

# A Scoping Review of Diabetes Telemedicine Research in Norway

Dillys Larbi<sup>1,2</sup>, Henriette Lauvhaug Nybakke<sup>1</sup>, Karianne Lind<sup>1</sup>, Eirin Rødseth<sup>1</sup> and Elia Gabarron<sup>1,3</sup>

<sup>1</sup> Norwegian Centre for E-health Research, University Hospital of North Norway, Norway, [dillys.larbi@ehealthresearch.no](mailto:dillys.larbi@ehealthresearch.no)

<sup>2</sup> Department of Clinical Medicine, UiT The Arctic University of Norway, Norway

<sup>3</sup> Institute for Education, ICT and Learning, Østfold University College, Norway

## Abstract

The recent pandemic highlighted telemedicine's potential for continuity of remote diabetes patients' care. The study objective was to identify diabetes telemedicine services, benefits, and challenges in Norway. We searched for publications on the topic in PubMed, ScienceDirect, CINAHL, and Nora. Most of the included studies (7/15) focused on telemedicine for type 2 diabetes. Telemedicine benefits include improved self-management and cost and time effectiveness. Challenges include organizational and technical issues. To optimize the health system, telemedicine can be used for highly engaged diabetes patients. Creating clear and practical national and organizational telemedicine guidelines for diabetes management could solve the identified challenges.

## Keywords

Diabetes; Telemedicine; Remote consultation; Videoconferencing; Remote sensing technology

## 1 INTRODUCTION

About 245,000 Norwegians (1 in 20) have been diagnosed with diabetes, and it is estimated that about 60,000 more could have undiagnosed diabetes in Norway [1]. The World Health Organization (WHO) describes diabetes as a chronic metabolic disease characterized by elevated levels of blood glucose or blood sugar [2]. There are serious and life-threatening complications associated with diabetes, including damage to vital organs such as the eyes, kidneys, nerves, and the heart [2,3].

To prevent these complications and premature death, people living with diabetes need constant, continuous, and coordinated care. This, however, becomes challenging when it involves travelling long distances to healthcare facilities or restricted access to healthcare due to disease outbreaks. The use of telemedicine could offer alternatives to standard care for people with diabetes [4]. Telemedicine basically involves healthcare delivery across geographical locations via electronic communication technologies [5].

Telemedicine solutions offer opportunities for the healthcare system to continue the care of long-distance patients living with diabetes, for example during infectious disease outbreaks [4,6]. Although Norway as a country adopted telemedicine at an early stage [7], very little is known about the benefits and challenges of using telemedicine solutions for diabetes care in Norway. Therefore, we conducted a scoping review to provide an overview of the evidence as preliminary assessment of the size and scope of available literature in this field.

The objective of this article is to identify what is known about the benefits, and challenges of telemedicine for diabetes in Norway. This includes benefits and challenges for all types of diabetes and within all areas where telemedicine for diabetes has been used in order to provide an overview of the field.

The 18th Scandinavian Conference on Health informatics, Tromsø, Norway, August 22-24, 2022. Organized by UiT The Arctic University of Norway. Conference Proceedings published by Linköping University Electronic Press at <https://doi.org/10.3384/ecp187>. © The Author(s). This work is licensed under the Creative Commons Attribution-NonCommercial 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/4.0/>

## 2 METHODS

We searched for publications with the keywords “Diabetes” AND “Telemedicine” OR “Remote consultation” OR “Videoconferencing” OR “Telemetry” OR “Remote sensing technology” in titles/abstracts AND Norway (where possible). The search was carried out in the following databases: PubMed, ScienceDirect, CINAHL, and Nora (Norwegian knowledge repository). Articles were included if they were 1) studies on use of telemedicine for diabetes care 2) conducted in Norway. No year or language limitations were used. The full search strategy is available in the Zenodo data repository [8].

All references were uploaded to EndNote 20 and X9 by Clarivate™, and duplicates removed. After that, the references were uploaded to Rayyan and DL, KFL, and EG carried out the first screening of titles and abstracts. In the second phase, the full texts of the remaining articles were downloaded. Two pairs of reviewers (HLN and KFL; DL and EG) carefully examined these full texts in order to confirm their eligibility. Eligibility incongruences were discussed with the other pair of reviewers until reaching an agreement. Articles that met the inclusion criteria were included in the qualitative synthesis. Benefits and challenges linked to technology were identified, summarized, and categorized using an inductive thematic analysis in NVivo 12 Pro for windows by QSR International.

