established as a pharmacotherapy consultant at the clinic before the start of the intervention. The clinical pharmacist evaluated patient's therapeutic regimens based on efficacy, safety, adverse effects, drug interactions, drug costs and monitoring. All therapeutic recommendations were discussed with the primary care provider before significant therapy alterations. The pharmacist also followed up on these recommendations. Face to face consultations between pharmacist and physician were included. Length: Initial one-hour consultation with patient and monthly telephone contact thereafter and saw patients in conjunction with their routine primary care visits for one year. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
4	Crowley 2015 USA	Intensive telemedicine intervention for veterans	An advanced comprehensive diabetes care (ACDC) program, including telemonitoring, physician guided mediation management, self-management behavioural support and physician guided depression management. It was delivered via a telephone using existing staff in the VA. VA home technology (HT) nurses delivered the intervention. Usual care involves HT nurses ringing patients, but they do not deliver a comprehensive diabetes management intervention like ACDC. In terms of telemonitoring, patients were asked and prompted to perform SMBG daily and to submit this on their HT-issued equipment. They were called by a HT nurse if they did not submit data for three days. In terms of self-management every two weeks a HT nurse rang the patient, delivering a diabetes self-management support module. This was a 30-minute telephone call every 2 weeks- reviewing blood glucose data, reconciling medications and reviewed adherence. For the physician medication management component, the HT nurse then contacted the study physician (an endocrinologist) and medication changes (such as insulin changes) were transmitted back to the HT nurse via an EHR- the nurse then relaying this on to the patients. In terms of depression, if the baseline or three-month PHQ9 was high, a psychiatrist of primary care physician input was made. Length: Daily telemonitoring, two weekly calls by a home technology nurse, input by endocrinology to nursing staff at two weekly intervals over six months. Predominant EPOC intervention type: Organisational Comparison: Usual care but received an educational packet in addition.
5	Dale 2009 England	Two intervention telecare groups: a) Peer-support telecare intervention b) Diabetic specialist	Two intervention telecare (telephone) groups: a) Telephone peer-delivered intervention. b) Diabetic specialist nurse telecare support The telecare support was intended to supplement routine care by motivating adherence to the advice provided by the GP or practice nurse at the time of change (medication and/ or lifestyle) in diabetes care.

		nurse telecare support	Length of intervention: The first telecare call was made 3-5 days later and a standard package offered support 7-10, 14-18 28-35, 56-70, 56-120 days later. Training for the telecare support was with a two days training programme (motivational interviewing, active listening skills). Peer supporters recruited through a diabetes care user group. Otherwise they were trained as above. Two were excluded from the trial as they could not master the techniques. The trained peer supporters had a median diabetes duration of 10 years and 6/9 had T2DM. They were paid a small fee and d had access to an experienced DSN educationalist. They were invited to 6 monthly review meetings. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
6	DePue 2013 U.S. Territory of America Somoa Cluster RCT	Nurse–Community Health Worker Team in American Somoa	Nurse–Community Health Worker Team: Nurse case manager (NCM) and four community health workers with a minimum of high school education- all staff underwent training. A filed director supervised the research. Length: The NCM met with all patients at least once over 12 months, conducting groups sessions with patients at high risk, providing feedback to physicians and oversight of CHW visits. The CHWs helped patients make and keep healthcare appointments, helped patients understand diabetes, reinforced adherence to medications and provided support. Patients at higher risk were seen weekly in a group meeting conducted by the NCM with CHW assistance or, if unable to attend the group meeting, they were seen individually by CHWs. Patients at moderate risk were seen monthly by CHWs and patients at lower risk were seen every 3 months. All individual visits occurred at the patient's home, workplace, or at TC, per the patient's choice. Family members were encouraged to attend these visits. BG and BP were monitored at each visit and urgent levels were referred immediately to the TC physician during clinic hours or to the hospital emergency department. Predominant EPOC intervention type: Organisational. Comparison: Usual care. Patients also received a self-care diabetes book and a risk profile was placed in their medical chart.
7	Edelman 2010 North Carolina and Virginia, USA.	Enrollment into a general medical clinic (GMC) with an internist, pharmacist and a nurse or educator that met seven times over 12 months	Patients in the intervention arm were assigned to a group medical clinic (GMC) that met on the patient's preferred half-day. Each group had 7-8 patients and a care team (a primary care internist, a pharmacist, a nurse or certified diabetes educator). The groups met every 2 months (7 visits over 12 months). Patients were given $10 for each GMC session they attended. The care team met the group at each visit and each group met the same care team at each visit. Each provider could be a member of more than one care team. Each GMC session lasted 90-120 minutes visit: BP and home glucose values were checked at each GMC session; education assessment was then delivered by nurse or educator- the patients chose certain topics so the education sessions were tailored to the member's needs. The pharmacist and PCP reviewed the

			medical record, BP and glucose levels at each session and an individualized management plan directed at improving HbA1c and BP was formulated (medications and lifestyle based). The Primary Care Provider was then informed. Signed attendance contacts to boost attendance, telephone contact if needed to change management based upon lab results. All patients received usual primary care on top of this. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
8*	Edelman 2015 USA	Nurse case management	A single nurse with experience in case management delivered both the tailored behavioral intervention and the control. For the intervention arm, the content was tailored to each patient's individual barriers to controlling blood sugar or BP. This content was divided into a series of topical modules addressing one or more behaviors appropriate for improving control of BP or blood sugar, and included physical activity, weight reduction, low salt intake, smoking cessation, medication adherence, management of hypoglycemia, and blood glucose monitoring. The modules assessed barriers to specific behaviors, and the nurse then tried to engage the patient in problem-solving in order to determine actions for overcoming these barriers. In addition, barriers that might generalize to a number of problems—specifically, low levels of disease knowledge, poor memory, poor social support, and concern about the quality of physician-patient decision- making—were addressed on their own. Fidelity was assessed by two nurse-investigators (KP, BG), who listened to a sample of 5 % of total calls for delivery of intended content. Length: The nurse rang intervention and control patients 12 times in total over 24 months every 2 months. Predominant EPOC intervention type: Organisational Comparison: "Attention Control". The control patients received calls that were not tailored; these calls provided traditional didactic information on a range of topics that had no relationship to HTN, DM, or any of the behaviors we were trying to improve (e.g., flu shots, skin cancer prevention). Content was tightly scripted, designed to limit the potential for productive interaction between nurse and patient, and was informed by standard guidelines as stated on government websites.
9	Farmer 2012 UK	Nurse-led, multilevel intervention to support medication adherence	Nurse- led, consultation-based intervention to support patients with adherence to taking glucose lowering medications. This was a multi-level intervention, targeting both health professional and patient behaviour. Initially there was training for the clinic nurses provided by a clinical psychologist and an intervention facilitator' as the first part of the intervention. The aim was to strengthen patient motivation to take OGLM regularly and support medicine taking through action-plans. 8 weeks after recruitment, patients were invited to the intervention visit to record and review their medication; and then randomised to either an intervention to support medication or adherence, or to standard care.

			There were 2 components in the intervention delivered to patients. (1) nurses elicited patient beliefs about intention to take their medications as prescribed. Positive beliefs were reinforced verbally and non-verbally, through provision of tailored information. Negative beliefs were addressed using problem solving and the nurse facilitated patients in action planning. The intervention consultation took 30 minutes, with 20 minutes for data collection, which both intervention and control patients received. Predominant EPOC intervention type: Organisational. Comparison: Usual care. The standard care visit lasted approximately 20 minutes, during which data were collected. Same nurses delivered this.
10	Forjouh 2014 USA	Three intervention groups, reflecting the individual and combined effects of a behavioural and technology intervention; a chronic Disease Self-Management Program (CDSMP) and a diabetes self-care software on a personal digital assistant (PDA).	Four arms in the trial: a) Chronic Disease Self Management Program (CDSMP) b) Personal digital assistant (PDA) c) Both CDSMP and PDA d) Usual care CDSMP: Involved a 6-week, classroom-based program for diabetes self-management. Based upon 1999 paper showing effectiveness of CDSMP. Its goal was to increase self-efficacy to decrease chronic disease related symptoms and avoidable healthcare utilization. It teaches participants techniques to facilitate enhanced decision making, action planning, and effective communication. CDSMP workshops hosted in clinical environments and community-based settings. Fidelity to classes not monitored. Master trainers/ lay leaders underwent 4 days of training- and the lay leaders used pre-scripted materials. PDA: This intervention arm were taught how to use a diabetes self-care software. It was loaded onto a handheld device and was called “Diabetes Pilot”. The Diabetes Pilot allowed recording and some monitoring of blood glucose, BP, medication usage, physical activity and dietary intake on the PDA. One-to one instruction by a project coordinator covering key areas such as data entry, foot database utilization and reports was provided. Participants were instructed to input information daily. Training effectiveness was not assessed. CDSMP and PDA group received both. The CDSMP was a 6 week program, based in a classroom. Unclear how many workshops. The PDA arm: Uncertain, participants asked to use it daily and input information into it. Primary outcome 12 months, followed up to 24 months CDSMP: 6 weeks PDA: Uncertain, possibly 2 years Predominant EPOC intervention type: Patient-centred. Comparison: Usual care along with Texas Diabetes Council patient education materials.

11	Frosch 2011 USA	A video behavioural support intervention by nurse educators with a workbook followed by 5 sessions of telephone coaching.	Intervention participants received a 24 minute long CDC program with an accompanying booklet called "Living with Diabetes: Making lifestyle changes to last a lifetime"- this was developed by the Foundation for Informed Decision Making. The participants were also entitled to have up to 5 sessions of telephone coaching with a bilingual nurse educator, trained in patient-centred approaches to diabetes management and motivational enhancement- with a goal to collaborate with participants in identifying behavioural goals and a behavioural plan. The first session was 60 minutes in length (2 weeks after enrollment), the second and third were 30 minutes, forth and fifth were 15 minutes. Interval between telephone coaching was open to participants and nurse educators to negotiate. Both groups received a telephone call one week after enrollment to review intervention materials. Five coaching sessions (spread over a max duration of 2.5 hours) and a 24-minute DVD to watch, as well as a booklet on lifestyle changes in diabetes. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care. Participants also received a 20-page brochure entitled "4 steps to control your diabetes for life" developed by the NIH.
12	Guerci 2003 France	A self-monitoring of blood glucose intervention Auto-Surveillance Intervention Active (ASIA) study.	Self monitoring of blood glucose (SMBG): Patients received initial training by their GP at the initial inclusion visit. Patients were required to perform at least six capillary assays a week (3 different days, including the weekend). Standardised management including medications, blood glucose level, diet and physical exercise. Five visits were conducted during the intervention. At each visit, a clinical evaluation was performed. Laboratory values took place at 3 visits. At the third visit the GP could modify the treatments based upon the SBGM. At each consultation the patients were advised about management for T2DM. The intervention period was 24 weeks. Followed up every 6 weeks. Five visits were conducted during the intervention. At each visit, a clinical evaluation was performed (weight, SBP, DBP). Laboratory values took place at 3 visits.. At the third visit the GP could modify the treatments based upon the SBGM. . At each consultation the patients were advised about management of T2DM. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
13	Heisler 2010	Reciprocal peer support	Initial face to face meeting in groups of 4-18 (in two age cohorts to aid cohesion and help patients get an age matched peer partner). Patients received $20 for the initial and 6 monthly assessment.

	USA		Reciprocal Peer support (RPS) 3 hour group session facilitated by a care manager and research associate. Action planning on laboratory results. Training in peer communication, paired with an age-matched peer for peer support. Encouraged to call each other at least once per week.. Given a DVD on communication skill and a diabetes self management work book. Also offered three 1.5 hour group sessions at months 1,3 and 6- entirely patient-driven to discuss progress on action plans. Facilitation by a care manager or research associate. The care managers went through training- 4 hour course on motivational interviewing. Nurse care manager (NCM) was usual care: Attended a 1.5 hour session, led by the NCM, to discuss the results from the initial assessment, review results, ask questions and get information. Their care manager's phone number was given and follow up phone calls and face to face meetings were encouraged. Patients were provided with diabetes self management educational materials. In effect this is enhanced usual care- as many patients are not aware of and do not avail of this. Predominant EPOC intervention type: Patient-centred. Comparison: The comparator was enhanced usual care with nurse care management.
14	Jacobs 2012 USA	A pharmacist assisted medication program intervention	PAMPERED (pharmacist assisted medication program enhancing the regulation of diabetes) study: An initial pharmacist-patient clinic visit at baseline involved obtaining a comprehensive medication review; performing a targeted physical assessment including checking BMI, BP and a foot examination; education on diabetes; ordering laboratory values; reviewing, modifying and monitoring the patient's medication and providing detailed counselling on all therapies; facilitating self-monitoring of blood glucose; and providing reinforcement of dietary guidelines and exercise. These recommendations were based on most recent guidance. Approval by the patient's PCP was required before a treatment recommendation was made. Patients were required to attend a minimum of three visits with the pharmacist; at baseline, 6 months and 12 months for focused preventive and secondary diabetes management. Additional visits arranged as clinically appropriate. Laboratory outcomes checked at baseline, 6 and 12 months. On average 6.5 office visits with a pharmacist occurred over the 12 months. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
15	Jameson 2010 USA	A pharmacist collaborative management intervention	One pharmacist provided the intervention to the entire intervention group. This pharmacist was a board certified pharmacotherapy specialist, had an American Society of Health-System Pharmacists diabetes management traineeship, a postgraduate course in diabetes management from the American Diabetes Association and an educators training program. Patients met the pharmacist at the primary care site for an assessment of medication adherence, barriers to optimizing glucose control and a medication review. Individualized education was provided regarding self-management, lifestyle, medications and monitoring. Guidelines were followed. This included early switching to insulin after failure of 2 oral medications. The PCP approved any changes. After this visit, subsequent visits depended on control. Telephone calls also included.

			Initial visit. Telephone calls also included. Thereafter conducted as needed- as subsequent visits depended on control. Average 6 office visits and 3 telephone calls per patient over a one-year period. Office visits lasted between 30-60 minutes. Phone calls 10-20 minutes. Predominant EPOC intervention type: Organisational. Comparison: Probably usual care.
16	Jovanovic 2004 USA	Diabetes case management by a nurse or dietician	Case Management: Intensive diabetes case management was provided to the intervention group in addition to primary care. Study staff met with all patients at the beginning and end of the trial to assess overall health status and collect study outcomes. Quarterly assessments of outcomes were performed. The case manager was either a nurse or a dietician (working in close collaboration with an endocrinologist). Evidence based practice in terms of insulin initiation was agreed with collaboration with the PCP. Potential barriers to care were identified and educational strategies designed to address these barriers. American Diabetes Association goals for diabetes, BP and lipid treatment were used. Flexibility to allow individualized targets allowed. All patients educated about self-management and given a monitor. Diabetic educators assessed lifestyle behaviours and gave patients strategies to improve self-care. Transportation issues addressed to improve visit completion. Unclear how many meetings or interaction with a case manager occurred over the 36 months Predominant EPOC intervention type: Organisational. Comparison: Usual care from primary care provider.
17	Keogh 2011 Ireland	Psychological family intervention	Psychological family intervention for poorly controlled Type 2 diabetes. Three weekly sessions delivered by a health psychologist who had received 16 hours of training in motivational interviewing. The first two sessions lasted 45 minutes, taking place in the patient's home, with a family member. The third and final session was a 10-15 minute telephone call. Each session was tailored to the patient's needs involving a/ challenging negative perceptions of diabetes, 2/ examining how negative perceptions influenced self management and 3/ developing ways to improve self management and mobilise family support. Techniques such as exchange information, elicitation of change talk, reducing resistance, building self-efficacy, problem solving and goal setting were used. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
18	Kim	A Community-based,	Culturally tailored comprehensive T2DM management intervention for Korean American immigrants.

	2009 USA	culturally tailored behavioral intervention	A community based self-help intervention program for type 2 diabetes mellitus (SHIP- DM) involving structured psycho-behavioural education, home glucose and BP telemonitoring and individualized telephone counselling from a bilingual nurse. It consisted of three concurrent programs. First, a 2 hourly weekly education session was delivered for 6 weeks. This was delivered at a community site by trained nurses and a nutritionist- to enhance knowledge and promote diabetes self-care behaviours for glucose control. Secondly, there was home glucose monitoring and teletransmission- this lasted for 24 weeks after the educational program- each patient received monitors and a teletransimission system. Nurses could view this information. Thirdly, monthly telephone counselling by a bilingual nurse for 24 weeks was provided according to a standardized protocol- to reinforce new knowledge, to discuss problems, find solutions and provide emotional support. These lasted 10-25 minutes. At least 7 (one meeting and monthly telephone contact X 6 months) Predominant EPOC intervention type: Patient-centred. Comparison: Usual care with delayed intervention.
19	Krein 2004 USA	Case management by nurse practitioners	Collaborative case management. All participants in trial given a blood pressure monitor, educational material and a periodical newsletter Two nurse practitioner care managers worked with patients and their primary care providers, monitoring and coordinating care for the intervention group for 18 months, through telephone calls, collaborative goal setting and treatment algorithms. There were two nurse case managers. One nurse was present at each site, providing 20 hours of care per week, to approximately 60 patients each. They had a 2 days training program on collaborative goal setting- and training updates at 6-month intervals. Patient contact was predominantly by telephone, though face-to-face contact could happen. Case managers encouraged self-management, diet exercise, provided reminders of screenings and tests, monitored home glucose and BP measures and identified medication changes as needed. Medications treatment algorithms were given to the case managers. Every change was approved by the PCP- being notified of changes by email. Predominant EPOC intervention type: Organisational. Comparison: Usual care. Patients also received educational materials. All participants in trial were given a blood pressure monitor, educational materials and a periodical newsletter.
20	Long	Two interventions:	Two intervention groups, one control. Received €25 for filling out a survey at Month 0 and Month 6. Also were notified of their starting HbA1c level and of the

	2012 USA	Peer mentoring Financial incentivisation of patients	ADA and VA recommendations. 1/ Peer mentoring: Patients in this group matched to a peer supporter within 1-3 weeks. Peer reviewers were all African American patients with prior poor T2Dm control in the past but well controlled recently. They were matched by sex and age (+/- 10 years). Training: They received a 1-hour long 1:1 training session informed by motivational interviewing techniques. Uncertain who trained the peer mentors. No monitoring of the calls. The mentor-mentee contacts were all telephone calls. Mentors were incentivized with $20 per month if they talked at least once per week with their mentee. Mentors were also given $25 after the training session and after an exit interview. Peer mentoring: Aiming to have 4 calls per month for 6 months. The Results showed 38% mentors talked 4 times per month during the first month and by Month 6, that reduced to 16% 2/ Financial incentives In the financial incentive arm, participants were told that they would receive $100 at 6 months if their HbA1c level decreased by 1%, and $200 if it reduced by 2% or to 6.5%. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
21	Maislos 2002 Israel	A mobile clinic providing interdisciplinary care	Interdisciplinary care via a mobile clinic offered by the Western Negev Mobile Clinic Diabetes Program (WNMCDP). WNMCDP is a weekly mobile diabetes clinic aimed to provide interdisciplinary care for patents, in primary care facilities. An initial visit involved a meeting with a diabetologist, the dietician and a nurse educator. After this regular follow visits were scheduled. The team held a weekly evening meeting at the clinic and the nurse and dietician have an additional weekly meeting at the primary care site. At the meeting, all patients received dietary counselling and have a session with the nurse educator. Continuation of treatment and follow up visits are scheduled according to the patient's condition. Special emphasis was placed on education, to improve compliance and lifestyle behaviours. Mobile clinic visited weekly. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
22	Mathers 2012 UK	Patient decision aid to improve decision quality and glycaemic control	PANDAs study: using patient decision aid (PDA): A complex intervention with three components; PDA, healthcare professional training workshop and use of PDA in a consultation. Development of PDA done with MRC framework- to facilitate decision making between clinicians and patients

	Cluster RCT		Doctors and nurses involved with diabetes care in the practice attended a 2-hour training session on how to use the PANDAs decision aid (shared decision making, communication skills, the evidence of different treatment options). The PANDAs decision aid was given to the patient prior to the consultation with the nurse or GP- it included information about insulin or other treatments, presented probabilities of outcomes, it clarified patient values and gave structured guidance. The patient then saw the GP and nurse, facilitated with the use of the PANDAs aid. This was a one off intervention given on 1 day Predominant EPOC intervention type: Professional. Comparison: Usual care.
23	McDermott 2015 Australia Cluster RCT	Community-based health-worker led case management approach to the care of Indigenous adults with poorly controlled type 2 diabetes in primary care services in remote northern Australia	Each site allocated to the intervention arm recruited an Indigenous health worker resident in the community (selected by the health service) to work as part of the primary care team, and allocated a caseload of between 9 and 26 clients. The health workers with low caseloads worked part-time. All health workers at the commencement of the study received an intensive 3-week training in clinical aspects of diabetes and other chronic condition care, including how to support patients in self-management skills, advice on medications, routine foot care, nutrition, smoking cessation, follow up referrals to other providers, and scheduled tests. Length: During the 18 month intervention period, the health workers attended two workshops where they underwent refresher training, including in Good Clinical Practice and reflective practice. During these sessions, they reported on their patients' progress and shared approaches to problem solving with the clinical support team and peers. Predominant EPOC intervention type: Organisational Comparison: Usual care.
24	McMahon 2005 USA	Web-based care management	Web based care management involving training and giving a notebook computer, glucose and blood pressure monitoring devices and access to a care management website. The website provided educational modules, accepted uploads from monitoring devices and had an internal messaging system for patients to communicate with the care manager. Given free internet. Training to each participant for mean of 2.3 hours. Home BP monitoring encouraged three times weekly. Glucose monitoring frequency was individualized. Participants could communicate with a care manager through the website. If they did not use the website for two weeks, they were contacted by phone. An advanced practice nurse reviewed patient information and provided recommendation to the PCP about treatment changes, based upon guidelines. Episodes: Unclear, one training session and then self-usage of web management (patients contacted if they didn't use after 2 weeks). 1 year. Predominant EPOC intervention type: Organisational. Comparison: Usual care. All participants attended a self-management educational session (prior to randomization).

25	Mons 2013 Germany	Supportive telephone counseling	Supportive telephone counseling intervention led by practice nurses of the participating GP practices- monthly over 12 months. Each nurse was trained before hand. Each call lasted 10 minutes, was structured and included questions on patients' physical and mental condition, medication adherence, symptoms, and lifestyle advice. The items were designed to motivate the patients, identify barriers and help self-management. Monthly over 12 months. Over 90% had 10-12 sessions. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
26	O'Connor 2014 USA Cluster RCT	Telephone Outreach to Improve Medication Adherence and Metabolic Control in Adults With Diabetes	The telephone intervention was delivered by interventionists who were pharmacists, diabetes educators, or nurse health managers trained in the use of the study protocol and intervention. Those randomized to the intervention, who had recently been prescribed a new medication for poorly controlled T2DM, received a single structured telephone call to ascertain if the patient had started the medication. Positive reinforcement was made to those who had started. For those who had not started, the interventionist probed for reasons of non-adherence and resolved to solve any barriers. Length: One phone-call lasting < 5 minutes. Most calls occurred within 2-6 weeks after prescription date. Predominant EPOC intervention type: Organisational Comparison: Usual care.
27	Odegard 2005 USA	A pharmacist intervention care management intervention	Pharmacist intervention was composed of a diabetes care plan (DCP), a regular pharmacist-patient communication on diabetes care progress and pharmacist-provider communication on the subject's diabetes care progress. Medication related problems were identified. The intervention commenced one week after baseline data interview. A face-to-face appointment created this DCP which was communicated to the PCP. Weekly face-to-face or telephone communication was kept with the patient and the pharmacist- then reduced to monthly when deemed necessary over a 6-month period. On average there were 4.5 telephone contacts and 2.1 in person visits. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
28	Palmas 2014 USA	Community health worker (CHW) intervention in an Hispanic population	12-month CHW intervention or enhanced usual care Two full time CHWs delivered a multicomponent intervention that included one-to-one visits, group visits and telephone follow up. They used the Small Steps, Big Rewards framework. Goal setting and discussing barriers were features of the visits. A needs assessment was performed throughout the year. Episodes of care: Aimed for 4 1:1 visits, 10 groups sessions and 20 follow up phone calls over the year per subject.

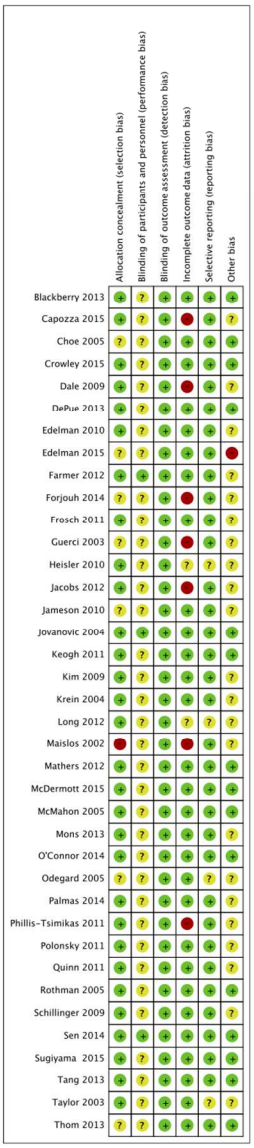
			Predominant EPOC intervention type: Patient-centred. Comparison: 'Enhanced usual care'. Spanish-language educational material posted every three months, preceded by phone calls, to ensure participants received the brochures.
29	Phillis-Tsimikas 2011 USA	Peer-led diabetes education programs in high-risk Mexican Americans	Assessments at month 0, 4 (post intervention) and 10- intervention participants were given a glucometer and a small gift card. The Project Dulce (intervention) group received eight weekly 2 hour diabetes self management classes for two months; and then monthly support groups, leach 2 hours in length, led by a trained peer educator. Before the intervention those individuals, living in this community, with diabetes, that had traits of being a good leader were identified and trained over a 3 month period. Peer educators spent 40 hours learning the curriculum, behavior modification techniques etc. Then they co-taught a session with a trainer, before being supervised giving a session before doing it alone. The curriculum covered many aspect of diabetes management. If patients were noticed not be meeting targets for diabetes care, the peer educator would direct them to the PCP- they would not make any medication related changes themselves. Episodes of care: Unclear how many, but envisaged as 8 weekly classes for two months, then monthly for the next three months. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
30	Polonsky 2011 USA Cluster RCT	Self blood glucose monitoring	STeP (Structured Testing Programme) is a 12-month Cluster RCT assessing efficacy of structured self-monitoring of blood glucose (SMBG) in T2DM patients (none on insulin). Both physicians and patients participated in a collaborative programme to gather, interpret and act upon the structured SMBG data, at 3 monthly intervals, to make treatment modifications. The study's duration was 12 months with patient visits occurring at initial screening and baseline followed by visits at months 1, 3, 6, 9, and 12. At all subsequent visits (months 1, 3, 6, 9, and 12), ACG and STG clinic staff collected laboratory samples, recorded changes in medications, and performed brief physical examinations. Point-of-care A1C equipment (A1CNow+ test kit; Bayer Healthcare, Tarrytown, NY) was provided to all practices for clinical use only to assure that differential availability of the equipment did not affect outcomes. Patients in both groups brought their meters to each subsequent visit for electronic data uploading; physicians and clinic staff were blinded to these data and all other study-collected measures. Patients also reported all changes made to their diabetes regimen since their last visit. All patients completed the STeP questionnaire and a post-visit questionnaire to record physician discussion of SMBG results and recommendations for pharmacologic and lifestyle changes that occurred during the visit. Predominant EPOC intervention type: Patient-centred. Comparison: 'Enhanced usual care': quarterly diabetes focused physician visits, free blood glucose meters and strips and they were evaluated at months 1, 3, 6, 9 and 12 (like the intervention group).
31	Quinn	Mobile phone-based	Mobile phone-based treatment/ behavioural coaching intervention

	2011 USA Cluster RCT	treatment/ behavioural coaching intervention	26 primary care practices, randomly assigned to one of four groups: 1/ Coach-only (CO) group- included a mobile diabetes management software application and a web portal. The mobile software allowed patients to enter diabetes self-care data (glucose, diet, mediations) on a mobile phone and receive automated, real-time educational, behavioural and motivational messaging specific to the entered data. 2/ Coach PCP portal (CPP)- The patient web portal augmented the mobile software and had a secure messaging centre with additional information. 3/ Coach PCP portal with decision support (CPDS): This group had providers with access to analysed patient data that could make decisions linked to standards of care. All patients received a glucometer and mobile phone with 1 year unlimited free data and service plan. Diabetes educators intermittently reviewed the patient data. Patients could communicate by phone or electronically to educators. Patients also received an electronic action plan every 2.5 months. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
32	Rothman 2005 USA	A primary care-based disease management program delivered by trained pharmacists.	Pharmacist intervention: Three pharmacists (trained in the outpatient department) delivered the intervention within the general medicine practice - two of them were diabetic educators. The intervention included intensive educational sessions, evidence-based algorithms, proactive management of clinical parameters and treatment recommendations that were shared with the PCP. A diabetes care coordinator was also part of the intervention and this person addressed health behaviour and education- this coordinator rang patients regularly. Pharmacists rang the patient or met them every 2-4 weeks, or more frequently if needed. Unclear if there was a face to face meeting (probably was in the General Medicine Practice. A coordinator also rang patients from time to time. A median of 45 contacts or care-related activities between pharmacists and patients were recorded; about 38 minutes each month. Predominant EPOC intervention type: Organisational. Comparison: Usual care after a 1-hour management session that was conducted by a clinical pharmacist practitioner from the disease management team, including education and treatment recommendations approved by the PCP.
33	Schillinger 2009	Two interventions: Self-Management	Two interventions in the Improving Diabetes Efforts Across Language and Literacy (IDEALL) Project: Two self management support (SMS) systems, conducted in a safety net health system were tested against a control; a) Automated telephone self management support (ATSM) and b) Group medical visits (GMVs).

	USA	Support via 1/ Automated telephone self-management support (ATSM) and 2/ Group medical visits (GMVs).	ATSM and GVCs attempt to activate patients, routed in efficacy theory. ATSM: ATSM patients received automated (pre-recorded) telephone calls over 39 weeks (9 months). Patient responses triggered immediate automated education messages and/ or a subsequent nurse phone follow-up. Each call took 5-10 minutes. The mean number automated calls completed over 9 months was 21.9 (envisaged to be 39); mean number of call backs was 9.2. GVC: The GVC group received 90-minute monthly sessions over 9 months, with 6-10 participants, co-facilitated by a primary care physician and health educator. Participants in this group received bus tokens and snacks. Mean number of GMVs attended was 4.8 out of 9. There was no specific expectation regarding co-management with the primary care physician. In both interventions action plans regarding self management were generated (information in other papers). All participants received €15 and €25 dollars for the baseline and one year follow up assessment. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
34	Sen 2014 USA	Financial incentives for home based monitoring- two interventions	Two intervention groups received financial incentives for home-based health monitoring. All three groups received three biometric devices, a self monitoring glucose device, a digital BP monitor and a device to automatically transmit readings from the biometric devices to the study website. All patients were instructed to use the biometric devices daily. In the intervention arms, participants who used all three devices on a given day were entered into a lottery to win something on the following day. In the daily lottery process, numbers between 0-99 were picked by the participant. In the high incentive intervention the average daily reward was €2.80; a two digit match (1: 100 chance) yielded a €100 award and a one digit match (1: 5 chance) yielded a €10 award. In the low incentive intervention, rewards were €50 and €5 respectively, expecting an average daily reward of €1.40. Each day all incentive arm participants were reminded by text message or email informing them of the lottery numbers. A study coordinator met with all participants at 3 and 6 months- participants were paid €25 for each visit. Episodes of care: daily Predominant EPOC intervention type: Financial Comparison: 'Daily home monitoring control group' received biometric devices.
35	Sugiyama	Diabetes self-management	Called the Diabetes Self-Care Study, the intervention involved community-based diabetes self-management education (DSME).

	2015 USA	education by trained health educators.	All study participants were given glucose meters and testing strips, and received a 2-hour training on self-monitoring of blood glucose by a certified diabetes educator. Health educators, who delivered the education, completed a one-year training program and received 8 hours of curricula delivered by the study team about diabetes and its clinical presentations and complications. Additionally, they received 12 hours of training and implementation of the empowerment sessions. Length: Participants in the intervention group received six weekly two-hour group self-care sessions consisting of 8 to 10 persons per group, conducted in English or Spanish, and facilitated by health educators. In the group session, participants identified self-management challenges and discussed why each activity was challenging and how to solve it. Each participant also had a one-on-one session with the health educator to review his or her baseline and follow-up laboratory and biometric data during one of the group sessions. There was also a $10 gift card for each assessment. Predominant EPOC intervention type: Patient Comparison: Usual care.
36	Tang 2013 USA	Online disease management of diabetes	Online disease management of diabetes: Engaging and Motivating Patients online with Enhanced Resources- Diabetes (EMPOWER-D): A personalized healthcare program (PHCP) comprising nurse care managers authorized to change medications, multi-disciplinary team based care, patient self-management tools and an online communication channel between patients and their healthcare team. This intervention comprised: 1/ Wireless glucometer uploading of information to the electronic health record 2/ A diabetes summary sheet with a personalized action plan and treatment goals, including displaying the risk of a variety of diabetes related complications, medication information and monitoring information. 3/ A nutrition log 4/ Insulin record 5/ Exercise log 6/ Online communication/ messaging system 7/ Nurse care managers who provide advice and can make medication changes. 8/ Patient specific text and video educational material. On top of this, participants in the intervention group had 3 in-persons visits, firstly a 90 minute group visit introducing the online tools, a 90 minute 1:1 meeting with a nurse care manager to develop a shared care plan and 3/ a 60 minute visit with a registered dietician. Also a pharmacist reviewed all intervention group medications and made recommendations- they were also consulted throughout the trial. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
37	Taylor 2003	Nurse care management (NCM)	Nurse care management (NCM): Initial 90 minute meeting with a registered nurse to review patient medications, lifestyle and psychosocial status. Self-management plan was developed.

	USA		Then a weekly group class (1-2 hours with 4-10 per class) was scheduled for 4 weeks; including group discussion and problem solving. This was followed with telephone follow-up calls at week 4,5,8,12,16,20,28,36 and 44 (9 in total) from the nurse, averaging 15 minutes each. The nurse care managers gave advice as per agreed protocols. The PCP was called if a change in medication was recommended. The NCMs underwent specific training. Episodes of care: 5 visits and 9 telephone calls Predominant EPOC intervention type: Organisational. Comparison: Some educational materials, otherwise usual care.
38	Thom 2013 USA	Peer health coaching	Potential peer coaches attended 36 hours of training over 8 weeks using a curriculum developed by the study team- learning active listening, non-judgmental communication, helping with diabetes self-management skills, provision of support, assisting with lifestyle change, facilitating medication adherence and understanding and navigation of the health system. There was a written and oral assessment for these persons- those who passed became peer coaches. The peer coach- patient interaction was at the discretion of the patient and peer coach, either in person or by telephone contact, either outside or inside the clinic. The goal was for two telephone contacts every month and two or more in-person contacts over 6 months. They helped devise action plans for the patients. Peer coaches received €125 for training and €25 per client coached each month. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.



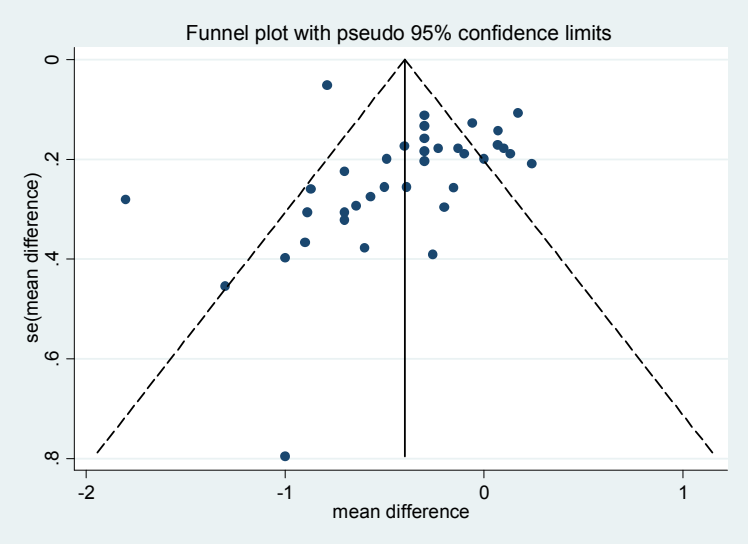
215x279mm (150 x 150 DPI)

Appendix 5: Overall quality assessment and predominant EPOC intervention type

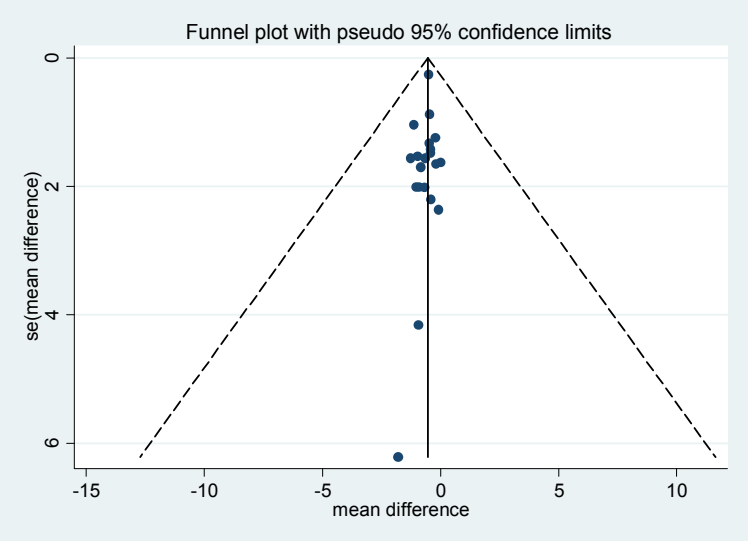
Study	Study_ID	Year	Predominant EPOC intervention type	Overall quality assessment
1	Blackberry	2009	Patient	Low-risk
2	Capozza	2015	Patient	Unclear-risk
3	Choe	2012	Organisational	Unclear-risk
4	Crowley	2015	Organisational	Low-risk
5	Dale	2003	Patient	Unclear-risk
6	DePue	2011	Organisational	Low-risk
7	Edelman	2012	Organisational	Low-risk
8	Edelman15	2015	Organisational	Unclear-risk
9	Farmer	2013	Organisational	Low-risk
10	Forjouh	2013	Patient	High-risk
11	Frosch	2005	Patient	Low-risk
12	Guerci	2013	Patient	High-risk
13	Heisler	2010	Patient	Unclear-risk
14	Jacobs	2014	Organisational	High-risk
15	Jameson	2011	Organisational	Unclear-risk
16	Jovanovic	2010	Organisational	Low-risk
17	Keogh	2012	Organisational	Low-risk
18	Kim	2010	Patient	Low-risk
19	Krein	2004	Organisational	Low-risk
20	Long	2009	Patient	Unclear-risk
21	Maislos	2004	Organisational	High-risk
22	Mathers	2012	Professional	Low-risk
23	McDermott	2015	Organisational	Low-risk
24	McMahon	2004	Organisational	Low-risk
25	Mons	2005	Patient	Low-risk
26	O'Connor	2014	Organisational	Low-risk
27	Odegard	2005	Organisational	Unclear-risk
28	Palmas	2014	Patient	Low-risk
29	Phillis-Tsimikas	2011	Patient	Unclear-risk
30	Polonsky	2011	Patient	Unclear-risk
31	Quinn	2011	Patient	Low-risk
32	Rothman	2005	Organisational	Low-risk
33	Schillinger	2009	Patient	Low-risk
34	Sen	2014	Financial	Low-risk
35	Sugiyama	2015	Patient	Low-risk
36	Tang	2013	Patient	Low-risk
37	Taylor	2003	Organisational	Unclear-risk
38	Thom	2013	Patient	Unclear-risk

Appendix 6: Funnel plot of included studies

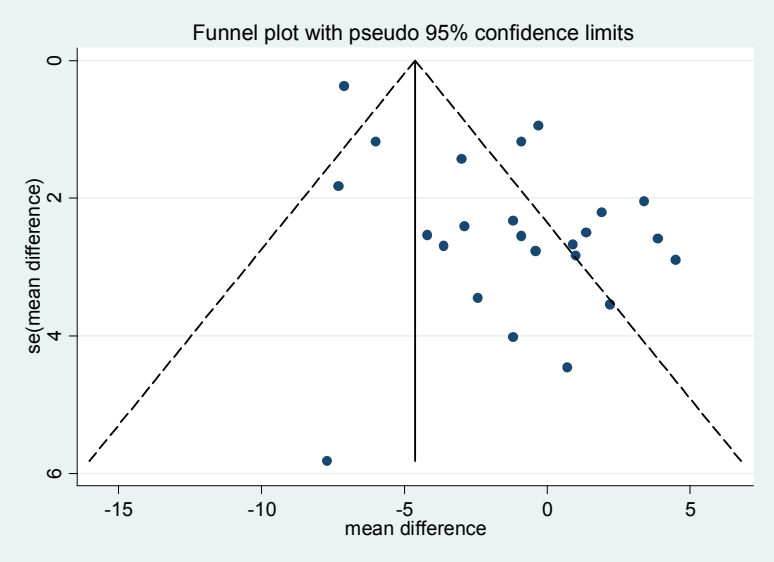
a. Funnel plot of studies included in the HbA1c analysis



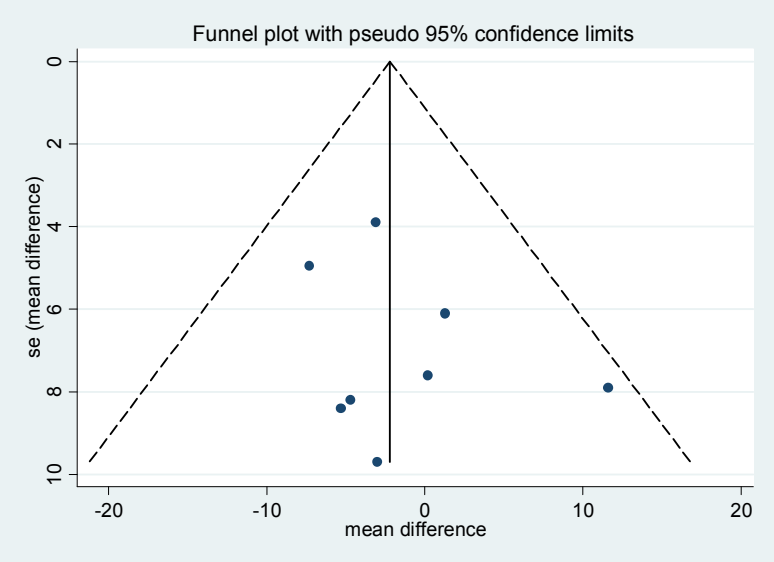
b. Funnel plot of studies included in the DBP analysis



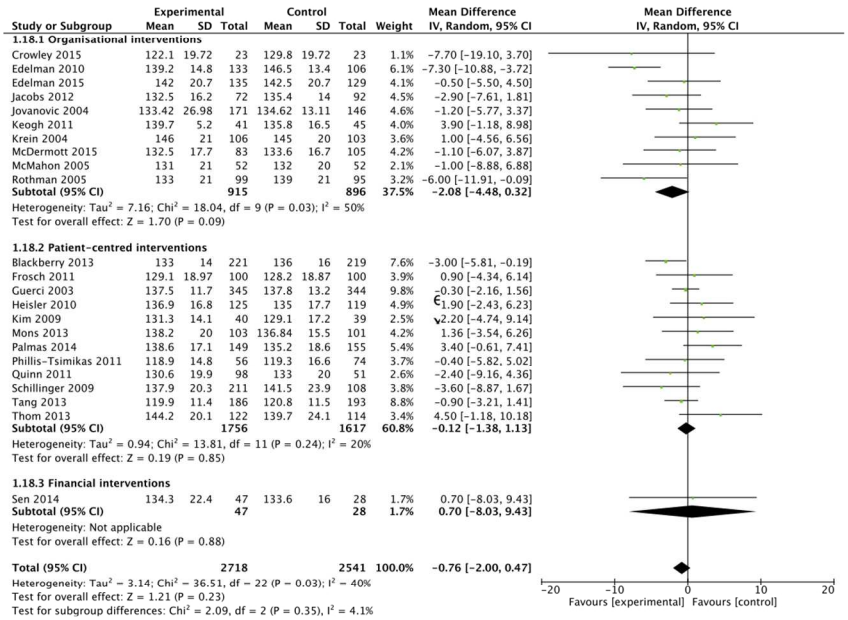
c. Funnel plot of studies included in the SBP analysis



d. Funnel plot of studies included in the lipid analysis



Appendix 7. Effects of interventions on systolic blood pressure



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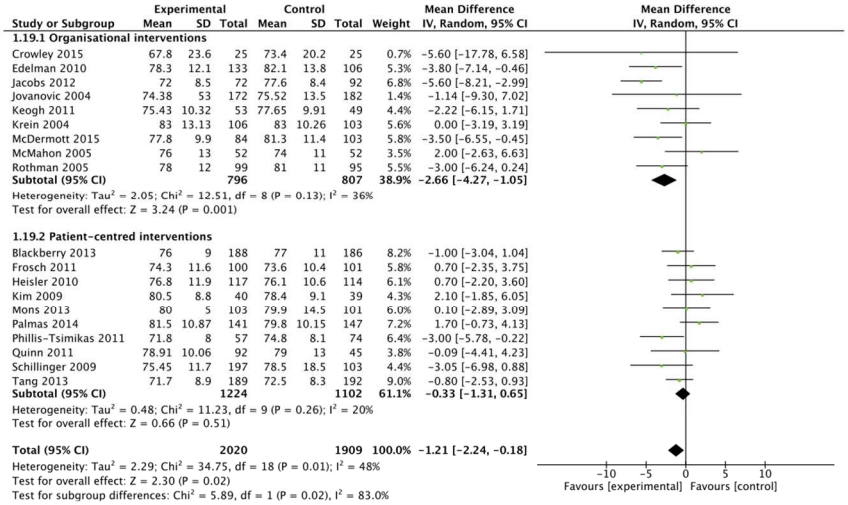
Appendix 8. Effects of interventions on diastolic blood pressure



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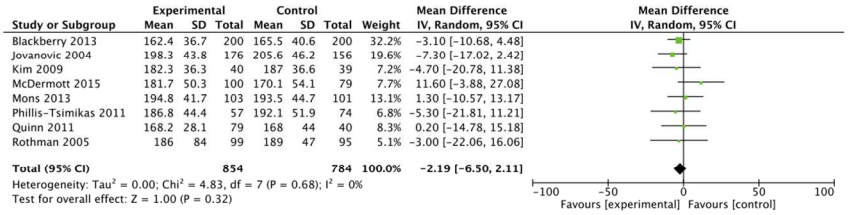
Appendix 9: Effects of interventions on total cholesterol



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Appendix 9: Secondary outcomes measured and results

Number	Study	Mental health outcomes	Pyschosocial outcomes	Adherence outcomes	Other physical outcomes	Healthcare utilsiation outcomes	Medication related outcomes
1	Blackberry	Major depression 1.09 (0.49 to 2.46) p= 0.83	Quality of life 0.02 (CI -0.01 to 0.05) p =0.16 Diabetes self efficacy -0.06 (CI -2.22 to 2.10) p 0.96 Diabetes support -0.09 (CI -0.01 to 0.18) p 0.08				
2	Capozza		Patient interaction and satisfaction (CSQ8) with the program by means of survey-intervention patients all scoring over 3 on a four point satisfaction scale. No clear comparison with usual care.				
3	Choe					Process measures: (% before, % after, p value) Rate of HbA1c measurement: 82.9% 92.3% 0.21 Dilated retinal examination: 74.3% 97.3% p= 0.004 Urine ACR or use of ACE Inhibitors: 85.7% 94.9% p= 0.18 Monofilament testing for diabetic neuropathy by chart review over 24	

						months: 62.9% 92.3% p= 0.002	
4	Crowley	Depression (PHQ-9): mean difference was not significant.	Diabetes self-management (Self-care inventory revised) SCI-R: mean difference was +7.0 (p=0.047) in favour of intervention	Self reported medication adherence (Morisky medication adherence scale 4): nonsignificant difference		Adverse events similar in both groups	
5	Dale		Diabetes distress (PAID) adjusted score showed no significant difference for two intervention groups versus control. Self efficacy (DMSES) adjusted score showed no significant difference for two intervention groups versus control. PS-CG, +4.17, p=0.28 DSN-CG, +0.38, p=0.94. Self efficacy (DMSES) improved for the patients in the peer support group but there were no significant differences between groups; diabetes related problems (PAID) reduced for those in the diabetes nurse specialists group. In all groups the HbA1c improved, but there were no significant differences between groups		Normal ACR: 1.05 (0.62 to 1.75) p= 0.87 Normal eGFR: 0.92 (0.55 to 1.53) p 0.76 Current smoker 0.043 (0.55 to 1.53) p 0.72 Healthy weight (BMI<25) 2.19 (1.1 to 4.38) p=0.03 Weight 0.12 (-1.53 to 1.77) p=0.89 Waist circumference Men 0.90 (-1.40 to 3.19) p=0.44 Waist circumference Women -1.52 (-4.08 to 1.04) p=0.24		
6	DePue		Mean perceived competence score significant difference 1.6 (CI: 0.9 to 2.4) p< 0.001 Physical activity Adapted measures of diabetes beliefs; no data reported.	Adherence: self reported medication adherence Nonsignificant difference.			

