EAST EUROPEAN UNIVERSITY

ARTIFICIAL INTELLIGENCE IN DIABETES CARE

A SYSTEMIC REVIEW (2018-2026)

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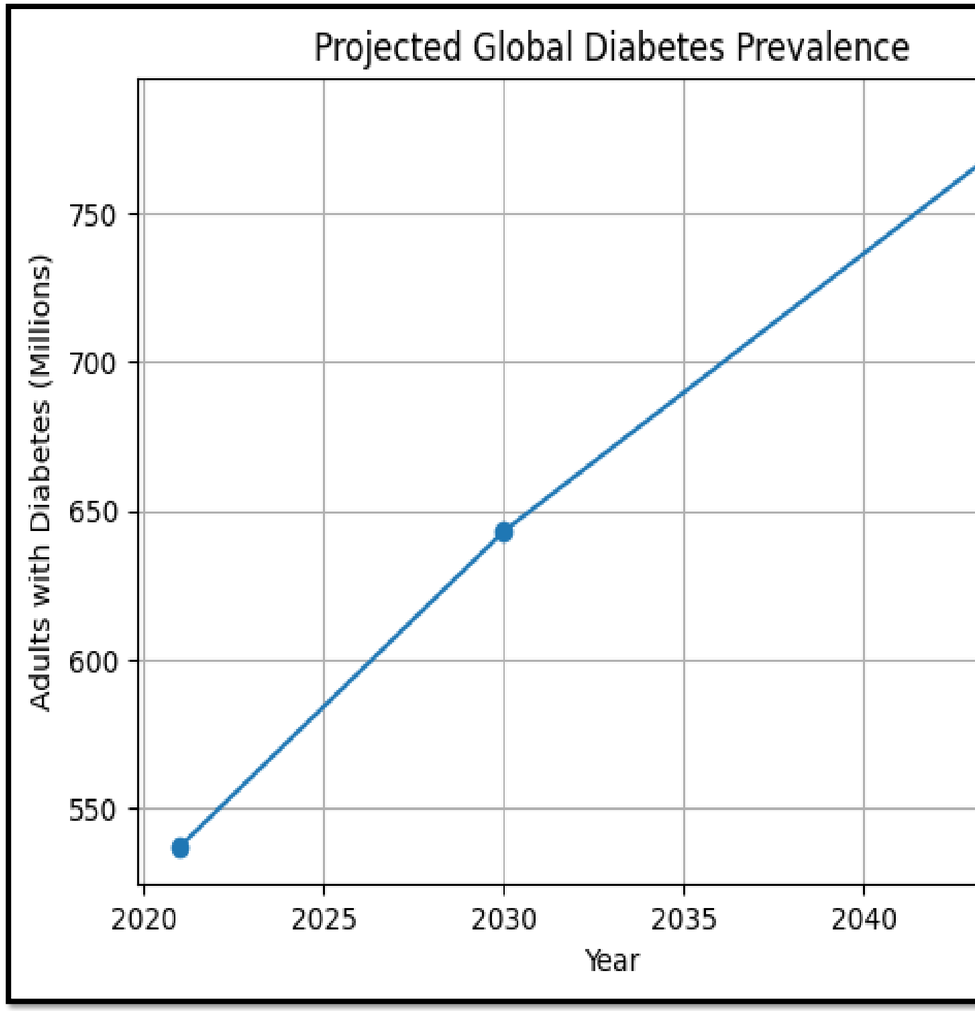
BACKGROUND

- Diabetes Mellitus is a chronic metabolic disorder characterized by impaired regulation of blood glucose due to insulin deficiency or resistance.
- Diabetes is associated with severe long-term complications including:
  - Cardiovascular disease
  - Kidney failure
  - Neuropathy
  - Diabetic retinopathy
- Despite advancements in treatment, challenges persist in early diagnosis, glycemic control, and timely detection of complications, contributing to significant healthcare burden.



RATIONALE

- Artificial Intelligence (AI) has emerged as a transformative technology capable of analyzing complex medical datasets with high efficiency.
- In diabetes care, AI offers potential to:
  - Detect disease at earlier stages
  - Predict complications before clinical manifestation
  - Enhance continuous glucose monitoring
  - Automate screening for retinopathy
- Therefore ,recent AI growth highlights the need for comprehensive evaluation in diabetes

OBJECTIVE

The objective of this systematic review was to evaluate advancements in artificial intelligence applications in diabetes care between 2018 and 2026.

- Specifically, this review aimed to assess:

1. AI-based diagnostic tools
2. Risk prediction models
3. Continuous glucose monitoring systems
4. Hypoglycemia prediction algorithms
5. AI-driven complication detection

METHODS

- This systematic review was conducted in accordance with the **PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines** to ensure methodological transparency and rigor.

