Norway grants

Norwegian Centre for E-health Research

Scoping review: Diabetes & Telemedicine in Norway

Summary of findings

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Objective

To perform a scoping review to identify what has been published about telemedicine for diabetes in Norway. Special focus on: 1) Telemedicine in the early diagnostics of ophthalmology complications in diabetes; and 2) Telemedicine to monitor glycaemic targets to provide proper treatment and counteract other complications in diabetes.

Method

Search strategy

We searched for publications including the keywords “Diabetes” AND “Telemedicine” OR “Remote consultation” OR “Videoconferencing” OR “Telemetry” OR “Remote sensing technology”. The search was carried in the following databases: PubMed, ScienceDirect, CINAHL and Nora (Norwegian knowledge repository). No year or language limitations were used for the search. The only limitation we used was that the article should refer to the use of any telemedicine system for diabetes in Norway.
The search strategy was carried out on the 4th March 2021. See full search strategy in Appendix 1.

Eligibility and data extraction

All references were uploaded to EndNote, and duplicates were removed. After that, the references were uploaded to Rayyan in order to carry out a first screening of titles and abstracts. In a second phase, the full-text of selected articles were downloaded. Two pairs of reviewers (HN and KL; 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 agreement.

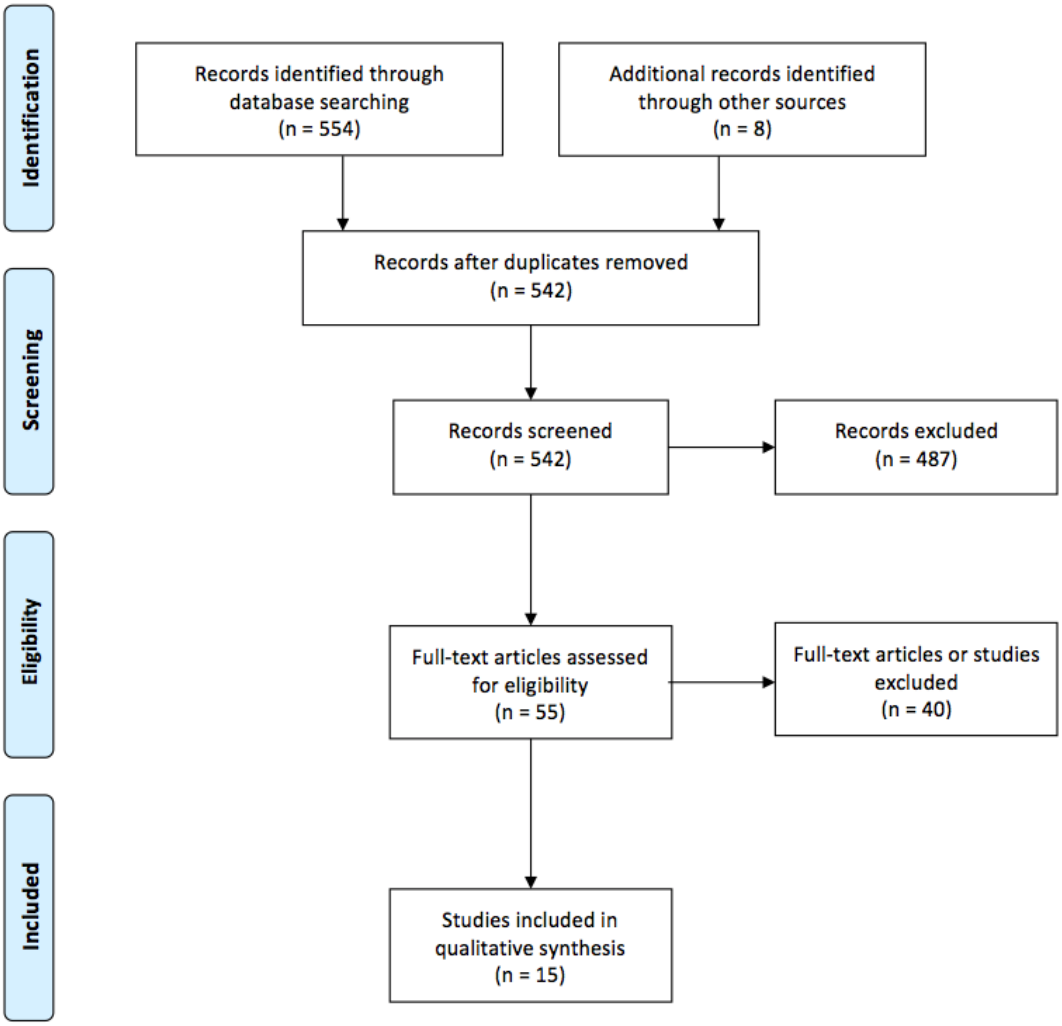
Next, we extracted the following data from the selected articles:

