



Artificial Intelligence for Diabetes Care during Ramadan Fasting: A Narrative Review

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Abstract

Keywords

- artificial intelligence
- diabetes
- Ramadan fasting
- glycemic control
- hypoglycemia
- closed-loop systems
- predictive analytics
- culturally competent care

Background Ramadan fasting poses unique challenges for individuals with diabetes, particularly regarding glycemic control and hypoglycemia risk. Artificial intelligence (AI) technologies are emerging as tools to support safe and individualized diabetes management during fasting.

Objectives To explore the current and potential roles of AI in diabetes care during Ramadan, with a focus on clinical applications, patient outcomes, provider training, and barriers to adoption.

Key Findings AI is integrated into diabetes care through automated insulin delivery systems and machine learning–based risk prediction models. These tools support real-time glucose monitoring, hypoglycemia prevention, and personalized care, especially for high-risk groups. Type 1 diabetes patients benefit from closed-loop systems, whereas type 2 diabetes patients primarily use AI for predictive analytics. Regional resources, digital literacy, cultural perceptions, and provider training influence adoption. Barriers include cost, regulatory gaps, and algorithmic limitations in diverse populations.

Conclusions AI technologies hold promises for enhancing safety and glycemic outcomes for individuals with diabetes during Ramadan. Their optimal use depends on context-specific strategies, including culturally sensitive education, equitable access, and comprehensive training for providers. Further validation and customization of AI tools for fasting populations are necessary to support the widespread and effective implementation of these tools.

Introduction

Ramadan, a sacred month of fasting observed by Muslims worldwide, presents unique challenges for individuals with diabetes mellitus.¹ Despite religious exemptions, many patients choose to fast, often without appropriate medical guidance, which increases their risk of hypoglycemia and hyperglycemia.² Balancing religious observance with safe diabetes management requires nuanced, individualized care.³

Artificial intelligence (AI), with its capacity for data-driven decision-making and real-time monitoring, is increasingly being employed in the management of chronic diseases, including diabetes.⁴

This narrative review synthesizes existing evidence on the applications, benefits, and limitations of AI in diabetes care during Ramadan fasting (RF). It emphasizes the perspectives of patients and health care providers, regional disparities in adoption, and the educational needs that

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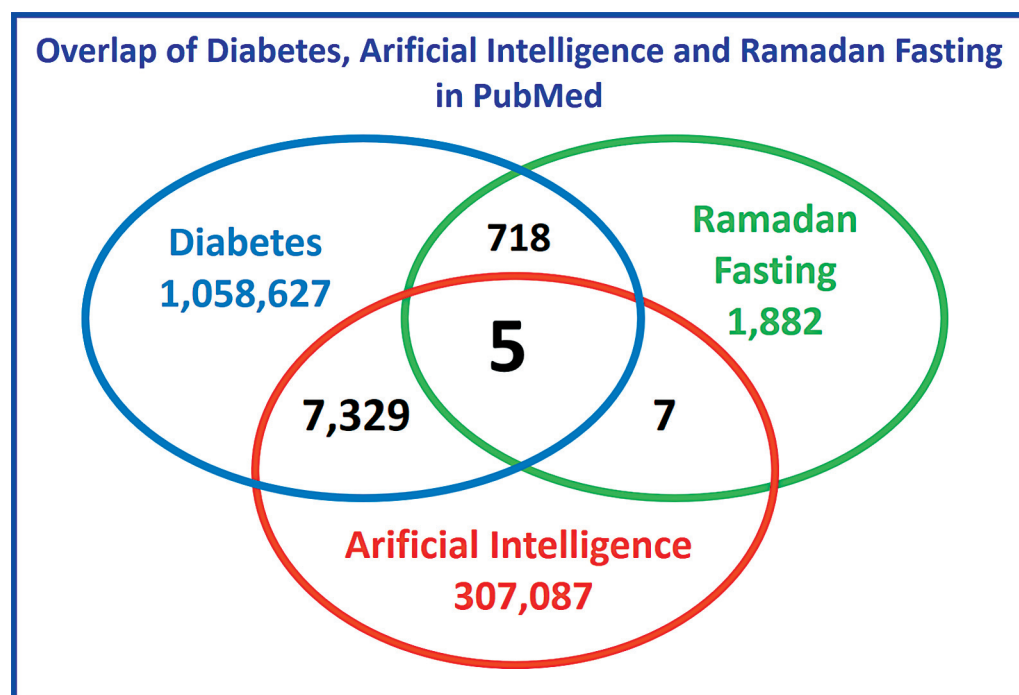


Fig. 1 Overlaps of PubMed records of diabetes, artificial intelligence (AI), and Ramadan fasting (RF).

influence the uptake of technology. In doing so, it aims to inform future clinical practice and policy in this evolving field.

