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RESEARCH ARTICLE
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Effectiveness of Using Telemedicine in Type 1 Diabetes Patients During the COVID-19 Pandemic

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ABSTRACT

The COVID-19 pandemic has had a major impact on people with comorbid conditions. Routine examination of patients with chronic diseases such as diabetes has become a challenge during the COVID-19 pandemic. Telemedicine is an effective way to provide health services to diabetic patients, so that this motivates researchers to develop this study aims to explore accurate evidence regarding the effect or effectiveness of using telemedicine in type 1 diabetes patients in the COVID-19 era. This study used a systematic review with the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) method without meta-analysis. The articles used in this study were articles in the Scopus, ProQuest, and ScienceDirect databases; search using the keywords "Effectiveness AND Telemedicine OR Telehealth AND Diabetes Type 1 AND COVID-19". The use of the telemedicine method for type 1 diabetes patients during the COVID-19 pandemic allows the provision of consultations and health checks through online communication media. Technological advances and the development of new devices will increase the ease between patients and health workers in exchanging information, and the use of telemedicine is the right choice during a pandemic to limit mobility and interaction to health facilities.

Keywords: COVID-19; diabetes; telemedicine; telehealth

INTRODUCTION

Corona Virus Disease 2019 (COVID-19) is caused by a disease of the coronavirus known as SARS-CoV-2. The World Health Organization (WHO) first discovered a new variant of the coronavirus in Wuhan, China, on December 31, 2019, and spread rapidly throughout the world, including Indonesia. On January 30, 2020, WHO declared COVID-19 a global health emergency.(1) Based on data from WHO, the total number of cases reported up to May 4, 2021, has contributed 151,812,556 cases and 3,186,817 deaths worldwide.(2) While in Indonesia, as of October 5, 2021, the number of people affected by the COVID-19 virus is increasing, reaching 4,221,610 confirmed infected with COVID-19 and 142,338 people dying.(3)

COVID-19 is a virus that is contagious and can spread from human to human through respiratory secretions so that the right steps to reduce the transmission of the COVID-19 virus are by imposing a lockdown both locally and nationally, reducing national and international travel, closing school activities, and reducing outpatient visits directly to the hospital.(4) The COVID-19 pandemic applies health protocols to the public to maintain distance and limit outdoor activities. The government also urges the public to reduce visits to health facilities.(5) Therefore, the pandemic has encouraged the adaptation of new habits in society by determining how to provide health services.(6)

Telemedicine is a management based on modern information and communication technology to provide convenience for medical staff and health facilities to provide health services, such as education about lifestyle, treatment, and assisting patients in dealing with their illness, to provide remote health services.(7) Based on study results, telemedicine was found to reduce HbA1c by 0.18% (95% CI: 0.04-0.33; p = 0.01) at the end of the intervention.(8) A study conducted by Mishra Mitali et al. in 2021 found that telemedicine is an effective way to provide health services to diabetic patients, such as providing education related to diabetes and administering insulin via video calls, voice calls, chat, and educational videos. Several previous studies also say that health services, especially diabetes through telemedicine, get comprehensive results with face-to-face health services.(9)

The COVID-19 pandemic has had a major impact on people with comorbid conditions. Diabetes is a comorbid disease in the second (9.7%) after cardiovascular disorders (12.5%). In 2019, the International Diabetes Federation (IDF) reported that as many as 465 million (9.3) were diagnosed with diabetes, and by 2045, it is predicted that this will increase to 700 million. As many as 79% of people with diabetes living with lower middle income countries.[10] Routine examination of patients with chronic diseases such as diabetes has become a challenge during the COVID-19 pandemic. The government has implemented several regulations and strategies to provide adequate assistance to avoid the severity of the disease. Diabetic patients are advised to follow general guidelines to reduce the risk of infection, monitor blood glucose, take medication, and maintain a healthy lifestyle.[11]

Based on the literature review, several scientific studies conducted research on the possibilities of telemedicine in diabetes treatment, but scientific evidence is limited for type 1 diabetes patients compared to type 2 diabetes patients. So that this motivates researchers to develop this study aims to explore accurate evidence regarding the effect or effectiveness of using telemedicine in type 1 diabetes patients in the COVID-19 era, and that can be provided an overview of health services through telemedicine in type 1 diabetes patients in the era of COVID-19.

