JAMA Internal Medicine | Original Investigation | LESS IS MORE

Diabetes Deprescribing in Older Adults
A Randomized Clinical Trial

Richard W. Grant, MD, MPH; Ilana Peterson, MPH; Jodi M. McCloskey, MPH; Kasia J. Lipska, MD, MHS; Joshua Nugent, PhD; Andrew J. Karter, PhD; Lisa K. Gilliam, MD, PhD

IMPORTANCE Medication-related hypoglycemia is the leading cause of iatrogenic complications among older adults with type 2 diabetes.

OBJECTIVE To compare physician academic detailing (AD) with or without patient previsit activation for insulin and/or sulfonylurea deprescribing in older patients with diabetes.

DESIGN, SETTING, AND PARTICIPANTS This randomized clinical trial was conducted from September 2020 to March 2024 with 6 and 12 months of follow-up in a large integrated health care system in Northern California. Primary care physicians (PCPs) and their patients with type 2 diabetes who were 75 years and older, had hemoglobin A_{1c} of 8.0% or lower, and were treated with insulin and/or sulfonylureas were included.

INTERVENTIONS Participating PCPs attended at least 1 AD session that provided evidence to support diabetes medication reassessment and potential deprescribing strategies in older patients with type 2 diabetes. Prior to their visit with a participating PCP, trial patients were randomly assigned to receive either a previsit activation deprescribing handout (AD plus previsit arm) or an attention control healthy lifestyle handout (AD-only arm).

MAIN OUTCOMES AND MEASURES Primary outcomes (assessed at 6 months) were diabetes medication deprescribing (an aggregate measure) and any patient-reported severe hypoglycemia episodes.

RESULTS A total of 211 PCPs were able to attend at least 1 AD session and treated 450 eligible patients (mean [SD] age, 79.9 [4.0] years; 223 [49.6%] female; mean [SD] concurrent chronic conditions, 6.2 [3.6]; and mean [SD] hemoglobin A_{1c}, 7.5% [1.1%]). At 6 months, there was a statistically significant higher diabetes medication deprescribing rate in the AD plus previsit activation arm compared with the AD-only arm (36 of 232 patients [15.8%] vs 19 of 218 patients [9.0%]; adjusted risk difference [RD], 7.5%; 95% CI, 1.5%-13.6%; $P = .01$); this difference persisted at 12 months (50 of 232 patients [22.8%] vs 33 of 218 patients [16.3%]; adjusted RD, 7.9%; 95% CI, 0.4%-15.5%; $P = .04$). There was not a statistically significant difference in severe self-reported hypoglycemia at 6 months between the AD plus previsit and AD-only arms (10 of 232 patients [4.7%] vs 13 of 218 patients [6.5%]; adjusted RD, −2.3%; 95% CI, −7.1% to 2.5%; $P = .04$).

CONCLUSIONS AND RELEVANCE In this randomized clinical trial, AD with previsit activation was a simple and effective strategy for increasing diabetes medication deprescribing in older patients with type 2 diabetes.

TRIAL REGISTRATION ClinicalTrials.gov Identifier: NCT04585191

Visual Abstract
Invited Commentary
Supplemental content

Author Affiliations: Division of Research, Kaiser Permanente Northern California, Pleasanton (Grant, Peterson, McCloskey, Nugent, Karter); Section of Endocrinology, Department of Medicine, Yale School of Medicine, New Haven, Connecticut (Lipska); Kaiser Northern California Diabetes Program, Endocrinology and Internal Medicine, Kaiser Permanente, South San Francisco Medical Center, South San Francisco (Gilliam).

Corresponding Author: Richard W. Grant, MD, MPH, Division of Research, Kaiser Permanente Northern California, 4480 Hacienda Dr, Pleasanton, CA 94588 (richard.w.grant@kp.org).

JAMA Intern Med. doi:10.1001/jamainternmed.2025.2015
Published online June 23, 2025.

As patients with type 2 diabetes age, they are less likely to experience the long-term benefits associated with tight glycemic control and more likely to experience the short-term risks of treatment-related hypoglycemia.[1,2] Indeed, iatrogenic hypoglycemia has become the leading preventable treatment complication in older adults with type 2 diabetes. Hypoglycemia prevention is of high importance to patients, clinicians, and care systems[3,4] due to the associated increased risk of cognitive decline and dementia,[5,6] falls,[7,8] lower health-related quality of life,[9] hospitalization,[10,11] and death.[12] In contrast to current robust evidence-based guidelines for intensifying treatment in younger patients,[13,14] there has been very limited success in shifting the care paradigm toward greater short-term safety in older patients with diabetes.[15] Given the strong evidence of harm from hypoglycemic episodes, there is a growing effort to reduce intensity of hypoglycemia-prone medication use in older adults at high risk for hypoglycemia.[16,17] Three major US professional societies (American Diabetes Association, American Geriatrics Society, and American College of Physicians) have published guidelines that recommend reducing treatment intensity among older adults with diabetes, particularly those experiencing hypoglycemia, having a heavy burden of comorbidities, or having a limited life expectancy.[18-20]

Medication deprescribing is defined as the general process of tapering (reducing dose or frequency) or discontinuing drugs with the goal of minimizing drug-related adverse effects and associated clinical complications.[21,22] As patients with diabetes age, the trade-offs between treatment benefit and risk evolve. Addressing this dynamic paradigm shift in diabetes management requires complex decisions around care goals that ideally reflect collaboration between patients and their physicians.[23] Although expert recommendations for how to reduce the dose or eliminate the use of glucose-lowering medicines in older patients have been published,[24,25] there remains a critical need to develop and evaluate new clinical care strategies for diabetes medication deprescribing in high-risk older patients that optimize current health and well-being.[26]

We conducted a comparative effectiveness randomized clinical trial to test the impact of 2 strategies for increasing diabetes medication deprescribing: primary care physician (PCP) academic detailing (AD) with or without patient previsit activation. AD involves evidence-based and often case-based teaching sessions for practicing clinicians.[27-36] Patient previsit activation is a patient-oriented approach to educate and prepare patients for their upcoming visit with the goal of engaging patients in shared decision-making.[37,38] For this clinical trial, PCPs participated in 1 or more AD sessions during regularly scheduled practice meetings.

Key Points

Question Does physician academic detailing (45-minute virtual presentation) with or without patient previsit activation (educational handout given prior to primary care physician visit) increase diabetes medication deprescribing in older patients with type 2 diabetes?

