AI-BASED DIABETES PREDICTION SYSTEM

1.ABSTRACT

Artificial intelligence (AI) is a fast-growing field and its applications to diabetes, a global pandemic, can reform the approach to diagnosis and management of this chronic condition. Principles of machine learning have been used to build algorithms to support predictive models for the risk of developing diabetes or its consequent complications. Digital therapeutics have proven to be an established intervention for lifestyle therapy in the management of diabetes. Patients are increasingly being empowered for self-management of diabetes, and both patients and health care professionals are benefitting from clinical decision support. AI allows a continuous and burden-free remote monitoring of the patient's symptoms and biomarkers. Further, social media and online communities enhance patient engagement in diabetes care. Technical advances have helped to optimize resource use in diabetes. Together, these intelligent technical reforms have produced better glycaemic control with reductions in fasting and postprandial glucose levels, glucose excursions, and glycosylated haemoglobin will introduce a paradigm shift in diabetes care from conventional management strategies to building targeted data-driven precision care.

2.INTRODUCTION

Diabetes, a chronic metabolic condition, is a global health care burden. According to the International Diabetes Federation (IDF), 463 million people between ages 20 and 79 years have diabetes, and 374 million have impaired glucose tolerance. By the year 2045, 693 million people are likely to have diabetes. While 8.8% of the world population was reported to have diabetes in 2017, the numbers are projected to rise to 10% by 2045.Diabetes is associated with various complications and a significant morbidity and mortality. It is important to intervene not only to treat but also to prevent and make a timely detection of diabetes. Management of diabetes is challenging because 1of 2 adults with diabetes are undiagnosed, yet 10% of global health expenditure (US$760 billion) are spent on diabetes. Artificial intelligence (AI) finds widespread use in four key areas in diabetes care, including automated retinal screening, clinical decision support, predictive population risk stratification, and patient self-management tools. The purpose of this review is to provide an overview of the scope and utility of AI in the prevention, diagnosis, and treatment of diabetes.

3.Artificial Intelligence

AI has been described as "a branch of computer science that aims to create systems or methods that analyse information and allow the handling of complexity in a wide range of applications. "The application of AI to diabetes is feasible and desirable for efficient data and the development of tools and devices for its management. To provide safer technology through AI, it is recommended to have safe designs, safety reserves, and procedural safeguards, with all uncertainties identified for all potential technical systems. Technical advances have introduced wearables, smartphones, and other gadgets that can aid in the continuous monitoring and tracking of patients symptoms and disease status. Physicians and health care professionals should allow patients to choose AI-assisted care for the effective management of diabetes.

Artificial neural networks: Neural networks have been created to link and analyse disparate information and build personalized solutions. Neural network methodology has found particular and vast applications in diabetes diagnosis. Intelligent algorithms have been constructed to study the impact of various factors on glycaemic indices.

Others: Other techniques like support vector regression (SVG) have been applied to diabetes care. Support vector regression has been used to build a hypoglycaemia predictor. This creates an alert for preventive intervention when patients have alarmingly low levels of blood glucose. Together, these technologies find wide application in diabetes care.

4.APPLICATIONS

Automated retinal screening: Deep learning algorithms have been developed to automate the diagnosis of diabetic retinopathy. AI-based screening of retina is a feasible, accurate, and well-accepted method for the detection and monitoring of diabetic retinopathy. A high sensitivity and specificity of 92.3% and 93.7%, respectively, have been reported for automated screening of the retina. Patient satisfaction for automated screening is also high with 96% patients reported as being satisfied or very satisfied with this method. Convolutional neural networks (CNN) have been trained on limited data sets to generate region-specific probability maps for haemorrhages, microaneurysms,exudates, neovascularization, and normal appearance in the retina.

Clinical decision support: Supervised machine learning based clinical decision support tools have been developed to predict short- and long-term HbA1c response after insulin initiation in patients with type 2 diabetes mellitus. These tools also help to identify clinical variables that can influence a patient's HbA1c response. The elastic net regularization based generalized linear model based on baseline HbA1c and estimated glomerular filtration rate is reported to reliably predict the HbA1c response after insulin initiation. Areas under the curve (AUC) of 0.80 (95% confidence interval [CI] 0.78−0.83) and 0.81 (95% CI 0.79−0.84), respectively.

Predictive population risk stratification: Healthcare recommendation system (HRS) using machine learning helped to predict the risk for a disease, including diabetes, by analysing patient's lifestyle, physical health factors, mental health factors, and their social network activities. Data from 68,994 healthy people and patients with diabetes has been used as a training data set for using decision tree, random forest, and neural networks to predict diabetes with high accuracy (accuracy = 0.8084with all attributes).

Genomics: Advanced molecular phenotyping, genomics, epigenetic alterations, and development of digital biomarkers is a new advance in the diagnosis and management of disease cocconditionThese can be applied to diabetes where huge data sets are generated owing to the heterogeneous nature and chronic course of the disease. Microbiome data has been used to build a repository of microbial marker genes that can be used to predict the possibility of development of diabetes and guide the treatment in patients with confirmed diabetes.32 Genome-wide association studies have identified more than 400 signals that could potentially establish the genetic susceptibility to diabetes.33 Convolutional neural networks models have been trained on multiple genome wide mapping and regulatory epigenetic annotations available for pancreatic islets to predict regulatory variants for refining the signals associated with diabetes.

Other applications: Telehealth has revolutionized the management of diabetes. Remote monitoring reduces the time spent in follow-up visits and allows a more real-time monitoring of the glycaemic status as well as the overall health of the patient. AI has the ability to replace 50%-70% of routine follow-up clinical consultations with virtual engagements and remote monitoring. Short message service (SMS) text messaging are being tested for improvement in medication adherence in a randomized control trail in over 800 patients with type 2 diabetes mellitus in sub-Saharan Africa.

Other devices: Diet and exercise are the initial and effective strategies to prevent type 2 diabetes mellitus in high-risk individuals.41 Various apps have been designed that provide customized dietary

plans and schedules and suggest alterations in food intake to suit an individual's lifestyle. Daily activity levels can be tracked by wearables that record step counts and time and intensity of other activities. devices are effective facilitators of changes in behaviour toward health. These devices enable tracking of daily activity and can motivate an individual to include a targeted activity into routine to prevent chronic diseases, including type 2 diabetes mellitus.

5.Limitations of Artificial Intelligence

The application of AI in diabetes care has several limitations.

Human factors: Factors influencing the use of AI in diabetes care have been evaluated in some studies. In a metaanalysis of 14 randomized control trials, younger patients were reported to attain greater benefits from mobile apps for diabetes care and the effect size was enhanced with health care professional feedback.45 AI can pose a risk of deskilling physicians by introducing dependence. This may introduce a vicious cycle of inadequate accuracy because AI in itself requires periodic refinements by experts.

Technical factors: Barriers for the use of AI in diabetes care include cost, access, and implementation. With a growing array of devices and apps, interoperability is reported as a common potential barrier to their use in diabetes management.

Limitations of data: Paucity of supporting data to build logical and accurate algorithms is a common challenge in diabetes care. Data sets will need to be more mature and structured to inform digital applications to construct impactful solutions. Concerns about security and data protection and regulatory concerns are also limiting the seamless adoption of technology in diabetes care.

Limitations of design: Current models and applications of AI in diabetes care have been validated using retrospective data sets. Prospective validation of these technical advances holds promise for automating diabetes care. Endpoints in clinical studies will need to be redefined to include the digital biomarkers and data from apps and monitors and activity trackers.