Transforming Diabetes Care: The Role of Artificial Intelligence in Diabetes Mellitus Management

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Abstract— **Diabetes is a chronic and complex metabolic disease that poses a significant health problem worldwide. Recent advances in artificial intelligence (AI) promise to improve the management and treatment of diabetes. This article explores various aspects of the role of intelligence in improving diabetes care, including predictive analytics, personalized care planning, and ongoing care. AI-powered tools can now analyse large amounts of patient data to predict the onset of diabetes, optimize insulin use, and provide instant advice from wearable devices. In addition, machine learning algorithms increase the accuracy of blood sugar monitoring and make it easier to detect problems early. Despite this progress, there are problems such as data privacy, integration with existing health systems, and ensuring equality. This article discusses the current state of AI applications in diabetes care, reviews research literature demonstrating its effectiveness, and offers recommendations that predict and potentially influence adoption. Finally, the integration of artificial intelligence into diabetes management promises to improve patient outcomes and reduce the burden of this disease.**

Index Terms—**Diabetes mellitus, Artificial intelligence, Management and Treatment, AI-driven tools, Machine learning, Advancements.**

1. Introduction

A. Overview of Diabetes Mellitus

1) Definition and classification:

Diabetes mellitus is a group of metabolic diseases caused by hyperglycaemia (high blood sugar) due to poor insulin secretion, insulin action, or both [1]. Acute hyperglycaemia is associated with long-term damage, dysfunction, and failure of many organs, especially the eyes, kidneys, nerves, heart, and blood vessels. The main types of diabetes are [2]:

- Type 1 diabetes (T1DM): An autoimmune disease where the insulin-producing beta cells in the pancreas attack the body and produce less insulin. Most teenagers and children are diagnosed with this disease [3].
- Type 2 diabetes (T2DM): This disease is most often caused by relatives who do not have insulin and are insulin resistant [4]. These conditions are similar to genetic predisposition, obesity and lack of exercise. Although it mostly affects the elderly, the younger group is more likely to contract the disease [5].
- Gestational diabetes (GDM): This is a type of diabetes that occurs during pregnancy and poses risks to both the mother and the foetus [6].
- Other special conditions: These include monogenic diabetes such as diabetes of the young (MODY), exocrine pancreatic diseases (such as cystic fibrosis-associated diabetes) [7], and drug- or medication-induced diabetes (such as diabetes resulting from long-term steroid use) [8].

2) Epidemiology:

Diabetes is a rapidly growing global health problem affecting an estimated 537 million adults by 2021 and expected to reach 783 million by 2045[9]. The disease is most common in the Western Pacific, Southeast Asia, and the Middle East, with cases occurring in: Developing countries due to urbanization, changing lifestyles, and aging populations. Type 2 diabetes is the most common type of diabetes and is associated with risk factors such as obesity, sedentary lifestyle, poor diet and genetics, tested in adults [10] and certain ethnic groups, including Africans, Hispanics, Native Americans. Natives and Americans. In contrast, type 1 diabetes, although less common, is mostly influenced by genetics and environment and tends to develop during childhood or adolescence [11]. The increase in gestational diabetes also highlights the potential impact of diabetes on maternal and child health [12]. Complications of the disease such as heart disease, kidney failure and blindness

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increase mortality and burden. Public health strategies that focus on prevention, early diagnosis, and effective management are critical to combating the global impact of diabetes [13].

3) Pathophysiology: The underlying pathophysiology of diabetes involves:

- Type 1 Diabetes: Pancreatic beta cells are destroyed by the immune system, causing complete absence of insulin [14].
- Type 2 Diabetes: There is an interaction between relative insulin resistance and insulin resistance. Initially, insulin resistance causes pancreatic beta cells to secrete more insulin, but eventually these cells malfunction and cannot produce enough insulin [15].

4) Clinical Manifestations:

Symptoms of high blood sugar include: weight loss, fatigue, blurred vision, polyuria (frequent urination), polydipsia (excessive thirst), and polyphagia (increased appetite) [16]. Hyperosmolar hyperglycaemic state (HHS) in T2DM and diabetic ketoacidosis (DKA) in T1DM can cause serious complications that require urgent treatment [17].

5) Diagnosis: Diagnosis of diabetes is typically based on one of the following criteria:

- A level of fasting plasma glucose (FPG) ≥126 mg/dL (7.0 mmol/L).
- At the 2-hour mark, plasma glucose during an oral glucose tolerance test (OGTT) was ≥200 mg/dL (11.1 mmol/L) [18].
- A1c (haemoglobin A1c) ≥6.5%
- Random plasma glucose ≤200 mg/dL (11.1 mmol/L) in patients with hyperglycemia or hyperglycemic crisis [19].

6) Management: The management of diabetes focuses on controlling blood glucose levels to prevent complications and includes:

- Lifestyle Modification: Diet, exercise, and weight management.
- Pharmacology: Insulin therapy is recommended for T1DM [20]. There are many oral and injectable medications for T2DM, such as metformin, sulfonylureas, DPP-4 inhibitors, GLP-1 receptor agonists, and SGLT2 inhibitors [21].
- Monitoring: Frequent HbA1c testing, blood glucose monitoring, and problem screening [22].

7) Complications: Chronic hyperglycaemia can lead to both microvascular and macrovascular complications, including:

- Microvascular: Retinopathy, nephropathy, and neuropathy.
- Macrovascular: Cardiovascular diseases, such as coronary artery disease, stroke, and peripheral artery disease [23].

8) Prevention and Education:

Preventing diabetes, especially type 2 diabetes, includes public health campaigns that emphasize exercise, healthy eating, and weight control [24]. Controlling diabetes and avoiding complications should be learned from patients and doctors [25].

Overall, diabetes is a different type of disease that requires careful attention and prevention strategies [26]. The use of technologies such as artificial intelligence has the potential to improve patient outcomes and improve current strategies.

B. Importance of Effective Diabetes Management:

Good diabetes management is important for many reasons that affect the overall health burden and quality of life of people with diabetes [27]. The following key ideas highlight its importance:

1) Preventing Acute Complications:

- Hypoglycemia: Good management can help prevent hypoglycemia, which can be fatal in severe cases and cause seizures, confusion, and loss of consciousness [28].
- Hyperglycaemia: It is important to avoid excessive hyperglycaemia because it can lead to hyperosmolar hyperglycaemic state (HHS) in type 2 diabetes or diabetic ketoacidosis (DKA) in type 1 diabetes. Both are diseases that need to be treated quickly [29].

2) Reducing the risk of Long- Term Complications:

- Microvascular Complications: Proper treatment can reduce the risk of diabetic retinopathy, which leads to blindness, nephropathy, and kidney failure [30].
- Macrovascular Complications: Adequate control of blood sugar can reduce the risk of cardiovascular disease [31], such as peripheral artery disease, heart disease, and stroke, which are leading causes of morbidity and mortality in diabetics.

3) Improving Quality of Life:

- Symptoms Management: A better quality of life can be achieved by managing symptoms such as excessive thirst, frequent urination, and fatigue by keeping blood sugar within the target range [32].
- Mental Health: Adequate treatment can reduce the psychological effects of diabetes, including anxiety and hopelessness, by enabling patients to manage their health cleanly [33].

4) Enhancing Longevity:

- Increasing life expectancy is associated with diabetes control [34]. Research shows that people with good blood sugar control can expect to live longer than people with poorly controlled diabetes [35].

5) Economic Benefits:

- Healthcare Costs: Good management can reduce health care costs by reducing the need for complex medical care, emergency room visits, and hospitalizations [36].
- Productivity: Improved management can benefit businesses and people by reducing sick days and increasing productivity [37].

6) Empowering Patients:

- Education and Self- Management: Effective management involves educating patients about their condition and allowing them to take control of their health through self-care, medication, and lifestyle changes [38].

- Technology Integration: Blood sugar control can be improved and patient independence increased through the use of technologies such as insulin pumps and continuous blood glucose meters (CGM) [39].

7) *Preventing Disease Progression:*
   - With early and effective intervention, long-term results can be achieved by delaying the onset and complications of diabetes. For example, controlling diabetes can prevent the onset of mild diabetes complications [40].

8) *Reducing Healthcare Burden:*
   - As diabetes becomes more common, good management can reduce the burden on healthcare by reducing hospitalizations and complications associated with the disease [41].

9) *Supporting Personalized Medicine:*
   - With the help of quality control, treatment planning can be made according to patient needs, thus improving outcomes and compliance [42].

C. *Emergence of AI in Healthcare:*

The application of artificial intelligence (AI) in healthcare has led to a revolution in analysing medical data, patient care, and improving medical outcomes [43]. Artificial Intelligence (AI) technology has revolutionized many areas of healthcare, including robotics, machine learning, and natural language processing [44]. The main points regarding the development and use of artificial intelligence in the field of health are as follows:

1) *Enhanced Diagnostic Accuracy:*
   - Artificial Intelligence (AI) is revolutionizing medical specialties such as radiation, pathology and art. Artificial intelligence (AI) systems such as IBM Watson and Google DeepMind have demonstrated accuracy in interpreting medical images such as MRIs, CT scans, and X-rays [45]. Often, these algorithms match or even surpass human scientists in diagnosing diseases such as cancer, osteoporosis, and brain abnormalities [46]. Artificial intelligence (AI) in pathology can help doctors detect abnormalities in tissue samples, speeding up the diagnostic process and reducing the chance of human error [47]. These developments demonstrate the potential of artificial intelligence to revolutionize healthcare by increasing the accuracy and precision of diagnosis [48].

2) *Predictive Analytics:*
   - In the healthcare industry, artificial intelligence (AI) has led to significant advances in patient care and risk prediction [49]. Artificial intelligence machines analyse large amounts of data to predict the risk of diseases such as diabetes, heart disease and cancer. This allows for early diagnosis and preventive measures [50]. AI-powered devices can also monitor patient vital signs and predict emergencies such as heart attack or sepsis, allowing life-saving interventions to be delivered in a timely manner [51]. These developments highlight the importance of artificial intelligence to improve patient care through health management and real-time monitoring [52].

3) *Personalized Medicine:*
   - Artificial intelligence is revolutionizing pharmacogenomics and treatment optimization in medicine [53]. AI can use patient information such as genetics, lifestyle decisions and treatment options to reduce side effects and improve quality of care [54]. Additionally, AI plays an important role in pharmacogenomics by analysing genetic variation associated with specific drug responses, making drugs easier and more effective to use [55]. These advances show that artificial intelligence has the potential to improve medication use and treatment outcomes [56].

4) *Robotic Surgery:*
   - Thanks to artificial intelligence and cutting-edge robotics, surgical procedures are becoming more precise and less invasive [57]. Tools like the Da Vinci Surgical System allow surgeons to perform more complex surgeries, resulting in faster recovery times and improved patient outcomes [58]. Additionally, research on autonomous surgical robots has advanced toward creating devices that can perform certain surgical procedures without human assistance [59]. These advancements have the potential to revolutionize the surgical industry by providing quality care to more people [60].

5) *Administrative Efficiency:*
   - Artificial intelligence (AI) is improving language processing (NLP) and accelerating business automation in healthcare [61]. Artificial intelligence reduces administrative costs and simplifies doctors' jobs by managing tasks such as scheduling, billing, and patient care [62]. Additionally, AI-powered natural language processing (NLP) technology facilitates accurate and rapid collection and analysis of medical data, improving information management and providing better decision-making support [63]. These advances show how AI can enhance data intelligence and improve clinical processes [64].

6) *Drug Discovery and Development:*
   - Artificial intelligence has helped advance medical research and improve clinical trials [65]. Artificial Intelligence systems accelerate the drug development process by evaluating biological data to identify therapeutic targets and predict the success of drug therapy [66]. Artificial Intelligence (AI) improves the analysis and management of clinical trials by identifying suitable applicants, predicting outcomes, and assessing side effects [67]. These advances show how AI can improve clinical trials and speed up the research process, making treatments faster and more effective [68].

2. Predictive Analytics in Diabetes Care

A. Role of AI in Predicting Diabetes Onset:

Artificial intelligence (AI) can now be used to predict the onset of diabetes, specifically type 2 diabetes (T2D) [69]. Artificial intelligence has the potential to improve early detection and prevention processes by classifying large amounts of data and identifying patterns that are difficult for humans to see [70]. Let's take a look at how IQ indicates when diabetes will occur:

1) Predictive Modeling:

Diabetes prediction uses many deep learning and machine learning algorithms [71]. To identify high-risk individuals, various machine learning algorithms, such as decision trees, random forests, support vector machines, and neural networks, are used to analyse large data sets and create predictive models [72]. In particular, deep learning methods such as convolutional neural networks (CNN) and recurrent neural networks (RNN) are good at predicting diabetes by processing complex data, especially time series, and are now included in electronic health records (EHRs) [73]. These cutting-edge methods increase the accuracy and efficiency of diabetes risk assessment and prediction [74].

2) Data sources:

Artificial intelligence uses a variety of data to identify high-risk groups and predict when diabetes will occur [75]. Electronic health records (EHRs) contain large amounts of patient information, including vital signs, test results, demographic information, and medication history [76]. Models learned from EHR data can predict the onset of diabetes years before diagnosis [77]. Additionally, AI uses genomic data to identify genetic markers associated with diabetes risk, making it easier to create polygenic scores for personalized assessment [78]. Fitness trackers and continuous blood monitors (CGM) are examples of technology that provide instant information about blood sugar patterns, heart rate, and activity levels [79]. This information enables predictive modelling, early detection and intervention. Artificial Intelligence (AI) advances diabetes prediction and prevention technology by combining information from multiple data streams to improve patient outcomes [80].