Findings In this randomized clinical trial involving 211 primary care physicians and 450 patients, the addition of patient previsit activation vs no activation resulted in substantially increased deprescribing (15.8% vs 9.0% at 6 months) among patients of physicians who participated in 1 or more academic detailing sessions.

Meaning Efforts to reduce the risk of treatment-related hypoglycemia in older patients with diabetes through medication deprescribing would benefit from combined academic detailing and patient previsit activation.

Methods

Setting and Study Population

This study was conducted within Kaiser Permanente Northern California (KPNC), an integrated health care delivery system with more than 4.2 million members across Northern California. Patients with type 2 diabetes within KPNC demonstrate broad representation of race and ethnicity, educational level, and neighborhood settings (eg, 22.4% of members live in the lowest neighborhood socioeconomic quartile based on the Neighborhood Deprivation Index[39]), and patients 65 years and older have similar hemoglobin A_{1c} (HbA_{1c}) control rates as the US population.[40] Most older patients with type 2 diabetes in KPNC are treated by PCPs (rather than by endocrinologists).

We implemented the clinical trial between September 30, 2020, and September 12, 2023, with final follow-up patient survey completed March 6, 2024, and final clinical outcome assessment September 11, 2024. Eligible PCPs had at least 1 eligible patient in their patient panel. Eligible patients of PCPs participating in the AD sessions provided verbal informed consent and were randomly allocated at the PCP level to receive a diabetes medication previsit activation handout (AD plus previsit arm) vs no diabetes medication previsit activation handout (AD-only arm). Patients in the AD-only arm received an attention control healthy lifestyle handout that did not mention medications.

Patient eligibility was based on the following criteria: (1) age 75 years or older, (2) type 2 diabetes with HbA_{1c} of 8.0% or lower measured at time of eligibility determination, and (3) currently taking insulin and/or sulfonylureas (ie, classes of diabetes medicines that cause hypoglycemia).[41] Patients were excluded if they were unable to provide informed consent (cognitive impairment, language or communication barriers, or severe mental illness), were receiving palliative care or chemotherapy, or were excluded by their PCP.

This study was approved by the Kaiser Permanente institutional review board (see Supplement 1 for the trial protocol). We followed the Consolidated Standards of Reporting Trials Extension (CONSORT Extension) guidelines for reporting pragmatic trials.[4]

Interventions

AD is a validated strategy for changing prescribing practices that uses focused and pragmatic education for practicing clinicians.[24,36,42-45] We designed the group-based PCP AD sessions in this study to be brief (30-45 minutes), integrated into

the usual work day (eg, during regularly scheduled weekly practice meetings or lunches), tailored, interactive, and consisting of clearly presented summaries of current evidence and guideline recommendations, with corresponding case examples for pragmatic learning (see eMethods 1 in Supplement 2 for slides). These sessions were led by an experienced diabetes endocrinologist (L.K.G.).

Patient previsit activation is a strategy to educate and activate patients for upcoming visits with the goal to improve clinical interactions and shared decision-making.[46,47] We worked closely with our patient advisory stakeholders to create an easy-to-read, 1-page (front and back) medication information page for patients to review prior to their upcoming PCP visit. This medication handout (eMethods 2 in Supplement 2) used plain language and accessible information regarding the balance of risk and benefit of treatment to achieve tight glycemic control. The reverse side included 5 questions designed to help patients think about their values and preferences and to help patients talk to their PCPs about their medication goals. The medication handout was shared via an email PDF attachment or a mailed paper copy in the period between when a primary care appointment was scheduled and when the visit occurred.

In the AD-only arm, patients received an attention control handout that listed general health reminders such as staying up to date on immunizations and screenings, preventing falls, maintaining a healthy diet, and engaging in exercise (eMethods 3 in Supplement 2).

Study Design

The comparative effectiveness randomized clinical trial compared AD with vs without patient previsit activation among older patients with type 2 diabetes using hypoglycemia-prone diabetes medications. Randomization was at the PCP level. Sample sizes were calculated by assessing differences in 2 proportions in a cluster-randomized design using 2-sided z test (unpooled) after specifying number of clusters, cluster size, effect size, and intracluster correlation coefficient. We aimed to enroll 440 high-risk patients (220 in each study arm) to have 90% power to detect a 15% difference in insulin and/or sulfonylurea deprescribing rates. This analysis was adjusted for any potential baseline patient differences and accounted for clustering within PCP.

Data Collection

Clinical and demographic data were collected from the electronic health record as part of usual care processes. Patient self-reported data were collected by telephone surveys at baseline and 6 months of follow-up using validated instruments.

Primary Outcomes

The primary outcome was medication deprescribing (defined as reduction in dose or discontinuation of diabetes medications, switching between high-risk to lower-risk medications, and/or reducing the number of therapeutic classes [eMethods 4 in Supplement 2]), comparing active orders at each patient's enrollment baseline to active orders 6 months after enrollment. The primary patient-reported outcome was self-reported major hypoglycemic episode (requiring help from someone else) during the 6 months following exposure to the intervention.[48]

Secondary Outcomes

We also examined hypoglycemia-related utilization (defined as primary emergency department or principal hospital hypoglycemia diagnosis) at 6 and 12 months and diabetes medication deprescribing at 12 months. The 6-month follow-up survey also included assessment of patient-reported hypoglycemia symptoms, Problem Areas in Diabetes,[49] and Perceived Efficacy in Patient-Physician Interactions.[50] We also conducted a structured medical record review of each patient's initial PCP visit to identify any documentation of diabetes management discussion or medication deprescribing. To investigate potential harms of deprescribing, we compared (1) primary emergency department or principal hospital hyperglycemia diagnoses (hyperglycemia, hyperosmolarity with or without coma, or ketoacidosis with or without coma), (2) proportion of patients with HbA_{1c} greater than 8% at 6 and 12 months (controlling for HbA_{1c} level preceding index PCP visit), and (3) reversal in the second 6-month period of any deprescribing in the first 6-month period.

