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Evolution of Practical Recommendations for the Management of Diabetes in Patients with COVID-19: An Experimental Observational Study

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Abstract

Background: Diabetes mellitus emerged as one of the most significant comorbidities influencing the severity and outcomes of COVID-19. The dynamic nature of the pandemic necessitated continuous evolution of practical diabetes management strategies, especially in hospitalized and home-isolated patients.

Objectives: To evaluate the evolution and effectiveness of structured, practical diabetes management recommendations on glycemic control and COVID-19 outcomes among patients with Type 2 diabetes mellitus (T2DM).

Methods: This prospective observational study with an embedded experimental management approach was conducted over 18 months (January 2021–June 2022) at a tertiary-care teaching hospital. A total of 220 RT-PCR–confirmed COVID-19 patients with T2DM were enrolled. Baseline socio-demographic, clinical, biochemical, and knowledge assessments were performed, followed by standardized glycemic optimization, COVID-19-specific management, and reinforced education. Glycemic parameters, inflammatory markers, clinical severity, and recovery outcomes were compared pre- and post-management.

Results: Post-intervention analysis demonstrated significant improvement in fasting and post-prandial blood glucose levels, reduction in HbA1c, and better stabilization of inflammatory markers. Patients with improved glycemic control showed reduced oxygen requirement, shorter hospital stay, and faster symptom resolution. Knowledge scores improved significantly following structured counselling.

Conclusion: Practical, adaptable diabetes management strategies significantly improve glycemic stability and COVID-19 outcomes. Continuous reinforcement of patient education and protocol-driven glucose monitoring plays a pivotal role during pandemic-related healthcare disruptions.

Keywords: COVID-19, Diabetes Mellitus, Glycemic Control, Insulin Therapy, Knowledge Assessment, Experimental Management.

Introduction

The COVID-19 pandemic posed unprecedented challenges to the management of chronic diseases, particularly diabetes mellitus. Type 2 diabetes mellitus (T2DM) is associated with impaired immune response, chronic

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inflammation, endothelial dysfunction, and prothrombotic states—factors that amplify COVID-19 severity. Early global reports demonstrated higher hospitalization rates, increased oxygen dependency, and mortality among diabetic patients.

During the evolving pandemic waves, traditional outpatient diabetes care was disrupted, necessitating innovative, practical, and adaptable management strategies. Frequent steroid use, hypoxia-related metabolic derangements, stress hyperglycemia, and limited patient-physician interaction further complicated glycemic control. These challenges highlighted the urgent need for structured yet flexible diabetes management protocols integrated into COVID-19 care.

Existing guidelines provided broad recommendations, but real-world implementation required localized, patient-centric adaptations, particularly in elderly and socio-economically vulnerable populations. Additionally, patient knowledge gaps regarding diabetes-COVID interaction significantly influenced treatment adherence and outcomes.

This study was designed to systematically evaluate the evolution of practical diabetes management recommendations during COVID-19, incorporating clinical care, patient education, and continuous monitoring, and to assess their impact on metabolic and clinical outcomes.

Materials and Methods

This was a prospective observational study with an embedded experimental management approach conducted to evaluate the evolution and effectiveness of practical diabetes management recommendations among patients diagnosed with COVID-19. The study was implemented in three structured phases:

1. Baseline assessment of socio-demographic, clinical, biochemical, and metabolic parameters;
2. Knowledge and impact evaluation related to diabetes–COVID interaction; and
3. Post-management comparative follow-up to assess outcomes following standardized management.

Although observational in nature, all participants received a uniform, protocol-driven diabetes and COVID-19 management strategy, enabling comparative evaluation of outcomes.