3) Key Predictors Identified by AI:

- Lifestyle Factors: Physical activity, diet, sleep patterns, and stress levels [81].
- Clinical Parameters: Body mass index (BMI), blood pressure, lipid profiles, fasting glucose levels, and HbA1c.
- Demographic Factors: Age, gender, ethnicity, and family history of diabetes [82].

4) Advantages of AI in Predicting Diabetes:

- Early Detection: Cognitive models identify risk factors and subtle changes in a person's early life, allowing rapid changes and interventions to prevent diabetes [83].
- Personalized Risk Assessment: Artificial intelligence enables preventive measures to be taken by structuring risk based on each person's different data [84].
- Scalability: Artificial intelligence is necessary and useful for many people because it can analyse data from millions of people [85].

5) Case Studies and Applications:

- Google's DeepMind: Use machine learning to analyse retinal images to predict the risk of developing diabetes in the eye, which is a good indicator of the overall risk of the disease [86].
- IBM Waston Health: Using artificial intelligence to evaluate electronic medical records and predict the onset of diabetes with high accuracy allows doctors to detect people at risk early [87]. Predictive health Systems: Many healthcare systems have integrated intelligent models to stratify patients according to their risk of developing diabetes and use prevention strategies [88].

B. Machine Learning Models for Risk Assessment:

This is true! Machine learning models; It is widely used to assess risks in industries including cybersecurity, insurance, healthcare, and finance [89]. Various popular machine learning models for risk assessment are summarized below:

- Logistic Regression: This is one of the best ways to deal with binary classification problems. Logistic regression is a tool used in risk assessment to predict the probability of occurrence (fraud, loan default, etc) [90].
- Decision Trees: Decision trees iteratively distribute the feature space and are simple, intuitive models. They assist in risk assessment where a clear and understandable decision-making process is required [91].
- Random Forest: An ensemble learning method called random forest creates multiple decision trees and combines the predictions of each decision tree. It can work well for large files and has good overall performance [92].
- Gradient Boosting Machines (GBM): Another integration method is GBM, which corrects errors in previous models by creating models one after the other [93]. Due to their excellent prediction performance, XGBoost and LightGBM are popular GBM applications frequently used in risk assessment [94].
- Support Vector Machines (SVM): The use of SVM can provide robust learning in developed regions. It can be used for risk assessment in situations with complex course decisions and is effective for both online and offline events [95].
- Neural Networks: Deep learning models, especially neural networks, are becoming increasingly popular in risk assessment applications because they can learn graphical representations of data [96]. They can process large amounts of data and analyse

complex patterns, but they often require large databases and powerful computers [97].

- Naive Bayes: The basis of the Naive Bayes classifier is the assumption of independence based on Bayes' theorem. This model is easy to use and effective when processing categorical data [98]. Naive Bayes can be used when performing risk assessment tasks with independent or arbitrary characteristics [99].
- Ensemble Methods: Besides random forests and gradient boosting, other integration methods such as bagging and stacking can also be used for risk assessment [100]. This technique improves prediction performance and robustness by combining several simple models.

When using these models for risk assessment, many factors need to be considered, including the type of data used, the interpretation of the model, its effectiveness, and the specific needs of the application record [101]. Extensive evaluation and validation procedures are required to ensure the effectiveness and reliability of the model in real-life situations [102].

C. Benefits and Limitations of Predictive Analytics:

The process of predicting future outcomes by extracting information from existing data has some advantages and also some disadvantages. This is called predictive analytics. Here's a good review of both:

1) Benefits of Predictive Analytics:

- *Improved Decision Making:* Forecasting provides insight through information that helps businesses make better decisions. The result is better performance and strategic planning [103].
- *Cost Reduction:* Through predictive analytics and preventive problem identification, organizations can reduce operating costs [104]. For example, predictive maintenance can predict equipment failure, enable timely intervention and prevent downtime.
- Enhanced Customer Insights: Companies can increase customer satisfaction and improve marketing by gaining a deeper understanding of customer behaviour, preferences, and needs [105]. Using predictive modeling makes it easier to deliver customized services to more profitable customers [106].
- Risk Management: Using predictive analytics helps assess and mitigate risk [107]. For example, it can predict the likelihood of uncertainty in the financial market and the isk of infection or readmission of patients in the medical industry [108].
- Operational Efficiency: Businesses can improve processes and improve resource allocation. For example, predictive analytics can help manage supply chains by optimizing inventory and forecasting demand [109].
- Competitive Advantage: Companies using predictive analytics can gain an advantage over their competitors by instantly responding to changes in the market and customer needs [110]. This strategy can help you stand out in a competitive market.

2) Limitations of Predictive Analytics:

- Data Quality: Data quality affects the accuracy of forecast models. Insufficient data can lead to inaccurate predictions and bad decisions [111].
- Complexity and Expertise: A strong foundation in data science and statistical methods is required to use predictive analytics. It must be expensive and time-consuming for businesses to spend money on employees receiving education or training [112].
- Overfitting and Underfitting: Overfitting, or over-adjusting model predictions based on historical data, reduces the ability to accurately predict the future [113]. On the other hand, underfitting occurs when it is too easy for the model to find the underlying pattern in the data [114].
- Ethical and Privacy Concerns: Using personal information in predictions raises privacy and ethical issues. Organizations need to ensure that their use of data complies with regulations and regulatory obligations, such as CCPA and GDPR [115].
- Uncertainty and Limitations of Predictions: Predictive models provide probabilities, not values. Estimates can be affected by unforeseen events and there is always room for error. Overreliance on these standards can lead to dissatisfaction [116].
- High Initial Investment: The development and implementation of predictive solutions will require significant investments in infrastructure, technology and human resources. These costs can be unaffordable for small businesses [117].
- Resistance to Change: Implementing predictive analytics often requires adjustments to organizational processes and culture. Employees accustomed to traditional decision-making processes may struggle [118].

3. Personalized Treatment Plans

A. AI- Driven Tools for Individualized Care

Customized care solutions driven by artificial intelligence are changing the way treatment is delivered by providing tailored treatment plans, increasing the efficiency of car and improving patient outcomes [119]. Here are some instruments and their utilizes:

1) Predictive Analytics and Machine Learning:

Artificial Intelligence (AI) systems are important for patient risk stratification because they can predict the likelihood of certain diseases by evaluating large patient data [120]. In this way, control and early intervention are possible. Predictive models built with AI identify patients most likely to be sent to the hospital or experience other adverse events, allowing doctors to implement and improve interventions that impact treatment plans [121]. Clinicians can use AI-driven risk allocation to allocate resources, improve patient outcomes, and ultimately improve the health model [122].

2) Natural Language Processing:

The use of natural language processing (NLP) can process patient data and greatly improve clinical data by extracting valuable information from unstructured medical data [123]. Additionally, the AI-powered symptom analyser uses NLP to understand the patient's symptoms and recommend diagnosis and treatment [124].

3) Digital Health Assistants and Chatbots:

Artificial intelligence (AI)-powered chatbots increase patient engagement by providing a variety of services, including answering questions, providing health-related information, and alerting people tired of appointments and drugs [125]. In addition to these benefits, digital health providers are also important for mental health services [126]. By offering cognitive behavioural therapy (CBT) approaches and other psychological support, they increase access to care for those who need it [127].

4) Genomics Analysis and Precision Medicine:

Artificial Intelligence technologies are essential for genetic analysis as they analyse genetic information to detect changes and mutations that may affect human health [128]. This may be particularly useful for personalized treatment strategies in oncology. Additionally, pharmacogenomics uses artificial intelligence to predict a patient's response to medications based on their genetic makeup, eliminating the need for trial and error in finding the right treatment [129].

5) Imaging and Diagnostic:

Artificial intelligence algorithms have greatly improved radiology and pathology by analysing medical images to identify abnormalities such as existing cancer, bone or disease [130]. This helps radiologists and doctors diagnose patients faster and more accurately. Additionally, the use of artificial intelligence tools for early diagnosis is also increasing. This technology is often used to detect conditions such as cancer, heart disease, and brain disease before symptoms appear [131].

B. Optimization of Insulin Dosing using AI

AI-based insulin dose optimization represents an important part of diabetes treatment [132]. AI-powered tools and systems can analyse a variety of data and provide recommendations for personalized insulin use to improve glycaemic control and reduce the risk of complications [133]. Here are some important AI insulin dosage tips:

1) Continuous Glucose Monitoring (CGM) Integration:

Intelligent algorithms that analyse blood glucose measurements from continuous glucose monitoring (CGM) devices play a key role in real-time data processing [134], allowing for a rapid understanding of blood glucose patterns and patterns. AI can also predict hypoglycaemic events by analysing historical data, current blood sugar levels and other variables [135]. Thanks to this predictive power, people can pre-adjust their insulin doses to prevent low blood sugar.

2) Personalized Insulin Dosing Algorithms:

To provide recommendations for personalized insulin use, the machine learning model measures a variety of factors, including carbohydrate intake, physical activity, stress levels, and personal insulin perceptions [136]. This is where machine learning models come into play when managing diabetes [137]. Additionally, adaptive learning increases the effectiveness of these cognitive processes by continuously learning from user data and gradually improving the accuracy of insulin dose recommendations [138].

3) Automated Insulin Delivery systems:

To automate insulin, the tumour system is combined with an insulin pump, a continuous blood pressure monitor (CGM) and an intelligent algorithm [139]. The product intelligently quickly adjusts the insulin dose to optimally control blood sugar [140]. These closed-loop solutions reduce the need for manual intervention by creating continuous feedback where artificial intelligence (AI) adjusts insulin dosage based on blood glucose data over time [141].

4) Predictive Analytics for Meal and Activity Planning:

Artificial intelligence (AI) applications can assist users with carbohydrate counting by accurately estimating the carbohydrate content of food, which in turn can help determine the amount of insulin. Additionally, AI predicts how physical activity will affect blood sugar, allowing users to adjust insulin to avoid diabetes or hyperglycaemia [142].

5) Examples of AI-Driven Tools for Insulin Dosing Optimization:

Tidepool Loop, an FDA-approved open-source project that works with insulin pumps and continuous glucose monitors (CGM), uses artificial intelligence (AI) algorithms to deliver insulin [143]. In contrast, the Medtronic Mini Med 780G is a hybrid closed-loop device that uses artificial intelligence (AI) to instantly adjust insulin levels in response to CGM blood glucose measurements [144]. Additionally, Insulet Omni pod 5 is an automated insulin delivery system that uses artificial intelligence (AI) to adjust insulin dosage according to the user's changing needs [145].

These AI solutions increase the accuracy and efficiency of insulin administration, improve overall glycaemic control, and improve the quality of life of people with diabetes [146].

C. Impact on Patient Adherence and Outcomes

To effectively manage diabetes, it is important for patients to follow their treatment plan, which affects patient outcomes [147]. Compliance includes taking medications as prescribed, eating the recommended diet, exercising regularly, and keeping regular doctor appointments [148]. The benefits of tracking diabetes benefits include:

1) Impact of Patient Adherence:

- Glycaemic Control: Patients who follow the treatment plan generally reduce the risk of hyperglycaemia and hypoglycemia by keeping their blood sugar levels within the desired range [149]. A1C levels are an important indicator of long-term diabetes control, and adherence to medication and lifestyle recommendations will lower A1C levels [150].
- Reduced Complications: The same medication may

help prevent or delay microvascular complications such as retinopathy, nephropathy, and neuropathy by keeping blood sugar levels stable [151]. Proper management also reduces the risk of cardiovascular disease such as heart attack and stroke, as well as the macrovascular problems that occur in people with diabetes [152].

- Medication Adherence: In order to effectively control blood sugar, insulin and oral hypoglycaemic drugs must be monitored regularly [153], because not using the drugs causes significant changes in blood sugar. This risk is particularly challenging for polypharmacy patients but is necessary as management of all health benefits requires appropriate management of multiple medications [154].
- Lifestyle Modifications: Following dietary recommendations can reduce the risk of complications by controlling blood sugar, weight and blood lipids [155]. Regular exercise also helps with weight management, increases insulin sensitivity and improves blood sugar control [156].
- Regular Monitoring and Follow-Up: Self-monitoring of continuous blood glucose (SMBG) in monitored patients allows improving glycaemic control with timely modification of treatment strategies [157]. Attending doctor appointments also ensures that treatment plans are continually evaluated and updated by doctors; This is important for cleaning up overall healthcare and improving long-term outcomes [158].

D. Impact on Patient Outcomes

- Quality of Life: Adherence to treatment that effectively controls diabetes can reduce symptoms such as thirst, fatigue, and urinary frequency, ultimately improving overall quality of life [159]. Adherence to medication therapy may also improve psychological outcomes by reducing stress and hopelessness associated with inadequate diabetes control [160]. Adaptation is important for helping people with diabetes live better lives because it refers to physical and mental health [161].
- Hospitalization and Healthcare Costs: Those who remained adherent experienced an overall reduction in the rate of hospitalization due to a lower incidence of severe hyperglycaemic or hypoglycaemic episodes requiring hospitalization [162]. Good diabetes management can also reduce the need for emergency care and help prevent long-term complications from noncompliance with treatment [163]. Then overall healthcare spending fell, resulting in lower healthcare costs. By addressing adherence, people with diabetes can improve health outcomes for people with diabetes as well as reduce the negative financial burden of the disease in the clinical setting [164].
- Longevity: Frequent monitoring of blood sugar is important to avoid serious complications of diabetes, such as kidney failure, neuropathy, retinopathy, and heart disease [165]. By testing blood sugar regularly, people can detect differences on target early and take immediate action to control blood sugar effectively. This great idea could help extend life expectancy while reducing the chance of complications [166]. People with diabetes can prevent the negative consequences of the disease and live a long, healthy life by keeping their blood sugar under control [167].

