

Application, Benefits, and Limitations of Telepharmacy for Patients with Diabetes in the Outpatient Setting

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Abstract: After the COVID-19 pandemic, telepharmacy has become increasingly widely used as an alternative to pharmaceutical care by remote pharmacists. Patients with diabetes mellitus are one of the patients who get benefit the most from telepharmacy practices, which allow patients to consult without meeting face to face and minimize the risk of virus transmission. The authors conduct an assessment of the benefits and limitations of using telepharmacy that are used throughout the world and then hopes that they can become a reference in the development of telepharmacy in the future. A total of 23 relevant articles were used for analysis in this narrative review after searching for articles in three sources, including PubMed, Google Scholar and ClinicalTrials.gov, until October 2022. This narrative review shows that telepharmacy plays an important role in improving clinical outcomes, patient therapy adherence and reduce the number of patient visit and hospitalization, but telepharmacy also has limitations in its use related to security and privacy, as well as pharmacist intervention that has not been maximized. However, telepharmacy has great potential to facilitate diabetes mellitus patients in pharmaceutical services.

Keywords: diabetes mellitus, telepharmacy, benefits, limitations, pharmacist, COVID-19

Introduction

The application of information and communication technology in the health sector is currently being widely used, especially since the COVID-19 pandemic.¹ The provision of health services through information technology is proven to help ease the burden on the health sector. One of them is telepharmacy. Telepharmacy has been highlighted as an effective and innovative strategy to help overcome this problem.² The National Association of Boards of Pharmacy in the United States defines telepharmacy as the provision of pharmacist care to patients remotely by registered pharmacists using telecommunications. Telepharmacy allows pharmacists with remote access to efficiently contribute their clinical expertise to multiple clinics and patients, while alleviating the strain on healthcare resources.³⁻⁵

Several telepharmacy services include clinical pharmacy services, patient consultation and monitoring, drug selection counseling, prescription checks, and dispensing. Telepharmacy services are very helpful for people with long-term illnesses who take medications regularly and need to see a physician.⁶ Telepharmacy has been shown to potentially be used as an alternative method of dealing with drug-related problems in diabetic patients because it is able to provide quality pharmaceutical services to remote areas and reach patients who are located far from hospitals, clinics, pharmacies or other health care facilities.⁷ Although, it has many benefits, there are still many limitations in the development and use of telepharmacy technology in society, especially in patients with diabetes mellitus. In this literature review, the authors

discuss and evaluate the applications, benefits and limitations of using telepharmacy for diabetic patients so that they can become a reference and consideration in the development of telepharmacy.

Methods

We conducted a search for journals with the keywords “Diabetes Mellitus”, “Telepharmacy”, “Telephone”, and “Pharmacist” in three journal sources: PubMed, Google Scholar, and ClinicalTrials.gov. This narrative review was prepared based on studies related to the implementation of pharmaceutical services for outpatients with diabetes mellitus using communication technology. Selection Criteria: The authors use all original research and clinical reports published from 2012 to October 2022 regarding telepharmacy in diabetes mellitus outpatients and select research articles that explain the practice of pharmaceutical services by pharmacists through information technology, either via fax, email, messages, telephone, or special tools. The authors exclude irrelevant articles, which are the results of telepharmacy research, but the results do not evaluate the effect on the health of research subjects, research articles that do not clearly state the role of pharmacists in interventions, and other sources such as book chapters, article abstracts only, conference reports, reviews, posters, discussion results, and articles that only contain research designs. All of the articles identified were examined by authors G.N.I, K.M.E and S.A.R for inclusion. The findings were later discussed by the authors to reach a consensus. The procedure for selecting research articles is shown in Figure 1.