METHODS

This study used a systematic review with the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) method without meta-analysis, which was carried out systematically by following the stages of the research according to the procedure. The articles used in this study were articles in the Scopus, ProQuest, and ScienceDirect databases; search by keywords "Effectiveness AND Telemedicine OR Telehealth AND Diabetes Type 1 AND COVID-19". Scopus online database screening used the following format: title-abs-key (effectiveness AND telemedicine OR telehealth AND type 1 diabetes AND COVID-19) AND (limit-to (oa, "all")) AND (limit-to (language, "English")) AND (limit-to (pubyear, 2021)) AND (limit-to (doctype), "ar")) AND (limit-to (exactkeyword, "Telemedicine")). Proquest's online database screening uses the following formats: Scholarly Journals, Last 12 Months, Keyword Telemedicine and COVID-19, Article, English. Science Direct's online database screening uses the format: Scholarly Journals, 2021, Research Article.

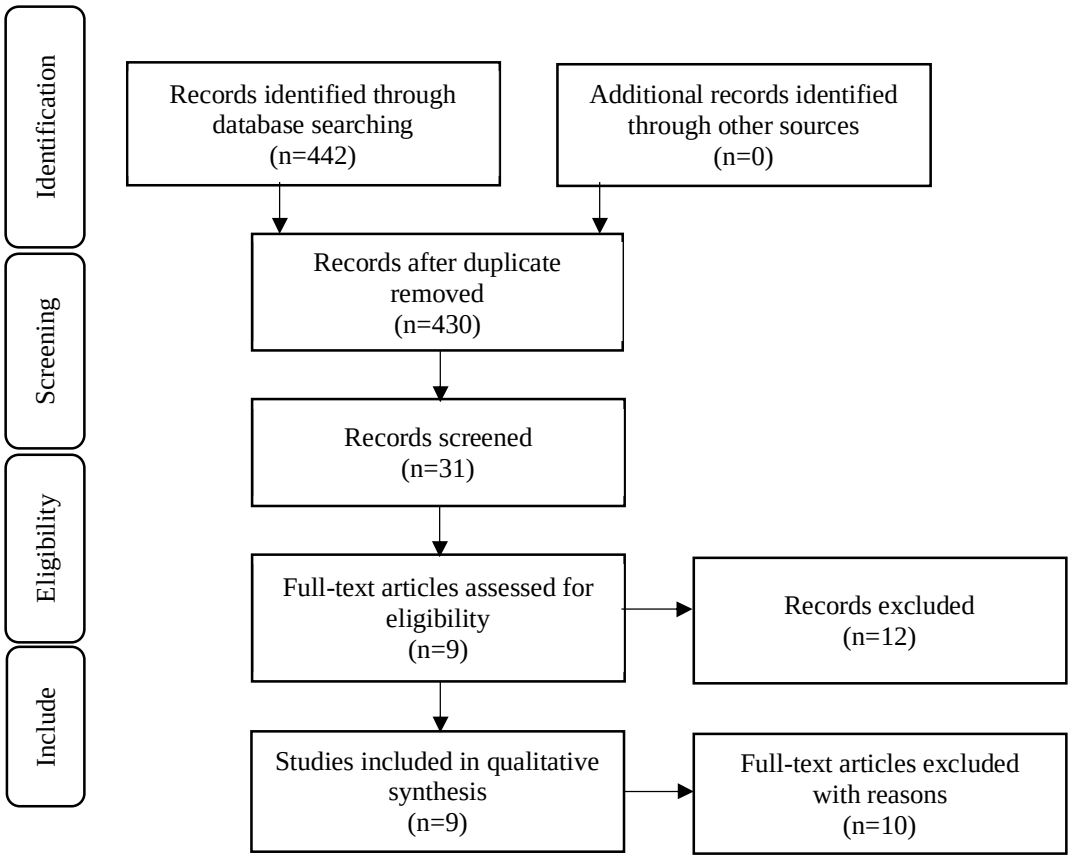

Figure 1. Systematic review steps

The article was filtered by checking for duplicate articles; then check the title to prevent differences in the topics that had been determined. After checking the title, the next step was to read the abstract and full-text article.

