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DIABETES GOES DIGITAL WITH ARTIFICIAL INTELLIGENCE AND BIG DATA

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ABSTRACT

Artificial intelligence is renovating our lives globally besides medical field. Prospective of AI to improve outstretch of diabetes care by making it so successful. Numerous cases of diabetes are brought into notice by the Endocrinologist universally and provide us with a possible opportunity for the active availability of data. Controlling the acquired big data using electronic medical records, by the specialists can put the globe at the possible forefront of research in this field. Clinical use of AI can provide larger insights to our obstacles faced during the effective treatment of all sorts of diabetes. As there are various treatment options which are to be added subsequently and incrementally, handling type,[2] diabetes is much more complicated than type,[1] diabetes. Based on a lot of patient personal factors such as BMI, beta-cell function and insulin resistance in comparison with others the choice of medication and its dosage varies. There are magnificent reviews on compiling studies which have used AI approach in diabetes. AI is too good as the big data used to generate this intelligence. In type 1 diabetes the research and reviews are witnessing the evolution of Closed Loop Insulin Delivery System with inbuilt AI algorithms to determine both hypoglycemic and hyperglycemic excursions. However, review of literature suggest that these systems are still in infancy and yet to show an impact on long-term outcomes and standard quality of life. A pile of disease can be transfigured into an opportunity, if entire big data is harnessed in a usable form and AI is used to produce insights and solutions very peculiar to our population. The constructive steps are needed by the Central and State

Governments and large associations, like, endocrine societies of various countries to initiate big data collections and research.

KEYWORDS: Electronic medical record, artificial intelligence, diabetes care, machine learning, Indian ophthalmology.

INTRODUCTION

AI/ML tools are being vastly in use in all scientific fields and are responsible for revolutionizing businesses throughout the world. Besides this Healthcare systems, have been very slow in adopting these advancements and are lagging far behind in this specialization. AI/ML can be useful in the control and management of chronic diseases, namely, diabetes. ML/AI is reportedly used to predict risk of diabetes based on genomic data, diagnosis of diabetes based on EHR data, to predict risk of various complications and ailments such as nephropathy and retinopathy, and also in diagnosis of diabetic retinopathy.[3] There is a sparseness of India specific data on all these aspects of AI in the published literature. It was stated that Google AI research unit in collaboration with Indian ophthalmology centers has already made great advances in the field of automated diagnosis and ranking of diabetic retinopathy based on fundus photographs.[4]

Artificial intelligence (AI) is a broad term defined as the theory and development of virtual systems which are able to perform tasks normally by utilizing human intelligence viz., visual perception, speech recognition, decision making, and translation between languages. It can be as simple as rule based or driven by complex statistical methods. Machine learning is a subset of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning can be supervised, unsupervised, semi supervised, or reinforcement based. Through deep learning machine tries to emulate human intelligence by simulating structure of human brain using recurrent neural networks.

Adoption of these technologies can promisingly increase detection and early treatment of diabetic complications.[4] Besides this, one area of diabetes care and its attempts, is management strategies for diabetes. In type 1 diabetes we are authenticating the advancement of closed loop insulin delivery system with inbuilt AI/ML algorithms to predict both hypoglycemic and hyperglycemic excursions.[5] These systems are still in infancy and yet to show an impact on long term outcomes and quality of life. Treating type 2 diabetes is even

more complicated than type 1 diabetes as there are multiple treatment options that are to be added sequentially and incrementally. Moreover, the choice of medication and its dosage also depends on a lot of individual factors such as BMI, underlying beta-cell function, and insulin resistance among others. There are excellent reviews on compiling studies that have used AI/ML approach in diabetes.

Type 2 Diabetes Management

AI/ML application would be even more useful in a country like India where the prevalence of diabetes is estimated at 8–10% with a slightly lower burden on rural areas as compared to urban areas.[6] However, in CARRS study, prevalence of diabetes in the city of Delhi has been determined at ~27% and it has been found that 46% or more population has prediabetes.[7] Similar prevalence has been found in three other metropolitan cities.[7] In another study, authors reported the highest incidence of diabetes in age group of 30–34 years.[8] Such an early and extensive occurrence of diabetes would be a huge burden on the healthcare system. Lacks of resources, specially trained doctors, are a roadblock for health all over. The application of AI/ML in diabetes can help in plugging this huge gap. Uniformity of care (or minimum standard care) is another issue witnessed in India. As large number of cases are being handled by primary health care physicians and due to lack of any audit of these practices, average HbA1c of people with diabetes in India stays around 9%.[9] This predicts the potentially ever increasing burden of complications resulting from poor diabetes control and also presents an opportunity to make things better with the help of AI/ML approach.

