

# Application of telenursing as a nursing care delivery model in improving treatment adherence and glycemic control: A scoping review

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## Abstract

**Background:** Diabetes mellitus is one of the chronic diseases that cause the highest mortality and high medical costs; therefore medication adherence and glycemic control are important in disease management, one of which is through telenursing.

**Purpose:** To determine the telenursing model to improve medication adherence and glycemic control in patients with type 2 diabetes mellitus.

**Methods:** This study was designed a scoping review. The databases used are CINAHL, PubMed, ScienceDirect and Google Scholar. Articles published from 2016-2022 with appropriate inclusion and exclusion criteria. Thematic analysis was used based on study design, telenursing communication model, telenursing process, duration of telenursing and results.

**Results:** There were 12 relevant articles out of 2112 articles. We found a telephone call follow up is the most common method used for delivery of telenursing intervention. Telenursing intervention is implemented from at least 3 months until 12 months, and includes the assessment of current disease conditions, assessment of adherence to the prescribed treatment plan, treatment plan information, and solutions or follow-up to current issue.

**Conclusion:** Telenursing can be used as a nursing care delivery model in the diabetes mellitus type 2 patients because it is proven to reduce glycemic control, improve treatment adherence, reduce body mass index (BMI), glycosylated hemoglobin (HbA1c), and cholesterol, and improve diet adherence, physical exercise and self-management.

**Keywords:** diabetes mellitus; glycemic control; telenursing; treatment adherence

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## Introduction

Chronic illness is defined as a condition that lasts a year or more and requires ongoing medical attention or requires restriction of activities of daily living or both. At the global level, chronic diseases are the cause of death as much as 63% with 36 million deaths every year (Anderson & Durstine, 2019). There is also an increase in chronic diseases in Indonesia, both in terms of morbidity and mortality. More than 80% of deaths are caused by cardiovascular disease and diabetes (Ministry of Health of the Republic of Indonesia, 2018). Basic Health Research shows that of the 10 highest causes of death, six of them are caused by chronic diseases, among which are hypertension and diabetes mellitus, which causes 44% (Ministry of Health of Republic Indonesia, 2017a). This description clearly shows that non-communicable diseases have become the main cause of death in Indonesia (Ministry of Health of Republic Indonesia, 2017a).

Treatment adherence of patients with chronic diseases is important because the disease cannot be cured and must always be controlled so that complications do not occur that cause death. According to the April 2015

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World Economic Forum publication, potential losses due to non-communicable diseases in Indonesia in the 2012-2030 period are predicted to reach US\$ 4.47 trillion, or 5.1 times GDP in 2012. The economic burden of non-communicable diseases can also be seen from Social Security Organizing Agency data which shows that INA-CBGs claims for the January-July 2014 period reached around Rp. 3.4 trillion for outpatient cases and around Rp. 12.6 trillion for inpatient cases (Ministry of Health of Republic Indonesia, 2017b).

Methods to improve compliance and nursing services in handling chronic diseases to achieve patient welfare can be done through telenursing. Telenursing in utilizing information and communication technology in providing nursing care to chronic patients can help patients control and manage their illness. The treatment model on telenursing through long-distance communication and information technology can minimize medical costs. The interventions provided in the implementation of telenursing are health education, health monitoring and health consultation (Ghoulami-Shilsari & Esmailpour Bandboni, 2019).

In recent years, research on the effectiveness of telenursing in providing care to chronic patients has been carried out with positive results. Telenursing has the potential to revolutionize healthcare delivery by increasing access for patients with chronic diseases, reducing healthcare costs, and increasing efficiency. Telenursing has advantages in providing interventions for patients with chronic diseases, such as making communication between patients and health workers more efficient, and telenursing more acceptable in intervening patients with chronic diseases at home on a regular basis (Ghoulami-Shilsari & Esmailpour Bandboni, 2019). Research