4. Continuous Monitoring and Real- Time Feedback

Continuous monitoring and feedback are now revolutionizing diabetes management, providing patients and doctors with optimal strategies for effective glycaemic control [168]. Here is a detailed explanation of its importance and usage:

A. Continuous Monitoring

- Continuous Glucose Monitoring (CGM): Continuous glucose monitoring (CGM) systems provide rapid information on blood sugar levels by measuring blood sugar levels at regular intervals throughout the day [169]. Thanks to this continuous monitoring, patients and doctors can obtain important information about blood sugar. CGM systems can analyse this data to identify patterns and trends in blood sugar, such as postprandial or nocturnal hypoglycemia. Additionally, CGM also features a rapid alert system to alert users to hyperglycaemic or hypoglycaemic events, allowing them to respond to changes in blood sugar by measuring rapid treatment [170]. CGM technology enables people with diabetes to make informed decisions about their lifestyle and treatment, thus improving their ability to properly manage their disease [171].
- Wearable Devices: For example, smartwatches and fitness trackers have integrated devices that are important for tracking important health indicators such as heart rate, sleep patterns and body activity [172]. These tips are very important for overall diabetes management. With the help of this tool, users can track relevant metrics and gain insight into their daily life and behaviour [173]. Additionally, data from these sensors can be synchronized with mobile phone health applications, thus facilitating the integration and integration of various health measures [174]. By centralizing this information, people can get a complete picture of their health, allowing them to make better decisions about managing their diabetes [175]. This technology connection makes it easier to monitor and also encourages customers to take important steps to improve their health [176].

B. Real- Time Feedback:

- Insulin Pumps and Automated Insulin Delivery: Closed-loop systems (sometimes called insulin pumps) deliver insulin through a continuous glucose monitor (CGM) reading. This represents a major advance in diabetes treatment [177]. To maintain good blood sugar levels, this device adjusts insulin dosage based on continuous glucose monitoring [178]. CGM provides a closed system containing the instant information needed to adjust insulin, thereby improving glycaemic control and reducing the risk of hypoglycemia and hyperglycaemia [179]. The closed system ensures timely replacement of insulin, improving safety, convenience and overall diabetes care for people with diabetes [180].

- Mobile Health Apps: Diabetes management apps provide consumers with personalized information and help by providing real-time information about various health-related factors such as diabetes, diet, and physical activity [181]. These applications evaluate data input from the user or integrated sensors to provide recommendations and adjustments based on specific needs and goals [182]. They also use behavioural techniques, such as motivational messages and reminders, to help patients stick to meal plans, exercise programs, and prescription schedules [183]. These apps enable people with diabetes to take important steps to better manage their disease and improve their overall health outcomes by using technology to provide personalized information and guidance on assistance [184].
- Telehealth and Remote Monitoring: Diabetes management now includes virtual communication as an important part, made possible by constant information sharing between patients and doctors [185]. With this information, doctors can conduct remote consultations and evaluate medication adherence, blood sugar levels, and life updates [186]. With instant access to information, doctors can adjust treatment plans in real time, ensuring patients receive personalized care based on their unique needs and events. Additionally, because virtual consultations are interactive, patients are more likely to participate because they can receive timely advice and guidance from their medical team [187]. In addition to improving adherence to treatment plans, this partnership gives patients the confidence to manage their diabetes and improve their health [188].

C. Benefits of Continuous Monitoring and Real- Time Feedback:

- Improved Glycaemic Control: Continuous blood sugar monitoring allows people with diabetes to better manage their condition by keeping blood sugar levels within target ranges [189]. As a result of prevention, HbA1c level decreases and blood sugar gradually decreases [190]. Additionally, continuous monitoring of emergency alerts can quickly alert users to poor blood sugar levels, allowing early intervention to prevent devastating hypoglycaemic events or hyperglycaemia [191]. People with diabetes can effectively manage their disease by using the right equipment and technology to regularly monitor blood sugar and send timely alerts [192]. This will improve blood sugar control and reduce the risk of complications.
- Reduction in Complications: Effective diabetes treatment strategies can improve glycaemic control, thereby reducing the risk of microvascular and macrovascular complications [193]. Retinopathy, kidney disease, neuropathy and heart disease are some of the consequences. People with diabetes can reduce the risk of these serious health problems by keeping their blood sugar within the desired range [194]. Additionally, better blood sugar control reduces the risk of serious side effects such as severe hypoglycemia and diabetic ketoacidosis (DKA), which can be life-threatening and require emergency treatment [195]. By using good health and diabetes management strategies, people can reduce their risk of complications and improve their overall health and quality of life [196].
- Enhanced Quality of Life: Getting regular advice is key to giving patients the confidence to monitor their diabetes and encouraging better self-care [197]. This sense of support translates directly into significant improvements in mental health due to reduced anxiety and stress related to diabetes management [198]. As patients feel that their disease is under better control, there are significant changes in their general health, thus improving their quality of life and increasing their perception of blood management [199].
- Healthcare Efficiency: Improving diabetes control not only benefits mental health and self-determination; It also has benefits such as lower hospital costs and greater savings [200]. The number of emergency department visits and hospitalizations has decreased due to improved daily management and early detection of complications [201]. In addition to improving the quality of care, this approach can also provide significant long-term cost savings for healthcare [202]. Complications and hospitalizations are reduced, thus reducing the financial burden of diabetes management, thus ensuring the stability and effectiveness of treatment [203].

5. Enhanced Glucose Monitoring

The term "improved blood sugar" describes the use of cutting-edge equipment and technology to check blood sugar more frequently, more accurately and more easily [204]. Below are some of the key features and enhancements that improve blood sugar tracking:

A. *Continuous Glucose Monitoring (CGM)*

Continuous glucose monitoring (CGM) devices provide continuous blood glucose measurement, typically every few minutes, providing valuable, immediate information [205]. Using interstitial fluid monitoring, this device can accurately estimate blood sugar levels without the need for frequent finger tests; This can also be troublesome [206]. Additionally, CGM technology facilitates analysis by revealing patterns and changes in blood sugar [207]. This allows patients and doctors to make informed decisions and adjust treatments as needed. CGM systems also provide alerts and warnings for hyperglycaemia and hypoglycemia. This enables rapid response, avoids severe blood sugar changes and improves daily blood sugar control [208].

B. *Flash Glucose Monitoring (FGM)*

In rapid blood glucose monitoring (FGM), the average glucose level is measured over time using a sensor attached to the skin. Since the desired value can be obtained by examining the sensor with a smartphone or reader, users can easily obtain blood sugar data without the need for constant blood sugar measurement [209]. In addition, the FGM system tracks historical blood sugar readings, allowing users to identify patterns and trends after the fact [210]. Through a combination of regular check-ups, on-demand readings and retrospectives, people with diabetes can now take control of their health and make informed decisions about treatment and lifestyle changes [211].

C. *Wearable Glucose Sensors*

New technology has expanded blood glucose monitoring with the advent of non-invasive technologies [212] such as optical devices that can detect blood glucose in skin tags without needle discomfort. The development offers a simpler and easier way to diagnose diabetes, which has the potential to transform the treatment of diabetes [213]. In addition, technologies such as fitness trackers and smartwatches are increasingly equipped with blood sugar monitoring features [214]. Thanks to this integration, blood sugar and other health conditions can be monitored easily and regularly, enabling people with diabetes to have a quick and easy understanding of their health [215]. As these technologies improve, they can improve the quality of life of people with diabetes by making it easier, more accurate, and cleaner to monitor their health status [216].

D. *Advanced Data Analysis and Insights*

Diabetes care has changed thanks to predictive models and advanced research data. Blood sugar patterns, various times, and blood sugar changes are identified by advanced algorithms that analyze blood sugar data from continuous monitoring devices [217]. Machine learning and artificial intelligence improve this further, predicting future blood sugar levels and hypoglycaemic or hyperglycaemic events, allowing accurate and precise treatment [218]. Improved blood sugar tracking can now provide recommendations based on each user's unique blood sugar profile [219]. These recommendations include insulin use, dietary modifications, and lifestyle changes and provide a personalized approach to diabetes management that maximizes results and improves overall health [220].

E. *Integration with Diabetes Management Platforms*

Effective monitoring and evaluation are now possible thanks to the integration of blood glucose data with diabetes management [221]. This connection enables instant sharing of blood sugar data with healthcare providers, enabling telemedicine appointments and remote consultations [222]. Therefore, timely intervention and program changes can be made, thus improving the overall results of diabetes treatment [223].

F. *Benefits of Enhanced Glucose Monitoring*

Intensive blood sugar monitoring to control diabetes has many benefits, including better blood sugar control, lower HbA1c, and a lower risk of complications [224]. In addition, the fact that this technology is more common and useful than finger-prick blood tests increase patient compliance. Taking quick action to prevent hypoglycaemic and hyperglycaemic crises by quickly measuring blood sugar and providing warnings can reduce the risk of serious consequences. Additionally, advanced data analysis can provide suggestions and recommendations to enhance self-treatment and improve diabetes management based on the patient's blood sugar profile [225].

6. Early Detection of Complications

A. Early Detection of Complications: Early detection of diabetes complications is important to avoid serious health problems and improve patient outcomes. Here's how common sense can help detect diabetes-related problems early:

AI-powered technology is changing the way diabetes complications such as retinopathy and nephropathy are diagnosed and treated [226]. Artificial intelligence (AI) systems can visually diagnose diabetic retinopathy and often detect early signs, such as bleeding and microaneurysms, before symptoms appear [227]. Google's IDx-DR and DeepMind algorithms are the best in the field [228]. Likewise, AI model prediction can assess the risk of diabetic nephropathy by analysing patient data such as blood and urine tests (such as proteinuria), blood pressure, and other measurements [229]. This early diagnosis can slow down the progression of the disease.

Artificial intelligence technology has improved the treatment of many diabetic diseases, such as neuropathy, heart problems, and foot pain [230]. Artificial intelligence (AI) technology measures changes in skin sensation and neurotransmission to monitor nerve damage in diabetic neuropathy [231]. Devices such as Sud Oscan can measure sweat gland function for the early detection of nerve abnormalities [232]. AI risk assessment models examine many variables, such as blood pressure, cholesterol, diabetes, and lifestyle, to determine heart disease risk and support management of heart problems [233]. Additionally, AI uses pressure sensors, thermal imaging, and video data to help diagnose diabetic foot ulcers and provide early intervention and preventative measures for a worsening wound [234].

B. AI in Identifying Diabetes-Related Complications

Artificial intelligence (AI) technologies are essential for recognizing issues associated with diabetes because they can evaluate large volumes of data and find patterns that human analysis could overlook:

Machine learning algorithms and artificial intelligence technology have improved the prediction and early detection of diabetes complications [235]. Predictive models can predict the risk of developing problems by using machine learning to analyse genetic information, lifestyle factors, and medical history [236]. AI pattern recognition capabilities can detect small data changes that can indicate the onset of neuropathy, such as changes in blood sugar [237]. Natural language processing (NLP) enables increased collaboration by extracting valuable information from medical records and electronic health records (EHRs) [238] and using that information to identify patients who may be at risk based on their medical history and physician assessments [239]. Additionally, medical images such as eye examinations and foot images can be processed and analysed with high efficiency through cognitively enhanced image visualization to facilitate the detection of problems at an early stage [240].

C. Clinical Applications and Benefits

1) Personalized Treatment and Plan:

- Customized Intervention: AI uses real-time data and predictive analytics to provide personalized recommendations for preventive measures, lifestyle changes, and medication adjustments [241].
- Dynamic Adjustment: As new information becomes available, AI systems can update treatment plans to provide the best care for disease and complications [242].

2) Enhanced Monitoring:

- Continuous Glucose Monitoring: AI-powered continuous glucose monitors (CGM) provide patients with alerts and real-time data on blood sugar levels to help them effectively manage diabetes and prevent complications [243].
- Remote Monitoring: Patients can monitor their health using smart devices. Doctors can analyze this information remotely to provide timely treatment [244].

3) Improved Patient Engagement:

- Educational Tools: Applications powered by AI provide self-learning context and insights into patient data to improve understanding and management of disease [245].
- Behavioral Nudges: AI programs can encourage adherence to treatment plans and diet and physical activity recommendations by sending reminders and motivational messages [246].

4) Efficiency in Healthcare Delivery:

- Reduced Burden on Healthcare Systems: The burden on healthcare can be reduced by managing complications and detecting them early to prevent hospitalizations and emergency room visits [247].
- Enhanced Decision Support: Artificial intelligence (AI) improves the quality of care through decision-support tools by providing doctors with evidence-based recommendations and risk assessment [248].

7. Future Directions

A. Emerging AI Technologies in Diabetes Care:

Artificial intelligence (AI) improves the quality of care by providing doctors with evidence-based recommendations and risk assessment through decision support tools:

Artificial intelligence is tailoring personalized medicine by analysing a variety of patient data, including genetics, lifestyle, and environment, to create personalized treatment plans [249]. By integrating genomic data, AI can predict a person's response to various treatments to create personalized medication treatment plans [250]. Additionally, AI algorithms are constantly learning and adjusting treatment plans based on real-time data from blood glucose meters and other health indicators to ensure that treatment is not continuous for all patients [251].