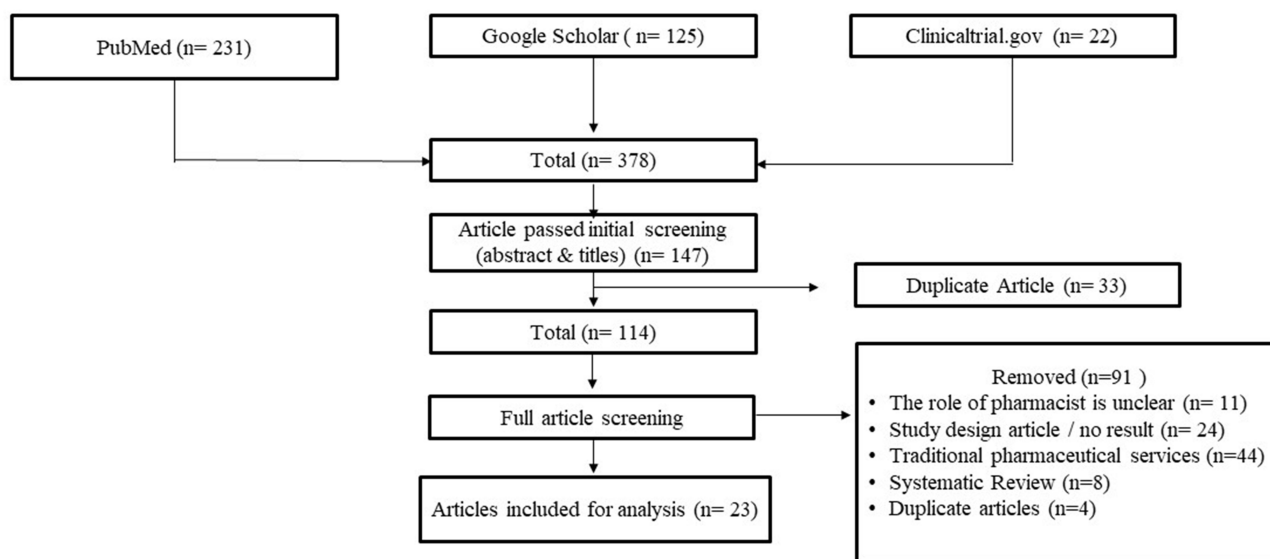


Figure 1 Flow chart of literature search.

Results

Of the total number of articles found, 23 articles passed the selection process and could be used in the analysis, all of which are written in English. Twenty-three selected articles reported on the use of telepharmacy in patients with diabetes mellitus in countries including the United States, Denmark, Saudi Arabia, Malaysia, Iran, Jordan, Taiwan, the United Kingdom, Ethiopia and Brazil. The scope of the implementation of telepharmacy includes counseling, monitoring patient therapy, prescription reviews, and dispensing.

Most of the research articles generally use the telephone as an information technology used in conducting pharmaceutical services, but some use web-based programs, special devices, and via messages or e-mail. Telepharmacy contributes to the improvement of pharmaceutical services in diabetes mellitus outpatients who require regular monitoring to avoid drug-related problems and unwanted side effects.

Of the 23 articles analyzed, 21 articles explained that telepharmacy services were in the form of counseling to monitor patient adherence and clinical outcomes. Counseling through telepharmacy is proven to be an effective form of pharmaceutical services with significant improvements in clinical outcomes and patient therapy adherence. However,

the telepharmacy has many obstacles and limitations, such as, the lack of education and training for patients in telepharmacy services, especially in telepharmacy with special devices.

Data and explanations regarding the application, benefits, and limitations of using telepharmacy in diabetes mellitus outpatients are shown in [Table 1](#).

Discussion and Future Perspectives

The use of information and communication technology in health practice is increasing, especially after the COVID-19 pandemic took place.⁸ The practice of pharmacy through telepharmacy has been carried out since 2000 in the United States for asthma patients.⁹ Telepharmacy has proven to be an innovative new approach to providing pharmaceutical services, both independently and in multidisciplinary care, by pharmacists.¹⁰ Over time, forms of service through telepharmacy are becoming increasingly diverse and are applied to various patient conditions. Outpatients with diabetes mellitus are one of the groups that can benefit the most from telepharmacy because they need to be checked on regularly by pharmacists and other health workers.¹¹ Patients with diabetes mellitus who use telepharmacy have shown better clinical outcomes and better adherence to therapy. Because of this, our study focuses on the benefits, advantages, and drawbacks of telepharmacy practice in outpatients with diabetes mellitus.