Concurrent Cohort Deprescribing Trends

We complemented the randomized clinical trial by also measuring temporal trends in deprescribing rates among similar patients of PCPs from neighboring Kaiser Permanente primary care practices not part of this trial. Applying the same trial eligibility criteria for PCPs and their patients that were available from electronic health records, we compared deprescribing rates over a concurrent 1-year period (beginning with the first set of PCP detailing sessions on November 1, 2020, with 1-year follow-up to October 31, 2021) between all study-eligible patients of PCPs participating in the trial who received AD vs similar patients of PCPs who did not participate in the trial and did not receive AD. We created 2 usual care PCP control cohorts: (1) PCPs from the same medical facilities who were unable to attend (to control for facility level differences), and (2) patients of PCPs from neighboring KPNC medical facilities that were not involved in the study (to provide a concurrent measure of deprescribing rates within similar KPNC facilities not potentially influenced by the trial).

Statistical Analysis

We constructed generalized estimating equation models to compare changes from baseline in clinical and patient-reported outcomes between clinical trial arms. For each deprescribing, patient-reported, and hypoglycemia-related outcome, a regression model was constructed with baseline measurements of the outcome included as covariates and robust variance to account for patient clustering within PCP panels (eMethods 5 in Supplement 2). We also examined heterogeneity of treatment effects based on dichotomized demographic and baseline clinical variables by examining coefficient P values from models for the 6- and 12-month deprescribing outcomes with an interaction term between the factor of interest and the study arm.

For the usual care cohort comparisons, generalized estimating equation models were fit with a larger set of adjustment covariates to control for possible confounding. These included patient characteristics (age, sex, self-reported race and ethnicity [African American or Black, American Indian or Alaska Native, Asian or Filipino, Hispanic or Latino, Pacific Islander or Native Hawaiian, White, multiracial, or other], and Medicare coverage) and baseline measurements of the outcome.

All statistical analyses were completed using SAS, version 9.4 (SAS Institute), and regression models were fit using PROC GENMOD. Two-sided $P < .05$ was considered statistically significant.

Results

AD was conducted in 12 KPNC primary care practices within 5 medical facilities (generally held during the lunch hour). Of the 268 PCPs with study-eligible patients, 211 PCPs (78.7%) were able to attend at least 1 AD session. Reasons for not attending for the remaining 57 PCPs (21.3%) included having the morning clinic session run over time or not being at work during the session dates. Participating PCPs had a mean (SD) 17.8 (9.2) years in practice and managed large patient panels (mean [SD] 2456 [920] patients) (eTable 1 in Supplement 2). There were no statistically significant differences in age, years in practice, or panel size compared to PCPs who did not attend the AD sessions, although attendees were somewhat likelier to be women (143 of 211 [67.8%] vs 31 of 57 [54.4%]; $P = .06$).

Of the 450 eligible patients, the mean (SD) age was 79.9 (4.0) years, 223 (49.6%) were female, the mean (SD) concurrent chronic conditions was 6.2 (3.6), and mean (SD) HbA_{1c} was 7.5% (1.1%). The population of patients meeting trial eligibility criteria was racially and ethnically diverse (**Table 1**). Patients who consented to participate were younger and less likely to be Asian, but otherwise there were few substantive differences between those who enrolled and who declined to enroll, indicating that study results from this pragmatic clinical trial should be widely generalizable (eTable 2 in Supplement 2). See the **Figure** for the patient flow through the study.

Patients who received the previsit activation handout (AD plus previsit arm) had a statistically significant higher likelihood of having their diabetes medicines deprescribed by 6 months after enrollment compared to those randomized to the AD-only arm (36 of 232 [15.8%] vs 19 of 218 [9.0%]; adjusted risk difference [RD], 7.5%; 95% CI, 1.5%-13.6%; $P = .01$); these differences were sustained at the 12-month follow-up (50 of 232 patients [22.8%] vs 33 of 218 patients [16.3%]; adjusted RD, 7.9%; 95% CI, 0.3%-15.5%; $P = .04$). Severe self-reported hypoglycemia at the 6-month follow-up was uncommon and similar between the AD plus previsit arm and AD-only arm (10 of 232 patients [4.7%] vs 13 of 218 patients [6.5%]; adjusted RD, −2.3%; 95% CI, −6.5% to 1.9%; $P = .28$).

In secondary analyses, all hypoglycemia-related clinical utilization outcomes also favored the AD plus previsit arm, but only emergency department visits at 6 months were statistically significant (adjusted RD, −1.9%; 95% CI, −3.8% to −0.2%; $P = .03$; **Table 2**). Patients in the 2 study arms also had similar response profiles to the Problem Areas in Diabetes and Perceived Efficacy in Patient-Physician Interactions measurements (**Table 3**). There were statistically significant differences in visit documentation (as a proxy for visit interactions), with patients receiving the previsit activation handout more likely to have diabetes discussion documented in the progress note from the index visit than those receiving the attention control health lifestyle handout (139 of 232 [59.9%] vs 106 of 218 [48.6%]; adjusted RD, 11.3%; 95% CI, 2.1%-20.4%; $P = .02$).

There appeared to be few negative clinical consequences of this intervention to educate PCPs and inform their patients about diabetes deprescribing. As shown in Table 2, emergency department or hospital admissions related to hyperglycemia were much less common than hypoglycemia-related admissions and did not differ by study arm. Similarly, there were no differences in glycemic control (HbA_{1c} >8%) between study arms at 6 or 12 months (Table 2). Of the 49 patients who were deprescribed at 6 months and were not lost to follow-up at 12 months, only 7 (14.3%) were no longer deprescribed at 12 months (4 patients in AD plus previsit arm and 3 patients in AD-only arm). There was not evidence of treatment effect heterogeneity by baseline clinical or demographic characteristics (eTable 5 in Supplement 2).

To compare concurrent deprescribing rates among study-eligible patients of PCPs enrolled in the AD trial to their local KPNC peers, 2 control cohorts were constructed. Control cohort 1 consisted of 35 PCPs in trial medical facilities who were unable to attend AD sessions and their 265 eligible patients. Control cohort 2 included 260 PCPs in neighboring KPNC medical facilities not involved in the trial and their 1331 eligible patients. PCPs (and their patients) in these 2 usual care cohorts were similar to PCPs (and their patients) who attended the AD sessions except for PCP sex proportion (eTable 3 in Supplement 2). Patients of PCPs who received AD had statistically significant higher deprescribing rates over the 1-year observation period (138 of 781 [19.1%]) vs the 2 comparison usual care cohorts (control cohort 1: 31 of 265 [12.4%]; adjusted RD, 7.4%; 95% CI, 2.8%-12.0%; $P = .02$; control cohort 2: 184 of 1331 [15.2%]; adjusted RD, 4.1%; 95% CI, 0.3%-7.9%; $P = .04$; eTable 4 in Supplement 2).