By analysing a variety of patient information, including genetics, lifestyle, and environment, the intelligence adapts to the individual by creating a treatment plan [252]. Artificial intelligence creates personalized medication programs using genomic data to predict a person's response to various treatments [253]. Additionally, smart algorithms use data from real-time blood sugar monitors and other health metrics to continually learn and update plans [254]. By using the right approach, treatment becomes more personalized and complete, rather than a one-size-fits-all model, replaced by a treatment that is continually optimized to meet the unique needs of each patient [255].

State-of-the-art analytics driven by artificial intelligence are changing the way diabetes is managed. Thanks to advances in knowledge and technology, continuous blood glucose monitoring (CGM) has become more accurate and efficient [256]. Research is also being done on infrared sensors and other technologies to create technology that does not affect blood sugar [257]. These advances hope to improve patient compliance and comfort by eliminating the need for surgery. Additionally, these systems connect to smart devices such as smartphones and other IoT devices, improving communication, providing various data analyses, and providing clean healthcare services [258]. This connection can improve the management process, helping doctors make informed decisions and enabling people with diabetes to take better care of their health [259].

Clinical Decision Support Systems (CDS) help doctors optimize and reduce errors by using artificial intelligence (AI) to make recommendations based on the latest research and patient-specific information [260]. AI is also helping develop insulin devices, sometimes called pancreatic devices, that can deliver insulin and continuously monitor blood sugar levels [261]. Machine learning improves these systems by optimizing insulin dosing algorithms and improving patient outcomes and accuracy [262].

Artificial intelligence (AI) is improving rural healthcare and making diabetes care easier and more efficient through telemedicine and remote patient care [263]. Artificial intelligence solutions facilitate remote consultations by evaluating patient data and providing recommended information to doctors [264]. AI also enables continuous monitoring of patients at home and improves overall patient management by informing doctors of abnormalities or complications [265].

B. Potential Development and Innovations:

The use of technology in diabetes treatment has great potential for advancement and innovation that could transform the treatment of this disease. Below are some special places:

Continuous glucose monitoring (CGM) and insulin pumps are being integrated into smart insulin delivery systems to quickly replace changing insulin, especially in insulin resistance devices [266]. Advanced machine learning algorithms improve these systems by learning from patient-specific data, improving insulin use, and reducing the risk of hypoglycemia [267]. The development of portable devices that measure blood glucose via sweat, organ fluids, or other non-invasive methods has led to advances in non-invasive blood glucose technology [268]. Thanks to advances in optical and infrared sensors that do not require a blood test, glucose levels can now be monitored through the skin [269].

Thanks to precision medicine, smart machines develop personalized treatment plans by developing treatments based on each patient's genetic characteristics, lifestyle preferences, and treatments [270]. Analysis of patient data is another feature of these systems; it allows for changes in treatment, such as medication and lifestyle recommendations [271]. Additionally, advanced AI algorithms automatically help doctors make decisions by showing drug interactions or side effects and providing evidence-based recommendations [272]. Automated data analysis continues to improve care management by discovering trends in medical records and patient information and recommending changes [273].

Artificial intelligence (AI) is revolutionizing drug development through machine learning algorithms that evaluate biological data to discover new therapeutic targets and predict the effectiveness of new drugs [274]. Additionally, AI solutions help improve clinical trials by improving patient selection, trial progression, and efficacy analysis. The treatment is improved by integrating it with other technologies [275]. For example, IoT connects different healthcare devices to increase data collection and provide a better view of a patient's health [276]. Virtual reality (VR) is also used in the treatment and education of patients. By providing experience to patients, it helps them learn how to manage their disease and improve their lifestyle [277].

8. Conclusion

A. Summary of AI on Diabetes Management

Artificial intelligence (AI) is becoming increasingly important in diabetes management as it has the potential to improve patient care, maximize treatment, and improve health outcomes. The main applications of artificial intelligence are:

Artificial intelligence (AI) algorithms can improve diabetes management by analysing large amounts of data from electronic health records (EHRs) and continuous blood glucose monitors (CGM) to create a personalized treatment plan. These plans take into account individual differences in blood sugar, nutrition, physical activity, and language intervention medicine, providing more accurate and effective diabetes management. Cognitive systems can also predict blood sugar changes and the likelihood of hypoglycemia or hyperglycaemia using predictive analysis. This system can predict blood sugar abnormalities by analysing time strategies and historical data, giving patients and doctors the opportunity to take preventive measures. Patients with type 1 diabetes, who need constant care and rapid treatment, especially benefit from the ability to predict. Artificial intelligence (AI)-powered automated insulin delivery systems, including tumour markers, use machine learning algorithms to calculate the correct insulin dose and adjust insulin doses based on continuous blood glucose measurements. Patients will have less to do when it comes to counting and prescribing. Smart apps, food intake, activities, etc. It can provide personalized recommendations for improving nutrition and lifestyle by analysing data about your diet. Doctors can analyse patient data in real time through remote monitoring through AI-powered telemedicine platforms, improving access to care, especially for people living in underserved or remote areas. Cognitive algorithms that analyse risk factors and biomarkers in clinical and diagnostic data are essential for the early detection and diagnosis of diabetes and its consequences. Early diagnosis leads to timely intervention, which is important for preventing diabetes and other health problems. Virtual healthcare assistants and chatbots powered by artificial intelligence can interact with patients to educate them, answer their questions, and provide support. With the help of these resources, patients can care for themselves, follow treatment plans, and manage their daily schedules effectively.

B. Challenges and Consideration:

AI has great potential in diabetes management, but there are still some limitations. These include addressing vulnerabilities in AI algorithms, ensuring data security and privacy, and integrating AI tools into healthcare processes. Additionally, ongoing research and validation are required to confirm the effectiveness and safety of AI applications across a wide range of patient populations. These are revolutionizing the treatment of diabetes. As technology advances, knowledge should also increase and provide new ways to improve the quality of life of people with diabetes.

References

[1]. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes care. 2014 Jan 1;37(Supplement_1): S81-90.

[2]. Lotfy M, Adeghate J, Kalasz H, Singh J, Adeghate E. Chronic complications of diabetes mellitus: a mini review. Current diabetes reviews. 2017 Feb 1;13(1):3-10.

[3]. Kakleas K, Soldatou A, Karachaliou F, Karavanaki K. Associated autoimmune diseases in children and adolescents with type 1 diabetes mellitus (T1DM). Autoimmunity reviews. 2015 Sep 1;14(9):781-97.

[4]. Petersen KF, Shulman GI. Etiology of insulin resistance. The American journal of medicine. 2006 May 1;119(5): S10-6.

[5]. Thomas NE, Baker JS, Davies B. Established and recently identified coronary heart disease risk factors in young people: the influence of physical activity and physical fitness. Sports medicine. 2003 Aug; 33:633-50.

[6]. McCance DR, Cassidy L. Diabetes in pregnancy. Textbook of Diabetes. 2024 Feb 7:1034-71.

[7]. Tjora E. Novel endoscopic and MRI-based methods for evaluating exocrine pancreatic function in pancreatitis and monogenic forms of diabetes.

[8]. Tosur M, Viau-Colindres J, Astudillo M, Redondo MJ, Lyons SK. Medication-induced hyperglycemia: pediatric perspective. BMJ Open Diabetes Research and Care. 2020 Jan 1;8(1): e000801.

[9]. Soomro MH, Jabbar A. Diabetes etiopathology, classification, diagnosis, and epidemiology. InBIDE's Diabetes Desk Book 2024 Jan 1 (pp. 19-42). Elsevier.

[10]. Wu Y, Ding Y, Tanaka Y, Zhang W. Risk factors contributing to type 2 diabetes and recent advances in the treatment and prevention. International journal of medical sciences. 2014;11(11):1185.

[11]. Peng H, Hagopian W. Environmental factors in the development of Type 1 diabetes. Reviews in endocrine and metabolic disorders. 2006 Sep; 7:149-62.

[12]. Ma RC, Tutino GE, Lillycrop KA, Hanson MA, Tam WH. Maternal diabetes, gestational diabetes and the role of epigenetics in their long-term effects on offspring. Progress in biophysics and molecular biology. 2015 Jul 1;118(1-2):55-68.

[13]. Rao GH. Management of diabetes epidemic: Global perspective. Current Trends in Diabetes. 2020 Nov 30:25.

[14]. Pipeleers D, Ling Z. Pancreatic beta cells in insulin-dependent diabetes. Diabetes Metabolism Reviews. 1992 Oct 1; 8:209.

[15]. Kahn BB. Type 2 diabetes: when insulin secretion fails to compensate for insulin resistance. Cell. 1998 Mar 6;92(5):593-6.

[16]. Balaji R, Duraisamy R, Kumar MP. Complications of diabetes mellitus: A review. Drug Invention Today. 2019 Jan 15;12(1).

[17]. French EK, Donihi AC, Korytkowski MT. Diabetic ketoacidosis and hyperosmolar hyperglycemic syndrome: review of acute decompensated diabetes in adult patients. Bmj. 2019 May 29;365.

[18]. Lobo AD. Correlation of HbA 1C with New and Old American Diabetic Asociation Fasting Glucose Levels for Normoglycemia (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).

[19]. Alqahtani N, Khan WA, Alhumaidi MH, Ahmed YA. Use of glycated hemoglobin in the diagnosis of diabetes mellitus and pre-diabetes and role of fasting plasma glucose, oral glucose tolerance test. International journal of preventive medicine. 2013 Sep;4(9):1025.

[20]. Tandon S, Ayis S, Hopkins D, Harding S, Stadler M. The impact of pharmacological and lifestyle interventions on body weight in people with type 1 diabetes: a systematic review and meta-analysis. Diabetes, Obesity and Metabolism. 2021 Feb;23(2):350-62.

[21]. Maruthur NM, Tseng E, Hutfless S, Wilson LM, Suarez-Cuervo C, Berger Z, Chu Y, Iyoha E, Segal JB, Bolen S. Diabetes medications as monotherapy or metformin-based combination therapy for type 2 diabetes: a systematic review and meta-analysis. Annals of internal medicine. 2016 Jun 7;164(11):740-51.

[22]. Higgins T. HbA1c for screening and diagnosis of diabetes mellitus. Endocrine. 2013 Apr;43(2):266-73.

[23]. Mota RI, Morgan SE, Bahnson EM. Diabetic vasculopathy: macro and microvascular injury. Current pathobiology reports. 2020 Mar; 8:1-4.

[24]. Centers for Disease Control and Prevention Primary Prevention Working Group*. Primary prevention of type 2 diabetes mellitus by lifestyle intervention: implications for health policy. Annals of internal medicine. 2004 Jun 1;140(11):951-7.

[25]. American Diabetes Association. Standards of medical care for patients with diabetes mellitus. Diabetes care. 2003 Jan 1;26(suppl_1): s33-50.

[26]. Alberti KG, Zimmet P, Shaw J. International Diabetes Federation: a consensus on Type 2 diabetes prevention. Diabetic Medicine. 2007 May;24(5):451-63.

[27]. Testa MA, Simonson DC. Health economic benefits and quality of life during improved glycemic control in patients with type 2 diabetes mellitus: a randomized, controlled, double-blind trial. Jama. 1998 Nov 4;280(17):1490-6.

[28]. S Oyer D. The science of hypoglycemia in patients with diabetes. Current diabetes reviews. 2013 May 1;9(3):195-208.

[29]. French EK, Donihi AC, Korytkowski MT. Diabetic ketoacidosis and hyperosmolar hyperglycemic syndrome: review of acute decompensated diabetes in adult patients. Bmj. 2019 May 29;365.

[30]. Khalil H. Diabetes microvascular complications—A clinical update. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2017 Nov 1;11: S133-9.

[31]. Huang D, Refaat M, Mohammedi K, Jayyousi A, Al Suwaidi J, Abi Khalil C. Macrovascular complications in patients with diabetes and prediabetes. BioMed research international. 2017 Oct;2017.

[32]. Yeo TP, Burrell SA, Sauter PK, Kennedy EP, Lavu H, Leiby BE, Yeo CJ. A progressive postresection walking program significantly improves fatigue and health-related quality of life in pancreas and periampullary cancer patients. Journal of the American College of Surgeons. 2012 Apr 1;214(4):463-75.

[33]. Sharpe L, Michalowski M, Richmond B, Menzies RE, Shaw J. Fear of progression in chronic illnesses other than cancer: a systematic review and meta-analysis of a transdiagnostic construct. Health Psychology Review. 2023 Apr 3;17(2):301-20.

[34]. Cunningham SA, Riosmena F, Wang J, Boyle JP, Rolka DB, Geiss LS. Decreases in diabetes-free life expectancy in the US and the role of obesity. Diabetes Care. 2011 Oct 1;34(10):2225-30.

[35]. Tong WT, Vethakkan SR, Ng CJ. Why do some people with type 2 diabetes who are using insulin have poor glycaemic control? A qualitative study. BMJ open. 2015 Jan 1;5(1): e006407.

[36]. Selby JV, Ray GT, Zhang D, Colby CJ. Excess costs of medical care for patients with diabetes in a managed care population. Diabetes care. 1997 Sep 1;20(9):1396-402.

[37]. Testa MA, Simonson DC. Health economic benefits and quality of life during improved glycemic control in patients with type 2 diabetes mellitus: a randomized, controlled, double-blind trial. Jama. 1998 Nov 4;280(17):1490-6.

[38]. Lambrinou E, Hansen TB, Beulens JW. Lifestyle factors, self-management and patient empowerment in diabetes care. European journal of preventive cardiology. 2019 Dec;26(2_suppl):55-63.