- Publication year
- Type of article
- Diabetes type
- Population
- Health service involved
- Technology type
- Technology use
    - Technology use for monitoring glycaemic levels ?
    - Technology use for treatment ?
    - Technology use for diagnostic / counteract ophthalmology complications ?
    - Technology use for diagnostic / counteract other diabetes complications ?
- Benefits linked to the technology use
- Challenges linked to the technology use

Results

Sample

A total of 542 records were identified and 15 met the inclusion criteria, and therefore were included in the qualitative synthesis (see search strategy in Appendix 1). The list of excluded articles in the full-text screening and the reasons for exclusion are reported in Appendix 2. See list of included articles in Appendix 3.



Publication year

The 15 included references were published between 2003 and 2020.

Publication year	Number of references in this category	References in this category
2003	1	Rotvold 2003
2010	1	Årsand 2010
2013	1	Ribu 2013
2014	2	Holmen 2014; Torbjørnsen 2014
2015	1	Hernandez 2015
2016	3	Iversen 2016; Kollveit 2016; Smith-Strøm 2016
2017	1	Kollveit 2017
2018	3	Kollveit 2018; Smith-Strøm 2018; Torbjørnsen 2018
2020	2	Birkeland 2020; Iversen 2020
Total	**15**	

Publication type

Among the 15 included publications: 40% were randomized controlled trials (6/15) and 26.7% observational or qualitative studies (4/15). The remaining included publications were study protocols, a feasibility and usability study, a project summary and an editorial.

Publication type	Number of references in this category	References in this category
RCT	6	Holmen 2014; Torbjørnsen 2014; Smith-Strøm 2016; Smith-Strøm 2018; Torbjørnsen 2018; Iversen 2020
Observational / Qualitative study	4	Rotvold 2003; Kollveit 2016; Kollveit 2017; Kollveit 2018
Study protocol	2	Ribu 2013; Iversen 2016
Feasibility and usability study	1	Årsand 2010
Project summary	1	Hernandez 2015
Editorial	1	Birkeland 2020
Total	**15**	

Diabetes type

Among the 15 included publications: 46.7% were about type 2 diabetes (7/15), 26.7% both type 1 and type 2 diabetes (4/15) and 20% diabetes in general (3/15). One publication was about type 1 diabetes.

Diabetes type	Number of references in this category	References in this category
Type 2 diabetes	7	Årsand 2010; Hernandez 2015; Holmen 2014; Ribu 2013; Rotvold 2003; Torbjørnsen 2014; Torbjørnsen 2018
Type 1 and type 2 diabetes	4	Iversen 2016; Iversen 2020; Smith-Strøm 2018; Smith-Strøm 2016
Diabetes in general	3	Kolltveit 2016; Kolltveit 2017; Kolltveit 2018
Type 1 diabetes	1	Birkeland 2020
Total	**15**	

Population

The population is summarized in two tables: Health care service and patients. The population is described by age and gender.

Health care service N	Age	Gender	References in this category
n=29 nurses + n=2 podiatrists + n=2 physicians	Mean age 47 (range 24-64)	1 male, 32 females	Kolltveit 2016
n=30 nurses + n=2 podiatrists + n=2 physician	Mean age 47 (range 26-64)	1 male, 32 females	Kolltveit 2017
n=4 wound care nurses + n=2 diabetes specialists nurses + n=1 podiatrist	NA	NA	Kolltveit 2018

Patients N	Age	Gender	References in this category
24	38-88	NA	Smith-Strøm 2016
42	37 patients above 50 years	12 males, 20 females	Rotvold 2003
75	35-80	33 males, 41 females	Torbjørnsen 2018
151	Mean age 57	NA	Torbjørnsen 2014
182	NA	NA	Iversen 2020
182	20 years or older	NA	Smith-Strøm 2018
114	20 years or older	NA	Iversen 2016

Health service

Four of the included articles focused on GPs services (4/15; 26.7%); and three on University hospital services (3/15; 20%). The remaining articles dealt with a (?) combination of several services (home-based care; outpatient clinics, primary care; municipal healthcare; county hospital).

