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# REDUCTION IN POLYPHARMACY BURDEN AMONG TYPE 2 DIABETES MELLITUS PATIENTS THROUGH COMPREHENSIVE DIABETES CARE PLAN-BASED INTEGRATIVE MANAGEMENT: IMPLICATIONS FOR ADVERSE DRUG INTERACTION RISK AND HEALTH SYSTEM COST

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**ABSTRACT**

**Background:** Polypharmacy — conventionally defined as the concurrent use of five or more medications — is prevalent among patients with Type 2 Diabetes Mellitus (T2DM) and is associated with adverse drug interactions, treatment non-adherence, and escalating healthcare costs. Integrative management programmes combining Panchakarma-based therapies, structured dietary intervention, and allopathic co-management have shown promise in glycaemic control, yet their impact on medication burden has not been systematically characterised. **Objective:** To quantify the reduction in allopathic antidiabetic medication burden in T2DM patients enrolled in the Comprehensive Diabetes Care (CDC) programme at Madhavbaug Integrative Clinic, Amravati, Maharashtra, and to assess associated changes in cardiometabolic parameters and post-treatment glycaemic remission. **Methods:** A retrospective before-after observational study was conducted on 39 T2DM patients enrolled in the Comprehensive Diabetes Care (CDC) programme at Amravati Fr clinic, Vidharbha RIC. Drug burden at enrolment and at last follow-up was quantified by counting individual allopathic agents listed per patient. Primary outcome was the proportion achieving ≥50% medication reduction or complete cessation. Secondary outcomes included changes in HbA1c, fasting blood glucose (RBS), systolic blood pressure (SBP), weight, and BMI. Paired t-tests and descriptive statistics were applied. Reporting followed the STROBE checklist for observational studies. **Results:** Of 39 CDC-enrolled patients (mean age 51.0 ± 10.1 years; 54% male), 25 (64.1%) were on allopathic OHA at enrolment with a mean drug count of 3.24 ± 2.50 agents. Mean drug count at last follow-up decreased significantly to 2.08 ± 2.40 (paired t=3.32, p=0.0029). Complete medication cessation was achieved in 6 patients (24.0% of OHA-positive cohort), and ≥50% reduction in 12 patients (48.0%). Polypharmacy (five or more drugs) was present in 5 patients at baseline and reduced to 2 at follow-up. HbA1c declined significantly from 9.09 ± 3.6% to 7.87 ± 2.7% (p=0.0040; Cohen's d=0.56). SBP reduced from 124.2 to 119.1 mmHg (p=0.013), weight from 68.9 to 66.5 kg (p<0.001), and BMI from 26.1 to 25.2 kg/m² (p<0.001). Four patients (10.3% of total cohort) achieved post-treatment glucose tolerance test (GTT) negativity, consistent with programme-associated glycaemic remission. **Conclusion:** The CDC programme was associated with significant reduction in allopathic medication burden alongside clinically meaningful cardiometabolic improvement. These findings suggest that structured integrative diabetes management may offer a viable deprescription pathway, with implications for adverse drug interaction risk reduction and out-of-pocket healthcare cost. Multi-site, prospective replication with standardised follow-up is warranted.

**KEYWORDS:** polypharmacy; deprescription; Type 2 Diabetes Mellitus; Panchakarma; integrative medicine; Comprehensive Diabetes Care; medication burden; glycaemic remission; adverse drug interactions; India.

## 1. INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a leading cause of morbidity, premature mortality, and healthcare expenditure globally, with India carrying the second-largest absolute diabetes burden, estimated at 101 million adults as of 2023.[1] The progressive nature of T2DM, compounded by high rates of comorbid hypertension, dyslipidaemia, and cardiovascular disease, frequently necessitates multi-drug pharmacological regimens.[2] Polypharmacy — commonly defined as the concurrent use of five or more medications, though definitions in the literature range from two to ten or more drugs — is therefore highly prevalent in this population.[3]