Aspects of diabetes care using AI/ML

Prediction of diabetes based on genetic as well as clinical data, algorithms have been used to ascertain risk of occurrence of diabetes. Based on electronic health record data, certain algorithms can alert physicians towards possibility of diagnosis of diabetes being missed. Glycemic control largely pertains to artificial pancreas system. A large number of studies using different AI approaches have tried to automate insulin infusion rates based on continuous glucose monitoring (CGM) data and also to suggest insulin bolus dose. Prediction of glycemic events, prediction of impending hypoglycemia or hyperglycemia can be predicted based on CGM data. This approach is already in commercial use. Prediction of risk of retinopathy, nephropathy, neuropathy or cardiovascular event by using baseline clinical and biochemical data. Diagnosis of Complications AI/ML approach is revolutionizing

detection of retinopathy in clinics of diabetologists by directly recognizing and classifying stages based on images obtained by fundus cameras

An excellent effort by a group from the center for chronic disease control (CCDC) and AIIMS, implemented a decision support system on a mobile platform to help primary care physicians in making better choices for selecting diabetes management strategy.[10,11] However, the intervention failed to show any improvement in glycemic control.[12] There can be few explanations for the same. First, there were logistic restrictions that were applicable for this study for example, only two drugs, viz, metformin and sulfonylureas were made available for titration; Second, drugs were only modified based on fasting blood glucose, postmeal blood glucose values, and HbA1c values. Inclusion of factors viz., adherence to diet and exercise, compliance to medications might have increased practical utility of the intervention. Literature survey on studies trying to optimize/automate therapy using machine learning algorithms at the patient level, on their routine visit is scant at the global level and is nonexistent at the national level. At the global level, there are few studies from China and western world.[13,15] Studies on type 2 diabetes management strategies have been summarized.

A few admonitions in these studies need to be noted while planning further research. Initially, these studies use data generated by multiple practitioners in routine diabetes care. While this may be the better mode to get big data for analysis, it would not lead to an improvement in the standards of care. In addition to this, at its best, system created from this data would match the outcomes of current practices. Second, due to multiple sources of data, noise level is likely to be very high making it difficult to delineate the most efficient path forward. Third, unless data has records of adherence to lifestyle measures (diet and exercise) and of compliance towards medication, the real world utility of this AI/ML approach would be restricted. Selecting specialist practices with glycemic control better than average would be the initial step towards facing these problems. Careful prospective data collection by these practices should include records of compliance levels. Using supervised machine learning initially and gradually switching over to unsupervised machine learning would make this data relevant in the real world.

Type 1 Diabetes Management

There is a huge amount of literature on AI/ML approach being used in type 1 diabetes. There are algorithms that have been used to detect composition of food based on images of food

thereby helping in carb counting.[16] Prediction of future blood glucose values and anticipating impending hypoglycemic or hyperglycemic event has been the focus of research in numerous publications.[17] Major work is also being done on developing bolus calculators to automate the process of calculating premeal insulin dose prediction.[18] From the perspective of the applicability of these approaches in India, there are two major lacunae. Firstly, most of this research is carried out among people using the insulin pumps and CGMs. As use of these modalities in India is limited due to economic issues, usability of this research in India is also limited. Secondly, different researchers have focused on individual areas of type 1 diabetes management and there is still no single application/technology available that can solve management of type 1 diabetes including carbohydrate counting, calculating insulin carbohydrate ratios, and also predicting insulin dose for each meal for each patient, especially on multiple subcutaneous daily injections.

Summary of studies using AI/ML in diabetes management

With reference to the articles published by the authors, year of publication, institute/industry, aim data source, AI/ML approach and results the following things can be summarized. Jing Mei *et al*.[13] 2017, belonging to China IBM Research China, theme was to provide personalized hypoglycemic medication prediction for diabetic patients 21,796 patients from an EHR repository of a level 2 city in China Hierarchical recurrent neural network (HRNN). Successful use of HRNN but no clinical benefits elaborated. Aileen P. Wright *et al*.[14] 2014, USA Yale School of Medicine, New Haven, CT, United States, were focusing in the Identification of temporal relationships between medications and accurately predicting the next medication likely to be prescribed for a patient. Inpatient claims data from insurance Constrained Sequential Pattern Discovery using Equivalence classes. Authors were able to predict the medication prescribed for 90.0% of patients when making predictions by drug class, and for 64.1% when making predictions at the generic drug level with three attempts. Adem Karahoca *et al*.[15] 2012, native of Turkey Bahçeßsehir University, Turkey, the theme was to manage the drug dosage planning process for three anitdiabetes drugs namely Metformin, Gliclazide and Pioglitazones Data set of T2DM patients were collected from Sinop State Hospital in Turkey. Diabetic data set had 142 diabetes assays from 45 T2DM patients Indexing High Dimensional Model Representation (HDMR) Indexing HDMR method worked well in modeling drug dosages.

Limitations and the way forward

AI/ML is too good to the data used to generate this intelligence as our country is sometimes called as "country with no records", but it does underline the scenario of deficiency of record keeping as an essential part of medical practice in India. A concerted and collective effort is needed by the government and large associations, like, endocrine society of India to start data collections and research.Loads of disease can be transformed into an excellent opportunity, if entire data is controlled in a usable form and AI/ML is used to generate perceptions and solutions specific to our population.

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