

Online Appendix 2. Characteristics of included studies

Authors Year	Setting/ Country	No. of patients (n)a Lost to follow-up (n)Age in years (mean (SD)) Gender (%)	Follow-up duration	Pharmacist intervention	Control	Outcome measures
Adams et al. 2015 (20)	Primary care medical practices/ United Kingdom	No. of patients (IG/CG): 67/66 Lost to follow-up (IG/CG): 9/2 Age (IG/CG): 69.18 (10.46)/68.31 (9.46) Gender (IG/CG): 68.0%/58.5% male	6 months	Medication review; creation of an individualized pharmaceutical care plan with any problem identified forwarded to specialist diabetes nurse or medical practitioner; and face-to-face consultation with patients	Usual care	HbA _{1c} , SBP, DBP, TC, medication adherence, HRQoL, SIMS, beliefs about medicines, satisfaction with diabetes treatment
Adepu and Ari 2010 (21)	Medicine outpatient department at tertiary care teaching hospital/ India	No. of patients: 240 Lost to follow-up: 13 Age: 57 Gender: 50,7% male	3 months	Education regarding disease, medication and lifestyle modification	Education at the end of the study	CBG, medication adherence, KAP regarding diabetes
Adibe et al. 2013 (22)	Tertiary hospitals/ Nigeria	No. of patients (IG/CG): 110/110 Lost to follow-up (IG/CG): 11/17 Age (IG/CG): 52.4 (7.6)/52.8 (8.2) Gender (IG/CG): 40.0%/44.6% male	12 months	Pharmaceutical care including education on diabetes, self-monitoring, medication and lifestyle modification, counseling and effective interaction with health providers	Usual care offered by the hospitals	HRQoL, cost-utility analysis (59)
Aguiar et al. 2016 (23)	Secondary care clinic at university hospital/ Brazil	No. of patients (IG/CG): 40/40 Lost to follow-up (IG/CG): 4/3 Age (IG/CG): 61.1 (7.9)/62.4 (8.2) Gender (IG/CG): 69.4%/64.9% female	12 months	Education on diabetes, lifestyle modification, self-monitoring and medication; provision of educational leaflets, self-monitoring diary and medication chart; medication review to identify DRPs; and suggestions on medication changes forwarded to physicians	Usual care from medical and nursing staff	HbA _{1c} ^b , SBP, DBP, LDL, medication adherence ^b , medication regimen complexity, use of medicines
Al Mazroui et al. 2009 (24)	Outpatient clinic of military hospital/ United Arab Emirates	No. of patients (IG/CG): 120/120 Lost to follow-up (IG/CG): 3/3 Age (IG/CG): 48.7 (8.2)/49.9 (8.3) Gender (IG/CG): 70.0%/68.3% male	12 months	Pharmaceutical care including discussions with the PCP regarding drug therapy; education on disease and medication; provision of information leaflets; and advice on self-monitoring, physical exercise, diet, medication adherence and smoking cessation	Usual care from medical and nursing staff	HbA _{1c} , FBG, SBP, DBP, TC, LDL, HDL, TG, BMI, 10-year CHD risk, medication knowledge, medication adherence, adherence to lifestyle advice, HRQoL
Butt et al. 2016 (25)	Endocrine clinic at medical center/ Malaysia	No. of patients (IG/CG): 37/36 Lost to follow-up (IG/CG): 3/3 Age (IG/CG): 57.42 (7.17)/57.12 (10.78) Gender (IG/CG): 60.6%/57.6% female	6 months	Counseling on diabetes, medication, lifestyle modification and self-monitoring	Standard care	HbA _{1c} ^b , FBG, TC, LDL, HDL, TG, BMI, medication adherence ^b , HRQoL ^b

