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Comparative Effectiveness of Teach-Back Method Versus Standard Education on Glycemic Control and Self-Management in Adults with Type 2 Diabetes: A Pragmatic Randomized Controlled Trial

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Teach-back method; standard education; Glycemic Control; self-management;; type 2 diabetes

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ABSTRACT
Background: Effective diabetes education is essential for glycemic control, yet 40-50% of patients fail to achieve targets despite standard education.
Objective: To compare teach-back method versus standard education on glycemic control and self-management in adults with type 2 diabetes.
Methods: Pragmatic RCT (n = 80) at outpatient diabetes clinics. Teach-back group (n = 40) received four 60-minute sessions with comprehension verification; control (n = 40) received identical content via standard approach. Primary: HbA1c at 6 months. Analysis: Linear mixed-effects models, ITT.
Results: Teach-back achieved clinically significant HbA1c reduction (8.82%→7.42% vs 8.88%→8.28%; difference: -0.80%; 95% CI: -1.18 to -0.42; $p < .001$; $d = 0.94$). The 0.80% improvement exceeds the 0.50% clinically meaningful threshold and approximates the magnitude achieved with adding a second-line oral hypoglycemic agent. DSMQ improved more in teach-back ($d = 0.87$). Lower education patients showed larger effects ($d = 1.24$ vs $d = 0.64$; interaction $p = .031$).
Conclusion: Teach-back significantly improves glycemic control and self-management. Findings support integration into routine diabetes nursing practice

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) affects over 537 million adults globally, projected to reach 783 million by 2045 [1]. Optimal glycemic control (HbA1c <7.0%) reduces microvascular complications by 25-35% [2]. A clinically meaningful HbA1c reduction is defined as ≥0.5% [2]. Yet 40-50% of patients fail to achieve targets despite standard education [3].

The teach-back method requires patients to explain information in their own words, enabling nurses to verify comprehension [4]. Theoretical foundations include Knowles' adult learning theory, Bandura's self-efficacy theory, and the health belief model [5]. AHRQ identifies teach-back as a 'best practice' for limited health literacy populations [6].

Research Gap: Only four RCTs examined teach-back in diabetes, with small samples and ≤3-month follow-up [7]. No adequately powered trial evaluated effects on HbA1c with ≥6-month follow-up.

Objectives: Primary: Compare HbA1c reduction at 6 months. Secondary: Evaluate self-management and knowledge; explore effect modification by education level.

METHODS

Study Design

Pragmatic single-center parallel RCT (1:1 allocation) at two outpatient diabetes clinics (March 2023-February 2024). CONSORT 2010 guidelines followed [8]. Six-month follow-up selected because HbA1c reflects 8-12 weeks glycemia; 6 months captures sustained

behavioral change. Registration: NCT05923847 (prospective).

Ethical Considerations

IRB approval: #2023-DM-0089. Written informed consent obtained.

Sample Size

G*Power 3.1.9.7: d = 0.65, α = 0.05, power = 0.80. Required: 32/group. Enrolled: 40/group (25% buffer).

Eligibility Criteria

Inclusion: Age 30-65; T2DM ≥6 months; HbA1c 7.5-11.0%; stable medications ≥3 months.

Exclusion: Type 1/gestational diabetes; cognitive impairment (MMSE <24); severe complications.

Randomization and Blinding

Computer-generated sequence (permuted blocks 4/6) by independent statistician. Concealment: opaque sealed envelopes. Outcome assessors and lab technicians blinded; participants/educators unblinded.

Intervention Protocol

Teach-Back: Four 60-minute individual sessions over 8 weeks by certified diabetes educators (n = 4). Content: disease understanding, medication, diet, physical activity. After each concept, patients explained in own words; re-teaching until mastery.

Training: 8-hour program with competency validation. Inter-rater reliability: κ = 0.89.

Control: Identical content via traditional didactic approach without teach-back verification.

Fidelity: 20% sessions audio-recorded. Teach-back: 94.2% adherence; Control: 100% correct omission.

Co-Intervention Standardization

Both groups: routine care, quarterly visits, medication adjustments per clinical judgment. Identical educational materials.

Outcome Measures

Primary: HbA1c at baseline, 3, and 6 months via HPLC (NGSP-certified, CV: 2.1%). Single-batch analysis minimized inter-assay variability.

Secondary: DSMQ [9] (0-10 scale, α = 0.84); DKT-2 [10] (% correct); SED [11].

