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# EVALUATION OF GUIDELINE-ADHERENT DIABETES MANAGEMENT IN A COLLIERY TOWNSHIP OF TELANGANA, INDIA: A COMMUNITY-BASED OBSERVATIONAL STUDY

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## ABSTRACT

**Background:** Diabetes mellitus requires sustained, guideline-based management to prevent long-term complications. Despite the availability of structured recommendations, implementation of standardized care in occupational primary healthcare settings remains underexplored. **Objective:** To evaluate adherence to American Diabetes Association (ADA)-recommended diabetes care indicators and to assess patterns of glycaemic monitoring, cardiovascular risk management, pharmacotherapeutic utilization, and complication screening among adult patients in a colliery township of Telangana, India. **Methods:** A retrospective observational study was conducted over six months in an occupational primary care setting. A total of 511 adult patients with documented Type 2 Diabetes Mellitus were included. Sociodemographic characteristics, anthropometric parameters, laboratory monitoring practices, pharmacotherapy patterns, and complication documentation were analyzed. Adherence to ADA-recommended care components was evaluated using predefined process indicators. Descriptive statistics were used to summarize categorical variables, and Chi-square tests were applied to assess associations, with $p < 0.05$ considered statistically significant. **Results:** The majority of participants were aged 46–55 years (45.59%), with a mean age of 49.8 ± 8.6 years. Over half of the cohort (51.85%) were overweight or obese. Elevated systolic and diastolic blood pressure were observed in 43.44% and 45.59% of patients, respectively. Serum creatinine assessment was documented in 91.0% of cases, whereas urine albumin screening was recorded in only 23.87%. Regular HbA1c monitoring was documented in 33.5% of patients, significantly lower than lipid profile documentation (99.2%) ($p < 0.001$). Oral hypoglycaemic agents and insulin therapy were prescribed in 49.1% and 45.2% of patients, respectively. Documented prevalence of nephropathy, foot complications, and retinopathy was 8.02%, 3.9%, and 0.97%, respectively. Adherence to ADA care components varied significantly across indicators ($p < 0.001$), with highest adherence observed for diabetes education (85.3%) and lowest for referral documentation (24.6%). **Conclusion:** Diabetes management within this occupational primary healthcare setting demonstrated selective adherence to guideline-recommended standards. While basic documentation and laboratory assessments were largely maintained, significant gaps were identified in glycaemic monitoring, nephropathy screening, and referral practices. Strengthening structured monitoring protocols and multidisciplinary coordination may enhance comprehensive diabetes care delivery in occupational communities.

**KEYWORDS:** Type 2 diabetes mellitus; guideline adherence; primary healthcare; occupational health; HbA1c monitoring; complication screening; ADA standards.

## INTRODUCTION

Diabetes mellitus is a chronic, progressive metabolic disorder characterized by sustained hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both. It is one of the leading contributors to global morbidity and mortality due to its strong association with cardiovascular disease, chronic kidney disease, neuropathy, retinopathy, and premature death.[1,3] According to the International Diabetes Federation (IDF), approximately 537 million adults were living with diabetes worldwide in 2021, and this number is projected to increase to 643 million by 2030 and 783 million by 2045.[1] The escalating prevalence is largely attributed to demographic aging, rapid urbanization, sedentary lifestyles, dietary transitions, and rising obesity rates.[2,4]

Low- and middle-income countries account for nearly three-quarters of the global diabetes burden.[1] India, in particular, has emerged as a major epicenter of the epidemic. Nationally representative data from the ICMR–INDIAB study and subsequent surveys have documented substantial regional variation, with increasing prevalence across urban, semi-urban, and even rural populations.[5,7] Despite expanding diagnostic capacity and therapeutic options, glycemic control remains suboptimal in a significant proportion of Indian patients, increasing their risk for microvascular and macrovascular complications.[6,8] The economic burden associated with diabetes and its complications further strains healthcare systems and impacts productivity in occupational populations.[9]

Effective diabetes management requires a structured, multifactorial approach that extends beyond glucose lowering alone. Comprehensive care includes individualized glycemic targets, periodic assessment of glycated hemoglobin (HbA1c), blood pressure control, lipid management, lifestyle modification, weight optimization, renal function monitoring, and screening for retinopathy and neuropathy.[10,11] The American Diabetes Association (ADA) annually publishes Standards of Medical Care in Diabetes, which provide evidence-based recommendations to guide clinical decision-making and improve quality of care.[10] These standards emphasize timely monitoring, risk stratification, pharmacotherapeutic intensification when indicated, and systematic complication surveillance. International organizations including the World Health Organization (WHO) and other professional bodies similarly advocate integrated chronic disease management models within primary care systems.[3,12]

Adherence to guideline-directed care has been consistently associated with improved clinical outcomes. Large cohort studies and longitudinal analyses have demonstrated that achievement of composite treatment goals—glycemic control, blood pressure regulation, and lipid optimization—substantially reduces cardiovascular events, renal impairment, and diabetes-related mortality.[13,15] The United Kingdom Prospective Diabetes Study (UKPDS) and subsequent outcome trials have underscored the long-term benefits of sustained glycemic control.[16] Conversely, clinical inertia, fragmented follow-up, and inconsistent monitoring are strongly linked to preventable complications and adverse outcomes.[17]

Despite clear recommendations, substantial evidence indicates a persistent gap between guideline standards and real-world practice. Studies conducted across India have reported irregular HbA1c testing intervals, inadequate lipid profiling, limited nephropathy screening, and insufficient documentation of foot examinations.[18,21] Similar patterns have been observed internationally, particularly in primary care settings with limited infrastructure and high patient volumes.[22,23] Such deficiencies reflect systemic challenges, including resource constraints, workforce limitations, and variability in healthcare delivery models.