Cani et al. 2015 (26)	Diabetes outpatient clinic of tertiary hospital/ Brazil	No. of patients (IG/CG): 37/41 Lost to follow-up (IG/CG): 3/5 Age (IG/CG): 61.91 (9.58)/61.58 (8.14) Gender (IG/CG): 38.2%/38.9% male	6 months	Individualized pharmacotherapeutic care plan; provision of pill organizers; education on diabetes, lifestyle changes and self-monitoring; and recommendations on insulin dose adjustments discussed with physician	Standard care	HbA _{1c} , diabetes and medication knowledge, medication adherence, insulin injection and blood glucose monitoring techniques, HRQoL
Chan et al. 2012 (27)	Diabetes clinic at public hospital/ Hong Kong	No. of patients (IG/CG): 51/54 Lost to follow-up (IG/CG): 0/0 Age (IG/CG): 63.2 (9.5)/61.7 (11.2) Gender (IG/CG): 58.8%/51.9% male	9 months	Pharmacist care program addressing medication adherence, knowledge and beliefs, skills, perceived health and cognitive functions; and identification of DRPs	Routine medical care	HbA _{1c} ^b , SBP, DBP, TC, LDL ^b , HDL, TG, BMI, ACR, CHD risk ^b , stroke risk ^b , medication knowledge ^b , medication adherence ^b , cost-effectiveness analysis
Chen et al. 2016 (28)	General hospital/ China	No. of patients (IG/CG): 50/50 Lost to follow-up (IG/CG): 0/0 Age (IG/CG): 72.16 (6.6)/72.76 (5.9) Gender (IG/CG): 50.0%/50.0% male	6 months	Pharmaceutical care including assessment of adherence to pillbox use and insulin injection technique, and the appropriateness of medication regimens, identification and resolution of DRPs, counseling on medication changes, and referrals to other diabetes care team members	Standard care	HbA _{1c} ^b , cost-effectiveness analysis
Choen et al. 2005 (29)	Primary care internal medicine clinic/ USA	No. of patients (IG/CG): 41/39 Lost to follow-up (IG/CG): 5/10 Age (IG/CG): 52.2 (11.2)/51.0 (9.0) Gender (IG/CG): 48.8%/46.1% male	24 months	Evaluation and modification of pharmacotherapy; education on diabetes self-management; and reinforcement of diabetes complications screening processes	Regular care	HbA _{1c} ^b , rates of LDL measurement ^b , retinal examination ^b , urine microalbumin screening, monofilament testing for neuropathy ^b and HbA _{1c} measurement
Chung et al. 2014 (30)	Teaching hospital/ Malaysia	No. of patients (IG/CG): 120/121 Lost to follow-up: NR Age (IG/CG): 59.7 (9.5)/58.5 (8.3) Gender (IG/CG): 58.3%/53.7% female	12 months	Pharmaceutical care including medication review; resolution of DRPs; and education on diabetes, hypertension, hyperlipidemia and medications, emphasizing the importance of medication adherence	Standard pharmacy services	HbA _{1c} , FBG, medication adherence
Cohen et al. 2011 (31)	Veterans Affairs Medical Center/ USA	No. of patients (IG/CG): 53/50 Lost to follow-up (IG/CG): 5/2 Age (IG/CG): 69.8 (10.7)/67.2 (9.4) Gender (IG/CG): 100.0%/96.0% male	6 months	Part of a multidisciplinary education intervention; behavioral and pharmacologic interventions, including medication changes	Standard primary care	HbA _{1c} , SBP ^b , LDL, HRQoL, perceived competence, adherence to self-care activities
Farsaei et al. 2011 (32)	Outpatient clinic/ Iran	No. of patients (IG/CG): 87/87 Lost to follow-up: NR Age (IG/CG): 53.4 (9.8)/52.9 (8.5) Gender (IG/CG): 63.2%/68.2% female	3 months	Education on medications, adherence and self-management; and provision of a diabetes dairy log and a pill box	Visits to the PCP every 3 months	HbA _{1c} , FBG



George et al. 2017 (33)	General medicine outpatient department of tertiary care teaching hospital/ India	No. of patients (IG/CG): 75/75 Lost to follow-up (IG/CG): 7/16 Age (IG/CG): 28% above 50 years Gender (IG/CG): 51.33% female	6 months	Counseling on diabetes, medication and lifestyle modifications; and provision of information leaflets	Counseling and information leaflets at the end of the study	FBG, KAP regarding diabetes