Discussion

Diabetes medication deprescribing in older patients with type 2 diabetes is a complex clinical decision-making process. Individuals of similar chronological age can have wide variation in biological age based on functional capacity, burden of comorbidity, and predicted lifespan. The decision to reduce diabetes medication intensity ideally involves a collaborative conversation between prescribing physician and patient that aligns with the patient's values and preferences; thus, deprescribing does not lend itself to simple, one-size-fits-all management protocols. We conducted a randomized trial to compare the effectiveness of 2 strategies for supporting this deprescribing process, one focused solely on health care pro-

Table 1. Patient Baseline Characteristics by Study Intervention Arm

Characteristic	No. (%)	
	AD + previsit handout (n = 232)	AD only (n = 218)
Age, mean (SD), y	79.7 (3.9)	80.2 (4.2)
Sex		
Female	111 (47.8)	112 (51.4)
Male	121 (53.3)	106 (46.7)
Race[a]		
African American or Black	26 (11.2)	30 (13.8)
American Indian or Alaska Native	2 (0.9)	3 (1.4)
Asian or Filipino	43 (18.5)	44 (20.2)
Pacific Islander or Native Hawaiian	2 (0.9)	2 (0.9)
White	120 (51.7)	105 (48.2)
Multiracial	8 (3.4)	4 (1.8)
Other	25 (10.8)	29 (13.3)
Prefer not to answer	6 (2.6)	1 (0.5)
Hispanic or Latino ethnicity[a]	30 (12.9)	33 (15.1)
Insurance		
Medicare	214 (92.2)	197 (90.4)
Commercial	12 (5.2)	16 (7.3)
Dual eligible	5 (2.2)	4 (1.8)
Medicaid	1 (0.4)	0
Baseline hemoglobin A_{1c}, mean (SD), %[b]	7.5 (1.0)	7.5 (1.2)
Baseline hemoglobin A_{1c} category[b]		
<7%	68 (29.3)	66 (30.3)
7%-8%	116 (50.0)	106 (48.6)
>8%	48 (20.7)	46 (21.1)
Education		
High school or GED or less	63 (27.2)	51 (23.4)
Some college	79 (34.1)	64 (29.4)
College degree or higher	90 (38.8)	102 (46.8)
Prefer not to answer	0	1 (0.5)
Baseline diabetes regimen		
Insulin	124 (53.4)	96 (44.0)
Sulfonylurea	151 (65.1)	162 (74.3)
Insulin and sulfonylurea	47 (20.3)	46 (21.1)
Metformin	144 (62.1)	118 (54.1)
SGLT2 inhibitor	20 (8.6)	17 (7.8)
Thiazolidinedione	9 (3.9)	12 (5.5)
No. of medicines, mean (SD)	7.1 (3.3)	7.6 (3.4)
No. of chronic conditions, mean (SD)	6.0 (3.6)	6.3 (3.6)
Comorbidity		
Hypertension	189 (81.5)	170 (78.0)
Hyperlipidemia	176 (75.9)	169 (77.5)
Peripheral vascular disease	134 (57.8)	123 (56.4)
Chronic kidney disease	120 (51.7)	124 (56.9)
Depression	26 (11.2)	35 (16.1)
Hypoglycemia-related ED or IP primary/principal diagnoses in prior year	7 (3.0)	7 (3.2)
Hyperglycemia-related ED or IP primary/principal diagnoses in prior year	3 (1.3)	2 (0.9)

Abbreviations: AD, academic detailing; ED, emergency department; GED, General Educational Development; IP, in patient; SGLT2, sodium-glucose cotransporter 2.

[a] Race and ethnicity were self-reported, including the other category.

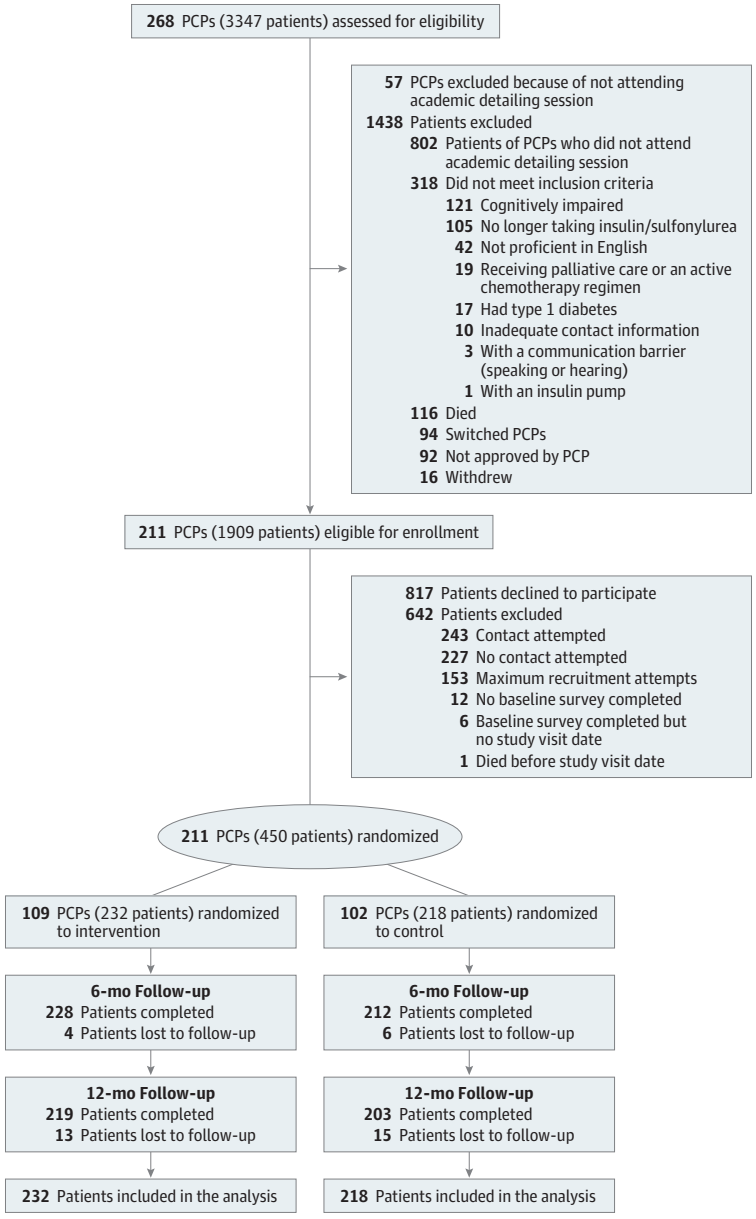
[b] Baseline hemoglobin A_{1c} values are the most recent results preceding the initial primary care physician visit.

fessionals (AD) and the other involving both health care professionals and patients (AD with patient previsit activation).