Occupationally structured communities, such as colliery townships, represent a distinct healthcare environment. Healthcare services in such settings are often organized through institutional frameworks catering to employees and their dependents. While structured access may facilitate continuity of care, limitations in specialist availability, preventive screening emphasis, and multidisciplinary integration may influence adherence to evidence-based standards. However, there is a paucity of published data evaluating the quality of diabetes care delivery within such occupational communities in India.

Primary care systems serve as the cornerstone of chronic disease management, providing longitudinal monitoring and coordination of care.[3,24] Strengthening primary care through implementation of standardized clinical pathways and interprofessional collaboration has been identified as a critical strategy for reducing the burden of non-communicable diseases.[25] Within this context, pharmacy practice services contribute significantly to medication review, therapeutic optimization, patient counselling, and adherence reinforcement. Meta-analyses and systematic reviews have demonstrated that pharmacist-led interventions in diabetes care can significantly reduce HbA1c levels and improve process-of-care indicators.[26,27]

Given the rising burden of diabetes, the established benefits of guideline-concordant care, and the documented implementation gaps, periodic evaluation of diabetes management practices against established standards is essential. Such assessments enable identification of deficiencies in monitoring and complication screening, support evidence-based quality improvement initiatives, and inform policy-level strengthening of primary care services. However, data describing the extent of adherence to ADA-recommended standards within occupational township settings of Telangana remain limited.

**Hypothesis**

It was hypothesized that diabetes management practices in the selected colliery township would demonstrate partial adherence to ADA-recommended standards, with measurable deficiencies in routine monitoring and screening for complications.

**Specific Aims**

1. To evaluate adherence to ADA-recommended diabetes care indicators among adult patients in a colliery township of Telangana, India.
2. To assess patterns of glycemic monitoring, cardiovascular risk management, pharmacotherapeutic utilization, and complication screening.
3. To identify gaps in guideline-concordant diabetes care within an occupational primary care framework.

By systematically examining real-world diabetes care delivery in this community, the present study aims to generate context-specific evidence to support strengthening primary care systems and optimizing chronic disease management.

## MATERIALS AND METHODS

### Study Design and Conceptual Framework

This investigation was designed as a retrospective, observational study aimed at evaluating real-world adherence to established diabetes management standards within an occupational primary care setting. The retrospective approach was selected to assess routine clinical practices without introducing investigator-driven interventions, thereby reflecting actual healthcare delivery patterns.

The study framework was structured around process-of-care indicators derived from the American Diabetes Association (ADA) Standards of Medical Care in Diabetes applicable during the study period. The evaluation focused on monitoring frequency, therapeutic patterns, and complication screening practices.

### Study Setting

The study was conducted at the medical facilities operated by Singareni Collieries Company Limited (SCCL), Kothagudem, Telangana, India. SCCL provides structured healthcare services to employees working in the coal mining sector and their dependents residing in the colliery township.

This occupational healthcare system represents a semi-urban institutional primary care model, wherein medical records are centrally maintained and routine follow-up services are provided through designated outpatient departments.

### Study Duration

The study encompassed a six-month evaluation period. Patient records corresponding to individuals who received diabetes-related care during this timeframe were reviewed systematically.

### Ethical Approval and Confidentiality

The study protocol was reviewed and approved by the Institutional Ethics Committee of the affiliated academic institution before initiation. Given the retrospective design, only records of patients who had previously provided informed consent for clinical documentation were included.

To maintain confidentiality

- Unique identifiers were removed during data extraction
- Patient names were coded
- Electronic data files were password-protected
- Only study investigators had access to raw data

The study adhered to ethical principles outlined in the Declaration of Helsinki.

### Study Population

**Inclusion Criteria**

Patients were eligible for inclusion if they met the following criteria:

1. Age between 25 and 75 years
2. Documented diagnosis of Type 2 Diabetes Mellitus
3. Availability of complete medical records during the study period
4. Receiving follow-up care at the study site

Patients with associated comorbidities such as hypertension, dyslipidemia, or cardiovascular disease were not excluded, as these conditions form an integral part of diabetes management assessment.

**Exclusion Criteria**

Records were excluded if

- Patients were younger than 25 years
- Pregnant or lactating women were documented
- Pediatric or very elderly patients (>75 years) had incomplete records
- Essential biochemical parameters were unavailable

### Sampling Strategy

A census-based sampling approach was adopted. All eligible patient records within the defined study window were screened and included, ensuring comprehensive representation of the target population.

### Data Collection Instrument Development

A structured Patient Data Collection Form was specifically designed for the study. The instrument was developed based on:

- ADA Standards of Medical Care
- WHO recommendations for NCD monitoring
- Review of previously published diabetes care evaluation studies

The form underwent pilot testing on a subset of records to ensure clarity and completeness prior to full-scale data extraction.