[39]. Umpierrez GE, Klonoff DC. Diabetes technology update: use of insulin pumps and continuous glucose monitoring in the hospital. Diabetes care. 2018 Aug 1;41(8):1579-89.

[40]. Diabetes Control and Complications Trial (DCCT) Research Group. The absence of a glycemic threshold for the development of long-term complications: the perspective of the Diabetes Control and Complications Trial. Diabetes. 1996 Oct 1;45(10):1289-98.

[41]. Tomic D, Shaw JE, Magliano DJ. The burden and risks of emerging complications of diabetes mellitus. Nature Reviews Endocrinology. 2022 Sep;18(9):525-39.

[42]. Ezzell GA, Galvin JM, Low D, Palta JR, Rosen I, Sharpe MB, Xia P, Xiao Y, Xing L, Yu CX. Guidance document on delivery, treatment planning, and clinical implementation of IMRT: report of the IMRT Subcommittee of the AAPM Radiation Therapy Committee. Medical physics. 2003 Aug;30(8):2089-115.

[43]. Shaheen MY. Applications of Artificial Intelligence (AI) in healthcare: A review. ScienceOpen Preprints. 2021 Sep 25.

[44]. Quazi S, Saha RP, Singh MK. Applications of artificial intelligence in healthcare. Journal of Experimental Biology and Agricultural Sciences. 2022 Feb;10(1):211-26.

[45]. Habuza T, Navaz AN, Hashim F, Alnajjar F, Zaki N, Serhani MA, Statsenko Y. AI applications in robotics, diagnostic image analysis and precision medicine: Current limitations, future trends, guidelines on CAD systems for medicine. Informatics in Medicine Unlocked. 2021 Jan 1;24:100596.

[46]. Ghaffar Nia N, Kaplanoglu E, Nasab A. Evaluation of artificial intelligence techniques in disease diagnosis and prediction. Discover Artificial Intelligence. 2023 Jan 30;3(1):5.

[47]. Shastry KA, Sanjay HA. Cancer diagnosis using artificial intelligence: A review. Artificial Intelligence Review. 2022 Apr;55(4):2641-73.

[48]. Mirbabaie M, Stieglitz S, Frick NR. Artificial intelligence in disease diagnostics: A critical review and classification on the current state of research guiding future direction. Health and Technology. 2021 Jul;11(4):693-731.

[49]. Lee D, Yoon SN. Application of artificial intelligence-based technologies in the healthcare industry: Opportunities and challenges. International journal of environmental research and public health. 2021 Jan;18(1):271.

[50]. Chang V, Bhavani VR, Xu AQ, Hossain MA. An artificial intelligence model for heart disease detection using machine learning algorithms. Healthcare Analytics. 2022 Nov 1; 2:100016.

[51]. Shajari S, Kuruvinashetti K, Komeili A, Sundararaj U. The emergence of AI-based wearable sensors for digital health technology: a review. Sensors. 2023 Nov 29;23(23):9498.

[52]. Ahmed Z, Mohamed K, Zeeshan S, Dong X. Artificial intelligence with multi-functional machine learning platform development for better healthcare and precision medicine. Database. 2020;2020: baaa010.

[53]. Abdelhalim H, Berber A, Lodi M, Jain R, Nair A, Pappu A, Patel K, Venkat V, Venkatesan C, Wable R, Dinatale M. Artificial intelligence, healthcare, clinical genomics, and pharmacogenomics approaches in precision medicine. Frontiers in genetics. 2022 Jul 6; 13:929736.

[54]. Johnson KB, Wei WQ, Weeraratne D, Frisse ME, Misulis K, Rhee K, Zhao J, Snowdon JL. Precision medicine, AI, and the future of personalized health care. Clinical and translational science. 2021 Jan;14(1):86-93.

[55]. Jhawat V, Gupta S, Gulia M, Nair A. Artificial intelligence and data science in pharmacogenomics-based drug discovery: Future of medicines. InData Science for Genomics 2023 Jan 1 (pp. 85-97). Academic Press.

[56]. Ellahham S. Artificial intelligence: the future for diabetes care. The American journal of medicine. 2020 Aug 1;133(8):895-900.

[57]. Thai MT, Phan PT, Hoang TT, Wong S, Lovell NH, Do TN. Advanced intelligent systems for surgical robotics. Advanced Intelligent Systems. 2020 Aug;2(8):1900138.

[58]. Darzi A, Munz Y. The impact of minimally invasive surgical techniques. Annu. Rev. Med. 2004 Feb 18; 55:223-37.

[59]. Moustris GP, Hiridis SC, Deliparaschos KM, Konstantinidis KM. Evolution of autonomous and semi-autonomous robotic surgical systems: a review of the literature. The international journal of medical robotics and computer assisted surgery. 2011 Dec;7(4):375-92.

[60]. Hashimoto DA, Rosman G, Rus D, Meireles OR. Artificial intelligence in surgery: promises and perils. Annals of surgery. 2018 Jul 1;268(1):70-6.

[61]. Bahja M. Natural language processing applications in business. E-Business-higher education and intelligence applications. 2020 May 11.

[62]. OGUNSAKIN OL, ANWANSEDO S. Leveraging AI for Healthcare Administration: Streamlining Operations and Reducing Costs.

[63]. Kasowaki L, Kooper J. Synergizing AI and Big Data: a Futuristic Approach to Data Management. EasyChair; 2024 Jan 29.

[64]. Alowais SA, Alghamdi SS, Alsuhebany N, Alqahtani T, Alshaya AI, Almohareb SN, Aldairem A, Alrashed M, Bin Saleh K, Badreldin HA, Al Yami MS. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. BMC medical education. 2023 Sep 22;23(1):689.

[65]. Saeed H, El Naqa I. Artificial intelligence in clinical trials. InMachine and Deep Learning in Oncology, Medical Physics and Radiology 2022 Feb 2 (pp. 453-501). Cham: Springer International Publishing.

[66]. Vatansever S, Schlessinger A, Wacker D, Kaniskan HÜ, Jin J, Zhou MM, Zhang B. Artificial intelligence and machine learning-aided drug discovery in central nervous system diseases: State-of-the-arts and future directions. Medicinal research reviews. 2021 May;41(3):1427-73.

[67]. Park SH, Han K. Methodologic guide for evaluating clinical performance and effect of artificial intelligence technology for medical diagnosis and prediction. Radiology. 2018 Mar;286(3):800-9.

[68]. Zhavoronkov A, Mamoshina P, Vanhaelen Q, Scheibye-Knudsen M, Moskalev A, Aliper A. Artificial intelligence for aging and longevity research: Recent advances and perspectives. Ageing research reviews. 2019 Jan 1; 49:49-66.

[69]. Elhadd T, Mall R, Bashir M, Palotti J, Fernandez-Luque L, Farooq F, Al Mohanadi D, Dabbous Z, Malik RA, Abou-Samra AB, PROFAST-Ramadan Study Group. Artificial Intelligence (AI) based machine learning models predict glucose variability and hypoglycaemia risk in patients with type 2 diabetes on a multiple drug regimen who fast during ramadan (The PROFAST–IT Ramadan study). Diabetes Research and Clinical Practice. 2020 Nov 1; 169:108388.

[70]. Jiang F, Jiang Y, Zhi H, Dong Y, Li H, Ma S, Wang Y, Dong Q, Shen H, Wang Y. Artificial intelligence in healthcare: past, present and future. Stroke and vascular neurology. 2017 Dec 1;2(4).

[71]. Ayon SI, Islam MM. Diabetes prediction: a deep learning approach. International Journal of Information Engineering and Electronic Business. 2019 Mar 1;13(2):21.

[72]. Lai H, Huang H, Keshavjee K, Guergachi A, Gao X. Predictive models for diabetes mellitus using machine learning techniques. BMC endocrine disorders. 2019 Dec; 19:1-9.

[73]. Zhu T, Li K, Herrero P, Georgiou P. Deep learning for diabetes: a systematic review. IEEE Journal of Biomedical and Health Informatics. 2020 Nov 24;25(7):2744-57.

[74]. Ashtagi R, Dhumale P, Mane D, Naveen HM, Bidwe RV, Zope B. IoT-Based Hybrid Ensemble Machine Learning Model for Efficient Diabetes Mellitus Prediction. International Journal of Intelligent Systems and Applications in Engineering. 2023 Aug 16;11(10s):714-26.

[75]. Fazakis N, Kocsis O, Dritsas E, Alexiou S, Fakotakis N, Moustakas K. Machine learning tools for long-term type 2 diabetes risk prediction. ieee Access. 2021 Jul 20; 9:103737-57.

[76]. Ehrenstein V, Kharrazi H, Lehmann H, Taylor CO. Obtaining data from electronic health records. InTools and technologies for registry interoperability, registries for evaluating patient outcomes: A user's guide, 3rd edition, Addendum 2 [Internet] 2019 Oct. Agency for Healthcare Research and Quality (US).

[77]. Kopitar L, Kocbek P, Cilar L, Sheikh A, Stiglic G. Early detection of type 2 diabetes mellitus using machine learning-based prediction models. Scientific reports. 2020 Jul 20;10(1):11981.

[78]. Addissouky T, Ali M, El Sayed IE, Wang Y. Revolutionary innovations in diabetes research: from biomarkers to genomic medicine. Iranian journal of diabetes and obesity. 2023 Dec 28.

[79]. Vashist SK. Continuous glucose monitoring systems: a review. Diagnostics. 2013 Oct 29;3(4):385-412.

[80]. Ahmed Z, Mohamed K, Zeeshan S, Dong X. Artificial intelligence with multi-functional machine learning platform development for better healthcare and precision medicine. Database. 2020;2020: baaa010.

[81]. Abe M, Abe H. Lifestyle medicine–An evidence-based approach to nutrition, sleep, physical activity, and stress management on health and chronic illness. Personalized Medicine Universe. 2019 Jul 1; 8:3-9.

[82]. Haghighatpanah M, Nejad AS, Haghighatpanah M, Thunga G, Mallayasamy S. Factors that correlate with poor glycemic control in type 2 diabetes mellitus patients with complications. Osong public health and research perspectives. 2018 Aug;9(4):167.

[83]. Dankwa-Mullan I, Rivo M, Sepulveda M, Park Y, Snowdon J, Rhee K. Transforming diabetes care through artificial intelligence: the future is here. Population health management. 2019 Jun 1;22(3):229-42.

[84]. Janssen M, Brous P, Estevez E, Barbosa LS, Janowski T. Data governance: Organizing data for trustworthy Artificial Intelligence. Government information quarterly. 2020 Jul 1;37(3):101493.

[85]. Ghosh A, Chakraborty D, Law A. Artificial intelligence in Internet of things. CAAI Transactions on Intelligence Technology. 2018 Dec;3(4):208-18.

[86]. Ting DS, Pasquale LR, Peng L, Campbell JP, Lee AY, Raman R, Tan GS, Schmetterer L, Keane PA, Wong TY. Artificial intelligence and deep learning in ophthalmology. British Journal of Ophthalmology. 2019 Feb 1;103(2):167-75.

[87]. Dankwa-Mullan I, Rivo M, Sepulveda M, Park Y, Snowdon J, Rhee K. Transforming diabetes care through artificial intelligence: the future is here. Population health management. 2019 Jun 1;22(3):229-42.