7	Edelman 2010		Self-efficacy using the Perceived Competence Scale Nonsignificant difference	Adherence to medications ??? Morisky self-reported medication adherence scale Nonsignificant difference	BMI nonsignificant differences	Adverse events through structured self report and medical record review Health utilization Cost data	
8	Edelman 2015		Self-effiacacy- but no report in Results section Health literacy- but no report in Results section.	Medication adherence (via self report) - but no report in Results section.	No significant differences weight or physical activity.	45.2% of intrevention group had GP management plan for diabetes V's 35.5% of controls (non-significant)	
9	Farmer		Functional status as per SF 12 Physical and SF 12 Mental Diabetes treatment satisfaction and satisfaction with nurse <u>SF 12 Physical</u> 46.3 (9.0) V's 44.6 (11.1) MD -0.7 (CI -2.7, 1.4) p = 0.52 <u>SF 12 Mental</u> 49.5 (10.4) V's 52.6 (8.8) MD -1.6 (CI -3.9, 0.6) p = 0.15	MARS Self reported adherence (range 5-25) with a higher score indicating higher levels of adherence Nonsignificant difference	BMI dietary nonsignificant difference.	% reporting hypoglycaemia nonsignificant difference Treatment satisfaction nonsignificant difference	Primary outcome % days over a 12 week period on which the correct number of doses of main glucose lowering medication was taken each day as prescribed. 77.4% (26.3) & days taking correct dose V's 69% = 8.4% MD (P = 0.044)
10	Forjouh		Self care data not given				
11	Frosch		Diabetes knowledge: (23 point Diabetes knowledge test) - nonsignificant difference. Self-care behaviours (SDSCA) - nonsignificant difference Diabetes knowledge and behavioural outcomes by group over time: Exercise was				Prescribed medications measured: taking most prescribed medications (*P* = .01; interaction, *P* = .41), and taking all prescribed medications (*P* .001; interaction, *P*=.75). Nonsignificant difference.

			statistically significantly reduced				
12	Guerci					Symptomatic hyoglycaemia Any hypoglycaemia: 53 (10.4%) in SMBG and 25 (5.2%) in control p= 0.003	Medications nonsignificant difference
13	Heisler		Diabetes social support score - nonsignificant difference Diabetes distress Diabetes QoL -nonsignificant difference	Medication adherence nonsignificant difference Medication intensification: Significant increase in insulin and oral diabetic medication prescribing .	BMI nonsignificant difference		Medication intensification: Significant increase in insulin and oral diabetic medication prescribing .
14	Jacobs				Weight and diet nonsignificant difference	Intervention group had more screening parameters performed (retinal screening, nephropathy and neuropathy)	Medication sse; intervention group had higher use of antiplatelet, diabetic and statin medications.
15	Jameson						Intervention group- 28.8% commenced basal bolus insulin V's 1 (2%) patient in the control group.
16	Jovanovic				HbA1c < 7% 35% V's 21% (but p = 0105)		Medication usage Increase in oral agents in intervention group, without any increase in numbers on insulin. Control group- no change.
17	Keogh		The intervention group reported better personal control, a better understanding of diabetes and an increased belief in treatment effectiveness. They also had fewer symptoms and lower levels of diabetes concern and distress. They also had better psychological well being, adherence to lifestyle factors, self efficacy and family		Statistically more patients in intervention group achieved at least 1.0% improvement in HbA1c.		

			support. Illness perceptions (Brief illness Perception Questionnaire)- statistically significant improvement Psychological wellbeing (12-item Well-Being questionnaire)- statistically significant improvement Diabetes self management (Summary of Diabetes Self-care Activities Questionnaire) Self Efficacy (UK version Diabetes Self-Efficacy Scale)- statistically significant improvement Family support (Diabetes Family Behaviour Checklist)- statistically significant improvement				
18	Kim	Depression (Kim Depression Scale for Korean Americans) nonsignificant difference Quality of Life (Diabetes Quality of Life Measure (DQOL) nonsignificant difference	Diabetes knowledge test (DKT) statistically significant difference Self efficacy (Stanford Chronic Disease Self-Efficacy scale) statistically significant difference Self care (Diabetes self care activitiis (SDSCA) statistically significant difference		% participants achieving HbA1c goals % participants achieving HbA1c goals &achieving HbA1c less 6.5, 7 and 7.5 greater in intervention group (Fig 3). statistically significant. But data not shown. BMI- nonsignificant difference		
19	Krein		General satisfaction score and		BMI nonsignificant		

			rating of diabetes provider score was marginally better and statistically better in the intervention group.		difference		
20	Long				BMI nonsignificant difference	Uptake of intervention Peer mentoring: Aiming to have 4 calls per month for 6 months. The Results showed 38% mentors talked 4 times per month and by Month 6, that reduced to 16%.	No difference in hypoglycaemia
21	Maisios					Adherence to follow up: 41/48 and 23/34 patients returned for follow up. 29% intervention group non-compliant.	Use of insulin nonsignificant difference INT: 25% to 40% CONTROL: 15 to 17%
22	Mathers		Decisional conflict: Mean difference between intervention and control groups on the total score for decisional conflict on the total score was -7.72 (CI -12.5, -2.97) Realistic expectations: Were better in intervention group Preferred option: - Proportion undecided: No significant difference Participation in decision-making: Statistically significant difference, intervention group had higher participation rates. Regret score. No significant difference. Acceptability: Most found PDA				

			useful.				
23	McDermott		Test of Functional Health Literacy for Adults (TOFHLA)- unclear if significant result present Assessment of Quality of Life (AQoL) instrument- unclear if significant result present	Waitlist patients had better self-report adherence Adherence: SS reduction	Slight non-significant reductions in rest of other physical outcomes (BMI, ACR, eGFR)	Intervention group patients statistically significantly more likely to have seen a dietician and dentist, be taking inculin and have influenza vaccination.	
24	McMahon					Frequency of data uploads on web-based care management system (used to look at effect on HbA1c primary outcome)	
25	Mons	Symptoms of depression: Geriatric depression scale GDS: No difference between groups.	Health related quality of life (Short Form General Health Survey: SF-12) No difference between groups at 12 months. Statistically significant change at 18 months.				
26	O'Connor			No significant difference between groups regarding medication adherence (one prescription fill within 60 days of prescription date)- 88% in intervention group vs 86% in control group. Similarly there was no significant difference between groups regarding medication persistance (two or more prescription fills			Medication persistance (two or more prescription fills within 180 days)

				within 180 days)			
27	Odegard			No improvement on self reported adherence.			No significant difference in MAI (medication appropriateness) at end of study.
28	Palmas						
29	Phillis-Tsimikas	Self management behaviours and Depression (in separate publication) - not published at time of search so not included	Self management behaviours and Depression (in separate publication)- not published at time of search so not included				
30	Polonsky		GWB WHO-5 - nonsignificant difference			Treatment intensification Changes in treatment: 75.5% of STG patients received a medication change at month 1 V's 28% of ACG patients (p <0.0001). Twice as many STB patients started on insulin between month 1 and 12. Heightened attention paid to subjects. Free meters: Requirement to bring meters to all study visits More frequent study visits STG physicians trained on a treatment algorithm SMBG: Lower test use in STG group (0.77) V's ACG group 1.05 (nonsignificant difference)	
31	Quinn	PHQ-9 depression -	Diabetes distress scale -		BMI unclear if	Hypoglycaemic events and	

		nonsignificant difference	nonsignificant difference Diabetes diabetes inventory - nonsignificant difference		statistically significant	hospitalizations were infrequent in all groups.	
32	Rothman		Diabetes knowledge Satisfaction: (Diabetes Treatment Satisfaction Questionnaire) MD in scores (INT V's control) Diabetes knowledge: +14 (CI 9 to 20) Diabetes treatment satisfaction +3 (CI 1 to 6) statistically significant reduction			Process measures (time spent with patients) and medication changes. But did not factor in any changes made by PCP. Aspirin use higher in intervention group at 12 months. Statin use equal. No statistically significant increase in services in intervention group.	
33	Schillinger		SF-12 instrument for QoL nonsignificant difference Patient assessment of chronic illness care (PACIC) score out of 100 Statistically significant difference ATSM +12.2 V's control GVC +12.6 V's control Data present Diabetes Quality Improvement Program (100 score) Self management behavior statistically significant difference ATSM +0.6 V's control GVC +0.3 V's control Data present Diabetes self efficacy statistically significant difference ATSM +6.0 V's control GVC +5.5 V's control			Functional outcomes: Bed days: ATSM significant reduction Restricted activity, ATSM significant improvement **Interpersonal Processes of Care** for Diverse Populations (IPC) instrument to capture reports of provider's communication. Statistically significant difference ATSM +9.0 V's control	

			Data present				
34	Sen					Primary outcome was adherence to biometric tests: At three months; total adherence rates were 81% in the low incentive arm V's 58% in control (p 0.007) and 77% in high incentive arm V's 58% (p0.02). No difference between the incentive arms. But no difference in the high incentive group V's control at month 6 (at 3 month post intervention follow up).. But the low incentive group still had significant improvement in adherence at month 6 Vs control (62% V's 27%, p 0.002).	
35	Sugiyama	Change Mental Component Summary Score (MCS-12) from the SF-12: A mean difference of +1.6 between intervention and control which was statistically significant	Secondary outcomes: Social support score from the Diabetes Care Profile: non-significant change				
36	Tang		Satisfaction/ Psychosocial		BMI nonsignificant	Healthcare utilsiation -	Significant increase in new

			wellbeing Intervention group had higher treatment satisfaction (statistically significant) and lower treatment distress scores. Other scales of diabetes distress had no change between groups.		difference	nonsignificant difference in total physician visits.	medications started and insulin commencement in intervention group. Patients already on insulin- the intervention group had a statistically significant higher number of dose increases.
37	Taylor		Psychosocial (SF 26 for QoL and Duke Activity Status): Nonsignificant difference in psychological variables Patient and physician satisfaction nonsignificant difference			Medical utilization (physician visits) nonsignificant difference in physician or ED visits	
38	Thom				10-year framingham risk nonsignificant difference		

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	7
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	8
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	8, 9
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	8
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	8
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	9, 10
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	9, 10
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	10
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	10, 11
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	10, 11

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	10
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	10, 11
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	12
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	12, 13
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	13
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	13, 14, 15
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	13, 14, 15
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	13
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	15
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	16, 17
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	4

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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Improving risk factor management for patients with poorly controlled type 2 diabetes: A systematic review of healthcare interventions in primary care and community settings

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Title

Improving risk factor management for patients with poorly controlled type 2 diabetes: A systematic review of healthcare interventions in primary care and community settings

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Abstract

Objectives: Poorly-controlled type 2 diabetes mellitus (T2DM) is a major international health problem. Our aim was to assess the effectiveness of healthcare interventions, specifically targeting patients with poorly-controlled T2DM, which seek to improve glycaemic control and cardiovascular risk in primary care settings.

Design: Systematic review.

Setting: Primary care and community settings.

Included studies: Randomised controlled trials (RCTs) targeting patients with poor glycaemic control were identified from Pubmed, Embase, Web of Science, Cochrane Library and SCOPUS. Poor glycaemic control was defined as HbA1c over 68mmol/ mol (7.5%).

Interventions: Interventions were classified as organisational, patient-oriented, professional, financial or regulatory.

Outcomes: Primary outcomes were HbA1c, blood pressure and lipid control. Two reviewers independently assessed studies for eligibility, extracted data, and assessed study quality. Meta-analyses were undertaken where appropriate using random-effects models. Subgroup analysis explored the effects of intervention type, baseline HbA1c, study quality and study duration. Meta-regression analyses were undertaken to investigate identified heterogeneity.

Results: Forty-two RCTs were identified, including 11,250 patients with most undertaken in the USA. In general studies had low risk of bias. The main intervention-types were patient-directed (48%) and organisational (48%). Overall, interventions reduced HbA1c by -0.34% (95% CI; -0.46%, -0.22%), but meta-analyses had high statistical heterogeneity. Subgroup analyses suggested that organisational interventions and interventions on those with baseline HbA1c over 9.5% had better improvements in HbA1c. Meta-regression analyses suggested that only interventions on those with population HbA1c over 9.5% were more effective. Interventions had a modest improvement of blood pressure and lipids, although baseline levels of

control were generally good.

Conclusions: This review suggests that interventions for T2DM, in primary care, are better targeted at individuals with very poor glycaemic control and that organisational interventions may be more effective.

Article summary:

'Strengths and limitations of the study'

- This systematic review adds to the evidence regarding the effectiveness of healthcare interventions, which specifically target patients with poor glycaemic control of Type 2 Diabetes Mellitus, in community settings.
- There is no specific definition for 'poor control' diabetes in the literature, but by including all studies that had patients with a HbA1c > 59 mmol/mol (7.5%), we captured the full range of poor glycaemic control and also examined other key risk factors such as blood pressure and lipids.
- Data were pooled from 42 studies across four continents, enhancing the generalisability of the findings.
- We did not account for medication use in the studies, but given that all included studies were RCTs, which would balance out delivery of medications, we think that differences in underlying medication usage may relate to how different interventions promote intensification of medications.
- An individual patient data meta-analysis may answer further questions not possible in this review.

Funding statement:

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Competing interests statement:

Nil

Author's contributions:

All authors contributed to the drafting of the paper. MEM, MB and RG independently assessed studies for eligibility, extracted data, and assessed study quality. Decisions or disagreements were brought to SMS. SMS, TF and FB provided methodological and statistical support to the paper. All authors contributed to the writing of the paper.

Main text

Introduction

Worldwide, type 2 diabetes mellitus (T2DM) is rising in prevalence and will exceed 4.4% of the world's population, or 366 million by 2030 (1). Despite a wealth of evidence regarding the importance of risk factor control in T2DM, many patients continue to have poor control of HbA1c, blood pressure and lipids. Up to 60% of patients fail to meet target HbA1c levels (2). Similarly over one third of patients with T2DM have inadequate blood pressure control (3). Poorly-controlled T2DM - and its associated microvascular and macrovascular complications - is associated with higher morbidity, higher mortality, poorer quality of life and substantial economic burden (4).

Several studies have examined interventions designed to support the delivery of diabetes care in the community to improve glycaemic and cardiovascular risk factor control (5-11). A 2011 review of community-based interventions including all patients with T2DM, comprising sixty-eight studies, showed that only one third had a statistically significant improvement in one of the relevant clinical outcomes for diabetes: HbA1c, blood pressure or lipids (8). The majority of included studies targeted all patients with T2DM without focussing on those with poor control. Although no overall effect was noted, combining organisational with professional (multifaceted) interventions was concluded to be more beneficial than single interventions and the highest quality multifaceted randomised controlled trials (RCTs) tended to include decision support interventions and elements. A 2013 review looked at 48 cluster RCTs, assessing the effectiveness of Quality Improvement (QI) strategies on the management of diabetes (both type 1 and 2) (11). It suggested that QI interventions, which intervened at a system level on diabetes management, were associated with the largest benefits in glycaemic control and that the effectiveness of interventions targeting healthcare practitioners varied with baseline glycaemic control; being more effective with patients with worse control (11). A 2016 review, of type 1 or type 2 diabetes in primary care, looked at the effects of Clinician Education, Clinician Reminders, Team Changes, Case Management,

Electronic Patient Registry, Telemedicine and Audit and Feedback (10). Including thirty studies, it concluded that multifaceted interventions on multidisciplinary teams were most effective. Interventions targeting family physicians were only effective if computerised feedback on insulin prescribing was provided.

Four large RCTs from North America and the UK have investigated the effects of intensive management of hyperglycaemic and cardiac risk factors on mortality in T2DM across all settings (12-17). Uncertainty remains regarding intensive glycaemic management for all patients with T2DM, with concerns about aggressive reductions in HbA1c (18). Targeted reductions in cardiovascular and glycaemic risk factors in certain vulnerable populations (cognitively impaired, disabled and frail) have been advocated (19). Interventions that specifically target those with very poor control of risk factors may be more beneficial than those targeting all patients, achieving the benefits of cardiovascular and glycaemic control, but without the potential risks of intensively lowering HbA1c in all persons with T2DM. The effect of interventions specifically targeting patients with poorly controlled T2DM in primary care is unknown.

Our aim was to assess the effectiveness of healthcare interventions delivered in primary care and community settings, targeting poorly-controlled T2DM, which seek to improve glycaemic control, blood pressure and lipids.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to standardise the conduct and reporting of the research and the protocol was registered on PROSPERO (20).

Data Sources and Searches

We searched articles in all languages from the Cochrane Library, Pubmed, Embase, Web of Science and SCOPUS from 1990 to 31st December 2016. Reference lists of all included papers were searched. Secondary searching of all references from included studies was also conducted. *Appendix 1* outlines the search string.

Study Selection

We considered RCTs, controlled clinical trials (CCTs), controlled before and after studies (CBAs) and interrupted time series analyses (ITS) meeting the Cochrane Effective Practice and Organisation of Care (EPOC) quality criteria (21). Studies published in all languages were eligible.

Population:

Individuals with 'poorly controlled' T2DM were our population of interest. Though there is a broad consensus about the importance of achieving good glycaemic control for the reasons described, there are no validated cut-offs, which define 'poor-control' of T2DM for targeted interventions. Poorly controlled T2DM has been defined based upon elevated glycated haemoglobin levels in the literature, with different thresholds of HbA1c described, from over 59 mmol/mol (7.5%), over 64 mmol/mol (8.0%) to over 75 mmol/mol (9.0%) (22-24). In this review, we considered participants to have poorly controlled T2DM if their HbA1c was over 59 mmol/mol (7.5%) (or if over 80% of the population in a study had a HbA1c over 59 mmol/mol). Similarly there is no defined cut off as to what defines 'poorly-controlled' blood pressure. We identified studies primarily based on poor glycaemic control but also included participants in these studies who had uncontrolled hypertension or elevated cholesterol/ lipids, if the risk factor level was above that of an accepted

international target, as designated by the study authors. Where studies included patients with 'poor control' based upon a range of risk factor profiles, for consistency, we only included a study if 80% of the population had a HbA1c over 59 mmol/mol (7.5%).

Interventions:

We included interventions delivered by healthcare professionals (HCPs) specifically aiming to target patients with poor control of T2DM, based in primary care or community settings. The primary healthcare setting was defined as providing "integrated, easy to access, health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained and continuous relationship with patients, and practicing in the context of family and community" (25). We excluded drug trials though interventions could have involved treatment intensification. Interventions were defined as simple if they had one identifiable component and multifaceted if they had more than one element. We excluded trials performed within the hospital or the hospital-outpatient setting. The Cochrane EPOC taxonomy of interventions was utilised and the predominant intervention type was defined using five categories including organisational, patient-centred, regulatory, financial and professional. Examples of these intervention types are provided in *Appendix 2* (21):

Comparison:

Comparison groups were included if they received usual care in that setting for T2DM. Controls were also included if they received minor enhanced elements of care, such as education leaflets, which the study authors believed did not go beyond usual care in most settings.

Outcome measures:

Primary outcomes included glycaemic control (HbA1c), blood pressure (systolic or diastolic) and lipid levels, but if studies did not include HbA1c they were excluded. Secondary outcomes included patient reported outcome measures (PROMs) (for example health related quality of life), utilisation of health services, behavioural

outcomes such as medication adherence, provider behaviour, acceptability of service to patients and providers, economic outcomes and adverse events.

Data Extraction and Quality Assessment

Two reviewers (MEM and RG) read the titles and/ or abstracts of the identified references and eliminated irrelevant studies. Studies that were deemed eligible for inclusion were read in full and their suitability for inclusion in the systematic review was independently determined by two reviewers. Disagreements were managed by a third, independent reviewer (SMS). The following information was extracted: a) Details of intervention, b) Participants, c) Clinical setting, d) Study design, e) Outcomes, f) Author Information. We contacted authors for missing data.

Risk of bias in articles was assessed using the Cochrane Handbook for systematic reviewing and EPOC criteria (26). Two review authors independently assessed the risk of bias of each included study against the criteria described in the Cochrane risk of bias tool. We explicitly judged each of these criteria using: low risk of bias, high risk of bias or unclear risk of bias (either lack of information or uncertainty over the potential for bias). We resolved disagreements by consensus and consulted a third review author to resolve disagreements if necessary. An overall assessment of a study's risk of bias was determined using EPOC guidance, with judgement and consensus reached between two reviewers (MEM and SMS) (26).

Data Analysis

For continuous data we calculated the treatment effect using mean differences (MD) and 95% confidence intervals (CI). No binary outcomes were included. Revman software was used to perform the analysis, determine heterogeneity and produce forest plots to illustrate pooled estimates (21). Stata version 13 was used to investigate publication bias by creating funnel plots and using Egger's test to assess funnel plot asymmetry (27). A random-effects analysis was performed and heterogeneity across the studies was quantified using the I^2 statistic. The I^2 statistic describes the percentage of the variability in effect estimates which is due to heterogeneity rather than sampling error (chance) (28). If the I^2 statistic was >50%, it

was deemed that there was significant heterogeneity between the studies.

Subgroup analyses were performed for primary outcomes based on a priori assumptions, as per the PROSPERO protocol (20). For HbA1c we explored the possible effects of subgroups; a) the type of intervention based upon the EPOC taxonomy (*Appendix 2*); b) study quality and c) baseline HbA1c in the study populations (HbA1c 7.5% - 9.4%, or ≥ 9.5%). After reviewing the included studies we also included study duration as a subgroup (< 12 months or ≥ 12 months), as a wide range in study duration was found. Subgroup analyses for systolic blood pressure (SBP) and diastolic blood pressure (DBP) explored the effects of intervention-type based upon the EPOC taxonomy.

When important heterogeneity was identified, we investigated its causes using meta-regression. Meta-regression is an extension to subgroup analysis that allows the effect of continuous, as well as categorical, characteristics to be investigated (29). Meta-regression was performed to explore the effects of; a) study quality (using the overall assessment risk of bias); b) study population characteristics (e.g. gender, age and baseline HbA1c and SBP); c) intervention type (EPOC taxonomy); and d) study duration on the primary outcomes (29). Random effects meta-regression was performed using Stata 13 (27).

Results

Overall 18,829 titles were screened and 42 full text articles met the inclusion criteria (*Figure 1*: PRISMA Flow diagram). All 42 studies were RCTs, encompassing 50 interventions in total, comprising 11,250 patients (22-24, 30-68). No other eligible study designs were identified.

Characteristics of studies

Twenty-nine of the 42 studies were conducted in the United States, nine in Europe, two in Australia, one in Mexico and one in Israel. Follow-up of outcomes in the studies varied in length from 3 (53) to 36 months (46). The mean HbA1c at baseline across all studies was 9.5% (95% CI; 9.3%, 9.8%). The mean age of patients in the studies was 58.0, varying from 47.9 (62) to 67.5 (41) partly reflecting different inclusion criteria (*Table 1*). Thirty studies explicitly defined their study population as "poorly controlled", "complicated" or "persistently poorly controlled", whereas the other twelve had poorly controlled T2DM with HbA1c ≥ 59 mmol/mol (7.5%) as per the review inclusion criteria. Twenty-seven of the 42 studies reported SBP results (22-24, 30-36, 38, 39, 41, 45, 46, 48-51, 54, 58-60, 62, 65, 66, 68) and of these, twenty-three reported DBP (22-24, 31, 32, 34-36, 38, 39, 41, 45, 46, 48, 49, 51, 54, 58, 59, 62, 65, 66, 68). Twenty of the studies reported a lipid outcome (23, 24, 30-32, 35, 36, 38, 39, 41, 45, 46, 48, 51, 56, 58, 62, 65, 66, 68). All of the 42 studies reported at least one secondary outcome. Two studies were excluded from primary outcome analysis due to lack of appropriate data, despite efforts to contact authors (31, 61).

Table 1: Characteristics of included studies

Study ID Author, Year Country	Patient participants Total patients (n) Intervention (n) Control (n) Age (mean, unless stated) Gender (% male, unless stated) HbA1c cutoff of 'poor control' Baseline HbA1c level (mean) Baseline BP (mean) % on insulin at baseline Diabetes duration: (years) **Practitioner and practice participants**	Brief Intervention description	Predominant Intervention type	Outcomes: Primary Secondary	Study duration Months
Anzaldo-Campos 2016 Mexico	**Patient participants** 301 Patients (99 Intervention 1 (PD) and 102 in Intervention 2 (PD-TE) and 100 Control) Mean age: 51.5 % male: 33% T2DM with HbA1c ≥ 8.0% Mean HbA1c: 11.16 Mean BP: 122/ 78 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 81 medical offices within one Family Medical Unit Trained clinicians, nurses and peer educators	Two interventions: Nurse care support and peer-led diabetes self-management education intervention (called Project Dulce). Nurse care support and peer-led diabetes self-management education intervention. A technology-enhanced intervention, using cell phone uploads of glucose and BP levels and text message support.	Patient-centred	Primary outcomes: HbA1c at 10 months Secondary outcomes: Lipid and TAG profile, BP, BMI. Self-reported outcomes: Self efficacy (Spanish Self-Efficacy), depression (PHQ-9), lifestyle (IMEVID), quality of life (Diabetes 39), diabetes knowledge (DKQ24)	10 months

Basudev 2016 UK	**Patient participants** 235 Patients (93 Intervention and 115 Control) Mean age: 59.9 % male: 57.4% T2DM with HbA1c > 8.5% Mean HbA1c: 10.3 Mean BP: 135/ 78 % insulin baseline: 38% Mean diabetes duration: NR **Practitioner and practice participants** From six general practices in London	Virtual clinic integrating primary and specialist care.	Organisational	Primary outcomes: HbA1c at 12 months Secondary outcomes: BP; BMI; Lipids; Renal Function (eGFR).	12 months
Blackberry 2013 Victoria, Australia	**Patient participants** 473 Patients (236 Intervention and 237 Control) Mean age: 62.8 % male: 57% T2DM with HbA1c > 7.5% Mean HbA1c: 8.06 Mean BP: NR % insulin baseline: 27% Mean diabetes duration 10 (5-14 range) **Practitioner and practice participants** 59 practices Practice-based nurses	Telephone coaching by nurses to support diabetes management and self monitoring	Patient-centred	Primary outcomes: HbA1c at 18 months Secondary outcomes: Lipid and TAG profile; eGFR and urine ACR; BP; BMI; waist circumference; smoking status; Quality of Life; Diabetes Self efficacy; Diabetes support; Depression status; Intensification of diabetes. Others: Health service utilization; Physical activity, Nutrition	18 months
Capozza 2015 USA	**Patient participants** 93 patients (58 Intervention; 35 Control) Mean age: 58.7 % male: 35.5% T2DM with HbA1c > 8% Mean Baseline HbA1c 9.1% Mean Baseline BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Recruited from 18 primary clinics	Text-message based behavioural intervention for T2DM	Patient-centred	Primary outcome: Change in HbA1c from day 0 to day 180 Secondary outcomes: Patient interaction and satisfaction (CSQ8) with the program	6 months

Choe 2005 USA	**Patient participants** 80 patients (41 Intervention and 39 Control) Age: 51.0 (all less 70) % male: 46% HbA1c ≥ 8.o% Mean HbA1c 10.1 Mean BP: NR % insulin baseline: 30% Diabetes duration: NR **Practitioner and practice participants** 1 clinic 1 pharmacist case manager	Pharmacist case management	Organisational.	Primary outcome: HbA1c level at 12 months Secondary outcomes: Rates of diabetes process measures (LDL, dilated retinal examination, urine ACR or use of ACE Inhibitors, monofilament testing for diabetic neuropathy, by chart review over 24 months); Rate of HbA1c measurement.	12 month intervention with primary outcome reporting at 12 months and a further 24 month follow up.
Crowley 2015 USA	**Patient participants** 50 patients (25 Intervention and 25 Control) Age: 60 % male: 24% HbA1c > 9% Definition: Yes, defined as 'persistently poor diabetes' Mean HbA1c 10.5% Mean SBP: 127/ 80 % insulin baseline: NR Diabetes duration: 12 **Practitioner and practice participants** Patients all receiving care by Durham VA primary care and endocrinology	Intensive telemedicine intervention for veterans	Organisational	Primary outcome: HbA1c Secondary outcomes: Diabetes self-management (Self-care inventory revised); Depression (PHQ-9); Self reported medication adherence (Morisky medication adherence); BP; Adverse events; Telephone encounters	6 months
Dale 2009 England Exploratory RCT	**Patient participants** 231 (90 (PS) Intervention 1, 44 (NS) Intervention 2 and 97 Control) Age: No mean age provided, but wide spectrum of ages from below 50 to over 70 in each of the intervention and control groups. % male: 57% HbA1c ≥7.5% Mean HbA1c: 8.6% Mean BP: NR % insulin baseline: 0% Diabetes duration: No mean, but between 1- 15 years mostly. **Practitioner and practice participants** 29 practices	Two intervention telecare groups: a) Peer-support telecare intervention b) Diabetic specialist nurse telecare support	Patient-centred.	Primary outcome: Self efficacy (DMSES) Secondary outcomes: HbA1c; Cholesterol; BMI. Diabetes distress (PAID)	6 months

	Peer coaching or diabetes specialist nurse delivered				
DePue 2013 U.S. Territory of America Somoa Cluster RCT	**Patient participants** 268 patients (104 Intervention and 164 Control) Age: 55 % male: 38% Intervention did not target poor control per se, mean baseline HbA1c of 9.6% (SD of 2.1%) was deemed eligible for inclusion Mean HbA1c 9.8 Mean BP: 133/ 84 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Cluster RCT based upon twelve village units Nurse care managers	Nurse–Community Health Worker Team in American Somoa	Organisational.	Primary outcome: HbA1c Secondary outcomes: BP; BMI; Dietary intake; Medication adherence; Physical activity; Adapted measures of diabetes beliefs	12 months
Edelman 2010 North Carolina and Virginia, USA.	**Patient participants** 239 patients (133 Intervention and 106 Control) Age: 61.9 % male: 96% T2DM HbA1c >7.5 AND (SPB > 140 DBP > 90) Mean HbA1c: 9.2% Mean BP: 152/ 84 % insulin baseline: unclear Duration of diabetes: NR **Practitioner and practice participants** 2 VA centres A care team involving internist, pharmacist, a nurse and educator	Enrollment into a general medical clinic (GMC) with an internist, pharmacist and a nurse or educator that met seven times over 12 months	Organisational.	Primary outcomes: HbA1c Secondary outcomes: Systolic blood pressure; Adherence to medications; Self-efficacy; Adverse events through structured self report and medical record review; Health utilization; Cost data	12 months
Edelman 2015 USA	**Patient participants** 377 patients (193 Intervention and 184 Control) Age: 58.7 % male: 45.4% HbA1c ≥ 7.5 (and HTN) Mean HbA1c 9.1% Mean BP: 142.2/ 80.7 % insulin baseline: NR	Nurse case management	Organisational	Primary outcome: HbA1c Secondary outcomes: BP; Weight; Physical activity; Self-efficacy; Health literacy; Medication adherence (via self report)	24 months

	Diabetes duration: NR **Practitioner and practice participants** 9 primary care practices in Duke.				
Farmer 2012 UK	**Patient participants** 211 patients (126 Intervention and 85 Control) Age: 63.2 % male: 65% HbA1c ≥ 7.5% Mean HbA1c: 8.3% Mean BP: 136.9/ 78.2 % insulin baseline: NR Mean diabetes duration: 6.8 years **Practitioner and practice participants** 13 practices Practice nurses	Nurse-led, multilevel intervention to support medication adherence	Organisational	Primary outcome: % days over a 12 week period on which the correct number of doses of main glucose lowering medication was taken each day as prescribed. Secondary outcomes: Hba1c at 0 and 20 weeks (from protocol); Functional status as per SF 12 Physical and SF 12 Mental; Diabetes treatment satisfaction and satisfaction with nurse; MARS Self reported adherence (range 5-25); % reporting hypoglycaemia	12 weeks (intervention was 8 weeks into a 20 week trial)
Forjouh 2014 USA	**Patient participants** 376 patients (101 Intervention 1 (CDSMP), 81 Intervention 2 (PDA), 99 Intervention 3 (PDA, CDSMP and 95 Control) Age: 57.6 % male: 44.0% HbA1c >7.5% Mean HbA1c: 9.3 Mean BP: 134.8/ 77 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 7 practices involved Technology intervention	Three intervention groups, reflecting the individual and combined effects of a behavioural and technology intervention; a chronic Disease Self-Management Program (CDSMP) and a diabetes self-care software on a personal digital assistant (PDA).	Patient-centred	Primary: HbA1c Secondary: BMI; BP; Self management behavioural measures (e.g. foot care)	12 months
Frosch 2011 USA	**Patient participants** 201 patients (100 Intervention and 101 Control) Age: 55.5 % male: 51.5% HbA1c > 8.0 Mean HbA1c: 9.6% Mean BP: 127.7/ 74.0 % insulin baseline: NR Mean diabetes duration: 9.5 **Practitioner and practice participants** 3 academic primary care practices and 1	A video behavioural support intervention by nurse educators with a workbook followed by 5 sessions of telephone coaching.	Patient-centred	Primary: HbA1c Secondary: LDL Cholesterol; BP; BMI; Prescribed medications; Diabetes knowledge (23 point Diabetes knowledge test); Self-care behaviours (SDSCA)	Unclear, possibly over 6 months

	community based safety net clinic Nurse educators				
Guerci 2003 France	**Patient participants** 988 patients (510 Intervention and 478 Control) Age: 60.6 % male: 53.7% HbA1c ≥ (7.5 and 11) diabetes. Mean HbA1c 8.95% Mean SBP: 139.6, 80.4 % insulin baseline: 0% Mean diabetes duration months: 96.6 **Practitioner and practice participants** 265 GPs involved, uncertain number of practices	A self-monitoring of blood glucose intervention Auto-Surveillance Intervention Active (ASIA) study.	Patient-centred	Primary: HbA1c Secondary: Changes in fasting glucose; Symptomatic hyoglycaemia; BP; Weight; Diet; Drugs; Adverse drug event	6 months
Heisler 2010 USA	**Patient participants** 244 patients (126 Intervention and 119 Control (NCM)) Age: 62.0 % male: 100% HbA1c > 7.5% Mean HbA1c 7.98 Mean BP: 138.4/ 76.5 % insulin baseline: 56% Diabetes duration: NR **Practitioner and practice participants** Two VA facilities Nurse and peer case managers	Reciprocal peer support	Patient-centred	Primary HbA1c 6 months Secondary: Medication adherence; Diabetes emotional distress; Diabetes specific social support; Medication changes Attendance at clinics	6 months
Jacobs 2012 USA	**Patient participants** 396 patients (195 Intervention and 201 Control) Age: 62.9 % male: 50% HbA1c > 8.0% Mean HbA1c 9.35 Mean BP: 138.7/ 78.9 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 5 pharmacists, patients came from practices of	A pharmacist assisted medication program intervention	Organisational	Primary No specific primary outcome given or sample size: Secondary: HbA1c < 7%; LDL Cholesterol < 100mg/dl; BP < 130/ 80mmHg	12 months

	66 primary care physicians.				
Jameson 2010 USA	**Patient participants** 104 patients (52 Intervention and 52 Control) Age: 49.6 % male: 49% HbA1c ≥ 9.0% (two of the population had T1DM) Mean HbA1c: 10.8% Mean BP: NR % insulin baseline: 49.6% Mean diabetes duration: NR **Practitioner and practice participants** 1 pharmacist.	A pharmacist collaborative management intervention	Organisational	Primary: HbA1c Secondary: % of patients with a 1.0% decrease in HbA1c.	12 months
Jovanovic 2004 USA	**Patient participants** 362 patients (186 Intervention and 172 Control) Age: 57.0 % male: 23.8% HbA1c > 7.5 Mean HbA1c: 9.65% Mean BP: 135/ 79 % insulin baseline: NR Mean diabetes duration: 11.1 **Practitioner and practice participants** Unclear number of case managers and practices	Diabetes case management by a nurse or dietician	Organisational	Primary: HbA1c Secondary: % participants achieving HbA1c goals medication usage; BP ; Lipids; BMI; Frequency of hypoglycaemia	36 months
Keogh 2011 Ireland	**Patient participants** 121 patients (60 Intervention and 61 Control) Age: 58.6 % male: 64% HbA1c ≥ 8.0% Median HbA1c: 9.2 Mean BP: 138.8/ 76.8 % insulin baseline: 52% Mean diabetes duration: 9.4 **Practitioner and practice participants** One practice One psychologist	Psychological family intervention	Organisational	Primary outcome: Hba1c Secondary outcomes: Illness perceptions (Brief illness Perception Questionnaire); Psychological wellbeing (12-item Well-Being questionnaire); BP; BMI; Diabetes self management (Summary of Diabetes Self-care Activities Questionnaire); Self Efficacy (UK version Diabetes Self-Efficacy Scale); Family support (Diabetes Family Behaviour Checklist).	6 months
Kim 2009	**Patient participants** 83 patients (41 Intervention and 42 Control) Age: 56.4	A Community-based, culturally tailored behavioral intervention	Patient-centred	Primary: HbA1c	30 weeks (7 months)