The clinical consequences of polypharmacy in T2DM are well-documented. Patients on five or more agents demonstrate significantly higher rates of adverse drug reactions, drug-drug interactions, medication non-adherence, and treatment-related hypoglycaemia compared to those on simplified regimens.[4,5] In the Indian context, where out-of-pocket pharmaceutical expenditure constitutes a major driver of catastrophic health spending, medication burden carries additional economic significance.[6] Paradoxically, guideline-driven intensification of pharmacological therapy — particularly with newer-class agents such as SGLT-2 inhibitors, GLP-1 receptor agonists, and DPP-4 inhibitors — may itself contribute to polypharmacy while delivering cardiovascular and renal benefits.[7]

Deprescription — the systematic, evidence-based reduction or cessation of medications that are no longer beneficial or that carry disproportionate risk relative to benefit — has emerged as a priority in diabetes management, particularly in older adults and those with multimorbidity.[8] However, deprescription in clinical practice has predominantly been conceptualised as a pharmaceutical or geriatric intervention, with limited published evidence on deprescription outcomes achievable through structured integrative management programmes.[9]

The Comprehensive Diabetes Care (CDC) programme, delivered within the Madhavbaug Integrative Clinic network across Vidharbha, Maharashtra, combines structured Panchakarma-based procedural intervention (Snehana, Swedana, Basti), a patent Ayurvedic dietary kit, physician-supervised allopathic co-management, and personalised diet counselling across tiered care plan variants. Existing evidence from this network has demonstrated significant HbA1c and weight reduction across multi-site cohorts[10,11], and a dose-response relationship between Panchakarma session completion and glycaemic improvement has been identified (Spearman $\rho=0.616$, $p<0.0001$) at the Medical Square, Nagpur site.[12] However, the programme's impact on allopathic medication burden has not been formally reported.

The present study addresses this gap by quantifying medication reduction outcomes in a CDC-enrolled T2DM cohort at the Amravati Fr clinic, Vidharbha RIC, and contextualising these within associated cardiometabolic changes. We additionally report a subset of patients achieving post-treatment glucose tolerance test negativity — constituting programme-associated glycaemic remission by contemporary criteria — and discuss implications for adverse drug interaction risk reduction and health system cost.

## 2. METHODS

### *2.1 Study Design and Setting*

This was a retrospective before-after observational cohort study conducted at the Madhavbaug Integrative Clinic, Amravati Fr, Vidharbha Research and Innovation Centre (Vidharbha RIC), Maharashtra, India. The clinic operates within the Madhavbaug Cardiac Clinics network and delivers structured integrative diabetes care across a defined patient population in the Vidharbha region. Data were extracted from the clinic's electronic patient management system for all patients enrolled in the Comprehensive Diabetes Care (CDC) programme with a registered care plan date and at least one follow-up record.

### *2.2 Study Population*

Inclusion criteria were: (i) confirmed diagnosis of Type 2 Diabetes Mellitus (established prior to enrolment by treating physician, with supporting glycaemic parameters including RBS and/or HbA1c); (ii) enrolment in a CDC care plan variant; (iii) availability of both enrolment-day and last-follow-up allopathic medication records. Exclusion criteria were: (i) enrolment in Navjeevan DM or Exercise-only care plans; (ii) records with all-zero vital parameters across all fields, indicating data-entry absence rather than true measurement; (iii) patients with a documented GTT-negative reclassification at baseline (indicating absence of diabetes at enrolment). One data entry outlier (last recorded weight of 5.2 kg in a female patient, corrected to 52.0 kg based on contextual and BMI-corroborated evidence) was corrected prior to analysis.

### *2.3 Intervention: Comprehensive Diabetes Care Programme*

The CDC programme is a multi-component integrative intervention comprising:

Panchakarma procedural therapy: Snehana (internal and external oleation with medicated oils), Swedana (sudation via medicated steam), and Basti (medicated enema containing herb-formulated Basti kadha incorporating.

*Gymnema sylvestre*, *Berberis aristata*, and ancillary herbs). Sessions were delivered in a structured protocol; expected session counts varied by care plan tier, with base-level plans prescribing fewer sessions and advanced plans prescribing the highest session targets.

Madhavbaug patent dietary kit: a standardised nutritional supplement formulation administered as part of the daily dietary protocol.

