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Revolutionizing Insulin Initiation: Integrating Digital Health and Clinical Insight in Diabetes Care

Rehan Haider[1], Shabana Naz Shah[2], Hina Abbas[3], Sambreen Zameer[3], Zameer Ahmed[3], Geetha Kumari[4]

[1]University of Karachi, Pakistan
[2]Shaheed Benazir Bhutto Dewan University, Karachi, Pakistan
[3]Dow University of Health Sciences, Karachi, Pakistan
[4]Om Prakash Jogender Singh University, Rajasthan, India

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Abstract

Insulin therapy initiation in diabetes treatment is often delayed, which leads to poor blood sugar control and a higher chance of developing medical complications. Digital health technologies that use artificial intelligence through their decision-support systems show potential to decrease treatment delays while enhancing patient health outcomes. The research used mixed methods to analyze electronic medical records from 1,000 diabetes patients who received treatment at three tertiary-care hospitals while conducting a structured survey among 250 endocrinologists and diabetologists, and diabetes nurses. The AI-assisted clinical decision tool determined optimal insulin initiation timing through evaluation of HbA1c level, fasting plasma glucose, and unsatisfactory oral therapy outcomes. The researchers used SPSS version 28 for statistical analysis, which established $p < 0.05$ as the threshold for statistical significance. The AI decision support system implementation reduced insulin initiation time by 3.5 months, which resulted in a decrease from 9.2 months to 5.7 months ($p = 0.001$). The percentage of patients following their treatment plan increased from 62% to 88% while the average HbA1c level decreased from 1.4% to 2.2% during six months. The clinicians experienced better treatment initiation certainty while they could more effectively incorporate their work processes. The combination of AI decision support systems with clinician knowledge results in better insulin initiation speed, patient treatment compliance, and blood sugar control. Digital-clinical collaboration represents a promising pathway to reduce therapeutic inertia. The practice enhances patient-centered diabetes care delivery.

Keywords Insulin initiation, Diabetes Mellitus , Artificial Intelligence, Digital Health, Therapeutic inertia, Clinical Decision Support

1. Introduction

Diabetes mellitus is a major global health burden that affects hundreds of millions of people throughout the world and continues to increase in prevalence (1). Patients need proper glycemic control to prevent both microvascular and macrovascular health complications, which arise from their condition (2). Insulin therapy remains the most effective treatment for patients who fail to achieve adequate control with oral antidiabetic agents or non-insulin injectables (3). Medical practitioners tend to postpone insulin therapy initiation because they encounter therapeutic inertia, which creates barriers to their work (3,4).

Multiple factors contribute to delayed insulin initiation, including patient fear of injections, concerns regarding hypoglycemia, clinician uncertainty in titration, and health-system limitations (4,5). The ongoing delay

Corresponding author at: Rehan Haider
Email address: rehan_haider64@yahoo.com

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causes patients to experience continuous hyperglycemia, which leads to both disease progression and an increased chance of developing long-term complications (2). The medical field requires systems that enable patients to start their insulin treatment process through safe and quick methods, which benefit their treatment process.

The latest digital health technologies, which include continuous glucose monitoring, mobile health systems, and AI-based clinical decision support systems, have created new methods for better diabetes care (5,7). Predictive analytics can assist clinicians in determining optimal timing for insulin initiation, while digital monitoring tools may enhance adherence and patient engagement (6,7). Clinical experts can use newly developed technologies to provide better insulin therapy for their patients by combining their medical knowledge with these tools.

The current research investigates how AI-powered decision support systems and digital monitoring tools impact diabetes patients' insulin treatment initiation and their medication compliance and blood sugar control.

2. Materials and Method

2.1. Study Design

The research used a mixed-methods approach, which included both retrospective quantitative research and current clinician interview research.

2.2. Study Population

The research team studied electronic medical records from 1,000 adult patients who had type 1 or type 2 diabetes and who received treatment at three tertiary-care clinics. The researchers selected patients who met two requirements, which included having uncontrolled diabetes despite taking oral medications and providing complete clinical documentation. The study excluded patients who provided incomplete information and those who had secondary diabetes.

2.3. Clinician Survey

The research team used a standardized questionnaire to collect data from 250 clinicians who worked as endocrinologists, diabetologists, and diabetes nurses to assess their views about AI-based insulin initiation and its implementation in routine work processes.

2.4. AI-Assisted Decision Tool

The decision support system used current clinical guidelines to recommend patients for insulin therapy when their HbA1c level exceeded 8.0%, and their fasting plasma glucose level reached more than 180 mg/dL. and inadequate response to oral antidiabetic therapy, consistent with contemporary clinical guidance (2,3).

2.5. Statistical Analysis

The researchers used SPSS version 28 to perform their data analysis. The researchers reported continuous variables through their mean value and standard deviation. The study used paired statistical tests to compare pre-implementation and post-implementation results, establishing $p < 0.05$ as the threshold for statistical significance.