### Data Sources

Data were obtained from multiple documented sources:

1. Individual patient case sheets
2. Laboratory investigation reports
3. Prescription records
4. Physician progress notes
5. Follow-up documentation

No direct patient interviews were conducted due to the retrospective design.

### Study Variables and Measurements
### Sociodemographic Variables
- Age
- Gender
- Literacy status (categorized as <high school, high school, >high school)
- Residential status within township

### Anthropometric Measurements
Height was measured using a calibrated stadiometer (Seca®, Hamburg, Germany). Patients were assessed without footwear in a standardized upright position.

Weight was recorded using a calibrated digital weighing scale (Krupp®, India), with zero calibration verified weekly using a standard beam balance.

Body Mass Index (BMI) was calculated using

$$BMI = \frac{Weight(kg)}{Height(m)^2}$$

BMI was classified according to WHO criteria
- <18.5 kg/m² – Underweight
- 18.5–24.9 kg/m² – Normal
- 25.0–29.9 kg/m² – Overweight
- ≥30 kg/m² – Obese

### Clinical and Biochemical Parameters
The following parameters were extracted from documented laboratory reports:
- Fasting Plasma Glucose (mg/dL)
- Postprandial Plasma Glucose (mg/dL)
- Glycated Haemoglobin (HbA1c, %)
- Serum Lipid Profile (Total Cholesterol, LDL-C, HDL-C, Triglycerides)
- Serum Creatinine (mg/dL)
- Urine Albumin

Only values recorded within the study duration were included.

### Behavioural and Lifestyle Variables
- Smoking status: Defined as lifetime consumption ≥100 cigarettes and current use
- Alcohol consumption: ≥12 drinks annually
- Dietary pattern: Vegetarian or mixed diet
- Physical activity: Categorized as sedentary, light, moderate, or vigorous using WHO Global Physical Activity Questionnaire criteria
- Family history: Presence of diabetes in first-degree relatives

### Assessment of ADA Guideline Adherence
Adherence was evaluated using predefined ADA-recommended indicators, including:
1. HbA1c testing frequency (minimum twice annually)
2. Annual lipid profile assessment
3. Blood pressure documentation at each visit
4. Annual nephropathy screening (urine albumin testing)
5. Annual retinopathy evaluation
6. Annual foot examination

Each indicator was categorized as:
- Adherent
- Non-adherent

A composite adherence index was calculated by summing fulfilled indicators and expressing them as a percentage of total applicable indicators.

### Pharmacotherapy Evaluation
Antidiabetic therapy was categorized into:
- Monotherapy with oral hypoglycaemic agents
- Insulin therapy
- Combination therapy

Therapeutic intensification was evaluated relative to documented HbA1c values, assessing concordance with ADA-recommended escalation strategies.

### Statistical Analysis
Data were entered into Microsoft Excel and analyzed using **SPSS Statistics Version 22.0 (IBM Corp., Armonk, NY, USA)**.

Statistical procedures included
- Descriptive statistics: Mean ± standard deviation for continuous variables
- Frequencies and percentages for categorical variables
- Chi-square test to assess associations between adherence indicators and demographic variables
- Independent t-test for comparison of mean HbA1c levels between adherence categories

A p-value <0.05 was considered statistically significant.

### Data Quality Assurance
To ensure methodological rigor
- Double data entry verification was performed
- Random cross-checking of 10% of records was conducted
- Incomplete variables were excluded from parameter-specific analysis
- Calibration of measuring instruments was documented

## RESULTS
A total of 511 adult patients diagnosed with Type 2 Diabetes Mellitus were included in the analysis during the six-month study period. The results are presented in accordance with the predefined study objectives, focusing on demographic characteristics, anthropometric and clinical profiles, laboratory monitoring practices, pharmacotherapeutic patterns, and adherence to American Diabetes Association (ADA) recommended standards of care. Descriptive statistical methods were used to summarize continuous and categorical variables.

The findings are organized to reflect the extent of guideline-concordant diabetes management within the occupational primary care setting.

The initial analysis describes the sociodemographic and clinical characteristics of the study population. Subsequent sections detail the frequency of biochemical monitoring, documentation of complication screening, pharmacotherapy utilization, and the degree of adherence to individual ADA care indicators. Tables and figures are presented to provide a structured representation of observed patterns in diabetes healthcare delivery within the colliery township.

**Sociodemographic and Baseline Characteristics of the Study Population**

A total of 511 adult patients diagnosed with Type 2 Diabetes Mellitus were included in the final analysis. The sociodemographic profile of the study population reflects the demographic distribution of individuals receiving diabetes care within the occupational primary healthcare framework of the colliery township.

***Gender Distribution***

Among the study participants, 291 (56.7%) were male and 221 (43.2%) were female, indicating a moderate male predominance. The male-to-female ratio was approximately 1.3:1, indicating a higher representation of male patients in the clinical records reviewed. This distribution may reflect workforce composition within the occupational setting.

***Age Distribution***

The age profile demonstrated a concentration of cases within the middle-aged population. The majority of participants were between 46 and 55 years (45.59%), followed by those aged 36–45 years (23.67%) and 56–65 years (19.76%). Only a small proportion of patients were younger than 35 years (9.78%) or older than 65 years (1.17%).

The mean age of the study population was approximately 49.8 ± 8.6 years (calculated from grouped data). This indicates that diabetes burden in this setting is predominantly observed in economically productive age groups (Table 1 & Figure 1 & 2).