USA	% male: 55.4% HbA1c ≥ 7.5% Mean HbA1c: 9.25% Mean BP 132.1/ 79.3 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Uncertain number practices Community nurse delivered			Secondary: Diabetes knowledge test (DKT)' Self efficacy (Stanford Chronic Disease Self-Efficacy scale); Self care (Diabetes self care activitiis (SDSCA); Depression (Kim Depression Scale for Korean Americans); Quality of Life (Diabetes Quality of Life Measure (DQOL); Lipids; BP; BMI	6 month intervention
Krein 2004 USA	**Patient participants** 246 patients (123 Intervention and 123 Control) Age: 61 % male: 97% HbA1c ≥7.5% Mean HbA1c 9.25 Mean BP: 145/ 86 % insulin baseline: 59% Mean diabetes duration: 11 **Practitioner and practice participants** One VA centre, unclear number of practices Two nurse case managers	Case management by nurse practitioners	Organisational	Primary: HbA1c Secondary: LDL; Cholesterol; BP; Health status; Patient satisfaction; Inpatient and outpatient encounters, pharmacy and laboratory use; Semi structured interviews also done.	18 months
Long 2012 USA	**Patient participants** 118 patients (38 Intervention 1 (PM), 40 Intervention 2 (FI) and 39 Control) Age: 60 % male: 94% HbA1c > 8.0% (two patients may have had T1DM) HbA1c Mean: 9.7 Mean BP: NR % insulin baseline: 74% Mean diabetes duration: NR Diabetes over 10 years: 58% **Practitioner and practice participants** Unclear number of practices Peer mentors	Two interventions: Peer mentoring Financial incentivisation of patients	Patient-centred	Primary: Hba1c Secondary: Patient recollection of hypoglycaemic event	6 months
Maislos 2002 Israel	**Patient participants** 82 patients (48 Intervention and 34 Control) Age: 60.5 % male: 29.5% HbA1c ≥ 10%	A mobile clinic providing interdisciplinary care	Organisational	Primary: Decrease of HbA1c of 0.5% at six months Secondary: Compliance with study protocol at six months	6 months

	Mean HbA1c 11.35 Mean BP: NR % insulin baseline: 20% Duration diabetes: 10 **Practitioner and practice participants** 2 practices involved via 1 mobile clinic				
Mathers 2012 UK Cluster RCT	**Patient participants** 175 patients (95 Intervention and 80 Control) Age: 64 % male: 54% HbA1c ≥ 7.5 Mean HbA1c: 8.7% Mean BP: NR % insulin baseline: NR Duration diabetes: 7.8 **Practitioner and practice participants** 49 practices involved GPs and nurses from practices delivered intervention	Patient decision aid to improve decision quality and glycaemic control	Professional	Primary: HbA1c Secondary: Decisional conflict scale score- indicator of decision quality; Knowledge and realistic expectations of the risks and benefits; Regret scale	6 months
McDermott 2015 Australia Cluster RCT	**Patient participants** 213 patients (113 Intervention and 100 Control) Age: 47.9 % male: 37.6% HbA1c ≥ 8.5 (69mmol/mol) Mean HbA1c 10.7 Mean BP: 131/ 79.3 % insulin baseline: 44.4% Diabetes duration: NR **Practitioner and practice participants** 12 remote communities in north Queensland.	Community-based health-worker led case management approach to the care of Indigenous adults with poorly controlled type 2 diabetes in primary care services in remote northern Australia	Organisational	Primary outcome: HbA1c level at 18 months Secondary outcomes: BP BMI Lipids Medications ACR eGFR Test of Functional Health Literacy for Adults (TOFHLA) Assessment of Quality of Life (AQoL) instrument Implementation Fidelity	18 months
McMahon 2005 USA	**Patient participants** 104 patients (52 Intervention and 52 Control) Age: 63.5 % male: 99% HbA1c ≥ 9% Mean HbA1c: 10.0% Mean BP: 140/ 81 % insulin baseline: 54% Duration diabetes: 12.3 years	Web-based care management	Organisational	Primary: HbA1c Secondary Systolic BP Diastolic BP TAG LDL Cholesterol HDL Cholesterol	12 months

	Practitioner and practice participants Practice number unclear Care manager available				
Mons 2013 Germany	**Patient participants** 204 patients (103 Intervention and 101 Control) Age: 67.5 % male: 61% HbA1c > 7.5% Mean HbA1c: 8.1% Mean BP: 137.5/ 80 % insulin baseline: NR Duration diabetes: NR **Practitioner and practice participants** 10 GP practices Practice nurses	Supportive telephone counseling	Patient-centred	Primary HbA1c Secondary Systolic BP; Diastolic BP; Cholesterol; Health related quality of life (Short Form General Health Survey: SF-12); Symptoms of depression: Geriatric depression scale	18 months
O'Connor 2014 USA **Cluster RCT**	**Patient participants** 1102 patients (569 Intervention and 533 Control) Age: 43% ≥ 65 years. ~ 61 mean % male: 51.3% HbA1c ≥ 8% Mean HbA1c: 9.8% Mean BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Large medical groups in California. Clusters defined on their linkage to primary care physicians.	Telephone Outreach to Improve Medication Adherence and Metabolic Control in Adults With Diabetes	Organisational	Primary Outcome: Medication adherence (at least one prescription fill within 60 days of prescription date). Secondary Outcomes: Medication persistence (two or more prescription fills within 180 days); HbA1c; BP; Lipids	6 months
Odegard 2005 USA	**Patient participants** 77 patients (43 Intervention and 34 Control) Age: 51.8 % male: 57% HbA1c ≥ 9.0% Mean HbA1c: 10.4% Mean BP: NR % insulin baseline: 32% Duration diabetes: 7.6 **Practitioner and practice participants** 7 primary care clinics	A pharmacist intervention care management intervention	Organisational	Primary HbA1c 12 months Secondary: Medication appropriateness (Medication Appropriate Index/ MAI); Self reported adherence by questionnaire	6 month intervention but HbA1c at 12 months

	Pharmacists: Unclear number				
Palmas 2014 USA	**Patient participants** 360 patients (181 Intervention and 179 Control) Age: 57.6 % male: 38% HbA1c ≥ 8.0% Mean HbA1c: 8.7% Mean BP: 136/ 81 % insulin baseline: NR Duration diabetes: NR **Practitioner and practice participants** Unclear number GP practices Two community health workers	Community health worker (CHW) intervention in an Hispanic population	Patient-centred	Primary: HbA1c Secondary: Systolic BP; Diastolic BP; LDL Cholesterol; Medication adherence; Dosage and intensity; Physical activity; Diet; Depression	12 months
Phillis-Tsimikas 2011 USA	**Patient participants** 207 patients (104 Intervention and 103 Control) Age: 50.7 % male: 29.5% HbA1c > 8.0% Mean HbA1c: 10.4% Mean BP: 122.6/75 Duration diabetes: NR % insulin baseline: NR **Practitioner and practice participants** Unclear number GP practices participating Peer educators	Peer-led diabetes education programs in high-risk Mexican Americans	Patient-centred	Primary: HbA1c Secondary: Lipids; BP; BMI; Self management behaviours and Depression (in separate publication)	10 months Intervention was 4 months and primary outcome was 6 months after this.
Polonsky 2011 USA Cluster RCT	**Patient participants** 499 patients (256 Intervention and 227 Control) Age: 55.8 % male: 53.2% HbA1c > 7.5% Mean HbA1c: 8.9 Mean BP: NR % on insulin: 0% Duration diabetes: 7.6 **Practitioner and practice participants** 34 GP practices participating	Self blood glucose monitoring	Patient-centred	Primary: Hba1c Secondary: Treatment intensification; Total number of visits with medication or lifestyle modifications; Time to the first treatment change; Frequency of SMBG; GWB from WHO-5 Well-Being Index	12 months
Protheroe	**Patient participants**	Lay Health Trainer (LHT) interviews with	Organisational	Feasibility study	7 months

2016 UK Feasibility study	76 Patients (37 Intervention and 39 Control) Mean age: 63.1 % male: 50.3% T2DM with HbA1c > 7.5% Mean HbA1c: 9.3 Mean BP: NR % insulin baseline: NR Mean diabetes duration: 61% > 5 years **Practitioner and practice participants** From six family doctor practices	patients, creating a self-management plan, with supportive phone calls.		Outcomes included: Deprivation; Health literacy; Diabetes self care; Diabetes Quality of Life; Diabetes UK Scale Items, Health-related Quality of Life, Warwick- Edinburgh Mental Well-Being, Illness Perception, health Status Measure, Resource Use, HbA1c.	
Quinn 2011 USA Cluster RCT	**Patient participants** Cluster trial, 3 intervention groups, 1 control 163 patients (Intervention 1 (CO) 23, Intervention 2 (CPP) 22, Intervention 3 (CPDS) 62 and Control 56) Age: 52.9 (weighted average) % male: 52.5% (weighted average) HbA1c ≥ 7.5% Mean HbA1c: 9.4 Mean SBP: 131/ NR % insulin baseline: NR Duration diabetes: 8.2 **Practitioner and practice participants** 26 GP practices participating	Mobile phone-based treatment/ behavioural coaching intervention	Patient-centred	Primary: HbA1c Secondary: PHQ-9 questionnaire for depressive symptoms; Self completion patient outcome instrument; Diabetes Distress Scale; BP; Lipids; Hypoglycaemic events; Hospitalisations and ED visits	12 months
Rothman 2005 USA	**Patient participants** 217 patients (112 Intervention and 105 Control) Age: 55.5 % male: 44% HbA1c ≥ 8.0% Mean HbA1c: 11 Mean BP: 138.5/ 81 % insulin baseline: 39% Duration diabetes: 8.5 **Practitioner and practice participants** Three pharmacists	A primary care-based disease management program delivered by trained pharmacists.	Organisational	Primary: HbA1c Secondary: BP; Aspirin; Lipids; Diabetes knowledge Satisfaction (Diabetes Treatment Satisfaction Questionnaire); Use of clinical services; Adverse events; Process measures (time spent with patients and medication changes)	12 months
Schillinger 2009	**Patient participants** 339 patients (112 intervention 1 (ATSM), 113 intervention 2 (GVC) and 114 Control) Age: 56.1	Two interventions: Self-Management Support via 1/	Patient-centred	Primary: Self management behaviour Secondary: Patient assessment of chronic illness care	12 months

USA	% male: 41 % HbA1c ≥ 8.0% Mean HbA1c: 9.5% Mean BP: 140/ 77.3 % insulin baseline: 38% Duration diabetes: 9.5 **Practitioner and practice participants** Uncertain number GPs- in a safety net health system	Automated telephone self management support (ATSM) and 2/ Group medical visits (GMVs).		(PACIC); Diabetes Quality Improvement Program; Interpersonal Processes of Care for Diverse Populations (IPC) instrument; Self management behavior (Foods, diets, exercise, self monitoring); SF-12 instrument for QoL; Functional status- likert scale; HbA1c; SBP; DBP; BMI	
Sen 2014 USA	**Patient participants** 75 patients (21 Intervention 1 (low), 26 Intervention 2 (high) and 28 Control) Age: 54.3 % male: 36% HbA1c ≥ 7.5% (90-95% had T2DM from personal correspondence with author) Mean HbA1c 9.5% Mean BP: 132.9/ 86.1 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 1 practice	Financial incentives for home based monitoring- two interventions	Financial	Primary: Adherence over three months Secondary: HbA1c	12 weeks
Sugiyama 2015 USA	**Patient participants** 516 patients (258 Intervention and 258 Control) Age: 63 % male: 30% HbA1c ≥ 8.0% Mean HbA1c: 9.7 Mean BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Participants were recruited from senior centers, churches, community clinics, and Los Angeles County Community and Senior Service Centers	Diabetes self management education by trained health educators.	Patient-centred	Primary: HbA1c Secondary: Change Mental Component Summary Score (MCS-12) from the SF-12; Social support score from the Diabetes Care Profile	6 months
Tang 2013	**Patient participants** 415 patients (203 Intervention and 213 Control) Age: 54 % male: 60%	Online disease management of diabetes	Patient-centred	Primary: HbA1c Secondary: SBP; DBP; LDL; 10 year Framingham risk;	12 months

USA	HbA1c ≥ 7.5% Mean HbA1c: 9.3 Mean BP: 126.6/ 72.7 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Uncertain number practices			Satisfaction; Psychosocial wellbeing; Healthcare utilization	
Taylor 2003 USA	**Patient participants** 169 patients (84 Intervention and 85 Control) Age: 55.2 % male: 52.7% HbA1c > 10.0% Mean HbA1c: 9.5% Mean BP: 127.5/ 72.8 % insulin baseline: NR Mean diabetes duration NR **Practitioner and practice participants** Uncertain number practices Nurse care managers	Nurse care management (NCM)	Organisational	Primary: % of patients in 'target' HbA1c Secondary: Total cholesterol; HDL Cholesterol; LDL cholesterol; TAGs; Glucose; Microalbuminuria; SBP; DBP; Processes of care (foot, eye, dental exam and flu shot); Psychosocial (SF 26 for QoL and Duke Activity Status); Patient and physician satisfaction; Medical utilization (physician visits)	12 months
Thom 2013 USA	**Patient participants** 299 patients (151 Intervention and 148 Control) Age: 55.2 % male: 47.8% HbA1c ≥ 8.0% Mean HbA1c: 10.0 Mean BP: 143.2/ NR % insulin baseline: 55% Mean diabetes duration: 8.9 **Practitioner and practice participants** 6 practices included Peer coaches	Peer health coaching	Patient-centred	Primary: HbA1c Secondary: % patients whose HbA1c dropped 1%; % patients with a HbA1c less 7.5; LDL; SBP; BMI	6 months
Wild 2016 UK	**Patient participants** 231 Patients (160 Intervention and 161 Control) Mean age: 61 % male: 66.8% T2DM with HbA1c > 7.5% Mean HbA1c: 8.9 Mean BP: 134/79 % insulin baseline: 26%	Supported telemonitoring involving twice-weekly self-measurement of glucose and transmission to a general practitioner	Patient-centred	Primary outcomes: HbA1c at 9 months Secondary outcomes: BP; BMI; Lipid and TAG profile; eGFR and urine ACR; UKPDS risk score; Anxiety and Depression score; Quality of Life; Diabetes Self efficacy; Self-reported physical activity, alcohol intake, exercise tolerance and diabetes knowledge; healthcare utilization.	9 months

	Mean diabetes duration 7.4 **Practitioner and practice participants** From 44 practices from four UK regions.				

Glossary of abbreviations:

ACR (albumin-creatinine ratio), AQoL (assessment of quality of life), ATSM (automated telephone self management support) , BMI (body mass index), BP (blood pressure), CDSMP (chronic disease self-management program) , CO (coach-only), CPDS (coach primary care provider portal with decision support), CPP (coach primary care physician portal), CSQ8 (client satisfaction scale 8), DBP (diastolic blood pressure), DMSES (diabetes management self efficacy scale) , DQOL (diabetes quality of life measure), ED (emergency department), eGFR (estimated glomerular filtration rate), FI (financial incentivisation), GMV (group medical visits), GWB (blobal well being), LDL (low density lipoproetin), MAI (medication appropriate index), MARS (medication adherence rating scale), MCS-12 (mental component summary score), NR (not recorded), PACIC (Patient assessment of chronic illness care), PAID (problems areas in diabetes scale), PDA (personal digital assistant), PHQ-9 (patient health questionnaire 9), PM (peer mentoring), SBP (systolic blood pressure), SDSCA (summary of diabetes self-care behaviours scale), SF-12 (short Form general health survey), T2DM (type 2 diabetes mellitus), TOFHLA (test of functional health literacy for adults), VA (veteran's affairs), WHO (World Health Organisation).

Interventions were all complex with multiple components. Studies were categorised based on the predominant intervention element using the EPOC taxonomy. The included interventions were categorised as predominantly patient-centred (n=20, 48%); organisational (n=20, 48%), financial (n=1, 2%) or professional (n=1, 2%). One study (Long et al. 2012) comprised two intervention arms with a patient-centred and financial intervention (included as a patient-centred predominant intervention in our analysis). Descriptions of the interventions are outlined in *Table 1.*

The twenty patient-centred interventions in our review included four telephone- (34, 41, 56, 58), five computerised/ mobile phone based- (32, 36, 52, 61, 68), one video-based- (51), five peer-support- (30, 38, 44, 49, 65), three self-monitoring-based (37, 50, 64) and two-culturally-supportive self-management interventions (39, 45). The twenty organisational interventions included five pharmacist interventions performing case management (35, 40, 47, 48, 57), six nurse case management interventions (23, 31, 46, 53, 55, 60), three web-based/ telemedicine/ telephone case management interventions (24, 59, 63), three new-clinic-based interventions (43, 54, 66), one community health-worker intervention (62), one psychological intervention (22) and one lay health worker intervention (67). Eight interventions had an mHealth or telehealth component (33, 36, 45, 52, 56, 59, 65, 68). More detailed descriptions of the interventions are outlined in *Appendix 3*.

Risk of bias

All 42 studies were RCTs, with six being cluster RCTs. Overall, 25 studies were classified as having a predominant low-risk of bias (59.5%) (22-24, 32-36, 39, 41, 42, 45, 46, 51, 53-55, 58, 59, 62-66, 68), thirteen studies had an unclear-risk (31%) (30, 31, 37, 38, 40, 44, 47, 49, 56, 57, 60, 61, 67) and four RCTs were classified as having a high-risk of bias (9.5%) (43, 48, 50, 52) (*Appendix 4*). Blinding of outcome assessment was classified as low-risk in all studies. Attrition bias was evident in seven studies. *Appendix 5* outlines the summary judgements for both overall risk of bias and predominant intervention type, which were used in the meta-regression analysis.

There was no evidence of publication bias in the studies included in the HbA1c (p

=0.37) or SPB analysis (p=0.54). However, there was some evidence of publication bias in the studies included in the DBP analysis (p <0.01). See *Appendix 6*.

Primary outcomes

HbA1c

Overall 40 of the 42 studies were included in a meta-analysis, which found a mean difference (MD) in HbA1c of -3.7 mmol/mol (-0.34%; 95% CI: -0.46%, -0.22%) favouring intervention groups, but with statistical heterogeneity (I^2 = 69%). *Figure 2(a)* outlines the overall effect of interventions on HbA1c, across EPOC categories.

Subgroup analyses were performed based upon the predominant intervention type (*Figure 2(a)*), the baseline HbA1c level (*Figure 2(b)*), study quality (*Figure 2(c)*) and study duration (*Figure 2(d)*). These analyses suggested that organisational interventions (MD in HbA1c of -5.2 mmol/mol (-0.42%; 95% CI: -0.66%, -0.18%; I^2 = 79%) had better improvements in HbA1c than patient-centred interventions (-0.30%; 95% CI: -0.43%, -0.18%; I^2 = 48%) (p=0.05). Similarly interventions performed when the baseline population-HbA1c was over 80mmol/mol (9.5%) (MD in HbA1c of -6.3 mmol/mol (-0.58%; 95% CI: -0.81%, -0.35%; I^2 = 75%) had better improvements in HbA1c than populations with a baseline-HbA1c < 9.5% (-0.17%%; 95% CI: -0.29%, -0.05%%; I^2 = 51%) (p=0.002). Studies with a low-risk of bias (MD in HbA1c was -2.8 mmol/mol (-0.26%; 95% CI: -0.39%, -0.13%; I^2 = 59%) appeared to have a smaller reduction in HbA1c compared to unclear (-0.49%%; 95% CI: -0.84%%, -0.15%; I^2 = 81%) and high-risk studies (-0.41%; 95% CI: -0.74%, -0.09%; I^2 = 61%), but there was no evidence of a statistically significant difference (p=0.35). Lastly, study duration did not appear to affect HbA1c (*Figure 2(d)*). Though not considered in our original protocol, subgroup analysis did not highlight additional benefit from those interventions (included in both organisational and patient-centred intervention types), which had a telemedicine or mHealth component (*Appendix 7*) (33, 36, 45, 52, 56, 59, 65, 68).

As the overall results showed statistical heterogeneity, meta-regression analysis was also conducted to explore the components of this heterogeneity. As with the meta-

analyses, higher baseline HbA1c was associated with a greater reduction in HbA1c (β-Coefficient: -0.27; 95% CI: -0.41, -0.13; p<0.001). The predominant-intervention type, risk of bias and study-duration were not associated with improved glycaemic control.

Blood pressure

Overall there was small improvement in SBP in the twenty-six interventions included in the meta-analysis, (MD SBP – 1.13 mmHg (95%; CI -2.19, -0.08)) with moderate heterogeneity (I^2 = 47%) (*Appendix 8*) (22-24, 30-36, 38, 39, 41, 45, 46, 48-51, 54, 58-60, 62, 65, 66, 68). DBP improved modestly in the twenty-two studies included in the meta-analysis (MD DBP – 1.37mmHg (95%; CI -2.25, -0.50)) with moderate heterogeneity (I^2 = 44%) (*Appendix 9*) (22-24, 31, 32, 34-36, 38, 39, 41, 45, 46, 48, 49, 51, 54, 58, 59, 62, 65, 66, 68).

In the subgroup analysis, organisational interventions appeared to improve SBP modestly (MD SBP: – 2.69mmHg; 95% CI: -5.11, -0.26; I^2 = 57%) compared to patient-centred interventions (MD SBP: – 0.52mmHg; 95% CI: -1.41, 0.38; I^2 = 20%) which showed no statistically significant improvement (*Appendix 8*). However, there was no evidence of a statistically significant difference between intervention types. Similarly with DBP, organisational interventions appeared to improve DBP modestly (MD DBP: -2.87mmHg; 95% CI: -4.29, -1.45; I^2 = 30%) compared to patient-centred interventions (MD DBP: -1.37mmHg; 95% CI: -1.42, 0.2; I^2 = 30%) (*Appendix 9*) and there was evidence of a statistically significant difference (p=0.007). Meta-regression analysis was not conducted for SBP or DBP as significant heterogeneity was not present on the overall effect sizes.

Lipids

Twenty of the 42 studies reported total cholesterol, LDL-cholesterol, HDL-cholesterol or triacylglicerides (23, 24, 30-32, 35, 36, 38, 39, 41, 45, 46, 48, 51, 56, 58, 62, 65, 66, 68). Statistically significant improvements in lipids were only demonstrated in four of these 20 studies (31, 32, 45, 48). Baseline lipid levels were generally not reported. Eleven of the twenty studies reported data relating to total cholesterol. Meta-

analysis was undertaken on these studies, which indicated a modest improvement in total cholesterol, favouring intervention groups (MD Total Cholesterol – 4.29 mg/dl (95% CI -7.68, -0.89); I^2 = 0%) (*Appendix 10*) (35, 36, 38, 41, 45, 46, 58, 62, 65, 66, 68).

Secondary outcomes

All but one the 42 included studies reported at least one of the eligible secondary outcomes (*Appendix 11*). Overall, interventions had very limited effect on secondary outcomes. Twenty-six studies reported other physical outcomes (e.g. BMI, and estimated glomerular filtration rate). Of the fifteen studies that reported on weight or BMI, only one showed significant improvement (56). Ten studies reported mental health outcomes (36, 38, 41, 45, 58, 59, 64) with two showing a significant improvement in the Change Mental Component Summary Score and the Short Form-12 Mental Health Score (64, 67). Twenty-eight studies reported PROMs, eleven showing an improvement with the intervention. Ten studies reported medication adherence outcomes, two showing improvement. Eighteen studies reported utilisation outcomes with four improving processes of care.

Discussion

Statement of principle findings

Healthcare interventions have positive, albeit modest, effects on HbA1c in poorly controlled T2DM. Interventions targeting those with a higher baseline HbA1c (≥ 80 mmol/mol (9.5%)) show the greatest effects. There was also evidence of a modest impact on both blood pressure and lipids, though baseline control of these risk factors was generally good. Generally little effect on secondary outcomes was found. Our results suggest that a targeted approach to T2DM management, focussing on individuals with very poor glycaemic control, may represent a prudent strategy for future management.

Strengths and weaknesses of the study

The methodology of our systematic review addresses key credibility issues (69, 70). The research question was sensible, our search of the literature was exhaustive and our results are outlined clearly for primary and secondary outcomes. The effect of baseline HbA1c was consistent across studies, biologically plausible and was an a priori hypothesis (70).

We performed meta-regression to explore the heterogeneity, which also confirmed the increased effectiveness of interventions on those with HbA1c ≥ 80 mmol/mol (9.5%). However, a major limitation is that meta-regression is usually underpowered to detect anything but very large associations. Meta-regression considers the interactions between trial level covariates and the treatment effect, but it inherits difficulties of interpretation attached to non-randomised studies, as it is not possible to randomise patients to one covariate value or another, so causality cannot be attached its findings (71). Though we do not believe the subgroup findings occurred by chance, there remained high heterogeneity and we explored between-study comparisons rather than within-study comparisons (70). There was some evidence of publication bias in the DBP analysis, but this was not present for the twenty-two studies reporting SBP. It should also be noted that the power of Egger's test is low when the number of studies is small and should only be used if the analysis includes a range of study sizes.

This study will inform researchers regarding the range of interventions that have been deployed to target patients with poorly controlled T2DM. There is no specific definition for 'poor control' of T2DM in the literature, but by including all studies that had patients with a HbA1c > 59 mmol/mol (7.5%), we captured the full range of poor glycaemic control. Studies examining poor control of HbA1c possess a risk of regression towards the mean. However, all included studies were RCTs with control groups, which should have accounted for this. Targeted interventions in poorly controlled T2DM need to be distinguished from interventions, which are designed to intensively reduce HbA1c in all patients. Though persons with very poor glycaemic control are also at risk of the adverse effects of hypoglycaemic agents, targeting this population is more likely to reach the right balance of reducing harms of

overtreatment and maximising potential benefits (18). The relative importance of targeting glycaemic or cardiovascular risk has been debated in the literature (17). We did not account for medication use in the studies, but given that all included studies were RCTs, which would balance out delivery of medications, we think that differences relating to underlying medication usage relate to how different interventions types promote the intensification of medications.

Comparison with other studies

The existing literature examining healthcare interventions to improve glycaemic control has focussed on a range of approaches. There have been systematic reviews of interventions including QI initiatives, education, self-management support, case-management, adherence to medication and professional interventions, though as outlined previously most have not specifically targeted patients with poor glycaemic control (8, 10, 11).

A synthesis of 27 systematic reviews and 347 randomised controlled trials identified the cost-effectiveness of self-management interventions in T2DM in all patients with T2DM (72). This overview included studies that targeted all patients with T2DM and found very good evidence that education improves blood glucose control in patients with T2DM in the short term (less than 12 months) and that behavioural and psychological interventions are associated with modest improvements in blood glucose control (HbA1C) (72, 73). A review of computer-based diabetes self-management interventions to manage T2DM reported a small beneficial effect on blood glucose control (MD of -0.2%) (74). Another recent systematic review of 118 self-management interventions found improvements in HbA1c in 62% of studies. The overall mean effect was to reduce HbA1c by -0.57%, although patients with persistently elevated HbA1c over 9 had greater improvements (75). In our review, patient-orientated interventions, such as self-monitoring of blood glucose and self-management interventions, seemed to be less effective than organisational interventions.

Case management by nurses and other professionals and case management in

socially disadvantaged have been shown to be beneficial when targeted at all patients with T2DM and our review supports this conclusion for poorly-controlled populations (5, 76-78). Pharmacist-based interventions have been studied, mainly in outpatient settings or in US primary care, and have been found to be effective and cost-effective (79, 80). The five pharmacist interventions in our review, targeting patients with poorly-controlled T2DM, showed mixed results, but overall had predominantly positive effects on HbA1c.

Attention to, and reporting of, intensification of anti-diabetic medications and patient's adherence to treatment regimens are needed to achieve optimal glycaemic control (81, 82). Evidence regarding adherence in T2DM is mixed. A previous systematic review of twenty one studies that included fourteen RCTs to enhance T2DM treatment adherence in community and hospital settings found that few studies measured or assessed adherence and that interventions to improve adherence did not show benefits or harms (83). A review by Farmer et al. found limited evidence of effect for interventions promoting the monitoring of medication use and brief messaging to support medication adherence in patients with T2DM, though the included studies did not specifically target patients with poorly controlled diabetes (84). Only ten of the 42 included studies in our review looked at adherence to medications as an outcome and only two of these nine studies had a statistically significant effect on adherence (49, 62). The baseline level of adherence varied considerably and studies used different scale ranges.

Our review identified only one professional-based interventions in poorly controlled T2DM, through a physician decision aid (42). Two systematic reviews have examined the impact of clinical decision support systems (CDSS) on the management of T2DM in primary care, between them looking at twenty eight trials, with varying results but none of these CDSS interventions were designed to promote intensification of prescribing in persons with poor glycaemic control (85, 86).

Future research

There is a need for further research examining professional-based interventions in poorly controlled T2DM, such as CDSS, which promote intensification of medications (81). Studies from jurisdictions outside North America on poorly controlled populations would also be welcome. An individual patient data meta-analysis would answer further questions not possible in this review and future research should attempt to obtain individual-level patient data. It is likely that most successful interventions have their impact as a result of intensification of medicines and/ or improving adherence to medicines (81). As adherence was not measured in most of the studies and intensification poorly documented, it is important that future interventions report on these findings. Furthermore organisational interventions could incur significant costs to a health system so cost-effectiveness analyses on future interventions should be undertaken to ensure the modest improvements in HbA1c are beneficial for the health systems.

In conclusion, clinicians and policy makers, when considering organisation of care for T2DM should focus their effects on those patients with very poor glycaemic control (≥80 mmol/mol (9.5%)). Prioritising interventions that emphasise structured organisation of care, which can include intensification and adherence to medications, also seem more likely to deliver optimal results in terms of glycaemic control for T2DM patients.

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Nil

Keywords

BMI- body mass index
CBAs- controlled before and after studies
CCTs- controlled clinical trials
CDSS- clinical decision support system

CI- confidence interval

DBP- diastolic blood pressure

EPOC- Effective Practice and Organisation of Care

HCP- health care professional

HDL- high density lipoprotein

ITS- interrupted time series analyses

LDL- high density lipoprotein

MD- mean difference

PRISMA- Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PROM- patient reported outcome measure

PROSPERO- international prospective register of systematic reviews

QI- quality improvement

RCT- randomised controlled trials

SBP- systolic blood pressure

T2DM- type 2 diabetes mellitus

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Figure 1: PRISMA Flow Sheet

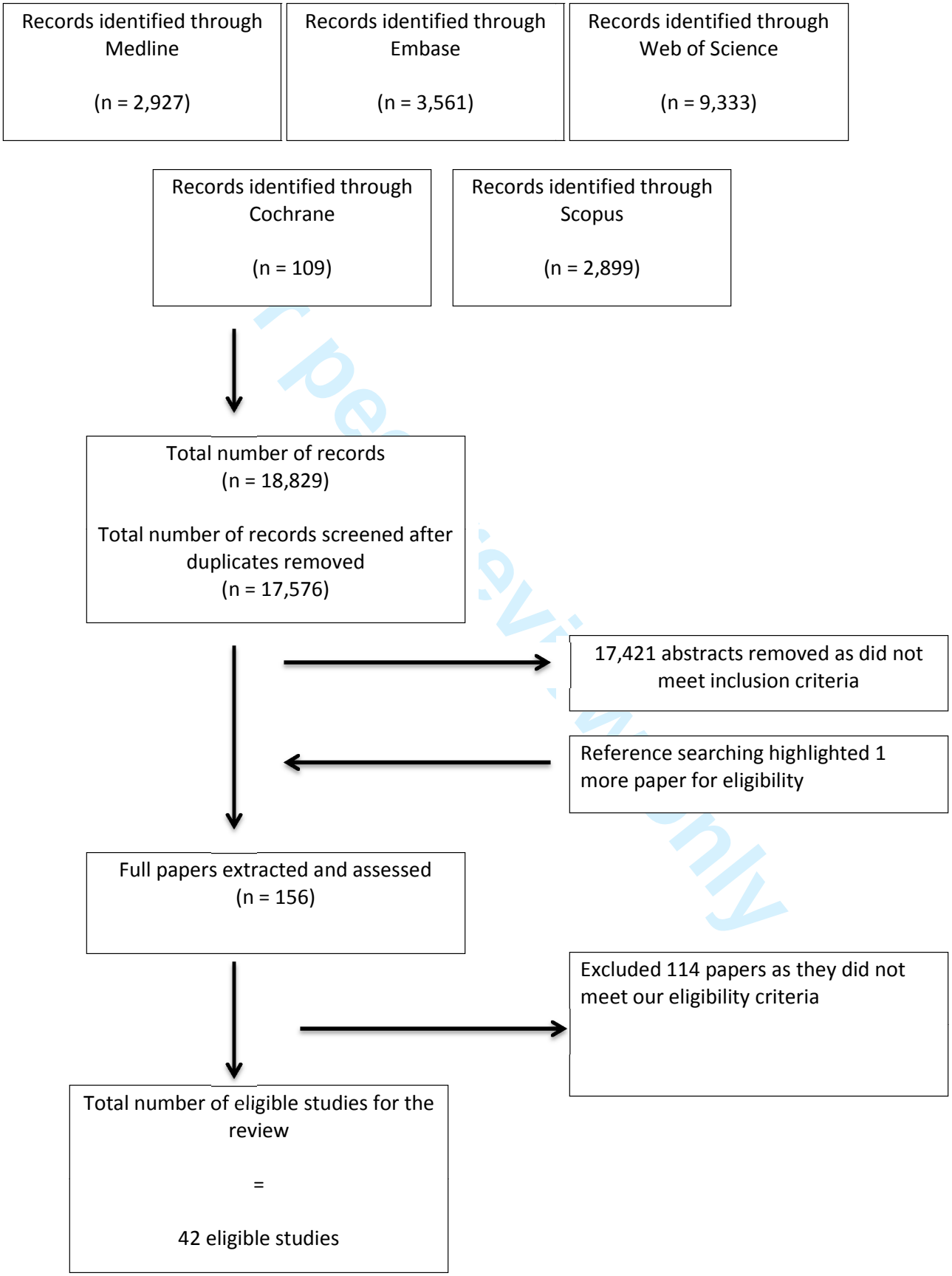

Figure 2a: Effects of interventions on HbA1c, with intervention-type subgroups

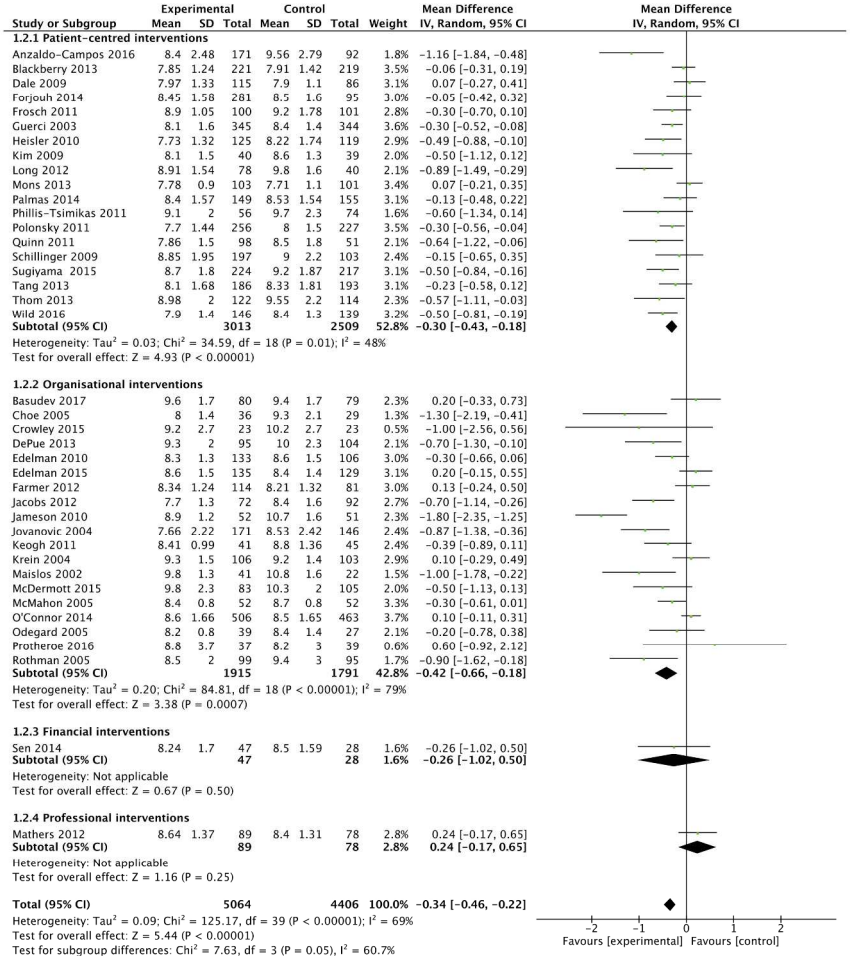

Figure 2a Effects of interventions on HbA1c, with intervention-type subgroups

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Figure 2b: Effects of interventions on HbA1c, with baseline-HbA1c subgroups

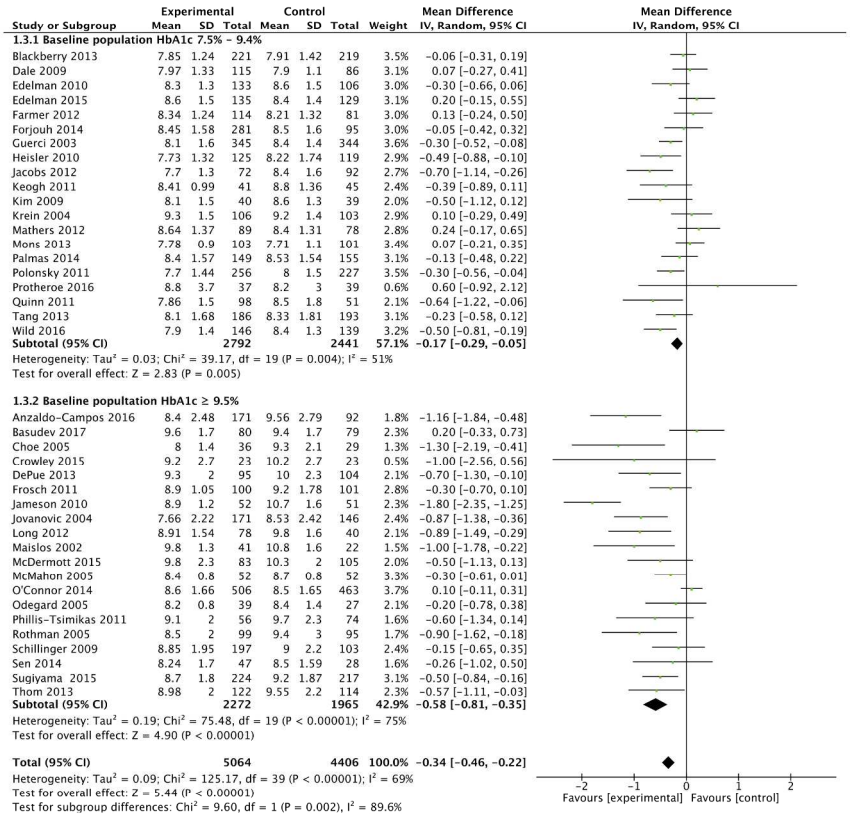

Figure 2b Effects of interventions on HbA1c, with baseline HbA1c subgroups

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Figure 2c: Effects of interventions on HbA1c, with study-duration subgroups

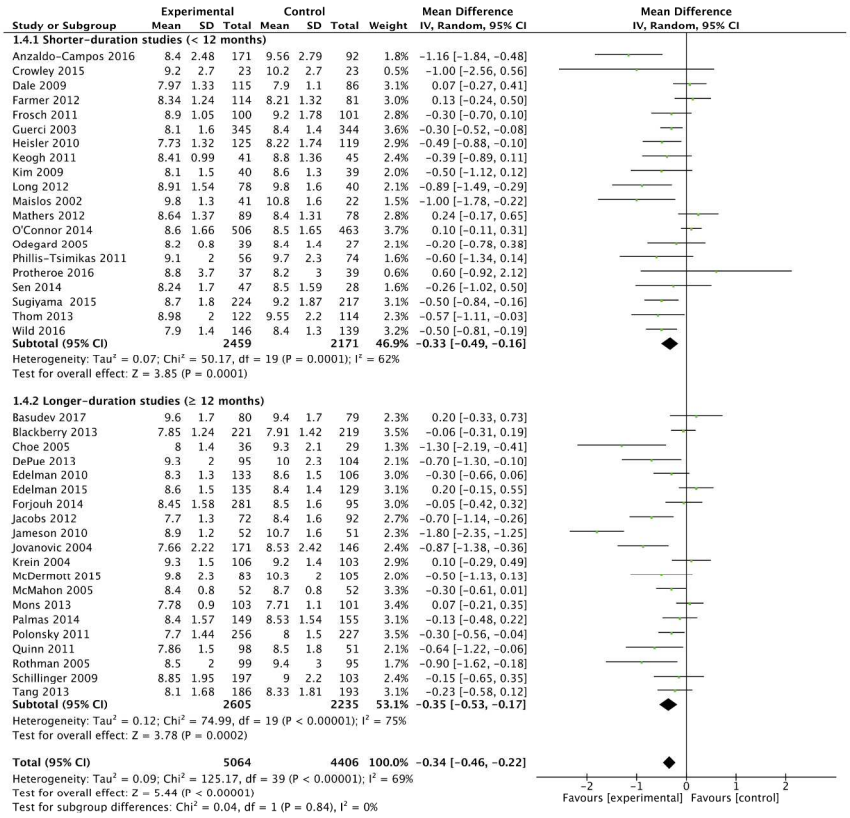

Figure 2c Effects of interventions on HbA1c, with with study quality subgroups

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Figure 2d: Effects of interventions on HbA1c, with study-quality subgroups

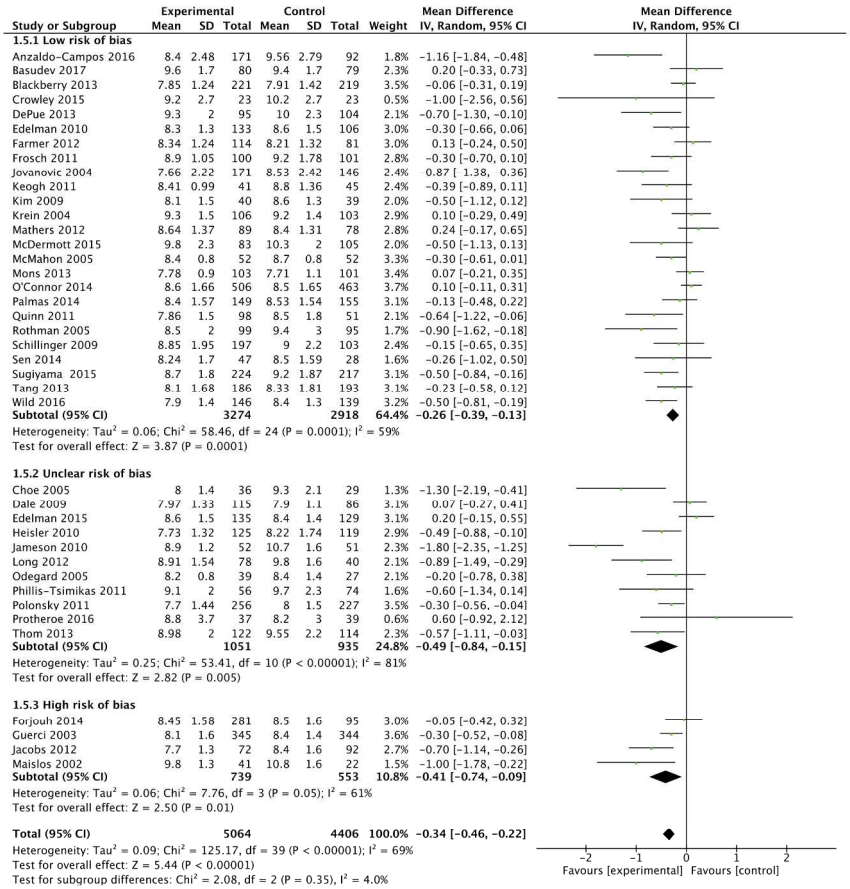

Figure 2d Effects of interventions on HbA1c, with study duration subgroups

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Appendix 1: Search String

Pubmed/ Medline

Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled

AND

Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin

AND

primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR OR health care provider OR case manager OR “case management” OR “care management”

(((primary care[Title/Abstract] OR primary health[Title/Abstract] OR (family physician[Title/Abstract] OR family physicians[Title/Abstract]) OR (general practicability[Title/Abstract] OR general practice[Title/Abstract] OR general practice,[Title/Abstract] OR general practices[Title/Abstract] OR general practician[Title/Abstract] OR general practicians[Title/Abstract] OR general practicioner[Title/Abstract] OR general practicioners[Title/Abstract] OR general practictioner[Title/Abstract] OR general practictioners[Title/Abstract] OR general practiioners[Title/Abstract] OR general practioner[Title/Abstract] OR general practioners[Title/Abstract] OR general practionner[Title/Abstract] OR general practionners[Title/Abstract] OR general practise[Title/Abstract] OR general practises[Title/Abstract] OR general practitioner[Title/Abstract] OR general

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WoS search

TS = (Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled)

AND

TS = (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin)

AND

TS = (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office)

TI = (Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled) AND TS = (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin) AND TS = (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office)

Indexes=SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH Timespan=1990-2016

SCOPUS

lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk

OR glycaemic OR glycemic OR hba1c OR a1c OR (hba AND (1c)) OR haemoglobin OR hemoglobin AND diabetes OR t2d$ OR niddm OR mody OR non-insulin dependent OR insulin OR iddm OR poorly-controlled AND primary care OR primary health OR family physician* OR general practi* OR family practi* OR outpatient? OR clinic? OR ambulatory OR health centre? OR health centre? OR office AND (EXCLUDE (SUBJAREA , "DENT") OR EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "DENT") OR EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "ARTS") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "ENGI") OR EXCLUDE (SUBJAREA , "BUSI") OR EXCLUDE (SUBJAREA , "ECON") OR EXCLUDE (SUBJAREA , "VETE") OR EXCLUDE (SUBJAREA , "MATE") OR EXCLUDE (SUBJAREA , "COMP") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "EART") OR EXCLUDE (SUBJAREA , "PHYS"))

1990- 2016 Title abstract

Embase

(primary care OR primary health OR family physician* OR general practi* OR family practi* OR outpatient? OR clinic? OR ambulatory OR health centre? OR health centre? OR office OR veterans OR pharmacist OR nurse OR doctor OR psychologist OR OR health care provider OR case manager OR case management OR care management):ab,ti

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(Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled)

AND

(Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin)

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(primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR health care provider OR case manager OR case management OR care management)

(Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled) AND (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin) AND (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR health care provider OR case manager OR case management OR care management) in Title, Abstract, Keywords in Cochrane Reviews

Appendix 2: Cochrane Effective Practice And Organisation of Care Review Group taxonomy of interventions:	
Professional interventions	For example; distribution of educational materials to healthcare professional, or educational meetings, or audit and feedback.
Organisational interventions	For example; Revision of professional role (e.g. community pharmacist providing case management for patient with diabetes) or skill mix changes (changes in numbers, types or qualifications of staff). Included telemedicine interventions with predominant organisational elements.
Patient-orientated interventions	For example; patient education, peer support or support for self management. Including telephone and telemedicine interventions with predominant patients elements (with focus on self-management)
Financial interventions	For example; Fee-for-service for provider or a penalty for the patient.
Regulatory interventions	For example; changes to local or national regulations designed to alter care delivery to improve outcomes.