Physician-supervised allopathic co-management: treating physicians reviewed allopathic medications at each visit, with adjustments made based on glycaemic response and clinical judgment. Medication reduction was clinician-directed and not protocol-mandated.

Diet counselling and lifestyle modification: personalised dietary advice delivered by trained healthcare staff at enrolment and follow-up visits.

### *2.4 Outcome Measures*

The primary outcome was the proportion of OHA-positive patients achieving (a) complete allopathic OHA cessation (100% drug count reduction) and (b) ≥50% reduction in allopathic drug count. Drug count was defined as the number of individual named allopathic agents listed in the patient's medication record at enrolment (Day 1) and at last follow-up, respectively. Patients documented as 'NOT ON OHA', 'NOT ON MEDICINE', or equivalent at enrolment were classified as OHA-negative and excluded from the primary outcome denominator.

Secondary outcomes included: paired changes in HbA1c (%), fasting random blood glucose (RBS, mg/dL), systolic blood pressure (SBP, mmHg), body weight (kg), and BMI (kg/m²). Post-treatment GTT-negative status was identified from clinical records and characterised as a descriptive sub-outcome.

### *2.5 Statistical Analysis*

Continuous variables are reported as mean ± standard deviation. Before-after comparisons were made using paired two-tailed t-tests for normally distributed variables. Effect size was estimated using Cohen's d. Polypharmacy was defined as concurrent use of five or more allopathic agents, consistent with the World Health Organization and commonly adopted clinical definitions.[3] All analyses were performed in Python (v3.12) using the pandas and scipy.stats libraries. Statistical significance was set at $p<0.05$. Given the exploratory and hypothesis-generating nature of this single-site observational study, no correction for multiple comparisons was applied; findings are reported with exact p-values to support reader interpretation.

### *2.6 Ethical Considerations*

The study was conducted in accordance with the principles of the Declaration of Helsinki. Patient data were anonymised prior to analysis. Institutional ethics committee review was obtained / is pending [state as applicable]. As this was a retrospective analysis of de-identified routinely collected clinical data, individual patient consent for research use was waived in accordance with applicable institutional guidelines. The study is registered with [Registry Name and Number, if applicable].

## 3. RESULTS

### *3.1 Study Cohort Characteristics*

Thirty-nine patients enrolled in the CDC programme at Amravati Fr clinic were included in the study (Table 1). The mean age was 51.0 ± 10.1 years (range 30–65 years); 21 (53.8%) were male. The predominant diagnosis was Type 2 DM alone (n=22, 56.4%), with comorbid hypertension present in 10 (25.6%), dyslipidaemia in 3 (7.7%), ischaemic heart disease in 2 (5.1%), and hypothyroidism in 2 (5.1%) patients. Mean comorbidity count was 1.69 per patient. Patients were distributed across the full range of CDC care plan tiers based on clinical assessment and programme duration. Mean Panchakarma sessions completed were 8.28 ± 4.28, and mean diet-kriya sessions were 1.03 ± 1.06.

**Table 1: Baseline Characteristics of CDC Programme Patients (n = 39)**

| Characteristic | Value | n (valid) |
|---|---|---|
| Age (years), mean ± SD | 51.0 ± 10.1 | 39 |
| Age range (years) | 30 – 65 | 39 |
| Sex: Male, n (%) | 21 (53.8%) | 39 |
| Sex: Female, n (%) | 18 (46.2%) | 39 |
| DM alone, n (%) | 22 (56.4%) | 39 |
| DM + Hypertension, n (%) | 10 (25.6%) | 39 |
| DM + Dyslipidaemia, n (%) | 3 (7.7%) | 39 |
| DM + IHD / CAD, n (%) | 2 (5.1%) | 39 |
| DM + Hypothyroid, n (%) | 2 (5.1%) | 39 |
| Mean comorbidities per patient | 1.69 | 39 |
| Panchakarma sessions completed, mean ± SD | 8.28 ± 4.28 | 39 |

| | | |
|---|---|---|
| Diet-Kriya sessions, mean ± SD | 1.03 ± 1.06 | 39 |
| Patients on allopathic OHA at Day 1, n (%) | 25 (64.1%) | 39 |
| Polypharmacy at Day 1 (≥5 drugs), n (%) | 5 (12.8%) | 39 |

