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Austrian Institute for
Health Technology Assessment
GmbH

Telehealth in Diabetes

EU mapping and systematic evaluation of organizational aspects

Final report

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List of abbreviations

ABC ....Anna, Berta, Cäsar
DEF.................Dora, Emil, Friedrich
AIHTA ....Austrian Institute for Health Technology Assessment
AIT ....Austrian Institute of Technology GmbH
AWMF ....Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften
BfArM ....Bundesinstitut für Arzneimittel und Medizinprodukte (the Federal Institute for Drugs and Medical Devices)
BG.....................Blood glucose
BP ....Blood pressure
BVAEB.............Versicherungsanstalt öffentlich Bediensteter, Eisenbahnen und Bergbau
CES-D ....Center for Epidemiological Studies Depression
CG ....Control Group
CGM................Continuous Glucose Monitoring
CI......................Confidence Interval
DDS ....The Diabetes Distress Scale
DES ....Diabetes Empowerment Scale
DFU ....Diabetic Foot Ulcers
DHTs ....Digital health technologies
DiGA................Digitale Gesundheitsanwendungen (Digital Health Applications)
DM ....Diabetes mellitus
DMP................Disease Management Program
Dsat ....Insulin treatment satisfaction scale
DSMQ ....Diabetes Self-Management Questionnaire
DTSQ ....Diabetes Treatment Satisfaction Questionnaire
EQ-5D-5L ....the 5-level EuroQol 5-Dimension
GDA ....Gesundheitsdienstanbieter
GDDM ....Gesundheitsdialog Diabetes mellitus
GDM ....Gestational diabetes mellitus
GP.....................General Practitioner
GSE ....General Self-efficacy Scale
HCPs................Healthcare Professionals
IDF...................International Diabetes Federation
IG ....Intervention Group
IKT...................Informations- und Kommunikationstechnologien
IQR...................Interquartile range
LDL-c ....Low-density lipoprotein cholesterol
m-apps ....Mobile applications
MARS-5 ....the Medication Adherence Report Scale
MCS ....Mental Component Summary
mHealth ....Mobile health
MRC................Medical Research Council
NICE ....National Institute for Health and Care Excellence
NHS ....National Health Service
ÖGK.................Österreichische Gesundheitskasse
PAID ....Problem Areas in Diabetes
Pat. ....Patient*innen
PECAN ....prise en charge anticipée des dispositifs médicaux numériques
PSC ....Physical Component Summary
PHQ ....Patient Health Questionnaire
PROMs ....Patient Reported Outcomes
PwD..................People living with diabetes
QoL ....Quality of Life
RCT..................Randomized controlled trial
RQ ....Research questions
SBGM...............Self-Blood Glucose Monitoring
SD.....................Standard deviation
SDSCA.............Summary of Diabetes Self-Care Activities measure
SF-12 ....12-Item Short Form Health Survey
SF-36 ....36-Item Short Form Health Survey
SWEMWBS .....Short-Warwick-Edinburgh Mental Well-being Scale
T1DM ....Type 1 diabetes mellitus
T2DM ....Type 2 diabetes mellitus
TCOACH.........Telecoaching
TH ....Telehealth
TMON.............Telemonitoring
UK....................United Kingdom
USD ....United States Dollar
WHO ....World Health Organization
WHO-5............The WHO-5 well-being scale

Executive Summary

Introduction

increasing Global Burden of Diabetes

Type 2 diabetes mellitus (T2DM) represents a growing chronic disease worldwide. In Europe, approximately 59.3 million people were affected in 2019, with projections indicating an increase to 68.1 million by 2045. Despite numerous telehealth products available for people living with diabetes (PwD), there remains uncertainty about optimal telemedical program design in Europe and experiences of PwD and healthcare professionals (HCPs).

Methods

online survey and scoping review conducted

This study employed two complementary approaches: an online survey through the International Diabetes Federation Europe (IDFE) in April 2024, and a scoping review updating a previous AIHTA report from 2022. The systematic literature search was conducted in five databases: MEDLINE, EMBASE, Cochrane Library, PsycINFO, and INAHTA.