Appendix 3: Detailed description of study interventions

N	Study	Brief intervention description	Intervention description
N.	Author Year Country	Brief Intervention description	Intervention description (detailed) Length intervention Predominant Intervention type Comparison
1	Anzaldo-Campos 2016 Mexico	Two interventions: Nurse care support and peer-led diabetes self-management education intervention (called Project Dulce). Nurse care support and peer-led diabetes self-management education intervention. A technology-enhanced intervention, using cell phone uploads of glucose and BP levels and text message support.	Two interventions, called the Project Dulce Model: 1. Nurse care management through a combination of a multidisciplinary team of clinicians and nurse, as well as trained peer-led diabetes self-management education (this collectively is the called Project Dulce (PD) model. Clinicans underwent 16 hours of training and monthly ongoing education. The nurses , trained in diabetes care, provided personalized education to patients, in accordance with national guidelines. They also liaised with the peer educators, who either had diabetes themselves or lived or worked with people with diabetes. They underwent a training programme, modified for a Mexican population. Addressing fears pertaining to insulin use and addressing self-management was a focus of their educational sessions. 2. The PD intervention above, was combined with a technology-enhanced intervention, using cell phone uploads of glucose and BP levels and text message support (called the PD-TE intervention). Participants received free glucose monitors and training, they were asked to check their sugars twice a day for one month, then two days per week thereafter. The glucose data was uploaded to a central system and medical staff monitored these readings. Text messages, surveys, videos and brochures were also sent out to participants. Length: The first intervention (PD) comprised eight weekly sessions with peer educators for two months, then monthly sessions thereafter up to 10 months in total. For the PD-TE group, text messages, surveys, videos and brochures were also sent throughout the 10 months. Predominant EPOC intervention type: Patient-centred Comparison: Usual general practice care

2	Basudev 2016 UK	Virtual clinic integrating primary and specialist care	The intervention involved four steps. Initially it involved identification of the target patients (HbA1c > 8.5%). The second step involved a virtual clinic meeting (with around 20 cases), involving the community diabetes (specialist) team and practice team. The management plan for each patient was determined. The care was then allocated to primary, intermediate or secondary care. The third step involved the patient consultation, agreeing an individualised plan of management in collaboration with the patient, including therapy changes and addressing patient goals. The forth step involved a 3-month review by the community diabetes team. Length: The intervention lasted 12 months with three-monthly reviews by the community diabetes team after the initial consultation. Predominant EPOC intervention type: Organisational. Comparison: Usual general practice care.
3	Blackberry 2013 Victoria, Australia	Telephone coaching by nurses to support diabetes management and self monitoring	The PEACH study: GP based nurse led telephone coaching; dealing with lifestyle issues, medication adherence and dosing, self monitoring of their disease, how to take greater initiative in the therapeutic alliance with their doctor, facilitating appropriate intensification of medications to achieve treatment goals. Nurses did not have prescribing rights. Length: In the first six months there were five telephone-coaching sessions at intervals of six weeks in the first six months, a coaching session at 8 and 10 months, a face-to-face coaching session at 12 months and a final coaching session at 15 months. Predominant EPOC intervention type: Patient-centred Comparison: Usual general practice care
4	Capozza 2015 USA	Text-message based behavioural intervention for T2DM	Receipt of 1-7 test diabetes-related messages per day, depending on the choices they made at enrolment. The content of the text messages were reviewed by certified diabetes educators and patients had control over the types and frequency of the messages. Users could turn off the program by texting the word 'stop'. The core messages related to diabetes education and health improvement (medication reminders, glucose testing reminders, BP measurement reminders and encouraging weight loss). Patients could reply to messages to get feedback. Length: 6 months of text messages Predominant EPOC intervention type: Patient Comparison: Usual care
5	Choe	Pharmacist case	The case manager was a clinical pharmacist who was already established as a pharmacotherapy consultant at the clinic before the start of the intervention. The

	2005 Michigan, USA	management	clinical pharmacist evaluated patient's therapeutic regimens based on efficacy, safety, adverse effects, drug interactions, drug costs and monitoring. All therapeutic recommendations were discussed with the primary care provider before significant therapy alterations. The pharmacist also followed up on these recommendations. Face to face consultations between pharmacist and physician were included. Length: Initial one-hour consultation with patient and monthly telephone contact thereafter and saw patients in conjunction with their routine primary care visits for one year. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
6	Crowley 2015 USA	Intensive telemedicine intervention for veterans	An advanced comprehensive diabetes care (ACDC) program, including telemonitoring, physician guided mediation management, self-management behavioural support and physician guided depression management. It was delivered via a telephone using existing staff in the VA. VA home technology (HT) nurses delivered the intervention. Usual care involves HT nurses ringing patients, but they do not deliver a comprehensive diabetes management intervention like ACDC. In terms of telemonitoring, patients were asked and prompted to perform SMBG daily and to submit this on their HT-issued equipment. They were called by a HT nurse if they did not submit data for three days. In terms of self-management every two weeks a HT nurse rang the patient, delivering a diabetes self-management support module. This was a 30-minute telephone call every 2 weeks- reviewing blood glucose data, reconciling medications and reviewed adherence. For the physician medication management component, the HT nurse then contacted the study physician (an endocrinologist) and medication changes (such as insulin changes) were transmitted back to the HT nurse via an EHR- the nurse then relaying this on to the patients. In terms of depression, if the baseline or three-month PHQ9 was high, a psychiatrist of primary care physician input was made. Length: Daily telemonitoring, two weekly calls by a home technology nurse, input by endocrinology to nursing staff at two weekly intervals over six months. Predominant EPOC intervention type: Organisational Comparison: Usual care but received an educational packet in addition.
7	Dale 2009 England	Two intervention telecare groups: a) Peer-support telecare intervention b) Diabetic specialist nurse telecare support	Two intervention telecare (telephone) groups: a) Telephone peer-delivered intervention. b) Diabetic specialist nurse telecare support The telecare support was intended to supplement routine care by motivating adherence to the advice provided by the GP or practice nurse at the time of change (medication and/ or lifestyle) in diabetes care. Length of intervention: The first telecare call was made 3-5 days later and a standard package offered support 7-10, 14-18 28-35, 56-70, 56-120 days later. Training for the telecare support was with a two days training programme (motivational interviewing, active listening skills). Peer supporters recruited through a diabetes care user group. Otherwise they were trained as above. Two were excluded from the trial as they could not master the techniques.

			The trained peer supporters had a median diabetes duration of 10 years and 6/9 had T2DM. They were paid a small fee and d had access to an experienced DSN educationalist. They were invited to 6 monthly review meetings. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
8*	DePue 2013 U.S. Territory of America Somoa Cluster RCT	Nurse–Community Health Worker Team in American Somoa	Nurse–Community Health Worker Team: Nurse case manager (NCM) and four community health workers with a minimum of high school education- all staff underwent training. A filed director supervised the research. Length: The NCM met with all patients at least once over 12 months, conducting groups sessions with patients at high risk, providing feedback to physicians and oversight of CHW visits. The CHWs helped patients make and keep healthcare appointments, helped patients understand diabetes, reinforced adherence to medications and provided support. Patients at higher risk were seen weekly in a group meeting conducted by the NCM with CHW assistance or, if unable to attend the group meeting, they were seen individually by CHWs. Patients at moderate risk were seen monthly by CHWs and patients at lower risk were seen every 3 months. All individual visits occurred at the patient's home, workplace, or at TC, per the patient's choice. Family members were encouraged to attend these visits. BG and BP were monitored at each visit and urgent levels were referred immediately to the TC physician during clinic hours or to the hospital emergency department. Predominant EPOC intervention type: Organisational. Comparison: Usual care. Patients also received a self-care diabetes book and a risk profile was placed in their medical chart.
9	Edelman 2010 North Carolina and Virginia, USA.	Enrollment into a general medical clinic (GMC) with an internist, pharmacist and a nurse or educator that met seven times over 12 months	Patients in the intervention arm were assigned to a group medical clinic (GMC) that met on the patient's preferred half-day. Each group had 7-8 patients and a care team (a primary care internist, a pharmacist, a nurse or certified diabetes educator). The groups met every 2 months (7 visits over 12 months). Patients were given $10 for each GMC session they attended. The care team met the group at each visit and each group met the same care team at each visit. Each provider could be a member of more than one care team. Each GMC session lasted 90-120 minutes visit: BP and home glucose values were checked at each GMC session; education assessment was then delivered by nurse or educator- the patients chose certain topics so the education sessions were tailored to the member's needs. The pharmacist and PCP reviewed the medical record, BP and glucose levels at each session and an individualized management plan directed at improving HbA1c and BP was formulated (medications and lifestyle based). The Primary Care Provider was then informed. Signed attendance contacts to boost attendance, telephone contact if needed to change management based upon lab results. All patients received usual primary care on top of this.

			Predominant EPOC intervention type: Organisational. Comparison: Usual care.
10	Edelman 2015 USA	Nurse case management	A single nurse with experience in case management delivered both the tailored behavioral intervention and the control. For the intervention arm, the content was tailored to each patient's individual barriers to controlling blood sugar or BP. This content was divided into a series of topical modules addressing one or more behaviors appropriate for improving control of BP or blood sugar, and included physical activity, weight reduction, low salt intake, smoking cessation, medication adherence, management of hypoglycemia, and blood glucose monitoring. The modules assessed barriers to specific behaviors, and the nurse then tried to engage the patient in problem-solving in order to determine actions for overcoming these barriers. In addition, barriers that might generalize to a number of problems—specifically, low levels of disease knowledge, poor memory, poor social support, and concern about the quality of physician-patient decision- making—were addressed on their own. Fidelity was assessed by two nurse-investigators (KP, BG), who listened to a sample of 5 % of total calls for delivery of intended content. Length: The nurse rang intervention and control patients 12 times in total over 24 months every 2 months. Predominant EPOC intervention type: Organisational Comparison: "Attention Control". The control patients received calls that were not tailored; these calls provided traditional didactic information on a range of topics that had no relationship to HTN, DM, or any of the behaviors we were trying to improve (e.g., flu shots, skin cancer prevention). Content was tightly scripted, designed to limit the potential for productive interaction between nurse and patient, and was informed by standard guidelines as stated on government websites.
11	Farmer 2012 UK	Nurse-led, multilevel intervention to support medication adherence	Nurse- led, consultation-based intervention to support patients with adherence to taking glucose lowering medications. This was a multi-level intervention, targeting both health professional and patient behaviour. Initially there was training for the clinic nurses provided by a clinical psychologist and an intervention facilitator' as the first part of the intervention. The aim was to strengthen patient motivation to take OGLM regularly and support medicine taking through action-plans. 8 weeks after recruitment, patients were invited to the intervention visit to record and review their medication; and then randomised to either an intervention to support medication or adherence, or to standard care. There were 2 components in the intervention delivered to patients. (1) nurses elicited patient beliefs about intention to take their medications as prescribed. Positive beliefs were reinforced verbally and non-verbally, through provision of tailored information. Negative beliefs were addressed using problem solving and the nurse facilitated patients in action planning. The intervention consultation took 30 minutes, with 20 minutes for data collection, which both intervention and control patients received. Predominant EPOC intervention type: Organisational.

			Comparison: Usual care. The standard care visit lasted approximately 20 minutes, during which data were collected. Same nurses delivered this.
12	Forjouh 2014 USA	Three intervention groups, reflecting the individual and combined effects of a behavioural and technology intervention; a chronic Disease Self-Management Program (CDSMP) and a diabetes self-care software on a personal digital assistant (PDA).	Four arms in the trial: a) Chronic Disease Self Management Program (CDSMP) b) Personal digital assistant (PDA) c) Both CDSMP and PDA d) Usual care CDSMP: Involved a 6-week, classroom-based program for diabetes self-management. Based upon 1999 paper showing effectiveness of CDSMP. Its goal was to increase self-efficacy to decrease chronic disease related symptoms and avoidable healthcare utilization. It teaches participants techniques to facilitate enhanced decision making, action planning, and effective communication. CDSMP workshops hosted in clinical environments and community-based settings. Fidelity to classes not monitored. Master trainers/ lay leaders underwent 4 days of training- and the lay leaders used pre-scripted materials. PDA: This intervention arm were taught how to use a diabetes self-care software. It was loaded onto a handheld device and was called “Diabetes Pilot”. The Diabetes Pilot allowed recording and some monitoring of blood glucose, BP, medication usage, physical activity and dietary intake on the PDA. One-to one instruction by a project coordinator covering key areas such as data entry, foot database utilization and reports was provided. Participants were instructed to input information daily. Training effectiveness was not assessed. CDSMP and PDA group received both. The CDSMP was a 6 week program, based in a classroom. Unclear how many workshops. The PDA arm: Uncertain, participants asked to use it daily and input information into it. Primary outcome 12 months, followed up to 24 months CDSMP: 6 weeks PDA: Uncertain, possibly 2 years Predominant EPOC intervention type: Patient-centred. Comparison: Usual care along with Texas Diabetes Council patient education materials.
13	Frosch 2011	A video behavioural support intervention by nurse educators with a workbook	Intervention participants received a 24 minute long CDC program with an accompanying booklet called “Living with Diabetes: Making lifestyle changes to last a lifetime”- this was developed by the Foundation for Informed Decision Making. The participants were also entitled to have up to 5 sessions of telephone coaching with a bilingual nurse educator, trained in patient-centred approaches to diabetes management and motivational enhancement- with a goal to collaborate with participants in identifying behavioural goals and a behavioural plan.

	USA	followed by 5 sessions of telephone coaching.	The first session was 60 minutes in length (2 weeks after enrollment), the second and third were 30 minutes, forth and fifth were 15 minutes. Interval between telephone coaching was open to participants and nurse educators to negotiate. Both groups received a telephone call one week after enrollment to review intervention materials. Five coaching sessions (spread over a max duration of 2.5 hours) and a 24-minute DVD to watch, as well as a booklet on lifestyle changes in diabetes. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care. Participants also received a 20-page brochure entitled “4 steps to control your diabetes for life” developed by the NIH.
14	Guerci 2003 France	A self-monitoring of blood glucose intervention Auto-Surveillance Intervention Active (ASIA) study.	Self monitoring of blood glucose (SMBG): Patients received initial training by their GP at the initial inclusion visit. Patients were required to perform at least six capillary assays a week (3 different days, including the weekend). Standardised management including medications, blood glucose level, diet and physical exercise. Five visits were conducted during the intervention. At each visit, a clinical evaluation was performed. Laboratory values took place at 3 visits. At the third visit the GP could modify the treatments based upon the SBGM. At each consultation the patients were advised about management for T2DM. The intervention period was 24 weeks. Followed up every 6 weeks. Five visits were conducted during the intervention. At each visit, a clinical evaluation was performed (weight, SBP, DBP). Laboratory values took place at 3 visits.. At the third visit the GP could modify the treatments based upon the SBGM. . At each consultation the patients were advised about management of T2DM. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
15	Heisler 2010 USA	Reciprocal peer support	Initial face to face meeting in groups of 4-18 (in two age cohorts to aid cohesion and help patients get an age matched peer partner). Patients received $20 for the initial and 6 monthly assessment. Reciprocal Peer support (RPS) 3 hour group session facilitated by a care manager and research associate. Action planning on laboratory results. Training in peer communication, paired with an age-matched peer for peer support. Encouraged to call each other at least once per week.. Given a DVD on communication skill and a diabetes self management work book. Also offered three 1.5 hour group sessions at months 1,3 and 6- entirely patient-driven to discuss progress on action plans. Facilitation by a care manager or research associate. The care managers went through training- 4 hour course on motivational interviewing.

			Nurse care manager (NCM) was usual care: Attended a 1.5 hour session, led by the NCM, to discuss the results from the initial assessment, review results, ask questions and get information. Their care manager's phone number was given and follow up phone calls and face to face meetings were encouraged. Patients were provided with diabetes self management educational materials. In effect this is enhanced usual care- as many patients are not aware of and do not avail of this. Predominant EPOC intervention type: Patient-centred. Comparison: The comparator was enhanced usual care with nurse care management.
16	Jacobs 2012 USA	A pharmacist assisted medication program intervention	PAMPERED (pharmacist assisted medication program enhancing the regulation of diabetes) study: An initial pharmacist-patient clinic visit at baseline involved obtaining a comprehensive medication review; performing a targeted physical assessment including checking BMI, BP and a foot examination; education on diabetes; ordering laboratory values; reviewing, modifying and monitoring the patient's medication and providing detailed counselling on all therapies; facilitating self-monitoring of blood glucose; and providing reinforcement of dietary guidelines and exercise. These recommendations were based on most recent guidance. Approval by the patient's PCP was required before a treatment recommendation was made. Patients were required to attend a minimum of three visits with the pharmacist; at baseline, 6 months and 12 months for focused preventive and secondary diabetes management. Additional visits arranged as clinically appropriate. Laboratory outcomes checked at baseline, 6 and 12 months. On average 6.5 office visits with a pharmacist occurred over the 12 months. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
17	Jameson 2010 USA	A pharmacist collaborative management intervention	One pharmacist provided the intervention to the entire intervention group. This pharmacist was a board certified pharmacotherapy specialist, had an American Society of Health-System Pharmacists diabetes management traineeship, a postgraduate course in diabetes management from the American Diabetes Association and an educators training program. Patients met the pharmacist at the primary care site for an assessment of medication adherence, barriers to optimizing glucose control and a medication review. Individualized education was provided regarding self-management, lifestyle, medications and monitoring. Guidelines were followed. This included early switching to insulin after failure of 2 oral medications. The PCP approved any changes. After this visit, subsequent visits depended on control. Telephone calls also included. Initial visit. Telephone calls also included. Thereafter conducted as needed- as subsequent visits depended on control. Average 6 office visits and 3 telephone calls per patient over a one-year period. Office visits lasted between 30-60 minutes. Phone calls 10-20 minutes. Predominant EPOC intervention type: Organisational. Comparison: Probably usual care.

18	Jovanovic 2004 USA	Diabetes case management by a nurse or dietician	Case Management: Intensive diabetes case management was provided to the intervention group in addition to primary care. Study staff met with all patients at the beginning and end of the trial to assess overall health status and collect study outcomes. Quarterly assessments of outcomes were performed. The case manager was either a nurse or a dietician (working in close collaboration with an endocrinologist). Evidence based practice in terms of insulin initiation was agreed with collaboration with the PCP. Potential barriers to care were identified and educational strategies designed to address these barriers. American Diabetes Association goals for diabetes, BP and lipid treatment were used. Flexibility to allow individualized targets allowed. All patients educated about self-management and given a monitor. Diabetic educators assessed lifestyle behaviours and gave patients strategies to improve self-care. Transportation issues addressed to improve visit completion. Unclear how many meetings or interaction with a case manager occurred over the 36 months Predominant EPOC intervention type: Organisational. Comparison: Usual care from primary care provider.
19	Keogh 2011 Ireland	Psychological family intervention	Psychological family intervention for poorly controlled Type 2 diabetes. Three weekly sessions delivered by a health psychologist who had received 16 hours of training in motivational interviewing. The first two sessions lasted 45 minutes, taking place in the patient's home, with a family member. The third and final session was a 10-15 minute telephone call. Each session was tailored to the patient's needs involving a/ challenging negative perceptions of diabetes, 2/ examining how negative perceptions influenced self management and 3/ developing ways to improve self management and mobilise family support. Techniques such as exchange information, elicitation of change talk, reducing resistance, building self-efficacy, problem solving and goal setting were used. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
20	Kim 2009 USA	A Community-based, culturally tailored behavioral intervention	Culturally tailored comprehensive T2DM management intervention for Korean American immigrants. A community based self-help intervention program for type 2 diabetes mellitus (SHIP- DM) involving structured psycho-behavioural education, home glucose and BP telemonitoring and individualized telephone counselling from a bilingual nurse. It consisted of three concurrent programs. First, a 2 hourly weekly education session was delivered for 6 weeks. This was delivered at a community site by trained nurses and a nutritionist- to enhance knowledge and promote diabetes self-care behaviours for glucose control.

			Secondly, there was home glucose monitoring and teletransmission- this lasted for 24 weeks after the educational program- each patient received monitors and a teletransimission system. Nurses could view this information. Thirdly, monthly telephone counselling by a bilingual nurse for 24 weeks was provided according to a standardized protocol- to reinforce new knowledge, to discuss problems, find solutions and provide emotional support. These lasted 10-25 minutes. At least 7 (one meeting and monthly telephone contact X 6 months) Predominant EPOC intervention type: Patient-centred. Comparison: Usual care with delayed intervention.
21	Krein 2004 USA	Case management by nurse practitioners	Collaborative case management. All participants in trial given a blood pressure monitor, educational material and a periodical newsletter Two nurse practitioner care managers worked with patients and their primary care providers, monitoring and coordinating care for the intervention group for 18 months, through telephone calls, collaborative goal setting and treatment algorithms. There were two nurse case managers. One nurse was present at each site, providing 20 hours of care per week, to approximately 60 patients each. They had a 2 days training program on collaborative goal setting- and training updates at 6-month intervals. Patient contact was predominantly by telephone, though face-to-face contact could happen. Case managers encouraged self-management, diet exercise, provided reminders of screenings and tests, monitored home glucose and BP measures and identified medication changes as needed. Medications treatment algorithms were given to the case managers. Every change was approved by the PCP- being notified of changes by email. Predominant EPOC intervention type: Organisational. Comparison: Usual care. Patients also received educational materials. All participants in trial were given a blood pressure monitor, educational materials and a periodical newsletter.
22	Long 2012 USA	Two interventions: Peer mentoring Financial incentivisation of patients	Two intervention groups, one control. Received €25 for filling out a survey at Month 0 and Month 6. Also were notified of their starting HbA1c level and of the ADA and VA recommendations. 1/ Peer mentoring: Patients in this group matched to a peer supporter within 1-3 weeks. Peer reviewers were all African American patients with prior poor T2Dm control in the past but well controlled recently. They were matched by sex and age (+/- 10 years). Training: They received a 1-hour long 1:1 training session informed by motivational interviewing techniques. Uncertain who trained the peer mentors. No monitoring of the calls. The mentor-mentee contacts were all telephone calls. Mentors were incentivized with $20 per month if they talked at least once per

			week with their mentee. Mentors were also given $25 after the training session and after an exit interview. Peer mentoring: Aiming to have 4 calls per month for 6 months. The Results showed 38% mentors talked 4 times per month during the first month and by Month 6, that reduced to 16% 2/ Financial incentives In the financial incentive arm, participants were told that they would receive $100 at 6 months if their HbA1c level decreased by 1%, and $200 if it reduced by 2% or to 6.5%. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
23	Maislos 2002 Israel	A mobile clinic providing interdisciplinary care	Interdisciplinary care via a mobile clinic offered by the Western Negev Mobile Clinic Diabetes Program (WNMCDP). WNMCDP is a weekly mobile diabetes clinic aimed to provide interdisciplinary care for patents, in primary care facilities. An initial visit involved a meeting with a diabetologist, the dietician and a nurse educator. After this regular follow visits were scheduled. The team held a weekly evening meeting at the clinic and the nurse and dietician have an additional weekly meeting at the primary care site. At the meeting, all patients received dietary counselling and have a session with the nurse educator. Continuation of treatment and follow up visits are scheduled according to the patient's condition. Special emphasis was placed on education, to improve compliance and lifestyle behaviours. Mobile clinic visited weekly. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
24	Mathers 2012 UK Cluster RCT	Patient decision aid to improve decision quality and glycaemic control	PANDAs study: using patient decision aid (PDA): A complex intervention with three components; PDA, healthcare professional training workshop and use of PDA in a consultation. Development of PDA done with MRC framework- to facilitate decision making between clinicians and patients Doctors and nurses involved with diabetes care in the practice attended a 2-hour training session on how to use the PANDAs decision aid (shared decision making, communication skills, the evidence of different treatment options). The PANDAs decision aid was given to the patient prior to the consultation with the nurse or GP- it included information about insulin or other treatments, presented probabilities of outcomes, it clarified patient values and gave structured guidance. The patient then saw the GP and nurse, facilitated with the use of the PANDAs aid. This was a one off intervention given on 1 day

			Predominant EPOC intervention type: Professional. Comparison: Usual care.
25	McDermott 2015 Australia Cluster RCT	Community-based health-worker led case management approach to the care of Indigenous adults with poorly controlled type 2 diabetes in primary care services in remote northern Australia	Each site allocated to the intervention arm recruited an Indigenous health worker resident in the community (selected by the health service) to work as part of the primary care team, and allocated a caseload of between 9 and 26 clients. The health workers with low caseloads worked part-time. All health workers at the commencement of the study received an intensive 3-week training in clinical aspects of diabetes and other chronic condition care, including how to support patients in self-management skills, advice on medications, routine foot care, nutrition, smoking cessation, follow up referrals to other providers, and scheduled tests. Length: During the 18 month intervention period, the health workers attended two workshops where they underwent refresher training, including in Good Clinical Practice and reflective practice. During these sessions, they reported on their patients' progress and shared approaches to problem solving with the clinical support team and peers. Predominant EPOC intervention type: Organisational Comparison: Usual care.
26	McMahon 2005 USA	Web-based care management	Web based care management involving training and giving a notebook computer, glucose and blood pressure monitoring devices and access to a care management website. The website provided educational modules, accepted uploads from monitoring devices and had an internal messaging system for patients to communicate with the care manager. Given free internet. Training to each participant for mean of 2.3 hours. Home BP monitoring encouraged three times weekly. Glucose monitoring frequency was individualized. Participants could communicate with a care manager through the website. If they did not use the website for two weeks, they were contacted by phone. An advanced practice nurse reviewed patient information and provided recommendation to the PCP about treatment changes, based upon guidelines. Episodes: Unclear, one training session and then self-usage of web management (patients contacted if they didn't use after 2 weeks). 1 year. Predominant EPOC intervention type: Organisational. Comparison: Usual care. All participants attended a self-management educational session (prior to randomization).
27	Mons 2013 Germany	Supportive telephone counseling	Supportive telephone counseling intervention led by practice nurses of the participating GP practices- monthly over 12 months. Each nurse was trained before hand. Each call lasted 10 minutes, was structured and included questions on patients' physical and mental condition, medication adherence, symptoms, and lifestyle advice. The items were designed to motivate the patients, identify barriers and help self-management. Monthly over 12 months. Over 90% had 10-12 sessions. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.

28	O'Connor 2014 USA Cluster RCT	Telephone Outreach to Improve Medication Adherence and Metabolic Control in Adults With Diabetes	The telephone intervention was delivered by interventionists who were pharmacists, diabetes educators, or nurse health managers trained in the use of the study protocol and intervention. Those randomized to the intervention, who had recently been prescribed a new medication for poorly controlled T2DM, received a single structured telephone call to ascertain if the patient had started the medication. Positive reinforcement was made to those who had started. For those who had not started, the interventionist probed for reasons of non-adherence and resolved to solve any barriers. Length: One phone-call lasting < 5 minutes. Most calls occurred within 2-6 weeks after prescription date. Predominant EPOC intervention type: Organisational Comparison: Usual care.
29	Odegard 2005 USA	A pharmacist intervention care management intervention	Pharmacist intervention was composed of a diabetes care plan (DCP), a regular pharmacist-patient communication on diabetes care progress and pharmacist-provider communication on the subject's diabetes care progress. Medication related problems were identified. The intervention commenced one week after baseline data interview. A face-to-face appointment created this DCP which was communicated to the PCP. Weekly face-to-face or telephone communication was kept with the patient and the pharmacist- then reduced to monthly when deemed necessary over a 6-month period. On average there were 4.5 telephone contacts and 2.1 in person visits. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
30	Palmas 2014 USA	Community health worker (CHW) intervention in an Hispanic population	12-month CHW intervention or enhanced usual care Two full time CHWs delivered a multicomponent intervention that included one-to-one visits, group visits and telephone follow up. They used the Small Steps, Big Rewards framework. Goal setting and discussing barriers were features of the visits. A needs assessment was performed throughout the year. Episodes of care: Aimed for 4 1:1 visits, 10 groups sessions and 20 follow up phone calls over the year per subject. Predominant EPOC intervention type: Patient-centred. Comparison: 'Enhanced usual care'. Spanish-language educational material posted every three months, preceded by phone calls, to ensure participants received the brochures.
31	Phillis-Tsimikas	Peer-led diabetes education programs in high-risk Mexican	Assessments at month 0, 4 (post intervention) and 10- intervention participants were given a glucometer and a small gift card. The Project Dulce (intervention) group received eight weekly 2 hour diabetes self management classes for two months; and then monthly support groups, leach 2 hours in length, led by a trained peer educator. Before the intervention those individuals, living in this community, with diabetes, that had traits of being a good leader were identified

	2011 USA	Americans	and trained over a 3 month period. Peer educators spent 40 hours learning the curriculum, behavior modification techniques etc. Then they co-taught a session with a trainer, before being supervised giving a session before doing it alone. The curriculum covered many aspect of diabetes management. If patients were noticed not be meeting targets for diabetes care, the peer educator would direct them to the PCP- they would not make any medication related changes themselves. Episodes of care: Unclear how many, but envisaged as 8 weekly classes for two months, then monthly for the next three months. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
32	Polonsky 2011 USA Cluster RCT	Self blood glucose monitoring	STeP (Structured Testing Programme) is a 12-month Cluster RCT assessing efficacy of structured self-monitoring of blood glucose (SMBG) in T2DM patients (none on insulin). Both physicians and patients participated in a collaborative programme to gather, interpret and act upon the structured SMBG data, at 3 monthly intervals, to make treatment modifications. The study's duration was 12 months with patient visits occurring at initial screening and baseline followed by visits at months 1, 3, 6, 9, and 12. At all subsequent visits (months 1, 3, 6, 9, and 12), ACG and STG clinic staff collected laboratory samples, recorded changes in medications, and performed brief physical examinations. Point-of-care A1C equipment (A1CNow+ test kit; Bayer Healthcare, Tarrytown, NY) was provided to all practices for clinical use only to assure that differential availability of the equipment did not affect outcomes. Patients in both groups brought their meters to each subsequent visit for electronic data uploading; physicians and clinic staff were blinded to these data and all other study-collected measures. Patients also reported all changes made to their diabetes regimen since their last visit. All patients completed the STeP questionnaire and a post-visit questionnaire to record physician discussion of SMBG results and recommendations for pharmacologic and lifestyle changes that occurred during the visit. Predominant EPOC intervention type: Patient-centred. Comparison: 'Enhanced usual care': quarterly diabetes focused physician visits, free blood glucose meters and strips and they were evaluated at months 1, 3, 6, 9 and 12 (like the intervention group).
33	Protheroe 2016 UK	Lay Health Trainer (LHT) interviews with patients, creating a self-management plan, with supportive phone calls	A structured interview with a Lay Health Trainer (LHT) and development of an individualised patient self-management plan and follow up thereafter with phone calls. The LHTs were trained on diabetes care and lifestyle advice, but they did not provide medical or nursing advice. They provided information to participants regarding advantages and disadvantages of behaviour change. Length: The intervention lasted 6 months. An initial structured interview was followed by up to three two-monthly support phone calls from the LHT for a maximum of 6 months. Predominant EPOC intervention type: Organisational

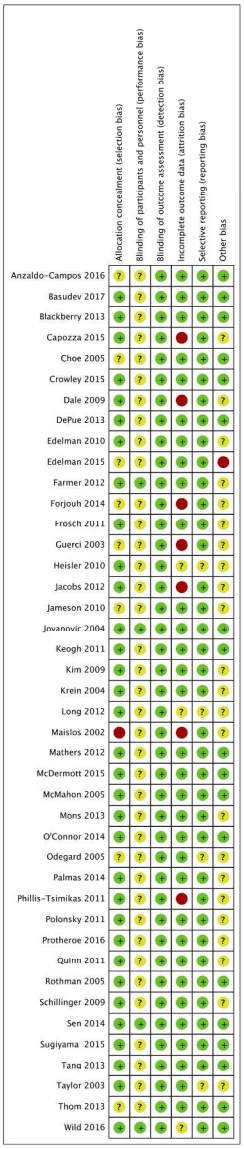
			Comparison: Usual general practice care
34	Quinn 2011 USA Cluster RCT	Mobile phone-based treatment/ behavioural coaching intervention	Mobile phone-based treatment/ behavioural coaching intervention 26 primary care practices, randomly assigned to one of four groups: 1/ Coach-only (CO) group- included a mobile diabetes management software application and a web portal. The mobile software allowed patients to enter diabetes self-care data (glucose, diet, mediations) on a mobile phone and receive automated, real-time educational, behavioural and motivational messaging specific to the entered data. 2/ Coach PCP portal (CPP)- The patient web portal augmented the mobile software and had a secure messaging centre with additional information. 3/ Coach PCP portal with decision support (CPDS): This group had providers with access to analysed patient data that could make decisions linked to standards of care. All patients received a glucometer and mobile phone with 1 year unlimited free data and service plan. Diabetes educators intermittently reviewed the patient data. Patients could communicate by phone or electronically to educators. Patients also received an electronic action plan every 2.5 months. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
35	Rothman 2005 USA	A primary care-based disease management program delivered by trained pharmacists.	Pharmacist intervention: Three pharmacists (trained in the outpatient department) delivered the intervention within the general medicine practice - two of them were diabetic educators. The intervention included intensive educational sessions, evidence-based algorithms, proactive management of clinical parameters and treatment recommendations that were shared with the PCP. A diabetes care coordinator was also part of the intervention and this person addressed health behaviour and education- this coordinator rang patients regularly. Pharmacists rang the patient or met them every 2-4 weeks, or more frequently if needed. Unclear if there was a face to face meeting (probably was in the General Medicine Practice. A coordinator also rang patients from time to time. A median of 45 contacts or care-related activities between pharmacists and patients were recorded; about 38 minutes each month. Predominant EPOC intervention type: Organisational. Comparison: Usual care after a 1-hour management session that was conducted by a clinical pharmacist practitioner from the disease management team, including education and treatment recommendations approved by the PCP.
36	Schillinger	Two interventions:	Two interventions in the Improving Diabetes Efforts Across Language and Literacy (IDEALL) Project:

	2009 USA	Self-Management Support via 1/ Automated telephone self-management support (ATSM) and 2/ Group medical visits (GMVs).	Two self management support (SMS) systems, conducted in a safety net health system were tested against a control; a) Automated telephone self management support (ATSM) and b) Group medical visits (GMVs). ATSM and GVCs attempt to activate patients, routed in efficacy theory. ATSM: ATSM patients received automated (pre-recorded) telephone calls over 39 weeks (9 months). Patient responses triggered immediate automated education messages and/ or a subsequent nurse phone follow-up. Each call took 5-10 minutes. The mean number automated calls completed over 9 months was 21.9 (envisaged to be 39); mean number of call backs was 9.2. GVC: The GVC group received 90-minute monthly sessions over 9 months, with 6-10 participants, co-facilitated by a primary care physician and health educator. Participants in this group received bus tokens and snacks. Mean number of GMVs attended was 4.8 out of 9. There was no specific expectation regarding co-management with the primary care physician. In both interventions action plans regarding self management were generated (information in other papers). All participants received €15 and €25 dollars for the baseline and one year follow up assessment. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
37	Sen 2014 USA	Financial incentives for home based monitoring- two interventions	Two intervention groups received financial incentives for home-based health monitoring. All three groups received three biometric devices, a self monitoring glucose device, a digital BP monitor and a device to automatically transmit readings from the biometric devices to the study website. All patients were instructed to use the biometric devices daily. In the intervention arms, participants who used all three devices on a given day were entered into a lottery to win something on the following day. In the daily lottery process, numbers between 0-99 were picked by the participant. In the high incentive intervention the average daily reward was €2.80; a two digit match (1: 100 chance) yielded a €100 award and a one digit match (1: 5 chance) yielded a €10 award. In the low incentive intervention, rewards were €50 and €5 respectively, expecting an average daily reward of €1.40. Each day all incentive arm participants were reminded by text message or email informing them of the lottery numbers. A study coordinator met with all participants at 3 and 6 months- participants were paid €25 for each visit. Episodes of care: daily Predominant EPOC intervention type: Financial Comparison: 'Daily home monitoring control group' received biometric devices.

38	Sugiyama 2015 USA	Diabetes self-management education by trained health educators.	Called the Diabetes Self-Care Study, the intervention involved community-based diabetes self-management education (DSME). All study participants were given glucose meters and testing strips, and received a 2-hour training on self-monitoring of blood glucose by a certified diabetes educator. Health educators, who delivered the education, completed a one-year training program and received 8 hours of curricula delivered by the study team about diabetes and its clinical presentations and complications. Additionally, they received 12 hours of training and implementation of the empowerment sessions. Length: Participants in the intervention group received six weekly two-hour group self-care sessions consisting of 8 to 10 persons per group, conducted in English or Spanish, and facilitated by health educators. In the group session, participants identified self-management challenges and discussed why each activity was challenging and how to solve it. Each participant also had a one-on-one session with the health educator to review his or her baseline and follow-up laboratory and biometric data during one of the group sessions. There was also a $10 gift card for each assessment. Predominant EPOC intervention type: Patient Comparison: Usual care.
39	Tang 2013 USA	Online disease management of diabetes	Online disease management of diabetes: Engaging and Motivating Patients online with Enhanced Resources- Diabetes (EMPOWER-D): A personalized healthcare program (PHCP) comprising nurse care managers authorized to change medications, multi-disciplinary team based care, patient self-management tools and an online communication channel between patients and their healthcare team. This intervention comprised: 1/ Wireless glucometer uploading of information to the electronic health record 2/ A diabetes summary sheet with a personalized action plan and treatment goals, including displaying the risk of a variety of diabetes related complications, medication information and monitoring information. 3/ A nutrition log 4/ Insulin record 5/ Exercise log 6/ Online communication/ messaging system 7/ Nurse care managers who provide advice and can make medication changes. 8/ Patient specific text and video educational material. On top of this, participants in the intervention group had 3 in-persons visits, firstly a 90 minute group visit introducing the online tools, a 90 minute 1:1 meeting with a nurse care manager to develop a shared care plan and 3/ a 60 minute visit with a registered dietician. Also a pharmacist reviewed all intervention group medications and made recommendations- they were also consulted throughout the trial. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.