Health service	**Number of references in this category**	**References in this category**
GPs	4	Hernandez 2015; Holmen 2014; Torbjørnsen 2014; Torbjørnsen 2018
University hospital	3	Birkeland 2020; Iversen 2016; Iversen 2020
Home-based care and outpatient clinics	2	Kolltveit 2018; Smith-Strøm 2016
Home-based care, primary care and outpatient clinics	2	Kolltveit 2016; Kolltveit 2017
University Hospital Municipal Health care * GPs	1	Rotvold 2003
University Hospital County hospital	1	Smith-Strøm 2018
GPs and University hospital	1	Ribu 2013
NA	1	Årsand 2010
Total	**15**	

Technology type

Six of the included articles were from projects that used an interactive wound platform (6/15: 40%), while five of the included articles were from projects that used a mobile phone with an app self-management system (5/15: 33.3%). Two of the included articles focused on telemedicine as a general concept (2/15: 13.3%). The remaining articles focused on other types of technology.

Technology type	**Number of references in this category**	**References in this category**
An interactive wound platform	6	Iversen 2016; Iversen 2020; Kolltveit 2017; Kolltveit 2018; Smith-Strøm 2018; Smith-Strøm 2016
Mobile phone with an App self-management system (includes diabetes diary app, a glucometer, food and physical activity registration system)	5	Årsand 2010; Ribu 2013; Torbjørnsen 2018; Torbjørnsen 2014; Holmen 2014
Telemedicine as a general concept	2	Birkeland 2020; Kolltveit 2016
Digital retinal images sent by email to the ophthalmologists.	1	Rotvold 2003
e-Messing/Bi-m calls. e-messages; Portable echocardiography	1	Hernàndez 2015
Total	**15**	

Technology use

In 46.7% of the publications was technology used to diagnose and counteract other diabetes complications (7/15), and in 40% of the publications was technology used to monitor glycaemic levels (6/15). Technology was used both to diagnose and counteract ophtalmology complications in one of the publications. One of the publications did not specify the use of technology.

Technology used for...	**Number of references in this category**	**References in this category**
Diagnostic / counteract other diabetes complications	7	Iversen 2016; Iversen 2020; Kolltveit 2016; Kolltveit 2017; Kolltveit 2018; Smith-Strøm 2016; Smith-Strøm 2018
Monitoring glycaemic levels	6	Årsand 2010; Birkeland 2020; Holmen 2014; Ribu 2013; Torbjørnsen 2014; Torbjørnsen 2018
Diagnostic / counteract ophthalmology complications	1	Rotvold 2003
Not specified	1	Hernàndez 2015
Treatment	0	
Total	**15**	

Benefits and challenges linked to the technology use

To summarize the benefits and challenges linked to technology use we did a thematic analysis. The identified benefits and challenges are summarized in the two tables, with references to which of the articles the challenge or benefit occurred.

Benefits	**References in this category**
Improved self-management and technology used as a self-help aid.	Årsand 2010; Holmen 2014; Torbjørnsen 2014; Torbjørnsen 2018
Alternative or supplement to usual care	Smith-Strøm 2018; Iversen 2020; Smith-Strøm 2016
Increase in wound assessment knowledge and skills in the nursing staff.	Kolltveit 2016; Kolltveit 2018
Greater reach and reducing travel distance.	Smith-Strøm 2018; Iversen 2020
Cost-effectiveness (Avoidance of costly institutional care)	Hernàndez 2015
Time effectiveness (Quicker to grade the level of retinopathy)	Rotvold 2003

Challenges	**References in this category**
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).	Holmen 2015; Iversen 2020; Torbjørnsen 2014
Technical and practical challenges (outdated equipment, technical problems, technological skills among the staff, app-related)	Årsand 2010; Kolltveit 2018; Smith-Strøm 2016
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?)	Rotvold 2003; Smith-Strøm 2018; Kolltveit 2017
Communication and information challenges (lack of information from physical examinations and nonverbal communication, communication among stakeholders across health care tiers).	Birkeland 2020; Hernandez 2015
The documentation process was time consuming.	Kolltveit 2016
The Norwegian legislation on data privacy and transfer was identified as a major limitation for the deployment of integrated care.	Hernandez 2015