## 3 RESULTS

A total of 542 records were identified and 15 met the inclusion criteria (see Figure 1). The search strategy and the list of excluded articles in the full-text screening, and the reasons for exclusion are available in the data repository [8]. Table 1 summarizes the publications included in this review.

### 3.1 Publication and targeted diabetes type

The 15 included studies were published between 2003 and 2020. Among these, 6 were randomized controlled trials [9-14]; 4 observational or qualitative studies [15-18]; 2 study protocols [19,20]; 1 feasibility and usability study [21]; 1 project summary [22] and 1 editorial article [6].

Of the 15 included studies, 7 were about type 2 diabetes only (7/15) [9,13,14,18,20-22]; 4 referred to both type 1 and type 2 diabetes [10-12,19]; 3 to diabetes in general [15-17]; and 1 publication was about type 1 diabetes [6].

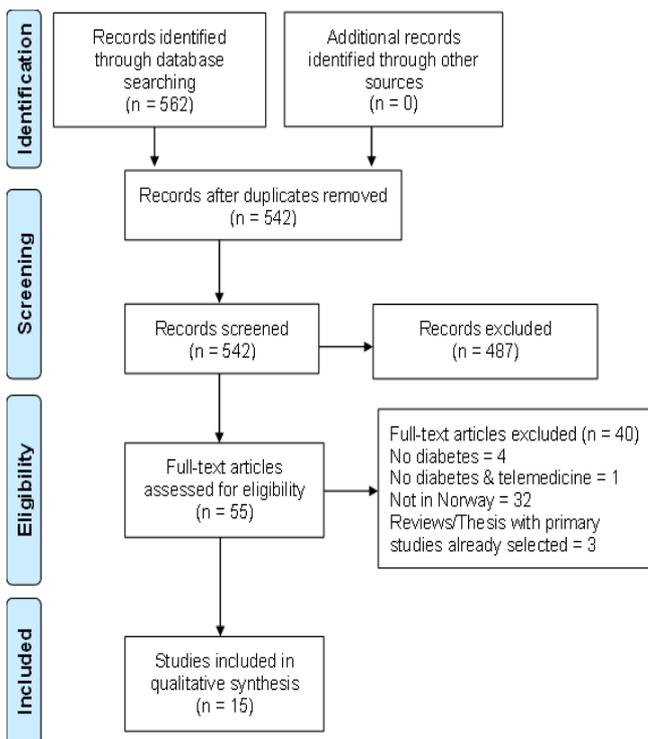


Figure 1. Flowchart of the selection procedure.

### 3.2 Diabetes telemedicine technologies

Six of the included articles were about telemedicine services via interactive wound platforms [10-12,16,17,19]; 5 articles were about the use of self-management systems via mobile phones [9,13,14,20,21]; 2 focused on telemedicine as a general concept [6,15]; and 2 referred to the use of image sharing technologies for diabetes management and care [18,22].

In 7 of the studies, diagnosing and counteracting diabetes complications were achieved through the use of telemedicine technologies [10-12,15-17,19]; and also ophthalmology complications [14]. Some studies (6/15) used telemedicine technology to monitor the blood glucose levels of people living with diabetes [6,9,13,14,20,21]. One of the publications did not specify the use of telemedicine technology [22].

### 3.3 Diabetes telemedicine benefits and challenges

The identified benefits of using diabetes telemedicine technologies include cost effectiveness [22] increased knowledge of managing diabetes complications such as wound assessment [15,17], and time effectiveness [18].

The included studies identified challenges associated with the use of telemedicine technologies for diabetes in Norway. These challenges include technical and practical issues associated with outdated equipment and inadequate technological skills among staff [12,17,21], organizational issues as a result of interorganizational and interdisciplinary collaboration to deliver telemedicine services [11,16,18], and communication and information issues due to missing elements associated with traditional delivery of care such as physical examination and non-verbal communication.

All the identified benefits and challenges are summarized in Table 2.

## 4 DISCUSSION

This review aimed to identify what is known about the benefits and challenges of telemedicine for diabetes in Norway. Most of the included studies focused on the use of telemedicine for type 2 diabetes, followed by type 1 diabetes.