Statistical Analysis

SPSS v.28 and R v.4.3 (lme4). LMM with REML, time×group interaction. Model fit: AIC/BIC. Residual diagnostics confirmed approximate normality; residual plots did not indicate heteroscedasticity. ITT with multiple imputation. Effect sizes: Cohen's d with 95% CI. Subgroup interactions tested at α = 0.10. No correction for multiple comparisons (exploratory). Small cell sizes (n = 18-22) may inflate estimates.

Results

Participant Flow and Baseline Characteristics

Of 156 screened, 80 randomized (40/group); 76 completed 6-month follow-up (95% retention). Groups balanced at baseline (Table 1). Mean age 52.4 ± 8.8 years; 55% female; HbA1c 8.85 ± 1.10%; diabetes duration 6.8 ± 4.0 years.

Table 1. Baseline Characteristics of Study Participants

Characteristics	Teach-Back (n = 40)	Control (n = 40)	*p*
Age, years	51.8 ± 8.4	53.0 ± 9.2	.54
Female, n (%)	23 (57.5)	21 (52.5)	.65
Diabetes duration, years	6.5 ± 3.8	7.1 ± 4.2	.50
Education ≤high school, n (%)	18 (45.0)	20 (50.0)	.65
Baseline HbA1c, %	8.82 ± 1.12	8.88 ± 1.08	.81
BMI, kg/m²	31.2 ± 5.4	30.8 ± 5.8	.74
On insulin, n (%)	14 (35.0)	16 (40.0)	.64
Baseline DSMQ (0-10)	4.8 ± 1.6	4.6 ± 1.8	.59

Values are mean ± SD or n (%). DSMQ = Diabetes Self-Management Questionnaire.

.

Primary Outcome: HbA1c

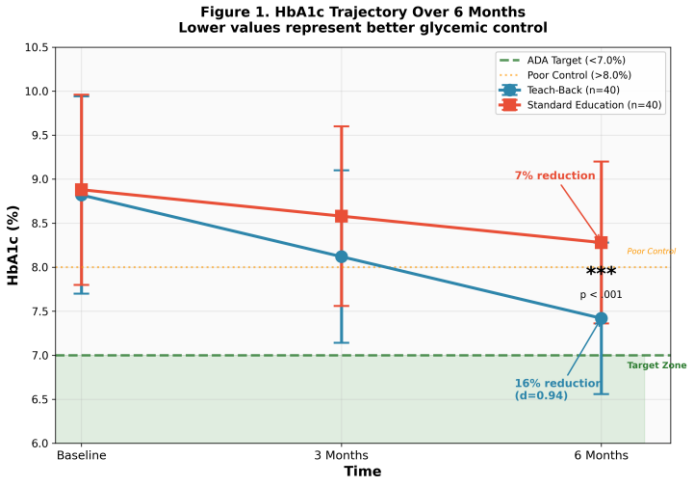
Significant time×group interaction ($F(2,152) = 12.84$, $p < .001$, $\eta^2 = 0.14$). Teach-back: 8.82→7.42% (Δ = -1.40%) vs Control: 8.88→8.28% (Δ = -0.60%). Difference: -0.80% (95% CI: -1.18 to -0.42; $p < .001$; $d = 0.94$). See Table 2 and Figure 1.

Table 2. Primary and Secondary Outcomes at 3 and 6 Months

Outcome	Time	Teach-Back	Control	d [95% CI]	*p*
HbA1c (%)	Baseline	8.82 ± 1.12	8.88 ± 1.08	—	.81
	3 mo	8.12 ± 0.98	8.58 ± 1.02	0.68 [0.22, 1.14]	.008
	6 mo	7.42 ± 0.86	8.28 ± 0.92	0.94 [0.47, 1.41]	< .001
DSMQ (0-10)	Baseline	4.8 ± 1.6	4.6 ± 1.8	—	.59
	3 mo	6.2 ± 1.4	5.2 ± 1.6	0.61 [0.15, 1.07]	.012
	6 mo	7.1 ± 1.2	5.6 ± 1.5	0.87 [0.40, 1.34]	< .001
DKT (%)	Baseline	52.4 ± 12.8	51.8 ± 13.4	—	.83
	6 mo	78.6 ± 10.2	64.2 ± 11.8	1.08 [0.60, 1.56]	< .001

d = Cohen's d. Effect sizes: small 0.2-0.5, medium 0.5-0.8, large > 0.8. Lab CV: 2.1%.