Appendix 1. Full search strategy

Database	Search engine	Search date	Results
Pubmed	((((((diabetes[Title/Abstract]) AND (telemedicine[Title/Abstract])) OR (remote consultation[Title/Abstract])) OR (videoconferencing[Title/Abstract])) OR (telemetry[Title/Abstract])) OR (remote sensing technology[Title/Abstract])) AND (Norway[Affiliation])	4th March 2021	130
CINAHL	AB diabetes AND CA (norway or norwegian) AND AB telemedicine OR AB remote consultation OR AB videoconferencing OR AB telemetry OR AB remote sensing technology	4th March 2021	133
Sciencedirect	Title, abstract, keywords: "diabetes" AND "telemedicine"	4th March 2021	250
	Title, abstract, keywords: "diabetes" AND "remote consultation"		5
	Title, abstract, keywords: "diabetes" AND "videoconferencing"		6
	Title, abstract, keywords: "diabetes" AND "telemetry"		29
	Title, abstract, keywords: "diabetes" AND "Remote sensing technology"		1
Nora Alt i norske vitenarkiv i én tjeneste	Diabetes+telemedicine	4th March 2021	8
	Diabetes+remote consultation		0
	Diabetes+videoconferencing		0
	Diabetes+telemetry		0
	Diabetes+remote sensing technology		0
		TOTAL	**562**

Appendix 2. List of publications that were rejected during the full-text review and exclusion reasons

Reference	Exclusion criteria			
	No focus on diabetes	No focus on telemedicine	Not carried out in Norway	Other
Aanestad M, Driveklepp AM, Sørli H, Hertzum M. Participatory Continuing Design: "Living with" Videoconferencing in Rehabilitation. Studies in health technology and informatics 2017; 233: 45-59.	X			
Abràmoff MD. Chapter 12 - The autonomous point-of-care diabetic retinopathy examination. In: Klonoff DC, Kerr D, Mulvaney SA, eds. Diabetes Digital Health: Elsevier; 2020: 159-78			X	
Adil M, Pariti B, Fischer T, Bonduelle D. PDB92 Cost-effectiveness of telemedicine for the management of diabetes mellitus: a systematic literature review. Value in Health 2019; 22: S589.			X	
Albisser AM, Wright CE, Sakkal S. Averting iatrogenic hypoglycemia through glucose prediction in clinical practice: Progress towards a new procedure in diabetes. Diabetes Research and Clinical Practice 2007; 76(2): 207-14			X	
Arsand E, Walseth OA, Andersson N, et al. Using blood glucose data as an indicator for epidemic disease outbreaks. Studies in health technology and informatics 2005; 116: 217-22	X	X		
Augestad KM, Han H, Paige J, et al. Educational implications for surgical telementoring: a current review with recommendations for future practice, policy, and research. Surg Endosc 2017; 31(10): 3836-46.	X			
Bakken S, Grullon-Figueroa L, Izquierdo R, et al. Development, Validation, and Use of English and Spanish Versions of the Telemedicine			X	

Satisfaction and Usefulness Questionnaire. Journal of the American Medical Informatics Association 2006; 13(6): 660-7.				
Bellazzi R, Larizza C, Montani S, et al. A telemedicine support for diabetes management: the T-IDDM project. Computer Methods and Programs in Biomedicine 2002; 69(2): 147-61.			X	
Bursell S-E. HD4-B Telemedicine facilitated diabetes health care delivery. Diabetes Research and Clinical Practice 2008; 79: S13.			X	
Cheng Y-R. The outcomes and influencing factors of telecare managing patients with type 2 diabetes. Chinese Nursing Research 2015; 2(2): 80-3			X	
El-Gayar O, Timsina P, Nawar N, Eid W. A systematic review of IT for diabetes self-management: Are we there yet? International Journal of Medical Informatics 2013; 82(8): 637-52.			X	
Evidence-based healthcare management. Computer-assisted care improves outcomes in people with diabetes. Evidence-based Healthcare and Public Health 2004; 8(6): 355-6.			X	
Feghali M, Binstock A, Henderson J, Simhan H. 401: Pregnancy outcomes with telemedicine management in women with gestational diabetes mellitus. American Journal of Obstetrics and Gynecology 2019; 220(1):S273			X	
Gonçalves-Bradley DC, AR JM, Ricci-Cabello I, et al. Mobile technologies to support healthcare provider to healthcare provider communication and management of care. Cochrane Database Syst Rev 2020; 8(8): Cd012927.				This review includes the paper from Iversen et al 2020 (already included in our review)
Guljas R, Ahmed A, Chang K, Whitlock A. Impact of Telemedicine in Managing Type 1 Diabetes Among School-age Children and Adolescents: An Integrative Review. Journal of Pediatric Nursing 2014; 29(3): 198-204.			X	