Materials and Methods

This manuscript is a narrative review of the literature. The primary research question guiding this review was: “What is the role of AI in diabetes care during Ramadan fasting?” The inquiry considered reported experiences, views, promoters, barriers, challenges, and the way forward, with a particular interest in the special needs of limited-resource settings and the necessary training for patients and health care professionals.

The author employed Open Evidence (www.openevidence.com), an AI-powered platform that synthesizes peer-reviewed academic content to identify relevant literature. A specific and detailed prompt generated the initial body of pertinent references ($N = 25$). The primary research question guiding this review was: “What is the role of AI in diabetes care during Ramadan fasting?” Predetermined search objectives guided the selection of follow-up questions. The retrieved citations were validated through additional PubMed searches to address any omissions or exclusions using the search term [((Artificial Intelligence) AND (Diabetes) AND (Ramadan fasting))] ($N = 5$) (► **Fig. 1**). A Google Scholar search using the combination of terms (Ramadan fasting AND Artificial Intelligence) only generated 471 results. However, manual examination detected two additional relevant records only. No new primary data were collected, nor was any reanalysis of original data performed. The primary and follow-up research questions are listed in ► **Table 1**.

Emerging Themes

Definitions and Scopes

Digital health encompasses the use of digital technologies to enhance health care services.

It includes a broad spectrum of tools and applications. Machine learning tools are a subset of AI that enables systems to learn from data without explicit programming. Machine learning tools often involve adaptive algorithms that improve over time with more data and training. Comprehensive discussion of the technical details is outside the scope of this exercise. The current exploratory review will focus on the applicability of AI for diabetes management during RF.

Role of AI in Diabetes Care during RF

The AI in Diabetes Care during RF in Context

AI is increasingly recognized as a valuable adjunct in diabetes care during RF, primarily by supporting risk prediction, glycemic monitoring, and individualized management.⁵ The American Diabetes Association (ADA) highlights that diabetes technologies—including machine learning models—can enhance safety during fasting, especially when combined with Ramadan-focused education and risk assessment tools such as those developed by the International Diabetes Federation (IDF) and Diabetes and Ramadan International Alliance (DAR).^{3,6} AI-based machine learning models have demonstrated the ability to predict glucose variability and risk of hypoglycemia in people with type 2 diabetes (T2D) who fast during Ramadan. However, current models show higher accuracy for predicting hyperglycemia than hypoglycemia, and their performance is influenced by factors such as medication regimen and physical activity.^{6,7}

Table 1 The primary (1) and follow-up research questions (2–13) were used to identify the appropriate literature and citations^a

1. What is the role of AI in diabetes care during RF?
2. Which patient populations benefit most from AI in diabetes management during RF?
3. How do AI interventions differ for T1D versus T2D populations during RF?
4. What are the most common side effects of digital health tools in T1D during RF?
5. How do cultural or regional differences influence the acceptance of AI in diabetes management during RF?
6. How do provider training needs differ across regions for successful AI technology adoption in RF?
7. Which health care provider groups require the most targeted training for AI use in diabetes management during RF?
8. How do health care provider training programs impact AI adoption rates in diabetes care during RF?
9. How do training programs address unique cultural or religious considerations for RF in diabetes care?
10. How do training programs evaluate the effectiveness of AI tools in diverse cultural contexts?
11. How do health care providers' attitudes influence AI adoption in diabetes care during Ramadan?
12. What strategies can address limited digital literacy among health care teams in resource-constrained settings?
13. How do resource constraints impact the sustainability of digital literacy programs in these settings?