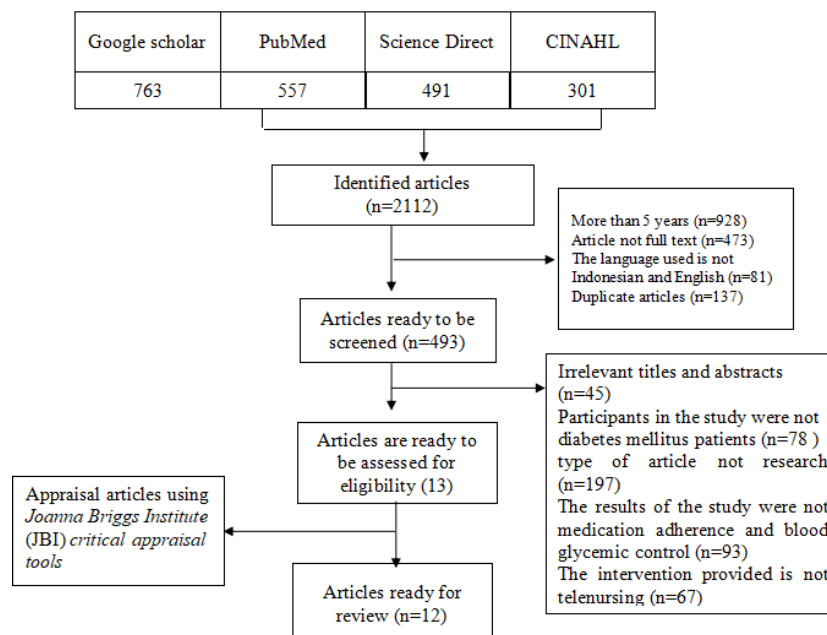
by Shahsavari and Bavarsad (2020) about the effectiveness of telenursing in the control of BMI and HbA1c in type 2 diabetes patients in Iran showed that telenursing can improve adherence to treatment programs and have a beneficial effect on HbA1c and BMI in type 2 diabetes patients (Shahsavari & Bakhshandeh Bavarsad, 2020). Research by Yulianti and Rayasari (2016) in Indonesia shows that telenursing has an effect on reducing fasting blood sugar in type 2 DM patients. Another similar study showed that health education through telenursing for 12 weeks showed significant improvements in glycemic control, metabolic parameters and adherence to diabetes medication (Mohamed et al., 2016).

The various benefits of using telenursing have been explained above, but no one has explained what kind of telenursing model is right for improving medication adherence and blood sugar control. Therefore, the researchers feel it is important to identify a telenursing model that can be applied to healthcare settings to improve medication adherence and blood sugar control in patients with type 2 diabetes.

## Methods

### Research design

This study was designed using Arksey and O'Malley's scoping review framework. The framework consists of six stages: (a) defining the research question; (b) identifying relevant studies or search strategy; (c) selecting studies; (d) charting the data and assessing the quality of studies included; (e) collating, summarizing, and reporting the data; and (f) consultation (Arksey & O'Malley, 2005).