These results underscore the value of involving both patients and physicians in any efforts to make meaningful changes to diabetes care plans. Engaging the patient with a simple previsit handout augmented the impact of the PCP AD education that focused on safe diabetes medication deprescribing.

AD is low cost, relatively easy to implement, and has had a positive effect on physician deprescribing practices.[45] However, alone, this strategy to address medication management is limited by the lack of direct patient involvement in the decision-making process. Results of this study provide rigorous randomized trial data supporting the value of engaging patients prior to their primary care visits to augment AD. This work builds on other

Figure. CONSORT Diagram



The final participant reached the 12-month end date on September 11, 2024. PCP indicates primary care physician.

recent research[51,52] on patient-directed education by demonstrating the additive benefit of intervening on both sides of the equation of prescriber and prescribee.

Overall rates of diabetes medication deprescribing were modest. This begs the question of what the ideal deprescribing rate should be. The challenge of estimating this ideal rate reflects the individual decision complexity that varies according to recent and longer-term treatment history, extent of current treatment burden, the trade-off between future risk and shorter-term benefit, patient health status and health trajectory, and patient preferences. For example, a robust and physically active 78-year-old patient whose diabetes is well controlled with a stable insulin dose for the past 8 years may be reluctant to make changes, whereas a frailer patient of the same age taking a long-acting sulfonylurea would be an excellent candidate for medication changes. The many factors that go into the deprescribing decision underscore the critical importance of engaging both the physician and the patient in informed discussions over time. This clinical trial finding that engaging patients using a simple previsit activation handout nearly doubled the deprescribing rate underscores the importance of directly engaging patients in this challenging process.[53]

Results of this randomized clinical trial set the stage for several potential follow-up innovations to promote safer medication management in older patients with type 2 diabetes. These include (1) multimodal medication deprescribing outreach: AD for physicians can be expanded and generalized to include deprescribing principles for all relevant medications in

Table 2. Deprescribing, Self-Reported Hypoglycemia, and Hypoglycemia- and Hyperglycemia-Related Admissions at 6 and 12 Months by Study Arm

Outcome	No. (%)		Adjusted risk difference, % (95% CI)[a]	*P* value
	AD + previsit handout (n = 232)	AD only (n = 218)		
Primary outcomes, 6-mo follow-up				
Diabetes medication deprescribing	36 (15.8)	19 (9.0)	7.5 (0.6 to 14.4)	.02
Severe self-reported hypoglycemia	10 (4.7)	13 (6.5)	−2.3 (−7.1 to 2.5)	.56
Secondary outcomes				
6-mo Follow-up				
Composite 6-mo hypoglycemia outcome[b]	12 (5.3)	17 (8.0)	−3.4 (−7.6 to 0.9)	NA
ED hypoglycemia-related admission	0	4 (1.9)	−1.9 (−3.8 to −0.2)	NA
IP hypoglycemia-related admission	2 (0.9)	3 (1.4)	−0.5 (−2.5 to 1.5)	NA
ED or IP hypoglycemia-related admission	2 (0.9)	6 (2.8)	−2.1 (−4.6 to 0.3)	NA
ED or IP hyperglycemia admission	1 (0.4)	0	0.5 (−0.4 to 1.3)	NA
Hemoglobin A_{1c} >8%	38 (22.4)	33 (21.2)	1.7 (−6.9 to 10.3)	NA
12-mo Follow-up				
Diabetes medication deprescribing	50 (22.8)	33 (16.3)	7.9 (−0.7 to 16.5)	NA
ED hypoglycemia-related admission	4 (1.8)	8 (3.9)	−2.1 (−5.3 to 1.1)	NA
IP hypoglycemia-related admission	4 (1.8)	3 (1.5)	0.4 (−2.1 to 2.8)	NA
ED or IP hypoglycemia-related admission	7 (3.2)	9 (4.4)	−1.2 (−4.9 to 2.5)	NA
ED or IP hyperglycemia admission	2 (0.9)	1 (0.5)	0.5 (−1.2 to 2.2)	NA
Hemoglobin A_{1c} >8%	53 (25.7)	49 (25.8)	0.3 (−7.3 to 7.8)	NA

Abbreviations: AD, academic detailing; ED, emergency department; IP, in patient; NA, not applicable.

[a]95% CIs for the primary outcomes are Bonferroni corrected.

[b]Composite 6-month outcome includes severe self-reported hypoglycemia and ED and/or hospital admission (self-reported data were only collected at the 6-month follow-up). Models use robust variance estimation to account for clustering by primary care physician.

Table 3. Patient-Reported Outcomes at 6 Months by Study Arm

Outcome	No. (%)		Adjusted risk difference, % (95% CI)[a]	*P* value
	AD + previsit handout (n = 232)	AD only (n = 218)		
Problem Areas in Diabetes[b]				
Which of the following are currently a problem for you?				
Feeling scared when you think about living with diabetes	26 (12.2)	32 (16.1)	0.69 (0.41-1.15)	.22
Feeling depressed when you think about living with diabetes	18 (8.4)	22 (11.1)	0.75 (0.39-1.45)	.45
Worrying about the future and the possibility of serious complications	60 (28.2)	55 (27.8)	1.12 (0.74-1.68)	.63
Feeling that diabetes is taking up too much of your mental and physical energy every day	36 (16.9)	45 (22.8)	0.74 (0.48-1.15)	.24
Coping with complications of diabetes	50 (23.4)	46 (23.4)	1.10 (0.72-1.70)	.73
Worrying about low blood glucose reactions (hypoglycemia)?	41 (19.2)	29 (14.6)	1.41 (0.84-2.34)	.25
Perceived Efficacy in Patient-Physician Interactions[c]				
Based on your most recent visit, how confident are you in your ability:				
To know what questions to ask a doctor	157 (74.1)	159 (81.1)	0.72 (0.44-1.19)	.25
To get a doctor to answer all of your questions	164 (77.7)	158 (80.6)	0.82 (0.53-1.26)	.43
To make the most of your visits with your doctor	173 (82.4)	155 (79.5)	1.24 (0.77-1.97)	.42
To get a doctor to take your chief health concern seriously	168 (80.8)	162 (83.5)	0.70 (0.43-1.15)	.20
To get a doctor to do something about your chief health concern	162 (77.9)	154 (79.8)	0.81 (0.47-1.39)	.49

[a] Risk difference from generalized estimating equation model with baseline response included as a covariate and robust variance to account for clustering by primary care physician.