Abbreviations: AI, artificial intelligence; RF, Ramadan fasting; T1D, type 1 diabetes; T2D, type 2 diabetes.

^aThe "Open Evidence Platform" was prompted with the primary question (Q1), and further questions were selected from follow-up questions proposed by the platform (Q2–213) based on a predetermined search strategy.

Promoters of AI adoption include improved glycemic control, reduced risk of acute complications, and the ability to tailor recommendations based on real-time data from continuous glucose monitoring (CGM) and wearable devices^{8,9}. Automated insulin delivery (AID) systems, an AI-driven closed-loop technology, have demonstrated superior outcomes in type 1 diabetes (T1D) during RF, with higher rates of successful fasting and better time-in-range compared with other modalities.⁸

The use of machine learning to support diabetes management during RF was explored.^{9–11} However, they focused on different patient groups and clinical contexts. However, these studies demonstrate the valuable role of machine learning in tailoring diabetes care during the Ramadan period. While Motaib et al¹⁰ emphasized predictive modeling for nonfasting individuals, Ansari and Bhatt¹¹ focused on decision-support systems for those who do fast, offering a comprehensive view of how AI can enhance clinical outcomes across varying patient behaviors during this significant religious period. Furthermore, Ahmed et al¹² investigated the effect of RF on stress levels, activity, and sleep patterns in 29 schoolchildren using wearable AI devices before, during, and after RF. The study suggests that RF poses no direct risks in terms of stress, implying rather that it may be linked to dietary habits. Furthermore, as stress score calculations are based on heart rate variability, this study suggests that fasting does not interfere with the cardiac autonomic nervous system.

Barriers and challenges include limited predictive accuracy for hypoglycemia, small sample sizes in current studies, data integration issues, clinician hesitancy, regulatory concerns, and health inequities in access to advanced technologies.⁷ Patient perspectives highlight the importance of culturally sensitive, individualized education and support, as well as the need to balance religious and health priorities.¹³

Who Benefits most from AI in Diabetes Management

Patients with T1D using AID systems and T2D on multiple glucose-lowering therapies at moderate to high risk of glycemic excursions benefit the most from AI in diabetes management during RF.

For T1D, real-world data show that AID systems, which leverage AI algorithms, are associated with the highest rates of successful fasting, improved time-in-range, and reduced hypoglycemia compared with conventional pump therapy or multiple daily injections, especially in those with a history of glycemic instability or previous fasting difficulties.⁸ The ADA recommends diabetes technologies, including machine learning models, as adjuncts to risk calculation and nutrition planning for high-risk groups during fasting.⁶

For T2D, AI-based machine learning models can predict glucose variability and hyperglycemia with high accuracy in those on complex regimens, though current models are less effective for hypoglycemia prediction. These tools are particularly valuable for individuals with a higher baseline HbA1c, a history of prior hypoglycemia, or those with negative previous Ramadan experiences, as identified by the IDF-DAR risk calculator.^{7,14}

Promoters for AI adoption include improved safety, individualized recommendations, and enhanced patient confidence. Barriers and challenges include limited predictive accuracy for hypoglycemia, access disparities, and the need for culturally sensitive education. The way forward involves refining AI algorithms for hypoglycemia, integrating multimodal data, and expanding access to advanced technologies, as emphasized by both patient perspectives and professional societies.^{6,13}

Differences in AI for T1D versus T2D

AI interventions for diabetes management during RF differ significantly between patients with T1D and those with T2D due to their distinct pathophysiology, risk profiles, and technology needs (–Table 2).

Table 2 Comparison of AI applications in type 1 diabetes versus type 2 diabetes during Ramadan

Feature/function	Type 1 diabetes	Type 2 diabetes
Primary AI tool	Automated insulin delivery (AID), closed-loop	Predictive analytics, risk calculators
Glycemic benefit	Improved time-in-range, reduced hypo/hyperglycemia	Enhanced risk stratification, medication adjustment
Monitoring	Real-time CGM with insulin feedback	Retrospective or trend-based CGM interpretation
Fasting suitability	High-risk but manageable with technology + education	Moderate-risk, improved with tailored adjustments
Main barriers	Cost, education, tech availability	Limited accuracy in hypoglycemia prediction
Training needs	Advanced tech use, sensor interpretation	Risk score application, patient counseling

Abbreviation: CGM, continuous glucose monitoring.