Our study shows that telepharmacy in patients with diabetes mellitus has been widely used in various countries with various forms of service in prescribing, drug administration, counseling, drug therapy monitoring, therapy adherence monitoring, dispensing, and patient activity management. The results of this study show that telepharmacy services have a lot of potential, especially for outpatients with diabetes mellitus.

Telepharmacy Benefits

Telepharmacy can help provide convenience while improving the quality of drug use, especially in terms of patient therapy compliance. This is due to the pharmaceutical services provided by clinical pharmacists in providing education about the drug therapy currently being used by patients,^{12–14} regular reminders of when to take drugs,^{15–18} and regular follow-up calls by pharmacists so that patients become more aware of the therapy they are currently undergoing.

Telepharmacy has also helped cut down on the number of hospitalizations and doctor visits that patients have to make.^{10,14} This could be because pharmacists use pharmaceutical care plans and services, which include preventing and treating problems with drug therapy that can lead to serious problems and the need to stay in the hospital.¹⁹ Several similar studies also found that pharmacist-led self-care counseling and training cut down on the number of hospitalizations and complications caused by diabetes.²⁰

Several studies examining the effectiveness of telepharmacy services in the COVID-19 era show that telepharmacy improves drug delivery practices, helping to improve patient access to pharmaceutical services.^{21,22} Therefore, the fact that telepharmacy exists can help make up for the lack of pharmacists in rural or remote areas, where diabetic patients and other patients can easily get access to pharmaceutical services.²³ In addition, telepharmacy also offers a more comfortable environment for pharmacists and patients to consult with patients without the risk of transmitting viruses.²²

Significant improvements in dietary and physical activity behaviors were also seen with the use of telepharmacy, which is likely due to the provision of education and educational materials regarding types and proportions of healthy diets and encouraging patients to engage in regular physical activity.^{13,24}

Telepharmacy Limitations

Telepharmacy practice, which is now widely used, still has some limitations. Consultation and counseling by pharmacists through telepharmacy focus more on improving patient adherence and clinical outcomes, not many telepharmacies provide education and information about self-management and self-activity of diabetes mellitus patients such as education about foot care, smoking, diet management, and weight reduction. There is a strong relationship between patient knowledge about the disease and medication adherence. It is hypothesized that well-informed patients have a better understanding of their disease and treatment process.²⁵

Compared to traditional pharmaceutical services, telepharmacy is more vulnerable to privacy and security risks.²⁶ For the broader application of telepharmacy, there are concerns about the privacy and security of the telehealth system. The

Table 1 Application, Benefits and Limitations of Telepharmacy in Diabetes Mellitus