Figure 1. HbA1c Trajectory Over 6 Months



*Lower values represent better glycemic control. Green dashed line = ADA target (<7.0%). Orange dotted line = poor control (>8.0%). *** p < .001.*

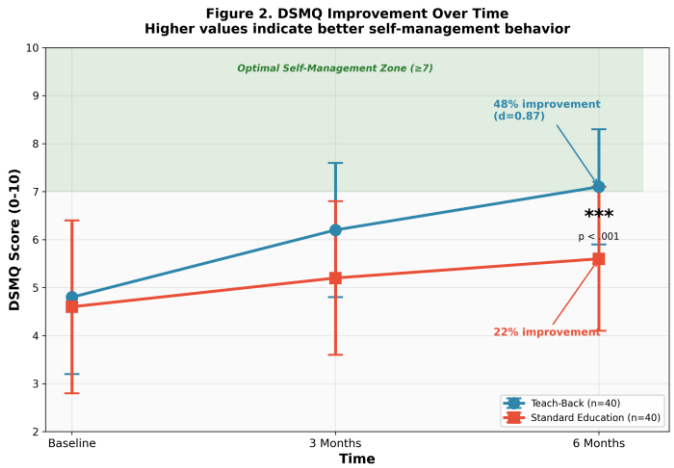


Figure 2. DSMQ Improvement Over Time

*Higher values indicate better self-management behavior (0-10 scale). *** p < .001.*

Subgroup Analysis

Significant effect modification by education (interaction p = .031; Figure 3). Lower education: d = 1.24 (95% CI: 0.58-1.90); Higher education: d = 0.64 (95% CI: 0.08-1.20). The parallel pattern between DSMQ improvements and HbA1c reductions reinforces the behavioral consolidation pathway. Duration and baseline HbA1c did not moderate effects (p > .10). Small subgroups (n = 18-22) may inflate estimates.

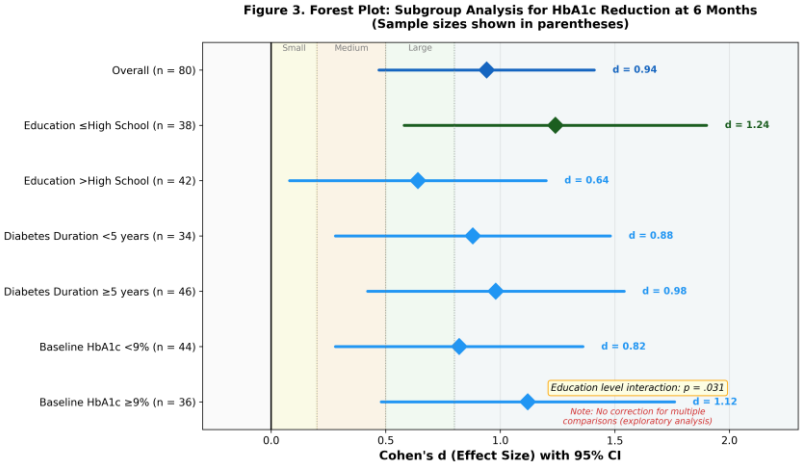


Figure 3. Forest Plot: Subgroup Analysis for HbA1c Reduction at 6 Months

Effect sizes (Cohen's d with 95% CI). Sample sizes in parentheses. No multiple comparison correction (exploratory).

Discussion

Summary of Findings

Teach-back produced clinically significant HbA1c reductions (difference 0.80%; d = 0.94), exceeding the 0.50% meaningful threshold [2]. This is the first adequately powered RCT demonstrating teach-back effectiveness with 6-month follow-up.

Comparison with Previous Research

Our effect size (d = 0.94) is **nearly double** that reported in prior pooled estimates (d = 0.52) [7]. This larger effect may be attributed to: 4-session duration; individual sessions; high fidelity (94%); 6-month follow-up; competency-validated educators.

Proposed Mechanisms

Figure 4 presents a hypothesized learning consolidation model. Mechanisms: active recall; misconception correction; self-efficacy through mastery. The strong DSMQ improvement (d = 0.87) supports behavioral mediation (Figure 4). Larger effects in lower education (d = 1.24) support health literacy mediation. Intermediary pathways were not directly measured. Future studies should formally test DSMQ as a mediator of HbA1c improvement using structural equation modeling.