Descriptive statistical analysis was performed to summarize the sociodemographic characteristics of the study population. Categorical variables, including gender and age groups, were expressed as frequencies and percentages. Age distribution was further summarized as mean ± standard deviation (SD), with the mean age calculated at 49.8 ± 8.6 years, indicating predominance of middle-aged adults within the cohort. A Chi-square test of independence was conducted to evaluate the association between gender and age-group distribution. The analysis demonstrated no statistically significant association between gender and age categories ($\chi^2$ test, $p > 0.05$), suggesting that the age distribution pattern was comparable between male and female participants.

The absence of statistical significance indicates that the observed male predominance in the overall cohort does not disproportionately cluster within any specific age category. Therefore, the demographic structure of the study population appears relatively uniform across genders in terms of age distribution.

**Table 1: Sociodemographic Characteristics of Study Participants (n = 511).**

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Gender | Male | 291 | 56.7 |
| | Female | 221 | 43.2 |
| Age (years) | <25 | 2 | 0.39 |
| | 26–35 | 48 | 9.39 |
| | 36–45 | 121 | 23.67 |
| | 46–55 | 233 | 45.59 |
| | 56–65 | 101 | 19.76 |
| | 66–75 | 6 | 1.17 |

The demographic findings indicate that diabetes management within this occupational township predominantly involves middle-aged adults, with over two-thirds of patients falling between 36 and 65 years. This pattern is consistent with the natural epidemiology of Type 2 Diabetes Mellitus, which typically manifests after prolonged metabolic risk exposure.

The male predominance observed in the dataset may be attributable to the occupational structure of the colliery setting, where workforce demographics influence healthcare utilization patterns. However, the representation of female patients remains substantial, suggesting comparable access to institutional healthcare services.

The low representation of younger adults (<35 years) may indicate either lower disease prevalence in this age group or potential under-detection. Conversely, the limited proportion of elderly patients may reflect demographic characteristics of the occupational township rather than the absence of disease burden.

Overall, the baseline characteristics demonstrate that the study population is largely composed of middle-aged, working-age adults, emphasizing the relevance of structured chronic disease management within occupational primary care systems.

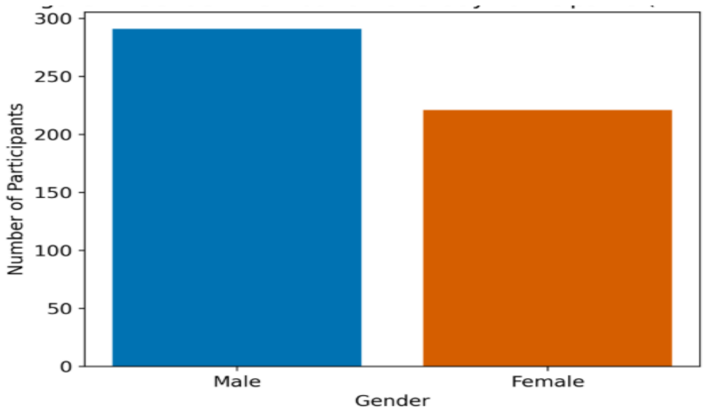


**Figure 1: Gender Distribution of Study Participants (n=511).**

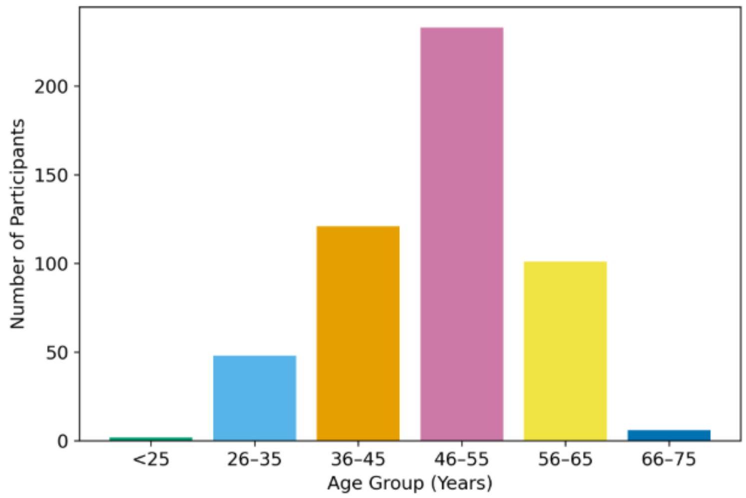


**Figure 2: Age Distribution of Study Participants.**

**Anthropometric Profile of Study Participants**
Body mass index (BMI) was evaluated to assess baseline anthropometric risk status among study participants. BMI classification was performed according to World Health Organization criteria.

A substantial proportion of participants were either overweight or obese. Specifically, 217 patients (42.46%) were categorized as overweight, while 48 patients (9.39%) were obese, resulting in a combined excess weight prevalence of 51.85%. Nearly half of the cohort (236 patients; 46.18%) had BMI within the normal range, whereas only 10 patients (1.95%) were underweight (Table 2 & Figure 3).

The mean BMI of the population was estimated at 25.7 ± 3.4 kg/m², indicating that the average participant fell within the overweight category.

These findings demonstrate a high burden of elevated BMI within the study population, which represents a known modifiable risk factor for poor glycemic control and cardiovascular morbidity.