[b] Reported are patients responding a moderate or serious problem.

[c] Reported are patients responding 4 or 5 on a 0 to 5 scale, with higher being more confident.

older adults and patient previsit engagement efforts can be augmented by developing interactive deprescribing websites with helpful video vignettes and other educational tools; (2) multiple chronic conditions: most older patients with diabetes also have other concurrent chronic conditions that require lifestyle and medication therapy, and future research can develop strategies to improve diabetes care that is individualized to each patient's overall clinical context; and (3) whole-patient perspective: in addition to concurrent chronic conditions, many older patients experience social barriers to care such as food insecu-

rity, housing instability, and transportation barriers; for these highest-risk individuals, efforts to address diabetes medication safety could be integrated into a whole-patient intervention that helps patients identify, prioritize, and address the full range of clinical and social needs that create barriers to safe care and optimal health.

Limitations

Results must be interpreted in the context of the study design. First, the randomized clinical trial compared 2 active arms since PCPs from both arms received the AD. Comparison to concurrent deprescribing rates was therefore examined using 2 distinct usual care parallel cohorts. While we controlled for baseline demographic differences, residual confounding may remain. However, the results likely reflect a true benefit of AD given the consistently and considerably greater deprescribing seen among patients of PCPs receiving AD compared to both cohorts in multilevel models. Second, due to changes in mode of care delivery during and following the COVID-19 pandemic, we were unable to conduct in-person education or support. However, the successful results using virtual methods have the effect of making the intervention more easily disseminated given the lower barriers to implementation. Third, we did not directly assess the extent of shared decision-making or patient satisfaction with the use of the previsit activation handout. Future studies involving direct analysis of visit dialogue could address these questions. Although only a proxy for visit interactions, the finding of statistically significant greater diabetes-specific documentation in the AD plus previsit arm suggests that visits in this arm more often included discussion of diabetes than visits in the AD-only arm. Finally, this study was conducted within a single integrated care delivery system. Because older patients with type 2 diabetes within KPNC have largely similar demographic, insurance, and clinical characteristics as US national patterns, the clinical findings are largely generalizable. Dissemination to other clinical settings, however, will require development of local strategies for delivery of AD sessions and for providing patients with the previsit medication handout.

Conclusions

In this randomized clinical trial, AD was an effective strategy for increasing diabetes medication deprescribing among older patients with type 2 diabetes. The impact of this strategy was augmented by directly involving and preparing patients before the visit by providing a simple 1-page handout. Further research on deprescribing with larger sample sizes may be required to demonstrate the hypothesized causal link between safe deprescribing and reduced hypoglycemia-related complications. Next steps in the effort to change diabetes management for older high-risk patients may further benefit from also including system-level and policy-level interventions.

ARTICLE INFORMATION

Accepted for Publication: March 31, 2025.

Published Online: June 23, 2025. doi:10.1001/jamainternmed.2025.2015

Author Contributions: Dr Grant had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Grant, Karter.
Acquisition, analysis, or interpretation of data: Peterson, McCloskey, Lipska, Nugent, Gilliam.
Drafting of the manuscript: Grant.
Critical review of the manuscript for important intellectual content: Peterson, McCloskey, Lipska, Nugent, Karter, Gilliam.
Statistical analysis: McCloskey, Nugent.
Obtained funding: Grant.
Administrative, technical, or material support: Peterson, McCloskey, Karter.
Supervision: Grant.

Conflict of Interest Disclosures: Dr Lipska reported grants from the National Institute of Diabetes and Digestive and Kidney Diseases, personal fees from UpToDate to write and edit content, and other support from the Centers for Medicare & Medicaid Services to design and evaluate publicly reported quality measures outside the submitted work. Dr Karter reported grants from Dexcom outside the submitted work. No other disclosures were reported.

Funding/Support: This study was funded by the Patient-Centered Outcomes Research Institute (CDR 2019C1-16126).

Role of the Funder/Sponsor: The Patient-Centered Outcomes Research Institute had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Data Sharing Statement: See Supplement 3.

Additional Contributions: We thank the physicians, medical assistants, stakeholders, and patients for their participation in this project. We also thank Kari Berglund, MPH, and Connie S. Uratsu, RN, MS, PHN, both of KPNC, for analytic support and advice related to trial conduct. Patients received a gift card for completing surveys, otherwise contributors were not compensated for their contributions.

REFERENCES

1. McCoy RG, Lipska KJ, Yao X, Ross JS, Montori VM, Shah ND. Intensive treatment and severe hypoglycemia among adults with type 2 diabetes. *JAMA Intern Med*. 2016;176(7):969-978. doi:10.1001/jamainternmed.2016.2275

2. Lipska KJ, Ross JS, Miao Y, Shah ND, Lee SJ, Steinman MA. Potential overtreatment of diabetes mellitus in older adults with tight glycemic control. *JAMA Intern Med*. 2015;175(3):356-362. doi:10.1001/jamainternmed.2014.7345

3. Pathak RD, Schroeder EB, Seaquist ER, et al; SUPREME-DM Study Group. Severe hypoglycemia requiring medical intervention in a large cohort of adults with diabetes receiving care in U.S. integrated health care delivery systems: 2005-2011. *Diabetes Care*. 2016;39(3):363-370. doi:10.2337/dc15-0858

4. Zwarenstein M, Treweek S, Gagnier JJ, et al; CONSORT group; Pragmatic Trials in Healthcare (Practihc) group. Improving the reporting of pragmatic trials: an extension of the CONSORT statement. *BMJ*. 2008;337:a2390. doi:10.1136/bmj.a2390

5. Feinkohl I, Aung PP, Keller M, et al; Edinburgh Type 2 Diabetes Study (ET2DS) Investigators. Severe hypoglycemia and cognitive decline in older people with type 2 diabetes: the Edinburgh type 2 diabetes study. *Diabetes Care*. 2014;37(2):507-515. doi:10.2337/dc13-1384

