Application of Artificial Intelligence for managing Diabetes Mellitus patients during the Covid-19 pandemic: A Narrative Review

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Abstract

The Covid-19 quarantine policy and mobility restriction were carried out to break coronavirus transmission. These were implemented for several months to affect the quality of life, especially in patients with diabetes mellitus. To overcome this, technology such as applications of artificial intelligence can be used. The aim of this study is to identify the use of Artificial Intelligence systems in managing diabetes mellitus during pandemics based on the latest literature. This review conducted a narrative review method. Articles were searched using PubMed, Science Direct, and EBSCO databases. The keywords were based on the medical subheading (MeSH) term and combined using a boolean operator. Articles were selected using inclusion criteria, namely the year of publication between 2016-2021, articles in English, full text, and open access. The articles that were duplicated and articles that did not fit the research topic were excluded. We found that six articles met the criteria. These discussed four programs, namely diabetes retinopathy screening, blood glucose monitoring, lifestyle management programs, and insulin therapy guidelines. The four programs can be used in the home care services for diabetes mellitus patients during the Covid-19 pandemic.

Keywords: artificial Intelligence, diabetes mellitus, telemedicine

Introduction

World Health Organization (WHO) has determined that the Coronavirus or Covid-19 originating from Wuhan, China, which occurred at the end of 2019, is a global pandemic that causes the number of confirmed cases to continue to increase. As a result of the increase in the number of confirmed cases, and the number of deaths caused by Covid-19, several policies have been implemented to break the chain of transmission, such as the use of masks, physical distancing, quarantine, and mobility restriction in the long term (Tuwu, 2020). Physical distancing and mobility restrictions carried out during the pandemic caused a health emergency status in the community, especially for diabetes mellitus patients who were unable to receive treatment at hospitals or health centers properly so that patients with diabetes mellitus were more at risk of being neglected during the pandemic. Considering that diabetes mellitus is a disease known as the silent killer because it is often not realized by the and when it is known that complications have occurred sufferers (Yusnaini, 2021).

According to the International Diabetes Federation (IDF) in 2017, there were around 425 million people in the world living with diabetes mellitus and it is estimated that this case will continue to increase by 2045 (Nugroho et al., 2020). Indonesia is the only country in Southeast Asia that is on the list of 10 countries with the highest number of people with diabetes mellitus in the world, which is ranked seventh among the 10 countries with the highest number of people with diabetes mellitus, namely 10.7 million people (Budiman et al., 2020). The International Diabetes Federation (IDF) in 2019 estimated that Indonesia would see an increase in the prevalence of diabetes mellitus by 14.1% in 2045 (Budiman et al., 2020). Riskesdas data (2018), states that there is an increase of 2% of the Indonesian population suffering from diabetes mellitus (Kemenkes RI, 2018)

The high prevalence of diabetes mellitus requires a fairly long and continuous treatment, especially during the Covid-19 pandemic, to reduce and prevent long-term complications. Research conducted by Corina in 2018 showed that the most complications in diabetes mellitus patients were microvascular complications (57%) with the most complications being diabetic neuropathy (45.6%), diabetic nephropathy (33.7%), and diabetic retinopathy (20.7%). In comparison, macrovascular complications (43%) with the most complications were foot diabetes (29.9%), coronary heart disease (27.8%), and cerebrovascular (19.4%) (Saputri, 2020). Diseases that require long-term care at this time pose a challenge for the world of nursing to improve sustainable nursing care providers. Continuous care, in this case, is transitional care, which is care that functions to manage patients at home so that the treatment process remains continuity, which aims to improve, maintain or restore and maximize the level of independence and minimize the impact of the disease (Chaki et al., 2020).