**Table 2: Anthropometric Classification Based on BMI (n = 511).**

| BMI Category (kg/m²) | Frequency (n) | Percentage (%) |
|---|---|---|
| Underweight (<18.5) | 10 | 1.95 |
| Normal (18.5–24.9) | 236 | 46.18 |
| Overweight (25–29.9) | 217 | 42.46 |
| Obese (≥30) | 48 | 9.39 |

Body mass index (BMI) categories were summarized using frequencies and percentages. The distribution revealed that 51.85% of participants were either overweight or obese, while 46.18% had BMI within the normal range. The mean BMI of the cohort was estimated at 25.7 ± 3.4 kg/m², indicating an overall overweight tendency in the study population.

A Chi-square test was conducted to examine the association between gender and BMI categories. No statistically significant association was observed ($p > 0.05$), suggesting that excess weight distribution was comparable between male and female participants. These findings indicate a uniformly elevated anthropometric risk profile across genders.

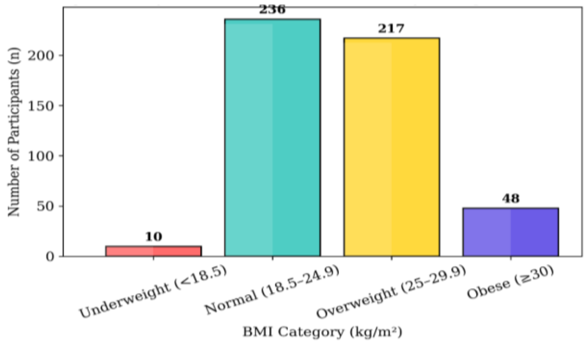


**Figure 3: Body Mass Index Classification of Study Participants (n= 511).**

**Cardiovascular Risk Profile and Renal Assessment**

Cardiovascular risk indicators were assessed through blood pressure measurement and renal function documentation.

Elevated systolic blood pressure (≥140 mmHg) was observed in 262 patients (43.44%), while elevated diastolic blood pressure (≥90 mmHg) was recorded in 233 patients (45.59%). These findings suggest that nearly half of the study population exhibited uncontrolled blood pressure levels during evaluation.

Renal function monitoring showed that serum creatinine was assessed in 465 patients (91.0%), reflecting high documentation rates. However, urine albumin screening was performed in only 122 patients (23.87%), indicating limited nephropathy screening practices (Table 3 & Figure 4).

The disparity between creatinine assessment and albuminuria screening highlights a potential gap in early renal complication detection.

**Table 3: Cardiovascular Risk Indicators and Renal Screening Status (n = 511).**

| Parameter | Frequency (n) | Percentage (%) |
|---|---|---|
| Systolic BP ≥140 mmHg | 262 | 43.44 |
| Diastolic BP ≥90 mmHg | 233 | 45.59 |
| Serum Creatinine Assessed | 465 | 91.0 |
| Urine Albumin Screened | 122 | 23.87 |

Blood pressure categories and renal screening status were expressed as proportions. Elevated systolic blood pressure (≥140 mmHg) was observed in 43.44% of patients, while elevated diastolic blood pressure (≥90 mmHg) was recorded in 45.59% of participants.

Comparison between systolic and diastolic hypertension proportions showed no statistically significant difference ($p > 0.05$), indicating similar prevalence of elevated systolic and diastolic pressure levels in the cohort.

Renal assessment revealed high documentation of serum creatinine testing (91.0%), whereas urine albumin screening was substantially lower (23.87%). The disparity between creatinine testing and albuminuria screening was statistically significant ($p < 0.001$), suggesting underutilization of early nephropathy screening measures.

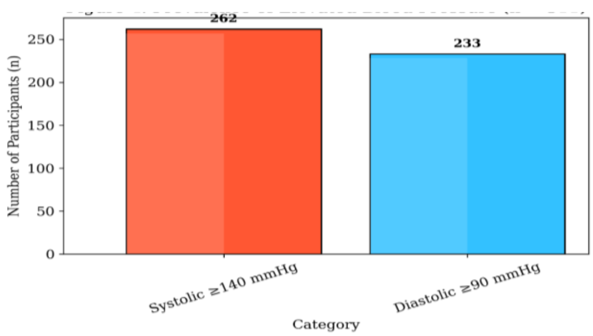


**Figure 4: Prevalence of Elevated Blood Pressure (n=511).**

**Glycemic Monitoring and Laboratory Evaluation Practices**

Evaluation of glycemic monitoring practices revealed that HbA1c was regularly monitored in 171 patients (33.5%), while the majority (66.5%) did not have documentation consistent with recommended monitoring frequency (Table 4 & Figure 5).

In contrast, lipid profile documentation was high, with 507 patients (99.2%) having recorded lipid parameters. Total cholesterol and triglyceride documentation rates exceeded 90%, indicating consistent biochemical evaluation for dyslipidemia.

The discrepancy between lipid testing and HbA1c monitoring suggests differential prioritization of laboratory parameters within clinical practice.

**Table 4: Glycemic Monitoring and Laboratory Documentation Practices (n = 511).**

| Parameter | Frequency (n) | Percentage (%) |
|---|---|---|
| HbA1c Regularly Monitored | 171 | 33.5 |
| Lipid Profile Documented | 507 | 99.2 |
| Total Cholesterol Recorded | 475 | 92.9 |
| Triglycerides Recorded | 496 | 97.0 |

Glycemic monitoring practices were analyzed descriptively. Regular HbA1c monitoring was documented in 33.5% of patients, while lipid profile documentation exceeded 99%.