6. Whitmer RA, Karter AJ, Yaffe K, Quesenberry CP Jr, Selby JV. Hypoglycemic episodes and risk of dementia in older patients with type 2 diabetes mellitus. *JAMA*. 2009;301(15):1565-1572. doi:10.1001/jama.2009.460

7. Kalyani RR, Tian J, Xue QL, et al. Hyperglycemia and incidence of frailty and lower extremity mobility limitations in older women. *J Am Geriatr Soc*. 2012;60(9):1701-1707. doi:10.1111/j.1532-5415.2012.04099.x

8. Moffet HH, Huang ES, Liu JY, et al. Severe hypoglycemia and falls in older adults with diabetes: the Diabetes & Aging Study. *Diabet Epidemiol Manag*. 2023;12:100162. doi:10.1016/j.deman.2023.100162

9. Green AJ, Fox KM, Grandy S; SHIELD Study Group. Self-reported hypoglycemia and impact on quality of life and depression among adults with type 2 diabetes mellitus. *Diabetes Res Clin Pract*. 2012;96(3):313-318. doi:10.1016/j.diabres.2012.01.002

10. Majumdar SR, Hemmelgarn BR, Lin M, McBrien K, Manns BJ, Tonelli M. Hypoglycemia associated with hospitalization and adverse events in older people: population-based cohort study. *Diabetes Care*. 2013;36(11):3585-3590. doi:10.2337/dc13-0523

11. Lipska KJ, Ross JS, Wang Y, et al. National trends in US hospital admissions for hyperglycemia and hypoglycemia among Medicare beneficiaries, 1999 to 2011. *JAMA Intern Med*. 2014;174(7):1116-1124. doi:10.1001/jamainternmed.2014.1824

12. Bonds DE, Miller ME, Bergenstal RM, et al. The association between symptomatic, severe hypoglycaemia and mortality in type 2 diabetes: retrospective epidemiological analysis of the ACCORD study. *BMJ*. 2010;340:b4909. doi:10.1136/bmj.b4909

13. Ali MK, Bullard KM, Saaddine JB, Cowie CC, Imperatore G, Gregg EW. Achievement of goals in U.S. diabetes care, 1999-2010. *N Engl J Med*. 2013;368(17):1613-1624. doi:10.1056/NEJMsa1213829

14. Tricco AC, Ivers NM, Grimshaw JM, et al. Effectiveness of quality improvement strategies on the management of diabetes: a systematic review and meta-analysis. *Lancet*. 2012;379(9833):2252-2261. doi:10.1016/S0140-6736(12)60480-2

15. Weiner JZ, Gopalan A, Mishra P, et al. Use and discontinuation of insulin treatment among adults aged 75 to 79 years with type 2 diabetes. *JAMA Intern Med*. 2019;179(12):1633-1641. doi:10.1001/jamainternmed.2019.3759

16. Lipska KJ, Montori VM. Glucose control in older adults with diabetes mellitus—more harm than good? *JAMA Intern Med*. 2013;173(14):1306-1307. doi:10.1001/jamainternmed.2013.6189

17. Lee SJ. So much insulin, so much hypoglycemia. *JAMA Intern Med*. 2014;174(5):686-688. doi:10.1001/jamainternmed.2013.13307

18. American Diabetes Association. 12. Older Adults: *Standards of Medical Care in Diabetes—2019. Diabetes Care*. 2019;42(suppl 1):S139-S147. doi:10.2337/dc19-S012

19. Moreno G, Mangione CM, Kimbro L, Vaisberg E; American Geriatrics Society Expert Panel on Care of Older Adults with Diabetes Mellitus. Guidelines abstracted from the American Geriatrics Society Guidelines for Improving the Care of Older Adults with Diabetes Mellitus: 2013 update. *J Am Geriatr Soc*. 2013;61(11):2020-2026. doi:10.1111/jgs.12514

20. Qaseem A, Wilt TJ, Kansagara D, et al; Clinical Guidelines Committee of the American College of Physicians. Hemoglobin A_{1c} targets for glycemic control with pharmacologic therapy for nonpregnant adults with type 2 diabetes mellitus: a guidance statement update from the American College of Physicians. *Ann Intern Med*. 2018;168(8):569-576. doi:10.7326/M17-0939

21. Thompson W, Farrell B. Deprescribing: what is it and what does the evidence tell us? *Can J Hosp Pharm*. 2013;66(3):201-202. doi:10.4212/cjhp.v66i3.1261

22. Scott IA, Hilmer SN, Reeve E, et al. Reducing inappropriate polypharmacy: the process of deprescribing. *JAMA Intern Med*. 2015;175(5):827-834. doi:10.1001/jamainternmed.2015.0324

23. Fried TR, Ouyang N, Gnjidic D, et al. Communication as a key component of deprescribing: conceptual framework and review of the literature. *J Am Geriatr Soc*. 2025;73(3):717-727. doi:10.1111/jgs.19305

24. Farrell B, Black C, Thompson W, et al. Deprescribing antihyperglycemic agents in older persons: evidence-based clinical practice guideline. *Can Fam Physician*. 2017;63(11):832-843.

25. Munshi MN, Slyne C, Segal AR, Saul N, Lyons C, Weinger K. Simplification of insulin regimen in older adults and risk of hypoglycemia. *JAMA Intern Med*. 2016;176(7):1023-1025. doi:10.1001/jamainternmed.2016.2288

26. International Hypoglycaemia Study Group. Hypoglycaemia, cardiovascular disease, and mortality in diabetes: epidemiology, pathogenesis, and management. *Lancet Diabetes Endocrinol*. 2019;7(5):385-396. doi:10.1016/S2213-8587(18)30315-2

27. Ammerman CA, Simpkins BA, Warman N, Downs TN. Potentially inappropriate medications in older adults: deprescribing with a clinical pharmacist. *J Am Geriatr Soc*. 2019;67(1):115-118. doi:10.1111/jgs.15623

28. Page AT, Potter K, Clifford R, Etherton-Beer C. Deprescribing in older people. *Maturitas*. 2016;91:115-134. doi:10.1016/j.maturitas.2016.06.006

29. Gnjidic D, Le Couteur DG, Kouladjian L, Hilmer SN. Deprescribing trials: methods to reduce polypharmacy and the impact on prescribing and clinical outcomes. *Clin Geriatr Med*. 2012;28(2):237-253. doi:10.1016/j.cger.2012.01.006