Results

Identified Programs and Technologies

24 unique DHTs identified through a survey and literature review

The survey received 26 responses from ten European countries. After excluding applications for Type 1 diabetes, general online clinics, standalone apps without professional support, and programs under clinical trials, nine digital health technologies (DHTs) were selected. The literature review identified 17 studies meeting eligibility criteria, documenting 16 unique DHTs. One DHT was identified in both the survey and literature review, bringing the total unique DHTs to 24. Studies included 11 randomized con-trolled trials, 3 pre-post studies, and 3 observational studies, with participant numbers ranging from 30 to 484 and follow-up periods of 2-24 months.

Organizational Characteristics

DHTs categorized into treatment support, behavioral change, and supportive care, with varying healthcare professional (HCPs) roles and contact frequencies

The identified DHTs were categorized into three main areas based on their functions and aims. Treatment support programs focused on clinical data telemetry and insulin dose management, enabling PwD to transmit blood glucose measurements for remote monitoring and treatment optimization. Behavioral change programs offered remote dietary management and physical activity support, incorporating comprehensive monitoring of physiological parameters and activity data. Other supportive care included diabetic foot ulcer monitoring and pharmaceutical tele-coaching. HCPs involvement varied by program type: physicians predominantly managed treatment support programs, while dieticians and diabetes consultants led behavioural change programs. Contact frequency ranged from as needed to scheduled weekly or monthly interactions.

Reimbursement

Five DHTs across three European countries had clearly defined reimbursement models. In France, coverage costs were determined through the PECAN system based on individual patient conditions. The German system included three DHTs registered in the DiGA directory, with quarterly costs ranging from 220 to 479 euros. In the UK, specific applications received NHS coverage, though availability varied by region.

5/24 DHTs are currently reimbursed in Europe

Process Evaluation

Nine studies reported process evaluation results. Treatment support technologies showed wide variation in adherence rates (11-75%), with insulin titration programs demonstrating higher engagement. Behavioral interventions reported dropout rates between 13.2%-26.6%, primarily due to loss of interest, health issues, and technical difficulties. Technology use varied significantly: treatment support applications averaged 1-3 messages between PwD and physicians, while behavioral change programs recorded more intensive engagement, including an average of 215 meal photos uploaded over three months.

adherence and engagement vary widely

Patient-Reported and Organizational Outcomes

Nine studies assessed various outcomes using validated instruments. Quality of life measurements using EQ-5D-5L showed no significant differences in treatment support programs, while three of four behavioral change pro-grams reported some improvements. Studies examining engagement, self-management, and well-being generally showed positive trends but lacked statistical significance. Treatment satisfaction significantly improved in one study after six months of intervention.

mixed results with limited significance

Organizational outcomes

Six studies evaluated organizational impacts, revealing significant reductions in hospital stay duration for intervention groups (7.1 vs 13.4 days over 12 months). Medication use improved in intervention groups, with 15% reducing glucose-lowering medication compared to 2% in control groups. Cost analyses showed additional expenses for telemedical consultations (approximately € 259 per patient over six months) but significantly lower direct costs for diabetic foot ulcer-related care (€ 3,471 vs € 7,185).

reduced hospital stays, medication use, and cost savings for diabetic foot ulcer care

Acceptance and Experiences

Assessment through multiple studies showed generally positive reception from both PwD and HCPs. The majority of participants (98%) reported easy daily integration, while 80% of physicians noted improved glucose monitoring and patient communication. Technical issues and the need for feedback from HCPs were identified as key challenges. HCPs' satisfaction was notable, with 85% of responding physicians successfully integrating the technologies into their practice.

positive reception from patients and HCPs, with challenges in technical issues and need for feedback from HCPs

Discussion and Conclusions

In the implementation of telehealth for diabetes, it must be considered that various approaches exist – not only DHTs for data transfer between HCPs and PwD, but also innovative approaches such as nutritional counselling via apps.

telehealth: increasingly multiprofessional

Regarding the reimbursement of telehealth services, a fundamental decision is required on whether to reimburse only the applications themselves (as in the German model) or to also compensate for telemonitoring services provided (as in the French approach). The choice of reimbursement model can impact the acceptance and adoption of telehealth programs and should therefore be carefully considered. It may be desirable to incorporate it into a care program rather than a separate reimbursement.