40	Taylor 2003 USA	Nurse care management (NCM)	Nurse care management (NCM): Initial 90 minute meeting with a registered nurse to review patient medications, lifestyle and psychosocial status. Self-management plan was developed. Then a weekly group class (1-2 hours with 4-10 per class) was scheduled for 4 weeks; including group discussion and problem solving. This was followed with telephone follow-up calls at week 4,5,8,12,16,20,28,36 and 44 (9 in total) from the nurse, averaging 15 minutes each. The nurse care managers gave advice as per agreed protocols. The PCP was called if a change in medication was recommended. The NCMs underwent specific training. Episodes of care: 5 visits and 9 telephone calls Predominant EPOC intervention type: Organisational. Comparison: Some educational materials, otherwise usual care.
41	Thom 2013 USA	Peer health coaching	Potential peer coaches attended 36 hours of training over 8 weeks using a curriculum developed by the study team- learning active listening, non-judgmental communication, helping with diabetes self-management skills, provision of support, assisting with lifestyle change, facilitating medication adherence and understanding and navigation of the health system. There was a written and oral assessment for these persons- those who passed became peer coaches. The peer coach- patient interaction was at the discretion of the patient and peer coach, either in person or by telephone contact, either outside or inside the clinic. The goal was for two telephone contacts every month and two or more in-person contacts over 6 months. They helped devise action plans for the patients. Peer coaches received €125 for training and €25 per client coached each month. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
42	Wild 2016 UK	Supported telemonitoring involving twice-weekly self-measurement of glucose and transmission to a general practitioner	The Telescot Diabetes Trial: Supervised, self-monitoring of glycaemic control, BP, and weight and telemetric transmission of measurements to the general practice team. A research nurse took all the baseline measures. Participants were given advice on lifestyle modification and how to contact the General Practice team. Length. The intervention lasted 9 months with the practice nurses checking patients' results weekly and oragnising changes in accordance with national guidelines. Predominant EPOC intervention type: Patient-centred Comparison: Usual general practice care

Appendix 4:
Risk of bias summary



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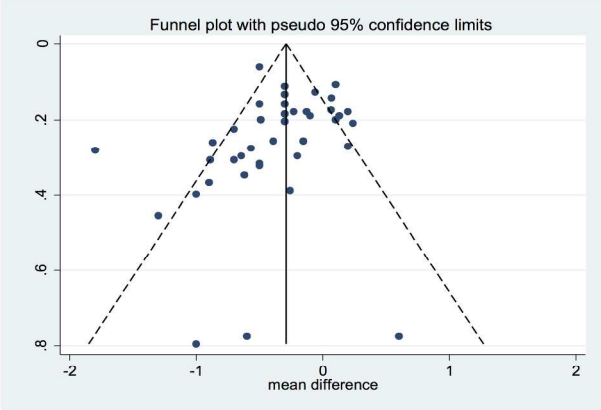
Appendix 5: Overall quality assessment and predominant EPOC intervention type

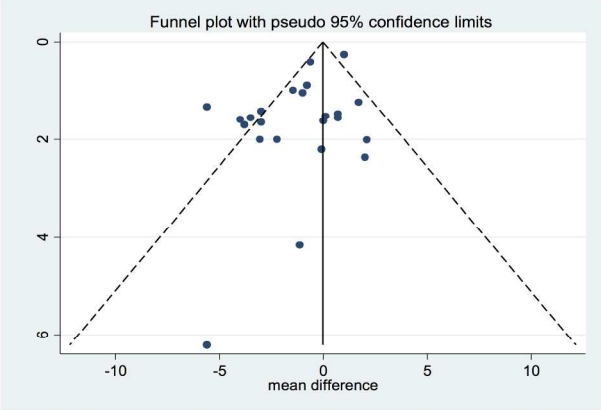
Study	Study_ID	Year	Predominant EPOC intervention type	Overall quality assessment
1	Anzaldo-Campos	2016	Patient	Low-risk
2	Basudev	2016	Organisational	Low-risk
3	Blackberry	2009	Patient	Low-risk
4	Capozza	2015	Patient	Unclear-risk
5	Choe	2012	Organisational	Unclear-risk
6	Crowley	2015	Organisational	Low-risk
7	Dale	2003	Patient	Unclear-risk
8	DePue	2011	Organisational	Low-risk
9	Edelman	2012	Organisational	Low-risk
10	Edelman15	2015	Organisational	Unclear-risk
11	Farmer	2013	Organisational	Low-risk
12	Forjouh	2013	Patient	High-risk
13	Frosch	2005	Patient	Low-risk
14	Guerci	2013	Patient	High-risk
15	Heisler	2010	Patient	Unclear-risk
16	Jacobs	2014	Organisational	High-risk
17	Jameson	2011	Organisational	Unclear-risk
18	Jovanovic	2010	Organisational	Low-risk
19	Keogh	2012	Organisational	Low-risk
20	Kim	2010	Patient	Low-risk
21	Krein	2004	Organisational	Low-risk
22	Long	2009	Patient	Unclear-risk
23	Maislos	2004	Organisational	High-risk
24	Mathers	2012	Professional	Low-risk
25	McDermott	2015	Organisational	Low-risk
26	McMahon	2004	Organisational	Low-risk
27	Mons	2005	Patient	Low-risk
28	O'Connor	2014	Organisational	Low-risk
29	Odegard	2005	Organisational	Unclear-risk
30	Palmas	2014	Patient	Low-risk
31	Phillis-Tsimikas	2011	Patient	Unclear-risk
32	Polonsky	2011	Patient	Unclear-risk
33	Protheroe	2016	Organisational	Unclear-risk
34	Quinn	2011	Patient	Low-risk
35	Rothman	2005	Organisational	Low-risk
36	Schillinger	2009	Patient	Low-risk
37	Sen	2014	Financial	Low-risk
38	Sugiyama	2015	Patient	Low-risk
39	Tang	2013	Patient	Low-risk
40	Taylor	2003	Organisational	Unclear-risk
41	Thom	2013	Patient	Unclear-risk
41	Wild	2016	Patient	Low-risk

Appendix 6a:

Funnel plot of studies included in the HbA1c analysis



Funnel plot of studies included in the DBP analysis



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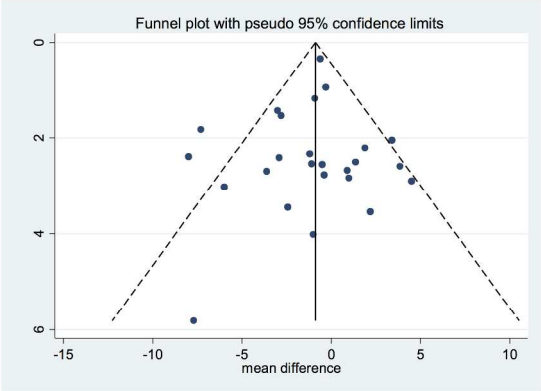
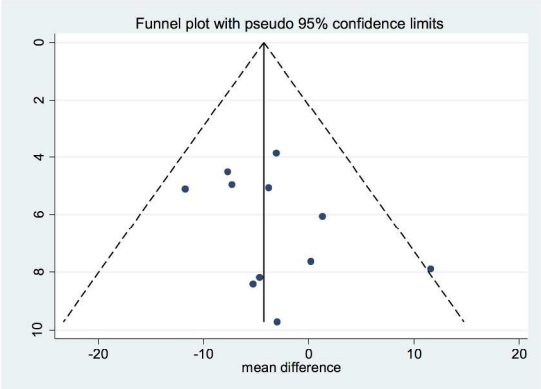
215x279mm (300 x 300 DPI)

Appendix 6b:

Funnel plot of studies included in the SBP analysis

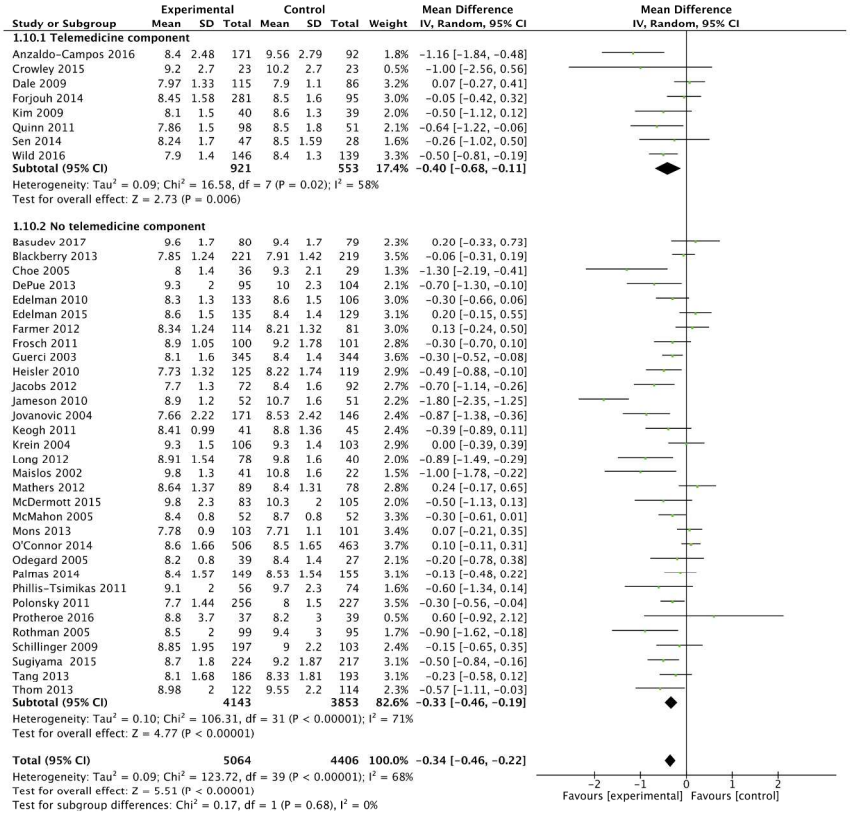


Funnel plot of studies included in the lipid analysis



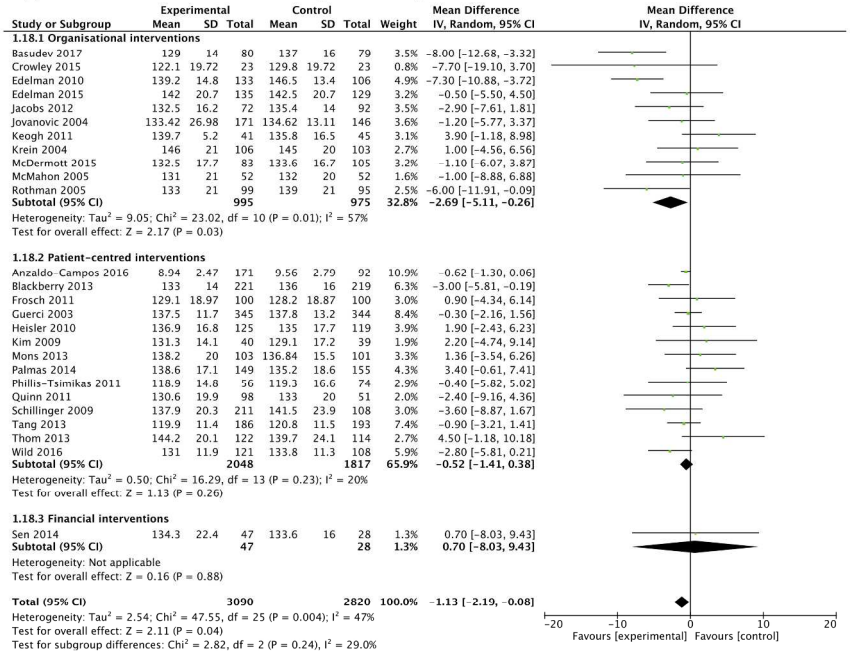
209x297mm (300 x 300 DPI)

Appendix 7: Effects of interventions on HbA1c, with TeleHealth subgroups



209x278mm (300 x 300 DPI)

Appendix 8: Effects of interventions on systolic blood pressure



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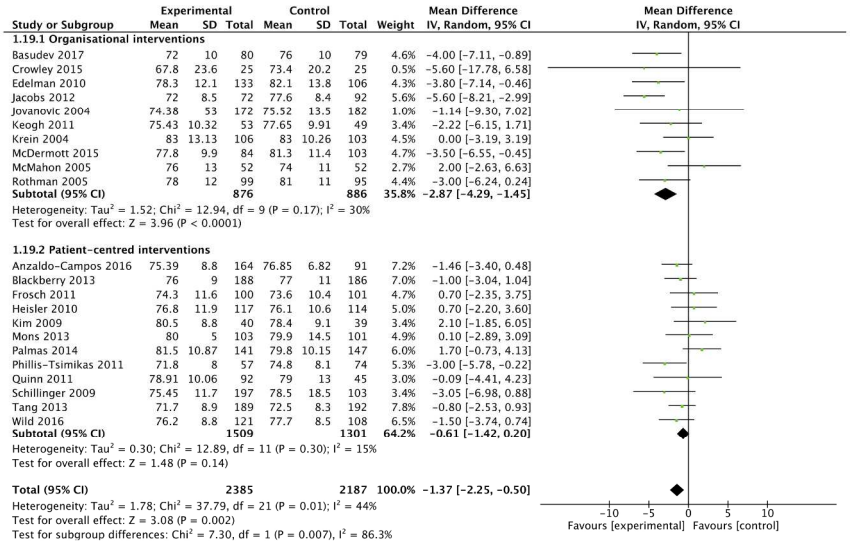
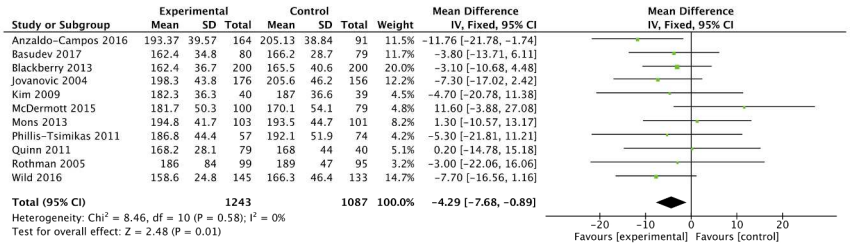
Appendix 9: Effects of interventions on diastolic blood pressure



209x278mm (300 x 300 DPI)

Appendix 10: Effects of interventions on Total Cholesterol



209x278mm (300 x 300 DPI)

Appendix 11: Secondary outcomes measured and results

Number	Study	Mental health outcomes	Pyschosocial outcomes	Adherence outcomes	Other physical outcomes	Healthcare utilisation outcomes	Medication related outcomes
1	Anzaoldo-Campos	Depression (PHQ-9): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was -1.83 favouring the PD group to control and -1.84 for PD-TE group to control.	Self efficacy (Spanish Self-Efficacy): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was -2.42 favouring the PD group to control and -0.54 for PD-TE group compared to control. Lifestyle (IMEVID): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was 2.3 favouring the PD group to control and 2.7 favouring the PD-TE group to control. Quality of life (Diabetes 39): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was -8.88 favouring the PD group to control and -4.87 favouring the PD-TE group to control. Diabetes knowledge (DKQ24): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was 2.05 favouring the PD group to control and 2.09 favouring the		Triacylglyceride: Unclear of MD between two intervention groups (PD or PD-TE groups) and control group.. Unadjusted MD was -21.46 favouring the PD group to control and –4.55 for PD-TE group compared to control. BMI: Unclear of MD between two intervention groups (PD or PD-TE groups) and control group.. Unadjusted MD was +0.33 comparing the PD group to control and +0.31 for PD-TE group compared to control.		Significantly higher insulin use in PD and PD-TE groups

			PD-TE group to control.				
2	Basudev				Weight MD 0 (p = NS) eGFR -3.9 (p = 0.1)	Care destination: NS change Frequency of contact: NS change	Medication change: 54% of intervention group had a change in glycaemic medication versus 46% in the control group (p=0.04). No other significant change in medications. Medication optimization: NS change
3	Blackberry	Major depression 1.09 (0.49 to 2.46) p= 0.83	Quality of life 0.02 (CI -0.01 to 0.05) p =0.16 Diabetes self efficacy -0.06 (CI -2.22 to 2.10) p 0.96 Diabetes support -0.09 (CI -0.01 to 0.18) p 0.08				
4	Capozza		Patient interaction and satisfaction (CSQ8) with the program by means of survey-intervention patients all scoring over 3 on a four point satisfaction scale. No clear comparison with usual care.				
5	Choe					Process measures: (% before, % after, p value) Rate of HbA1c measurement: 82.9% 92.3% 0.21 Dilated retinal examination: 74.3% 97.3% p= 0.004 Urine ACR or use of ACE Inhibitors: 85.7% 94.9% p= 0.18	

						Monofilament testing for diabetic neuropathy by chart review over 24 months: 62.9% 92.3% p= 0.002	
6	Crowley	Depression (PHQ-9): mean difference was not significant.	Diabetes self-management (Self-care inventory revised) SCI-R: mean difference was +7.0 (p=0.047) in favour of intervention	Self reported medication adherence (Morisky medication adherence scale 4): nonsignificant difference		Adverse events similar in both groups	
7	Dale		Diabetes distress (PAID) adjusted score showed no significant difference for two intervention groups versus control. Self efficacy (DMSES) adjusted score showed no significant difference for two intervention groups versus control. PS-CG, +4.17, p=0.28 DSN-CG, +0.38, p=0.94. Self efficacy (DMSES) improved for the patients in the peer support group but there were no significant differences between groups; diabetes related problems (PAID) reduced for those in the diabetes nurse specialists group. In all groups the HbA1c improved, but there were no significant differences between groups		Normal ACR: 1.05 (0.62 to 1.75) p= 0.87 Normal eGFR: 0.92 (0.55 to 1.53) p 0.76 Current smoker 0.043 (0.55 to 1.53) p 0.72 Healthy weight (BMI<25) 2.19 (1.1 to 4.38) p=0.03 Weight 0.12 (-1.53 to 1.77) p=0.89 Waist circumference Men 0.90 (-1.40 to 3.19) p=0.44 Waist circumference Women -1.52 (-4.08 to 1.04) p=0.24		
8	DePue		Mean perceived competence score significant difference 1.6 (CI: 0.9 to 2.4) p< 0.001	Adherence: self reported medication adherence			

			Physical activity Adapted measures of diabetes beliefs; no data reported.	Nonsignificant difference.			
9	Edelman 2010		Self-efficacy using the Perceived Competence Scale Nonsignificant difference	Adherence to medications ??? Morisky self-reported medication adherence scale Nonsignificant difference	BMI nonsignificant differences	Adverse events through structured self report and medical record review Health utilization Cost data	
10	Edelman 2015		Self-effiacacy- but no report in Results section Health literacy- but no report in Results section.	Medication adherence (via self report) - but no report in Results section.	No significant differences weight or physical activity.	45.2% of intrevention group had GP management plan for diabetes V's 35.5% of controls (non-significant)	
11	Farmer		Functional status as per SF 12 Physical and SF 12 Mental Diabetes treatment satisfaction and satisfaction with nurse <u>SF 12 Physical</u> 46.3 (9.0) V's 44.6 (11.1) MD -0.7 (CI -2.7, 1.4) p = 0.52 <u>SF 12 Mental</u> 49.5 (10.4) V's 52.6 (8.8) MD -1.6 (CI -3.9, 0.6) p = 0.15	MARS Self reported adherence (range 5-25) with a higher score indicating higher levels of adherence Nonsignificant difference	BMI dietary nonsignificant difference.	% reporting hypoglycaemia nonsignificant difference Treatment satisfaction nonsignificant difference	Primary outcome % days over a 12 week period on which the correct number of doses of main glucose lowering medication was taken each day as prescribed. 77.4% (26.3) & days taking correct dose V's 69% = 8.4% MD (P = 0.044)
12	Forjouh		Self care data not given				
13	Frosch		Diabetes knowledge: (23 point Diabetes knowledge test) - nonsignificant difference. Self-care behaviours (SDSCA) - nonsignificant difference				Prescribed medications measured: taking most prescribed medications (*P* = .01; interaction, *P* = .41), and taking all prescribed medications (*P* .001; interaction, *P*=.75).

			Diabetes knowledge and behavioural outcomes by group over time: Exercise was statistically significantly reduced				Nonsignificant difference.
14	Guerci					Symptomatic hyoglycaemia Any hypoglycaemia: 53 (10.4%) in SMBG and 25 (5.2%) in control p= 0.003	Medications nonsignificant difference
15	Heisler		Diabetes social support score - nonsignificant difference Diabetes distress Diabetes QoL -nonsignificant difference	Medication adherence nonsignificant difference Medication intensification: Significant increase in insulin and oral diabetic medication prescribing .	BMI nonsignificant difference		Medication intensification: Significant increase in insulin and oral diabetic medication prescribing .
16	Jacobs				Weight and diet nonsignificant difference	Intervention group had more screening parameters performed (retinal screening, nephropathy and neuropathy)	Medication sse; intervention group had higher use of antiplatelet, diabetic and statin medications.
17	Jameson						Intervention group- 28.8% commenced basal bolus insulin V's 1 (2%) patient in the control group.
18	Jovanovic				HbA1c < 7% 35% V's 21% (but p = 0105)		Medication usage Increase in oral agents in intervention group, without any increase in numbers on insulin. Control group- no change.
19	Keogh		The intervention group reported better personal control, a better understanding of diabetes and an increased belief in treatment effectiveness. They also had fewer symptoms and lower levels of diabetes concern and		Statistically more patients in intervention group achieved at least 1.0% improvement in HbA1c.		

			distress. They also had better psychological well being, adherence to lifestyle factors, self efficacy and family support. Illness perceptions (Brief illness Perception Questionnaire)- statistically significant improvement Psychological wellbeing (12-item Well-Being questionnaire)- statistically significant improvement Diabetes self management (Summary of Diabetes Self-care Activities Questionnaire) Self Efficacy (UK version Diabetes Self-Efficacy Scale)- statistically significant improvement Family support (Diabetes Family Behaviour Checklist)- statistically significant improvement				
20	Kim	Depression (Kim Depression Scale for Korean Americans) nonsignificant difference Quality of Life (Diabetes Quality of Life Measure (DQOL) nonsignificant difference	Diabetes knowledge test (DKT) statistically significant difference Self efficacy (Stanford Chronic Disease Self-Efficacy scale) statistically significant difference Self care (Diabetes self care activitiis (SDSCA) statistically significant difference		% participants achieving HbA1c goals % participants achieving HbA1c goals &achieving HbA1c less 6.5, 7 and 7.5 greater in intervention group (Fig 3). statistically significant. But data not shown. BMI- nonsignificant		

					difference		
21	Krein		General satisfaction score and rating of diabetes provider score was marginally better and statistically better in the intervention group.		BMI nonsignificant difference		
22	Long				BMI nonsignificant difference	Uptake of intervention Peer mentoring: Aiming to have 4 calls per month for 6 months. The Results showed 38% mentors talked 4 times per month and by Month 6, that reduced to 16%.	No difference in hypoglycaemia
23	Maisios					Adherence to follow up: 41/48 and 23/34 patients returned for follow up. 29% intervention group non-compliant.	Use of insulin nonsignificant difference INT: 25% to 40% CONTROL: 15 to 17%
24	Mathers		Decisional conflict: Mean difference between intervention and control groups on the total score for decisional conflict on the total score was -7.72 (CI -12.5, -2.97) Realistic expectations: Were better in intervention group Preferred option: - Proportion undecided: No significant difference Participation in decision-making: Statistically significant difference, intervention group had higher participation rates.				

			Regret score. No significant difference. Acceptability: Most found PDA useful.				
25	McDermott		Test of Functional Health Literacy for Adults (TOFHLA)- unclear if significant result present Assessment of Quality of Life (AQoL) instrument- unclear if significant result present	Waitlist patients had better self-report adherence Adherence: SS reduction	Slight non-significant reductions in rest of other physical outcomes (BMI, ACR, eGFR)	Intervention group patients statistically significantly more likely to have seen a dietician and dentist, be taking inculin and have influenza vaccination.	
26	McMahon					Frequency of data uploads on web-based care management system (used to look at effect on HbA1c primary outcome)	
27	Mons	Symptoms of depression: Geriatric depression scale GDS: No difference between groups.	Health related quality of life (Short Form General Health Survey: SF-12) No difference between groups at 12 months. Statistically significant change at 18 months.				
28	O'Connor			No significant difference between groups regarding medication adherence (one prescription fill within 60 days of prescription date)- 88% in intervention group vs 86% in control group. Similarly there was no significant difference			Medication persistance (two or more prescription fills within 180 days)

				between groups regarding medication persistance (two or more prescription fills within 180 days)			
29	Odegard			No improvement on self reported adherence.			No significant difference in MAI (medication appropriateness) at end of study.
30	Palmas						
31	Phillis-Tsimikas	Self management behaviours and Depression (in separate publication) - not published at time of search so not included	Self management behaviours and Depression (in separate publication)- not published at time of search so not included				
32	Polonsky		GWB WHO-5 - nonsignificant difference			Treatment intensification Changes in treatment: 75.5% of STG patients received a medication change at month 1 V's 28% of ACG patients (p <0.0001). Twice as many STB patients started on insulin between month 1 and 12. Heightened attention paid to subjects. Free meters: Requirement to bring meters to all study visits More frequent study visits STG physicians trained on a treatment algorithm SMBG: Lower test use in	

						STG group (0.77) V's ACG group 1.05 (nonsignificant difference)	
33	Protheroe	Warwick- Edinburgh Mental Well-Being: Adjusted MD was -0.17 (p=0.87) Health Status Measure (from Sf12) Adjusted MD for mental health score was 5.46 (p=0.049)	Diabetes self care (Summary of Diabetes Self-Care Activities Measure) : Adjusted MD was 0.33 (p=0.2) Diabetes Quality of Life (Diabetes Quality of Life Inventory) : Adjusted MD was -4.24 (p=0.46) Diabetes UK Scale Items: Adjusted MD was 0.4 (p=0.22) Health-related Quality of Life (EQ5D) : Adjusted MD was 0.1 (p=0.135) Illness Perception (Brief Illness Perception Score) : Adjusted MD was -5.74 (p=0.04)			No significant difference in resource use (inpatient nights, Emergency Department visits, Outpatient visits, GP visits or practice nurse visits)	
34	Quinn	PHQ-9 depression - nonsignificant difference	Diabetes distress scale - nonsignificant difference Diabetes diabetes inventory - nonsignificant difference		BMI unclear if statistically significant	Hypoglycaemic events and hospitalizations were infrequent in all groups.	
35	Rothman		Diabetes knowledge Satisfaction: (Diabetes Treatment Satisfaction Questionnaire) MD in scores (INT V's control) Diabetes knowledge: +14 (CI 9 to 20) Diabetes treatment satisfaction +3 (CI 1 to 6) statistically significant reduction			Process measures (time spent with patients) and medication changes. But did not factor in any changes made by PCP. Aspirin use higher in intervention group at 12 months. Statin use equal. No statistically significant increase in services in intervention group.	
36	Schillinger		SF-12 instrument for QoL			Functional outcomes:	

			nonsignificant difference Patient assessment of chronic illness care (PACIC) score out of 100 Statistically significant difference ATSM +12.2 V's control GVC +12.6 V's control Data present Diabetes Quality Improvement Program (100 score) Self management behavior statistically significant difference ATSM +0.6 V's control GVC +0.3 V's control Data present Diabetes self efficacy statistically significant difference ATSM +6.0 V's control GVC +5.5 V's control Data present			Bed days: ATSM significant reduction Restricted activity, ATSM significant improvement **Interpersonal Processes of Care** for Diverse Populations (IPC) instrument to capture reports of provider's communication. Statistically significant difference ATSM +9.0 V's control	
37	Sen					Primary outcome was adherence to biometric tests: At three months; total adherence rates were 81% in the low incentive arm V's 58% in control (p 0.007) and 77% in high incentive arm V's 58% (p0.02). No difference between the incentive arms. But no difference in the high incentive group V's	

						control at month 6 (at 3 month post intervention follow up).. But the low incentive group still had significant improvement in adherence at month 6 Vs control (62% V's 27%, p 0.002).	
38	Sugiyama	Change Mental Component Summary Score (MCS-12) from the SF-12: A mean difference of +1.6 between intervention and control which was statistically significant	Secondary outcomes: Social support score from the Diabetes Care Profile: non-significant change				
39	Tang		Satisfaction/ Psychosocial wellbeing Intervention group had higher treatment satisfaction (statistically significant) and lower treatment distress scores. Other scales of diabetes distress had no change between groups.		BMI nonsignificant difference	Healthcare utilsiation - nonsignificant difference in total physician visits.	Significant increase in new medications started and insulin commencement in intervention group. Patients already on insulin- the intervention group had a statistically significant higher number of dose increases.
40	Taylor		Psychosocial (SF 26 for QoL and Duke Activity Status): Nonsignificant difference in psychological variables Patient and physician satisfaction nonsignificant difference			Medical utilization (physician visits) nonsignificant difference in physician or ED visits	
41	Thom				10-year framingham risk nonsignificant difference		

42	Wild	EQ-5D index: Adjusted MD was 0.00 (non-significant) Total HADS score: Adjusted MD was -0.31 (non-significant)	Self-efficacy: Adjusted MD was +0.69 (non-significant) Self-reported total physical activity score (IPAQ): Adjusted MD was -467.31 (non-significant) Diabetes Knowledge (first 14 items only): Adjusted MD was +0.04 (non-significant)	Medication adherence	Weight: adjusted MD supporting telemonitoring group -0.35 (p = 0.6) No significant differences in alcohol use, smoking, or urinary sodium/ creatinine ratio.	Greater number of telephone calls in intervention group (rate ratio 7.5 p<0.0001)	No significant change in use of insulin or other medications (from Supplementary File 1). No change in forgetfulness taking medications or carelessness taking medications.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	7
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	8
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	8, 9
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	8
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	8
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	9, 10
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	9, 10
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	10
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	10, 11
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	10, 11

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	10
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	10, 11
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	12
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	12, 13
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	13
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	13, 14, 15
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	13, 14, 15
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	13
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	15
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	16, 17
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	4

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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Improving risk factor management for patients with poorly controlled type 2 diabetes: A systematic review of healthcare interventions in primary care and community settings

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Title

Improving risk factor management for patients with poorly controlled type 2 diabetes: A systematic review of healthcare interventions in primary care and community settings

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Word Count: 3976

Abstract

Objectives: Poorly-controlled type 2 diabetes mellitus (T2DM) is a major international health problem. Our aim was to assess the effectiveness of healthcare interventions, specifically targeting patients with poorly-controlled T2DM, which seek to improve glycaemic control and cardiovascular risk in primary care settings.

Design: Systematic review.

Setting: Primary care and community settings.

Included studies: Randomised controlled trials (RCTs) targeting patients with poor glycaemic control were identified from Pubmed, Embase, Web of Science, Cochrane Library and SCOPUS. Poor glycaemic control was defined as HbA1c over 59 mmol/ mol (7.5%).

Interventions: Interventions were classified as organisational, patient-oriented, professional, financial or regulatory.

Outcomes: Primary outcomes were HbA1c, blood pressure and lipid control. Two reviewers independently assessed studies for eligibility, extracted data, and assessed study quality. Meta-analyses were undertaken where appropriate using random-effects models. Subgroup analysis explored the effects of intervention type, baseline HbA1c, study quality and study duration. Meta-regression analyses were undertaken to investigate identified heterogeneity.

Results: Forty-two RCTs were identified, including 11,250 patients with most undertaken in the USA. In general studies had low risk of bias. The main intervention-types were patient-directed (48%) and organisational (48%). Overall, interventions reduced HbA1c by -0.34% (95% CI; -0.46%, -0.22%), but meta-analyses had high statistical heterogeneity. Subgroup analyses suggested that organisational interventions and interventions on those with baseline HbA1c over 9.5% had better improvements in HbA1c. Meta-regression analyses suggested that only interventions on those with population HbA1c over 9.5% were more effective. Interventions had a modest improvement of blood pressure and lipids, although baseline levels of

control were generally good.

Conclusions: This review suggests that interventions for T2DM, in primary care, are better targeted at individuals with very poor glycaemic control and that organisational interventions may be more effective.

Article summary:

'Strengths and limitations of the study'

- This systematic review adds to the evidence regarding the effectiveness of healthcare interventions, which specifically target patients with poor glycaemic control of Type 2 Diabetes Mellitus, in community settings.
- There is no specific definition for 'poor control' diabetes in the literature, but by including all studies that had patients with a HbA1c ≥ 59 mmol/mol (7.5%), we captured the full range of poor glycaemic control and also examined other key risk factors such as blood pressure and lipids.
- Data were pooled from 42 studies across four continents, enhancing the generalisability of the findings.
- We did not account for medication use in the studies, but given that all included studies were RCTs, which would balance out delivery of medications, we think that differences in underlying medication usage may relate to how different interventions promote intensification of medications.
- An individual patient data meta-analysis may answer further questions not possible in this review.

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Competing interests statement:

Nil

Author's contributions:

All authors contributed to the drafting of the paper. MEM, MB and RG independently assessed studies for eligibility, extracted data, and assessed study quality. Decisions or disagreements were brought to SMS. SMS, TF and FB provided methodological and statistical support to the paper. All authors contributed to the writing of the paper.

Main text

Introduction

Worldwide, type 2 diabetes mellitus (T2DM) is rising in prevalence and will exceed 4.4% of the world's population, or 366 million by 2030 (1). Despite a wealth of evidence regarding the importance of risk factor control in T2DM, many patients continue to have poor control of HbA1c, blood pressure and lipids. Up to 60% of patients fail to meet target HbA1c levels (2). Similarly over one third of patients with T2DM have inadequate blood pressure control (3). Poorly-controlled T2DM - and its associated microvascular and macrovascular complications - is associated with higher morbidity, higher mortality, poorer quality of life and substantial economic burden (4).

Several studies have examined interventions designed to support the delivery of diabetes care in the community to improve glycaemic and cardiovascular risk factor control (5-11). A 2011 review of community-based interventions including all patients with T2DM, comprising sixty-eight studies, showed that only one third had a statistically significant improvement in one of the relevant clinical outcomes for diabetes: HbA1c, blood pressure or lipids (8). The majority of included studies targeted all patients with T2DM without focussing on those with poor control. Although no overall effect was noted, combining organisational with professional (multifaceted) interventions was concluded to be more beneficial than single interventions and the highest quality multifaceted randomised controlled trials (RCTs) tended to include decision support interventions and elements. A 2013 review looked at 48 cluster RCTs, assessing the effectiveness of Quality Improvement (QI) strategies on the management of diabetes (both type 1 and 2) (11). It suggested that QI interventions, which intervened at a system level on diabetes management, were associated with the largest benefits in glycaemic control and that the effectiveness of interventions targeting healthcare practitioners varied with baseline glycaemic control; being more effective with patients with worse control (11). A 2016 review, of type 1 or type 2 diabetes in primary care, looked at the effects of Clinician Education, Clinician Reminders, Team Changes, Case Management,

Electronic Patient Registry, Telemedicine and Audit and Feedback (10). Including thirty studies, it concluded that multifaceted interventions on multidisciplinary teams were most effective. Interventions targeting family physicians were only effective if computerised feedback on insulin prescribing was provided.

Four large RCTs from North America and the UK have investigated the effects of intensive management of hyperglycaemic and cardiac risk factors on mortality in T2DM across all settings (12-17). Uncertainty remains regarding intensive glycaemic management for all patients with T2DM, with concerns about aggressive reductions in HbA1c (18). Targeted reductions in cardiovascular and glycaemic risk factors in certain vulnerable populations (cognitively impaired, disabled and frail) have been advocated (19). Interventions that specifically target those with very poor control of risk factors may be more beneficial than those targeting all patients, achieving the benefits of cardiovascular and glycaemic control, but without the potential risks of intensively lowering HbA1c in all persons with T2DM. The effect of interventions specifically targeting patients with poorly controlled T2DM in primary care is unknown.

Our aim was to assess the effectiveness of healthcare interventions delivered in primary care and community settings, targeting poorly-controlled T2DM, which seek to improve glycaemic control, blood pressure and lipids.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to standardise the conduct and reporting of the research and the protocol was registered on PROSPERO (20).

Data Sources and Searches

We searched articles in all languages from the Cochrane Library, Pubmed, Embase, Web of Science and SCOPUS from 1990 to 31st December 2016. Reference lists of all included papers were searched. Secondary searching of all references from included studies was also conducted. *Appendix 1* outlines the search string.

Study Selection

We considered RCTs, controlled clinical trials (CCTs), controlled before and after studies (CBAs) and interrupted time series analyses (ITS) meeting the Cochrane Effective Practice and Organisation of Care (EPOC) quality criteria (21). Studies published in all languages were eligible.

Population:

Individuals with 'poorly controlled' T2DM were our population of interest. Though there is a broad consensus about the importance of achieving good glycaemic control for the reasons described, there are no validated cut-offs, which define 'poor-control' of T2DM for targeted interventions. Poorly controlled T2DM has been defined based upon elevated glycated haemoglobin levels in the literature, with different thresholds of HbA1c described, from over 59 mmol/mol (7.5%), over 64 mmol/mol (8.0%) to over 75 mmol/mol (9.0%) (22-24). In this review, we considered participants to have poorly controlled T2DM if their HbA1c was over 59 mmol/mol (7.5%) (or if over 80% of the population in a study had a HbA1c over 59 mmol/mol). Similarly there is no defined cut off as to what defines 'poorly-controlled' blood pressure. We identified studies primarily based on poor glycaemic control but also included participants in these studies who had uncontrolled hypertension or elevated cholesterol/ lipids, if the risk factor level was above that of an accepted

international target, as designated by the study authors. Where studies included patients with 'poor control' based upon a range of risk factor profiles, for consistency, we only included a study if 80% of the population had a HbA1c over 59 mmol/mol (7.5%).

Interventions:

We included interventions delivered by healthcare professionals (HCPs) specifically aiming to target patients with poor control of T2DM, based in primary care or community settings. The primary healthcare setting was defined as providing "integrated, easy to access, health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained and continuous relationship with patients, and practicing in the context of family and community" (25). We excluded drug trials though interventions could have involved treatment intensification. Interventions were defined as simple if they had one identifiable component and multifaceted if they had more than one element. We excluded trials performed within the hospital or the hospital-outpatient setting. The Cochrane EPOC taxonomy of interventions was utilised and the predominant intervention type was defined using five categories including organisational, patient-centred, regulatory, financial and professional. Examples of these intervention types are provided in *Appendix 2* (21):

Comparison:

Comparison groups were included if they received usual care in that setting for T2DM. Controls were also included if they received minor enhanced elements of care, such as education leaflets, which the study authors believed did not go beyond usual care in most settings.

Outcome measures:

Primary outcomes included glycaemic control (HbA1c), blood pressure (systolic or diastolic) and lipid levels, but if studies did not include HbA1c they were excluded. Secondary outcomes included patient reported outcome measures (PROMs) (for example health related quality of life), utilisation of health services, behavioural

outcomes such as medication adherence, provider behaviour, acceptability of service to patients and providers, economic outcomes and adverse events.

Data Extraction and Quality Assessment

Two reviewers (MEM and RG) read the titles and/ or abstracts of the identified references and eliminated irrelevant studies. Studies that were deemed eligible for inclusion were read in full and their suitability for inclusion in the systematic review was independently determined by two reviewers. Disagreements were managed by a third, independent reviewer (SMS). The following information was extracted: a) Details of intervention, b) Participants, c) Clinical setting, d) Study design, e) Outcomes, f) Author Information. We contacted authors for missing data.

Risk of bias in articles was assessed using the Cochrane Handbook for systematic reviewing and EPOC criteria (26). Two review authors independently assessed the risk of bias of each included study against the criteria described in the Cochrane risk of bias tool. We explicitly judged each of these criteria using: low risk of bias, high risk of bias or unclear risk of bias (either lack of information or uncertainty over the potential for bias). We resolved disagreements by consensus and consulted a third review author to resolve disagreements if necessary. An overall assessment of a study's risk of bias was determined using EPOC guidance, with judgement and consensus reached between two reviewers (MEM and SMS) (26).

Data Analysis

For continuous data we calculated the treatment effect using mean differences (MD) and 95% confidence intervals (CI). No binary outcomes were included. Revman software was used to perform the analysis, determine heterogeneity and produce forest plots to illustrate pooled estimates (21). Stata version 13 was used to investigate publication bias by creating funnel plots and using Egger's test to assess funnel plot asymmetry (27). A random-effects analysis was performed and heterogeneity across the studies was quantified using the I^2 statistic. The I^2 statistic describes the percentage of the variability in effect estimates which is due to heterogeneity rather than sampling error (chance) (28). If the I^2 statistic was >50%, it

was deemed that there was significant heterogeneity between the studies.

Subgroup analyses were performed for primary outcomes based on a priori assumptions, as per the PROSPERO protocol (20). For HbA1c we explored the possible effects of subgroups; a) the type of intervention based upon the EPOC taxonomy (*Appendix 2*); b) study quality and c) baseline HbA1c in the study populations (HbA1c 7.5% - 9.4%, or ≥ 9.5%). After reviewing the included studies we also included study duration as a subgroup (< 12 months or ≥ 12 months), as a wide range in study duration was found. Subgroup analyses for systolic blood pressure (SBP) and diastolic blood pressure (DBP) explored the effects of intervention-type based upon the EPOC taxonomy.

When important heterogeneity was identified, we investigated its causes using meta-regression. Meta-regression is an extension to subgroup analysis that allows the effect of continuous, as well as categorical, characteristics to be investigated (29). Meta-regression was performed to explore the effects of; a) study quality (using the overall assessment risk of bias); b) study population characteristics (e.g. gender, age and baseline HbA1c and SBP); c) intervention type (EPOC taxonomy); and d) study duration on the primary outcomes (29). Random effects meta-regression was performed using Stata 13 (27).

Results

Overall 18,829 titles were screened and 42 full text articles met the inclusion criteria (*Figure 1*: PRISMA Flow diagram). All 42 studies were RCTs, encompassing 50 interventions in total, comprising 11,250 patients (22-24, 30-68). No other eligible study designs were identified.

Characteristics of studies

Twenty-nine of the 42 studies were conducted in the United States, nine in Europe, two in Australia, one in Mexico and one in Israel. Follow-up of outcomes in the studies varied in length from 3 (53) to 36 months (46). The mean HbA1c at baseline across all studies was 9.5% (95% CI; 9.3%, 9.8%). The mean age of patients in the studies was 58.0, varying from 47.9 (62) to 67.5 (41) partly reflecting different inclusion criteria (*Table 1*). Thirty studies explicitly defined their study population as "poorly controlled", "complicated" or "persistently poorly controlled", whereas the other twelve had poorly controlled T2DM with HbA1c ≥ 59 mmol/mol (7.5%) as per the review inclusion criteria. Twenty-seven of the 42 studies reported SBP results (22-24, 30-36, 38, 39, 41, 45, 46, 48-51, 54, 58-60, 62, 65, 66, 68) and of these, twenty-three reported DBP (22-24, 31, 32, 34-36, 38, 39, 41, 45, 46, 48, 49, 51, 54, 58, 59, 62, 65, 66, 68). Twenty of the studies reported a lipid outcome (23, 24, 30-32, 35, 36, 38, 39, 41, 45, 46, 48, 51, 56, 58, 62, 65, 66, 68). All of the 42 studies reported at least one secondary outcome. Two studies were excluded from primary outcome analysis due to lack of appropriate data, despite efforts to contact authors (31, 61).