- A comprehensive literature search was performed across three electronic databases: **PubMed, Scopus, and Google Scholar**. The search covered studies published between **2018 and JANUARY 2026**. Keywords included combinations of *“diabetes,” “diabetes mellitus,” “artificial intelligence,” “machine learning,” “deep learning,” “prediction,” “diagnosis,” and “continuous glucose monitoring.”*

ELIGIBILITY CRITERIA

Inclusion Criteria:

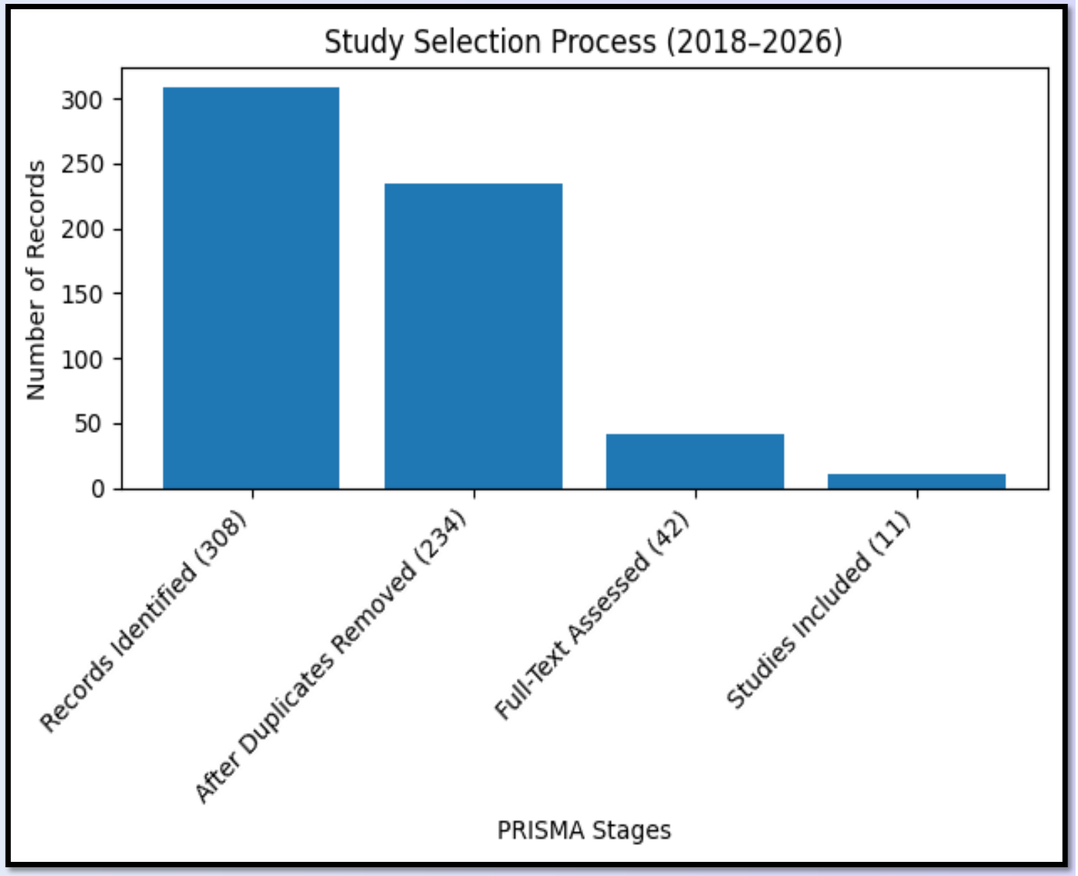
- Human clinical studies
- Studies applying AI for diagnosis, prediction, glucose monitoring, or complication detection
- Studies reporting clinical performance metrics or patient outcomes