Inclusion Criteria

1. Adults aged **≥40 years** with diagnosed T2DM
2. Laboratory-confirmed COVID-19 infection (RT-PCR positive)
3. Willingness to provide informed consent
4. Completion of both baseline and follow-up assessments
5. Elderly patients (≥60 years) included for specialized glucose monitoring

Exclusion Criteria

1. Type 1 diabetes mellitus
2. Gestational diabetes
3. Severe chronic illnesses (CKD stage 5, decompensated liver disease, malignancy on active treatment)
4. Patients requiring mechanical ventilation at admission
5. Inability or unwillingness to participate in follow-up

Data Collection Tools and Procedures

1. Socio-Demographic and Socio-Economic Assessment

A structured, pre-tested questionnaire was used to collect:

- Age, gender, residence
- Educational status and occupation
- Socio-economic status (Modified Kuppuswamy Scale)
- Duration of diabetes and comorbidities
- Prior COVID-19 exposure and treatment history

2. Knowledge Assessment Tool

A validated **20-item questionnaire** assessed patient knowledge regarding:

- COVID-19 basics
- Diabetes-COVID interaction
- Importance of glycemic control
- Medication adherence
- Self-monitoring practices
- Preventive behaviors

Scoring system:

- Good: **75–100%**
- Moderate: **50–74%**
- Poor: **<50%**

3. Clinical Examination

- Performed at baseline and follow-up:
- Temperature, pulse rate, blood pressure
- Oxygen saturation (SpO_2)
- Respiratory rate
- Anthropometry (weight, height, BMI)
- COVID-19 severity classification (mild/moderate/severe)

Laboratory Investigations

Baseline investigations

- Fasting blood glucose (GOD-POD method)
- Post-prandial blood glucose
- Random blood glucose
- HbA1c (HPLC method)
- Complete blood count
- C-reactive protein
- Ferritin
- D-dimer
- Renal and liver function tests

Monitoring Investigations (Elderly ≥60 years)

Conducted on Days **1, 7, and 14**:

- FBG, PPBG, RBS
- Oxygen saturation
- Daily symptom score

Intervention / Management Protocol

1. Glycemic Optimization

- Insulin titration based on ADA COVID guidelines
- Modification of oral hypoglycemic agents (metformin withheld during hypoxia)
- Glucose monitoring:
    - 4-point SMBG for stable patients
    - 7-point capillary glucose monitoring for unstable patients

2. COVID-19 Management

- Antiviral therapy as per national guidelines
- Oxygen therapy for SpO_2 <94%
- Steroid therapy with glucose-adjusted dosing
- Thromboprophylaxis for moderate to severe cases

3. Lifestyle and Dietary Counseling

- Individualized diabetic diet
- Hydration and home-based mild physical activity
- Teleconsultation reinforcement every 48 hours

4. Knowledge Reinforcement

- Educational leaflets
- Telephonic counseling on diabetes-COVID interaction
- Monitoring of medication adherence

Statistical Analysis

Data were analyzed using **SPSS version 25**. Continuous variables were expressed as mean ± SD and categorical variables as frequency and percentage. Paired t-test or Wilcoxon signed-rank test was used for pre- and post-intervention comparisons. Chi-square test assessed associations. A **p-value <0.05** was considered statistically significant.

Results

Table 1: Socio-Demographic Characteristics of Study Participants (n = 220)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
40–49	46	20.9
50–59	78	35.5
≥60	96	43.6
Gender		
Male	138	62.7
Female	82	37.3
Residence		
Urban	132	60.0
Rural	88	40.0
Socio-economic Status (Modified Kuppuswamy)		
Upper / Upper Middle	58	26.4
Middle	92	41.8
Lower / Upper Lower	70	31.8

Table 2: Clinical Profile of Participants at Baseline

Variable	Mean ± SD / n (%)
Duration of diabetes (years)	8.6 ± 5.2
Hypertension	146 (66.4)
Dyslipidaemia	128 (58.2)
Obesity (BMI ≥25 kg/m²)	102 (46.4)
COVID-19 severity	
• Mild	72 (32.7)
• Moderate	104 (47.3)
• Severe	44 (20.0)
Baseline SpO_2 (%)	93.8 ± 3.6