Gupta R, Hussain A, Misra A. Diabetes and COVID-19: evidence, current status and unanswered research questions. Eur J Clin Nutr 2020; 74(6): 864-70.			X	
Haider R, Hyun K, Cheung NW, Redfern J, Thiagalingam A, Chow CK. Effect of lifestyle focused text messaging on risk factor modification in patients with diabetes and coronary heart disease: A sub-analysis of the TEXT ME study. Diabetes Research and Clinical Practice 2019; 153: 184-90.			X	
Harris LT, Tufano J, Le T, et al. Designing mobile support for glycemic control in patients with diabetes. Journal of Biomedical Informatics 2010; 43(5, Supplement): S37-S40.			X	
Heinemann L. AP@home: An European Project to Bring the Artificial Pancreas Home. IFAC Proceedings Volumes 2012; 45(18): 52-4			X	
Holtan A. Patient reactions to specialist telemedicine consultations--a sociological approach. J Telemed Telecare 1998; 4(4): 206-13.	X			
Hussain FN, Garvey KL, Karotkin L, et al. 1028 Managing gestational diabetes mellitus with telemedicine during COVID-19: was there an impact on pregnancy outcomes? American Journal of Obstetrics and Gynecology 2021; 224(2, Supplement): S636-S7			X	
inaldi G, Hijazi A, Haghparast-Bidgoli H. Cost and cost-effectiveness of mHealth interventions for the prevention and control of type 2 diabetes mellitus: A systematic review. Diabetes Research and Clinical Practice 2020; 162: 108084.			X	
Kampik T, Larsen F, Bellika JG. Internet-based remote consultations - general practitioner experience and attitudes in Norway and Germany. Studies in health technology and informatics 2015; 210: 452-4.	X			

Killebrew KD, Pedigo TL. Creating awareness of type 2 diabetes using videoconferencing technology. Journal of the American Dietetic Association 2003; 103: 102.			X	
Joiner KL, Nam S, Whittemore R. Lifestyle interventions based on the diabetes prevention program delivered via eHealth: A systematic review and meta-analysis. Preventive Medicine 2017; 100: 194-207.			X	
Lehmann ED, Deutsch T. Compartmental models for glycaemic prediction and decision-support in clinical diabetes care: promise and reality. Computer Methods and Programs in Biomedicine 1998; 56(2): 193-204			X	
Lunde P, Nilsson BB, Bergland A, Kværner KJ, Bye A. The Effectiveness of Smartphone Apps for Lifestyle Improvement in Noncommunicable Diseases: Systematic Review and Meta-Analyses. J Med Internet Res 2018; 20(5): e162.				This review includes the paper from Holmen et al 2014 (already included in our review)
Maramba I, Chatterjee A, Newman C. Methods of usability testing in the development of eHealth applications: A scoping review. International Journal of Medical Informatics 2019; 126: 95-104.			X	
Moradi F, Ghadiri-Anari A, Enjezab B. COVID-19 and self-care strategies for women with gestational diabetes mellitus. Diabetes & Metabolic Syndrome: Clinical Research & Reviews 2020; 14(5): 1535-9.			X	
Niznik JD, He H, Kane-Gill SL. Impact of clinical pharmacist services delivered via telemedicine in the outpatient or ambulatory care setting: A systematic review. Research in Social and Administrative Pharmacy 2018; 14(8): 707-17.			X	
Paccagnella A, Vigo C, Nollino L, et al. Chapter 5 - The Relationship Between the Organization of Services for the Treatment of Type 2 Diabetes and the Risk of Long-Term Complications. In: Watson RR, Dokken BB, eds. Glucose Intake and Utilization in Pre-Diabetes and Diabetes. Boston: Academic Press; 2015: 57-70			X	