In T1D, the primary AI-based interventions are the AHCL (advanced hybrid closed loop) and AID systems. These systems utilize AI algorithms to continuously adjust insulin delivery based on real-time glucose sensor data, thereby minimizing hypoglycemia and hyperglycemia during prolonged fasting periods. Evidence demonstrates that AID systems provide superior glycemic control, higher time-in-range, and lower glycemic variability compared with conventional pump or multiple daily injection regimens, with minimal increase in hypoglycemia risk and high rates of successful fasting. The ADA recommends such technologies as adjuncts to risk calculation and nutrition planning for high-risk groups during fasting. However, these systems require patient engagement, structured education, and access to advanced technology, which may limit their widespread use.^{6,8,15–18}

In T2D, AI applications primarily focus on predictive analytics using machine learning models to forecast glucose variability and identify periods of increased risk for hypo- or hyperglycemia, especially in those on complex regimens. These models integrate clinical, demographic, and activity data to support individualized management but currently have higher accuracy for predicting hyperglycemia than hypoglycemia. For T2D, the main benefit is enhanced risk stratification and support for medication adjustment rather than real-time AID. The ADA and the IDF-DAR recommend prioritizing agents with low hypoglycemia risk and using technology to support monitoring and education.⁷

Limitations for both populations include access disparities, the need for culturally sensitive education, and, in T2D,

the limited predictive accuracy of current AI models for hypoglycemia. In T1D, the primary challenge is the need for close monitoring and rapid response to glucose fluctuations, which is best addressed by closed-loop systems.⁷

In summary, AI-based closed-loop insulin delivery has the most significant impact on individuals with T1D. At the same time, AI-driven predictive analytics and decision support are more relevant for T2D during RF, each tailored to the unique clinical needs and risks of these populations.^{6,7}

Safety of Digital Health Tools in T1D during Ramadan

The most common side effects of using digital health tools, such as AI-driven AID systems and CGM systems, in patients with T1D who observe RF are mild hypoglycemia and hyperglycemia, as well as local skin reactions at sensor or infusion sites (►Table 3).

Mild hypoglycemia remains the most frequent adverse event. Still, rates are generally low and not increased compared with nonfasting periods when using AHCL or AID systems, as shown in multiple real-world and interventional studies during RF. Severe hypoglycemia and diabetic ketoacidosis are rare with appropriate use and structured education and were not reported in recent studies of these technologies during RF.^{8,15–20} The ADA notes that technology use, especially when combined with Ramadan-focused education, supports safety and reduces hypoglycemia risk in high-risk groups.⁶

Mild hyperglycemia, particularly postprandial, can occur due to changes in meal composition and timing during Ramadan; however, it is generally well-managed by the adaptive algorithms in AID systems.⁸ Local skin irritation

Table 3 Barriers and enablers of AI adoption for diabetes management during Ramadan

Category	Barriers	Enablers
Technical	Limited hypoglycemia prediction; data integration issues	Real-time feedback, adaptive algorithms
Clinical	Small sample sizes; guideline unfamiliarity	Improved safety; evidence-based fasting management
Cultural/religious	Technology mistrust, religious autonomy concerns	Culturally sensitive tools; religious authority support
Educational	Low digital literacy; provider training gaps	Inter-professional training; Ramadan-focused education
Economic/infrastructure	Cost, lack of reimbursement, poor internet/device access	Subsidies, public-private partnerships

or discomfort at the sensor or infusion set placement site is occasionally reported, but it is not unique to RF.^{18,20}

Overall, the use of these digital health tools is associated with improved glycemic control and a favorable safety profile during RF, provided that patients receive structured education and individualized care.^{6,8}

Cultural and Regional Differences in the AI Acceptance

Cultural and regional differences significantly influence the acceptance and implementation of AI-based technologies in diabetes care during RF. Acceptance is higher in regions with greater access to diabetes technology, robust health care infrastructure, and established diabetes education programs focused on Ramadan. In the Middle East and parts of South-east Asia, where RF is widely practiced and diabetes prevalence is high, there is growing interest in AI-driven tools such as CGM and AID systems, but uptake is limited by cost, availability, and digital literacy disparities (►Table 3).^{8,21}