Citation	Study Design	Purposes	Model of Pharmaceutical Services	Description of Intervention	Sample Size	Strength	Limitation
Jarab et al (2012), Jordan ³⁷	RCT	To evaluate the impact of clinical pharmacist-led pharmaceutical program on clinical outcomes and self-behaviour	Counseling	Counseling and follow-up via telephone for 8 weeks	156	Significant improvement in the intervention group on fasting blood glucose levels, blood pressure, total cholesterol, LDL-C, serum triglycerides, and medication adherence	There was no significant reduction in smoking behavior due to the lack of interventions given
McFarland et al (2012), USA ⁴¹	RCT	To compare the effect of medication therapy management by clinical pharmacy specialist who use Care Coordination Home Telehealth (CCHT) with clinical pharmacist who did not use CCHT	Counseling, home pharmacy care	Monitoring and communication using messaging device to monitor blood glucose and follow-up telephone with clinical pharmacy specialist	103	HbA1c decreased <7% in 69% of the intervention group	Device purchase costs are needed, training and device use training are needed for patients
Odegard et al (2012), USA ¹⁷	RCT	To evaluate the impact of intervention on medication adherence for diabetic patients	Counseling	Telephone-initiated adherence support by pharmacist following computer-generated missed refill alerts	265	Telepharmacy made a significant change in the patient's MPR value at the 12th month of intervention	Not identified
O'Connor et al (2014), USA ¹⁸	RCT	To evaluate the impact of intervention on medication adherence	Home pharmacy care, counseling	Monitoring, follow-up, education and reminders to take medication via telephone for 2–6 weeks	2378	The decrease in HbA1c value and increase in adherence to therapy were not significant between the the intervention group and the control group	Counseling and follow-up via telephone only takes an average of 5 minutes
Olesen et al (2014), Denmark ⁴²	RCT	To investigate the impact of pharmaceutical care on medication adherence, hospitalization and mortality of elderly	Home pharmacy care, counseling	Visits by the pharmacist for education and telephone follow-up at 3, 6 and 9 months	517	No significant differences in medication adherence, mortality and hospitalisation between intervention and control groups	Prescription by fax does not go well
Jyun et al (2015), Taiwan ³⁴	RCT	To assess change in HbA1c levels and medical expenses	Home pharmacy care, counseling	Monitoring and follow-up treatment via telephone	100	A significant decrease in HbA1C levels	There is no significant reduction in costs
Shane McWhorter et al (2015), USA ²⁴	RCT	To assess clinical outcomes and measurements with the use of telemonitoring device	Home pharmacy care, counselling	Monitoring daily blood glucose and blood pressure, and follow-up phone calls by pharmacist	150	<ul style="list-style-type: none"> • Telepharmacy provides a significant decrease in HbA1c levels reaching 2.07%, increased knowledge about diabetes and compliance with anti-hypertensive therapy • Patient compliance in using tele-monitoring tools reached 79.7% 	Costs are required to purchase equipment, patients who are rarely exposed to technology can experience difficulties
Jahangard-Rafsanjani et al (2015), Iran ¹³	RCT	To investigate the efficacy of pharmacist-delivered diabetes support for patients in middle-income country	Counseling and Home pharmacy care	Monthly visits and follow-up calls to strengthen adherence to therapy and resolve drug therapy problems and provide diabetes education (diet, use of blood glucose monitoring devices)	85	<ul style="list-style-type: none"> • Decrease in HbA1c levels in the intervention group up to 1.0% ± 1.5% • Self-care activity increases in diet, blood glucose monitoring, and foot care • Significant improvement in medication adherence and BMI 	Not identified