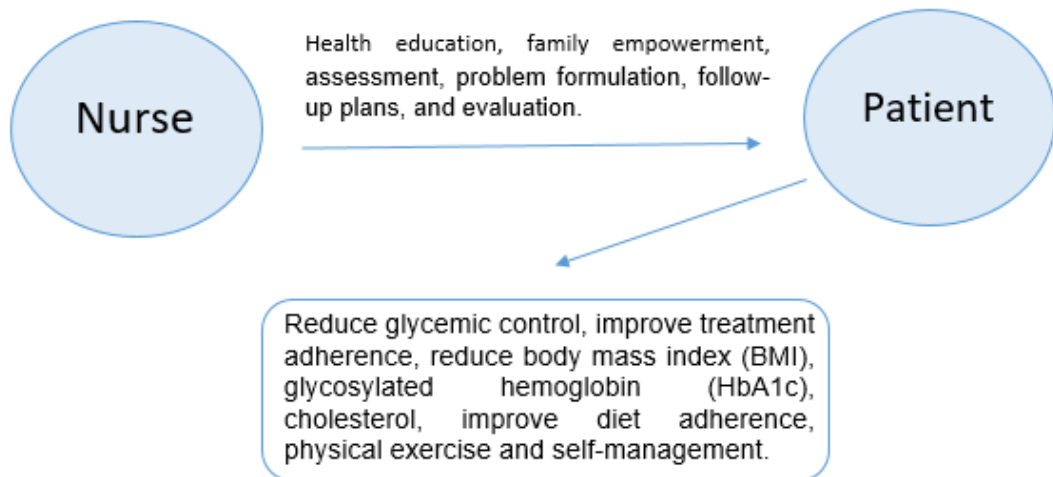


**Table 1. Data Extraction of The Telenursing Communication Model to Improve Medication Adherence And Glycemic Control**

Author/ Year	Sample	Location	Study design	Result
Shahsavari and Bavarsad (2020)	60 type 2 diabetes mellitus patients	lorestan, iran	Randomized controlled trial	The results showed that telenursing via telephone calls led by nurses could significantly reduce BMI and hba1c in the intervention group in type 2 diabetes mellitus patients who were illiterate and aged 50 years and over.
Mo-hamed et al., (2016)	60 type 2 diabetes mellitus patients	Egypt	Quasi experimental design	The results showed that the health education intervention given by telephone call for 12 weeks by nurses showed significant improvements in glycemic control, metabolic parameters and adherence to diabetes treatment regimens.
Yasmin et al. (2020)	320 type 2 diabetes mellitus patients	Bangladesh	A mixed-method, sequential explanatory design	Significant improvements in patient adherence to diet, physical exercise, tobacco cessation and blood glycemic control were found in the intervention group. Cost and other co-morbidities were found to be the main reasons for non-adherence.
Shahabi et al. (2022)	60 type 2 diabetes mellitus patients	Irans	A randomized clinical trial	After telenursing intervention and family empowerment, the adherence score increased significantly. The results showed a positive effect of a family-centered empowerment pattern used follow-up telephone calls on improving adherence to dietary regimens in patients.
Patimah et al. (2019)	32 diabetes mellitus pasien	Indonesia	Quasi eksperimen with control group pre and post test design	The results showed that there was a significant effect between telenursing (follow-up via telephone) and fasting blood sugar. The telenursing program also affects the dynamic behavior change process based on the awareness of type 2 diabetes mellitus patients to seek a healthy and quality life
Iljaz et al. (2017)	120 diabetes mellitus patients	Slovenia	Randomized controlled trial	The results showed that there was a significant decrease in Hba1c and blood pressure. The involvement of diabetic patients in web-based interventions has only a temporary impact on their functional health status.
Nelson et al. (2016)	80 diabetes mellitus patients		Quasi eksperimental	The results showed that adherence to treatment increased in the first and second months, but in the third month there was no difference in the control group and the intervention group. The results of the HbA1c measurement showed a stable value at three months and did not show any difference between the intervention group and the control group.
Li et al. (2021)	124 cchronic disease (included diabetes mellitus patient)	Australia	Randomised controlled trial	The results showed that the HbA1c value in the intervention group experienced a greater decrease when compared to the control group
Owolabi et al. (2019)	216 diabetes mellitus patients	South Africa	Randomised controlled trial design	The results showed that participants in the intervention group experienced an increase in adherence at the second, third and 12th months. The probability of HbA1c was 6.5% greater in the Perx group at months 9 and 12 and cholesterol (low density lipoprotein cholesterol and total) was lower in the Perx group at month 3. This intervention is very effective for those who are obese, taking medication for diabetes and taking 4 medications

**Cont. Table 1. Data Extraction of The Telenursing Communication Model to Improve Medication Adherence And Glycemic Control**

Author/ Year	Sample	Location	Study design	Result
Wild et al. (2016)	321 diabetes mellitus patizents	United Kingdom	Randomised controlled trial	The results of the study showed that both groups experienced an increase in blood glucose levels, but the intervention group had no significant effect, the adjusted mean change in blood glucose was 0.26 (-0.81 to 1.32), p = 0.634. The intervention group also had no significant effect on body weight, body mass index, systolic and diastolic blood pressure. Almost all participants (90.74%) were happy with the intervention and found it helpful.
Pichay-apinyo et al. (2019)	6 nurse dan 35 diabetes mellitus patients	Thailand	Randomized clinical trial	The results showed that the intervention group had significantly better control of diabetes and blood pressure than those on treatment as usual and that telemonitoring did not make a significant difference in the patients' body weight. Patients reported reduced carbohydrate intake, increased physical activity, increased medication adherence, improved sleep quality, and more frequent foot care. Patients and nurses both recommended the use of the intervention, although nurses reported an increase in workload.
Huo et al. (2019)	502 patients with both coronary heart disease and diabetes mellitus	China	Randomized clinical trial	The results showed that a text message intervention resulted in better glycemic control in patients with diabetes mellitus and coronary heart disease. While the mechanism of this benefit remains to be determined, the results suggest that a simple, culturally sensitive mobile text messaging program may provide an effective and feasible way to improve disease self-management.