[88]. Ellahham S. Artificial intelligence: the future for diabetes care. The American journal of medicine. 2020 Aug 1;133(8):895-900.
[89]. Dhieb N, Ghazzai H, Besbes H, Massoud Y. A secure ai-driven architecture for automated insurance systems: Fraud detection and risk measurement. IEEE Access. 2020 Mar 25; 8:58546-58.
[90]. Wang Y, Zhang Y, Lu Y, Yu X. A Comparative Assessment of Credit Risk Model Based on Machine Learning——a case study of bank loan data. Procedia Computer Science. 2020 Jan 1; 174:141-9.
[91]. Arrieta AB, Díaz-Rodríguez N, Del Ser J, Bennetot A, Tabik S, Barbado A, García S, Gil-López S, Molina D, Benjamins R, Chatila R. Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI. Information fusion. 2020 Jun 1; 58:82-115.
[92]. González S, García S, Del Ser J, Rokach L, Herrera F. A practical tutorial on bagging and boosting based ensembles for machine learning: Algorithms, software tools, performance study, practical perspectives and opportunities. Information Fusion. 2020 Dec 1; 64:205-37.
[93]. Zhang Y, Haghani A. A gradient boosting method to improve travel time prediction. Transportation Research Part C: Emerging Technologies. 2015 Sep 1; 58:308-24.
[94]. Zhang D, Gong Y. The comparison of LightGBM and XGBoost coupling factor analysis and prediagnosis of acute liver failure. Ieee Access. 2020 Dec 7; 8:220990-1003.
[95]. Zhang Y, Shi X, Zhang H, Cao Y, Terzija V. Review on deep learning applications in frequency analysis and control of modern power system. International Journal of Electrical Power & Energy Systems. 2022 Mar 1; 136:107744.
[96]. Paltrinieri N, Comfort L, Reniers G. Learning about risk: Machine learning for risk assessment. Safety science. 2019 Oct 1; 118:475-86.
[97]. Chen CP, Zhang CY. Data-intensive applications, challenges, techniques and technologies: A survey on Big Data. Information sciences. 2014 Aug 10; 275:314-47.
[98]. Islam MJ, Wu QJ, Ahmadi M, Sid-Ahmed MA. Investigating the performance of naive-bayes classifiers and k-nearest neighbor classifiers. In2007 international conference on convergence information technology (ICCIT 2007) 2007 Nov 21 (pp. 1541-1546). IEEE.
[99]. Rish I. An empirical study of the naive Bayes classifier. InIJCAI 2001 workshop on empirical methods in artificial intelligence 2001 Aug 4 (Vol. 3, No. 22, pp. 41-46).
[100]. Zounemat-Kermani M, Batelaan O, Fadaee M, Hinkelmann R. Ensemble machine learning paradigms in hydrology: A review. Journal of Hydrology. 2021 Jul 1; 598:126266.
[101]. Li W. Risk assessment of power systems: models, methods, and applications. John Wiley & Sons; 2014 Mar 24.
[102]. McGrath JL, Taekman JM, Dev P, Danforth DR, Mohan D, Kman N, Crichlow A, Bond WF, Riker S, Lemheney AJ, Talbot TB. Using virtual reality simulation environments to assess competence for emergency medicine learners. Academic Emergency Medicine. 2018 Feb;25(2):186-95.
[103]. Anumandla SK. AI-enabled Decision Support Systems and Reciprocal Symmetry: Empowering Managers for Better Business Outcomes. International Journal of Reciprocal Symmetry and Theoretical Physics. 2018; 5:33-41.
[104]. Javaid M, Haleem A, Singh RP, Suman R. Artificial intelligence applications for industry 4.0: A literature-based study. Journal of Industrial Integration and Management. 2022 Mar 21;7(01):83-111.
[105]. Huang MH, Rust RT. A strategic framework for artificial intelligence in marketing. Journal of the Academy of Marketing Science. 2021 Jan; 49:30-50.
[106]. Haleem A, Javaid M, Qadri MA, Singh RP, Suman R. Artificial intelligence (AI) applications for marketing: A literature-based study. International Journal of Intelligent Networks. 2022 Jan 1; 3:119-32.
[107]. Aljohani A. Predictive analytics and machine learning for real-time supply chain risk mitigation and agility. Sustainability. 2023 Oct 20;15(20):15088.
[108]. Bates DW, Saria S, Ohno-Machado L, Shah A, Escobar G. Big data in health care: using analytics to identify and manage high-risk and high-cost patients. Health affairs. 2014 Jul 1;33(7):1123-31.
[109]. Dash R, McMurtrey M, Rebman C, Kar UK. Application of artificial intelligence in automation of supply chain management. Journal of Strategic Innovation and Sustainability. 2019 Jul 18;14(3).
[110]. Davenport T, Harris J. Competing on analytics: Updated, with a new introduction: The new science of winning. Harvard Business Press; 2017 Aug 29.
[111]. Sambasivan N, Kapania S, Highfill H, Akrong D, Paritosh P, Aroyo LM. “Everyone wants to do the model work, not the data work”: Data Cascades in High-Stakes AI. Inproceedings of the 2021 CHI Conference on Human Factors in Computing Systems 2021 May 6 (pp. 1-15).
[112]. Henke N, Jacques Bughin L. The age of analytics: Competing in a data-driven world.
[113]. van de Schoot R, Depaoli S, King R, Kramer B, Märtens K, Tadesse MG, Vannucci M, Gelman A, Veen D, Willemsen J, Yau C. Bayesian statistics and modelling. Nature Reviews Methods Primers. 2021 Jan 14;1(1):1.
[114]. Ghasemian A, Hosseinmardi H, Clauset A. Evaluating overfit and underfit in models of network community structure. IEEE Transactions on Knowledge and Data Engineering. 2019 Apr 16;32(9):1722-35.
[115]. ElBaih M. The role of privacy regulations in ai development (A Discussion of the Ways in Which Privacy Regulations Can Shape the Development of AI). Available at SSRN 4589207. 2023 Apr 1.
[116]. Taleb NN, Douady R. Mathematical definition, mapping, and detection of (anti) fragility. Quantitative Finance. 2013 Nov 1;13(11):1677-89.
[117]. Dwivedi YK, Hughes L, Ismagilova E, Aarts G, Coombs C, Crick T, Duan Y, Dwivedi R, Edwards J, Eirug A, Galanos V. Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International

Journal of Information Management. 2021 Apr 1; 57:101994.

[118]. Davenport TH, Harris JG, Morison R. Analytics at work: Smarter decisions, better results. Harvard Business Press; 2010.

[119]. Schork NJ. Artificial intelligence and personalized medicine. Precision medicine in Cancer therapy. 2019:265-83.

[120]. Choudhury A, Asan O. Role of artificial intelligence in patient safety outcomes: systematic literature review. JMIR medical informatics. 2020 Jul 24;8(7): e18599.

[121]. Alowais SA, Alghamdi SS, Alsuhebany N, Alqahtani T, Alshaya AI, Almohareb SN, Aldairem A, Alrashed M, Bin Saleh K, Badreldin HA, Al Yami MS. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. BMC medical education. 2023 Sep 22;23(1):689.

[122]. Reddy S, Allan S, Coghlan S, Cooper P. A governance model for the application of AI in health care. Journal of the American Medical Informatics Association. 2020 Mar;27(3):491-7.

[123]. Locke S, Bashall A, Al-Adely S, Moore J, Wilson A, Kitchen GB. Natural language processing in medicine: a review. Trends in Anaesthesia and Critical Care. 2021 Jun 1; 38:4-9.

[124]. Alowais SA, Alghamdi SS, Alsuhebany N, Alqahtani T, Alshaya AI, Almohareb SN, Aldairem A, Alrashed M, Bin Saleh K, Badreldin HA, Al Yami MS. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. BMC medical education. 2023 Sep 22;23(1):689.

[125]. Raval HY, Parikh SM, Patel HR. Self-maintained health surveillance artificial intelligence assistant. InHandbook of Research on Lifestyle Sustainability and Management Solutions Using AI, Big Data Analytics, and Visualization 2022 (pp. 168-184). IGI Global.

[126]. Boucher EM, Harake NR, Ward HE, Stoeckl SE, Vargas J, Minkel J, Parks AC, Zilca R. Artificially intelligent chatbots in digital mental health interventions: a review. Expert Review of Medical Devices. 2021 Dec 3;18(sup1):37-49.

[127]. Fulmer R, Joerin A, Gentile B, Lakerink L, Rauws M. Using psychological artificial intelligence (Tess) to relieve symptoms of depression and anxiety: randomized controlled trial. JMIR mental health. 2018 Dec 13;5(4):e9782.

[128]. Dias R, Torkamani A. Artificial intelligence in clinical and genomic diagnostics. Genome medicine. 2019 Nov 19;11(1):70.

[129]. Kalinin AA, Higgins GA, Reamaroon N, Soroushmehr S, Allyn-Feuer A, Dinov ID, Najarian K, Athey BD. Deep learning in pharmacogenomics: from gene regulation to patient stratification. Pharmacogenomics. 2018 May;19(7):629-50.

[130]. Santos MK, Ferreira JR, Wada DT, Tenório AP, Nogueira-Barbosa MH, Marques PM. Artificial intelligence, machine learning, computer-aided diagnosis, and radiomics: advances in imaging towards to precision medicine. Radiologia brasileira. 2019 Sep 23;52(06):387-96.

[131]. Kumar Y, Koul A, Singla R, Ijaz MF. Artificial intelligence in disease diagnosis: a systematic literature review, synthesizing framework and future research agenda. Journal of ambient intelligence and humanized computing. 2023 Jul;14(7):8459-86.

[132]. Guan Z, Li H, Liu R, Cai C, Liu Y, Li J, Wang X, Huang S, Wu L, Liu D, Yu S. Artificial intelligence in diabetes management: advancements, opportunities, and challenges. Cell Reports Medicine. 2023 Oct 2.

[133]. Contreras I, Vehi J. Artificial intelligence for diabetes management and decision support: literature review. Journal of medical Internet research. 2018 May 30;20(5): e10775.

[134]. Pérez-Gandía C, Facchinetti A, Sparacino G, Cobelli C, Gómez EJ, Rigla M, de Leiva A, Hernando ME. Artificial neural network algorithm for online glucose prediction from continuous glucose monitoring. Diabetes technology & therapeutics. 2010 Jan 1;12(1):81-8.

[135]. Porumb M, Stranges S, Pescapè A, Pecchia L. Precision medicine and artificial intelligence: a pilot study on deep learning for hypoglycemic events detection based on ECG. Scientific reports. 2020 Jan 13;10(1):170.

[136]. Donsa K, Spat S, Beck P, Pieber TR, Holzinger A. Towards personalization of diabetes therapy using computerized decision support and machine learning: some open problems and challenges. Smart Health: Open Problems and Future Challenges. 2015:237-60.

[137]. Mujumdar A, Vaidehi V. Diabetes prediction using machine learning algorithms. Procedia Computer Science. 2019 Jan 1; 165:292-9.

[138]. Makroum MA, Adda M, Bouzouane A, Ibrahim H. Machine learning and smart devices for diabetes management: Systematic review. Sensors. 2022 Feb 25;22(5):1843.

[139]. Kovatchev B. A century of diabetes technology: signals, models, and artificial pancreas control. Trends in Endocrinology & Metabolism. 2019 Jul 1;30(7):432-44.

[140]. Li J, Huang J, Zheng L, Li X. Application of artificial intelligence in diabetes education and management: present status and promising prospect. Frontiers in public health. 2020 May 29; 8:521222.

[141]. Mackenzie SC, Sainsbury CA, Wake DJ. Diabetes and artificial intelligence beyond the closed loop: a review of the landscape, promise and challenges. Diabetologia. 2024 Feb;67(2):223-35.

[142]. Contreras I, Vehi J. Artificial intelligence for diabetes management and decision support: literature review. Journal of medical Internet research. 2018 May 30;20(5):e10775.

[143]. Yoo JH, Kim JH. Advances in continuous glucose monitoring and integrated devices for management of diabetes with insulin-based therapy: improvement in glycemic control. Diabetes & Metabolism Journal. 2023 Jan;47(1):27.

[144]. Nimri R, Kovatchev B, Phillip M. Decision support systems and closed-loop. Diabetes Technology & Therapeutics. 2021 Jun 1;23(S2) :S-69.

[145]. Kesavadev J, Saboo B, Krishna MB, Krishnan G. Evolution of insulin delivery devices: from syringes, pens, and pumps to DIY artificial pancreas. Diabetes Therapy. 2020 Jun;11(6):1251-69.

[146]. Ellahham S. Artificial intelligence: the future for diabetes care. The American journal of medicine. 2020 Aug 1;133(8):895-900.

[147]. Funnell MM, Anderson RM. Empowerment and self-management of diabetes. Clinical diabetes. 2004 Jun 22;22(3):123-8.

[148]. Lin EH, Katon W, Von Korff M, Rutter C, Simon GE, Oliver M, Ciechanowski P, Ludman EJ, Bush T, Young B. Relationship of depression and diabetes self-care, medication adherence, and preventive care. Diabetes care. 2004 Sep 1;27(9):2154-60.

[149]. Ahrén B. Avoiding hypoglycemia: a key to success for glucose-lowering therapy in type 2 diabetes. Vascular health and risk management. 2013 Apr 24:155-63.

[150]. Stark Casagrande S, Fradkin JE, Saydah SH, Rust KF, Cowie CC. The prevalence of meeting A1C, blood pressure, and LDL goals among people with diabetes, 1988–2010. Diabetes care. 2013 Aug 1;36(8):2271-9.

[151]. Safi SZ, Qvist R, Kumar S, Batumalaie K, Ismail IS. Molecular mechanisms of diabetic retinopathy, general preventive strategies, and novel therapeutic targets. BioMed research international. 2014;2014(1):801269.

[152]. American Diabetes Association. 9. cardiovascular disease and risk management: standards of medical care in diabetes—2018. Diabetes care. 2018 Jan 1;41(Supplement_1): S86-104.

[153]. Montagnana M, Caputo M, Giavarina D, Lippi G. Overview on self-monitoring of blood glucose. Clinica Chimica Acta. 2009 Apr 1;402(1-2):7-13.

[154]. Good CB. Polypharmacy in elderly patients with diabetes. Diabetes Spectrum. 2002 Oct 1;15(4):240-8.

[155]. American Diabetes Association. Evidence-based nutrition principles and recommendations for the treatment and prevention of diabetes and related complications. Diabetes care. 2002 Jan 1;25(suppl_1): s50-60.

[156]. Borghouts LB, Keizer HA. Exercise and insulin sensitivity: a review. International journal of sports medicine. 2000 Jan;21(01):1-2.

[157]. Wilson DD, McAllister G, West A. Assessing glycaemic control: self-monitoring of blood glucose. British Journal of Nursing. 2011 Aug 11;20(15):919-25.

[158]. World Health Organization. Adherence to long-term therapies: evidence for action. World Health Organization; 2003.

[159]. Hinds-Beharrie V. Improving Quality-of-Life in Older Adults with Depression and Diabetes through Medication Compliance Education (Doctoral dissertation, Walden University).

[160]. Gonzalez JS, Tanenbaum ML, Commissariat PV. Psychosocial factors in medication adherence and diabetes self-management: Implications for research and practice. American Psychologist. 2016 Oct;71(7):539.

[161]. Yi JP, Vitaliano PP, Smith RE, Yi JC, Weinger K. The role of resilience on psychological adjustment and physical health in patients with diabetes. British journal of health psychology. 2008 May;13(2):311-25.