30. Fajardo MA, Weir KR, Bonner C, Gnjidic D, Jansen J. Availability and readability of patient education materials for deprescribing: an environmental scan. *Br J Clin Pharmacol*. 2019;85(7):1396-1406. doi:10.1111/bcp.13912

31. Page AT, Etherton-Beer CD, Clifford RM, Burrows S, Eames M, Potter K. Deprescribing in frail older people—do doctors and pharmacists agree? *Res Social Adm Pharm*. 2016;12(3):438-449. doi:10.1016/j.sapharm.2015.08.011

32. Page AT, Clifford RM, Potter K, Schwartz D, Etherton-Beer CD. The feasibility and effect of deprescribing in older adults on mortality and health: a systematic review and meta-analysis. *Br J Clin Pharmacol*. 2016;82(3):583-623. doi:10.1111/bcp.12975

33. Iyer S, Naganathan V, McLachlan AJ, Le Couteur DG. Medication withdrawal trials in people aged 65 years and older: a systematic review. *Drugs Aging*. 2008;25(12):1021-1031. doi:10.2165/0002512-200825120-00004

34. Sarkar U, Lyles C, Steinman M, et al. Changes in medication use after dementia diagnosis in an observational cohort of individuals with diabetes mellitus. *J Am Geriatr Soc*. 2017;65(1):77-82. doi:10.1111/jgs.14429

35. Seidu S, Kunutsor SK, Topsever P, Hambling CE, Cos FX, Khunti K. Deintensification in older patients with type 2 diabetes: a systematic review of approaches, rates and outcomes. *Diabetes Obes Metab*. 2019;21(7):1668-1679. doi:10.1111/dom.13724

36. O'Brien MA, Rogers S, Jamtvedt G, et al. Educational outreach visits: effects on professional practice and health care outcomes. *Cochrane Database Syst Rev*. 2007;2007(4):CD000409. doi:10.1002/14651858.CD000409.pub2

37. Vo MT, Uratsu CS, Estacio KR, et al. Prompting patients with poorly controlled diabetes to identify visit priorities before primary care visits: a pragmatic cluster randomized trial. *J Gen Intern Med*. 2019;34(6):831-838. doi:10.1007/s11606-018-4756-4

38. Grant RW, Adams AS, Bayliss EA, Heisler M. Establishing visit priorities for complex patients: a summary of the literature and conceptual model to guide innovative interventions. *Healthc (Amst)*. 2013;1(3-4):117-122. doi:10.1016/j.hjdsi.2013.07.008

39. Laraia BA, Karter AJ, Warton EM, Schillinger D, Moffet HH, Adler N. Place matters: neighborhood deprivation and cardiometabolic risk factors in the Diabetes Study of Northern California (DISTANCE). *Soc Sci Med*. 2012;74(7):1082-1090. doi:10.1016/j.socscimed.2011.11.036

40. Ali MK, Bullard KM, Gregg EW, Del Rio C. A cascade of care for diabetes in the United States: visualizing the gaps. *Ann Intern Med*. 2014;161(10):681-689. doi:10.7326/M14-0019

41. 2019 American Geriatrics Society Beers Criteria Update Expert Panel. American Geriatrics Society 2019 Updated AGS Beers Criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 2019;67(4):674-694. doi:10.1111/jgs.15767

42. Avorn J, Soumerai SB. Improving drug-therapy decisions through educational outreach: a randomized controlled trial of academically based "detailing". *N Engl J Med*. 1983;308(24):1457-1463. doi:10.1056/NEJM198306163082406

43. Fischer MA, Avorn J. Academic detailing can play a key role in assessing and implementing comparative effectiveness research findings. *Health Aff (Millwood)*. 2012;31(10):2206-2212. doi:10.1377/hlthaff.2012.0817

44. Avorn J. Academic detailing: "marketing" the best evidence to clinicians. *JAMA*. 2017;317(4):361-362. doi:10.1001/jama.2016.16036

45. Fralick M, Kesselheim A, Avorn J. Applying academic detailing and process change to promote Choosing Wisely. *JAMA Intern Med*. 2017;177(2):282. doi:10.1001/jamainternmed.2016.8503

46. Greenfield S, Kaplan S, Ware JE Jr. Expanding patient involvement in care: effects on patient outcomes. *Ann Intern Med*. 1985;102(4):520-528. doi:10.7326/0003-4819-102-4-520

47. Greenfield S, Kaplan SH, Ware JE Jr, Yano EM, Frank HJ. Patients' participation in medical care: effects on blood sugar control and quality of life in diabetes. *J Gen Intern Med*. 1988;3(5):448-457. doi:10.1007/BF02595921

48. Fitzgerald JT, Davis WK, Connell CM, Hess GE, Funnell MM, Hiss RG. Development and validation of the Diabetes Care Profile. *Eval Health Prof*. 1996;19(2):208-230. doi:10.1177/016327879601900205

49. McGuire BE, Morrison TG, Hermanns N, et al. Short-form measures of diabetes-related emotional distress: the Problem Areas in Diabetes Scale (PAID)-5 and PAID-1. *Diabetologia*. 2010;53(1):66-69. doi:10.1007/s00125-009-1559-5

50. Maly RC, Frank JC, Marshall GN, DiMatteo MR, Reuben DB. Perceived efficacy in patient-physician interactions (PEPPI): validation of an instrument in older persons. *J Am Geriatr Soc*. 1998;46(7):889-894. doi:10.1111/j.1532-5415.1998.tb02725.x

51. Tannenbaum C, Martin P, Tamblyn R, Benedetti A, Ahmed S. Reduction of inappropriate benzodiazepine prescriptions among older adults through direct patient education: the EMPOWER cluster randomized trial. *JAMA Intern Med*. 2014;174(6):890-898. doi:10.1001/jamainternmed.2014.949

52. Jones KF, Stolzmann K, Wormwood J, et al. Patient-directed education to promote deprescribing: a nonrandomized clinical trial. *JAMA Intern Med*. 2024;184(11):1339-1346. doi:10.1001/jamainternmed.2024.4739

53. Fried TR, Ouyang N, Gnjidic D, et al. Communication as a key component of deprescribing: conceptual framework and review of the literature. *J Am Geriatr Soc*. 2025;73(3):717-727. doi:10.1111/jgs.19305