**Figure 1. Telenursing as A Nursing Care Delivery Model**

## Search methods

The literature search method uses an electronic database, are as follows PubMed, ScienceDirect, Cinahl and Google Scholar. The author formulated the article search keywords using Boolean operators and phrase operators (OR and AND) to specify the search. Keywords adapted to Medical Subject Heading (MESH) are as follows: diabetes mellitus type 2 OR diabetes mellitus AND telenursing OR telemedicine OR telehealth AND treatment adherence OR therapeutic adherence and compliance OR adherence OR therapeutic AND glycemic control OR blood glucose control.

## Inclusion and exclusion criteria

The inclusion and exclusion criteria in this study are based on the Participants/populations, Concept, and Context (PCC) framework. The inclusion criteria are the participants of type 2 DM patients, the concept used is telenursing, the contexts measured are medication adherence and glycemic control, articles sourced from the literature are clear and indexed, articles in English and Indonesian are full text and types of research articles. The exclusion criteria were the types of review articles, editorials, commentaries, letters to editors (LTE), and textbooks.

## Screening of articles

The first author (YW) filtered articles by title, abstract, publication years and language after removing duplicates. Full-text articles were then screened for their eligibility based on the inclusion and exclusion criteria. All studies were consulted with the second (MK) and third authors (IR).

## Data charting

Data were charted into a table to summarize the finding for the narrative result of this scoping review (Table 1). The first author (YW) extracted data on inclusion and exclusion criteria and identified the association of telenursing with medication adherence and glycemic control. The second and third authors (MK and IR) provided input and suggestions for which articles to be included or excluded from the review.

## Data analysis

We gathered and charted the following information: characteristics of the selected studies, telenursing communication model, telenursing process, the effectiveness of telenursing in improving medication adherence and glycemic control based on the selected article. Information about the factors that influence the successful implementation of telenursing was taken from the discussion and limitations sections of the manuscripts that were taken and underwent thematic analysis. After carrying out selection, analysis, and validation, we mapped and presented it in table format in Microsoft Excel 2016.

## Results

Based on 12 relevant articles from the selection results, the following table includes data that have been categorized based on author, sample, research location, study design, and results.

### Characteristics of the selected studies

There are 12 relevant articles from 2112 articles from 2016-2022, with the research design being five articles using randomized control trial (Iljaz et al., 2017; Li et al., 2021; Owolabi et al., 2019; Shahsavari & Bavarsad, 2020; Wild et al., 2016), three articles using quasi-experimental (Mohamed et al., 2016; Nelson et al., 2016; Patimah et al., 2019), three articles using randomized clinical trial (Huo et al., 2019; Pichayapinyo et al., 2019; Shahabi et al., 2022) and one article using the mixed method (Yasmin et al., 2020). The total number of participants was 1,930 patients with diabetes mellitus and the research sites were in Iran two articles, Egypt two articles, and on each from Indonesia, Thailand, Australia, China, United Kingdom, South Africa, Bangladesh and Slovenia.

Based on the analysis of the 12 articles, this scoping review describes the telenursing model used to improve medication adherence and blood sugar control in patients with diabetes mellitus. The telenursing models include: 1) telenursing communication model, 2) the process of providing telenursing-based nursing care, and 3) the role of telenursing in improving medication adherence and glycemic control.

### Telenursing communication model

Based on the analysis of the articles, it shows that telephone calls are the most widely used communication model in telenursing. Of the 12 articles reviewed, five articles used telephone calls (Mohamed et al., 2016; Patimah et al., 2019; Shahabi et al., 2022; Shahsavari & Bavarsad, 2020; Yasmin et al., 2020), two articles used text messages (Huo et al., 2019; Vedanthan et al., 2017), one article used a mobile application (Li et al., 2021), one article used a website (Wild et al., 2016), one article used text messages and mobile applications (Iljaz et al., 2017), one article used text messages and phone calls (Yasmin et al., 2020), and one article used Automated Interactive Voice Response (Pichayapinyo et al., 2019).

The telenursing communication model can be grouped into three, namely telephone calls, text messages, and mobile applications and websites. The telephone call communication model is used by research nurses or research assistants to monitor and assess the health of research respondents through scheduled phone calls. Text messages as a model of telenursing communication are given in various ways such as sending automatic messages, one-way text messages and two-way text messages. The telenursing communication model for mobile applications and websites is carried out by means of

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each respondent recording and entering data from the respondent's independent measurements into the application and the data that have been entered into the application will be assessed or followed up by the researcher.