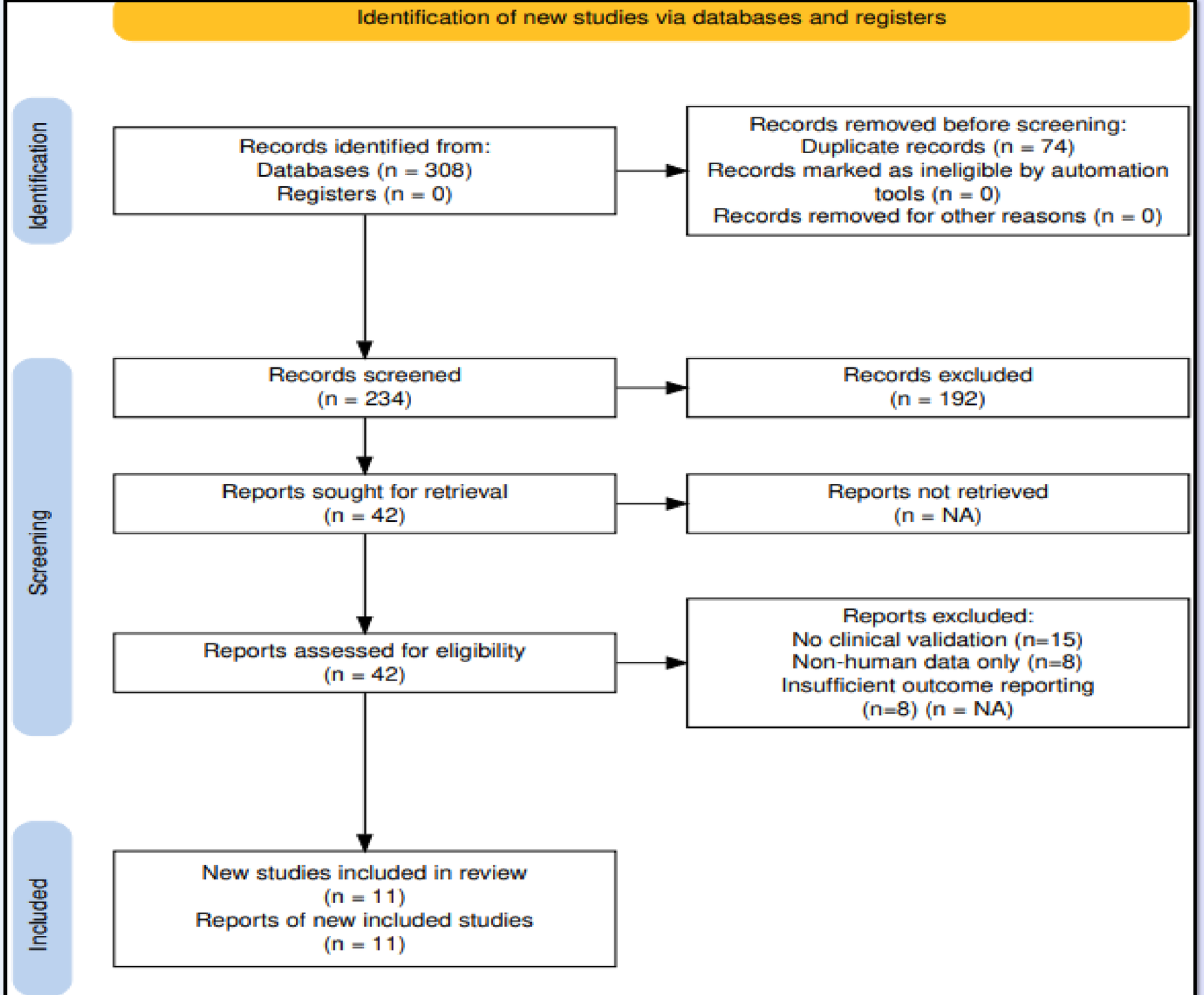
Exclusion Criteria:

- Non-human or simulation-only studies
- Studies without clinical validation
- Conference abstracts without full-text availability
- Non-English publications

SEARCH AND SCREENING STRATEGY

- A search of three electronic databases (2018– January 2026) identified 308 records. After removal of 74 duplicate records, 234 records remained for screening.
- Of these, 192 were excluded based on title and abstract review due to irrelevance, review design, or lack of clinical validation. Forty-two full-text articles were assessed for eligibility. Following full-text evaluation, 31 studies were excluded due to non-human data, absence of reported performance metrics, or insufficient methodological detail. Ultimately, 11 studies were included in the final qualitative synthesis..
- A meta-analysis was not performed due to heterogeneity in study design and validation approaches




Identification of new studies via databases and registers
Identification
Screening
Included
Records identified from:
Databases (n = 308)
Registers (n = 0)
Records removed before screening:
Duplicate records (n = 74)
Records marked as ineligible by automation tools (n = 0)
Records removed for other reasons (n = 0)
Records screened
(n = 234)
Records excluded
(n = 192)
Reports sought for retrieval
(n = 42)
Reports not retrieved
(n = NA)
Reports assessed for eligibility
(n = 42)
Reports excluded:
No clinical validation (n=15)
Non-human data only (n=8)
Insufficient outcome reporting
(n=8) (n = NA)
New studies included in review
(n = 11)
Reports of new included studies
(n = 11)

QUALITY ASSESSMENT

- To assess risk of bias and methodological validity:
  - PROBAST was used for prediction model studies.
  - QUADAS-2 was used for diagnostic accuracy studies.