Ghosh et al. 2010 (34)	Medicine department at medical hospital/ India	No. of patients: 22 Lost to follow-up: 4 Age: 77.8% above 50 years Gender: 72.0% male	45 days	Counseling on disease, medication, lifestyle modification, self-monitoring and self-care; and provision of information leaflets	Counseling and information leaflets at the end of the study	FBG, PPBG
Goruntla et al 2019 (35)	outpatient medical department of a secondary care referral hospital/ India	No. of patients (IG/CG): 165/165 Lost to follow-up (IG/CG): 10/14 Age (IG/CG): 57.4(8.55)/59.2 (8.53) Gender (IG/CG): 51.5% / 52.1% male	6 months	Pharmaceutical intervention included counseling on diabetes self-care and medication The pharmacist also gave counseling regarding non-pharmacological management strategies such as about lifestyle modifications.	Standard care	HbA _{1c} , SBP, LDL, TG, and BMI
Grant et al. 2003 (36)	Community health center/ USA	No. of patients (IG/CG): 118/114 Lost to follow-up (IG/CG): 8/13 Age (IG/CG): 63.3 (12.7)/64.9 (12.1) Gender (IG/CG): 52.0%/51.0% female	3 months	Assessment of medication use; education regarding medication; arrangements for social services or nutrition consultation; and information forwarded to the PCP	baseline interview	Medication adherence, adherence to diet and exercise program, adherence barriers, medication discrepancies
Jaber et al. 1996 (37)	Internal medicine outpatient clinic/ USA	No. of patients (IG/CG): 23/22 Lost to follow-up (IG/CG): 6/0 Age (IG/CG): 59 (12)/65 (12) Gender (IG/CG): 70.6%/68.2% female	4 months	Pharmaceutical care including education on diabetes; counseling on medication, instructions on dietary regulation, exercise and self-monitoring; and evaluation and adjustment of diabetes medication	Standard medical care from PCP	HbA _{1c} ^b , FBG, SBP, DBP, TC, LDL, HDL, TG, SCR, CrCl, ACR, body weight, HRQoL
Jacobs et al. 2012 (38)	Ambulatory general internal medicine clinic/ USA	No. of patients (IG/CG): 195/201 Lost to follow-up (IG/CG): 22/24 Age (IG/CG): 62.7 (10.8)/63.0 (11.2) Gender (IG/CG): 68.0%/55.0% male	12 months	Education on diabetes; targeted physical assessment; laboratory tests ordering; pharmacotherapy review, modification and monitoring; facilitation of self-monitoring; reinforcement of dietary guidelines and exercise; and referrals to other services	Usual care	HbA _{1c} ^b , SBP, DBP, LDL, BMI, medication use, microvascular parameters screening
Jarab et al. 2012 (39)	Outpatient diabetes clinic at teaching hospital/ Jordan	No. of patients (IG/CG): 85/86 Lost to follow-up (IG/CG): 8/7 Age (IG/CG): 63.4 (10.1)/65.3 (9.2) Gender (IG/CG): 42.4%/44.2% female	6 months	Pharmaceutical care including education on diabetes, medication and lifestyle changes; review of prescribed treatment; referral to a smoking cessation program and provision of a booklet about diabetes medications and lifestyle changes	Usual care from medical and nursing staff	HbA _{1c} ^b , FBG ^b , SBP ^b , DBP ^b , TC ^b , LDL ^b , HDL, TG ^b , BMI, medication adherence, adherence to self-care activities