*SD = standard deviation; OHA = oral hypoglycaemic agent; IHD = ischaemic heart disease; CAD = coronary artery disease.*

### *3.2 Primary Outcome: Medication Burden Reduction*

Among the 25 patients on allopathic OHA at enrolment, the mean number of individual allopathic agents at enrolment was 3.24 ± 2.50, declining to 2.08 ± 2.40 at last follow-up. The mean reduction of 1.16 agents per patient was statistically significant (paired t=3.32, p=0.0029). In polypharmacy terms, 5 patients (12.8% of total cohort) met the ≥5-drug threshold at enrolment; this reduced to 2 patients (5.1%) at follow-up, representing a 60% absolute reduction in polypharmacy prevalence.

Complete allopathic OHA cessation (100% drug count reduction) was achieved by 6 of 25 OHA-positive patients (24.0%). An additional 6 patients achieved 50–99% reduction, bringing the proportion with ≥50% medication reduction to 12 of 25 (48.0%). The medication burden outcomes are summarised in Table 2.

**Table 2: Allopathic Medication Burden Outcomes (n = 25, OHA-positive patients)**

| Medication Outcome Parameter | Day 1 (Enrolment) | Last Follow-up |
|---|---|---|
| Mean drug count, mean ± SD | 3.24 ± 2.50 | **2.08 ± 2.40** |
| Mean drug count change (paired t-test) | — | **−1.16 (p = 0.0029)** |
| Polypharmacy (≥5 drugs), n (%) | 5 (20.0%) | **2 (8.0%)** |
| Complete cessation (100% reduction), n (%) | — | **6 (24.0%)** |
| ≥50% reduction (incl. cessation), n (%) | — | **12 (48.0%)** |
| Any reduction (>0%), n (%) | — | **13 (52.0%)** |
| No change (0%), n (%) | — | 11 (44.0%) |
| Indeterminate / missing, n | — | 1 |

*SD = standard deviation. Bold values indicate statistically significant or clinically notable outcomes. Cessation = all allopathic OHA stopped; drug count confirmed zero at last visit.*

### *3.3 Secondary Outcomes: Cardiometabolic Parameters*

Statistically significant improvements were observed across all primary cardiometabolic parameters (Table 3). HbA1c declined from a mean of 9.09 ± 3.6% at enrolment to 7.87 ± 2.7% at last follow-up, representing a mean reduction of 1.22 percentage points (paired t=3.12, p=0.004; Cohen's d=0.56; n=31 valid pairs). Fasting random blood glucose (RBS) showed a directional decline from 201.2 to 162.6 mg/dL (p=0.072; n=33). Systolic blood pressure reduced from 124.2 to 119.1 mmHg (p=0.013; n=33). Body weight declined significantly from 68.9 to 66.5 kg (p<0.001; n=36), and BMI from 26.1 to 25.2 kg/m² (p<0.001; n=36).

**Table 3: Cardiometabolic Outcomes Before and After CDC Programme (n = 39)**

| Parameter | Enrolment (Mean ± SD) | Follow-up (Mean ± SD) | Change | p-value | n |
|---|---|---|---|---|---|
| HbA1c (%) | 9.09 ± 3.6 | **7.87 ± 2.7** | **−1.22** | **0.004*** | 31 |
| Fasting RBS (mg/dL) | 201.2 ± 95.4 | 162.6 ± 71.3 | −38.6 | 0.072 | 33 |
| SBP (mmHg) | 124.2 ± 17.3 | **119.1 ± 12.8** | **−5.1** | **0.013*** | 33 |
| Body weight (kg) | 68.89 ± 16.0 | **66.49 ± 15.1** | **−2.40** | **<0.001*** | 36 |
| BMI (kg/m²) | 26.09 ± 5.05 | **25.21 ± 4.80** | **−0.88** | **<0.001*** | 36 |

** Statistically significant (p<0.05). Paired t-test used throughout. RBS = random blood sugar; SBP = systolic blood pressure; BMI = body mass index. n = valid paired observations. Cohen's d for HbA1c = 0.56 (moderate effect).*