reimbursement: monitoring services in addition to technology

Given the variable therapy adherence and barriers identified in studies (including technical problems), continuous monitoring of adherence, patient experience, and technical performance of digital technologies is essential. Only through such monitoring can problems be identified and addressed promptly to ensure the effectiveness and acceptance of interventions in practice.

monitoring of adherence, patient experience and technical problems

As recommended in the previous report regarding the measurement of organizational and social effects of telemedicine, attention should be focused on the impacts of telemedicine implementation on healthcare systems, such as medical staff response times, consultation patterns, and changes in overall healthcare costs. The measurement of these organizational outcomes is important for understanding the broader implications of telehealth integration into the healthcare system.

analysis of the organizational impact is important

Zusammenfassung

Hintergrund

Diabetes mellitus Typ 2 (T2DM) stellt eine weltweit zunehmende chronische Erkrankung dar. In Europa waren 2019 etwa 59,3 Millionen Menschen betroffen. Bis 2049 wird eine Steigerung auf 68,1 Millionen prognostiziert. Derzeit sind viele telemedizinische Technologien für Diabetes-Patient*innen verfügbar. Einige Studien zeigen dabei positive Effekte auf den HbA1c-Wert (glykiertes Hämoglobin) – insbesondere bei Programmen mit Medikamentenunterstützung und Interaktion mit medizinischem Fachpersonal (Healthcare Professionals, HCP). Dennoch besteht Unklarheit über die optimale Gestaltung telemedizinischer Programme in Europa sowie die Erfahrungen von Patient*innen und Gesundheitsdienstanbieter*innen (GDA).

T2DM in Europa: 59,3 Mio Betroffene, Anstieg bis 2045 Prognostiziert

Telemedizin: positive HbA1c-Effekte, optimale Gestaltung noch unklar

Methoden

Zur Identifizierung und Analyse telemedizinischer Programme wurden zwei komplementäre methodische Ansätze genutzt: Einerseits wurde eine Online-Umfrage im April 2024 über die International Diabetes Federation Europe (IDFE) durchgeführt. Die Distribution der Umfrage erfolgte über den IDFE-Newsletter. Ziel war die Erfassung von Technologien, die aktuell in europäischen telemedizinischen Versorgungsprogrammen implementiert sind bzw. zum Einsatz kommen. Der Schwerpunkt lag dabei auf digitalen Gesundheitstechnologien, die eine bidirektionale Kommunikation zwischen Patient*innen und GDA ermöglichen. Andererseits wurde ein Scoping Review durchgeführt, der einen AIHTA-Bericht zur Telemedizin in der Diabetesversorgung aus dem Jahr 2022 aktualisierte. Die systematische Literatursuche umfasste fünf medizinische Datenbanken. Die Studienselektion erfolgte durch zwei Wissenschafter*innen.

2 methodische Ansätze: IDFE-Umfrage 2024 Scoping Review als Update

Nach Identifizierung der digitalen Gesundheitstechnologien wurden Daten zu organisatorischen Rahmenbedingungen, Erstattung, Prozessevaluierungsindikatoren, patient*innenberichteten Ergebnissen und Implementierungserfahrungen extrahiert. Es folgte eine narrative Synthese der Ergebnisse. Alle Arbeitsschritte erfolgten im VierAugen-Prinzip.

Fokus: organisatorische Aspekte

Ergebnisse

Identifizierte telemedizinische Programme und Technologien

Die Untersuchung stützt sich auf Rückmeldungen aus zehn europäischen Ländern, mit insgesamt 26 eingegangenen Antworten. Aus diesen wurden nach sorgfältiger Prüfung neun digitale Gesundheitstechnologien (engl. digital health technologies, DHTs) für die weitere Analyse ausgewählt. Nicht berücksichtigt wurden dabei Anwendungen für Typ-1-Diabetes, reine Online-Kliniken sowie eigenständige Apps, die ohne professionelle Begleitung auskommen.