Currently, in the Covid-19 pandemic, chronic diseases' patients faced problems as the Indonesian government applied the lockdown policy that impacted to many aspect of services including health services. The problems were the limited supply of needed drugs, including insulin or food, and the procurement of medical equipment tools such as blood sugar strips (Nugroho et al., 2020). These situations interfered the quality patients' management of diabetes mellitus
Home care in the form of telenursing is a form of continuous and comprehensive home nursing services provided to patients and their families. This home care service is considered very effective and efficient in the current state of the Covid-19 pandemic (Nugroho et al., 2020). In current conditions, technology is the right tool for patients who need health care assistance to stay in touch without having to meet face-to-face with a doctor. Therefore, in this modernization era, efforts are needed to help diabetes mellitus patients control their blood sugar levels, the use of technology in improving blood sugar control management, such as artificial intelligence (Chaki et al., 2020). The use of artificial intelligence is to provide a composite picture, panoramic view of individual medical data, make important decisions, avoid errors such as misdiagnosis and unnecessary procedures, assist in ordering and interpreting appropriate tests,

and recommend the appropriate treatment (Saputri, 2020). Therefore, this review aims to identify Artificial Intelligence Applications in home care services for DM patients during the COVID-19 pandemic.

Research Method

A narrative review was conducted to answer research questions. Searching strategy using databases, such as PubMed, Science Direct, and EBSCO. The keywords were based on MeSH, namely artificial intelligence, diabetes mellitus, and telemedicine. These keywords were combined using boolean operators so that it becomes ((Artificial Intelligence) AND (Diabetes Mellitus)) AND (Telemedicine). Articles were selected using criteria, namely Publication year was around 2016-2021, articles were written in English, full text, and open access. The duplicated articles, articles reviewed and do not fit the research topic were excluded. Figure 1 shows the article selection process.

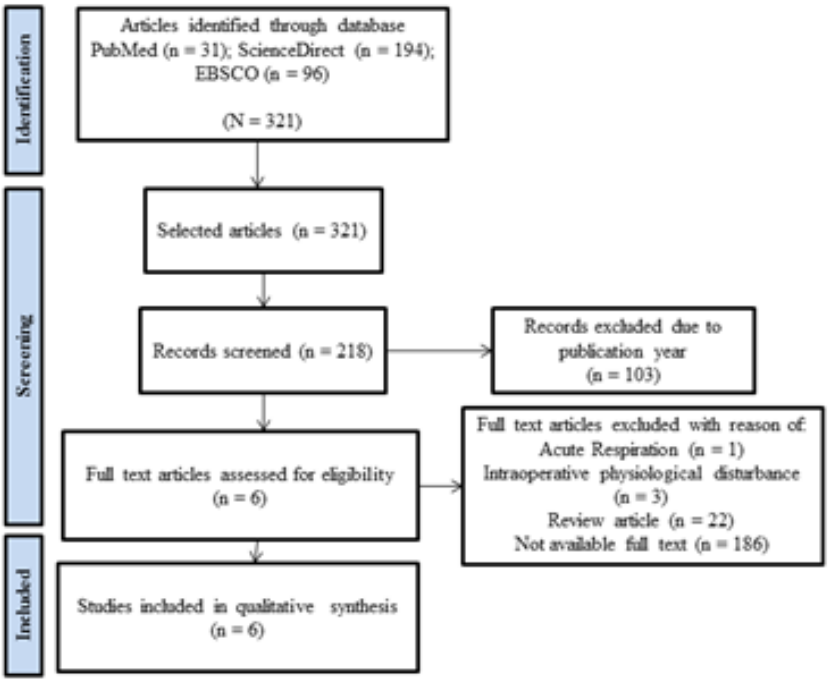

Figure 1. The Flowchart of articles selection process

The narrative review includes a summary, critical analysis, and does not have a specific analytical method (Paré et al., 2016). Therefore, the included articles were only summarized and critically analyzed for time efficiency.

Results

Six articles met the criteria, these articles are original articles that were researched in America, Germany, Israel, Hong Kong (n = 4); and India (n = 2). The majority of the methods used in the findings article are randomized controlled trials. The samples range from 24 to 900 participants. Based on the articles, we found that diabetic retinopathy screening, blood glucose monitoring, lifestyle management programs, and insulin therapy guidelines are the major themes that will be discussed in this review.