We did not find any publication on telemedicine for gestational diabetes, which could be of relevance, for example during infectious diseases outbreaks. The results are summarized in table 2.

Although the included studies reported no significant changes in HbA1c between the intervention and the control groups [9,13], there was a decline in HbA1c levels among all participants. Similarly, mobile applications as an advanced telediabetology method have been shown to reduce HbA1c levels in people living with type 1 and 2 diabetes, as well as minimize the occurrence of hypoglycaemic events [4,23]. There is also a reported increase in quality of life among individuals with type 1 and 2 diabetes who use mobile applications for self-management. This is due to the improved design and development of these technological tools with features such as bolus calculator, carbohydrate counting, automated glucose pattern feedback, and the ability to share one's data with healthcare providers [4].

Iversen et al. [10] found that there was no significant difference between the use of telemedicine and usual care for treating foot ulcers. Cost and time effectiveness can be realised from the use of telemedicine as an alternative to usual care in remote regions in Norway since patients can visit their local health facilities while having access to specialist care. Lee et al. [24] associated cost-effectiveness with the use of telemedicine for retinal screening, telemonitoring, and telephone reminders in diabetes management. It seems that telemedicine can be offered as a low-cost alternative to people living with diabetes in Norway who are already engaged in the health system to ensure cost-effectiveness without compromising on the quality of care [25].

The use of telemedicine can increase the knowledge and skills of healthcare providers in diagnosing and treating diabetes complications [15,17]. However, this acquired knowledge will not be useful if there are identified organizational challenges associated with the use of telemedicine services and technologies. Challenges encountered during the use of telemedicine for diabetes care were; The problem of identifying who is responsible

for the care of the patient because healthcare professionals are working across different management systems and organizational structures [11,16,18], technical, and practical challenges where available equipment are outdated, and applications do not work as intended [12,17,21]. These challenges need to be properly and effectively addressed. Aberer et al. [4] suggest political and structural adjustments as a solution to diabetes telemedicine-related challenges. Adjustments made at the national and organizational level for the use of telemedicine for diabetes can contribute immensely to improved telemedicine services and quality of life of people living with diabetes in the country.

#### 4.1 Limitations

Our review focused only on telemedicine and diabetes in the Norwegian context, and we used only few keywords in our data search. Therefore, we might have missed relevant publications on the topic carried out within the Norwegian context. Our findings cannot be generalized to other countries or to other fields where telemedicine is used. All publications we found were focusing on Type 1 and Type 2 diabetes, and none in gestational diabetes. Future research could also study the potential benefits of telemedicine for managing gestational diabetes in Norway.

## 5 CONCLUSIONS

There is evidence to suggest that telemedicine for diabetes management and care can be adopted in Norway to supplement the usual care. People living with diabetes who are interested in and enthusiastic about monitoring their condition can be offered telemedicine services as an alternative to usual care, especially those who live in remote areas and for follow-up purposes. Telemedicine as a supplement to usual care is beneficial to both the health system as a whole and to people living with diabetes in terms of reduced cost and efficiency of care.

Creating clear and practical national and organizational guidelines for telemedicine for diabetes care in Norway could be a way to solve the various identified challenges associated with its use.

## 6 AUTHORS CONTRIBUTIONS

Conceptualization: EG, ER, DL, KL, HLN; Literature searching: EG, KL; Title, abstract, and full-text screening: EG, KL, DL, HLN; Data extraction: EG, KL, DL, HLN; Data analysis and interpretation: EG, ER, DL, KL, HLN. Article Writing: EG, ER, DL, KL, HLN. All authors have read and agreed to the published version of the manuscript.

## 7 ACKNOWLEDGEMENT

This project is funded by the EEA and Norway Grants.

## 8 REFERENCES

[1] Norwegian Institute of Public Health. "Diabetes in Norway" 2021 Available from: <https://www.fhi.no/en/op/hin/health-disease/diabetes-in-norway---public-health/> (Accessed: 18<sup>th</sup> November, 2021).

[2] World Health Organization. "Diabetes" 2022 Available from: [https://www.who.int/health-topics/diabetes#tab=tab\\_1](https://www.who.int/health-topics/diabetes#tab=tab_1) (Accessed: 19<sup>th</sup> May, 2022).

[3] World Health Organization. "Diabetes" 2020 Available from: <https://www.who.int/news-room/facts-in-pictures/detail/diabetes> (Accessed: 19<sup>th</sup> May, 2022).