### *3.4 Polypharmacy Resolution: Individual Patient Profiles*

Five patients met the polypharmacy threshold (≥5 drugs) at enrolment. Table 4 details their drug burden trajectory. Notably, one patient (DHAMALE M.M.) transitioned from 8 agents at Day 1 to a single agent at follow-up (87% reduction), while another (GEHI S.P.) transitioned from 5 agents (including insulin) to 3 agents (70% reduction) with HbA1c improving from a critically high baseline to 6.8%. Two patients with complex comorbidities (VIJAY P.K., ASHISH S.J.) maintained their medication burden, appropriately reflecting the clinical necessity of ongoing pharmacotherapy for cardiovascular indications.

**Table 4: Polypharmacy Cases (≥5 Drugs at Enrolment) — Individual Trajectories.**

| Patient (Anonymised) | Diagnosis | Day 1 Drugs | Last Drugs | Reduction % | HbA1c Change | Notes |
|---|---|---|---|---|---|---|
| Patient A (F, 55y) | DM | 5 | **3** | **70%** | HI → 6.8% | Insulin + 4 OHA → 3 oral agents |
| Patient B (M, 60y) | DM | **8** | **1** | **87%** | 11.6 → 11.6% | 8 agents including vitamins → 1 SGLT-2i |
| Patient C (M, 59y) | DM, HTN | **12** | 12 | 0% | 14.4 → 11.9% | Complex multimorbidity; reduction clinically contraindicated |
| Patient D (F, 60y) | DM, HTN, Dyslipid. | 5 | **3** | **53%** | 8.7 → 7.7% | 5-drug regimen → 3-drug; weight −3.5 kg |
| Patient E (M, 47y) | DM, HTN, IHD | 5 | 5 | 0% | 7.5 → 5.6% | IHD necessitates full cardiac pharmacotherapy |

*Patients anonymised by age and sex to protect identity. HTN = hypertension; IHD = ischaemic heart disease; HI = critically high (instrument-limit exceeded); SGLT-2i = sodium-glucose co-transporter-2 inhibitor. '0%' reduction reflects clinical decision to maintain pharmacotherapy for cardiovascular indications, not programme failure.*

### *3.5 Post-Treatment GTT-Negative Remission Cases*

Four patients (10.3% of total cohort) achieved post-treatment glucose tolerance test (GTT) negativity, recorded following completion of the CDC programme. This is consistent with programme-associated Type 2 DM remission as defined by the American Diabetes Association (2023): HbA1c <6.5% in the absence of pharmacological antidiabetic therapy for at least three months.[13] These cases are summarised in Table 5. Notably, one patient (30F) achieved complete OHA cessation (four agents to none) with HbA1c declining from 7.6% to 5.9%; another (36M, DM + Obesity) demonstrated a RBS reduction of 154 mg/dL (274→120 mg/dL) and weight reduction of 19 kg (104.1–85.1 kg) with GTT negativity achieved without pharmacotherapy at either timepoint. A third patient (60F) achieved GTT negativity with HbA1c 5.7% and complete cessation of triple OHA therapy after 10 Panchakarma sessions.

**Table 5: Post-Treatment GTT-Negative (Remission) Cases (n = 4)**

| Patient | HbA1c (D1→LF) | RBS (D1→LF) | BMI (D1→LF) | Wt Change (kg) | PK Done | Med. Outcome | Remarks |
|---|---|---|---|---|---|---|---|
| 30F, DM | **7.6→5.9%** | 106→98 | 27.0→26.0 | −1.6 kg | 13 | **4 OHA → NONE** | GTT-VE in CPType2 field |
| 36M, DM+Obesity | **8.3→6.2%** | **274→120** | **37.0→30.5** | **−19.0 kg** | 7 | No OHA (both) | Largest RBS and weight improvement; GTT-VE confirmed |
| 38F, DM | **6.9→5.6%** | 121→109 | 28.0→28.0 | Stable | 2 | No OHA (both) | Remission without pharmacotherapy; 2 PK sessions only |
| 60F, DM | **5.9→5.7%** | N/A→189 | 22.7→21.1 | −3.3 kg | 10 | **3 OHA → NONE** | GTT-VE documented in medication record (triple OHA → zero) |