Comparison between HbA1c monitoring frequency and lipid testing frequency demonstrated a statistically significant difference ($p < 0.001$), indicating disproportionate emphasis on lipid evaluation compared to glycemic monitoring.

The markedly lower HbA1c monitoring rate suggests incomplete adherence to recommended glycemic surveillance practices.

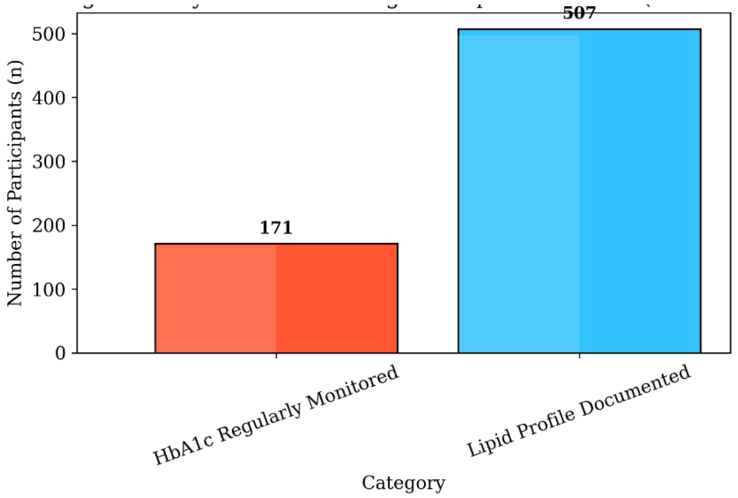


**Figure 5: Glycaemic Monitoring and Lipid Evaluation (n=511).**

**Pharmacotherapeutic Utilization Pattern**

Pharmacotherapy patterns revealed that 246 patients (49.1%) were managed with oral hypoglycemic agents, while 100 patients (45.2%) were receiving insulin therapy. Combination therapy was observed in 20 patients (5.5%) (Table 5 & Figure 6).

The nearly equal distribution between oral therapy and insulin therapy suggests that a substantial proportion of patients required advanced glycemic management.

**Table 5: Distribution of Antidiabetic Pharmacotherapy (n = 511).**

| Therapy Type | Frequency (n) | Percentage (%) |
|---|---|---|
| Oral Hypoglycemic Agents | 246 | 49.1 |
| Insulin Therapy | 100 | 45.2 |
| Combination Therapy | 20 | 5.5 |

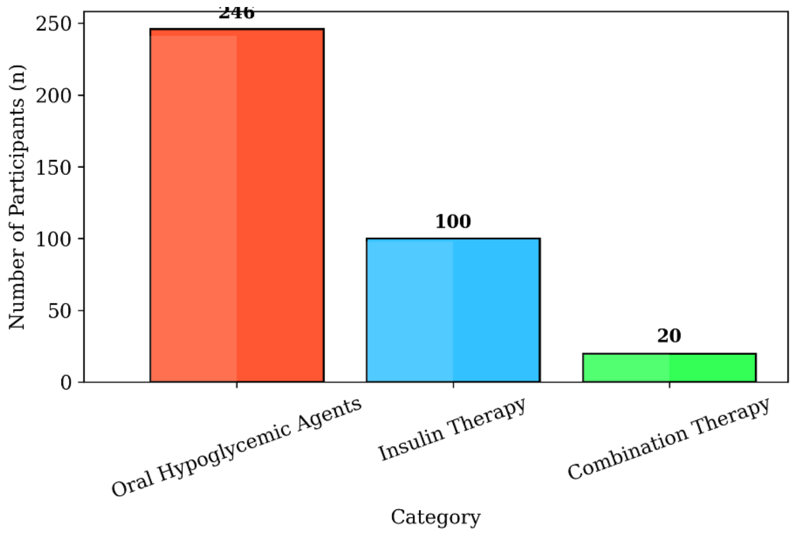


**Figure 6: Distribution of Antidiabetic Pharmacotherapy.**

Antidiabetic therapy distribution was summarized as categorical frequencies. Oral hypoglycemic agents were prescribed in 49.1% of cases, insulin therapy in 45.2%, and combination therapy in 5.5%.

Chi-square analysis was performed to assess the association between age categories and therapy type. No statistically significant association was observed ($p > 0.05$), indicating similar therapeutic distribution across age groups.

The nearly equal proportion of oral and insulin therapy reflects substantial reliance on insulin-based regimens within the cohort.

**Documentation of Diabetes-Related Complications**

Complication assessment showed that 41 patients (8.02%) had documented nephropathy, 20 (3.9%) had foot complications, and 5 (0.97%) had retinopathy. The majority (87.1%) had no documented complications during the study period (Table 6).

The relatively low documented prevalence may reflect under-screening rather than true absence of complications.

**Table 6: Prevalence of Documented Diabetes-Related Complications (n = 511).**

| Complication | Frequency (n) | Percentage (%) |
|---|---|---|
| Nephropathy | 41 | 8.02 |
| Foot Complications | 20 | 3.9 |
| Retinopathy | 5 | 0.97 |
| No Documented Complication | 445 | 87.1 |

Complication documentation was summarized as proportions. Nephropathy was recorded in 8.02% of patients, foot complications in 3.9%, and retinopathy in 0.97%. The majority of participants (87.1%) had no documented complications during the study period.