The next step was to synthesize the inclusion and exclusion criteria in the article. The inclusion criteria in this study were patients with type 1 diabetes and articles published in 2021, accessible in full text and English. The exclusion criteria were research journals that are not in accordance with the topic of effectiveness telemedicine or telehealth in people with type 1 diabetes during the pandemic. The next step was to extract data by determining the research questions, objectives, and information relevant to the PICOS.

RESULTS

The search results for articles using the keywords "Effectiveness AND Telemedicine OR Telehealth AND Diabetes Type 1 AND COVID-19" obtained 442 articles (ProQuest 227 articles, Scopus 97 articles, and ScienceDirect 118 articles). The articles were then filtered, 9 articles according to the eligibility criteria. The articles that corresponding the systematic review were then analyzed based on the author's name, year of publication, research location, study design, and research results.

Most of the studies used a quantitative retrospective design to explain the effectiveness of telemedicine in type 1 diabetes patients during the pandemic. The study using a quantitative retrospective design, divided the respondents into two groups based on the date of the telemedicine visit. The division was performed to exclude an impact on glycemic control associated with the lockdown. The evaluation was carried out separately on respondents who lived during the second lockdown period, before and after telemedicine. This group had similar improvements in glycemic control with a decrease in mean glucose from 160.2 to 154.4, an increase in time in range from 64.1 to 67.1, and a reduced in time spent in *hyperglycemia*.

While the study used a prospective cohort observed a significantly lower proportion of the use of *Continuous Glucose Monitoring* (CGM) and *Continuous Subcutaneous Insulin Infusion* (CSII) in respondents who were not included in the study compared to respondents who completed the research. Time in range increased significantly from the first virtual visit to the second virtual visit. This increase was seen among respondents using a traditional meter and continuous glucose monitoring, and in those with a continuous glucose monitoring of 7.5% than in those with a continuous glucose monitoring of <7.5%.

Table 1. Article search results

No	Author, year	Location	Study design	Results
1	(Parise Martina et al., 2021)	Italy	Prospective observational study	The COVID-19 lockdown period has provided an opportunity to use telemedicine as the front line in treating diabetes. Advances in technology will facilitate the exchange of health information between patients, health workers, and health facilities.[11]
2	(Scott Sam N. et al., 2021)	Europe, North America, South America, Oceania, Africa and Asia	Quantitative study	As many as 28% of patients with type 1 diabetes received telemedicine examinations via telephone and video calls. Of these, 86% said telemedicine was helpful and 75% plan to continue using telemedicine in the future. Glucose control examination (HbA1c) was positively associated with positive perceptions of telemedicine.[12]
3	(Lee Joyce M. et al., 2021)	United States	Quantitative study	The proportion of telemedicine use in T1DX-QI has increased during the COVID-19 pandemic. Most clinics (62%) conduct health monitoring via the Zoom platform.[13]
4	(Zabeen Bedowra et al., 2021)	Bangladesh	Quantitative study	During the COVID-19 crisis in Bangladesh, type 1 diabetes patients who use insulin pumps can perform Ramadan fasting with the support of telemedicine services by health workers.[14]
5	(Boscari Federico et al., 2021)	Italy	Monocentric observational retrospective study	After using telemedicine for 4 weeks, there was an increase in glycemic control. Structured telemedicine services include discussing glycemic data and providing advice that has a positive impact on glycemic control in type 1 diabetes patients.[15]
6	(Gómez Ana M. et al., 2021)	Colombia	Prospective observational cohort study	The use of the Hybrid Closed-Loop (HCL) system allows type 1 diabetes patients to increase their Time in Range (TIR) and reduce glycemic variability.[16]
7	(Vigersky Robert A. et al., 2021)	United States	Retrospective study	The results of the Continuous Glucose Monitoring (CGM) matrix can be compared between before and during the pandemic. Using the Zoom application has a patient satisfaction of 98%. Virtual training of type 1