Table 1: Characteristics of included studies

Study ID Author, Year Country	Patient participants Total patients (n) Intervention (n) Control (n) Age (mean, unless stated) Gender (% male, unless stated) HbA1c cutoff of 'poor control' Baseline HbA1c level (mean) Baseline BP (mean) % on insulin at baseline Diabetes duration: (years) **Practitioner and practice participants**	Brief Intervention description	Predominant Intervention type	Outcomes: Primary Secondary	Study duration Months
Anzaldo-Campos 2016 Mexico	**Patient participants** 301 Patients (99 Intervention 1 (PD) and 102 in Intervention 2 (PD-TE) and 100 Control) Mean age: 51.5 % male: 33% T2DM with HbA1c ≥ 8.0% Mean HbA1c: 11.16 Mean BP: 122/ 78 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 81 medical offices within one Family Medical Unit Trained clinicians, nurses and peer educators	Two interventions: Nurse care support and peer-led diabetes self-management education intervention (called Project Dulce). Nurse care support and peer-led diabetes self-management education intervention. A technology-enhanced intervention, using cell phone uploads of glucose and BP levels and text message support.	Patient-centred	Primary outcomes: HbA1c at 10 months Secondary outcomes: Lipid and TAG profile, BP, BMI. Self-reported outcomes: Self efficacy (Spanish Self-Efficacy), depression (PHQ-9), lifestyle (IMEVID), quality of life (Diabetes 39), diabetes knowledge (DKQ24)	10 months

Basudev 2016 UK	**Patient participants** 235 Patients (93 Intervention and 115 Control) Mean age: 59.9 % male: 57.4% T2DM with HbA1c > 8.5% Mean HbA1c: 10.3 Mean BP: 135/ 78 % insulin baseline: 38% Mean diabetes duration: NR **Practitioner and practice participants** From six general practices in London	Virtual clinic integrating primary and specialist care.	Organisational	Primary outcomes: HbA1c at 12 months Secondary outcomes: BP; BMI; Lipids; Renal Function (eGFR).	12 months
Blackberry 2013 Victoria, Australia	**Patient participants** 473 Patients (236 Intervention and 237 Control) Mean age: 62.8 % male: 57% T2DM with HbA1c > 7.5% Mean HbA1c: 8.06 Mean BP: NR % insulin baseline: 27% Mean diabetes duration 10 (5-14 range) **Practitioner and practice participants** 59 practices Practice-based nurses	Telephone coaching by nurses to support diabetes management and self monitoring	Patient-centred	Primary outcomes: HbA1c at 18 months Secondary outcomes: Lipid and TAG profile; eGFR and urine ACR; BP; BMI; waist circumference; smoking status; Quality of Life; Diabetes Self efficacy; Diabetes support; Depression status; Intensification of diabetes. Others: Health service utilization; Physical activity, Nutrition	18 months
Capozza 2015 USA	**Patient participants** 93 patients (58 Intervention; 35 Control) Mean age: 58.7 % male: 35.5% T2DM with HbA1c > 8% Mean Baseline HbA1c 9.1% Mean Baseline BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Recruited from 18 primary clinics	Text-message based behavioural intervention for T2DM	Patient-centred	Primary outcome: Change in HbA1c from day 0 to day 180 Secondary outcomes: Patient interaction and satisfaction (CSQ8) with the program	6 months

Choe 2005 USA	**Patient participants** 80 patients (41 Intervention and 39 Control) Age: 51.0 (all less 70) % male: 46% HbA1c ≥ 8.o% Mean HbA1c 10.1 Mean BP: NR % insulin baseline: 30% Diabetes duration: NR **Practitioner and practice participants** 1 clinic 1 pharmacist case manager	Pharmacist case management	Organisational.	Primary outcome: HbA1c level at 12 months Secondary outcomes: Rates of diabetes process measures (LDL, dilated retinal examination, urine ACR or use of ACE Inhibitors, monofilament testing for diabetic neuropathy, by chart review over 24 months); Rate of HbA1c measurement.	12 month intervention with primary outcome reporting at 12 months and a further 24 month follow up.
Crowley 2015 USA	**Patient participants** 50 patients (25 Intervention and 25 Control) Age: 60 % male: 24% HbA1c > 9% Definition: Yes, defined as 'persistently poor diabetes' Mean HbA1c 10.5% Mean SBP: 127/ 80 % insulin baseline: NR Diabetes duration: 12 **Practitioner and practice participants** Patients all receiving care by Durham VA primary care and endocrinology	Intensive telemedicine intervention for veterans	Organisational	Primary outcome: HbA1c Secondary outcomes: Diabetes self-management (Self-care inventory revised); Depression (PHQ-9); Self reported medication adherence (Morisky medication adherence); BP; Adverse events; Telephone encounters	6 months
Dale 2009 England Exploratory RCT	**Patient participants** 231 (90 (PS) Intervention 1, 44 (NS) Intervention 2 and 97 Control) Age: No mean age provided, but wide spectrum of ages from below 50 to over 70 in each of the intervention and control groups. % male: 57% HbA1c ≥7.5% Mean HbA1c: 8.6% Mean BP: NR % insulin baseline: 0% Diabetes duration: No mean, but between 1- 15 years mostly. **Practitioner and practice participants** 29 practices	Two intervention telecare groups: a) Peer-support telecare intervention b) Diabetic specialist nurse telecare support	Patient-centred.	Primary outcome: Self efficacy (DMSES) Secondary outcomes: HbA1c; Cholesterol; BMI. Diabetes distress (PAID)	6 months

	Peer coaching or diabetes specialist nurse delivered				
DePue 2013 U.S. Territory of America Somoa Cluster RCT	**Patient participants** 268 patients (104 Intervention and 164 Control) Age: 55 % male: 38% Intervention did not target poor control per se, mean baseline HbA1c of 9.6% (SD of 2.1%) was deemed eligible for inclusion Mean HbA1c 9.8 Mean BP: 133/ 84 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Cluster RCT based upon twelve village units Nurse care managers	Nurse–Community Health Worker Team in American Somoa	Organisational.	Primary outcome: HbA1c Secondary outcomes: BP; BMI; Dietary intake; Medication adherence; Physical activity; Adapted measures of diabetes beliefs	12 months
Edelman 2010 North Carolina and Virginia, USA.	**Patient participants** 239 patients (133 Intervention and 106 Control) Age: 61.9 % male: 96% T2DM HbA1c >7.5 AND (SPB > 140 DBP > 90) Mean HbA1c: 9.2% Mean BP: 152/ 84 % insulin baseline: unclear Duration of diabetes: NR **Practitioner and practice participants** 2 VA centres A care team involving internist, pharmacist, a nurse and educator	Enrollment into a general medical clinic (GMC) with an internist, pharmacist and a nurse or educator that met seven times over 12 months	Organisational.	Primary outcomes: HbA1c Secondary outcomes: Systolic blood pressure; Adherence to medications; Self-efficacy; Adverse events through structured self report and medical record review; Health utilization; Cost data	12 months
Edelman 2015 USA	**Patient participants** 377 patients (193 Intervention and 184 Control) Age: 58.7 % male: 45.4% HbA1c ≥ 7.5 (and HTN) Mean HbA1c 9.1% Mean BP: 142.2/ 80.7 % insulin baseline: NR	Nurse case management	Organisational	Primary outcome: HbA1c Secondary outcomes: BP; Weight; Physical activity; Self-efficacy; Health literacy; Medication adherence (via self report)	24 months

	Diabetes duration: NR **Practitioner and practice participants** 9 primary care practices in Duke.				
Farmer 2012 UK	**Patient participants** 211 patients (126 Intervention and 85 Control) Age: 63.2 % male: 65% HbA1c ≥ 7.5% Mean HbA1c: 8.3% Mean BP: 136.9/ 78.2 % insulin baseline: NR Mean diabetes duration: 6.8 years **Practitioner and practice participants** 13 practices Practice nurses	Nurse-led, multilevel intervention to support medication adherence	Organisational	Primary outcome: % days over a 12 week period on which the correct number of doses of main glucose lowering medication was taken each day as prescribed. Secondary outcomes: Hba1c at 0 and 20 weeks (from protocol); Functional status as per SF 12 Physical and SF 12 Mental; Diabetes treatment satisfaction and satisfaction with nurse; MARS Self reported adherence (range 5-25); % reporting hypoglycaemia	12 weeks (intervention was 8 weeks into a 20 week trial)
Forjouh 2014 USA	**Patient participants** 376 patients (101 Intervention 1 (CDSMP), 81 Intervention 2 (PDA), 99 Intervention 3 (PDA, CDSMP and 95 Control) Age: 57.6 % male: 44.0% HbA1c >7.5% Mean HbA1c: 9.3 Mean BP: 134.8/ 77 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 7 practices involved Technology intervention	Three intervention groups, reflecting the individual and combined effects of a behavioural and technology intervention; a chronic Disease Self-Management Program (CDSMP) and a diabetes self-care software on a personal digital assistant (PDA).	Patient-centred	Primary: HbA1c Secondary: BMI; BP; Self management behavioural measures (e.g. foot care)	12 months
Frosch 2011 USA	**Patient participants** 201 patients (100 Intervention and 101 Control) Age: 55.5 % male: 51.5% HbA1c > 8.0 Mean HbA1c: 9.6% Mean BP: 127.7/ 74.0 % insulin baseline: NR Mean diabetes duration: 9.5 **Practitioner and practice participants** 3 academic primary care practices and 1	A video behavioural support intervention by nurse educators with a workbook followed by 5 sessions of telephone coaching.	Patient-centred	Primary: HbA1c Secondary: LDL Cholesterol; BP; BMI; Prescribed medications; Diabetes knowledge (23 point Diabetes knowledge test); Self-care behaviours (SDSCA)	Unclear, possibly over 6 months

	community based safety net clinic Nurse educators				
Guerci 2003 France	**Patient participants** 988 patients (510 Intervention and 478 Control) Age: 60.6 % male: 53.7% HbA1c ≥ (7.5 and 11) diabetes. Mean HbA1c 8.95% Mean SBP: 139.6, 80.4 % insulin baseline: 0% Mean diabetes duration months: 96.6 **Practitioner and practice participants** 265 GPs involved, uncertain number of practices	A self-monitoring of blood glucose intervention Auto-Surveillance Intervention Active (ASIA) study.	Patient-centred	Primary: HbA1c Secondary: Changes in fasting glucose; Symptomatic hyoglycaemia; BP; Weight; Diet; Drugs; Adverse drug event	6 months
Heisler 2010 USA	**Patient participants** 244 patients (126 Intervention and 119 Control (NCM)) Age: 62.0 % male: 100% HbA1c > 7.5% Mean HbA1c 7.98 Mean BP: 138.4/ 76.5 % insulin baseline: 56% Diabetes duration: NR **Practitioner and practice participants** Two VA facilities Nurse and peer case managers	Reciprocal peer support	Patient-centred	Primary HbA1c 6 months Secondary: Medication adherence; Diabetes emotional distress; Diabetes specific social support; Medication changes Attendance at clinics	6 months
Jacobs 2012 USA	**Patient participants** 396 patients (195 Intervention and 201 Control) Age: 62.9 % male: 50% HbA1c > 8.0% Mean HbA1c 9.35 Mean BP: 138.7/ 78.9 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 5 pharmacists, patients came from practices of	A pharmacist assisted medication program intervention	Organisational	Primary No specific primary outcome given or sample size: Secondary: HbA1c < 7%; LDL Cholesterol < 100mg/dl; BP < 130/ 80mmHg	12 months

	66 primary care physicians.				
Jameson 2010 USA	**Patient participants** 104 patients (52 Intervention and 52 Control) Age: 49.6 % male: 49% HbA1c ≥ 9.0% (two of the population had T1DM) Mean HbA1c: 10.8% Mean BP: NR % insulin baseline: 49.6% Mean diabetes duration: NR **Practitioner and practice participants** 1 pharmacist.	A pharmacist collaborative management intervention	Organisational	Primary: HbA1c Secondary: % of patients with a 1.0% decrease in HbA1c.	12 months
Jovanovic 2004 USA	**Patient participants** 362 patients (186 Intervention and 172 Control) Age: 57.0 % male: 23.8% HbA1c > 7.5 Mean HbA1c: 9.65% Mean BP: 135/ 79 % insulin baseline: NR Mean diabetes duration: 11.1 **Practitioner and practice participants** Unclear number of case managers and practices	Diabetes case management by a nurse or dietician	Organisational	Primary: HbA1c Secondary: % participants achieving HbA1c goals medication usage; BP ; Lipids; BMI; Frequency of hypoglycaemia	36 months
Keogh 2011 Ireland	**Patient participants** 121 patients (60 Intervention and 61 Control) Age: 58.6 % male: 64% HbA1c ≥ 8.0% Median HbA1c: 9.2 Mean BP: 138.8/ 76.8 % insulin baseline: 52% Mean diabetes duration: 9.4 **Practitioner and practice participants** One practice One psychologist	Psychological family intervention	Organisational	Primary outcome: Hba1c Secondary outcomes: Illness perceptions (Brief illness Perception Questionnaire); Psychological wellbeing (12-item Well-Being questionnaire); BP; BMI; Diabetes self management (Summary of Diabetes Self-care Activities Questionnaire); Self Efficacy (UK version Diabetes Self-Efficacy Scale); Family support (Diabetes Family Behaviour Checklist).	6 months
Kim 2009	**Patient participants** 83 patients (41 Intervention and 42 Control) Age: 56.4	A Community-based, culturally tailored behavioral intervention	Patient-centred	Primary: HbA1c	30 weeks (7 months)

USA	% male: 55.4% HbA1c ≥ 7.5% Mean HbA1c: 9.25% Mean BP 132.1/ 79.3 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Uncertain number practices Community nurse delivered			Secondary: Diabetes knowledge test (DKT)' Self efficacy (Stanford Chronic Disease Self-Efficacy scale); Self care (Diabetes self care activitiis (SDSCA); Depression (Kim Depression Scale for Korean Americans); Quality of Life (Diabetes Quality of Life Measure (DQOL); Lipids; BP; BMI	6 month intervention
Krein 2004 USA	**Patient participants** 246 patients (123 Intervention and 123 Control) Age: 61 % male: 97% HbA1c ≥7.5% Mean HbA1c 9.25 Mean BP: 145/ 86 % insulin baseline: 59% Mean diabetes duration: 11 **Practitioner and practice participants** One VA centre, unclear number of practices Two nurse case managers	Case management by nurse practitioners	Organisational	Primary: HbA1c Secondary: LDL; Cholesterol; BP; Health status; Patient satisfaction; Inpatient and outpatient encounters, pharmacy and laboratory use; Semi structured interviews also done.	18 months
Long 2012 USA	**Patient participants** 118 patients (38 Intervention 1 (PM), 40 Intervention 2 (FI) and 39 Control) Age: 60 % male: 94% HbA1c > 8.0% (two patients may have had T1DM) HbA1c Mean: 9.7 Mean BP: NR % insulin baseline: 74% Mean diabetes duration: NR Diabetes over 10 years: 58% **Practitioner and practice participants** Unclear number of practices Peer mentors	Two interventions: Peer mentoring Financial incentivisation of patients	Patient-centred	Primary: Hba1c Secondary: Patient recollection of hypoglycaemic event	6 months
Maislos 2002 Israel	**Patient participants** 82 patients (48 Intervention and 34 Control) Age: 60.5 % male: 29.5% HbA1c ≥ 10%	A mobile clinic providing interdisciplinary care	Organisational	Primary: Decrease of HbA1c of 0.5% at six months Secondary: Compliance with study protocol at six months	6 months

	Mean HbA1c 11.35 Mean BP: NR % insulin baseline: 20% Duration diabetes: 10 **Practitioner and practice participants** 2 practices involved via 1 mobile clinic				
Mathers 2012 UK Cluster RCT	**Patient participants** 175 patients (95 Intervention and 80 Control) Age: 64 % male: 54% HbA1c ≥ 7.5 Mean HbA1c: 8.7% Mean BP: NR % insulin baseline: NR Duration diabetes: 7.8 **Practitioner and practice participants** 49 practices involved GPs and nurses from practices delivered intervention	Patient decision aid to improve decision quality and glycaemic control	Professional	Primary: HbA1c Secondary: Decisional conflict scale score- indicator of decision quality; Knowledge and realistic expectations of the risks and benefits; Regret scale	6 months
McDermott 2015 Australia Cluster RCT	**Patient participants** 213 patients (113 Intervention and 100 Control) Age: 47.9 % male: 37.6% HbA1c ≥ 8.5 (69mmol/mol) Mean HbA1c 10.7 Mean BP: 131/ 79.3 % insulin baseline: 44.4% Diabetes duration: NR **Practitioner and practice participants** 12 remote communities in north Queensland.	Community-based health-worker led case management approach to the care of Indigenous adults with poorly controlled type 2 diabetes in primary care services in remote northern Australia	Organisational	Primary outcome: HbA1c level at 18 months Secondary outcomes: BP BMI Lipids Medications ACR eGFR Test of Functional Health Literacy for Adults (TOFHLA) Assessment of Quality of Life (AQoL) instrument Implementation Fidelity	18 months
McMahon 2005 USA	**Patient participants** 104 patients (52 Intervention and 52 Control) Age: 63.5 % male: 99% HbA1c ≥ 9% Mean HbA1c: 10.0% Mean BP: 140/ 81 % insulin baseline: 54% Duration diabetes: 12.3 years	Web-based care management	Organisational	Primary: HbA1c Secondary Systolic BP Diastolic BP TAG LDL Cholesterol HDL Cholesterol	12 months

	Practitioner and practice participants Practice number unclear Care manager available				
Mons 2013 Germany	**Patient participants** 204 patients (103 Intervention and 101 Control) Age: 67.5 % male: 61% HbA1c > 7.5% Mean HbA1c: 8.1% Mean BP: 137.5/ 80 % insulin baseline: NR Duration diabetes: NR **Practitioner and practice participants** 10 GP practices Practice nurses	Supportive telephone counseling	Patient-centred	Primary HbA1c Secondary Systolic BP; Diastolic BP; Cholesterol; Health related quality of life (Short Form General Health Survey: SF-12); Symptoms of depression: Geriatric depression scale	18 months
O'Connor 2014 USA **Cluster RCT**	**Patient participants** 1102 patients (569 Intervention and 533 Control) Age: 43% ≥ 65 years. ~ 61 mean % male: 51.3% HbA1c ≥ 8% Mean HbA1c: 9.8% Mean BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Large medical groups in California. Clusters defined on their linkage to primary care physicians.	Telephone Outreach to Improve Medication Adherence and Metabolic Control in Adults With Diabetes	Organisational	Primary Outcome: Medication adherence (at least one prescription fill within 60 days of prescription date). Secondary Outcomes: Medication persistence (two or more prescription fills within 180 days); HbA1c; BP; Lipids	6 months
Odegard 2005 USA	**Patient participants** 77 patients (43 Intervention and 34 Control) Age: 51.8 % male: 57% HbA1c ≥ 9.0% Mean HbA1c: 10.4% Mean BP: NR % insulin baseline: 32% Duration diabetes: 7.6 **Practitioner and practice participants** 7 primary care clinics	A pharmacist intervention care management intervention	Organisational	Primary HbA1c 12 months Secondary: Medication appropriateness (Medication Appropriate Index/ MAI); Self reported adherence by questionnaire	6 month intervention but HbA1c at 12 months

	Pharmacists: Unclear number				
Palmas 2014 USA	**Patient participants** 360 patients (181 Intervention and 179 Control) Age: 57.6 % male: 38% HbA1c ≥ 8.0% Mean HbA1c: 8.7% Mean BP: 136/ 81 % insulin baseline: NR Duration diabetes: NR **Practitioner and practice participants** Unclear number GP practices Two community health workers	Community health worker (CHW) intervention in an Hispanic population	Patient-centred	Primary: HbA1c Secondary: Systolic BP; Diastolic BP; LDL Cholesterol; Medication adherence; Dosage and intensity; Physical activity; Diet; Depression	12 months
Phillis-Tsimikas 2011 USA	**Patient participants** 207 patients (104 Intervention and 103 Control) Age: 50.7 % male: 29.5% HbA1c > 8.0% Mean HbA1c: 10.4% Mean BP: 122.6/75 Duration diabetes: NR % insulin baseline: NR **Practitioner and practice participants** Unclear number GP practices participating Peer educators	Peer-led diabetes education programs in high-risk Mexican Americans	Patient-centred	Primary: HbA1c Secondary: Lipids; BP; BMI; Self management behaviours and Depression (in separate publication)	10 months Intervention was 4 months and primary outcome was 6 months after this.
Polonsky 2011 USA Cluster RCT	**Patient participants** 499 patients (256 Intervention and 227 Control) Age: 55.8 % male: 53.2% HbA1c > 7.5% Mean HbA1c: 8.9 Mean BP: NR % on insulin: 0% Duration diabetes: 7.6 **Practitioner and practice participants** 34 GP practices participating	Self blood glucose monitoring	Patient-centred	Primary: Hba1c Secondary: Treatment intensification; Total number of visits with medication or lifestyle modifications; Time to the first treatment change; Frequency of SMBG; GWB from WHO-5 Well-Being Index	12 months
Protheroe	**Patient participants**	Lay Health Trainer (LHT) interviews with	Organisational	Feasibility study	7 months

2016 UK Feasibility study	76 Patients (37 Intervention and 39 Control) Mean age: 63.1 % male: 50.3% T2DM with HbA1c > 7.5% Mean HbA1c: 9.3 Mean BP: NR % insulin baseline: NR Mean diabetes duration: 61% > 5 years **Practitioner and practice participants** From six family doctor practices	patients, creating a self-management plan, with supportive phone calls.		Outcomes included: Deprivation; Health literacy; Diabetes self care; Diabetes Quality of Life; Diabetes UK Scale Items, Health-related Quality of Life, Warwick- Edinburgh Mental Well-Being, Illness Perception, health Status Measure, Resource Use, HbA1c.	
Quinn 2011 USA Cluster RCT	**Patient participants** Cluster trial, 3 intervention groups, 1 control 163 patients (Intervention 1 (CO) 23, Intervention 2 (CPP) 22, Intervention 3 (CPDS) 62 and Control 56) Age: 52.9 (weighted average) % male: 52.5% (weighted average) HbA1c ≥ 7.5% Mean HbA1c: 9.4 Mean SBP: 131/ NR % insulin baseline: NR Duration diabetes: 8.2 **Practitioner and practice participants** 26 GP practices participating	Mobile phone-based treatment/ behavioural coaching intervention	Patient-centred	Primary: HbA1c Secondary: PHQ-9 questionnaire for depressive symptoms; Self completion patient outcome instrument; Diabetes Distress Scale; BP; Lipids; Hypoglycaemic events; Hospitalisations and ED visits	12 months
Rothman 2005 USA	**Patient participants** 217 patients (112 Intervention and 105 Control) Age: 55.5 % male: 44% HbA1c ≥ 8.0% Mean HbA1c: 11 Mean BP: 138.5/ 81 % insulin baseline: 39% Duration diabetes: 8.5 **Practitioner and practice participants** Three pharmacists	A primary care-based disease management program delivered by trained pharmacists.	Organisational	Primary: HbA1c Secondary: BP; Aspirin; Lipids; Diabetes knowledge Satisfaction (Diabetes Treatment Satisfaction Questionnaire); Use of clinical services; Adverse events; Process measures (time spent with patients and medication changes)	12 months
Schillinger 2009	**Patient participants** 339 patients (112 intervention 1 (ATSM), 113 intervention 2 (GVC) and 114 Control) Age: 56.1	Two interventions: Self-Management Support via 1/	Patient-centred	Primary: Self management behaviour Secondary: Patient assessment of chronic illness care	12 months

USA	% male: 41 % HbA1c ≥ 8.0% Mean HbA1c: 9.5% Mean BP: 140/ 77.3 % insulin baseline: 38% Duration diabetes: 9.5 **Practitioner and practice participants** Uncertain number GPs- in a safety net health system	Automated telephone self management support (ATSM) and 2/ Group medical visits (GMVs).		(PACIC); Diabetes Quality Improvement Program; Interpersonal Processes of Care for Diverse Populations (IPC) instrument; Self management behavior (Foods, diets, exercise, self monitoring); SF-12 instrument for QoL; Functional status- likert scale; HbA1c; SBP; DBP; BMI	
Sen 2014 USA	**Patient participants** 75 patients (21 Intervention 1 (low), 26 Intervention 2 (high) and 28 Control) Age: 54.3 % male: 36% HbA1c ≥ 7.5% (90-95% had T2DM from personal correspondence with author) Mean HbA1c 9.5% Mean BP: 132.9/ 86.1 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** 1 practice	Financial incentives for home based monitoring- two interventions	Financial	Primary: Adherence over three months Secondary: HbA1c	12 weeks
Sugiyama 2015 USA	**Patient participants** 516 patients (258 Intervention and 258 Control) Age: 63 % male: 30% HbA1c ≥ 8.0% Mean HbA1c: 9.7 Mean BP: NR % insulin baseline: NR Diabetes duration: NR **Practitioner and practice participants** Participants were recruited from senior centers, churches, community clinics, and Los Angeles County Community and Senior Service Centers	Diabetes self management education by trained health educators.	Patient-centred	Primary: HbA1c Secondary: Change Mental Component Summary Score (MCS-12) from the SF-12; Social support score from the Diabetes Care Profile	6 months
Tang 2013	**Patient participants** 415 patients (203 Intervention and 213 Control) Age: 54 % male: 60%	Online disease management of diabetes	Patient-centred	Primary: HbA1c Secondary: SBP; DBP; LDL; 10 year Framingham risk;	12 months

USA	HbA1c ≥ 7.5% Mean HbA1c: 9.3 Mean BP: 126.6/ 72.7 % insulin baseline: NR Mean diabetes duration: NR **Practitioner and practice participants** Uncertain number practices			Satisfaction; Psychosocial wellbeing; Healthcare utilization	
Taylor 2003 USA	**Patient participants** 169 patients (84 Intervention and 85 Control) Age: 55.2 % male: 52.7% HbA1c > 10.0% Mean HbA1c: 9.5% Mean BP: 127.5/ 72.8 % insulin baseline: NR Mean diabetes duration NR **Practitioner and practice participants** Uncertain number practices Nurse care managers	Nurse care management (NCM)	Organisational	Primary: % of patients in 'target' HbA1c Secondary: Total cholesterol; HDL Cholesterol; LDL cholesterol; TAGs; Glucose; Microalbuminuria; SBP; DBP; Processes of care (foot, eye, dental exam and flu shot); Psychosocial (SF 26 for QoL and Duke Activity Status); Patient and physician satisfaction; Medical utilization (physician visits)	12 months
Thom 2013 USA	**Patient participants** 299 patients (151 Intervention and 148 Control) Age: 55.2 % male: 47.8% HbA1c ≥ 8.0% Mean HbA1c: 10.0 Mean BP: 143.2/ NR % insulin baseline: 55% Mean diabetes duration: 8.9 **Practitioner and practice participants** 6 practices included Peer coaches	Peer health coaching	Patient-centred	Primary: HbA1c Secondary: % patients whose HbA1c dropped 1%; % patients with a HbA1c less 7.5; LDL; SBP; BMI	6 months
Wild 2016 UK	**Patient participants** 231 Patients (160 Intervention and 161 Control) Mean age: 61 % male: 66.8% T2DM with HbA1c > 7.5% Mean HbA1c: 8.9 Mean BP: 134/79 % insulin baseline: 26%	Supported telemonitoring involving twice-weekly self-measurement of glucose and transmission to a general practitioner	Patient-centred	Primary outcomes: HbA1c at 9 months Secondary outcomes: BP; BMI; Lipid and TAG profile; eGFR and urine ACR; UKPDS risk score; Anxiety and Depression score; Quality of Life; Diabetes Self efficacy; Self-reported physical activity, alcohol intake, exercise tolerance and diabetes knowledge; healthcare utilization.	9 months

	Mean diabetes duration 7.4 **Practitioner and practice participants** From 44 practices from four UK regions.				

Glossary of abbreviations:

ACR (albumin-creatinine ratio), AQoL (assessment of quality of life), ATSM (automated telephone self management support) , BMI (body mass index), BP (blood pressure), CDSMP (chronic disease self-management program) , CO (coach-only), CPDS (coach primary care provider portal with decision support), CPP (coach primary care physician portal), CSQ8 (client satisfaction scale 8), DBP (diastolic blood pressure), DMSES (diabetes management self efficacy scale) , DQOL (diabetes quality of life measure), ED (emergency department), eGFR (estimated glomerular filtration rate), FI (financial incentivisation), GMV (group medical visits), GWB (blobal well being), LDL (low density lipoproetin), MAI (medication appropriate index), MARS (medication adherence rating scale), MCS-12 (mental component summary score), NR (not recorded), PACIC (Patient assessment of chronic illness care), PAID (problems areas in diabetes scale), PDA (personal digital assistant), PHQ-9 (patient health questionnaire 9), PM (peer mentoring), SBP (systolic blood pressure), SDSCA (summary of diabetes self-care behaviours scale), SF-12 (short Form general health survey), T2DM (type 2 diabetes mellitus), TOFHLA (test of functional health literacy for adults), VA (veteran's affairs), WHO (World Health Organisation).

Interventions were all complex with multiple components. Studies were categorised based on the predominant intervention element using the EPOC taxonomy. The included interventions were categorised as predominantly patient-centred (n=20, 48%); organisational (n=20, 48%), financial (n=1, 2%) or professional (n=1, 2%). One study (Long et al. 2012) comprised two intervention arms with a patient-centred and financial intervention (included as a patient-centred predominant intervention in our analysis). Descriptions of the interventions are outlined in *Table 1.*

The twenty patient-centred interventions in our review included four telephone- (34, 41, 56, 58), five computerised/ mobile phone based- (32, 36, 52, 61, 68), one video-based- (51), five peer-support- (30, 38, 44, 49, 65), three self-monitoring-based (37, 50, 64) and two-culturally-supportive self-management interventions (39, 45). The twenty organisational interventions included five pharmacist interventions performing case management (35, 40, 47, 48, 57), six nurse case management interventions (23, 31, 46, 53, 55, 60), three web-based/ telemedicine/ telephone case management interventions (24, 59, 63), three new-clinic-based interventions (43, 54, 66), one community health-worker intervention (62), one psychological intervention (22) and one lay health worker intervention (67). Eight interventions had an mHealth or telehealth component (33, 36, 45, 52, 56, 59, 65, 68). More detailed descriptions of the interventions are outlined in *Appendix 3*.

Risk of bias

All 42 studies were RCTs, with six being cluster RCTs. Overall, 25 studies were classified as having a predominant low-risk of bias (59.5%) (22-24, 32-36, 39, 41, 42, 45, 46, 51, 53-55, 58, 59, 62-66, 68), thirteen studies had an unclear-risk (31%) (30, 31, 37, 38, 40, 44, 47, 49, 56, 57, 60, 61, 67) and four RCTs were classified as having a high-risk of bias (9.5%) (43, 48, 50, 52) (*Appendix 4*). Blinding of outcome assessment was classified as low-risk in all studies. Attrition bias was evident in seven studies. *Appendix 5* outlines the summary judgements for both overall risk of bias and predominant intervention type, which were used in the meta-regression analysis.

There was no evidence of publication bias in the studies included in the HbA1c (p

=0.37) or SPB analysis (p=0.54). However, there was some evidence of publication bias in the studies included in the DBP analysis (p <0.01). See *Appendix 6*.

Primary outcomes

HbA1c

Overall 40 of the 42 studies were included in a meta-analysis, which found a mean difference (MD) in HbA1c of -3.7 mmol/mol (-0.34%; 95% CI: -0.46%, -0.22%) favouring intervention groups, but with statistical heterogeneity (I^2 = 69%). *Figure 2(a)* outlines the overall effect of interventions on HbA1c, across EPOC categories.

Subgroup analyses were performed based upon the predominant intervention type (*Figure 2(a)*), the baseline HbA1c level (*Figure 2(b)*), study duration (*Figure 2(c)*) and study quality (*Figure 2(d)*). These analyses suggested that organisational interventions (MD in HbA1c of -5.2 mmol/mol (-0.42%; 95% CI: -0.66%, -0.18%; I^2 = 79%) had better improvements in HbA1c than patient-centred interventions (-0.30%; 95% CI: -0.43%, -0.18%; I^2 = 48%) (p=0.05). Similarly interventions performed when the baseline population-HbA1c was over 80mmol/mol (9.5%) (MD in HbA1c of -6.3 mmol/mol (-0.58%; 95% CI: -0.81%, -0.35%; I^2 = 75%) had better improvements in HbA1c than populations with a baseline-HbA1c < 9.5% (-0.17%%; 95% CI: -0.29%, -0.05%%; I^2 = 51%) (p=0.002). Study duration did not appear to affect HbA1c (*Figure 2(c)*). Lastly, studies with a low-risk of bias (MD in HbA1c was -2.8 mmol/mol (-0.26%; 95% CI: -0.39%, -0.13%; I^2 = 59%) appeared to have a smaller reduction in HbA1c compared to unclear (-0.49%%; 95% CI: -0.84%%, -0.15%; I^2 = 81%) and high-risk studies (-0.41%; 95% CI: -0.74%, -0.09%; I^2 = 61%), but there was no evidence of a statistically significant difference (p=0.35). Though not considered in our original protocol, subgroup analysis did not highlight additional benefit from those interventions (included in both organisational and patient-centred intervention types), which had a telemedicine or mHealth component (*Appendix 7*) (33, 36, 45, 52, 56, 59, 65, 68).

As the overall results showed statistical heterogeneity, meta-regression analysis was also conducted to explore the components of this heterogeneity. As with the meta-

analyses, higher baseline HbA1c was associated with a greater reduction in HbA1c (β-Coefficient: -0.27; 95% CI: -0.41, -0.13; p<0.001). The predominant-intervention type, risk of bias and study-duration were not associated with improved glycaemic control.

Blood pressure

Overall there was small improvement in SBP in the twenty-six interventions included in the meta-analysis, (MD SBP – 1.13 mmHg (95%; CI -2.19, -0.08)) with moderate heterogeneity (I^2 = 47%) (*Appendix 8*) (22-24, 30-36, 38, 39, 41, 45, 46, 48-51, 54, 58-60, 62, 65, 66, 68). DBP improved modestly in the twenty-two studies included in the meta-analysis (MD DBP – 1.37mmHg (95%; CI -2.25, -0.50)) with moderate heterogeneity (I^2 = 44%) (*Appendix 9*) (22-24, 31, 32, 34-36, 38, 39, 41, 45, 46, 48, 49, 51, 54, 58, 59, 62, 65, 66, 68).

In the subgroup analysis, organisational interventions appeared to improve SBP modestly (MD SBP: – 2.69mmHg; 95% CI: -5.11, -0.26; I^2 = 57%) compared to patient-centred interventions (MD SBP: – 0.52mmHg; 95% CI: -1.41, 0.38; I^2 = 20%) which showed no statistically significant improvement (*Appendix 8*). However, there was no evidence of a statistically significant difference between intervention types. Similarly with DBP, organisational interventions appeared to improve DBP modestly (MD DBP: -2.87mmHg; 95% CI: -4.29, -1.45; I^2 = 30%) compared to patient-centred interventions (MD DBP: -1.37mmHg; 95% CI: -1.42, 0.2; I^2 = 30%) (*Appendix 9*) and there was evidence of a statistically significant difference (p=0.007). Meta-regression analysis was not conducted for SBP or DBP as significant heterogeneity was not present on the overall effect sizes.

Lipids

Twenty of the 42 studies reported total cholesterol, LDL-cholesterol, HDL-cholesterol or triacylglicerides (23, 24, 30-32, 35, 36, 38, 39, 41, 45, 46, 48, 51, 56, 58, 62, 65, 66, 68). Statistically significant improvements in lipids were only demonstrated in four of these 20 studies (31, 32, 45, 48). Baseline lipid levels were generally not reported. Eleven of the twenty studies reported data relating to total cholesterol. Meta-

analysis was undertaken on these studies, which indicated a modest improvement in total cholesterol, favouring intervention groups (MD Total Cholesterol – 4.29 mg/dl (95% CI -7.68, -0.89); I^2 = 0%) (*Appendix 10*) (35, 36, 38, 41, 45, 46, 58, 62, 65, 66, 68).

Secondary outcomes

All but one the 42 included studies reported at least one of the eligible secondary outcomes (*Appendix 11*). Overall, interventions had very limited effect on secondary outcomes. Twenty-six studies reported other physical outcomes (e.g. BMI, and estimated glomerular filtration rate). Of the fifteen studies that reported on weight or BMI, only one showed significant improvement (56). Ten studies reported mental health outcomes (36, 38, 41, 45, 58, 59, 64) with two showing a significant improvement in the Change Mental Component Summary Score and the Short Form-12 Mental Health Score (64, 67). Twenty-eight studies reported PROMs, eleven showing an improvement with the intervention. Ten studies reported medication adherence outcomes, two showing improvement. Eighteen studies reported utilisation outcomes with four improving processes of care.

Discussion

Statement of principle findings

Healthcare interventions have positive, albeit modest, effects on HbA1c in poorly controlled T2DM. Interventions targeting those with a higher baseline HbA1c (≥ 80 mmol/mol (9.5%)) show the greatest effects. There was also evidence of a modest impact on both blood pressure and lipids, though baseline control of these risk factors was generally good. Generally little effect on secondary outcomes was found. Our results suggest that a targeted approach to T2DM management, focussing on individuals with very poor glycaemic control, may represent a prudent strategy for future management.

Strengths and weaknesses of the study

The methodology of our systematic review addresses key credibility issues (69, 70). The research question was sensible, our search of the literature was exhaustive and our results are outlined clearly for primary and secondary outcomes. The effect of baseline HbA1c was consistent across studies, biologically plausible and was an a priori hypothesis (70).

We performed meta-regression to explore the heterogeneity, which also confirmed the increased effectiveness of interventions on those with HbA1c ≥ 80 mmol/mol (9.5%). However, a major limitation is that meta-regression is usually underpowered to detect anything but very large associations. Meta-regression considers the interactions between trial level covariates and the treatment effect, but it inherits difficulties of interpretation attached to non-randomised studies, as it is not possible to randomise patients to one covariate value or another, so causality cannot be attached its findings (71). Though we do not believe the subgroup findings occurred by chance, there remained high heterogeneity and we explored between-study comparisons rather than within-study comparisons (70). There was some evidence of publication bias in the DBP analysis, but this was not present for the twenty-two studies reporting SBP. It should also be noted that the power of Egger's test is low when the number of studies is small and should only be used if the analysis includes a range of study sizes.

This study will inform researchers regarding the range of interventions that have been deployed to target patients with poorly controlled T2DM. There is no specific definition for 'poor control' of T2DM in the literature, but by including all studies that had patients with a HbA1c > 59 mmol/mol (7.5%), we captured the full range of poor glycaemic control. Studies examining poor control of HbA1c possess a risk of regression towards the mean. However, all included studies were RCTs with control groups, which should have accounted for this. Targeted interventions in poorly controlled T2DM need to be distinguished from interventions, which are designed to intensively reduce HbA1c in all patients. Though persons with very poor glycaemic control are also at risk of the adverse effects of hypoglycaemic agents, targeting this population is more likely to reach the right balance of reducing harms of

overtreatment and maximising potential benefits (18). The relative importance of targeting glycaemic or cardiovascular risk has been debated in the literature (17). We did not account for medication use in the studies, but given that all included studies were RCTs, which would balance out delivery of medications, we think that differences relating to underlying medication usage relate to how different interventions types promote the intensification of medications.

Comparison with other studies

The existing literature examining healthcare interventions to improve glycaemic control has focussed on a range of approaches. There have been systematic reviews of interventions including QI initiatives, education, self-management support, case-management, adherence to medication and professional interventions, though as outlined previously most have not specifically targeted patients with poor glycaemic control (8, 10, 11).

A synthesis of 27 systematic reviews and 347 randomised controlled trials identified the cost-effectiveness of self-management interventions in T2DM in all patients with T2DM (72). This overview included studies that targeted all patients with T2DM and found very good evidence that education improves blood glucose control in patients with T2DM in the short term (less than 12 months) and that behavioural and psychological interventions are associated with modest improvements in blood glucose control (HbA1C) (72, 73). A review of computer-based diabetes self-management interventions to manage T2DM reported a small beneficial effect on blood glucose control (MD of -0.2%) (74). Another recent systematic review of 118 self-management interventions found improvements in HbA1c in 62% of studies. The overall mean effect was to reduce HbA1c by -0.57%, although patients with persistently elevated HbA1c over 9 had greater improvements (75). In our review, patient-orientated interventions, such as self-monitoring of blood glucose and self-management interventions, seemed to be less effective than organisational interventions.

Case management by nurses and other professionals and case management in

socially disadvantaged have been shown to be beneficial when targeted at all patients with T2DM and our review supports this conclusion for poorly-controlled populations (5, 76-78). Pharmacist-based interventions have been studied, mainly in outpatient settings or in US primary care, and have been found to be effective and cost-effective (79, 80). The five pharmacist interventions in our review, targeting patients with poorly-controlled T2DM, showed mixed results, but overall had predominantly positive effects on HbA1c.

Attention to, and reporting of, intensification of anti-diabetic medications and patient's adherence to treatment regimens are needed to achieve optimal glycaemic control (81, 82). Evidence regarding adherence in T2DM is mixed. A previous systematic review of twenty one studies that included fourteen RCTs to enhance T2DM treatment adherence in community and hospital settings found that few studies measured or assessed adherence and that interventions to improve adherence did not show benefits or harms (83). A review by Farmer et al. found limited evidence of effect for interventions promoting the monitoring of medication use and brief messaging to support medication adherence in patients with T2DM, though the included studies did not specifically target patients with poorly controlled diabetes (84). Only ten of the 42 included studies in our review looked at adherence to medications as an outcome and only two of these nine studies had a statistically significant effect on adherence (49, 62). The baseline level of adherence varied considerably and studies used different scale ranges.

Our review identified only one professional-based interventions in poorly controlled T2DM, through a physician decision aid (42). Two systematic reviews have examined the impact of clinical decision support systems (CDSS) on the management of T2DM in primary care, between them looking at twenty eight trials, with varying results but none of these CDSS interventions were designed to promote intensification of prescribing in persons with poor glycaemic control (85, 86).

Future research

There is a need for further research examining professional-based interventions in poorly controlled T2DM, such as CDSS, which promote intensification of medications (81). Studies from jurisdictions outside North America on poorly controlled populations would also be welcome. An individual patient data meta-analysis would answer further questions not possible in this review and future research should attempt to obtain individual-level patient data. It is likely that most successful interventions have their impact as a result of intensification of medicines and/ or improving adherence to medicines (81). As adherence was not measured in most of the studies and intensification poorly documented, it is important that future interventions report on these findings. Furthermore organisational interventions could incur significant costs to a health system so cost-effectiveness analyses on future interventions should be undertaken to ensure the modest improvements in HbA1c are beneficial for the health systems.

In conclusion, clinicians and policy makers, when considering organisation of care for T2DM should focus their effects on those patients with very poor glycaemic control (≥80 mmol/mol (9.5%)). Prioritising interventions that emphasise structured organisation of care, which can include intensification and adherence to medications, also seem more likely to deliver optimal results in terms of glycaemic control for T2DM patients.

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Data sharing statement

All collected data has been supplied as Supplementary Files. Please contact the corresponding author (MEM) if there are queries regarding this data.