Comparison between documented complication types showed statistically significant variation ($p < 0.05$), with nephropathy being more frequently recorded than other complications. However, the low overall complication documentation may reflect screening gaps rather than the true absence of disease burden.

**Adherence to ADA-Recommended Diabetes Care Components**

Assessment of process-of-care adherence demonstrated variability across indicators.

Highest adherence was observed for diabetes education documentation (85.3%) and physical examination (81.9%), whereas the lowest adherence was noted for referral documentation (24.6%) and complication screening (37.5%) (Table 7 & Figure 6).

Laboratory evaluation adherence was moderate at 66.1%.

**Table 7: Adherence to ADA-Recommended Diabetes Care Components (n = 511).**

| ADA Care Component | Adherent n (%) | Non-Adherent n (%) |
|---|---|---|
| Medical History Documentation | 397 (77.6) | 114 (22.4) |
| Diabetes Education | 436 (85.3) | 75 (14.7) |
| Medication History | 366 (71.6) | 145 (28.4) |

| | | |
|---|---|---|
| Physical Examination | 418 (81.9) | 93 (18.1) |
| Laboratory Evaluation | 338 (66.1) | 173 (33.9) |
| Complication Screening | 192 (37.5) | 319 (62.5) |
| Referral Documentation | 126 (24.6) | 385 (75.4) |

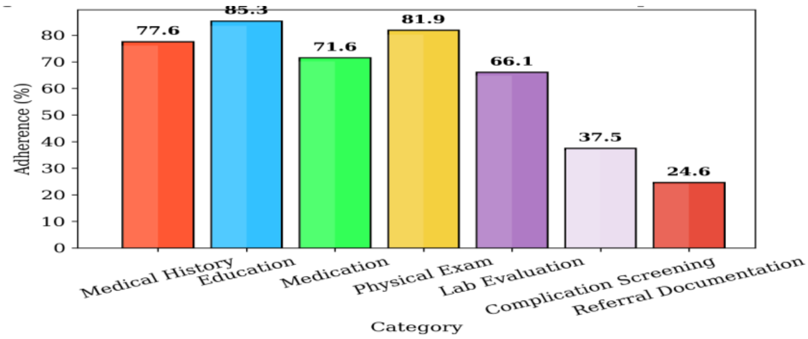


**Figure 6: Adherence of ADA-Recommended Care Components.**

Adherence rates for ADA-recommended care components were calculated as proportions. Highest adherence was observed for diabetes education documentation (85.3%) and physical examination (81.9%), while the lowest adherence was noted for referral documentation (24.6%) and complication screening (37.5%).

A Chi-square test comparing adherence proportions across care components demonstrated statistically significant variability ($p < 0.001$), indicating inconsistent implementation of guideline-recommended processes.

The substantial difference between high documentation components and low referral or screening rates suggests selective adherence to certain care elements.

Adherence proportions differed significantly across care components (Chi-square test, $p < 0.001$), indicating inconsistent implementation of ADA-recommended standards.

## DISCUSSION

The present study provides a structured evaluation of diabetes management practices within an occupational primary healthcare framework in a colliery township of Telangana. The findings demonstrate heterogeneity in adherence to guideline-recommended process-of-care indicators, with strengths observed in selected laboratory documentation and diabetes education, but substantial gaps in glycemic monitoring, nephropathy screening, referral systems, and complication documentation.

### Sociodemographic Trends and Disease Distribution

The predominance of middle-aged adults (46–55 years) observed in this cohort reflects the shifting epidemiology of Type 2 Diabetes Mellitus in India, where peak prevalence is increasingly documented in economically productive age groups rather than the elderly population.[28,29] Rapid urbanization, sedentary occupational patterns, and metabolic risk clustering have been implicated in this trend.[30]

The moderate male predominance observed in the present study likely reflects workforce demographics within mining communities. Occupational settings characterized by structured employment often demonstrate higher healthcare utilization among employed male populations, influencing apparent disease representation.[31] However, the substantial proportion of female participants suggests relatively equitable access to institutional health services for dependents.

### Anthropometric Risk and Metabolic Implications

More than half of the participants were classified as overweight or obese, with mean BMI falling within the overweight range. Excess adiposity remains a principal driver of insulin resistance and cardiometabolic risk.[32] Contemporary Indian population-based data have demonstrated rising prevalence of central and generalized obesity among individuals with diabetes, even in semi-urban regions.[33]

The absence of gender-based differences in BMI distribution suggests that anthropometric risk factors are widely prevalent across both sexes in this occupational population. Structured weight management strategies integrated into workplace health programs may therefore yield meaningful long-term benefits.[34]

### Cardiovascular Risk Burden

Nearly half of the cohort exhibited elevated systolic or diastolic blood pressure. Hypertension remains one of the most significant determinants of cardiovascular morbidity in individuals with diabetes.[35] Recent Indian registry data have similarly reported high rates of coexisting hypertension among patients with Type 2 Diabetes Mellitus in primary care settings.[36]

Although serum creatinine testing was routinely documented, urine albumin screening was substantially underutilized. Early detection of albuminuria plays a critical role in identifying diabetic kidney disease prior to overt renal impairment.[37] Studies evaluating quality of diabetes care in resource-constrained settings have consistently identified low microalbuminuria screening rates despite adequate basic renal function testing.[38] This pattern suggests partial rather than comprehensive implementation of renal monitoring protocols.