[162]. Magny-Normilus C, Nolido NV, Borges JC, Brady M, Labonville S, Williams D, Soukup J, Lipsitz S, Hudson M, Schnipper JL. Effects of an intensive discharge intervention on medication adherence, glycemic control, and readmission rates in patients with type 2 diabetes. Journal of patient safety. 2021 Mar 1;17(2):73-80.

[163]. García-Pérez LE, Álvarez M, Dilla T, Gil-Guillén V, Orozco-Beltrán D. Adherence to therapies in patients with type 2 diabetes. Diabetes Therapy. 2013 Dec; 4:175-94.

[164]. Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: recognizing the scope of the problem and its key contributors. Patient preference and adherence. 2016 Jul 22:1299-307.

[165]. Balaji R, Duraisamy R, Kumar MP. Complications of diabetes mellitus: A review. Drug Invention Today. 2019 Jan 15;12(1).

[166]. Deshpande AD, Harris-Hayes M, Schootman M. Epidemiology of diabetes and diabetes-related complications. Physical therapy. 2008 Nov 1;88(11):1254-64.

[167]. Miller B. 7 Keys to Bring Your Diabetes Under Control: Add Years and Quality to Life by Keeping Your Sugar Level Under Control. Oak Publication Sdn Bhd; 2016.

[168]. Cappon G, Vettoretti M, Sparacino G, Facchinetti A. Continuous glucose monitoring sensors for diabetes management: a review of technologies and applications. Diabetes & metabolism journal. 2019 Aug;43(4):383.

[169]. Vashist SK. Continuous glucose monitoring systems: a review. Diagnostics. 2013 Oct 29;3(4):385-412.

[170]. Rodbard D. Continuous glucose monitoring: a review of recent studies demonstrating improved glycemic outcomes. Diabetes technology & therapeutics. 2017 Jun 1;19(S3) :S-25.

[171]. Alcántara-Aragón V. Improving patient self-care using diabetes technologies. Therapeutic advances in endocrinology and metabolism. 2019 Jan; 10:2042018818824215.

[172]. Rodriguez-León C, Villalonga C, Munoz-Torres M, Ruiz JR, Banos O. Mobile and wearable technology for the monitoring of diabetes-related parameters: Systematic review. JMIR mHealth and uHealth. 2021 Jun 3;9(6): e25138.

[173]. Fagherazzi G, Ravaud P. Digital diabetes: Perspectives for diabetes prevention, management and research. Diabetes & metabolism. 2019 Sep 1;45(4):322-9.

[174]. Heintzman ND. A digital ecosystem of diabetes data and technology: services, systems, and tools enabled by wearables, sensors, and apps. Journal of diabetes science and technology. 2016 Jan;10(1):35-41.

[175]. Bellazzi R, Larizza C, Montani S, Riva A, Stefanelli M, d'Annunzio G, Lorini R, Gómez EJ, Hernando E, Brugués E, Cermeno J. A telemedicine support for diabetes management: the T-IDDM project. Computer methods and programs in biomedicine. 2002 Aug 1;69(2):147-61.

[176]. Fleming GA, Petrie JR, Bergenstal RM, Holl RW, Peters AL, Heinemann L. Diabetes digital app technology: benefits, challenges, and recommendations. A consensus report by the

European Association for the Study of Diabetes (EASD) and the American Diabetes Association (ADA) Diabetes Technology Working Group. Diabetes care. 2020 Jan 1;43(1):250-60.

[177]. Shah VN, Shoskes A, Tawfik B, Garg SK. Closed-loop system in the management of diabetes: past, present, and future. Diabetes technology & therapeutics. 2014 Aug 1;16(8):477-90.

[178]. Bode BW, Gross TM, Thornton KR, Mastrototaro JJ. Continuous glucose monitoring used to adjust diabetes therapy improves glycosylated hemoglobin: a pilot study. Diabetes research and clinical practice. 1999 Dec 1;46(3):183-90.

[179]. Carlson AL, Mullen DM, Bergenstal RM. Clinical use of continuous glucose monitoring in adults with type 2 diabetes. Diabetes technology & therapeutics. 2017 May 1;19(S2) :S-4.

[180]. American Diabetes Association. 7. Diabetes technology: standards of medical care in diabetes—2020. Diabetes Care. 2020 Jan 1;43(Supplement_1): S77-88.

[181]. Peng W, Yuan S, Holtz BE. Exploring the challenges and opportunities of health mobile apps for individuals with type 2 diabetes living in rural communities. Telemedicine and e-Health. 2016 Sep 1;22(9):733-8.

[182]. Hirsch IB, Armstrong D, Bergenstal RM, Buckingham B, Childs BP, Clarke WL, Peters A, Wolpert H. Clinical application of emerging sensor technologies in diabetes management: consensus guidelines for continuous glucose monitoring (CGM). Diabetes technology & therapeutics. 2008 Aug 1;10(4):232-46.

[183]. Sieverdes JC, Treiber F, Jenkins C, Hermayer K. Improving diabetes management with mobile health technology. The American journal of the medical sciences. 2013 Apr 1;345(4):289-95.

[184]. Beck J, Greenwood DA, Blanton L, Bollinger ST, Butcher MK, Condon JE, Cypress M, Faulkner P, Fischl AH, Francis T, Kolb LE. 2017 National standards for diabetes self-management education and support. The Diabetes Educator. 2017 Oct;43(5):449-64.

[185]. Greene JA, Choudhry NK, Kilabuk E, Shrank WH. Online social networking by patients with diabetes: a qualitative evaluation of communication with Facebook. Journal of general internal medicine. 2011 Mar; 26:287-92.

[186]. Car J, Tan WS, Huang Z, Sloot P, Franklin BD. eHealth in the future of medications management: personalisation, monitoring and adherence. BMC medicine. 2017 Dec; 15:1-9.

[187]. Almathami HK, Win KT, Vlahu-Gjorgievska E. Barriers and facilitators that influence telemedicine-based, real-time, online consultation at patients’ homes: systematic literature review. Journal of medical Internet research. 2020 Feb 20;22(2):e16407.

[188]. Wens J, Vermeire E, Van Royen P, Sabbe B, Denekens J. GPs' perspectives of type 2 diabetes patients' adherence to treatment: A qualitative analysis of barriers and solutions. BMC family practice. 2005 Dec; 6:1-0.

[189]. Hirsch IB, Armstrong D, Bergenstal RM, Buckingham B, Childs BP, Clarke WL, Peters A, Wolpert H. Clinical application of emerging sensor technologies in diabetes management: consensus guidelines for continuous glucose monitoring (CGM). Diabetes technology & therapeutics. 2008 Aug 1;10(4):232-46.

[190]. Cho JH, Chang SA, Kwon HS, Choi YH, Ko SH, Moon SD, Yoo SJ, Song KH, Son HS, Kim HS, Lee WC. Long-term effect of the Internet-based glucose monitoring system on HbA1c reduction and glucose stability: a 30-month follow-up study for diabetes management with a ubiquitous medical care system. Diabetes care. 2006 Dec 1;29(12):2625-31.

[191]. Frier BM. Hypoglycaemia in diabetes mellitus: epidemiology and clinical implications. Nature Reviews Endocrinology. 2014 Dec;10(12):711-22.

[192]. Klonoff DC. The current status of mHealth for diabetes: will it be the next big thing? Journal of diabetes science and technology. 2013 May;7(3):749-58.

[193]. Tandon N, Ali MK, Venkat Narayan KM. Pharmacologic prevention of microvascular and macrovascular complications in diabetes mellitus: implications of the results of recent clinical trials in type 2 diabetes. American Journal of Cardiovascular Drugs. 2012 Feb; 12:7-22.

[194]. Kahn AP, Ismail FJ. diabetes. Orient Publishing; 2019 Aug 6.

[195]. Nasa P, Chaudhary S, Shrivastava PK, Singh A. Euglycemic diabetic ketoacidosis: A missed diagnosis. World journal of diabetes. 2021 May 5;12(5):514.

[196]. Rubin RR, Peyrot M. Quality of life and diabetes. Diabetes/metabolism research and reviews. 1999 May;15(3):205-18.

[197]. Anderson R, Funnell M, Carlson A, Saleh-Statin N, Cradock S, Skinner TC. Facilitating self-care through empowerment. Psychology in diabetes care. 2000 Apr 19:69-97.

[198]. Bickett A, Tapp H. Anxiety and diabetes: Innovative approaches to management in primary care. Experimental Biology and Medicine. 2016 Sep;241(15):1724-31.

[199]. Greenfield S, Kaplan SH, Ware JE, Yano EM, Frank HJ. Patients’ participation in medical care: effects on blood sugar control and quality of life in diabetes. Journal of general internal medicine. 1988 Sep; 3:448-57.

[200]. Ng JY, Ntoumanis N, Thøgersen-Ntoumani C, Deci EL, Ryan RM, Duda JL, Williams GC. Self-determination theory applied to health contexts: A meta-analysis. Perspectives on psychological science. 2012 Jul;7(4):325-40.

[201]. Echouffo-Tcheugui JB, Garg R. Management of hyperglycemia and diabetes in the emergency department. Current diabetes reports. 2017 Aug; 17:1-8.

[202]. Tricco AC, Ivers NM, Grimshaw JM, Moher D, Turner L, Galipeau J, Halperin I, Vachon B, Ramsay T, Manns B, Tonelli M. Effectiveness of quality improvement strategies on the management of diabetes: a systematic review and meta-analysis. The Lancet. 2012 Jun 16;379(9833):2252-61.

[203]. American Diabetes Association. Standards of medical care in diabetes—2014. Diabetes care. 2014 Jan 1;37(Supplement_1): S14-80.

[204]. Joyal SV. What Your Doctor May Not Tell You About (Tm): Diabetes: An Innovative Program to Prevent, Treat, and Beat This Controllable Disease. Hachette UK; 2008 Feb 28.

[205]. Klonoff DC, Ahn D, Drincic A. Continuous glucose monitoring: a review of the technology and clinical use. Diabetes Research and Clinical Practice. 2017 Nov 1; 133:178-92.

[206]. Yunos MF, Nordin AN. Non-invasive glucose monitoring devices: A review. Bulletin of Electrical Engineering and Informatics. 2020 Dec 1;9(6):2609-18.

[207]. Hirsch IB, Armstrong D, Bergenstal RM, Buckingham B, Childs BP, Clarke WL, Peters A, Wolpert H. Clinical application of emerging sensor technologies in diabetes management: consensus guidelines for continuous glucose monitoring (CGM). Diabetes technology & therapeutics. 2008 Aug 1;10(4):232-46.

[208]. Mian Z, Hermayer KL, Jenkins A. Continuous glucose monitoring: review of an innovation in diabetes management. The American journal of the medical sciences. 2019 Nov 1;358(5):332-9.

[209]. Gu W, Zhou Y, Zhou Z, Liu X, Zou H, Zhang P, Spanos CJ, Zhang L. Sugarmate: Non-intrusive blood glucose monitoring with smartphones. Proceedings of the ACM on interactive, mobile, wearable and ubiquitous technologies. 2017 Sep 11;1(3):1-27.

[210]. Salvi E, Bosoni P, Tibollo V, Kruijver L, Calcaterra V, Sacchi L, Bellazzi R, Larizza C. Patient-generated health data integration and advanced analytics for diabetes management: the AID-GM platform. Sensors. 2019 Dec 24;20(1):128.

[211]. Attar R. Exploration of the Experiences and Perceptions of a Sample Group of Health Care Employees in Mississippi Regarding Regular Comprehensive Eye Exams as Part of Preventive Health Services (Doctoral dissertation, The University of Mississippi Medical Center).

[212]. Bolla AS, Priefer R. Blood glucose monitoring-an overview of current and future non-invasive devices. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2020 Sep 1;14(5):739-51.

[213]. Bratlie KM, York RL, Invernale MA, Langer R, Anderson DG. Materials for diabetes therapeutics. Advanced healthcare materials. 2012 May;1(3):267-84.

[214]. Rodriguez-León C, Villalonga C, Munoz-Torres M, Ruiz JR, Banos O. Mobile and wearable technology for the monitoring of diabetes-related parameters: Systematic review. JMIR mHealth and uHealth. 2021 Jun 3;9(6): e25138.

[215]. Chiauzzi E, Rodarte C, DasMahapatra P. Patient-centered activity monitoring in the self-management of chronic health conditions. BMC medicine. 2015 Dec; 13:1-6.

[216]. Alfian G, Syafrudin M, Ijaz MF, Syaekhoni MA, Fitriyani NL, Rhee J. A personalized healthcare monitoring system for diabetic patients by utilizing BLE-based sensors and real-time data processing. Sensors. 2018 Jul 6;18(7):2183.

[217]. Zarkogianni K, Litsa E, Mitsis K, Wu PY, Kaddi CD, Cheng CW, Wang MD, Nikita KS. A review of emerging technologies for the management of diabetes mellitus. IEEE Transactions on Biomedical Engineering. 2015 Aug 19;62(12):2735-49.

[218]. Jacobs PG, Herrero P, Facchinetti A, Vehi J, Kovatchev B, Breton M, Cinar A, Nikita K, Doyle F, Bondia J, Battelino T. Artificial intelligence and machine learning for improving glycemic control in diabetes: best practices, pitfalls and opportunities. IEEE Reviews in Biomedical Engineering. 2023 Nov 9.

[219]. Bergenstal RM, Ahmann AJ, Bailey T, Beck RW, Bissen J, Buckingham B, Deeb L, Dolin RH, Garg SK, Goland R, Hirsch IB. Recommendations for standardizing glucose reporting and analysis to optimize clinical decision making in diabetes: the Ambulatory Glucose Profile (AGP).