### Telenursing process

In several studies, the nursing care process through telenursing begins with health education and training about diabetes mellitus to all respondents (Mohamed et al., 2016; Patimah et al., 2019; Pichayapinyo et al., 2019; Shahsavari & Bakhshandeh Bavarsad, 2020). In addition, several articles conducted training to use the application and understand the program that would be followed by respondents (Li et al., 2021; Pichayapinyo et al., 2019). After the health education and training were completed, respondents received nursing care through telenursing communication models such as telephone calls, text messages and/or mobile applications and websites.

The telenursing process to improve medication adherence and glycemic control includes assessment, problem formulation, follow-up plans, health education and evaluation. In the assessment, the researcher assessed the respondent's medication adherence to the treatment plan, including exercise, diet and medication (Shahabi et al., 2022; Shahsavari & Bakhshandeh Bavarsad, 2020; Wild et al., 2016), dietary recommendations, walking habits, blood sugar monitoring (Huo et al., 2019; Mohamed et al., 2016; Nelson et al., 2016; Wild et al., 2016), and barriers in implementing treatment adherence (Nelson et al., 2016). Current health problems include symptoms of hypoglycemia and hyperglycemia, diabetes medication adherence, carbohydrate consumption, physical activity, sleep quality, and foot examination (Mohamed et al., 2016; Nelson et al., 2016; Pichayapinyo et al., 2019). Furthermore, after getting the results of the assessment, the researcher formulated the problem and determined a follow-up plan to provide a solution. Health education was also provided by researchers to respondents who participated in the research program. Evaluations for medication adherence and glycemic control were carried out at the end of the study (Huo et al., 2019; Iljaz et al., 2017; Nelson et al., 2016; Owolabi et al., 2019; Shahabi et al., 2022; Yasmin et al., 2020).

The telenursing intervention in this scoping review was carried out between 3–12 months. Telenursing communication model through telephone calls had a frequency of once to twice a week and a call duration of 10-30 minutes, depending on the patient's condition. Scheduled telephone calls were made at the time agreed upon by the respondent and the researcher. The telenursing communication model through text messages was carried out by sending text messages once every 1-2 days and consisted of one-way text messages and two-way text messages given alternately. The contents of the text messages included medication reminders, control schedule reminders, educative messages

about diabetes, motivational messages, and text messages to assess the patient's current condition. Telenursing communication model through mobile media applications and websites involved inputting data from the results of independent measurements by respondents into the application. The input time was adapted to the measurements of each patient, such as reports of taking medication every day, for reporting blood sugar twice a week, for measuring blood pressure and weight once a week and other measurements according to research needs.

### The effectiveness of telenursing in improving medication adherence and glycemic control

The use of telenursing in improving medication adherence and glycemic control in type 2 diabetes mellitus patients has good effectiveness as a model of nursing care. Telenursing is also considered effective for use in patients who have low education, the elderly and even in patients who live in rural areas. Patients and nurses recommend the use of telenursing, although nurses say its use increases the workload. In addition to improving medication adherence and glycemic control, telenursing can also reduce body mass index (Shahsavari & Bakhshandeh Bavarsad, 2020), increase glycemic control (Mohamed et al., 2016; Shahabi et al., 2022), reduce treatment costs and comorbidities (Yasmin et al., 2020), increase family empowerment (Shahabi et al., 2022), increase healthy and quality living behavior (Patimah et al., 2019), improve blood pressure control (Iljaz et al., 2017; Wild et al., 2016), lower cholesterol (Li et al., 2021), and decrease carbohydrate consumption, increase physical activity, and improve sleep quality, and foot care (Wild et al., 2016).

Telenursing communication models that are effective in improving medication adherence and glycemic control are telephone calls given once or twice a week with a duration of 10-30 minutes and text messages given once or twice a day. In this study, the effective duration of telenursing in increasing medication adherence and glycemic control was 3-12 months.

### Discussion

In this scoping review, the authors examined the effectiveness of telenursing as a model of nursing care to improve medication adherence and glycemic control in type 2 diabetes mellitus patients. The results of the scoping review represented that telenursing can be provided through several communication models such as telephone calls, text messages, mobile applications and websites, and can combine the two communication models. Telephone calls are the most widely used telenursing communication model (Vijayalakshmi et al., 2020). The telephone communication model has several advantages such as convenient and fast, wide and unlimited coverage, suitable for urgent cases, no

separate infrastructure is needed, patient privacy is guaranteed and it is real-time interaction. In addition, the telephone communication model in telenursing can increase the involvement of more respondents and can be used easily by all groups, especially those with low levels of education (Schillinger et al., 2008).