Javaid et al. 2019 (40)	primary health care facility/Pakistan	No. of patients (IG/CG): 123/121 Lost to follow-up (IG/CG): 22/69 Age (IG/CG): 50.3(7.7)/50.4(10.5) Gender (IG/CG): 68.7 versus 67.3% Female	9 months	The pharmacological intervention included identification of drug related problems, in collaboration with physician, while non-pharmacological intervention consisted of diet, lifestyle and behavior counseling.	Standard care	HbA _{1c} , TC, LDL, HDL, VLDL TG, SBP, DBP, BMI, glucose
Korcegez et al. 2017 (41)	Outpatient diabetes clinic at public hospital/ Cyprus	No. of patients (IG/CG): 79/80 Lost to follow-up (IG/CG): 4/3 Age (IG/CG): 61.80 (10.38)/62.22 (9.54) Gender (IG/CG): 77.3%/74.0% female	12 months	Education on diabetes, medication, lifestyle changes, self-monitoring and self-care; provision of information pamphlets; and medication review including identification and resolution of DRPs	Usual care	HbA _{1c} ^b , FBG, SBP ^b , DBP ^b , TC ^b , LDL, HDL, TG, BMI ^b , WC ^b , medication adherence, adherence to self-care activities
Lim et al. 2016 (42)	Diabetic clinic at outpatient department of hospital/ Malaysia	No. of patients (IG/CG): 50/50 Lost to follow-up (IG/CG): 11/13 Age (IG/CG): 57.00 (1.56)/55.62 (1.49) Gender (IG/CG): 53.8%/54.1% female	NR	Medication review; education on diabetes, medication and lifestyle modification; medication changes; and provision of a guiding booklet regarding medication and targets for diabetes, lipids and blood pressure	Usual care	HbA _{1c} ^b , FBG ^b , SBP ^b , DBP, TC, LDL, HDL, TG, BMI, medication adherence
Mahwi and Obied 2013 (43)	Diabetic center/ Iraq	No. of patients (IG/CG): 65/65 Lost to follow-up (IG/CG): 3/4 Age (IG/CG): 52.0 (7.86)/53.4 (10.81) Gender (IG/CG): 71.0%/67.2% female	3 months	Pharmaceutical care including education sessions, identification and resolution of DRPs	Usual medical care	HbA _{1c} , FBG, medication adherence, DRPs
Maidana et al. 2016 (44)	Health care center/ Paraguay	No. of patients (IG/CG): 32/32 Lost to follow-up (IG/CG): 2/1 Age (IG/CG): 56.7 (9.8)/54.2 (11.6) Gender (IG/CG): 66.7%/77.4% female	6 months	Pharmaceutical care	Traditional pharmaceutical service	HbA _{1c} , FBG, HRQoL,
Mourão et al. 2013 (45)	Primary health care units/ Brazil	No. of patients (IG/CG): 65/64 Lost to follow-up (IG/CG): 12/9 Age (IG/CG): 60.0 (10.2)/61.3 (9.9) Gender (IG/CG): 68.0%/66.0% female	6 months	Pharmaceutical care including identification of DRPs; proposals for pharmacotherapy changes forwarded to the PCP; and education on diabetes, non-pharmacological issues and pharmacological treatments	Usual health care	HbA _{1c} ^b , FBG ^b , SBP ^b , DBP, TC ^b , LDL ^b , HDL ^b , TG ^b , BMI, medication use ^b , DRPs
Nascimento et al. 2016 (46)	Diabetes care clinic/ Portugal	No. of patients: 90 Lost to follow-up: 3 Age (IG/CG): 74.2 (5.4)/72.3 (4.5) Gender (IG/CG): 56.8%/58.1% male	6 months	Individualized pharmacotherapy management service at patients' home; and education on diabetes and medication	Standard medical care	HbA _{1c} , FBG ^b , medication adherence, adherence to self-care activities
Odegard et al. 2005 (47)	Medicine clinics/ USA	No. of patients (IG/CG): 43/43 Lost to follow-up (IG/CG): 4/7 Age (IG/CG): 51.6 (11.6)/51.9 (10.4) Gender (IG/CG): 48.0%/38.0% female	12 months	Development and implementation of a diabetes care plan and regular communication with patient and PCP regarding patients' diabetes care progress	Normal care from PCP	HbA _{1c} , medication appropriateness, medication adherence