[4] Aberer F, Hochfellner DA, Mader JK. "Application of Telemedicine in Diabetes Care: The Time is Now" in *Diabetes Ther* Vol. 12, Issue 3, pp. 629-39. 2021.

[5] Zanaboni P, Knarvik U, Wootton R. "Adoption of routine telemedicine in Norway: the current picture" in *Glob Health Action* Vol. 7, p. 22801. 2014.

[6] Birkeland KI. "Some Lessons Learned About Diabetes and COVID-19 During the Early Stage of the Epidemic in Norway" in *J Diabetes Sci Technol* Vol. 14, Issue 4, pp. 718-9. 2020.

[7] Zanaboni P, Wootton R. "Adoption of routine telemedicine in Norwegian hospitals: progress over 5 years" in *BMC health services research* Vol. 16, p. 496. 2016.

[8] Larbi D, Nybakke Lauvhaug H, Lind K, et al. "Telemedicine for diabetes in Norway: Scoping review appendices [Data Set]" *Zenodo*; 2021 Available from: <https://doi.org/10.5281/zenodo.5718818>.

[9] Holmen H, Torbjørnsen A, Wahl AK, et al. "A Mobile Health Intervention for Self-Management and Lifestyle Change for Persons With Type 2 Diabetes, Part 2: One-Year Results From the Norwegian Randomized Controlled Trial RENEWING HEALTH" in *JMIR Mhealth Uhealth* Vol. 2, Issue 4, p. e57. 2014.

[10] Iversen MM, Igland J, Smith-Strøm H, et al. "Effect of a telemedicine intervention for diabetes-related foot ulcers on health, well-being and quality of life: secondary outcomes from a cluster randomized controlled trial (DiaFOTo)" in *BMC Endocr Disord* Vol. 20, Issue 1, p. 157. 2020.

[11] Smith-Strøm H, Igland J, Østbye T, et al. "The Effect of Telemedicine Follow-up Care on Diabetes-Related Foot Ulcers: A Cluster-Randomized Controlled Noninferiority Trial" in *Diabetes Care* Vol. 41, Issue 1, pp. 96-103. 2018.

[12] Smith-Strøm H, Iversen MM, Graue M, et al. "An integrated wound-care pathway, supported by telemedicine, and competent wound management-Essential in follow-up care of adults with diabetic foot ulcers" in *Int J Med Inform* Vol. 94, pp. 59-66. 2016.

[13] Torbjørnsen A, Jennum AK, Småstuen MC, et al. "A Low-Intensity Mobile Health Intervention With and Without Health Counseling for Persons With Type 2 Diabetes, Part 1: Baseline and Short-Term Results From a Randomized Controlled Trial in the Norwegian Part of RENEWING HEALTH" in *JMIR Mhealth Uhealth* Vol. 2, Issue 4, p. e52. 2014.

[14] Torbjørnsen A, Småstuen MC, Jennum AK, et al. "Acceptability of an mHealth App Intervention for Persons With Type 2 Diabetes and its Associations With Initial Self-Management: Randomized Controlled Trial" in *JMIR Mhealth Uhealth* Vol. 6, Issue 5, p. e125. 2018.