Religious beliefs, autonomy, and trust in technology shape patient perspectives. Many Muslims with diabetes prioritize religious observance and may fast against medical advice, relying on self-assessment and community or religious guidance rather than health care provider recommendations.^{13,22} This can create barriers to the adoption of AI-based tools, especially if these technologies are perceived as intrusive or incompatible with cultural values. Provider perspectives vary by region and training; in some areas, physicians are less familiar with international guidelines and advanced technologies, resulting in inconsistent recommendations and limited integration of AI into routine care.²³

Promoters of AI adoption include improved safety, real-time monitoring, and the potential for individualized care, especially when combined with culturally sensitive education and pre-Ramadan risk assessment as recommended by the ADA and IDF.^{3,6} Barriers include high costs, limited access, a lack of culturally tailored education, and concerns about data privacy. Challenges also arise from the need for region-specific validation of AI algorithms and the integration of technology into existing care pathways.

The way forward involves expanding access to diabetes technology, enhancing provider education, and developing culturally adapted AI tools and educational resources tailored to diverse populations. Collaborative efforts among health care systems, religious authorities, and patient communities are crucial for addressing regional disparities and promoting safe and effective diabetes management during Ramadan.^{6,23}

Health Providers' Hesitancy Toward AI

Health Care Providers' Attitudes to AI Adoption

Health care providers' attitudes are crucial to the adoption of AI technologies in diabetes care during RF. Providers who are knowledgeable, confident, and supportive of diabetes technology—including AI-driven CGM and risk prediction tools—are more likely to recommend and integrate these solutions into patient care, thereby enhancing safety and individualized management during fasting. The ADA specifically recom-

mends that diabetes technologies be considered as adjuncts to risk calculation and nutrition planning during religious fasting, highlighting the importance of provider endorsement for successful implementation (►Table 3).^{3,6}

Reported experiences indicate that providers who engage in pre-Ramadan education and risk assessment and are familiar with current guidelines facilitate better patient outcomes and higher technology uptake. However, barriers include limited provider familiarity with AI tools, lack of structured education programs, and reliance on personal experience rather than standardized guidelines, as seen in surveys where many physicians did not follow specific protocols.²³ Additional challenges include concerns about the accuracy of AI in predicting hypoglycemia, data privacy, and disparities in access to advanced technologies.⁷

Promoting adoption requires targeted education for providers, integrating AI tools into existing clinical workflows, and ongoing evaluation of technology performance in real-world Ramadan settings. The way forward involves structured training, guideline-based practice, and collaborative decision-making with patients, as well as addressing system-level barriers to ensure equitable access and safe, effective diabetes management during religious fasting.^{6,23}

Provider Training Needs for Successful AI Adoption during RF

Provider training needs for successfully adopting AI-based technologies in diabetes management during RF differ across regions due to variations in health care infrastructure, digital literacy, cultural attitudes, and guideline familiarity. In areas with advanced health care systems and greater access to diabetes technology, such as the Gulf states, provider training focuses on integrating AI-driven tools (e.g., AID and CGM analytics) into individualized care, interpreting AI-generated risk scores, and delivering culturally sensitive Ramadan-focused education. Training also emphasizes shared decision-making and patient empowerment, reflecting patient autonomy and religious priorities.^{13,23}

In contrast, in regions with limited resources or less exposure to advanced diabetes technology, such as parts of South Asia or North Africa, provider training needs are more foundational. These include building familiarity with international guidelines (such as those from the ADA and the IDF), understanding the principles of AI-based risk stratification, and learning to deliver structured pre-Ramadan education that addresses medical and cultural factors.^{6,23} Surveys indicate that many providers in these regions rely on personal experience rather than guidelines, highlighting the need for structured, guideline-based training and practical workshops.²³

Barriers include limited access to technology, cost, and skepticism about the relevance of AI to local practice. Promoters of adoption are improved patient safety and the ability to tailor care to individual risk profiles. The way forward involves regionally adapted training programs, collaboration with religious and community leaders, and ongoing education to bridge gaps in digital literacy and cultural competence.^{13,23}

Which Health Care Providers Require Targeted Training in AI Use for Diabetes Management in RF?