Plaster et al. 2012 (48)	Community health center/ Brazil	No. of patients (IG/CG): 38/36 Lost to follow-up (IG/CG): 4/7 Age: 52.9%/60.0% above 60 years Gender (IG/CG): 70.6%/60.0% female	6 months	Pharmaceutical care program including promotion on correct use of medication; provision of educative instructional material about lifestyle modifications; and interaction with the PCP	Standard care	FBG, SBP, DBP, TC, LDL, HDL, TG, WC, body weight, 10-year CHD risk, negative outcomes associated with medication



Ramanath and Santhosh 2011 (49)	General medicine department at tertiary care hospital/ India	No. of patients (IG/CG): 57/56 Lost to follow-up (IG/CG): 5/8 Age: 55.8%/58.4% above 51 years Gender (IG/CG): 67.3%/50.0% male	3 months	Educational materials and counseling	Educational materials and counseling at last follow-up	FBG, PPBG, medication adherence, KAP regarding diabetes, HRQoL
Scott et al. 2006 (50)	Community health center/ USA	No. of patients (IG/CG): 76/73 Lost to follow-up (IG/CG): 5/4 Age: 50.0%/54.8% above 50 years Gender (IG/CG): 57.9%/64.4% female	9 months	Education on diabetes, medication, lifestyle adjustments, self-monitoring and self-care; medication review; and pharmacotherapy recommendations made to the PCP	Standard diabetes care	HbA _{1c} ^b , SBP ^b , DBP, LDL ^b , HDL, BMI, body weight, DQoL, aspirin use, influenza vaccination
Shao et al. 2017 (51)	Endocrinology outpatient service at hospital/ China	No. of patients (IG/CG): 120/120 Lost to follow-up (IG/CG): 20/21 Age (IG/CG): 58.86 (10.59)/59.2 (10.34) Gender (IG/CG): 51.0%/47.5% male	6 months	Pharmaceutical care including education on diabetes, medication, self-monitoring and lifestyle changes	Usual care from medical staff	HbA _{1c} , FBG, SBP, DBP, TC, LDL, HDL, TG, BMI, medication adherence
Siaw et al. 2017 (52)	Outpatient health care institutions/ Singapore	No. of patients (IG/CG): 214/197 Lost to follow-up (IG/CG): 73/8 Age (IG/CG): 59.2 (8.2)/60.1 (8.1) Gender (IG/CG): 52.3%/60.9% male	6 months	Pharmacotherapy management including close monitoring, enhancement of drug adherence and knowledge, and medication optimization	Usual care	HbA _{1c} ^b , SBP, LDL, TG, BMI, diabetes-related distress ^b , satisfaction with diabetes treatment ^b , health service utilization and economic evaluation ^b
Simpson et al. 2011 (53)	Primary care clinics/ Canada	No. of patients (IG/CG): 131/129 Lost to follow-up (IG/CG): 21/16 Age (IG/CG): 58.8 (11.1)/59.4 (12.1) Gender (IG/CG): 56.5%/58.1% female	12 months	Medication assessments; limited history and physical examinations; and guideline-concordant recommendations discussed with the PCP to optimize medication management	Usual care from primary care team	HbA _{1c} , SBP ^b , DBP ^b , TC, LDL, HDL, TG, 10-year CHD risk ^b , antihypertensive medication changes and adherence (60), number of health care-related contacts, cost-effectiveness analysis (61)
Sriram et al. 2011 (54)	General medicine department at tertiary care teaching hospital/ India	No. of patients (IG/CG): 60/60 Lost to follow-up: NR Age (IG/CG): 53.65 (2.38)/57.98 (2.62) Gender (IG/CG): 50.0%/50.0% female	3 months	Pharmaceutical care including education on diabetes and counseling on medication and lifestyle modification; and provision of an information leaflet, a diabetic diet chart and a diabetic diary	Pharmaceutical care at the end of the study	HbA _{1c} , FBG, BMI, DQoL, satisfaction with diabetes treatment