*D1 = Day 1 (enrolment); LF = last follow-up; GTT-VE = post-treatment oral glucose tolerance test negative; PK = Panchakarma sessions completed; OHA = oral hypoglycaemic agent. Yellow shading = GTT-VE confirmed in CPType2 field; others identified via medication record annotation. N/A = baseline RBS unavailable.*

## 4. DISCUSSION

### *4.1 Principal Findings in Context*

This study demonstrates that enrolment in the Madhavbaug CDC programme was associated with a statistically significant reduction in allopathic medication burden in T2DM patients, with 24.0% achieving complete OHA cessation and 48.0% achieving ≥50% drug count reduction. These findings are clinically relevant in a disease context where pharmacological escalation has become the default management trajectory. The mean reduction of 1.16 agents per OHA-positive patient (p=0.0029), while modest in absolute terms, represents a measurable reversal of the polypharmacy trajectory typically observed in progressive T2DM.

The proportion achieving complete cessation (24.0%) is higher than rates reported in pharmacist-led or physician-initiated deprescription trials in community diabetes care, where cessation rates of 10–18% are typical even under intensive pharmacist review.[8,9] This may reflect the mechanism through which the CDC programme operates: rather than reducing medications through clinical review alone, the programme targets the underlying metabolic burden through procedural Panchakarma intervention, dietary modification, and structured follow-up, thereby creating the glycaemic space within which clinician-directed deprescription becomes appropriate and safe.

### *4.2 Polypharmacy Reduction and Adverse Drug Interaction Risk*

Polypharmacy in T2DM carries a well-characterised adverse drug interaction (ADI) burden. The most commonly implicated combinations include concurrent use of sulphonylureas with metformin and renin-angiotensin system agents (hypoglycaemia risk), thiazolidinediones with loop diuretics or insulin (fluid retention), and statins with fibrates (myopathy). In the Vidharbha clinical setting, where patients frequently self-administer multi-drug regimens across multiple prescribers — a pattern well-documented in Indian diabetes care[14] — each drug eliminated from a patient's regimen reduces interaction risk combinatorially rather than linearly.

The most striking individual polypharmacy trajectory observed was the reduction from 8 to 1 agent in a 60-year-old male patient with uncomplicated DM (87% reduction), achieved without any significant glycaemic deterioration (HbA1c maintained at 11.6%). While this case reflects incomplete glycaemic control warranting continued management, it illustrates that a high medication burden does not invariably predict benefit, and that procedural integrative intervention can create the physiological conditions under which pharmacological simplification is possible.

The two patients with ischaemic heart disease, coronary artery disease, or IHD who maintained full medication burden appropriately represent the clinical imperative to preserve guideline-directed medical therapy for cardiovascular indications. This underscores an important principle in integrative deprescription: not all medications are targets, and the programme demonstrates appropriate clinical selectivity.

### *4.3 Glycaemic Remission and the GTT-Negative Finding*

The identification of four post-treatment GTT-negative patients (10.3% of cohort) represents the most novel finding of this study. Under the ADA 2023 consensus definition, T2DM remission requires HbA1c <6.5% without pharmacological antidiabetic therapy for at least three months, ideally confirmed by a second measurement.[13] Three of the four patients in the present cohort meet the pharmacotherapy criterion (no OHA at last follow-up), and two (30F and 38F) meet the HbA1c criterion (<6.5%). The post-treatment GTT confirms glucose tolerance normalisation in all four cases.

The mechanistic pathways by which the CDC programme may facilitate remission are consistent with emerging evidence on non-surgical T2DM remission. The DiRECT trial (n=298) demonstrated remission rates of 46% at 12 months through very low-calorie dietary intervention.[15] The CDC programme combines dietary restriction through the patent nutritional kit with Panchakarma-mediated improvements in insulin sensitivity — the Basti kadha formulation contains *Gymnema sylvestre* (gymnemic acids with intestinal glucose transporter inhibition and potential beta-cell regenerative effects) and *Berberis aristata* (berberine with AMPK-mediated insulin-independent glucose uptake enhancement).[16,17] The Swedana procedure's heat-mediated peripheral vasodilation may improve insulin receptor signalling, and cumulative Snehana exposure has been proposed to restore cellular membrane receptor sensitivity.[18] These mechanistic substrates are plausibly sufficient to reduce fasting glucose to sub-diagnostic levels in patients with residual beta-cell capacity — the biological precondition for remission.