Table 1. Characteristic of sample articles

Researcher	Objective	Methods	Artificial Intelligence Application	Sample	Findings
Marc et al., 2018. Virginia, USA	to identify the effectiveness of the Decision support system (DSS) on glucose variability (GV) and glucose monitoring was assessed using continuous glucose monitoring (CGM).	Randomized experimental control	Decision support system on blood glucose variability	24 subjects with type 1 diabetes mellitus (T1DM), total daily insulin dose (TDI) 46.7±22.3U, with carbohydrate counting with usual care or with a decision support system (DSS). DSS consists of a combination of automatic titration of insulin, bolus calculations, and treatment suggestions based on the recommendation of high carbohydrate (CHO) The	Using a decision support system (DSS) significantly reduced glucose variability by (coefficient of variation: 0.36±08. vs. 0.33±0.06, P=0.045) while maintaining glycemic control (mean CGM: 155.2±27.1mg/Dl and reducing hypoglycemia
Sosale et al., 2019. India The	to evaluate Smartphones with Artificial Intelligence (AI) algorithms in the diagnosis of diabetic retinopathy	Cross-sectional study	Diabetic retinopathy diagnosis	900 people with diabetes mellitus	Technology Artificial Intelligence (AI) has high sensitivity and specificity in detecting Referable diabetic retinopathy (RDR) using Remidio non-mydriatic (RN) retinal images.
Natarajan et al., 2019. India	to evaluate the performance of Artificial Intelligence (AI), with a smartphone, in analyzing Automated retinal images, to detect reference diabetic retinopathy (RDR)	Cross-sectional study	Diabetic retinopathy screening	213 patients were analyzed for assessment of diabetic retinopathy(RDR) uses Artificial Intelligence (AI)	System Artificial Intelligence (AI) in the screening of diabetic retinopathy can be done with a fundus camera-based smartphone. And the use of Artificial Intelligence allows screening for diabetic retinopathy (RDR) references.
Katja Von Storch et al., 2019. Germany The	to evaluate the effect on glycated hemoglobin (HbA1c) values and self-management behavior of self-medication with a telemedicine program in patients with Type 2 DM.	Randomized prospective study	Management of lifestyle	60 patients in the intervention group telemedicine and 55 in the control group. The intervention group was given a tablet computer, glucometer, and step counter and received telephone coaching to overcome and increase motivation for diabetes self-management in daily life. The control group did not receive any additional treatment.	The result from the intervention group was a significantly greater decrease in HbA1c in the telemedicine group with HbA1c values, F (1.14) = 11.2, P = 0.001. In addition, the telemedicine group showed significant improvement in the Diabetes Self-Management scale score and body mass index with, P=0.01, gp2=0.107 compared to the usual care group.

Revital et al., 2020. Israel The	to test insulin dosing guided by an-guided insulin Artificial Intelligence - Decision support system whether (DSS) was as effective and safe as a doctor in changing glucose levels.	Randomized controlled trial	Guided insulin administration	108 participants with type 1 diabetes, aged 10-21 years and taking insulin pump therapy. Participants were randomized 1:1 to receive remote insulin doses every three weeks with the AI-DSS system, (AI-DSS, n = 54) and direct insulin administration by medical personnel (n = 54).	Results for primary efficacy measures percentage time within the target glucose range (70–180 mg dl−1 (3.9–10.0 mmol l−1)) and severe diabetes-related adverse events (severe hypoglycemia, diabetic ketoacidosis) did not occur in the group. Ar
Calvin et al., 2020. Hong Kong	to test the effectiveness and safety of Technological surrogate nursing (TSN) and Artificial Intelligence (AI) in type 2 diabetes patients with hypertension.	Randomized Controlled Trial	Monitor Blood pressure diabetes mellitus	299 patients were randomized to either the intervention group (n=151) or the control group (n=148).	Statistically significant results which di demonstrated the effectiveness of Technological surrogate nursing (TSN) in changing hemoglobin 1c in the control group and the intervention group.

Discussion

Application of artificial intelligence in home care services for diabetes mellitus patients during the Covid-19 pandemic has various features for treating diabetes mellitus patients. This review revealed that various features. For monitoring, Blood glucose monitor through artificial intelligence plays a role in diabetes management (Hadiyoso, 2019). According to the research of Or Ck et al., (2020) Artificial Intelligence (AI) can monitor blood pressure and blood glucose simultaneously connected to bluetooth, then the results in the data analysis system are presented in tables and structured charts on the application screen (Or et al., 2020). Then also in the research of Breton Marc et al., (2018) In the application of artificial intelligence according to the results, text-and-based learning resources are provided video related to the causes and prevention of diabetes mellitus and hypertension. Supported by audio that serves to guide and be a reminder of actions at a predetermined time in the next program (Breton et al., 2018). During the Covid-19 pandemic, diabetes mellitus patients took blood sugar measurements using applications of artificial intelligence through telemedicine services which were then guided by telephone to take measurements and recommendations for storing glucose stocks such as glucose D as energy drinks during quarantine and limited access to health services (Banerjee et al., 2020).