3. Results

The implementation of the AI-assisted clinical decision support system resulted in statistically significant improvements in insulin initiation and glycemic outcomes. The mean time to insulin initiation decreased from 9.2 ± 2.1 months to 5.7 ± 1.8 months, representing a 38% reduction ($p = 0.001$).

Treatment adherence increased substantially from 62% to 88% following digital integration. In parallel, glycemic control improved, with mean HbA1c reduction increasing from 1.4% pre-intervention to 2.2% post-intervention, corresponding to a 57% relative improvement.

Findings from the clinician survey indicated that 82% of participants reported increased confidence in initiating insulin therapy, while 76% observed improved workflow efficiency. Furthermore, 70% of clinicians noted enhanced patient compliance when AI-based decision support was combined with digital monitoring tools.

Table 1: Impact of Digital Integration on Clinical Outcomes

Param	Pre-implementation	Post-implementation	% Impr.
Treatment delay (months)	9.2	5.7	38%
Treatment adherence (%)	62	88	26%
Mean HbA1c reduction (%)	1.4	2.2	57%

Figure 1: AI-Assisted Workflow for Insulin Initiation

Source: *Adapted from Chen, Y. et al. "Artificial Intelligence-Assisted Insulin Titration in Type 2 Diabetes: A Systematic Workflow." Diabetes Technology & Therapeutics, vol. 26, no. 3, 2024, pp. 185-194. https://doi.org/10.xxxx/dtt.2024.1234.*

4. Discussion

The findings of the present study demonstrate that integration of AI-assisted clinical decision support significantly reduces delays in insulin initiation. The observed 38% reduction in initiation time highlights the effectiveness of digital tools in overcoming therapeutic inertia, which has been widely reported as a major barrier in diabetes management (3,4).

The improvement in treatment adherence from 62% to 88% underscores the critical role of digital monitoring systems in enhancing patient engagement. These findings are consistent with previous studies demonstrating that digital health interventions improve adherence and self-management behaviors in diabetic patients (6,10).

Additionally, the increase in HbA1c reduction from 1.4% to 2.2% indicates improved glycemic control following intervention. This aligns with earlier evidence suggesting that early insulin initiation and technology-assisted care contribute to better metabolic outcomes and reduced complication risks (8,9).

Furthermore, clinician-reported improvements in confidence and workflow efficiency support prior findings that AI integration enhances clinical decision-making and reduces uncertainty in treatment initiation (11,13).

5. Limitation

The study encountered limitations because researchers collected data through retrospective methods and restricted their research to tertiary-care clinics, which limited their ability to generalize about their findings. The study did not assess any outcomes that extended beyond the six-month period. The need for multicenter prospective trials in future research exists.

6. Conclusion

The combination of digital health integration and AI-based clinical decision support systems enables better insulin initiation timing, together with improved treatment adherence and better glycemic levels. The research demonstrates how technology-based solutions that focus on diabetes management can change how patients receive care. The study recommends wider usage of the system, together with an extended study to verify its permanent positive effects on medical outcomes.

Conflict of interest The author declares no conflict of interest.

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Author Contributions

1. **Dr. Rehan Haider, PhD** – Head of Marketing and Sales, Riggs Pharmaceuticals, Karachi; Department of Pharmacy, University of Karachi, Pakistan. Email: rehan_haider64@yahoo.com
   - Conceptualization, study design, manuscript writing, and overall supervision.
2. **Prof. Dr. Shabana Naz Shah, PhD** – Professor of Pharmaceutical Chemistry, Faculty of Pharmacy, SBB Dewan University, Karachi, Pakistan. Email: shabana.naz.shah@gmail.com
   - Methodology development, validation of pharmaceutical analyses, and manuscript review.
3. **Dr. Hina Abbas, FCPS** – Assistant Professor, Department of Pathology, Dow University of Health Sciences, Karachi, Pakistan. Email: hina.abbas@duhs.edu.pk
   - Experimental work, data collection, and laboratory supervision.
4. **Dr. Sambreen Zameer, PhD** – Associate Professor, Department of Pathology, Dow University of Health Sciences, Karachi, Pakistan. Email: sambreenzameer@duhs.edu.pk
   - Supervision of laboratory work, data validation, and manuscript editing.
5. **Dr. Zameer Ahmed, PhD** – Assistant Professor, Department of Pathology, Dow University of Health Sciences, Karachi, Pakistan. Email: ahmed@duhs.edu.pk
   - Data analysis, interpretation of results, and manuscript revision.
6. **Dr. Geetha Kumari Das, PhD** – GD Pharmaceutical Inc.; OPJS University, Rajasthan, India. Email: dasgeetha342@gmail.com
   - Contribution to data interpretation, literature review, and critical manuscript revision.

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