Umfrage: 26 Antworten aus 10 Ländern zu 9 Technologien inkludiert

Außerdem wurden durch eine umfassende Literaturrecherche weitere 17 Studien identifiziert, die den Einschlusskriterien entsprachen. In diesen Studien wurden 16 DHTs beschrieben, von denen eine bereits im Zuge der Online-Umfrage identifiziert wurde. Die Studien stammten aus verschiedenen europäischen Ländern und wiesen unterschiedliche Studiendesigns auf, die von

15 weitere Technologien durch Literatursuche identifiziert

randomisierten kontrollierten Studien bis hin zu Beobachtungsstudien reichten. Die Teilnehmer*innenzahlen variierten zwischen 30 und 484 Personen, mit Nachbeobachtungszeiträumen von zwei bis 24 Monaten.

Organisatorische Rahmenbedingungen der Programme

Die identifizierten DHTs lassen sich in drei Hauptkategorien einteilen: Behandlungsunterstützung, Verhaltensänderung und sonstige unterstützende Versorgung. Die Behandlungsunterstützung dreht sich vor allem um die Fernüberwachung klinischer Werte und die Anpassung der Insulindosis. Bei den Verhaltensänderungen steht im Mittelpunkt, wie sich Patient*innen besser ernähren und mehr bewegen können. Der dritte Bereich – die unter-stützende Versorgung – umfasst die Überwachung von diabetischen Fußulzera und pharmazeutisches Telecoaching.

3 Kategorien telemedizinischer Versorgung: Behandlung, Verhaltensänderung, Unterstützung

Je nach Art des Programms unterscheidet sich die personelle Besetzung: In der Behandlungsunterstützung sind es vorwiegend Ärzt*innen, während bei Programmen zur Verhaltensänderung hauptsächlich Ernährungs- und Diabetesberater*innen zum Einsatz kommen. Wie oft die Patient*innen Kontakt mit den Fachkräften haben, ist unterschiedlich geregelt – manchmal nach Bedarf, manchmal in festen wöchentlichen oder monatlichen Abständen.

Personaleinsatz und Kontaktfrequenz programmbezogen

Die technische Basis bilden üblicherweise Computer-Systeme für die medizinischen Fachkräfte und Smartphone-Apps für die Patient*innen. Je nach Schwerpunkt des Programms kommen verschiedene Zusatzgeräte zum Einsatz – von Blutzuckermessgeräten über Aktivitätstracker bis hin zu Waagen. Auch bei den Schulungsangeboten gibt es deutliche Unterschiede: Manche Programme setzen auf umfassende Schulungsinhalte, andere beschränken sich im Wesentlichen darauf, Daten zu übertragen und zu überwachen.

technische Ausstattung: PC für Personal, Apps für Patient*innen, Peripheriegeräte, Schulungsmodule

Erstattung

Bei fünf DHTs, die in drei europäischen Ländern bereits im Einsatz sind, konnten die Vergütungsmodalitäten ermittelt werden. In Frankreich wird myDiabby von der Krankenversicherung erstattet, wobei sich die Höhe der Telemonitoring-Kosten nach dem spezifischen Zustand der Patient*innen richtet. Das deutsche DiGA-Verzeichnis listet drei digitale Gesundheitsanwendungen: Vitadio und My Dose Coach mit vorläufiger sowie Oviva mit dauerhafter Aufnahme. Im Vereinigten Königreich trägt das NHS die Kosten für Oviva. Das Liva-Programm zur Gewichtskontrolle wird in bestimmten britischen Regionen – Lancashire und South Cumbria – ebenfalls vom NHS übernommen. Die Preise zwischen den Ländern lassen sich allerdings nicht direkt vergleichen, da die Gesundheitssysteme zu unterschiedlich aufgebaut sind.

Refundierung von digitalen Diabetes-Technologien: 1 in FR refundiert 3 in DE gelistet 2 in UK erstattet

Prozessevaluierung

Von den 17 in der Übersichtsarbeit eingeschlossenen Studien berichteten neun über Prozessevaluierungsergebnisse. Die Bewertung konzentrierte sich auf drei Hauptbereiche: Programmadhärenz, Aktivitäten der Gesundheitsdienstleister und die Technologienutzung durch Patient*innen.