No	Author, year	Location	Study design	Results
				diabetic patients on the Minimed 670G system resulted in high satisfaction and comparable short-term glycemic results carried out face-to-face.[17]
8	(Magliah Sultan F. et al., 2021)	Saudi Arabia	Cross-sectional study	A total of 59.2% of patients were satisfied with the examination experience using telemedicine and had a high preference for continuing to use telemedicine.[18]
9	(Salabelle Claire et al., 2021)	France	Observational study	There was a significant improvement in glucose control and self-monitoring in adolescents and young adults with type 1 diabetes during the COVID-19 lockdown period in France.[19]

DISCUSSION

This study suggests that telemedicine may have a role in the glycemic management of type 1 diabetes patients, particularly in adults. Several studies have been conducted to determine the effectiveness of using telemedicine in patients with type 1 diabetes. Study conducted by Boscari Federico et al. in 71 type 1 diabetic patients with a mean metabolic control of 7.5% HbA1c. In this study, researchers analyzed data from a *Continuous Glucose Monitoring* (CGM) system and compared the data obtained four weeks before and four weeks after regular telephone visits. The variables used in this study were average glucose levels, time in range (70-180 mg/dl), *hypoglycemia* (<70 mg/dl), *hyperglycemia* (>180 mg/dl), coefficient of variation, and duration of use. The results obtained were an increase in glycemic control, a decrease in the average glucose value, an increase in time spent in target, and a reduction in *hyperglycemia* time after four weeks of regular telephone visits. This study concludes that telemedicine and regular telephone visits effectively monitor health in type 1 diabetic patients during the pandemic.[15]

The glycemic control monitoring study is the same as the study conducted by Salabelle Claire et al. in 77 patients aged 13-25 years with a diagnosis of type 1 diabetes over one year and undergoing continuous glucose monitoring. In this study, there was an increase in glucose control and health monitoring during the COVID-19 lockdown. In fact, in patients who previously did not perform glycemic control showed a greater improvement.[19]

Another study related to monitoring type 1 diabetes patients via telemedicine was also conducted in Colombia on 91 patients. All patients underwent a *Hybrid Closed Loop* (HCL) training program under the guidance of specialist doctors, education and nutrition teams. The number of virtual meetings depends on basic therapy, and there are additional meetings about carbohydrate calculations and the basic concepts of continuous glucose monitoring carried out through the Zoom application. The study showed that using a HCL training program helped type 1 diabetes patients increase time in range and reduce glycemic variability. Virtual training supports doctors in providing health education and is the right choice during the COVID-19 lockdown.[16]

Objectively, we cannot deny that telemedicine is an effective solution for currently unstable health services and provides opportunities for developing telemedicine.[20] There is a change in telehealth policy. Such effort to disseminate information and implement telehealth to the entire community needs to be continuously carried out to improve health. The policy of the telemedicine service system is expected to be a long-term health care provider. The development of regulations and policies on digital health solutions has been recommended to the government and policymakers.[21] Based on the studies reviewed above, it can be said that telemedicine is an effective service for type 1 diabetes patients during the pandemic. Through telemedicine, patients can be protected from COVID-19 infection because they limit visits to hospitals or clinics, and take continuous diabetes treatment.[22]

The limitation of this study is the evaluation was carried out only on patients who used telemedicine for continuous blood glucose monitoring and excluded type 1 diabetes patients who did not use data sharing platforms.[15] Telemedicine usage surveys are only given to respondents who have internet access, thus allowing for bias in data collection.[18] Considering such a limitation, aspects that can be considered for investigations in future studies are there are programs to help patients with limited internet access and resources that can help researchers see the bigger picture of telemedicine use without bias. Future studies should monitor and evaluate the use of telemedicine in the long term to provide follow-up to policymakers in diabetes management during the pandemic.

CONCLUSION

The COVID-19 pandemic has prompted an increase in the use of telemedicine in providing health services. The use of the telemedicine method for type 1 diabetes patients during the pandemic allows the provision of consultations and health checks through online communication media. Technological advances and the development of new devices will increase the ease between patients and health workers in exchanging information, and the use of telemedicine is the right choice during a pandemic to limit mobility and interaction to health facilities.

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