Keywords

BMI- body mass index

CBAs- controlled before and after studies

CCTs- controlled clinical trials

CDSS- clinical decision support system

CI- confidence interval

DBP- diastolic blood pressure

EPOC- Effective Practice and Organisation of Care

HCP- health care professional

HDL- high density lipoprotein

ITS- interrupted time series analyses

LDL- high density lipoprotein

MD- mean difference

PRISMA- Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PROM- patient reported outcome measure

PROSPERO- international prospective register of systematic reviews

QI- quality improvement

RCT- randomised controlled trials

SBP- systolic blood pressure

T2DM- type 2 diabetes mellitus

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Figure 1: PRISMA Flow Sheet

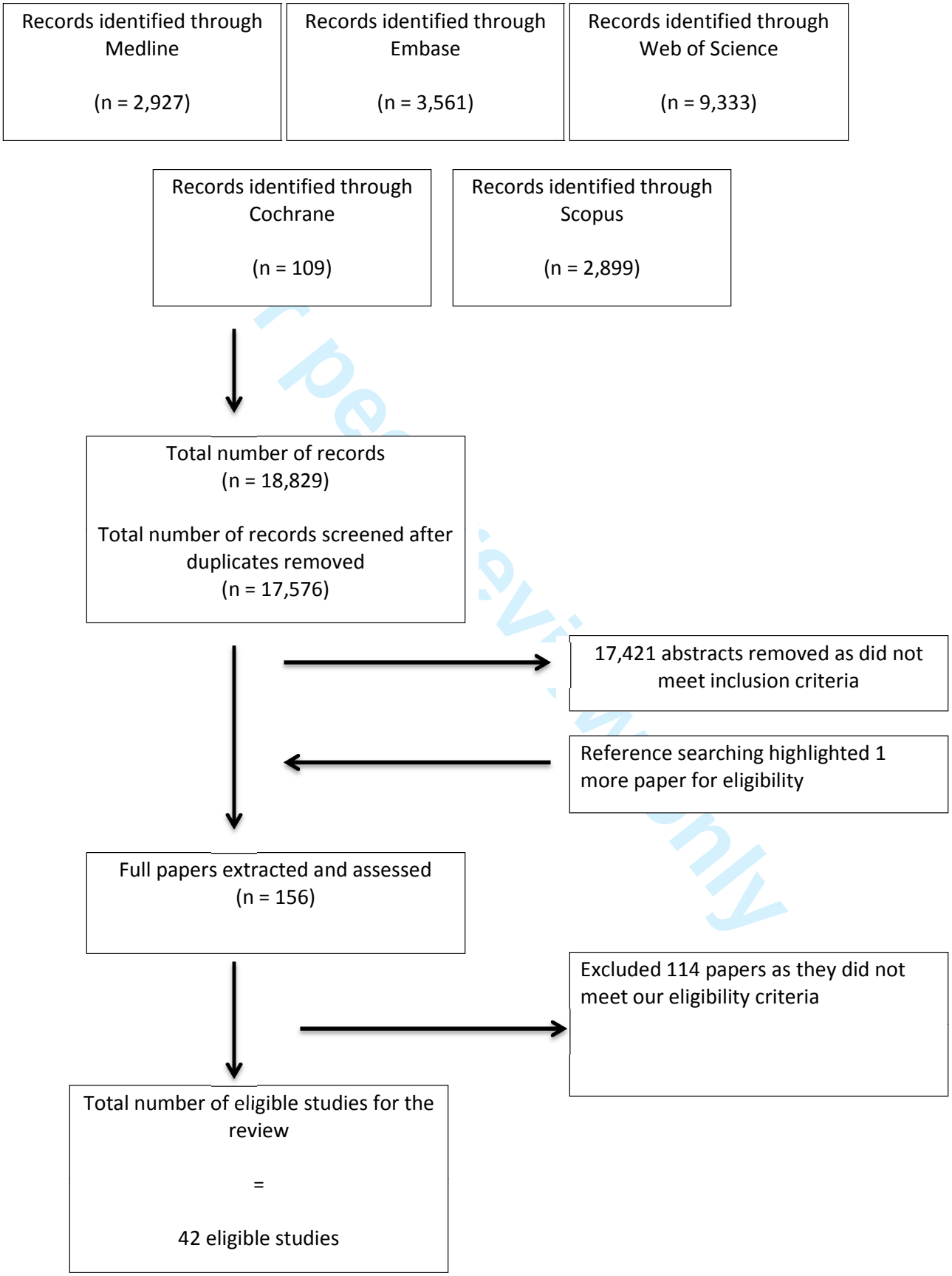

Figure 2a: Effects of interventions on HbA1c, with intervention-type subgroups

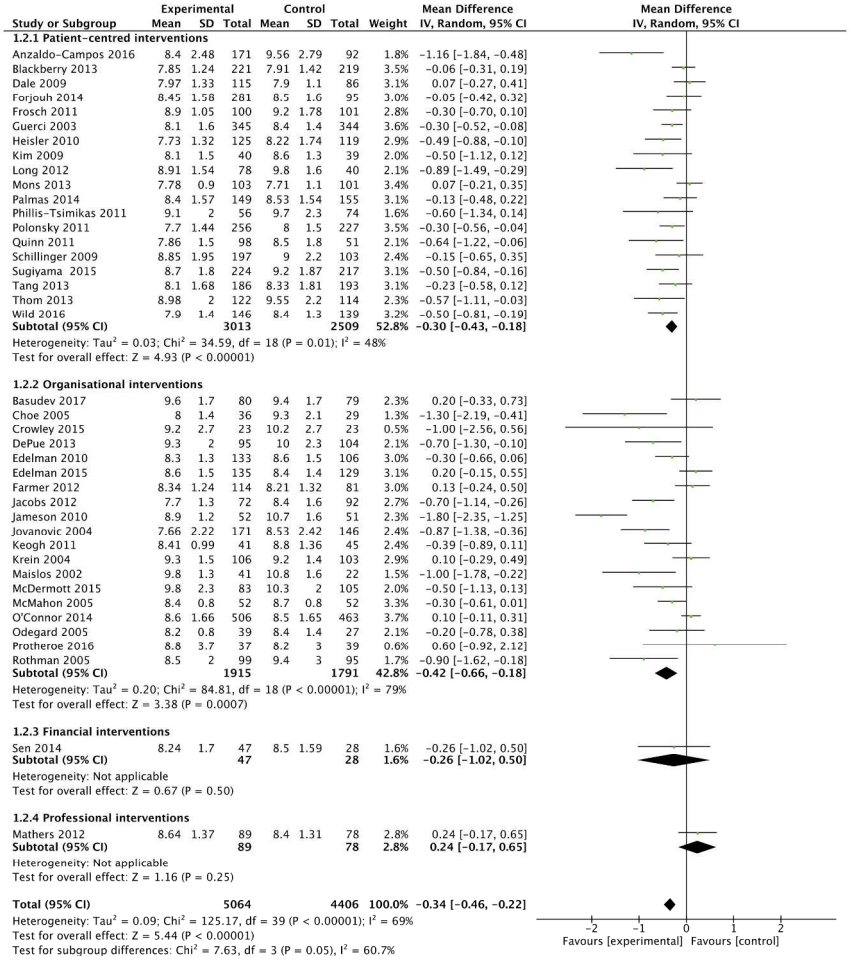

Figure 2a Effects of interventions on HbA1c, with intervention-type subgroups

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Figure 2b: Effects of interventions on HbA1c, with baseline-HbA1c subgroups

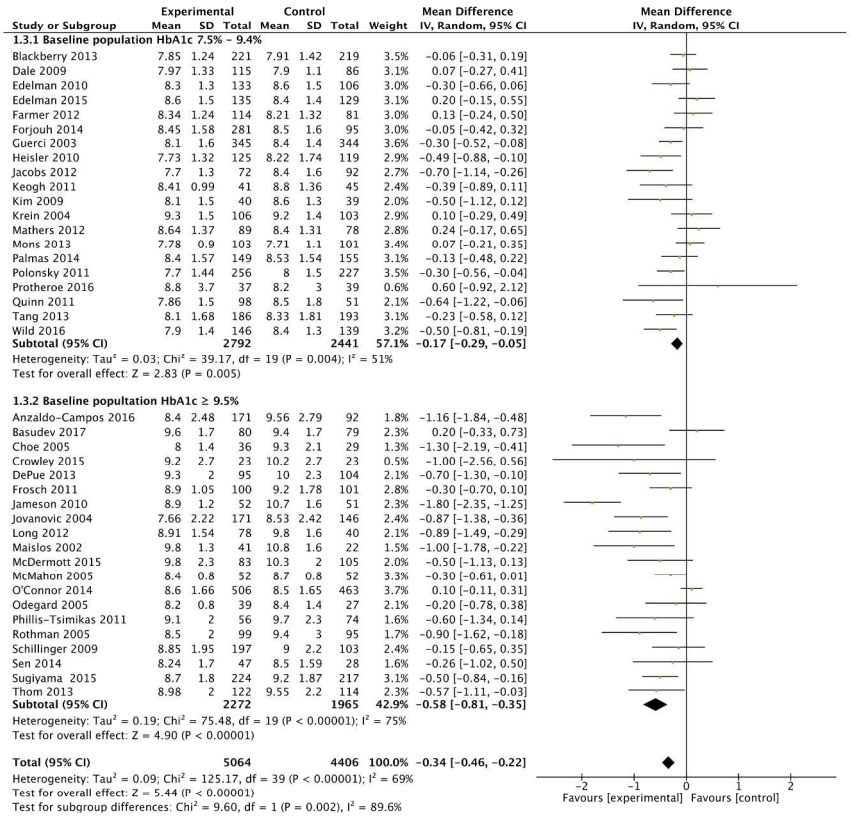

Figure 2b Effects of interventions on HbA1c, with baseline HbA1c subgroups

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Figure 2c: Effects of interventions on HbA1c, with study-duration subgroups

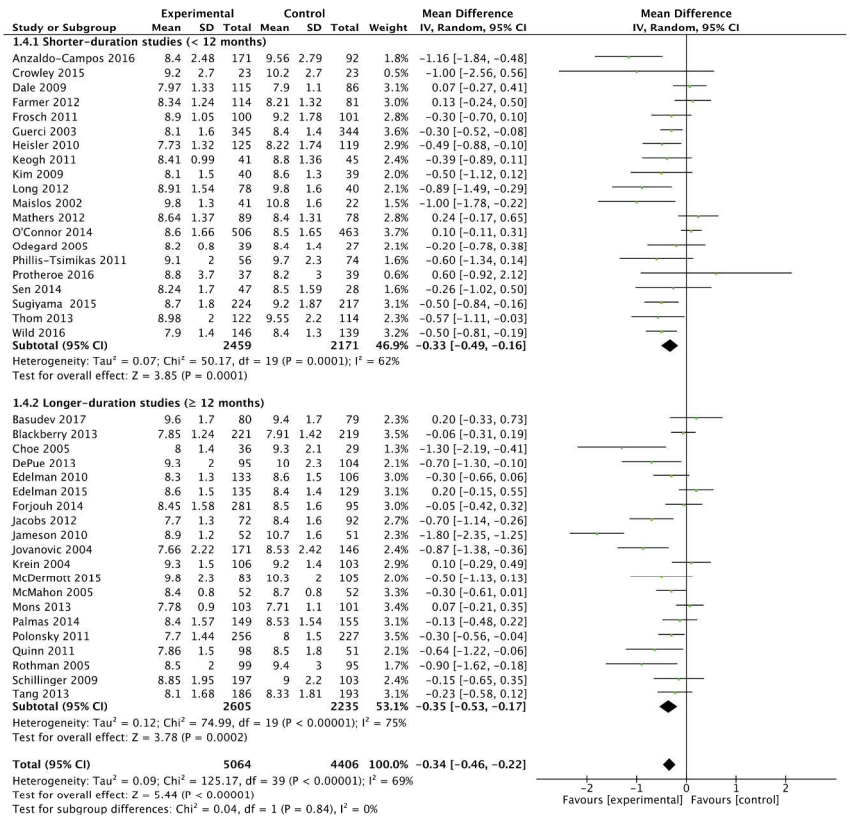

Figure 2c Effects of interventions on HbA1c, with baseline study duration subgroups

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Figure 2d: Effects of interventions on HbA1c, with study-quality subgroups

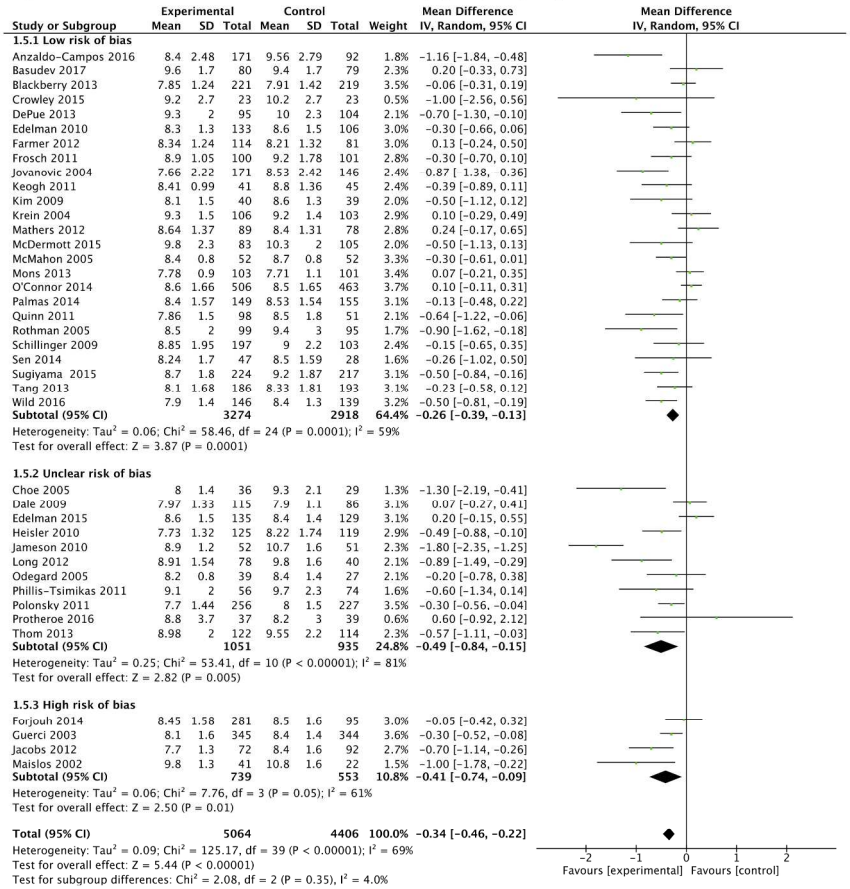

Figure 2d Effects of interventions on HbA1c, with baseline study quality subgroups

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Appendix 1: Search String

Pubmed/ Medline

Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled

AND

Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin

AND

primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR OR health care provider OR case manager OR “case management” OR “care management”

(((primary care[Title/Abstract] OR primary health[Title/Abstract] OR (family physician[Title/Abstract] OR family physicians[Title/Abstract]) OR (general practicability[Title/Abstract] OR general practice[Title/Abstract] OR general practice,[Title/Abstract] OR general practices[Title/Abstract] OR general practician[Title/Abstract] OR general practicians[Title/Abstract] OR general practicioner[Title/Abstract] OR general practicioners[Title/Abstract] OR general practictioner[Title/Abstract] OR general practictioners[Title/Abstract] OR general practiioners[Title/Abstract] OR general practioner[Title/Abstract] OR general practioners[Title/Abstract] OR general practionner[Title/Abstract] OR general practionners[Title/Abstract] OR general practise[Title/Abstract] OR general practises[Title/Abstract] OR general practitioner[Title/Abstract] OR general

practitioner's[Title/Abstract] OR general practitioners[Title/Abstract] OR general practitionner[Title/Abstract] OR general practitionners[Title/Abstract] OR general practive[Title/Abstract]) OR (family practice[Title/Abstract] OR family practices[Title/Abstract] OR family practioner[Title/Abstract] OR family practise[Title/Abstract] OR family practitioner[Title/Abstract] OR family practitioners[Title/Abstract]) OR outpatient?[Title/Abstract] OR clinic?[Title/Abstract] OR ambulatory[Title/Abstract] OR health centre?[Title/Abstract] OR health centre?[Title/Abstract] OR office[Title/Abstract] OR veterans[Title/Abstract] OR pharmacist[Title/Abstract] OR nurse[Title/Abstract] OR doctor[Title/Abstract] OR psychologist[Title/Abstract] OR health care provider[Title/Abstract] OR case manager[Title/Abstract] OR "case management"[Title/Abstract] OR "care management"[Title/Abstract]) AND ("1990/01/01"[PDAT] : "2016/12/31"[PDAT])) AND ((Lipid[Title/Abstract] OR cholesterol[Title/Abstract] OR blood pressure[Title/Abstract] OR hypertension[Title/Abstract] OR cardiovascular risk[Title/Abstract] OR glycaemic[Title/Abstract] OR glycemic[Title/Abstract] OR HbA1c[Title/Abstract] OR A1c[Title/Abstract] OR (HbA[Title/Abstract] AND 1c[All Fields]) AND Title/Abstract[All Fields] OR haemoglobin[Title/Abstract] OR hemoglobin[Title/Abstract]) AND ("1990/01/01"[PDAT] : "2016/12/31"[PDAT]))) AND ((Diabetes[Title/Abstract] OR T2D$[Title/Abstract] OR NIDDM[Title/Abstract] OR MODY[Title/Abstract] OR Non-insulin dependent[Title/Abstract] OR Insulin[Title/Abstract] OR IDDM[Title/Abstract] OR Poorly-controlled[Title/Abstract]) AND ("1990/01/01"[PDAT] : "2016/12/31"[PDAT])) AND ("1990/01/01"[PDAT] : "2016/12/31"[PDAT])

WoS search

TS = (Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled)

AND

TS = (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin)

AND

TS = (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office)

TI = (Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled) AND TS = (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin) AND TS = (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office)

Indexes=SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH Timespan=1990-2016

SCOPUS

lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk

OR glycaemic OR glycemic OR hba1c OR a1c OR (hba AND (1c)) OR haemoglobin OR hemoglobin AND diabetes OR t2d$ OR niddm OR mody OR non-insulin dependent OR insulin OR iddm OR poorly-controlled AND primary care OR primary health OR family physician* OR general practi* OR family practi* OR outpatient? OR clinic? OR ambulatory OR health centre? OR health centre? OR office AND (EXCLUDE (SUBJAREA , "DENT") OR EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "DENT") OR EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "ARTS") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "ENGI") OR EXCLUDE (SUBJAREA , "BUSI") OR EXCLUDE (SUBJAREA , "ECON") OR EXCLUDE (SUBJAREA , "VETE") OR EXCLUDE (SUBJAREA , "MATE") OR EXCLUDE (SUBJAREA , "COMP") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "EART") OR EXCLUDE (SUBJAREA , "PHYS"))

1990- 2016 Title abstract

Embase

(primary care OR primary health OR family physician* OR general practi* OR family practi* OR outpatient? OR clinic? OR ambulatory OR health centre? OR health centre? OR office OR veterans OR pharmacist OR nurse OR doctor OR psychologist OR OR health care provider OR case manager OR case management OR care management):ab,ti

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Cochrane Library = 74

(Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled)

AND

(Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin OR hemoglobin)

AND

(primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR health care provider OR case manager OR case management OR care management)

(Diabetes OR T2D$ OR NIDDM OR MODY OR Non-insulin dependent OR Insulin OR IDDM OR Poorly-controlled) AND (Lipid OR cholesterol OR blood pressure OR hypertension OR cardiovascular risk OR glycaemic OR glycemic OR HbA1c OR A1c OR (HbA AND (1c)) OR haemoglobin) AND (primary care or primary health or family physician* or general practi* or family practi* or outpatient? or clinic? or ambulatory or health centre? or health centre? or office or veterans OR pharmacist OR nurse OR doctor OR psychologist OR health care provider OR case manager OR case management OR care management) in Title, Abstract, Keywords in Cochrane Reviews

Appendix 2: Cochrane Effective Practice And Organisation of Care Review Group taxonomy of interventions:	
Professional interventions	For example; distribution of educational materials to healthcare professional, or educational meetings, or audit and feedback.
Organisational interventions	For example; Revision of professional role (e.g. community pharmacist providing case management for patient with diabetes) or skill mix changes (changes in numbers, types or qualifications of staff). Included telemedicine interventions with predominant organisational elements.
Patient-orientated interventions	For example; patient education, peer support or support for self management. Including telephone and telemedicine interventions with predominant patients elements (with focus on self-management)
Financial interventions	For example; Fee-for-service for provider or a penalty for the patient.
Regulatory interventions	For example; changes to local or national regulations designed to alter care delivery to improve outcomes.

Appendix 3: Detailed description of study interventions

N	Study	Brief intervention description	Intervention description
N.	Author Year Country	Brief Intervention description	Intervention description (detailed) Length intervention Predominant Intervention type Comparison
1	Anzaldo-Campos 2016 Mexico	Two interventions: Nurse care support and peer-led diabetes self-management education intervention (called Project Dulce). Nurse care support and peer-led diabetes self-management education intervention. A technology-enhanced intervention, using cell phone uploads of glucose and BP levels and text message support.	Two interventions, called the Project Dulce Model: 1. Nurse care management through a combination of a multidisciplinary team of clinicians and nurse, as well as trained peer-led diabetes self-management education (this collectively is the called Project Dulce (PD) model. Clinicans underwent 16 hours of training and monthly ongoing education. The nurses , trained in diabetes care, provided personalized education to patients, in accordance with national guidelines. They also liaised with the peer educators, who either had diabetes themselves or lived or worked with people with diabetes. They underwent a training programme, modified for a Mexican population. Addressing fears pertaining to insulin use and addressing self-management was a focus of their educational sessions. 2. The PD intervention above, was combined with a technology-enhanced intervention, using cell phone uploads of glucose and BP levels and text message support (called the PD-TE intervention). Participants received free glucose monitors and training, they were asked to check their sugars twice a day for one month, then two days per week thereafter. The glucose data was uploaded to a central system and medical staff monitored these readings. Text messages, surveys, videos and brochures were also sent out to participants. Length: The first intervention (PD) comprised eight weekly sessions with peer educators for two months, then monthly sessions thereafter up to 10 months in total. For the PD-TE group, text messages, surveys, videos and brochures were also sent throughout the 10 months. Predominant EPOC intervention type: Patient-centred Comparison: Usual general practice care

2	Basudev 2016 UK	Virtual clinic integrating primary and specialist care	The intervention involved four steps. Initially it involved identification of the target patients (HbA1c > 8.5%). The second step involved a virtual clinic meeting (with around 20 cases), involving the community diabetes (specialist) team and practice team. The management plan for each patient was determined. The care was then allocated to primary, intermediate or secondary care. The third step involved the patient consultation, agreeing an individualised plan of management in collaboration with the patient, including therapy changes and addressing patient goals. The forth step involved a 3-month review by the community diabetes team. Length: The intervention lasted 12 months with three-monthly reviews by the community diabetes team after the initial consultation. Predominant EPOC intervention type: Organisational. Comparison: Usual general practice care.
3	Blackberry 2013 Victoria, Australia	Telephone coaching by nurses to support diabetes management and self monitoring	The PEACH study: GP based nurse led telephone coaching; dealing with lifestyle issues, medication adherence and dosing, self monitoring of their disease, how to take greater initiative in the therapeutic alliance with their doctor, facilitating appropriate intensification of medications to achieve treatment goals. Nurses did not have prescribing rights. Length: In the first six months there were five telephone-coaching sessions at intervals of six weeks in the first six months, a coaching session at 8 and 10 months, a face-to-face coaching session at 12 months and a final coaching session at 15 months. Predominant EPOC intervention type: Patient-centred Comparison: Usual general practice care
4	Capozza 2015 USA	Text-message based behavioural intervention for T2DM	Receipt of 1-7 test diabetes-related messages per day, depending on the choices they made at enrolment. The content of the text messages were reviewed by certified diabetes educators and patients had control over the types and frequency of the messages. Users could turn off the program by texting the word 'stop'. The core messages related to diabetes education and health improvement (medication reminders, glucose testing reminders, BP measurement reminders and encouraging weight loss). Patients could reply to messages to get feedback. Length: 6 months of text messages Predominant EPOC intervention type: Patient Comparison: Usual care
5	Choe	Pharmacist case	The case manager was a clinical pharmacist who was already established as a pharmacotherapy consultant at the clinic before the start of the intervention. The

	2005 Michigan, USA	management	clinical pharmacist evaluated patient's therapeutic regimens based on efficacy, safety, adverse effects, drug interactions, drug costs and monitoring. All therapeutic recommendations were discussed with the primary care provider before significant therapy alterations. The pharmacist also followed up on these recommendations. Face to face consultations between pharmacist and physician were included. Length: Initial one-hour consultation with patient and monthly telephone contact thereafter and saw patients in conjunction with their routine primary care visits for one year. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
6	Crowley 2015 USA	Intensive telemedicine intervention for veterans	An advanced comprehensive diabetes care (ACDC) program, including telemonitoring, physician guided mediation management, self-management behavioural support and physician guided depression management. It was delivered via a telephone using existing staff in the VA. VA home technology (HT) nurses delivered the intervention. Usual care involves HT nurses ringing patients, but they do not deliver a comprehensive diabetes management intervention like ACDC. In terms of telemonitoring, patients were asked and prompted to perform SMBG daily and to submit this on their HT-issued equipment. They were called by a HT nurse if they did not submit data for three days. In terms of self-management every two weeks a HT nurse rang the patient, delivering a diabetes self-management support module. This was a 30-minute telephone call every 2 weeks- reviewing blood glucose data, reconciling medications and reviewed adherence. For the physician medication management component, the HT nurse then contacted the study physician (an endocrinologist) and medication changes (such as insulin changes) were transmitted back to the HT nurse via an EHR- the nurse then relaying this on to the patients. In terms of depression, if the baseline or three-month PHQ9 was high, a psychiatrist of primary care physician input was made. Length: Daily telemonitoring, two weekly calls by a home technology nurse, input by endocrinology to nursing staff at two weekly intervals over six months. Predominant EPOC intervention type: Organisational Comparison: Usual care but received an educational packet in addition.
7	Dale 2009 England	Two intervention telecare groups: a) Peer-support telecare intervention b) Diabetic specialist nurse telecare support	Two intervention telecare (telephone) groups: a) Telephone peer-delivered intervention. b) Diabetic specialist nurse telecare support The telecare support was intended to supplement routine care by motivating adherence to the advice provided by the GP or practice nurse at the time of change (medication and/ or lifestyle) in diabetes care. Length of intervention: The first telecare call was made 3-5 days later and a standard package offered support 7-10, 14-18 28-35, 56-70, 56-120 days later. Training for the telecare support was with a two days training programme (motivational interviewing, active listening skills). Peer supporters recruited through a diabetes care user group. Otherwise they were trained as above. Two were excluded from the trial as they could not master the techniques.

			The trained peer supporters had a median diabetes duration of 10 years and 6/9 had T2DM. They were paid a small fee and d had access to an experienced DSN educationalist. They were invited to 6 monthly review meetings. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
8*	DePue 2013 U.S. Territory of America Somoa Cluster RCT	Nurse–Community Health Worker Team in American Somoa	Nurse–Community Health Worker Team: Nurse case manager (NCM) and four community health workers with a minimum of high school education- all staff underwent training. A filed director supervised the research. Length: The NCM met with all patients at least once over 12 months, conducting groups sessions with patients at high risk, providing feedback to physicians and oversight of CHW visits. The CHWs helped patients make and keep healthcare appointments, helped patients understand diabetes, reinforced adherence to medications and provided support. Patients at higher risk were seen weekly in a group meeting conducted by the NCM with CHW assistance or, if unable to attend the group meeting, they were seen individually by CHWs. Patients at moderate risk were seen monthly by CHWs and patients at lower risk were seen every 3 months. All individual visits occurred at the patient's home, workplace, or at TC, per the patient's choice. Family members were encouraged to attend these visits. BG and BP were monitored at each visit and urgent levels were referred immediately to the TC physician during clinic hours or to the hospital emergency department. Predominant EPOC intervention type: Organisational. Comparison: Usual care. Patients also received a self-care diabetes book and a risk profile was placed in their medical chart.
9	Edelman 2010 North Carolina and Virginia, USA.	Enrollment into a general medical clinic (GMC) with an internist, pharmacist and a nurse or educator that met seven times over 12 months	Patients in the intervention arm were assigned to a group medical clinic (GMC) that met on the patient's preferred half-day. Each group had 7-8 patients and a care team (a primary care internist, a pharmacist, a nurse or certified diabetes educator). The groups met every 2 months (7 visits over 12 months). Patients were given $10 for each GMC session they attended. The care team met the group at each visit and each group met the same care team at each visit. Each provider could be a member of more than one care team. Each GMC session lasted 90-120 minutes visit: BP and home glucose values were checked at each GMC session; education assessment was then delivered by nurse or educator- the patients chose certain topics so the education sessions were tailored to the member's needs. The pharmacist and PCP reviewed the medical record, BP and glucose levels at each session and an individualized management plan directed at improving HbA1c and BP was formulated (medications and lifestyle based). The Primary Care Provider was then informed. Signed attendance contacts to boost attendance, telephone contact if needed to change management based upon lab results. All patients received usual primary care on top of this.

			Predominant EPOC intervention type: Organisational. Comparison: Usual care.
10	Edelman 2015 USA	Nurse case management	A single nurse with experience in case management delivered both the tailored behavioral intervention and the control. For the intervention arm, the content was tailored to each patient's individual barriers to controlling blood sugar or BP. This content was divided into a series of topical modules addressing one or more behaviors appropriate for improving control of BP or blood sugar, and included physical activity, weight reduction, low salt intake, smoking cessation, medication adherence, management of hypoglycemia, and blood glucose monitoring. The modules assessed barriers to specific behaviors, and the nurse then tried to engage the patient in problem-solving in order to determine actions for overcoming these barriers. In addition, barriers that might generalize to a number of problems—specifically, low levels of disease knowledge, poor memory, poor social support, and concern about the quality of physician-patient decision- making—were addressed on their own. Fidelity was assessed by two nurse-investigators (KP, BG), who listened to a sample of 5 % of total calls for delivery of intended content. Length: The nurse rang intervention and control patients 12 times in total over 24 months every 2 months. Predominant EPOC intervention type: Organisational Comparison: "Attention Control". The control patients received calls that were not tailored; these calls provided traditional didactic information on a range of topics that had no relationship to HTN, DM, or any of the behaviors we were trying to improve (e.g., flu shots, skin cancer prevention). Content was tightly scripted, designed to limit the potential for productive interaction between nurse and patient, and was informed by standard guidelines as stated on government websites.
11	Farmer 2012 UK	Nurse-led, multilevel intervention to support medication adherence	Nurse- led, consultation-based intervention to support patients with adherence to taking glucose lowering medications. This was a multi-level intervention, targeting both health professional and patient behaviour. Initially there was training for the clinic nurses provided by a clinical psychologist and an intervention facilitator' as the first part of the intervention. The aim was to strengthen patient motivation to take OGLM regularly and support medicine taking through action-plans. 8 weeks after recruitment, patients were invited to the intervention visit to record and review their medication; and then randomised to either an intervention to support medication or adherence, or to standard care. There were 2 components in the intervention delivered to patients. (1) nurses elicited patient beliefs about intention to take their medications as prescribed. Positive beliefs were reinforced verbally and non-verbally, through provision of tailored information. Negative beliefs were addressed using problem solving and the nurse facilitated patients in action planning. The intervention consultation took 30 minutes, with 20 minutes for data collection, which both intervention and control patients received. Predominant EPOC intervention type: Organisational.

			Comparison: Usual care. The standard care visit lasted approximately 20 minutes, during which data were collected. Same nurses delivered this.
12	Forjouh 2014 USA	Three intervention groups, reflecting the individual and combined effects of a behavioural and technology intervention; a chronic Disease Self-Management Program (CDSMP) and a diabetes self-care software on a personal digital assistant (PDA).	Four arms in the trial: a) Chronic Disease Self Management Program (CDSMP) b) Personal digital assistant (PDA) c) Both CDSMP and PDA d) Usual care CDSMP: Involved a 6-week, classroom-based program for diabetes self-management. Based upon 1999 paper showing effectiveness of CDSMP. Its goal was to increase self-efficacy to decrease chronic disease related symptoms and avoidable healthcare utilization. It teaches participants techniques to facilitate enhanced decision making, action planning, and effective communication. CDSMP workshops hosted in clinical environments and community-based settings. Fidelity to classes not monitored. Master trainers/ lay leaders underwent 4 days of training- and the lay leaders used pre-scripted materials. PDA: This intervention arm were taught how to use a diabetes self-care software. It was loaded onto a handheld device and was called “Diabetes Pilot”. The Diabetes Pilot allowed recording and some monitoring of blood glucose, BP, medication usage, physical activity and dietary intake on the PDA. One-to one instruction by a project coordinator covering key areas such as data entry, foot database utilization and reports was provided. Participants were instructed to input information daily. Training effectiveness was not assessed. CDSMP and PDA group received both. The CDSMP was a 6 week program, based in a classroom. Unclear how many workshops. The PDA arm: Uncertain, participants asked to use it daily and input information into it. Primary outcome 12 months, followed up to 24 months CDSMP: 6 weeks PDA: Uncertain, possibly 2 years Predominant EPOC intervention type: Patient-centred. Comparison: Usual care along with Texas Diabetes Council patient education materials.
13	Frosch 2011	A video behavioural support intervention by nurse educators with a workbook	Intervention participants received a 24 minute long CDC program with an accompanying booklet called “Living with Diabetes: Making lifestyle changes to last a lifetime”- this was developed by the Foundation for Informed Decision Making. The participants were also entitled to have up to 5 sessions of telephone coaching with a bilingual nurse educator, trained in patient-centred approaches to diabetes management and motivational enhancement- with a goal to collaborate with participants in identifying behavioural goals and a behavioural plan.

	USA	followed by 5 sessions of telephone coaching.	The first session was 60 minutes in length (2 weeks after enrollment), the second and third were 30 minutes, forth and fifth were 15 minutes. Interval between telephone coaching was open to participants and nurse educators to negotiate. Both groups received a telephone call one week after enrollment to review intervention materials. Five coaching sessions (spread over a max duration of 2.5 hours) and a 24-minute DVD to watch, as well as a booklet on lifestyle changes in diabetes. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care. Participants also received a 20-page brochure entitled “4 steps to control your diabetes for life” developed by the NIH.
14	Guerci 2003 France	A self-monitoring of blood glucose intervention Auto-Surveillance Intervention Active (ASIA) study.	Self monitoring of blood glucose (SMBG): Patients received initial training by their GP at the initial inclusion visit. Patients were required to perform at least six capillary assays a week (3 different days, including the weekend). Standardised management including medications, blood glucose level, diet and physical exercise. Five visits were conducted during the intervention. At each visit, a clinical evaluation was performed. Laboratory values took place at 3 visits. At the third visit the GP could modify the treatments based upon the SBGM. At each consultation the patients were advised about management for T2DM. The intervention period was 24 weeks. Followed up every 6 weeks. Five visits were conducted during the intervention. At each visit, a clinical evaluation was performed (weight, SBP, DBP). Laboratory values took place at 3 visits.. At the third visit the GP could modify the treatments based upon the SBGM. . At each consultation the patients were advised about management of T2DM. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
15	Heisler 2010 USA	Reciprocal peer support	Initial face to face meeting in groups of 4-18 (in two age cohorts to aid cohesion and help patients get an age matched peer partner). Patients received $20 for the initial and 6 monthly assessment. Reciprocal Peer support (RPS) 3 hour group session facilitated by a care manager and research associate. Action planning on laboratory results. Training in peer communication, paired with an age-matched peer for peer support. Encouraged to call each other at least once per week.. Given a DVD on communication skill and a diabetes self management work book. Also offered three 1.5 hour group sessions at months 1,3 and 6- entirely patient-driven to discuss progress on action plans. Facilitation by a care manager or research associate. The care managers went through training- 4 hour course on motivational interviewing.

			Nurse care manager (NCM) was usual care: Attended a 1.5 hour session, led by the NCM, to discuss the results from the initial assessment, review results, ask questions and get information. Their care manager's phone number was given and follow up phone calls and face to face meetings were encouraged. Patients were provided with diabetes self management educational materials. In effect this is enhanced usual care- as many patients are not aware of and do not avail of this. Predominant EPOC intervention type: Patient-centred. Comparison: The comparator was enhanced usual care with nurse care management.
16	Jacobs 2012 USA	A pharmacist assisted medication program intervention	PAMPERED (pharmacist assisted medication program enhancing the regulation of diabetes) study: An initial pharmacist-patient clinic visit at baseline involved obtaining a comprehensive medication review; performing a targeted physical assessment including checking BMI, BP and a foot examination; education on diabetes; ordering laboratory values; reviewing, modifying and monitoring the patient's medication and providing detailed counselling on all therapies; facilitating self-monitoring of blood glucose; and providing reinforcement of dietary guidelines and exercise. These recommendations were based on most recent guidance. Approval by the patient's PCP was required before a treatment recommendation was made. Patients were required to attend a minimum of three visits with the pharmacist; at baseline, 6 months and 12 months for focused preventive and secondary diabetes management. Additional visits arranged as clinically appropriate. Laboratory outcomes checked at baseline, 6 and 12 months. On average 6.5 office visits with a pharmacist occurred over the 12 months. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
17	Jameson 2010 USA	A pharmacist collaborative management intervention	One pharmacist provided the intervention to the entire intervention group. This pharmacist was a board certified pharmacotherapy specialist, had an American Society of Health-System Pharmacists diabetes management traineeship, a postgraduate course in diabetes management from the American Diabetes Association and an educators training program. Patients met the pharmacist at the primary care site for an assessment of medication adherence, barriers to optimizing glucose control and a medication review. Individualized education was provided regarding self-management, lifestyle, medications and monitoring. Guidelines were followed. This included early switching to insulin after failure of 2 oral medications. The PCP approved any changes. After this visit, subsequent visits depended on control. Telephone calls also included. Initial visit. Telephone calls also included. Thereafter conducted as needed- as subsequent visits depended on control. Average 6 office visits and 3 telephone calls per patient over a one-year period. Office visits lasted between 30-60 minutes. Phone calls 10-20 minutes. Predominant EPOC intervention type: Organisational. Comparison: Probably usual care.

18	Jovanovic 2004 USA	Diabetes case management by a nurse or dietician	Case Management: Intensive diabetes case management was provided to the intervention group in addition to primary care. Study staff met with all patients at the beginning and end of the trial to assess overall health status and collect study outcomes. Quarterly assessments of outcomes were performed. The case manager was either a nurse or a dietician (working in close collaboration with an endocrinologist). Evidence based practice in terms of insulin initiation was agreed with collaboration with the PCP. Potential barriers to care were identified and educational strategies designed to address these barriers. American Diabetes Association goals for diabetes, BP and lipid treatment were used. Flexibility to allow individualized targets allowed. All patients educated about self-management and given a monitor. Diabetic educators assessed lifestyle behaviours and gave patients strategies to improve self-care. Transportation issues addressed to improve visit completion. Unclear how many meetings or interaction with a case manager occurred over the 36 months Predominant EPOC intervention type: Organisational. Comparison: Usual care from primary care provider.
19	Keogh 2011 Ireland	Psychological family intervention	Psychological family intervention for poorly controlled Type 2 diabetes. Three weekly sessions delivered by a health psychologist who had received 16 hours of training in motivational interviewing. The first two sessions lasted 45 minutes, taking place in the patient's home, with a family member. The third and final session was a 10-15 minute telephone call. Each session was tailored to the patient's needs involving a/ challenging negative perceptions of diabetes, 2/ examining how negative perceptions influenced self management and 3/ developing ways to improve self management and mobilise family support. Techniques such as exchange information, elicitation of change talk, reducing resistance, building self-efficacy, problem solving and goal setting were used. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
20	Kim 2009 USA	A Community-based, culturally tailored behavioral intervention	Culturally tailored comprehensive T2DM management intervention for Korean American immigrants. A community based self-help intervention program for type 2 diabetes mellitus (SHIP- DM) involving structured psycho-behavioural education, home glucose and BP telemonitoring and individualized telephone counselling from a bilingual nurse. It consisted of three concurrent programs. First, a 2 hourly weekly education session was delivered for 6 weeks. This was delivered at a community site by trained nurses and a nutritionist- to enhance knowledge and promote diabetes self-care behaviours for glucose control.

			Secondly, there was home glucose monitoring and teletransmission- this lasted for 24 weeks after the educational program- each patient received monitors and a teletransimission system. Nurses could view this information. Thirdly, monthly telephone counselling by a bilingual nurse for 24 weeks was provided according to a standardized protocol- to reinforce new knowledge, to discuss problems, find solutions and provide emotional support. These lasted 10-25 minutes. At least 7 (one meeting and monthly telephone contact X 6 months) Predominant EPOC intervention type: Patient-centred. Comparison: Usual care with delayed intervention.
21	Krein 2004 USA	Case management by nurse practitioners	Collaborative case management. All participants in trial given a blood pressure monitor, educational material and a periodical newsletter Two nurse practitioner care managers worked with patients and their primary care providers, monitoring and coordinating care for the intervention group for 18 months, through telephone calls, collaborative goal setting and treatment algorithms. There were two nurse case managers. One nurse was present at each site, providing 20 hours of care per week, to approximately 60 patients each. They had a 2 days training program on collaborative goal setting- and training updates at 6-month intervals. Patient contact was predominantly by telephone, though face-to-face contact could happen. Case managers encouraged self-management, diet exercise, provided reminders of screenings and tests, monitored home glucose and BP measures and identified medication changes as needed. Medications treatment algorithms were given to the case managers. Every change was approved by the PCP- being notified of changes by email. Predominant EPOC intervention type: Organisational. Comparison: Usual care. Patients also received educational materials. All participants in trial were given a blood pressure monitor, educational materials and a periodical newsletter.
22	Long 2012 USA	Two interventions: Peer mentoring Financial incentivisation of patients	Two intervention groups, one control. Received €25 for filling out a survey at Month 0 and Month 6. Also were notified of their starting HbA1c level and of the ADA and VA recommendations. 1/ Peer mentoring: Patients in this group matched to a peer supporter within 1-3 weeks. Peer reviewers were all African American patients with prior poor T2Dm control in the past but well controlled recently. They were matched by sex and age (+/- 10 years). Training: They received a 1-hour long 1:1 training session informed by motivational interviewing techniques. Uncertain who trained the peer mentors. No monitoring of the calls. The mentor-mentee contacts were all telephone calls. Mentors were incentivized with $20 per month if they talked at least once per

			week with their mentee. Mentors were also given $25 after the training session and after an exit interview. Peer mentoring: Aiming to have 4 calls per month for 6 months. The Results showed 38% mentors talked 4 times per month during the first month and by Month 6, that reduced to 16% 2/ Financial incentives In the financial incentive arm, participants were told that they would receive $100 at 6 months if their HbA1c level decreased by 1%, and $200 if it reduced by 2% or to 6.5%. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
23	Maislos 2002 Israel	A mobile clinic providing interdisciplinary care	Interdisciplinary care via a mobile clinic offered by the Western Negev Mobile Clinic Diabetes Program (WNMCDP). WNMCDP is a weekly mobile diabetes clinic aimed to provide interdisciplinary care for patents, in primary care facilities. An initial visit involved a meeting with a diabetologist, the dietician and a nurse educator. After this regular follow visits were scheduled. The team held a weekly evening meeting at the clinic and the nurse and dietician have an additional weekly meeting at the primary care site. At the meeting, all patients received dietary counselling and have a session with the nurse educator. Continuation of treatment and follow up visits are scheduled according to the patient's condition. Special emphasis was placed on education, to improve compliance and lifestyle behaviours. Mobile clinic visited weekly. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
24	Mathers 2012 UK Cluster RCT	Patient decision aid to improve decision quality and glycaemic control	PANDAs study: using patient decision aid (PDA): A complex intervention with three components; PDA, healthcare professional training workshop and use of PDA in a consultation. Development of PDA done with MRC framework- to facilitate decision making between clinicians and patients Doctors and nurses involved with diabetes care in the practice attended a 2-hour training session on how to use the PANDAs decision aid (shared decision making, communication skills, the evidence of different treatment options). The PANDAs decision aid was given to the patient prior to the consultation with the nurse or GP- it included information about insulin or other treatments, presented probabilities of outcomes, it clarified patient values and gave structured guidance. The patient then saw the GP and nurse, facilitated with the use of the PANDAs aid. This was a one off intervention given on 1 day

			Predominant EPOC intervention type: Professional. Comparison: Usual care.
25	McDermott 2015 Australia Cluster RCT	Community-based health-worker led case management approach to the care of Indigenous adults with poorly controlled type 2 diabetes in primary care services in remote northern Australia	Each site allocated to the intervention arm recruited an Indigenous health worker resident in the community (selected by the health service) to work as part of the primary care team, and allocated a caseload of between 9 and 26 clients. The health workers with low caseloads worked part-time. All health workers at the commencement of the study received an intensive 3-week training in clinical aspects of diabetes and other chronic condition care, including how to support patients in self-management skills, advice on medications, routine foot care, nutrition, smoking cessation, follow up referrals to other providers, and scheduled tests. Length: During the 18 month intervention period, the health workers attended two workshops where they underwent refresher training, including in Good Clinical Practice and reflective practice. During these sessions, they reported on their patients' progress and shared approaches to problem solving with the clinical support team and peers. Predominant EPOC intervention type: Organisational Comparison: Usual care.
26	McMahon 2005 USA	Web-based care management	Web based care management involving training and giving a notebook computer, glucose and blood pressure monitoring devices and access to a care management website. The website provided educational modules, accepted uploads from monitoring devices and had an internal messaging system for patients to communicate with the care manager. Given free internet. Training to each participant for mean of 2.3 hours. Home BP monitoring encouraged three times weekly. Glucose monitoring frequency was individualized. Participants could communicate with a care manager through the website. If they did not use the website for two weeks, they were contacted by phone. An advanced practice nurse reviewed patient information and provided recommendation to the PCP about treatment changes, based upon guidelines. Episodes: Unclear, one training session and then self-usage of web management (patients contacted if they didn't use after 2 weeks). 1 year. Predominant EPOC intervention type: Organisational. Comparison: Usual care. All participants attended a self-management educational session (prior to randomization).
27	Mons 2013 Germany	Supportive telephone counseling	Supportive telephone counseling intervention led by practice nurses of the participating GP practices- monthly over 12 months. Each nurse was trained before hand. Each call lasted 10 minutes, was structured and included questions on patients' physical and mental condition, medication adherence, symptoms, and lifestyle advice. The items were designed to motivate the patients, identify barriers and help self-management. Monthly over 12 months. Over 90% had 10-12 sessions. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.