PROBAST (Prediction models) :

- Participants
- Predictors
- Outcome
- Analysis

QUADAS-2 (Diagnostic accuracy):

- Patient selection
- Index test
- Reference standard
- Flow & timing

AI MODELS IDENTIFIED

- Common AI models identified included:
  - Random Forest
  - Gradient Boosting
  - Support Vector Machines
  - Deep Neural Networks

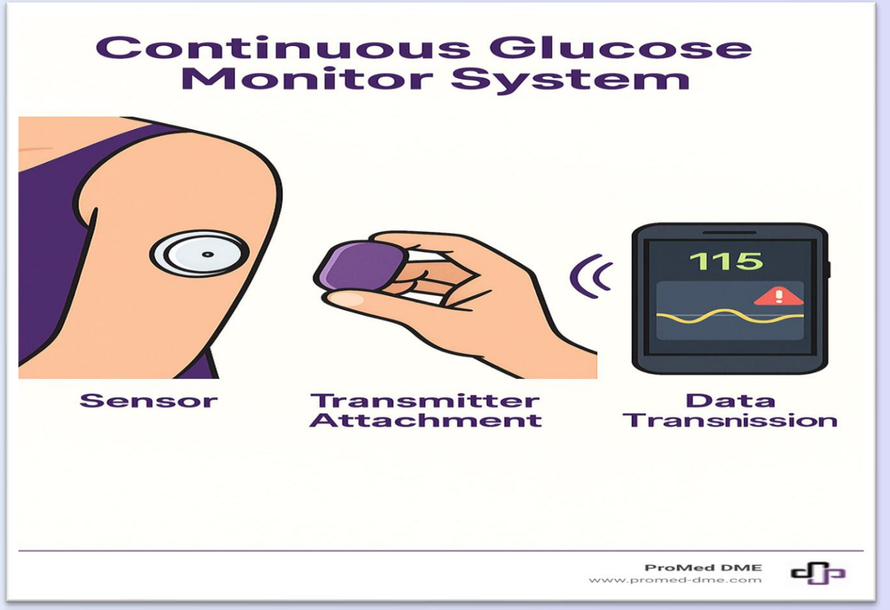
- Performance range across studies:
- Accuracy: ~80–96%
- High AUC in image-based detection

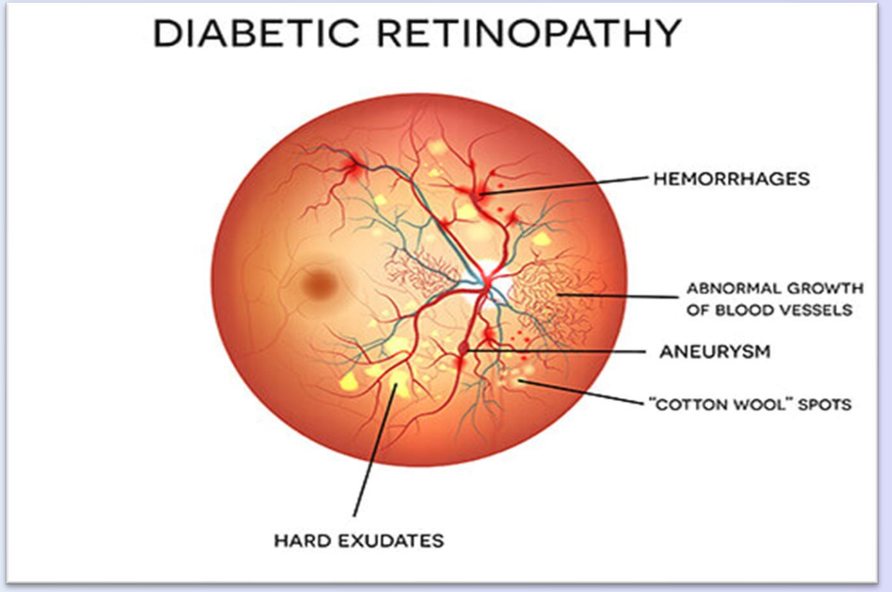
CLINICAL APPLICATIONS

1. Continuous Glucose Monitoring (CGM)
    1. Real-time glucose analysis
    2. Hypoglycemia prediction
    3. Insulin dosing optimization

    --PROFAST-IT Ramadan study demonstrated improved hypoglycemia risk prediction.
2. Diabetic Retinopathy Screening
    1. Deep learning-based retinal image analysis
    2. High sensitivity detection
    3. Scalable screening solutions

    --AI systems comparable to ophthalmologists in some studies.