Pérez-Ferre N, Galindo M, Fernández MD, et al. A Telemedicine system based on Internet and short message service as a new approach in the follow-up of patients with gestational diabetes. Diabetes Research and Clinical Practice 2010; 87(2): e15-e7.			X	
Petrelli F, Cangelosi G, Scuri S, et al. Diabetes and technology: A pilot study on the management of patients with insulin pumps during the COVID-19 pandemic. Diabetes Research and Clinical Practice 2020; 169: 108481.			X	
Rudnisky CJ, Tennant MTS, de Leon AR, Hinz BJ, Greve MDJ. Benefits of stereopsis when identifying clinically significant macular edema via teleophthalmology. Canadian Journal of Ophthalmology 2006; 41(6): 727-32			X	
Sayed S. COVID-19 and diabetes; Possible role of polymorphism and rise of telemedicine. Primary Care Diabetes 2021; 15(1): 4-9.			X	
Seidu S, Walker NS, Bodicoat DH, Davies MJ, Khunti K. A systematic review of interventions targeting primary care or community based professionals on cardio-metabolic risk factor control in people with diabetes. Diabetes Research and Clinical Practice 2016; 113: 1-13.			X	
Singh AK, Gupta R, Ghosh A, Misra A. Diabetes in COVID-19: Prevalence, pathophysiology, prognosis and practical considerations. Diabetes & Metabolic Syndrome: Clinical Research & Reviews 2020; 14(4): 303-10.			X	
Smith-Strøm H. Diabetic foot ulcers - predictors of healing time and aspects of telemedicine: University of Bergen; 2018.				This PhD thesis includes the articles from Smith-Strøm et al 2016, and Smith-Strøm et al 2018 (both already included in our review)

Su D, Zhou J, Kelley MS, et al. Does telemedicine improve treatment outcomes for diabetes? A meta-analysis of results from 55 randomized controlled trials. Diabetes Research and Clinical Practice 2016; 116: 136-48.			X	
Wootton R. Twenty years of telemedicine in chronic disease management--an evidence synthesis. J Telemed Telecare 2012; 18(4): 211-20			X	

Appendix 3. List of included articles

- Årsand E, Tatara N, Østengen G, Hartvigsen G. Mobile phone-based self-management tools for type 2 diabetes: the few touch application. *Journal of diabetes science and technology* 2010; **4**(2): 328-36.
- Birkeland KI. Some Lessons Learned About Diabetes and COVID-19 During the Early Stage of the Epidemic in Norway. *Journal of diabetes science and technology* 2020; **14**(4): 718-9.
- Hernández C, Alonso A, Garcia-Aymerich J, et al. Integrated care services: lessons learned from the deployment of the NEXES project. *Int J Integr Care* 2015; **15**: e006.
- 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. *JMIR Mhealth Uhealth* 2014; **2**(4): e57.
- 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). *JMIR Res Protoc* 2016; **5**(3): e148.
- 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). *BMC Endocr Disord* 2020; **20**(1): 157.
- Kolltveit BC, Gjengedal E, Graue M, Iversen MM, Thorne S, Kirkevold M. Telemedicine in diabetes foot care delivery: health care professionals' experience. *BMC Health Serv Res* 2016; **16**: 134.
- Kolltveit BH, Gjengedal E, Graue M, Iversen MM, Thorne S, Kirkevold M. Conditions for success in introducing telemedicine in diabetes foot care: a qualitative inquiry. *BMC Nurs* 2017; **16**: 2.
- Kolltveit BH, Thorne S, Graue M, Gjengedal E, Iversen MM, Kirkevold M. Telemedicine follow-up facilitates more comprehensive diabetes foot ulcer care: A qualitative study in home-based and specialist health care. *J Clin Nurs* 2018; **27**(5-6): e1134-e45.
- 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. *JMIR Res Protoc* 2013; **2**(2): e34.
- Rotvold GH, Knarvik U, Johansen MA, Fossen K. Telemedicine screening for diabetic retinopathy: staff and patient satisfaction. *J Telemed Telecare* 2003; **9**(2): 109-13.
- 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. *Diabetes Care* 2018; **41**(1): 96-103.
- Smith-Strøm H, Iversen MM, Graue M, Skeie S, Kirkevold M. An integrated wound-care pathway, supported by telemedicine, and competent wound management-Essential in follow-up care of adults with diabetic foot ulcers. *Int J Med Inform* 2016; **94**: 59-66.
- Torbjørnsen A, Jenum 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. *JMIR Mhealth Uhealth* 2014; **2**(4): e52.
- Torbjørnsen A, Småstuen MC, Jenum AK, Årsand E, Ribu L. Acceptability of an mHealth App Intervention for Persons With Type 2 Diabetes and its Associations With Initial Self-Management: Randomized Controlled Trial. *JMIR Mhealth Uhealth* 2018; **6**(5): e125.