28	O'Connor 2014 USA Cluster RCT	Telephone Outreach to Improve Medication Adherence and Metabolic Control in Adults With Diabetes	The telephone intervention was delivered by interventionists who were pharmacists, diabetes educators, or nurse health managers trained in the use of the study protocol and intervention. Those randomized to the intervention, who had recently been prescribed a new medication for poorly controlled T2DM, received a single structured telephone call to ascertain if the patient had started the medication. Positive reinforcement was made to those who had started. For those who had not started, the interventionist probed for reasons of non-adherence and resolved to solve any barriers. Length: One phone-call lasting < 5 minutes. Most calls occurred within 2-6 weeks after prescription date. Predominant EPOC intervention type: Organisational Comparison: Usual care.
29	Odegard 2005 USA	A pharmacist intervention care management intervention	Pharmacist intervention was composed of a diabetes care plan (DCP), a regular pharmacist-patient communication on diabetes care progress and pharmacist-provider communication on the subject's diabetes care progress. Medication related problems were identified. The intervention commenced one week after baseline data interview. A face-to-face appointment created this DCP which was communicated to the PCP. Weekly face-to-face or telephone communication was kept with the patient and the pharmacist- then reduced to monthly when deemed necessary over a 6-month period. On average there were 4.5 telephone contacts and 2.1 in person visits. Predominant EPOC intervention type: Organisational. Comparison: Usual care.
30	Palmas 2014 USA	Community health worker (CHW) intervention in an Hispanic population	12-month CHW intervention or enhanced usual care Two full time CHWs delivered a multicomponent intervention that included one-to-one visits, group visits and telephone follow up. They used the Small Steps, Big Rewards framework. Goal setting and discussing barriers were features of the visits. A needs assessment was performed throughout the year. Episodes of care: Aimed for 4 1:1 visits, 10 groups sessions and 20 follow up phone calls over the year per subject. Predominant EPOC intervention type: Patient-centred. Comparison: 'Enhanced usual care'. Spanish-language educational material posted every three months, preceded by phone calls, to ensure participants received the brochures.
31	Phillis-Tsimikas	Peer-led diabetes education programs in high-risk Mexican	Assessments at month 0, 4 (post intervention) and 10- intervention participants were given a glucometer and a small gift card. The Project Dulce (intervention) group received eight weekly 2 hour diabetes self management classes for two months; and then monthly support groups, leach 2 hours in length, led by a trained peer educator. Before the intervention those individuals, living in this community, with diabetes, that had traits of being a good leader were identified

	2011 USA	Americans	and trained over a 3 month period. Peer educators spent 40 hours learning the curriculum, behavior modification techniques etc. Then they co-taught a session with a trainer, before being supervised giving a session before doing it alone. The curriculum covered many aspect of diabetes management. If patients were noticed not be meeting targets for diabetes care, the peer educator would direct them to the PCP- they would not make any medication related changes themselves. Episodes of care: Unclear how many, but envisaged as 8 weekly classes for two months, then monthly for the next three months. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
32	Polonsky 2011 USA Cluster RCT	Self blood glucose monitoring	STeP (Structured Testing Programme) is a 12-month Cluster RCT assessing efficacy of structured self-monitoring of blood glucose (SMBG) in T2DM patients (none on insulin). Both physicians and patients participated in a collaborative programme to gather, interpret and act upon the structured SMBG data, at 3 monthly intervals, to make treatment modifications. The study's duration was 12 months with patient visits occurring at initial screening and baseline followed by visits at months 1, 3, 6, 9, and 12. At all subsequent visits (months 1, 3, 6, 9, and 12), ACG and STG clinic staff collected laboratory samples, recorded changes in medications, and performed brief physical examinations. Point-of-care A1C equipment (A1CNow+ test kit; Bayer Healthcare, Tarrytown, NY) was provided to all practices for clinical use only to assure that differential availability of the equipment did not affect outcomes. Patients in both groups brought their meters to each subsequent visit for electronic data uploading; physicians and clinic staff were blinded to these data and all other study-collected measures. Patients also reported all changes made to their diabetes regimen since their last visit. All patients completed the STeP questionnaire and a post-visit questionnaire to record physician discussion of SMBG results and recommendations for pharmacologic and lifestyle changes that occurred during the visit. Predominant EPOC intervention type: Patient-centred. Comparison: 'Enhanced usual care': quarterly diabetes focused physician visits, free blood glucose meters and strips and they were evaluated at months 1, 3, 6, 9 and 12 (like the intervention group).
33	Protheroe 2016 UK	Lay Health Trainer (LHT) interviews with patients, creating a self-management plan, with supportive phone calls	A structured interview with a Lay Health Trainer (LHT) and development of an individualised patient self-management plan and follow up thereafter with phone calls. The LHTs were trained on diabetes care and lifestyle advice, but they did not provide medical or nursing advice. They provided information to participants regarding advantages and disadvantages of behaviour change. Length: The intervention lasted 6 months. An initial structured interview was followed by up to three two-monthly support phone calls from the LHT for a maximum of 6 months. Predominant EPOC intervention type: Organisational

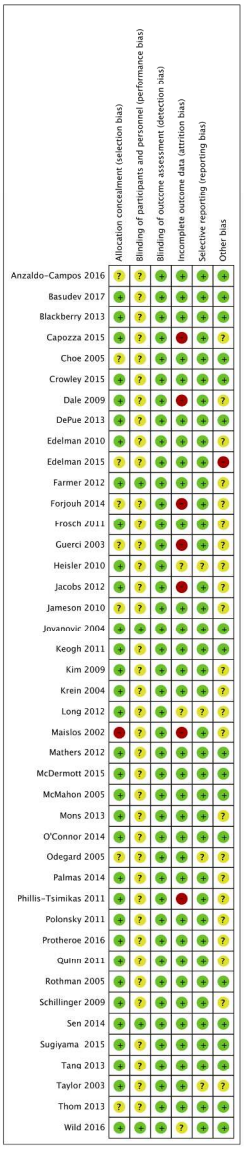
			Comparison: Usual general practice care
34	Quinn 2011 USA Cluster RCT	Mobile phone-based treatment/ behavioural coaching intervention	Mobile phone-based treatment/ behavioural coaching intervention 26 primary care practices, randomly assigned to one of four groups: 1/ Coach-only (CO) group- included a mobile diabetes management software application and a web portal. The mobile software allowed patients to enter diabetes self-care data (glucose, diet, mediations) on a mobile phone and receive automated, real-time educational, behavioural and motivational messaging specific to the entered data. 2/ Coach PCP portal (CPP)- The patient web portal augmented the mobile software and had a secure messaging centre with additional information. 3/ Coach PCP portal with decision support (CPDS): This group had providers with access to analysed patient data that could make decisions linked to standards of care. All patients received a glucometer and mobile phone with 1 year unlimited free data and service plan. Diabetes educators intermittently reviewed the patient data. Patients could communicate by phone or electronically to educators. Patients also received an electronic action plan every 2.5 months. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
35	Rothman 2005 USA	A primary care-based disease management program delivered by trained pharmacists.	Pharmacist intervention: Three pharmacists (trained in the outpatient department) delivered the intervention within the general medicine practice - two of them were diabetic educators. The intervention included intensive educational sessions, evidence-based algorithms, proactive management of clinical parameters and treatment recommendations that were shared with the PCP. A diabetes care coordinator was also part of the intervention and this person addressed health behaviour and education- this coordinator rang patients regularly. Pharmacists rang the patient or met them every 2-4 weeks, or more frequently if needed. Unclear if there was a face to face meeting (probably was in the General Medicine Practice. A coordinator also rang patients from time to time. A median of 45 contacts or care-related activities between pharmacists and patients were recorded; about 38 minutes each month. Predominant EPOC intervention type: Organisational. Comparison: Usual care after a 1-hour management session that was conducted by a clinical pharmacist practitioner from the disease management team, including education and treatment recommendations approved by the PCP.
36	Schillinger	Two interventions:	Two interventions in the Improving Diabetes Efforts Across Language and Literacy (IDEALL) Project:

	2009 USA	Self-Management Support via 1/ Automated telephone self-management support (ATSM) and 2/ Group medical visits (GMVs).	Two self management support (SMS) systems, conducted in a safety net health system were tested against a control; a) Automated telephone self management support (ATSM) and b) Group medical visits (GMVs). ATSM and GVCs attempt to activate patients, routed in efficacy theory. ATSM: ATSM patients received automated (pre-recorded) telephone calls over 39 weeks (9 months). Patient responses triggered immediate automated education messages and/ or a subsequent nurse phone follow-up. Each call took 5-10 minutes. The mean number automated calls completed over 9 months was 21.9 (envisaged to be 39); mean number of call backs was 9.2. GVC: The GVC group received 90-minute monthly sessions over 9 months, with 6-10 participants, co-facilitated by a primary care physician and health educator. Participants in this group received bus tokens and snacks. Mean number of GMVs attended was 4.8 out of 9. There was no specific expectation regarding co-management with the primary care physician. In both interventions action plans regarding self management were generated (information in other papers). All participants received €15 and €25 dollars for the baseline and one year follow up assessment. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
37	Sen 2014 USA	Financial incentives for home based monitoring- two interventions	Two intervention groups received financial incentives for home-based health monitoring. All three groups received three biometric devices, a self monitoring glucose device, a digital BP monitor and a device to automatically transmit readings from the biometric devices to the study website. All patients were instructed to use the biometric devices daily. In the intervention arms, participants who used all three devices on a given day were entered into a lottery to win something on the following day. In the daily lottery process, numbers between 0-99 were picked by the participant. In the high incentive intervention the average daily reward was €2.80; a two digit match (1: 100 chance) yielded a €100 award and a one digit match (1: 5 chance) yielded a €10 award. In the low incentive intervention, rewards were €50 and €5 respectively, expecting an average daily reward of €1.40. Each day all incentive arm participants were reminded by text message or email informing them of the lottery numbers. A study coordinator met with all participants at 3 and 6 months- participants were paid €25 for each visit. Episodes of care: daily Predominant EPOC intervention type: Financial Comparison: 'Daily home monitoring control group' received biometric devices.

38	Sugiyama 2015 USA	Diabetes self-management education by trained health educators.	Called the Diabetes Self-Care Study, the intervention involved community-based diabetes self-management education (DSME). All study participants were given glucose meters and testing strips, and received a 2-hour training on self-monitoring of blood glucose by a certified diabetes educator. Health educators, who delivered the education, completed a one-year training program and received 8 hours of curricula delivered by the study team about diabetes and its clinical presentations and complications. Additionally, they received 12 hours of training and implementation of the empowerment sessions. Length: Participants in the intervention group received six weekly two-hour group self-care sessions consisting of 8 to 10 persons per group, conducted in English or Spanish, and facilitated by health educators. In the group session, participants identified self-management challenges and discussed why each activity was challenging and how to solve it. Each participant also had a one-on-one session with the health educator to review his or her baseline and follow-up laboratory and biometric data during one of the group sessions. There was also a $10 gift card for each assessment. Predominant EPOC intervention type: Patient Comparison: Usual care.
39	Tang 2013 USA	Online disease management of diabetes	Online disease management of diabetes: Engaging and Motivating Patients online with Enhanced Resources- Diabetes (EMPOWER-D): A personalized healthcare program (PHCP) comprising nurse care managers authorized to change medications, multi-disciplinary team based care, patient self-management tools and an online communication channel between patients and their healthcare team. This intervention comprised: 1/ Wireless glucometer uploading of information to the electronic health record 2/ A diabetes summary sheet with a personalized action plan and treatment goals, including displaying the risk of a variety of diabetes related complications, medication information and monitoring information. 3/ A nutrition log 4/ Insulin record 5/ Exercise log 6/ Online communication/ messaging system 7/ Nurse care managers who provide advice and can make medication changes. 8/ Patient specific text and video educational material. On top of this, participants in the intervention group had 3 in-persons visits, firstly a 90 minute group visit introducing the online tools, a 90 minute 1:1 meeting with a nurse care manager to develop a shared care plan and 3/ a 60 minute visit with a registered dietician. Also a pharmacist reviewed all intervention group medications and made recommendations- they were also consulted throughout the trial. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.

40	Taylor 2003 USA	Nurse care management (NCM)	Nurse care management (NCM): Initial 90 minute meeting with a registered nurse to review patient medications, lifestyle and psychosocial status. Self-management plan was developed. Then a weekly group class (1-2 hours with 4-10 per class) was scheduled for 4 weeks; including group discussion and problem solving. This was followed with telephone follow-up calls at week 4,5,8,12,16,20,28,36 and 44 (9 in total) from the nurse, averaging 15 minutes each. The nurse care managers gave advice as per agreed protocols. The PCP was called if a change in medication was recommended. The NCMs underwent specific training. Episodes of care: 5 visits and 9 telephone calls Predominant EPOC intervention type: Organisational. Comparison: Some educational materials, otherwise usual care.
41	Thom 2013 USA	Peer health coaching	Potential peer coaches attended 36 hours of training over 8 weeks using a curriculum developed by the study team- learning active listening, non-judgmental communication, helping with diabetes self-management skills, provision of support, assisting with lifestyle change, facilitating medication adherence and understanding and navigation of the health system. There was a written and oral assessment for these persons- those who passed became peer coaches. The peer coach- patient interaction was at the discretion of the patient and peer coach, either in person or by telephone contact, either outside or inside the clinic. The goal was for two telephone contacts every month and two or more in-person contacts over 6 months. They helped devise action plans for the patients. Peer coaches received €125 for training and €25 per client coached each month. Predominant EPOC intervention type: Patient-centred. Comparison: Usual care.
42	Wild 2016 UK	Supported telemonitoring involving twice-weekly self-measurement of glucose and transmission to a general practitioner	The Telescot Diabetes Trial: Supervised, self-monitoring of glycaemic control, BP, and weight and telemetric transmission of measurements to the general practice team. A research nurse took all the baseline measures. Participants were given advice on lifestyle modification and how to contact the General Practice team. Length. The intervention lasted 9 months with the practice nurses checking patients' results weekly and oragnising changes in accordance with national guidelines. Predominant EPOC intervention type: Patient-centred Comparison: Usual general practice care

Appendix 4:
Risk of bias summary



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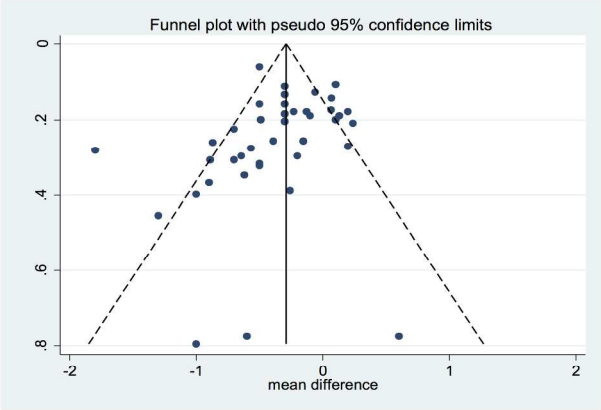
Appendix 5: Overall quality assessment and predominant EPOC intervention type

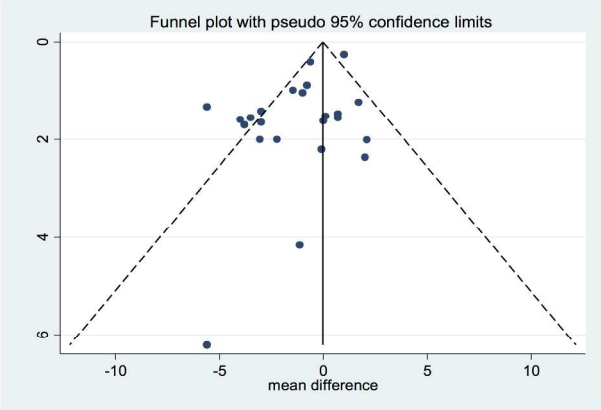
Study	Study_ID	Year	Predominant EPOC intervention type	Overall quality assessment
1	Anzaldo-Campos	2016	Patient	Low-risk
2	Basudev	2016	Organisational	Low-risk
3	Blackberry	2009	Patient	Low-risk
4	Capozza	2015	Patient	Unclear-risk
5	Choe	2012	Organisational	Unclear-risk
6	Crowley	2015	Organisational	Low-risk
7	Dale	2003	Patient	Unclear-risk
8	DePue	2011	Organisational	Low-risk
9	Edelman	2012	Organisational	Low-risk
10	Edelman15	2015	Organisational	Unclear-risk
11	Farmer	2013	Organisational	Low-risk
12	Forjouh	2013	Patient	High-risk
13	Frosch	2005	Patient	Low-risk
14	Guerci	2013	Patient	High-risk
15	Heisler	2010	Patient	Unclear-risk
16	Jacobs	2014	Organisational	High-risk
17	Jameson	2011	Organisational	Unclear-risk
18	Jovanovic	2010	Organisational	Low-risk
19	Keogh	2012	Organisational	Low-risk
20	Kim	2010	Patient	Low-risk
21	Krein	2004	Organisational	Low-risk
22	Long	2009	Patient	Unclear-risk
23	Maislos	2004	Organisational	High-risk
24	Mathers	2012	Professional	Low-risk
25	McDermott	2015	Organisational	Low-risk
26	McMahon	2004	Organisational	Low-risk
27	Mons	2005	Patient	Low-risk
28	O'Connor	2014	Organisational	Low-risk
29	Odegard	2005	Organisational	Unclear-risk
30	Palmas	2014	Patient	Low-risk
31	Phillis-Tsimikas	2011	Patient	Unclear-risk
32	Polonsky	2011	Patient	Unclear-risk
33	Protheroe	2016	Organisational	Unclear-risk
34	Quinn	2011	Patient	Low-risk
35	Rothman	2005	Organisational	Low-risk
36	Schillinger	2009	Patient	Low-risk
37	Sen	2014	Financial	Low-risk
38	Sugiyama	2015	Patient	Low-risk
39	Tang	2013	Patient	Low-risk
40	Taylor	2003	Organisational	Unclear-risk
41	Thom	2013	Patient	Unclear-risk
41	Wild	2016	Patient	Low-risk

Appendix 6a:

Funnel plot of studies included in the HbA1c analysis



Funnel plot of studies included in the DBP analysis



1

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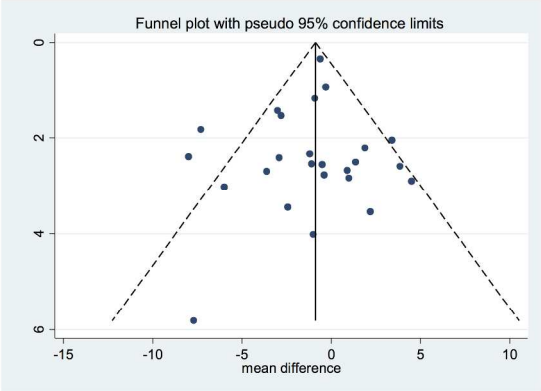
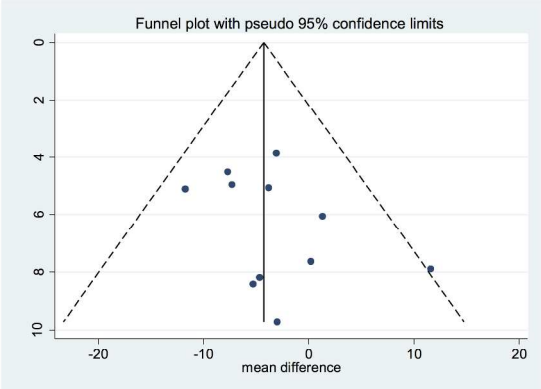
Appendix 6b:

Funnel plot of studies included in the SBP analysis



Funnel plot of studies included in the lipid analysis



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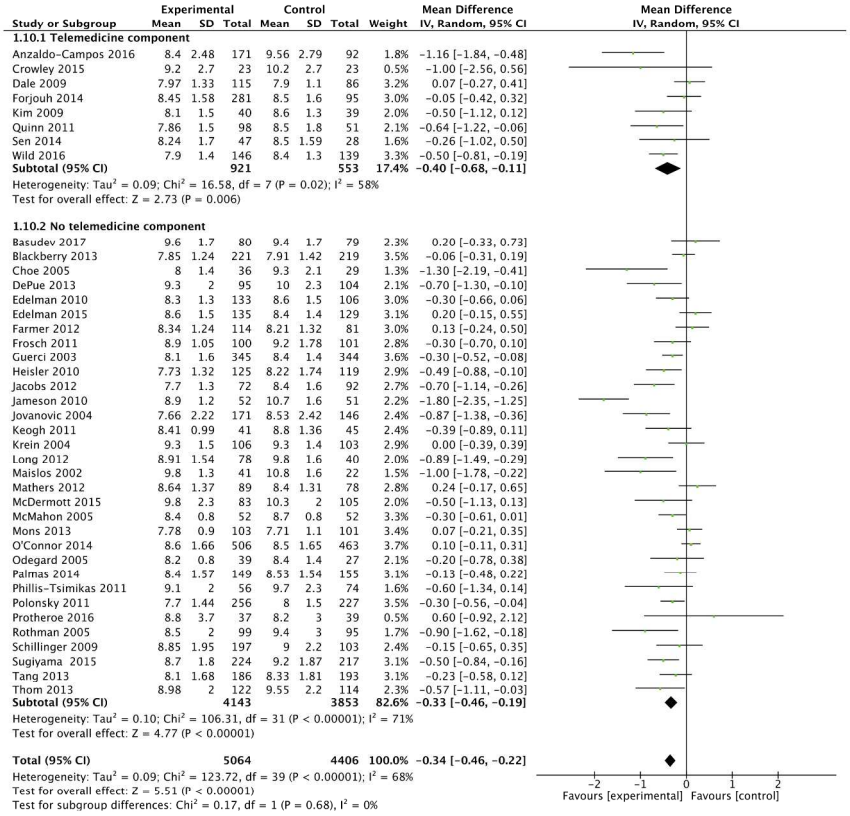
Appendix 7: Effects of interventions on HbA1c, with TeleHealth subgroups



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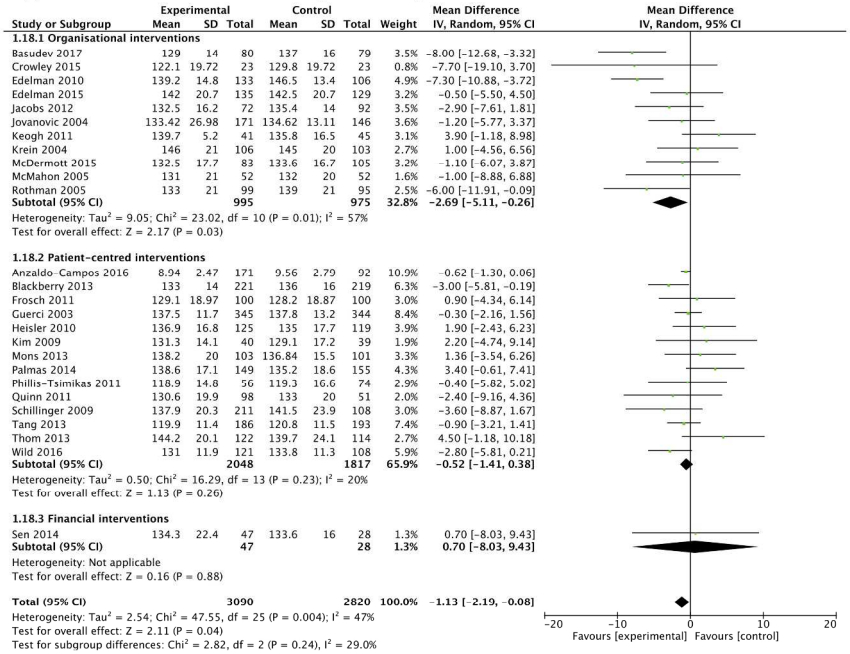
Appendix 8: Effects of interventions on systolic blood pressure



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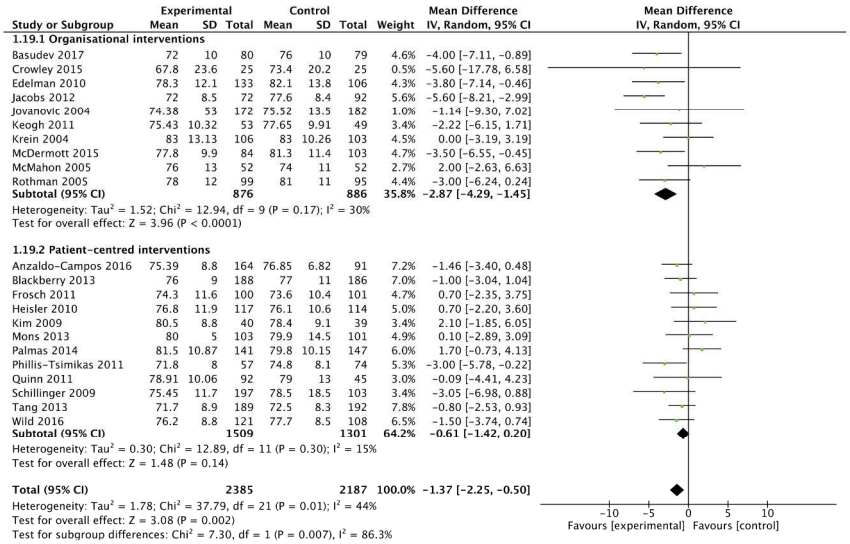
Appendix 9: Effects of interventions on diastolic blood pressure



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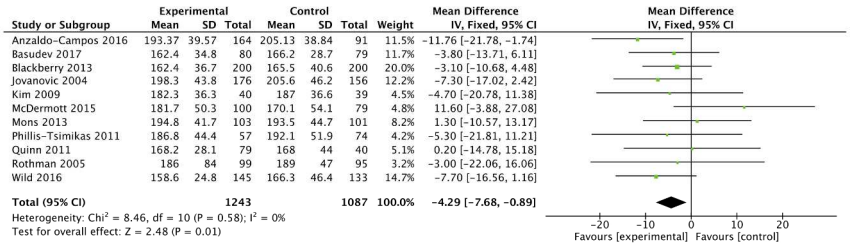
Appendix 10: Effects of interventions on Total Cholesterol



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Appendix 11: Secondary outcomes measured and results

Number	Study	Mental health outcomes	Pyschosocial outcomes	Adherence outcomes	Other physical outcomes	Healthcare utilisation outcomes	Medication related outcomes
1	Anzaoldo-Campos	Depression (PHQ-9): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was -1.83 favouring the PD group to control and -1.84 for PD-TE group to control.	Self efficacy (Spanish Self-Efficacy): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was -2.42 favouring the PD group to control and -0.54 for PD-TE group compared to control. Lifestyle (IMEVID): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was 2.3 favouring the PD group to control and 2.7 favouring the PD-TE group to control. Quality of life (Diabetes 39): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was -8.88 favouring the PD group to control and -4.87 favouring the PD-TE group to control. Diabetes knowledge (DKQ24): Unclear of MD between two intervention groups (PD or PD-TE groups) and control group. Unadjusted MD was 2.05 favouring the PD group to control and 2.09 favouring the		Triacylglyceride: Unclear of MD between two intervention groups (PD or PD-TE groups) and control group.. Unadjusted MD was -21.46 favouring the PD group to control and –4.55 for PD-TE group compared to control. BMI: Unclear of MD between two intervention groups (PD or PD-TE groups) and control group.. Unadjusted MD was +0.33 comparing the PD group to control and +0.31 for PD-TE group compared to control.		Significantly higher insulin use in PD and PD-TE groups

			PD-TE group to control.				
2	Basudev				Weight MD 0 (p = NS) eGFR -3.9 (p = 0.1)	Care destination: NS change Frequency of contact: NS change	Medication change: 54% of intervention group had a change in glycaemic medication versus 46% in the control group (p=0.04). No other significant change in medications. Medication optimization: NS change
3	Blackberry	Major depression 1.09 (0.49 to 2.46) p= 0.83	Quality of life 0.02 (CI -0.01 to 0.05) p =0.16 Diabetes self efficacy -0.06 (CI -2.22 to 2.10) p 0.96 Diabetes support -0.09 (CI -0.01 to 0.18) p 0.08				
4	Capozza		Patient interaction and satisfaction (CSQ8) with the program by means of survey-intervention patients all scoring over 3 on a four point satisfaction scale. No clear comparison with usual care.				
5	Choe					Process measures: (% before, % after, p value) Rate of HbA1c measurement: 82.9% 92.3% 0.21 Dilated retinal examination: 74.3% 97.3% p= 0.004 Urine ACR or use of ACE Inhibitors: 85.7% 94.9% p= 0.18	

						Monofilament testing for diabetic neuropathy by chart review over 24 months: 62.9% 92.3% p= 0.002	
6	Crowley	Depression (PHQ-9): mean difference was not significant.	Diabetes self-management (Self-care inventory revised) SCI-R: mean difference was +7.0 (p=0.047) in favour of intervention	Self reported medication adherence (Morisky medication adherence scale 4): nonsignificant difference		Adverse events similar in both groups	
7	Dale		Diabetes distress (PAID) adjusted score showed no significant difference for two intervention groups versus control. Self efficacy (DMSES) adjusted score showed no significant difference for two intervention groups versus control. PS-CG, +4.17, p=0.28 DSN-CG, +0.38, p=0.94. Self efficacy (DMSES) improved for the patients in the peer support group but there were no significant differences between groups; diabetes related problems (PAID) reduced for those in the diabetes nurse specialists group. In all groups the HbA1c improved, but there were no significant differences between groups		Normal ACR: 1.05 (0.62 to 1.75) p= 0.87 Normal eGFR: 0.92 (0.55 to 1.53) p 0.76 Current smoker 0.043 (0.55 to 1.53) p 0.72 Healthy weight (BMI<25) 2.19 (1.1 to 4.38) p=0.03 Weight 0.12 (-1.53 to 1.77) p=0.89 Waist circumference Men 0.90 (-1.40 to 3.19) p=0.44 Waist circumference Women -1.52 (-4.08 to 1.04) p=0.24		
8	DePue		Mean perceived competence score significant difference 1.6 (CI: 0.9 to 2.4) p< 0.001	Adherence: self reported medication adherence			

			Physical activity Adapted measures of diabetes beliefs; no data reported.	Nonsignificant difference.			
9	Edelman 2010		Self-efficacy using the Perceived Competence Scale Nonsignificant difference	Adherence to medications ??? Morisky self-reported medication adherence scale Nonsignificant difference	BMI nonsignificant differences	Adverse events through structured self report and medical record review Health utilization Cost data	
10	Edelman 2015		Self-effiacacy- but no report in Results section Health literacy- but no report in Results section.	Medication adherence (via self report) - but no report in Results section.	No significant differences weight or physical activity.	45.2% of intrevention group had GP management plan for diabetes V's 35.5% of controls (non-significant)	
11	Farmer		Functional status as per SF 12 Physical and SF 12 Mental Diabetes treatment satisfaction and satisfaction with nurse <u>SF 12 Physical</u> 46.3 (9.0) V's 44.6 (11.1) MD -0.7 (CI -2.7, 1.4) p = 0.52 <u>SF 12 Mental</u> 49.5 (10.4) V's 52.6 (8.8) MD -1.6 (CI -3.9, 0.6) p = 0.15	MARS Self reported adherence (range 5-25) with a higher score indicating higher levels of adherence Nonsignificant difference	BMI dietary nonsignificant difference.	% reporting hypoglycaemia nonsignificant difference Treatment satisfaction nonsignificant difference	Primary outcome % days over a 12 week period on which the correct number of doses of main glucose lowering medication was taken each day as prescribed. 77.4% (26.3) & days taking correct dose V's 69% = 8.4% MD (P = 0.044)
12	Forjouh		Self care data not given				
13	Frosch		Diabetes knowledge: (23 point Diabetes knowledge test) - nonsignificant difference. Self-care behaviours (SDSCA) - nonsignificant difference				Prescribed medications measured: taking most prescribed medications (*P* = .01; interaction, *P* = .41), and taking all prescribed medications (*P* .001; interaction, *P*=.75).

			Diabetes knowledge and behavioural outcomes by group over time: Exercise was statistically significantly reduced				Nonsignificant difference.
14	Guerci					Symptomatic hyoglycaemia Any hypoglycaemia: 53 (10.4%) in SMBG and 25 (5.2%) in control p= 0.003	Medications nonsignificant difference
15	Heisler		Diabetes social support score - nonsignificant difference Diabetes distress Diabetes QoL -nonsignificant difference	Medication adherence nonsignificant difference Medication intensification: Significant increase in insulin and oral diabetic medication prescribing .	BMI nonsignificant difference		Medication intensification: Significant increase in insulin and oral diabetic medication prescribing .
16	Jacobs				Weight and diet nonsignificant difference	Intervention group had more screening parameters performed (retinal screening, nephropathy and neuropathy)	Medication sse; intervention group had higher use of antiplatelet, diabetic and statin medications.
17	Jameson						Intervention group- 28.8% commenced basal bolus insulin V's 1 (2%) patient in the control group.
18	Jovanovic				HbA1c < 7% 35% V's 21% (but p = 0105)		Medication usage Increase in oral agents in intervention group, without any increase in numbers on insulin. Control group- no change.
19	Keogh		The intervention group reported better personal control, a better understanding of diabetes and an increased belief in treatment effectiveness. They also had fewer symptoms and lower levels of diabetes concern and		Statistically more patients in intervention group achieved at least 1.0% improvement in HbA1c.		

			distress. They also had better psychological well being, adherence to lifestyle factors, self efficacy and family support. Illness perceptions (Brief illness Perception Questionnaire)- statistically significant improvement Psychological wellbeing (12-item Well-Being questionnaire)- statistically significant improvement Diabetes self management (Summary of Diabetes Self-care Activities Questionnaire) Self Efficacy (UK version Diabetes Self-Efficacy Scale)- statistically significant improvement Family support (Diabetes Family Behaviour Checklist)- statistically significant improvement				
20	Kim	Depression (Kim Depression Scale for Korean Americans) nonsignificant difference Quality of Life (Diabetes Quality of Life Measure (DQOL) nonsignificant difference	Diabetes knowledge test (DKT) statistically significant difference Self efficacy (Stanford Chronic Disease Self-Efficacy scale) statistically significant difference Self care (Diabetes self care activitiis (SDSCA) statistically significant difference		% participants achieving HbA1c goals % participants achieving HbA1c goals &achieving HbA1c less 6.5, 7 and 7.5 greater in intervention group (Fig 3). statistically significant. But data not shown. BMI- nonsignificant		

					difference		
21	Krein		General satisfaction score and rating of diabetes provider score was marginally better and statistically better in the intervention group.		BMI nonsignificant difference		
22	Long				BMI nonsignificant difference	Uptake of intervention Peer mentoring: Aiming to have 4 calls per month for 6 months. The Results showed 38% mentors talked 4 times per month and by Month 6, that reduced to 16%.	No difference in hypoglycaemia
23	Maisios					Adherence to follow up: 41/48 and 23/34 patients returned for follow up. 29% intervention group non-compliant.	Use of insulin nonsignificant difference INT: 25% to 40% CONTROL: 15 to 17%
24	Mathers		Decisional conflict: Mean difference between intervention and control groups on the total score for decisional conflict on the total score was -7.72 (CI -12.5, -2.97) Realistic expectations: Were better in intervention group Preferred option: - Proportion undecided: No significant difference Participation in decision-making: Statistically significant difference, intervention group had higher participation rates.				

			Regret score. No significant difference. Acceptability: Most found PDA useful.				
25	McDermott		Test of Functional Health Literacy for Adults (TOFHLA)- unclear if significant result present Assessment of Quality of Life (AQoL) instrument- unclear if significant result present	Waitlist patients had better self-report adherence Adherence: SS reduction	Slight non-significant reductions in rest of other physical outcomes (BMI, ACR, eGFR)	Intervention group patients statistically significantly more likely to have seen a dietician and dentist, be taking inculin and have influenza vaccination.	
26	McMahon					Frequency of data uploads on web-based care management system (used to look at effect on HbA1c primary outcome)	
27	Mons	Symptoms of depression: Geriatric depression scale GDS: No difference between groups.	Health related quality of life (Short Form General Health Survey: SF-12) No difference between groups at 12 months. Statistically significant change at 18 months.				
28	O'Connor			No significant difference between groups regarding medication adherence (one prescription fill within 60 days of prescription date)- 88% in intervention group vs 86% in control group. Similarly there was no significant difference			Medication persistance (two or more prescription fills within 180 days)

				between groups regarding medication persistance (two or more prescription fills within 180 days)			
29	Odegard			No improvement on self reported adherence.			No significant difference in MAI (medication appropriateness) at end of study.
30	Palmas						
31	Phillis-Tsimikas	Self management behaviours and Depression (in separate publication) - not published at time of search so not included	Self management behaviours and Depression (in separate publication)- not published at time of search so not included				
32	Polonsky		GWB WHO-5 - nonsignificant difference			Treatment intensification Changes in treatment: 75.5% of STG patients received a medication change at month 1 V's 28% of ACG patients (p <0.0001). Twice as many STB patients started on insulin between month 1 and 12. Heightened attention paid to subjects. Free meters: Requirement to bring meters to all study visits More frequent study visits STG physicians trained on a treatment algorithm SMBG: Lower test use in	

						STG group (0.77) V's ACG group 1.05 (nonsignificant difference)	
33	Protheroe	Warwick- Edinburgh Mental Well-Being: Adjusted MD was -0.17 (p=0.87) Health Status Measure (from Sf12) Adjusted MD for mental health score was 5.46 (p=0.049)	Diabetes self care (Summary of Diabetes Self-Care Activities Measure) : Adjusted MD was 0.33 (p=0.2) Diabetes Quality of Life (Diabetes Quality of Life Inventory) : Adjusted MD was -4.24 (p=0.46) Diabetes UK Scale Items: Adjusted MD was 0.4 (p=0.22) Health-related Quality of Life (EQ5D) : Adjusted MD was 0.1 (p=0.135) Illness Perception (Brief Illness Perception Score) : Adjusted MD was -5.74 (p=0.04)			No significant difference in resource use (inpatient nights, Emergency Department visits, Outpatient visits, GP visits or practice nurse visits)	
34	Quinn	PHQ-9 depression - nonsignificant difference	Diabetes distress scale - nonsignificant difference Diabetes diabetes inventory - nonsignificant difference		BMI unclear if statistically significant	Hypoglycaemic events and hospitalizations were infrequent in all groups.	
35	Rothman		Diabetes knowledge Satisfaction: (Diabetes Treatment Satisfaction Questionnaire) MD in scores (INT V's control) Diabetes knowledge: +14 (CI 9 to 20) Diabetes treatment satisfaction +3 (CI 1 to 6) statistically significant reduction			Process measures (time spent with patients) and medication changes. But did not factor in any changes made by PCP. Aspirin use higher in intervention group at 12 months. Statin use equal. No statistically significant increase in services in intervention group.	
36	Schillinger		SF-12 instrument for QoL			Functional outcomes:	

			nonsignificant difference Patient assessment of chronic illness care (PACIC) score out of 100 Statistically significant difference ATSM +12.2 V's control GVC +12.6 V's control Data present Diabetes Quality Improvement Program (100 score) Self management behavior statistically significant difference ATSM +0.6 V's control GVC +0.3 V's control Data present Diabetes self efficacy statistically significant difference ATSM +6.0 V's control GVC +5.5 V's control Data present			Bed days: ATSM significant reduction Restricted activity, ATSM significant improvement **Interpersonal Processes of Care** for Diverse Populations (IPC) instrument to capture reports of provider's communication. Statistically significant difference ATSM +9.0 V's control	
37	Sen					Primary outcome was adherence to biometric tests: At three months; total adherence rates were 81% in the low incentive arm V's 58% in control (p 0.007) and 77% in high incentive arm V's 58% (p0.02). No difference between the incentive arms. But no difference in the high incentive group V's	

						control at month 6 (at 3 month post intervention follow up).. But the low incentive group still had significant improvement in adherence at month 6 Vs control (62% V's 27%, p 0.002).	
38	Sugiyama	Change Mental Component Summary Score (MCS-12) from the SF-12: A mean difference of +1.6 between intervention and control which was statistically significant	Secondary outcomes: Social support score from the Diabetes Care Profile: non-significant change				
39	Tang		Satisfaction/ Psychosocial wellbeing Intervention group had higher treatment satisfaction (statistically significant) and lower treatment distress scores. Other scales of diabetes distress had no change between groups.		BMI nonsignificant difference	Healthcare utilsiation - nonsignificant difference in total physician visits.	Significant increase in new medications started and insulin commencement in intervention group. Patients already on insulin- the intervention group had a statistically significant higher number of dose increases.
40	Taylor		Psychosocial (SF 26 for QoL and Duke Activity Status): Nonsignificant difference in psychological variables Patient and physician satisfaction nonsignificant difference			Medical utilization (physician visits) nonsignificant difference in physician or ED visits	
41	Thom				10-year framingham risk nonsignificant difference		

42	Wild	EQ-5D index: Adjusted MD was 0.00 (non-significant) Total HADS score: Adjusted MD was -0.31 (non-significant)	Self-efficacy: Adjusted MD was +0.69 (non-significant) Self-reported total physical activity score (IPAQ): Adjusted MD was -467.31 (non-significant) Diabetes Knowledge (first 14 items only): Adjusted MD was +0.04 (non-significant)	Medication adherence	Weight: adjusted MD supporting telemonitoring group -0.35 (p = 0.6) No significant differences in alcohol use, smoking, or urinary sodium/ creatinine ratio.	Greater number of telephone calls in intervention group (rate ratio 7.5 p<0.0001)	No significant change in use of insulin or other medications (from Supplementary File 1). No change in forgetfulness taking medications or carelessness taking medications.

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	7
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	8
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	8, 9
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	8
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	8
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	9, 10
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	9, 10
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	10
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	10, 11
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	10, 11

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	10
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	10, 11
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	12
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	12, 13
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	13
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	13, 14, 15
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	13, 14, 15
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	13
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	15
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	16
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	16, 17
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	19
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	4

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097