Prozessevaluation in 9 von 17 Studien:

Sieben Studien, darunter fünf randomisiert kontrollierte, untersuchten die Programmadhärenz – also wie gut die Patient*innen bei den Programmen mitarbeiteten. Bei den Technologien zur Behandlungsunterstützung schwankte diese Mitarbeit stark – zwischen 11 % und 75 %. Programme zur Verhaltensänderung brachen zwischen 13,2 % und 26,6 % der Teilnehmenden ab. Die Gründe dafür waren meist schwindendes Interesse, gesundheitliche Einschränkungen oder Probleme mit der Technik.

Adhärenz-Spanne: 11-75 %

Die Technologienutzung wurde in vier Studien untersucht. Als Bewertungskriterien dienten die Anzahl der mit Ärzt*innen ausgetauschten Nachrichten, die Häufigkeit der Gerätenutzung sowie wie regelmäßig Daten wie Blutzuckerwerte und Essensfotos hochgeladen wurden.

Technologienutzung

Eine Studie erfasste den zeitlichen Aufwand der Ärzt*innen: Sie widmeten der Kommunikation durchschnittlich fünf Minuten pro Patient*in und Woche. Bei allen betreuten Patient*innen summierte sich dies auf etwa zwei Stunden pro Woche.

Zusätzliche Arbeitsbelastung der GDA

Patient*innenberichtete Outcomes

Von den 17 untersuchten Studien berichteten neun über patient*innenberichtete Ergebnisse. Die Bewertung umfasste verschiedene Aspekte: Lebensqualität (QoL), Engagement/Empowerment, Selbstmanagement, Belastung, Selbstwirksamkeit, Wohlbefinden, Behandlungszufriedenheit und psychische Gesundheitssymptome.

Patient*innenberichtete Endpunkte in 9 von 17 Studien

Bei den behandlungsunterstützenden Technologien untersuchten zwei Studien die Auswirkungen auf die *Lebensqualität* mittels EQ-5D-5L, wobei keine statistisch signifikanten Gruppenunterschiede festgestellt wurden. Bei den verhaltensändernden Technologien berichteten drei von vier Stu-dien über eine gewisse Programmwirksamkeit bezüglich der Lebensqualität. Das *Engagement und Empowerment* wurde in zwei randomisierten kontrollierten Studien untersucht. Zwar verbesserten sich die Werte, doch ließen sich keine signifikanten Unterschiede zwischen den Gruppen nachweisen. Ähnlich verhielt es sich beim Selbstmanagement, das in drei Studien untersucht wurde – wiederum blieben statistisch bedeutsame Verbesserungen aus. Auch bei der *diabetesbezogenen* Belastung, die zwei Studien untersuchten, zeigte der Vergleich der Gruppen keine statistisch bedeutsamen Unterschiede.

Patient*innenberichtete Endpunkte: mehrheitlich keine signifikanten Effekte

Eine Studie untersuchte die *Selbstwirksamkeit* mittels der allgemeinen Selbstwirksamkeitsskala, konnte aber keine statistisch signifikanten Gruppenunterschiede feststellen. Drei Studien bewerteten das *Wohlbefinden* mit verschiedenen Messinstrumenten, keine davon zeigte signifikante Effekte. Die *Behandlungszufriedenheit* wurde in zwei Studien untersucht: Eine Studie fand keine signifikanten Gruppenunterschiede, während die andere eine signifikante Verbesserung nach sechs Monaten feststellte. Eine Studie untersuchte *psychische Gesundheitssymptome*, konnte jedoch keine signifikante Verbesserung nachweisen.

signifikante Verbesserung unter anderem bei Therapiezufriedenheit

Organisatorische Endpunkte

Von den 17 untersuchten Studien berichteten sechs über organisatorische Endpunkte. Dazu zählen die Krankenhausaufenthaltsdauer, Medikamentennutzung, Häufigkeit von Besuchen bei Ärzt*innen, Medikamentenadhärenz und medizinische Kosten.