Primary care providers require the most targeted training for using AI-based technologies in diabetes management during RF, especially in regions with limited health care infrastructure, lower digital literacy, and less familiarity with international guidelines such as those from the ADA and the IDF. Studies from Turkey and Iraq demonstrate that family physicians are often the first point of contact for people with diabetes during Ramadan, yet they have the lowest awareness and utilization of international guidelines, and frequently rely on personal experience rather than evidence-based protocols.^{23,24}

In contrast, endocrinologists and diabetes specialists in tertiary centers tend to be more familiar with advanced technologies and guidelines. Still, gaps remain in primary care and among general practitioners, particularly in low- and middle-income countries. Targeted training for these groups should focus on guideline-based risk assessment, safe integration of AI-driven tools (such as CGM and risk calculators), and culturally sensitive patient education, as emphasized by the ADA and the IDF.^{3,6}

Nurses and allied health professionals involved in diabetes care also benefit from structured education. Still, given their central role and current knowledge gaps, the most critical need is among family physicians and primary care providers.^{23–25}

Improving AI Adoption for Diabetes Care in RF

Impact of Health Care Provider Training on AI Adoption Rates
Health care provider training programs significantly increase the adoption rates of AI technologies in diabetes care during RF by improving provider knowledge, confidence, and willingness to implement these tools. Structured education—especially when interdisciplinary and focused on the unique challenges of Ramadan—has been shown to enhance providers' ability to adjust medications, counsel patients, and utilize technology, including AI-driven solutions, for safe fasting (►Table 4).^{25,26}

Reported experiences indicate that providers who participate in targeted training demonstrate improved skills in medication adjustment and risk assessment, and are more likely to recommend and integrate diabetes technologies, such as CGM and AI-based risk calculators, into clinical practice.^{25,26} The ADA emphasizes that diabetes technologies should be considered adjuncts to risk calculation and education during religious fasting, and that provider education is essential for effective implementation.⁶

Promotors of adoption include increased provider confidence, improved patient outcomes, and alignment with guideline-based care. Barriers and challenges include a lack of awareness of international guidelines, insufficient training in AI applications, and a reliance on personal experience rather than evidence-based protocols, as highlighted by surveys showing low familiarity with guidelines and inconsistent practice patterns among physicians.^{23,24} Training programs address these gaps by standardizing knowledge and fostering positive attitudes toward technology adoption.

The way forward involves integrating Ramadan-specific diabetes management and AI technology training into continuing medical education. This ensures that providers can deliver guideline-concordant, technology-enabled care for fasting patients.⁶

Cultural Considerations for Diabetes During RF

Health care provider training programs address the unique cultural and religious considerations in diabetes care for patients fasting during Ramadan by incorporating structured, culturally sensitive education emphasizing respect for spiritual practices, shared decision-making, and individualized care. These programs train providers to conduct comprehensive pre-fasting risk assessments using tools such as the IDF-DAR risk calculator, as recommended by the ADA, to ensure safety and appropriateness of fasting for each patient.⁶

Training emphasizes the importance of fasting-focused education, including guidance on meal composition, hydration, and the timing of glucose monitoring, particularly during

Table 4 Knowledge gaps and future research directions in AI-driven diabetes care during Ramadan

Knowledge gap	Future research direction
Limited real-world validation of AI tools during Ramadan	Conduct multicenter, prospective studies in fasting populations across diverse settings
Poor predictive accuracy for hypoglycemia in T2D models	Develop and test improved machine learning algorithms using multimodal data
Insufficient data from low- and middle-income Muslim-majority countries	Include underrepresented regions in trials; build local datasets for model training
Lack of distinction between general digital tools and AI-specific innovations	Clarify AI versus non-AI technologies in research design and reporting
Unclear ethical and legal frameworks for AI in RF.	Explore patient attitudes, consent practices, and regulatory gaps in culturally specific contexts.
Minimal evaluation of provider training program efficacy	Assess the impact of structured AI training on clinical outcomes and technology adoption
Underdeveloped culturally sensitive AI design	Co-develop tools with patients, religious scholars, and clinicians to ensure local relevance