[220]. Sugandh FN, Chandio M, Raveena FN, Kumar L, Karishma FN, Khuwaja S, Memon UA, Bai K, Kashif M, Varrassi G, Khatri M. Advances in the management of diabetes mellitus: a focus on personalized medicine. Cureus. 2023 Aug;15(8).

[221]. Cappon G, Vettoretti M, Sparacino G, Facchinetti A. Continuous glucose monitoring sensors for diabetes management: a review of technologies and applications. Diabetes & metabolism journal. 2019 Aug;43(4):383.

[222]. Cappon G, Vettoretti M, Sparacino G, Facchinetti A. Continuous glucose monitoring sensors for diabetes management: a review of technologies and applications. Diabetes & metabolism journal. 2019 Aug;43(4):383.

[223]. Holbrook A, Thabane L, Keshavjee K, Dolovich L, Bernstein B, Chan D, Troyan S, Foster G, Gerstein H. Individualized electronic decision support and reminders to improve diabetes care in the community: COMPETE II randomized trial. Cmaj. 2009 Jul 7;181(1-2):37-44.

[224]. Poolsup N, Suksomboon N, Rattanasookchit S. Meta-analysis of the benefits of self-monitoring of blood glucose on glycemic control in type 2 diabetes patients: an update. Diabetes technology & therapeutics. 2009 Dec 1;11(12):775-84.

[225]. Gonder-Frederick LA, Cox DJ. Symptom perception, symptom beliefs, and blood glucose discrimination in the self-treatment of insulin-dependent diabetes. InMental representation in health and illness 1991 (pp. 220-246). New York, NY: Springer US.

[226]. Jawaid SA, Qureshi J. How Artificial Intelligence Technology can be Used to Treat Diabetes.

[227]. Bidwai P, Gite S, Pahuja K, Kotecha K. A systematic literature review on diabetic retinopathy using an artificial intelligence approach. Big Data and Cognitive Computing. 2022 Dec 8;6(4):152.

[228]. Pelayes DE, Mendoza JA, Folgar AM. Artificial intelligence use in diabetes. Latin American Journal of Ophthalmology. 2022 Dec 10;5.

[229]. Papadopoulou-Marketou N, Kanaka-Gantenbein C, Marketos N, Chrousos GP, Papassotiriou I. Biomarkers of

diabetic nephropathy: A 2017 update. Critical reviews in clinical laboratory sciences. 2017 Jul 4;54(5):326-42.

[230]. Chemello G, Salvatori B, Morettini M, Tura A. Artificial intelligence methodologies applied to technologies for screening, diagnosis and care of the diabetic foot: a narrative review. Biosensors. 2022 Nov;12(11):985.

[231]. Qian Y, Alhaskawi A, Dong Y, Ni J, Abdalbary S, Lu H. Transforming medicine: artificial intelligence integration in the peripheral nervous system. Frontiers in Neurology. 2024 Feb 14; 15:1332048.

[232]. Liu B, Cheng X, Chen M, Dong W, Sun J, Lun Y. Changes of sweat gland function in type 2 diabetes mellitus patients with peripheral neuropathy. International Journal of Diabetes in Developing Countries. 2024 Mar;44(1):84-90.

[233]. Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. Circulation. 1998 May 12;97(18):1837-47.

[234]. Dabas M, Schwartz D, Beeckman D, Gefen A. Application of artificial intelligence methodologies to chronic wound care and management: a scoping review. Advances in wound care. 2023 Apr 1;12(4):205-40.

[235]. Ljubic B, Hai AA, Stanojevic M, Diaz W, Polimac D, Pavlovski M, Obradovic Z. Predicting complications of diabetes mellitus using advanced machine learning algorithms. Journal of the American Medical Informatics Association. 2020 Sep;27(9):1343-51.

[236]. Li R, Chen Y, Ritchie MD, Moore JH. Electronic health records and polygenic risk scores for predicting disease risk. Nature Reviews Genetics. 2020 Aug;21(8):493-502.

[237]. Selvarajah D, Kar D, Khunti K, Davies MJ, Scott AR, Walker J, Tesfaye S. Diabetic peripheral neuropathy: advances in diagnosis and strategies for screening and early intervention. The lancet Diabetes & endocrinology. 2019 Dec 1;7(12):938-48.

[238]. Kaswan KS, Gaur L, Dhatterwal JS, Kumar R. AI-based natural language processing for the generation of meaningful information electronic health record (EHR) data. InAdvanced AI techniques and applications in bioinformatics 2021 Oct 17 (pp. 41-86). CRC Press.

[239]. Davis DA, Chawla NV, Blumm N, Christakis N, Barabási AL. Predicting individual disease risk based on medical history. InProceedings of the 17th ACM conference on Information and knowledge management 2008 Oct 26 (pp. 769-778).

[240]. Lalithadevi B, Krishnaveni S. Detection of diabetic retinopathy and related retinal disorders using fundus images based on deep learning and image processing techniques: A comprehensive review. Concurrency and Computation: Practice and Experience. 2022 Aug 30;34(19): e7032.

[241]. Dogheim GM, Hussain A. Patient care through AI-driven remote monitoring: Analyzing the role of predictive models and intelligent alerts in preventive medicine. Journal of Contemporary Healthcare Analytics. 2023 Jun 5;7(1):94-110.

[242]. Dilsizian SE, Siegel EL. Artificial intelligence in medicine and cardiac imaging: harnessing big data and advanced computing to provide personalized medical diagnosis and treatment. Current cardiology reports. 2014 Jan; 16:1-8.

[243]. Chmayssem A, Nadolska M, Tubbs E, Sadowska K, Vadgma P, Shitanda I, Tsujimura S, Lattach Y, Peacock M, Tingry S, Marinesco S. Insight into continuous glucose monitoring: from medical basics to commercialized devices. Microchimica Acta. 2023 May;190(5):177.

[244]. Basatneh R, Najafi B, Armstrong DG. Health sensors, smart home devices, and the internet of medical things: an opportunity for dramatic improvement in care for the lower extremity complications of diabetes. Journal of diabetes science and technology. 2018 May;12(3):577-86.

[245]. Chang A. The role of artificial intelligence in digital health. InDigital health entrepreneurship 2023 Sep 5 (pp. 75-85). Cham: Springer International Publishing.

[246]. Yom-Tov E, Feraru G, Kozdoba M, Mannor S, Tennenholtz M, Hochberg I. Encouraging physical activity in patients with diabetes: intervention using a reinforcement learning system. Journal of medical Internet research. 2017 Oct 10;19(10): e338.

[247]. Dall TM, Zhang Y, Chen YJ, Quick WW, Yang WG, Fogli J. The economic burden of diabetes. Health affairs. 2010 Feb 1;29(2):297-303.

[248]. Khalifa M, Albadawy M, Iqbal U. Advancing clinical decision support: The role of artificial intelligence across six domains. Computer Methods and Programs in Biomedicine Update. 2024 Feb 17:100142.

[249]. Shah V. Next-Generation Artificial Intelligence for Personalized Medicine: Challenges and Innovations. INTERNATIONAL JOURNAL OF COMPUTER SCIENCE AND TECHNOLOGY. 2018 Jun 30;2(2):1-5.

[250]. Schork NJ. Artificial intelligence and personalized medicine. Precision medicine in Cancer therapy. 2019:265-83.

[251]. Contreras I, Vehi J. Artificial intelligence for diabetes management and decision support: literature review. Journal of medical Internet research. 2018 May 30;20(5):e10775.

[252]. Subramanian M, Wojtusciszyn A, Favre L, Boughorbel S, Shan J, Letaief KB, Pitteloud N, Chouchane L. Precision medicine in the era of artificial intelligence: implications in chronic disease management. Journal of translational medicine. 2020 Dec; 18:1-2.

[253]. Singh AV, Chandrasekar V, Paudel N, Laux P, Luch A, Gemmati D, Tisato V, Prabhu KS, Uddin S, Dakua SP. Integrative toxicogenomics: Advancing precision medicine and toxicology through artificial intelligence and OMICs technology. Biomedicine & Pharmacotherapy. 2023 Jul 1; 163:114784.

[254]. Rghioui A, Lloret J, Sendra S, Oumnad A. A smart architecture for diabetic patient monitoring using machine learning algorithms. InHealthcare 2020 Sep 19 (Vol. 8, No. 3, p. 348). MDPI.

[255]. Goldsmith P. One Size Doesn't Fit All: A New Age in Healthcare. Closed Loop Medicine. 2022.

[256]. Li J, Huang J, Zheng L, Li X. Application of artificial intelligence in diabetes education and management: present

status and promising prospect. Frontiers in public health. 2020 May 29; 8:521222.

[257]. Oliver NS, Toumazou C, Cass AE, Johnston DG. Glucose sensors: a review of current and emerging technology. Diabetic medicine. 2009 Mar;26(3):197-210.

[258]. Jagadeeswari V, Subramaniyaswamy V, Logesh R, Vijayakumar V. A study on medical Internet of Things and Big Data in personalized healthcare system. Health information science and systems. 2018 Sep 20;6(1):14.

[259]. Montori VM, Gafni A, Charles C. A shared treatment decision-making approach between patients with chronic conditions and their clinicians: the case of diabetes. Health Expectations. 2006 Mar;9(1):25-36.

[260]. Zhang X, Jiang H, Ozanich G. Clinical decision support systems for diabetes care: evidence and development between 2017 and present. InTelehealth and Telemedicine-The Far-Reaching Medicine for Everyone and Everywhere 2022 Oct 30. IntechOpen.

[261]. Trevitt S, Simpson S, Wood A. Artificial pancreas device systems for the closed-loop control of type 1 diabetes: what systems are in development? Journal of diabetes science and technology. 2016 May;10(3):714-23.

[262]. Eghbali-Zarch M, Masoud S. Application of machine learning in affordable and accessible insulin management for type 1 and 2 diabetes: A comprehensive review. Artificial Intelligence in Medicine. 2024 Apr 4:102868.

[263]. Jeddi Z, Bohr A. Remote patient monitoring using artificial intelligence. InArtificial intelligence in healthcare 2020 Jan 1 (pp. 203-234). Academic Press.

[264]. Guan Z, Li H, Liu R, Cai C, Liu Y, Li J, Wang X, Huang S, Wu L, Liu D, Yu S. Artificial intelligence in diabetes management: advancements, opportunities, and challenges. Cell Reports Medicine. 2023 Oct 2.

[265]. Makroum MA, Adda M, Bouzouane A, Ibrahim H. Machine learning and smart devices for diabetes management: Systematic review. Sensors. 2022 Feb 25;22(5):1843.

[266]. Domingo-Lopez DA, Lattanzi G, Schreiber LH, Wallace EJ, Wylie R, O'Sullivan J, Dolan EB, Duffy GP. Medical devices, smart drug delivery, wearables and technology for the treatment of Diabetes Mellitus. Advanced Drug Delivery Reviews. 2022 Jun 1; 185:114280.

[267]. Mathioudakis NN, Abusamaan MS, Shakarchi AF, Sokolinsky S, Fayzullin S, McGready J, Zilbermint M, Saria S, Golden SH. Development and validation of a machine learning model to predict near-term risk of iatrogenic hypoglycemia in hospitalized patients. JAMA Network Open. 2021 Jan 4;4(1): e2030913-.

[268]. Reddy VS, Agarwal B, Ye Z, Zhang C, Roy K, Chinnappan A, Narayan RJ, Ramakrishna S, Ghosh R. Recent advancement in biofluid-based glucose sensors using invasive, minimally invasive, and non-invasive technologies: a review. Nanomaterials. 2022 Mar 25;12(7):1082.

[269]. Delbeck S, Vahlsing T, Leonhardt S, Steiner G, Heise HM. Non-invasive monitoring of blood glucose using optical methods for skin spectroscopy—Opportunities and recent advances. Analytical and bioanalytical chemistry. 2019 Jan; 411:63-77.

[270]. Chintala S. AI-Driven Personalised Treatment Plans: The Future of Precision Medicine. Machine Intelligence Research. 2023;17(02):9718-28.

[271]. Razzak MI, Imran M, Xu G. Big data analytics for preventive medicine. Neural Computing and Applications. 2020 May;32(9):4417-51.

[272]. Roosan D, Padua P, Khan R, Khan H, Verzosa C, Wu Y. Effectiveness of ChatGPT in clinical pharmacy and the role of artificial intelligence in medication therapy management. Journal of the American Pharmacists Association. 2024 Mar 1;64(2):422-8.

[273]. Cichosz SL, Johansen MD, Hejlesen O. Toward big data analytics: review of predictive models in management of diabetes and its complications. Journal of diabetes science and technology. 2016 Jan;10(1):27-34.

[274]. Nayarisseri A, Khandelwal R, Tanwar P, Madhavi M, Sharma D, Thakur G, Speck-Planche A, Singh SK. Artificial intelligence, big data and machine learning approaches in precision medicine & drug discovery. Current drug targets. 2021 Apr 1;22(6):631-55.

[275]. Chopra H, Shin DK, Munjal K, Dhama K, Emran TB. Revolutionizing clinical trials: the role of AI in accelerating medical breakthroughs. International Journal of Surgery. 2023 Dec 1;109(12):4211-20.

[276]. Dimitrov DV. Medical internet of things and big data in healthcare. Healthcare informatics research. 2016 Jul;22(3):156.

[277]. Pandrangi VC, Gaston B, Appelbaum NP, Albuquerque Jr FC, Levy MM, Larson RA. The application of virtual reality in patient education. Annals of vascular surgery. 2019 Aug 1; 59:184-9.