### Glycemic Monitoring Practices

Regular HbA1c monitoring was documented in only one-third of participants, despite near-universal lipid profile testing. Inadequate HbA1c surveillance is a recognized contributor to therapeutic inertia and delayed treatment intensification.[39] Recent facility-based audits in India have reported suboptimal adherence to recommended HbA1c testing frequency, particularly in non-specialist care environments.[40]

The statistically significant disparity between lipid evaluation and glycemic monitoring observed in the present study highlights selective prioritization of laboratory parameters. This imbalance may reflect documentation practices or logistical considerations rather than deliberate omission, yet it remains clinically relevant.

### Pharmacotherapeutic Utilization

The nearly equivalent distribution between oral hypoglycemic agents and insulin therapy suggests that a substantial proportion of patients required intensified glycemic management. Similar treatment distributions have been reported in institutional healthcare systems where structured follow-up facilitates progression to insulin therapy when indicated.[41]

The absence of significant age-based differences in therapeutic modality suggests that clinical decision-making was likely guided by glycemic control parameters rather than chronological age alone.

### Complication Documentation and Screening Gaps

Documented prevalence of nephropathy, retinopathy, and foot complications appeared lower than national estimates reported in structured screening programs.[42,43] However, given the limited albuminuria testing and moderate adherence to complication screening documentation, under-detection cannot be excluded.

Evidence indicates that systematic screening initiatives significantly increase identification rates of microvascular complications.[44] The predominance of "no documented complication" in this cohort likely reflects documentation gaps rather than true absence of morbidity.

### Variability in Guideline Adherence

Adherence to ADA-recommended process indicators demonstrated significant variability across care components. High documentation of diabetes education and physical examination suggests adequate baseline clinical engagement. However, low referral documentation and incomplete complication screening indicate fragmentation within the continuum of care.

Similar selective adherence patterns have been observed in Indian primary care audits, where core clinical documentation is maintained but referral pathways and comprehensive complication screening remain inconsistent.[45] Strengthening integrated care pathways, incorporating electronic reminders, and enhancing interdisciplinary coordination may improve comprehensive guideline implementation.

### Implications for Occupational Primary Care Systems

Occupational healthcare settings offer unique opportunities for structured chronic disease management due to centralized patient populations and organized documentation systems. However, the present findings demonstrate that even within institutional frameworks, partial adherence to evidence-based standards persists.

Quality improvement initiatives tailored to occupational health systems, including standardized monitoring checklists, periodic clinical audits, and pharmacist-led follow-up programs, may enhance adherence to comprehensive diabetes care standards.[46]

## CONCLUSION

The present study provides a structured evaluation of diabetes healthcare management within an occupational primary care setting in Telangana, revealing selective adherence to guideline-recommended care processes.

While documentation of basic clinical parameters, lipid assessment, and diabetes education was relatively strong, substantial gaps were identified in regular HbA1c monitoring, nephropathy screening, referral documentation, and comprehensive complication assessment.

The predominance of middle-aged individuals with elevated anthropometric and cardiovascular risk factors underscores the need for intensified risk factor modification strategies within workplace-linked healthcare systems. Although pharmacotherapeutic utilization patterns indicate active glycaemic management, inconsistent monitoring practices may limit optimal therapeutic outcomes.

The findings highlight the importance of transitioning from partial compliance to fully integrated guideline-concordant care. Strengthening systematic screening protocols, enhancing multidisciplinary coordination, and implementing structured quality improvement mechanisms within occupational primary healthcare frameworks may improve long-term diabetes outcomes.

This study contributes context-specific evidence from a semi-urban occupational community, emphasizing the critical role of organized primary care systems in addressing chronic disease burden. Future initiatives should focus on closing identified process gaps to ensure comprehensive, standardized, and sustainable diabetes care delivery.

## ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

The study protocol was reviewed and approved by the Institutional Ethics Committee of the affiliated institution prior to initiation of the research. The investigation was conducted in accordance with ethical principles outlined in the Declaration of Helsinki.

As this study involved retrospective evaluation of patient medical records, informed consent procedures were followed as per institutional guidelines. Patient confidentiality was strictly maintained throughout the study by anonymizing all identifiable information during data extraction and analysis.

No experimental animals were used in this study.

## AUTHORSHIP STATEMENT

All listed authors have made substantial contributions to the conception, design, data acquisition, analysis, and interpretation of the study. All authors have reviewed and approved the final version of the manuscript and agree to its submission.

The manuscript is original, has not been published previously, and is not under consideration for publication elsewhere. If accepted, it will not be published in the same or similar form in any language without prior written consent from the publisher.

Any modification in authorship after submission, including addition, deletion, or change in the order of authors, will be made only with the written approval of all authors.

## CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest, financial or otherwise, that could have influenced the outcomes or interpretation of this study.

## COPYRIGHT STATEMENT



## GALLEY PROOFS

The corresponding author will be responsible for reviewing and returning galley proofs within the stipulated time frame to ensure timely publication.

## PRIVACY AND CONFIDENTIALITY

All personal data obtained during the study was handled confidentially. The names and contact information of the authors will be used solely for editorial and publication purposes and will not be disclosed to third parties.

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