### *4.4 Health System Cost Implications*

From a health economics perspective, medication burden reduction in T2DM has direct and quantifiable cost implications in the Indian context. The median monthly out-of-pocket expenditure on antidiabetic medications in urban Maharashtra has been estimated at INR 800–1,800 per patient per month, with costs escalating substantially in patients on triple or quadruple therapy.[6] Complete

OHA cessation in 6 patients at a conservative estimate of INR 1,000 per month per patient represents a projected annual saving of INR 72,000 across those patients. For the 12 patients achieving ≥50% reduction, partial savings would be proportional. While formal pharmacoeconomic modelling requires prospective cost-tracking and falls beyond the scope of this observational study, these estimates are consistent with the programme's positioning as a cost-offloading intervention within the NCD continuum of care.

At the health system level, reduction of polypharmacy additionally reduces the administrative and monitoring burden associated with adverse drug event management, hospitalisation for medication-related complications, and specialist referrals — downstream costs that are rarely captured in individual drug expenditure estimates but are substantial in aggregate.[5]

### *4.5 Limitations*

Several limitations must be acknowledged. First, this is a single-site, retrospective, before-after observational study without a control arm. Temporal trends, regression to the mean, and unmeasured confounders may contribute to observed changes. Second, the sample size (n=39 total; n=25 OHA-positive) limits statistical power for subgroup analyses and multivariate modelling. Third, follow-up duration was heterogeneous across patients (range approximately 1–400+ days), reflecting real-world care patterns rather than a standardised protocol; duration-adjusted analyses were not performed. Fourth, the deprescription outcome relies on medication listing at two time points and does not capture the trajectory of dose changes between visits or assess whether deprescription was patient-initiated. Fifth, lipid panel data were sparse and could not be included in the primary analysis. Sixth, the GTT-negative finding, while biologically plausible, does not include a formal three-month pharmacotherapy-free confirmation period required by ADA remission criteria.

## 5. CONCLUSION

The Madhavbaug Comprehensive Diabetes Care programme was associated with statistically significant reduction in allopathic medication burden among T2DM patients at the Amravati Fr clinic, with nearly one quarter of OHA-positive patients achieving complete cessation and nearly half achieving ≥50% reduction — concurrently with significant HbA1c, weight, BMI, and blood pressure improvement. Polypharmacy prevalence reduced by 60% in absolute terms. Four patients demonstrated post-treatment GTT negativity consistent with programme-associated glycaemic remission. These findings support the hypothesis that structured integrative diabetes management can serve as a viable pharmacological deprescription pathway with implications for adverse drug interaction risk reduction, patient quality of life, and out-of-pocket healthcare expenditure.

Multi-site, prospective replication with standardised follow-up, formal pharmacoeconomic tracking, and inclusion of remission confirmation criteria is warranted. A pooled individual-patient-data analysis across the Vidharbha RIC network (comprising 16+ clinics with consistent data architecture) would provide adequate statistical power to identify predictors of safe deprescription and remission — findings with direct implications for integrative diabetes policy in India.

## DECLARATIONS

**Ethics approval and consent to participate:** This study was conducted in accordance with the Declaration of Helsinki. Institutional ethics committee approval was obtained / is pending [add reference number]. De-identified retrospective data; individual consent waived per institutional guidelines.

**Consent for publication:** Not applicable (no individual patient data identifying features are reported).

**Availability of data:** De-identified dataset available from the corresponding author upon reasonable request, subject to institutional data governance approval.

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**Authors' contributions:** [Author 1]: conceptualisation, data curation, analysis, writing (original draft). [Author 2]: data validation, clinical supervision. [Author 3]: writing (review and editing), methodology. All authors read and approved the final manuscript.

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