Aguilar et al (2016), Brazil ³³	RCT	To evaluate the effect of a pharmacist-physician collaborative care model on clinical outcomes for patients with uncontrolled type 2 diabetes	Home-care Pharmacy and Counseling	Telephone consultation, and monitoring medication therapy adherence	80	Counseling and monitoring of therapy resulted in significant improvement in clinical assessment (HbA1c, and blood sugar,) with no change in the consumption of anti-diabetic drugs	Not identified
Lee et al (2017), Malaysia ⁴⁰	RCT	To examine the effects of telemonitoring program with feedback in type 2 diabetes mellitus patients fasting during Ramadhan	Home pharmacy care	Using a web-enabled glucometer (MyGlucoHealth) to monitor patient's blood glucose and messages alert	85	In the intervention group, patients had lower hypoglycaemia situation, and decrease in HbA1c reaching 1.07%.	Training and guidance is required for the use of tools, the cost of purchasing tools
Lyons et al (2017), UK ¹⁶	RCT	To test the effectiveness of pharmacist-led service to improve medication adherence	Counseling and Home pharmacy care	Telephone consultation with pharmacist, medicines reminder chart	677	Medication adherence reached $\geq 90\%$ in the intervention group, Achievement of HbA1c values ($< 7\%$) reached 66.7%	Not identified
Siaw et al (2017), Taiwan ⁴⁵	Randomized controlled cross-over study	To evaluate the impact of mHealth clinical pharmacist on HbA1c, blood pressure and LDL in African-American and Latinos diabetic patients	Counseling	Phone consultation with clinical pharmacist regularly	411	<ul style="list-style-type: none"> Decrease in average HbA1c from 8.6% to 8.1% Average cost savings US\$ 91.01 per patient 	Not identified
Erku et al (2017), Ethiopia ¹⁴	RCT	To evaluate the impact of intervention on medication adherence, and hospital admissions in patients with type 2 DM	Drug therapy monitoring, counseling	Medication therapy management to review patient's medication regimen, customized education, and education on health promoting behaviors, and regular telephone counselling	127	<ul style="list-style-type: none"> Increase in medication adherence from 9.2% to 61% Decrease in hospital admissions reached 52.1% 	Not identified
Choudhry et al (2018), USA ³⁵	RCT	To evaluate the effect of intervention to improve medication adherence	Counseling	Telephone consultation	4078	10% increase in diabetes mellitus outpatient adherence	Imbalance of pharmacist workload with salary received
Sarayani et al (2018), Iran ⁴⁴	RCT	To evaluate the efficacy of a telephone based intervention to improve clinical outcomes in type 2 DM	Counseling	Consultation by phone calls with trained pharmacist for 3 months	84	Telepharmacy has a significant effect on reducing HbA1c levels and medication adherence scores	Not identified
Cohen et al (2019), USA ²⁹	RCT	To determine the effect of pharmacist-led telehealth for improving diabetes medication adherence	Counseling	Special electronic device (The Health Buddy) and telephone-based consultation	30	Significant improvement in adherence to therapy and HbA1c values	The Health Buddy device requires a landline telephone and a three-prong power plug to operate
Lauffenburger et al (2019), USA ¹²	RCT	To evaluate the impact of telephone-based intervention on HbA1c for poorly-controlled diabetic patients	Counseling	Telephone consultation and monitoring on medication adherence, lifestyle modifications, and treatment intensification for 12 months	1400	Significant change in HbA1c value, no significant change in medication adherence	Assistance by pharmacists in controlling diet and exercise is inadequate, lifestyle change assistance by pharmacists has not been fully accepted by patients.

(Continued)

Table 1 (Continued).

Citation	Study Design	Purposes	Model of Pharmaceutical Services	Description of Intervention	Sample Size	Strength	Limitation
Lauffenburger et al (2019), USA ³⁹	RCT	To evaluate whether delivering more intensive insulin-adherence interventions was more effective than delivering a lower-intensity intervention	Counseling	<ul style="list-style-type: none"> Low intensity: 2 follow-up calls, pillbox, reminder postcard Moderate intensity: 6 follow-up calls, weekly text messaging High intensity: 12 follow-up calls, daily text messages 	5596	Significant blood sugar control in the high intensity intervention group	The group that received moderate intensity had more emergency visits and hospitalization than the low intensity group
Peasah et al (2019), USA ⁴³	Prospective, RCT	To evaluate the effectiveness of student pharmacist led telephone follow up to improve HbA1c	Counseling, Pemantauan Terapi Obat	Weekly phone call fo 12 weeks to monitor medication adherence, side effects and DRP	78	The telepharmacy given had the effect of reducing HbA1c levels by 0.35% in the intervention group	Not identified
McConnell et al (2020), USA ³⁶	RCT	To test the impact of connecting physicians and pharmacists to address medication adherence	Counseling	Counseling via telephone to follow up patient medication adherence	2602	No significant improvement in patient medication adherence	The challenge of communication between physicians and pharmacists to be able to provide the right information to address adherence issues
Arain et al (2021), USA ¹⁵	RCT	To examine the effectiveness of an in-home electronic medication dispensing system (MDS) on improving medication adherence and health perception	Dispensing	Use of non-surgical devices in the form of pre-packaged medication administration on time with medication administration reminders.	50	Drug delivery technology can improve medication adherence in adults	The risk of MDS not functioning properly, the user does not clearly understand the function of the device
Tourkmani et al (2021), Saudi Arabia ¹⁰	Prospective single cohort pre/post intervention	To assess the impact of virtual clinics on glycaemic control among patients with type 2 DM	Counseling	Medication counseling and therapeutic interventions using virtual clinic by telephone	Not mentioned	Significant decrease in HbA1c values from 9.98 ± 1.33 pre intervention to 8.32 ± 1.31 post intervention, decreased patient visits to the hospital in 64% of the patients.	<ul style="list-style-type: none"> There is no specific platform that guarantees patient privacy There is no classification of patients based on condition status Collaboration and coordination with health facilities should be through written workflows
Khan et al (2022), Saudi Arabia ³⁸	RCT	To evaluate the impact of pharmacist-based diabetic intervention on disease knowledge, medication adherence and self-care management	Counseling	Counseling and monitoring via telepharmacy services (calls, messages or emails) for 6 months	109	<ul style="list-style-type: none"> Significant improvement in the intervention group towards knowledge of diabetes, and self-care management. Improvements in medication adherence and HbA1c values in the intervention and control groups 	Not identified