Organisatorische Endpunkte in 6 von 17 Studien:

Die *Krankenhausaufenthaltsdauer* war in der Interventionsgruppe signifikant niedriger. Bei der Medikamentennutzung zeigte eine von zwei Studien, dass 15 % der Interventionsgruppe ihre blutzuckersenkende Medikation reduzierten, verglichen mit 2 % in der Kontrollgruppe. Studien zu ärztlichen Besuchen und Medikamentenadhärenz ergaben keine signifikanten Unterschiede. Bezüglich der *medizinischen Kosten* entstanden zusätzliche Kosten für telemedizinische Beratung über sechs Monate, jedoch waren die diabetischen Fußulzera-bezogene Direktkosten in der Interventionsgruppe signifikant niedriger.

kürzere Aufenthaltsdauer im Krankenhaus, weniger Medikamente und geringere Fußulzerakosten trotz Mehrkosten durch Telemedizin

Akzeptanz und Erfahrungen

Akzeptanz in 6 Studien:

Die quantitative und qualitative Bewertung der Akzeptanz erfolgte in vier RCTs und zwei Prä-Post-Studien. In einer Studie wurden fünf Teilnehmer*innen interviewt. Alle berichteten von einer einfachen Einrichtung der App, vier fanden die Tracking-Funktion nützlich und würden die App weiter nutzen.

hohe Zufriedenheit trotz technischer Schwierigkeiten

Eine Studie führte qualitative telefonische Interviews mit 20 Patient*innen und einer Ärztin durch. Der häufigste Wunsch (8 von 20 Teilnehmer*innen) war der Kontakt mit GDA für Feedback. Mehr als die Hälfte (12 von 20) berichtete von technischen Problemen. Neun von 20 Teilnehmer*innen erhielten nach eigener Einschätzung gute und relevante Antworten. In einer Prä-Post-Studie bewerteten 60 % der Ärzt*innen die Umsetzbarkeit im Alltag positiv. 80 % stellten Verbesserungen beim Glukosemonitoring und in der Kommunikation mit den Patient*innen fest. Auf Seiten der Patient*innen bewerteten 98% die Einbindung in ihren Alltag als unkompliziert. Eine weitere Studie bestätigte die hohe Zufriedenheit – 97,4 % waren mit der Gerätenutzung und der Zusammenführung der Telemonitoring-Daten zufrieden.

Diskussion und Schlussfolgerungen

Telemedizin: zunehmend multiprofessionell

Bei der Implementierung von Telemedizin für Diabetes müssen verschiedene Ansätze berücksichtigt werden. Diese reichen von Technologien für den Datenaustausch zwischen medizinischem Personal und Patient*innen bis hin zu innovativen Beratungsformen wie digitale Ernährungsberatung.

Erstattung: neben Technologie auch Monitoring-Leistungen

Eine zentrale Herausforderung ist die Gestaltung des Vergütungssystems. Hier sollte grundlegend entschieden werden, ob nur die digitalen Anwendungen selbst (nach deutschem Modell) oder auch die Telemonitoring-Dienstleistungen (nach französischem Modell) vergütet werden sollen. Die Entscheidung für ein bestimmtes Vergütungsmodell kann einen Einfluss darauf haben, wie gut die Programme angenommen und genutzt werden. Statt einer separaten Vergütung könnte es sinnvoller sein, diese Angebote in die bereits bestehenden Versorgungsprogramme zu integrieren.

Monitoring von Adhärenz, Patient*innenerfahrung und technische Probleme: Analyse der organisatorischen Auswirkungen wichtig

Für den nachhaltigen Erfolg telemedizinischer Interventionen müssen mehrerer Faktoren laufend überwacht werden: die Therapieadhärenz, Patient*innenerfahrungen und die technische Leistungsfähigkeit der digitalen Systeme. Nur wenn diese Faktoren erfasst werden, lassen sich Probleme früh erkennen und beheben. Darüber hinaus sollten die organisatorischen Auswirkungen auf das Gesundheitssystem, wie Reaktionszeiten des medizinischen Personals, Veränderungen in Konsultationsmustern und Entwicklung der Gesundheitskosten, systematisch erfasst und analysiert werden.