- [15] Kolltveit BC, Gjengedal E, Graue M, et al. "Telemedicine in diabetes foot care delivery: health care professionals' experience" in *BMC Health Serv Res* Vol. 16, p. 134. 2016.
- [16] Kolltveit BH, Gjengedal E, Graue M, et al. "Conditions for success in introducing telemedicine in diabetes foot care: a qualitative inquiry" in *BMC Nurs* Vol. 16, p. 2. 2017.
- [17] Kolltveit BH, Thorne S, Graue M, et al. "Telemedicine follow-up facilitates more comprehensive diabetes foot ulcer care: A qualitative study in home-based and specialist health care" in *J Clin Nurs* Vol. 27, Issue 5-6, pp. e1134-e45. 2018.
- [18] Rotvold GH, Knarvik U, Johansen MA, et al. "Telemedicine screening for diabetic retinopathy: staff and patient satisfaction" in *J Telemed Telecare* Vol. 9, Issue 2, pp. 109-13. 2003.
- [19] Iversen MM, Espehaug B, Hausken MF, et al. "Telemedicine Versus Standard Follow-Up Care for Diabetes-Related Foot Ulcers: Protocol for a Cluster Randomized Controlled Noninferiority Trial (DiaFOTo)" in *JMIR Res Protoc* Vol. 5, Issue 3, p. e148. 2016.
- [20] Ribu L, Holmen H, Torbjørnsen A, et al. "Low-intensity self-management intervention for persons with type 2 diabetes using a mobile phone-based diabetes diary, with and without health counseling and motivational interviewing: protocol for a randomized controlled trial" in *JMIR Res Protoc* Vol. 2, Issue 2, p. e34. 2013.
- [21] Arsand E, Tataru N, Østengen G, et al. "Mobile phone-based self-management tools for type 2 diabetes: the few touch application" in *J Diabetes Sci Technol* Vol. 4, Issue 2, pp. 328-36. 2010.
- [22] Hernández C, Alonso A, Garcia-Aymerich J, et al. "Integrated care services: lessons learned from the deployment of the NEXES project" in *Int J Integr Care* Vol. 15, p. e006. 2015.
- [23] Doupis J, Festas G, Tsilivigos C, et al. "Smartphone-Based Technology in Diabetes Management" in *Diabetes Ther* Vol. 11, Issue 3, pp. 607-19. 2020.
- [24] Lee JY, Lee SWH. "Telemedicine Cost-Effectiveness for Diabetes Management: A Systematic Review" in *Diabetes Technol Ther* Vol. 20, Issue 7, pp. 492-500. 2018.
- [25] McDonnell ME. "Telemedicine in Complex Diabetes Management" in *Curr Diab Rep* Vol. 18, Issue 7, p. 42. 2018.

<b>Reference</b>	<b>Publication type</b>	<b>Diabetes type</b>
Rotvold GH, et al. (2003) [18]	Observational / Qualitative study	Type 2 diabetes
Årsand E, et al. (2010) [21]	Feasibility and usability study	Type 2 diabetes
Ribu L, et al (2013) [20]	Study protocol	Type 2 diabetes
Holmen H, et al. (2014) [9]	RCT	Type 2 diabetes
Torbjørnsen A, et al. (2014) [13]	RCT	Type 2 diabetes
Hernández C, et al. (2015) [22]	Summary of project	Type 2 diabetes
Iversen MM, et al. (2016) [19]	Study protocol	Type 1 and Type 2 Diabetes
Kolltveit BC, et al. (2016) [15]	Observational / Qualitative study	Diabetes in general
Smith-Strøm H, et al. (2016) [12]	RCT	Type 1 and Type 2 Diabetes
Kolltveit BH, et al. (2017) [16]	Observational / Qualitative study	Diabetes in general
Kolltveit BH, et al. (2018) [17]	Observational / Qualitative study	Diabetes in general
Smith-Strøm H, et al. (2018) [11]	RCT	Type 1 and Type 2 Diabetes
Torbjørnsen A, et al. (2018) [14]	RCT	Type 2 diabetes
Birkeland KI. (2020) [6]	Editorial	Type 1 diabetes
Iversen MM, et al. (2020) [10]	RCT	Type 1 and Type 2 Diabetes

**Table 1.** Summary of publications included in the review (n=15)

Benefits	Challenges
Improved self-management and technology used as a self-help aid [9,13,14,21]	No significant effect or impact (No differences in HbA1c-level, no significant effect on foot ulcers treatment, no significant difference in consultations, no significant impact on self-management) [9,10,13]
Alternative or supplement to usual care [10-12]	Technical and practical challenges (outdated equipment, technical problems, technological skills among the staff, app-related) [12,17,21]
Increase in wound assessment knowledge and skills in the nursing staff [15,17]	Organizational challenges (health care professionals working across different management systems and organizational structures, between the primary care sector and the specialist care sector – who is responsible for the care?) [11,16,18]
Cost-effectiveness (avoidance of costly institutional care, e.g., hospital admissions) [22]	Communication and information challenges (lack of information from physical examinations and nonverbal communication, communication among stakeholders across health care tiers) [6,22]
Time effectiveness (quicker to grade the level of retinopathy) [18]	The documentation process was time-consuming [15]
Greater reach and reduced travel distance [10,11]	The Norwegian legislation on data privacy and transfer was identified as a major limitation for the deployment of integrated care [22]

**Table 2.** Benefits and challenges associated with the use of telemedicine technology