Diabetic retinopathy screening is diabetic retinopathy is a retinal disorder in patients with diabetes mellitus that causes screening by glucose reduction, which causes damage to the retinal blood vessel endothelium. Diabetic retinopathy characterizes microaneurysm, as well as bleeding in the retinal blood vessels, and usually, there is an abnormal growth of blood vessels (neovascularization) (Erlvira & Suryawijaya, 2019). Features of artificial intelligence for the occurrence of complications of diabetic retinopathy can be used as early diagnostic screening that can be used in people with diabetes mellitus. According to the research of Natarajan et al., (2019) based fundus cameras Smartphone applications, artificial intelligence has a positive impact on screening for vision-threatening complications because of diabetes. In diabetic patients during the pandemic, it is very important to control diabetes and the form of complications in diabetics that can be accessed from home (Natarajan et al., 2019). Then based on the research of Sosale et al., (2020) System is Artificial Intelligence carried out with offline AI Algorithms on smartphones, where the results are displayed in images from the retina display. Then the image is uploaded to a service cloud hosted by Web Services (AWS) provided by the manufacturer or an application that cooperates with an application that supports systems artificial intelligence,

the results in diagnosing according to the level of complications are provided in the application, then in patients with a higher level of diagnosis results screening are at risk it is recommended in the application contact the nearest health service (Sosale et al., 2020). In line with the research of Natarajan et al., (2019) The advantages of automated analysis algorithms in using screening can also be used offline on smartphones and do not require internet access to send images (Natarajan et al., 2019). Then, in real-time, the results of the screening are given to the patient.

Lifestyle management program, based on the research of Storch Von et al., (2019) The important goals of treatment in diabetic patients are pre-prevention or delay of complications and maintenance of the quality of life. System Artificial intelligence in the quality's influence of the life of diabetic patients with a program of increasing daily physical activity to compensate for the lifestyle (Von Storch et al., 2019). Physical activity programs that can be carried out during the Covid-19 pandemic quarantine by doing 60 minutes of physical activity/day are divided into aerobic activities, activities related to daily homework, and muscle-strengthening activities (Banerjee et al., 2020). According to research in Indonesia by Kusnanto et al., (2019) System, Artificial Intelligence with calendar-app guides, self-care services, exercise, diet, health plans, and stress management (Kusnanto et al., 2019) . Diet in patients with diabetes mellitus by targeting a dietary pattern program with fruits and sodium intake and carbohydrate consumption of 64.1% of total dietary energy during a pandemic has been shown to improve the quality of diet in people with diabetes mellitus (Banerjee et al., 2020) . This program is useful in increasing the prevention of diabetes mellitus patients against cardiovascular complications and all complications that cause death in diabetic patients.

Free insulin therapy, system digital support can be useful in facilitating the administration of insulin injection therapy in diabetes patients. Home care according to research by Nimri et al., (2020) applications Artificial intelligence facilitates timely and more frequent insulin administration, as well as director remote, does change guidelines, as well as guidelines for injecting insulin with services home care, which are beneficial in the care of diabetic patients during a pandemic. By improving individual glycemic control in diabetics (Nimri et al., 2020). According to Breton Marc et al., (2018), insulin dose change in the application of systems Artificial Intelligence by health professionals between direct visits using data downloaded from the device has been shown to improve glycemic control (Breton et al., 2018).

Conclusion

The application of Artificial Intelligence in home care services for diabetics has several programs to support the goals of managing diabetes mellitus during a pandemic. There are diabetes retinopathy screening programs, blood glucose monitoring, lifestyle management programs, and insulin therapy guidelines that researchers have reported on. Some of these technology-based services can be applied go to home care services for diabetes mellitus patients during the Covid-19 pandemic.

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