1 Introduction

1.1 Diabetes mellitus

Diabetes mellitus (DM) refers to a group of metabolic disorders characterized by chronically elevated blood glucose levels. This condition arises either from insufficient insulin production or from the body's ineffective utilization of this hormone. Insulin, a crucial hormone produced by the pancreas, facilitates the uptake of glucose from the bloodstream into cells for energy conversion or storage. Additionally, insulin plays a vital role in protein and fat metabolism. When there is a deficiency of insulin or cells fail to respond appropriately to insulin, hyperglycemia (elevated blood glucose levels) occurs, which serves as the diagnostic criterion for diabetes [1]. The diagnostic thresholds for diabetes are illustrated in Figure 1-1.

Diabetes mellitus: Stoffwechselstörung mit erhöhtem Blutzucker

Test	**Diabetes** Should be diagnosed if ONE OR MORE of the following criteria are met	**Impaired Glucose Tolerance (IGT)** Should be diagnosed if BOTH of the following criteria are met	**Impaired Fasting Glucose (IFG)** Should be diagnosed if THE FIRST OR BOTH of the following are met
Fasting plasma glucose	**≥7.0 mmol/L** (126 mg/dL)	**<7.0 mmol/L** (126 mg/dL)	**6.1 – 6.9 mmol/L** (110 – 125 mg/dL)
	or	and	and if measured
Two-hour plasma glucose after 75g oral glucose load (oral glucose tolerance test (OGTT))	**≥11.1 mmol/L** (200 mg/dL)	**≥7.8 and <11.1 mmol/L** (140–200 mg/dL)	**<7.8 mmol/L** (140 mg/dL)
	or		
HbA1c	**≥48 mmol/mol** (equivalent to 6.5%)		
	or		
Random plasma glucose in the presence of symptoms of hyperglycaemia	**≥11.1 mmol/L** (200 mg/dL)		

Fasting is defined as no caloric intake for at least eight hours.

The HbA1c test should be performed in a laboratory using a method that is NGSP-certified and standardised to the Diabetes Control and Complications Trial assay.

The two-hour postprandial plasma glucose test should be performed using a glucose load containing the equivalent of 75-g anhydrous glucose dissolved in water.

In the absence of symptoms of hyperglycaemia, two abnormal tests are required for the diagnosis of diabetes mellitus.

The American Diabetes Association (ADA) recommends diagnosing "prediabetes" with HbA1c values between 39 and 47 mmol/mol (5.7–6.4%) and impaired fasting glucose when the fasting plasma glucose is between 5.6 and 6.9mmol/L (100–125mg/dL).

Figure 1-1: Modified diagnostic criteria for diabetes (cited from IDF Atlas 10th edition) [4]

Individuals with diabetes are at a higher risk of developing severe health complications, leading to increased medical costs, diminished quality of life, and higher mortality rates [2]. Persistent hyperglycemia causes widespread vascular damage, affecting the heart, eyes, kidneys, and nerves, which results in various complications [3]. The International Diabetes Federation (IDF) has reported that there are 537 million people (age-adjusted prevalence rate: 9.8%) aged 20 to 79 living with diabetes in the world and it is responsible for 6.7 million deaths in 2021. This number of people living with diabetes (PwD) is predicted to rise to 643 million by 2030 and 783 million by 2045 [4]. The long-term nature of diabetes treatment and the potential for complications result in substantial medical costs associated with the disease. In Europe, approximately 61 million people were living with diabetes in 2021 [4].

Diabetes Prävalenz weltweit: 537 Millionen

Europa (2021): 61 Millionen

In Austria, as of 2021, approximately 450,000 individuals (age-adjusted prevalence rate: 4.6%) were diagnosed with diabetes, with an additional estimated 150,000 cases remaining undiagnosed [1]. While these figures of Austria are relatively low by global standards, the patient population is expected to increase in the coming years, making diabetes a persistent healthcare challenge.