Abbreviation: RCT, randomized controlled trial.

telepharmacy provider must be responsible for ensuring regulatory compliance, patient confidentiality, and system security at all times. In addition to knowledge of the legal aspects of telepharmacy,²⁷ it is important for providers to know and practice telepharmacy ethics. These ethical standards must be observed when pharmacists work remotely from home or make outpatient visits at their respective residences.²⁸

Some of the telepharmacy services provided also require special devices that are usually used to monitor the patient's daily blood sugar levels,^{15,29} telepharmacy that uses special devices also needs to provide comprehensive training to patients before using these devices, considering that diabetes mellitus patients are usually in their old age and are rarely exposed to technology, so they may experience difficulties.

With the rapid advancement of technology in the health sector, education on telepharmacy is very important, not only for pharmacists but also for patients. To get more people to use it, a formal continuing education program could keep pharmacists up to date on how telepharmacy is used today.^{30–32}

Future Developments

Going forward, many steps need to be done to ensure the use of telepharmacy services growing and getting better. Pharmacist associations and pharmacists need to advocate for laws and regulations regarding telepharmacy that can guarantee security, privacy and legacy. Telepharmacy education not only for pharmacists but also for patients is also very important, the more telepharmacy education the more telepharmacy can be used widely. To facilitate communication between pharmacists and patients, a powerful, secure, and needs-based telepharmacy platform must be considered during creation. Additionally, there is a critical need for formal education programs to support pharmacists in maintaining their knowledge of modern telepharmacy procedures and their proficiency in offering pharmaceutical services. The general patients, and diabetes patients, feel secure during the consultation and, ultimately, can increase the existence of pharmacists as high-quality health workers.

Limitations

This literature review has limitations; maybe not all articles discuss the role of telepharmacy in patients with diabetes mellitus, because it depends on how the role of the pharmacist is described in articles. In addition, this study also focuses on discussing the benefits of telepharmacy in improving clinical outcomes and patient compliance, so that the output regarding cost and operational effectiveness is not discussed. However, the authors hoped that this literature review can become a reference in the future development of telepharmacy, especially for diabetes mellitus patients whose goal is to continue to provide high-quality pharmaceutical services.

Conclusion

Telepharmacy might be a different option for pharmaceutical services, even though there are still some restrictions on its use. It has been shown to be successful in giving interventions with notable results in clinical conditions and adherence to therapy in patients with diabetes mellitus. This literature review demonstrates the enormous potential of telepharmacy and serves as a guide for the creation of telepharmacy that can effectively assist patients, particularly those with diabetes mellitus, in receiving pharmaceutical services.

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Disclosure

The authors report no conflicts of interest in this work.

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