Abbreviations: AI, artificial intelligence; RF, Ramadan fasting; T2D, type 2 diabetes.

the last hours of fasting, when the risk of hypoglycemia is highest. Providers are taught to deliver advice that is both evidence-based and respectful of patients' religious motivations, supporting autonomy and informed choice.^{6,13,22} Programs also address the need for individualized treatment adjustments, prioritizing medications with a lower risk of hypoglycemia and tailoring regimens to the fasting context (► **Table 4**).^{6,27,28}

In adopting AI technologies and diabetes management tools, training programs focus on integrating these tools into culturally competent care. Providers are educated on using AI-driven risk calculators and glucose monitoring systems to align with patients' religious values and daily fasting routines, thereby empowering patients through shared decision-making and self-management strategies.^{28,29} This approach fosters trust, improves patient engagement, and enhances the safety and effectiveness of diabetes management during RF.

Continuous quality improvement is achieved by comparing pre- and post-training outcomes, including adverse event rates and patient satisfaction, and adapting educational content to local practices and beliefs. This approach ensures that AI adoption is both clinically effective and culturally appropriate during RF.^{6,7,14}

Challenges and Solutions in AI for Diabetes in Resource-Limited Settings

Challenges

Resource constraints undermine the long-term sustainability of digital literacy programs for health care teams—particularly family physicians and primary care providers—in resource-constrained settings aiming to adopt AI-based technologies for diabetes management during RF by limiting access to ongoing training, technology, and support infrastructure (► **Table 4**).

Financial limitations restrict the availability of digital devices, internet connectivity, and up-to-date software, which are essential for training and the practical use of AI-based tools. High staff turnover and heavy clinical workloads further reduce the time and continuity needed for sustained digital literacy development. The lack of structured, guideline-based education—highlighted in studies from Iraq and Turkey—means that many family physicians rely on personal experience rather than evidence-based protocols, and only a minority are familiar with international guidelines such as those from the ADA and the IDF.^{23,24}

The absence of local trainers and digital health champions, as well as the limited integration of digital literacy into existing continuing medical education frameworks, also challenges sustainability. Without institutional support and regular reinforcement, initial gains from short-term training are often lost, and digital skills do not translate into routine clinical practice.

Solutions

The ADA emphasizes the need for comprehensive, fasting-focused education and technology integration as adjuncts to

risk assessment and patient education. Still, these recommendations are difficult to implement and sustain in resource-constrained settings without dedicated funding, leadership, and policy support (► **Table 4**).⁶

Empowerment-based, collaborative care models and mentorship can be effective, but require ongoing investment and adaptation to local needs.²⁸ Specifically, to address limited digital literacy among health care teams, particularly family physicians and primary care providers, in resource-constrained settings for the adoption of AI-based technologies in Ramadan diabetes management, several strategies are supported by the medical literature:

Structured, guideline-based education programs: the ADA recommends comprehensive, fasting-focused education for health care providers, emphasizing the use of risk calculators and technology as adjuncts to clinical decision-making. Training should be practical, case-based, and tailored to local needs, focusing on the safe use of digital tools and AI-driven risk assessment in Ramadan.⁶

Inter-professional and collaborative training: interprofessional curricula that include physicians, nurses, pharmacists, and allied health professionals have improved knowledge, confidence, and skills in managing diabetes related to Ramadan. These programs should incorporate digital literacy components, hands-on workshops, and simulation of AI tool use.^{25,26}

Empowerment and shared decision-making frameworks: empowerment-based algorithms and collaborative care models facilitate provider engagement with technology, promoting patient-centered care. Training should include modules on shared decision-making, cultural competence, and integrating AI outputs into individualized care plans.²⁸

Local adaptation and mentorship: training should be adapted to the regional context, using local languages and culturally relevant materials. Mentorship from diabetes specialists and digital health champions can support ongoing learning and troubleshooting.^{23,24}

Pre-Ramadan preparation and continuous support: early and repeated training sessions before Ramadan, with ongoing support during the fasting month, help reinforce digital skills, and address emerging challenges.²⁵

When implemented together, these strategies can bridge digital literacy gaps and support the safe, effective adoption of AI-based technologies for diabetes management during RF.^{6,23,25}

Ethical Implications

Integrating AI into diabetes management during RF raises several ethical considerations that merit deeper exploration.