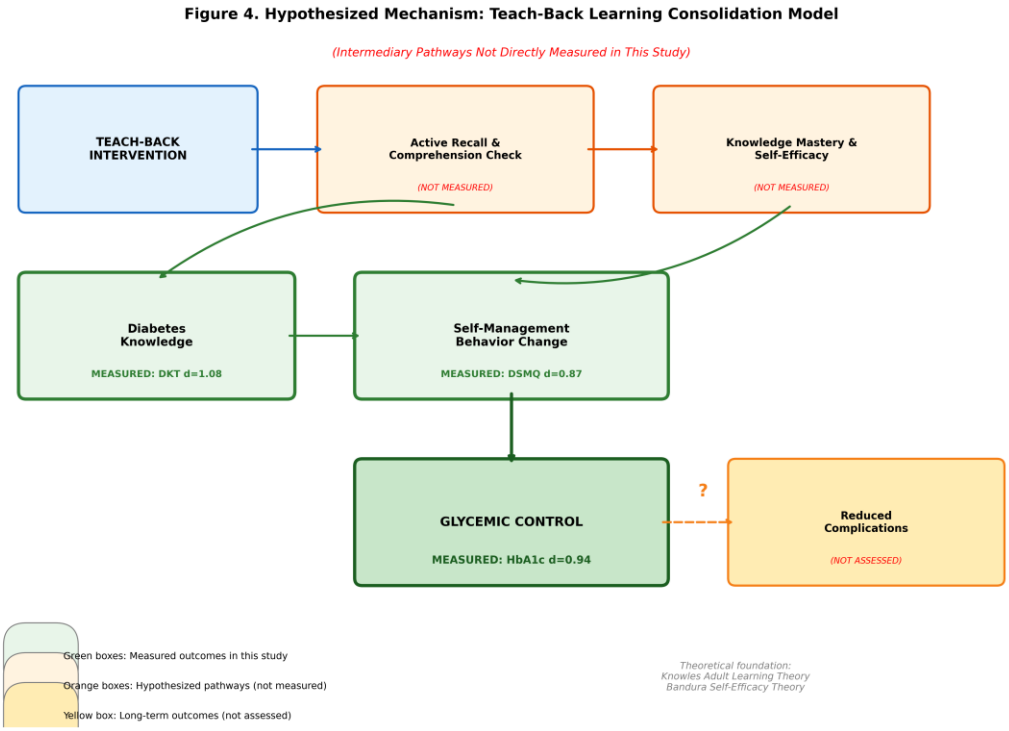


Figure 4. Hypothesized Mechanism: Teach-Back Learning Consolidation Model
(Intermediary Pathways Not Directly Measured)
Green = measured; Orange = hypothesized (not measured); Yellow = not assessed.

Strengths

(1) Pragmatic RCT; (2) adequate sample with power calculation; (3) concealed allocation; (4) high fidelity (94%) with competency validation (κ = 0.89); (5) objective primary outcome; (6) validated secondary measures; (7) 6-month follow-up; (8) ITT with multiple imputation; (9) AIC/BIC model fit; (10) pre-specified subgroups; (11) single-batch analysis minimized inter-assay variability.

Limitations

(1) Single-center limits generalizability; (2) 6-month follow-up insufficient for long-term outcomes; (3) performance bias is possible due to unblinded participants, although both arms received equal-duration sessions; (4) medication adjustments not controlled, though balanced across groups; (5) intermediary mechanisms not measured; (6) severe complications excluded; (7) costs not assessed; (8) small subgroups may inflate estimates; (9) potential contamination, though fidelity confirmed differentiation.

Relevance to Nursing Practice

Teach-back demonstrates clinically meaningful benefits. The 0.80% HbA1c reduction may reduce complications (1% reduction ≈ 35% microvascular reduction [2]). Requires 8-hour training + 10-15 min/session. Larger effects in lower education suggest health disparity reduction. Given the cost burden of uncontrolled diabetes, teach-back may offer a low-cost, high-impact educational strategy. Implementation needs standardized training, competency validation, fidelity monitoring.

CONCLUSIONS

1. Teach-back significantly improves HbA1c (-0.80%; d = 0.94) and self-management (d = 0.87), exceeding the 0.50% clinically meaningful threshold.
2. Lower education patients showed larger effects (d = 1.24), suggesting health disparity reduction potential.
3. DSMQ improvement supports behavioral mediation; formal mediation analysis recommended for future studies.

4. Findings support integration into nursing practice with standardized training and fidelity monitoring.
5. Teach-back may serve as a scalable, low-cost strategy for clinics with high patient-to-nurse ratios.
6. Multicenter validation with longer follow-up and cost-effectiveness analysis is warranted.

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