Suppakitiporn et al. 2005 (55)	Endocrine clinic at hospital/ Thailand	No. of patients (IG/CG): 180/180 Lost to follow-up: NR Age (IG/CG): 61.4 (10.6)/59.9 (11.5) Gender (IG/CG): 67.2%/64.4% female	6 months	IG divided into 4 groups: all groups received diabetes drug counseling; additionally, one group received a diabetes booklet, one group received special medication containers and the last group received both	Conventional treatment	HbA _{1c} , FBG
Wishah et al. 2014 (56)	Outpatient diabetes clinic at teaching hospital/ Jordan	No. of patients (IG/CG): 52/54 Lost to follow-up (IG/CG): 2/3 Age (IG/CG): 52.9 (9.6)/53.2 (11.2) Gender (IG/CG): 61.5%/51.9% female	6 months	Pharmaceutical care including optimization of drug therapy; education and counseling on diabetes and medication; enhancement of adherence to medication and self-care activities; and provision of educational leaflet and brochures	Usual care from medical and nursing staff	HbA _{1c} ^b , FBG ^b , TC, LDL, HDL, TG, BMI, diabetes knowledge ^b , medication adherence, adherence to self-care activities



Withidpanyawong et al. 2019 (57)	Outpatient diabetes clinic at a hospital Thailand	No. of patients (IG/CG): 98/98 Lost to follow-up (IG/CG): 10/6 Age (IG/CG): 60.53 (10.71)/58.13 (10.10) Gender (IG/CG): 72.7%/75.0% female	9 months	A pharmacist delivered the educational sessions and encouraged family members to take an active role in self-management practices. The intervention was administered during 4 visits, at approximately 3-month intervals. Each intervention lasted 40-50 min and was carried out in a private room.	Usual diabetes service provided by physicians, nurses and pharmacists during their outpatient visits to the hospital every 3 months	HbA _{1c} ^b , TC, LDL ^b , HDL, TG, SBP ^b , DBP ^b , BMI, diabetes knowledge of patients ^b and family members, positive family support ^b , negative family support, medication adherence (pill count ^b and Morisky score), self-management ^b and self-efficacy ^b
Wu et al. 2018 (58)	Veteran Health Administration Hospitals/ USA	No. of patients (IG/CG): 117/133 Lost to follow-up (IG/CG): 20/16 Age (IG/CG): 65.8(8.7)/65.0(9.5) Gender (IG/CG): 95.7 versus 96% male	13 months	Pharmaceutical care including education and counseling on diabetes self-care and medication; Behavioral counseling and comprehensive medication management for hyper- (and hypo-) glycemia, hypertension, and dyslipidemia	Standard care regular visits with primary care and specialty care providers	HbA _{1c} , SBP, LDL-cholesterol, health-related quality-of-life, Healthcare costs

^aAllocated to intervention group and control group.

^bThe study reported a statistically significant difference in change between groups.

ACR = albumin-to-creatinine ratio; BG = blood glucose; BMI = body mass index; CBG = capillary blood glucose; CG = control group; CHD = coronary heart disease; CrCl = creatinine clearance; DBP = diastolic blood pressure; DQoL = diabetes quality of life; DRPs = drug related problems; FBG = fasting blood glucose; HbA_{1c} = glycosylated hemoglobin; HDL = high-density lipoprotein cholesterol; HRQoL = health-related quality of life; IG = intervention group; KAP = knowledge, attitude and practice; LDL = low-density lipoprotein cholesterol; NR = not reported; PCP = primary care provider; PPBG = postprandial blood glucose; SBP = systolic blood pressure; SCr = serum creatinine; SD = standard deviation; SIMS = satisfaction with information received about medicines; TC = total cholesterol; TG = triglycerides; WC = waist circumference.