AI applications often require continuous health data capture, raising concerns about patient consent, data security, and compliance with data protection laws. In many low-resource or culturally conservative settings, the use and ownership of data remain limited in terms of transparency.

Many AI models are trained on homogeneous datasets and may not account for the clinical and cultural heterogeneity of Muslim populations. This can lead to biased outputs,

inaccurate risk assessments, or underperformance in marginalized groups.

Fasting during Ramadan is a deeply personal and religious choice. AI tools must support, not override, patient autonomy. Ethical deployment requires interpretable tools, allows shared decision-making, and is integrated into culturally sensitive care plans.

Unequal access to AI technologies can exacerbate health disparities. Without equitable distribution and training infrastructure, AI may deepen existing inequalities in diabetes outcomes between high- and low-resource regions.

These ethical concerns underscore the need for robust regulatory frameworks, inclusive algorithm design, and culturally tailored deployment strategies to ensure that AI technologies promote, rather than hinder, equitable and respectful diabetes care during Ramadan.

Limitations

While this review provides a comprehensive synthesis of AI applications in diabetes care during RF, several limitations warrant attention.

The studies included span a variety of settings, populations, and technologies, which may limit the generalizability of the findings. Most evidence is derived from small-scale or observational studies, particularly in T1D populations, and may not reflect broader real-world usage patterns.

The literature sometimes overlaps general digital tools (e.g., CGM, telehealth) with AI-specific applications (e.g., machine learning models, closed-loop systems). Although both are integral to technology-enabled care, future work should delineate their distinct contributions more precisely.

Data from certain regions, such as sub-Saharan Africa or non-Arab Muslim-majority countries, are limited. Socioeconomic and cultural diversity within Muslim communities is broad, and localized studies are needed to validate AI tools in these settings. Current AI models show limited predictive accuracy for hypoglycemia, especially in diverse populations. Furthermore, the real-world validation and explainability of algorithms remain underdeveloped, posing risks to their clinical adoption and implementation.

Finally, as a narrative review, the findings are inherently qualitative. No systematic evaluation metrics or meta-analytical synthesis were included. Furthermore, existing literature often conflates general digital health tools (e.g., CGM, insulin pumps) with AI-specific innovations, blurring distinctions in outcomes. Sample sizes in fasting-focused trials remain small, and there is limited data from low- and middle-income countries where Ramadan is widely observed but health care infrastructure is underdeveloped.

Conclusions

AI technologies are transforming diabetes care, offering new opportunities to improve outcomes for individuals who fast during Ramadan. By enabling real-time monitoring, glycemic prediction, and individualized management, AI tools—particularly AI systems and machine learning-based risk strati-

fication—enhance patient safety and support autonomy. However, their benefits are tempered by disparities in access, digital literacy, and regional health system capabilities. Effective implementation requires more than technological innovation; it demands culturally competent education, structured provider training, and inclusive policy frameworks. Tailoring AI solutions to fasting populations and validating their effectiveness across diverse settings are essential next steps.

Future directions involve refining AI algorithms for more accurate hypoglycemia prediction, integrating multimodal data, expanding access to care, and ensuring robust validation across diverse populations. Future research should include multicenter trials of AI systems specifically designed for Ramadan, comparative studies of algorithm performance across diverse cultural contexts with patient input, and evaluations of how AI can either mitigate or exacerbate global health inequities. Transparent, inclusive, and participatory design principles will be crucial to ensuring the ethical and effective deployment of AI in this space. Collaboration among clinicians, patients, and technology developers is crucial to realizing the full potential of AI-supported diabetes care during Ramadan, exemplifying how AI can serve as both a scientific advancement and a culturally sensitive health care solution.

Use of AI in Scientific Writing

During the composition of this review, the author used generative AI tools solely for literature discovery and drafting assistance. Specifically, Open Evidence was consulted on June 29, 2025. The author reviewed and edited all substantive content, assuming full accountability for the manuscript's intellectual integrity and originality.

Compliance with Ethical Principles

No ethical approval is required for narrative review articles.

Data Availability Statement

Not applicable.

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None.

Conflict of Interest

None declared.

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