Telenursing has been shown to improve medication adherence and glycemic control (Huo et al., 2019; Iljaz et al., 2017; Li et al., 2021; Mohamed et al., 2016; Nelson et al., 2016; Owolabi et al., 2019; Patimah et al., 2019; Pichayapinyo et al., 2019; Shahabi et al., 2022; Shahsavari & Bakhshandeh Bavarsad, 2020; Wild et al., 2016; Yasmin et al., 2020). This is related to the telenursing process as a whole. The telenursing process found in this scoping review is assessment, problem formulation, follow-up plans, health education and evaluation. The assessment phase includes an assessment of the respondent's compliance with the treatment plan, including exercise, medication, diet, physical activity, sugar monitoring, obstacles in implementing medication adherence, and current health problems including symptoms of hypoglycemia and hyperglycemia. Furthermore, in the formulation of the problem, the problem experienced by the respondent will be determined and then a follow-up plan will be designed to provide a solution. The follow-up plan includes self-monitoring of blood sugar, weight monitoring, blood pressure monitoring, insulin injection monitoring, and health education according to patient needs. In the final stage an evaluation for medication adherence and glycemic control will be carried out.

Although telenursing is changing the way in which professional nursing care is delivered over long distances, the fundamentals of nursing practice must still be applied. In delivering telenursing, nurses must continue to carry out the nursing process such as when delivering face-to-face nursing care, and assessment, planning, intervention implementation, evaluation and documentation must still be carried out. All nurses involved in telenursing are responsible for performing nursing care in accordance with applicable standards of practice, code of ethics, laws and policies as is done for face-to-face client care. This means that the quality of care provided through telenursing must be the same as the quality of care provided face-to-face (Nova Scotia College of Nursing, 2022).

The application of telenursing has great potential in increasing nursing access through technology so that it can reach patients more easily. Telenursing can help patients improve self-management through the nurse (Samimi et al., 2018). Patients with diabetes mellitus need more frequent contact with healthcare providers to manage their health problems. The application of telenursing can make it easier for diabetes mellitus patients to contact the health facilities they need. Barriers to complying with treatment programs such as transportation, long waiting times, overcrowded clinics and

uncomfortable waiting areas can be overcome by telenursing.

In addition, the positive effect of telenursing was found to increase medication adherence and glycemic control. Telenursing can also reduce body mass index (Shahsavari & Bakhshandeh Bavarsad, 2020), improve glycemic control (Mohamed et al., 2016; Shahsavari & Bakhshandeh Bavarsad, 2020), reduce medical costs and co-morbidities (Yasmin et al., 2020), increase family empowerment (Shahabi et al., 2022), improve healthy and quality life behavior (Patimah et al., 2019), control blood pressure (Iljaz et al., 2017; Wild et al., 2016), lower cholesterol (Li et al., 2021), reduce carbohydrate consumption, increase physical activity, and improve sleep quality and foot care (Wild et al., 2016).

The use of telenursing technology has many benefits and advantages for various parties, including patients, health workers and the government. The aspect of convenience and increasing reach as well as reducing costs are advantages that can be seen directly (Sharma, 2014). Nurses' skills and knowledge about communication are an important factor in the success of telenursing, because in practice nurses will be faced with various types of patients through long-distance communication (Fadhila & Afriani, 2019).

The implementation of telenursing in developing countries has several challenges and obstacles, such as costs, human resources and policies. The main challenges faced in implementing telenursing are the occurrence of inadequate communication about the patient's clinical condition, causing clinical errors, limitations of computer support systems regarding communication, lack of visual references when communicating between nurses and patients, especially communication without video, difficulties in understanding nonverbal communication, especially when done by telephone. In interaction with video, the visual source is a distance compensation mechanism, providing a sense of closeness, integration, protection, and security to express needs, hopes and feelings (Sharma, 2014).

## Conclusion

Telenursing can be used as a nursing care delivery model to patients with type 2 diabetes mellitus because it is proven to reduce glycemic control, improve medication adherence, reduce body mass index (BMI), glycosylated hemoglobin (HbA1c), cholesterol, and improve diet compliance, physical exercise and self-management.

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## Conflict Of Interest

The authors declare no conflicts of interest.

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