DISCUSSION

- AI demonstrates significant potential in enhancing diagnostic accuracy, predictive modeling, and personalized diabetes management.
- Explainable AI techniques such as SHAP and LIME improve interpretability and clinician trust.
  - SHAP - Shows how much each input (e.g., age, blood pressure) influences the prediction
  - LIME- Provides local explanations for individual patients' results - Transparency builds trust among clinicians and supports decision-making
- Federated learning enables multi-institutional collaboration while preserving patient privacy and complying with GDPR and HIPAA standards.
- However, many models remain limited by homogeneous datasets and lack of external validation.

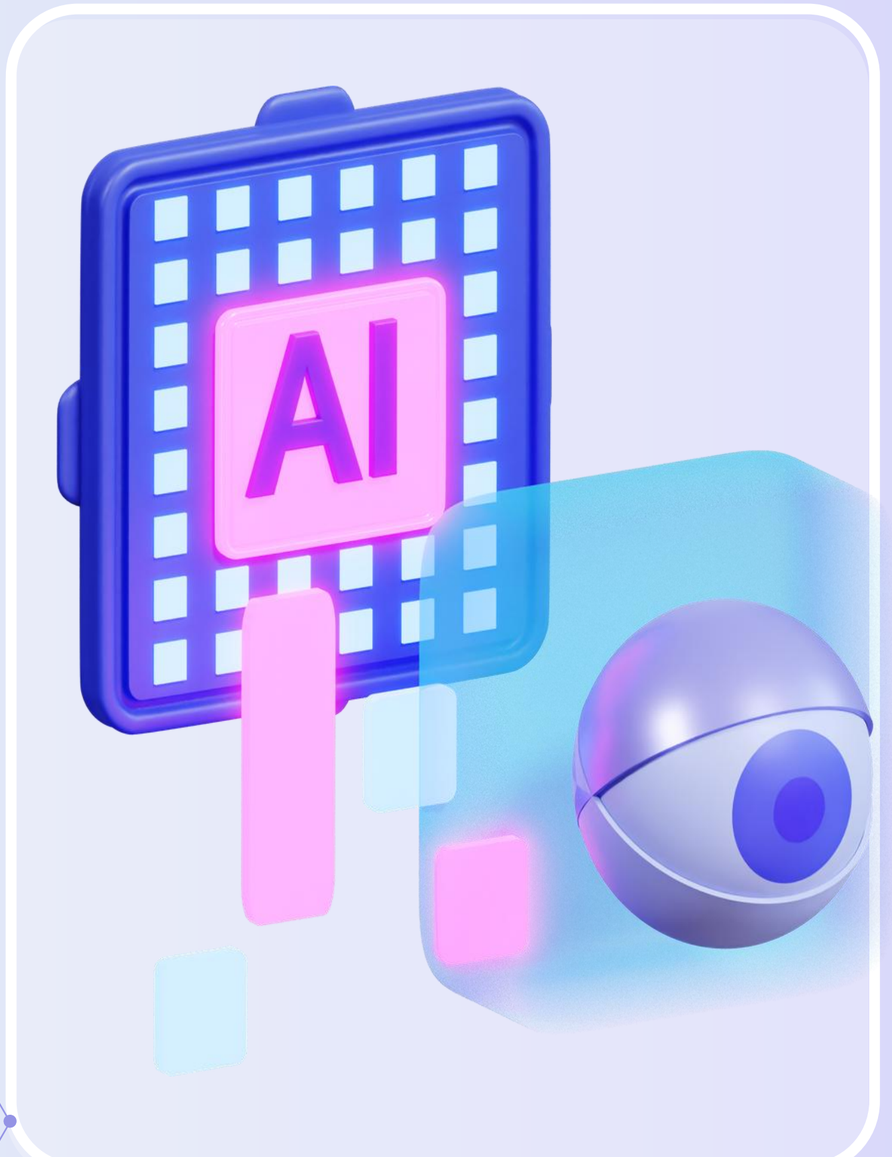
LIMITATION & CONCLUSION

LIMITATIONS

- Small, single-center datasets
- Limited external validation
- Regulatory uncertainty
- Lack of long-term outcome studies
- No meta-analysis due to heterogeneity

CONCLUSION

- AI holds major potential to transform diabetes care by improving: - Early diagnosis and risk prediction
- Continuous glucose monitoring and hypoglycemia prevention - Detection of early complications like retinopathy
- To unlock these benefits, we need: - Multi-center validation and real-world clinical studies
- Integration of explainable and privacy-preserving AI methods
- Clear regulatory pathways to ensure safety and efficacy



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