Table 3: Baseline Glycemic Parameters of Study Participants

Parameter	Mean ± SD
Fasting Blood Glucose (mg/dL)	168.4 ± 42.6
Post-Prandial Blood Glucose (mg/dL)	246.7 ± 58.9
Random Blood Glucose (mg/dL)	262.3 ± 64.1
HbA1c (%)	8.9 ± 1.6

Table 4: Comparison of Glycemic Parameters Pre- and Post-Management

Parameter	Baseline	Follow-up	p-value
FBG (mg/dL)	168.4 ± 42.6	132.6 ± 28.4	<0.001*
PPBG (mg/dL)	246.7 ± 58.9	184.3 ± 36.7	<0.001*
RBS (mg/dL)	262.3 ± 64.1	198.5 ± 44.6	<0.001*
HbA1c (%)	8.9 ± 1.6	7.6 ± 1.2	<0.001*

*Statistically significant

Table 5: Changes in Inflammatory Markers Following Glycemic Optimization

Marker	Baseline	Follow-up	p-value
CRP (mg/L)	38.6 ± 22.4	18.9 ± 11.6	<0.001*
Ferritin (ng/mL)	496.2 ± 210.8	302.5 ± 156.4	<0.001*
D-dimer (mg/L)	1.24 ± 0.68	0.74 ± 0.42	0.002*

Table 6: Knowledge Assessment Scores Pre- and Post-Intervention

Knowledge Level	Baseline n (%)	Follow-up n (%)
Good (75–100%)	38 (17.3)	142 (64.5)
Moderate (50–74%)	96 (43.6)	64 (29.1)
Poor (<50%)	86 (39.1)	14 (6.4)

Table 7: COVID-19 Clinical Outcomes Based on Glycemic Control

Outcome	Controlled Diabetes (n=128)	Uncontrolled Diabetes (n=92)	p-value
Oxygen requirement	36 (28.1%)	54 (58.7%)	<0.001*
ICU admission	14 (10.9%)	32 (34.8%)	<0.001*
Mean hospital stay (days)	7.4 ± 2.8	11.6 ± 4.2	<0.001*
Recovery without complications	114 (89.1%)	58 (63.0%)	<0.001*

Table 8: Glycemic Variability in Elderly Patients (≥60 years, n = 96)

Parameter	Day 1	Day 7	Day 14	p-value
FBG (mg/dL)	182.6 ± 46.8	148.4 ± 32.5	134.2 ± 26.1	<0.001*
PPBG (mg/dL)	268.9 ± 62.4	206.7 ± 41.8	186.5 ± 34.9	<0.001*
RBS (mg/dL)	282.3 ± 70.6	218.6 ± 48.2	196.4 ± 39.1	<0.001*

Discussion

This study demonstrates that evolving, practical diabetes management strategies, when integrated into COVID-19 care, significantly improve metabolic control and clinical outcomes. Hyperglycemia is known to exacerbate

immune dysfunction, viral replication, endothelial injury, and inflammatory responses, all of which contribute to COVID-19 severity.

The observed improvement in glycemic parameters supports the critical role of early insulin optimization and frequent glucose monitoring, particularly in patients receiving corticosteroids. Our findings align with emerging evidence that glucose variability, rather than absolute hyperglycemia alone, predicts adverse COVID-19 outcomes.

Reduction in inflammatory markers among patients with improved glycemic control highlights the bidirectional relationship between metabolic regulation and systemic inflammation. This reinforces the concept that diabetes management is not merely supportive but a core therapeutic strategy in COVID-19.

Knowledge reinforcement played a pivotal role in improving adherence, self-monitoring practices, and preventive behaviors. Teleconsultation emerged as an effective tool for maintaining continuity of care during isolation, especially among elderly patients.

The elderly subgroup showed greater glucose fluctuations, emphasizing the need for intensive monitoring protocols in this vulnerable population.

Conclusion

Practical, evolving diabetes management strategies significantly mitigate adverse COVID-19 outcomes. Integrating structured glycemic control, patient education, and telemedicine ensures resilient chronic disease management during pandemics.

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