Österreich (2021): 450.000 diagnostizierte und geschätzt 150.000 undiagnostiziert

Diabetes mellitus is classified into four categories based on its etiology: (1) Type 1 diabetes mellitus (T1DM), (2) Type 2 diabetes mellitus (T2DM), (3) Gestational diabetes mellitus (GDM), and (4) Other specific types of diabetes (e.g., Drug and chemical-induced diabetes or caused by diseases of the pancreas). In T2DM, hyperglycemia occurs primarily because the body's cells become less responsive to insulin, a phenomenon known as insulin resistance. As insulin resistance sets in, the hormone becomes less efficient, leading to a compensatory increase in insulin production. However, over time, the pancreatic beta cells may fail to meet this increased demand, resulting in insufficient insulin production [4]. T2DM is the most common type of diabetes, accounting for over 90% of all diabetes worldwide [4]. This rise can be linked to several factors, including population ageing, accelerated urbanization, and environments that promote obesity [5]. These societal changes have led to more sedentary lifestyles and increased consumption of unhealthy foods. Additionally, improvements in early detection and more effective diabetes management have resulted in better survival rates and reduced premature mortality, further contributing to the growing prevalence [6].

4 Diabetes-Typen: T1DM, T2DM, GDM sowie andere spezifische Formen

Effective diabetes management plays a vital role in ameliorating symptoms and preventing the development of diabetes-related complications. For the management of T2DM, IDF issued the IDF Clinical Practice Recommendations for Managing Type 2 Diabetes in Primary Care in 2017 [7]. According to the recommendations, the foundation of T2DM management is promoting a healthy lifestyle, which includes a balanced diet, regular physical activity, smoking cessation, and maintaining a healthy weight. If lifestyle modifications alone do not achieve adequate glycemic control, oral pharmacotherapy, typically starting with metformin as the first-line agent, is usually initiated. When monotherapy is insufficient, a variety of combination therapy options are available, including sulfonylureas, alpha-glucosidase inhibitors, thiazolidinediones, dipeptidyl peptidase-4 (DPP-4) inhibitors, glucagon-like peptide-1 (GLP-1) agonists, and sodium-glucose cotransporter 2 (SGLT2) inhibitors.

Behandlungsziele: Symptomfreiheit, Vermeidung akuter Komplikationen sowie schwerwiegender Folgeerkrankungen

Interventionen: Lebensstilveränderungen vor Pharmakotherapie

In cases where glycemic control cannot be achieved with non-insulin therapies, insulin injections may be required to bring blood glucose levels within the recommended range. Furthermore, it is crucial not only to manage blood glucose (BG) levels but also to control blood pressure (BP) and low-density lipoprotein cholesterol (LDL-c) levels, regularly assessing these risk factors at least once a year. Regular screening for early diabetes-related complications such as kidney disease, retinopathy, neuropathy, peripheral artery disease, and foot ulcers allows for preventive treatments, potentially preventing or delaying the onset and progression of these complications. With consistent monitoring, effective lifestyle management, and pharmacotherapy, when necessary, patients with T2DM can lead long and healthy lives.

regelmäßiges Screening auf Komplikationen: Nieren, Retinopathie, Neuropathie etc.

1.2 Telehealth for Diabetes

1.2.1 Definitions

In recent years, various terms such as telehealth, telemedicine and eHealth, have been frequently used to describe the application of digital technologies for health purposes. The World Health Organization (WHO), in its 2019 guidelines, has consolidated the use of information and communication technologies to support health and health-related fields under the term "e-health." Mobile health (mHealth) is defined as a subset of eHealth, referring to "the use of mobile wireless technologies for health." [8] More recently, the term digital health has been introduced as a broader, more comprehensive term that encompasses eHealth (including mHealth) along with new fields such as the use of advanced computational sciences in big data, genomics, and artificial intelligence. Furthermore, in another set of guidelines, WHO defines telemedicine as [9]:

Telehealth (TH): Gesundheitsdienste zwischen Patient*innen und Gesundheitsdienst-anbieter*innen (GDA) nicht am selben Ort

> *"**Telemedicine** is defined as the delivery of health-care services where distance is a critical factor, by all health-care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries all in the interests of advancing the health of individuals and their communities."*

While the evolution of digital technologies has also introduced new terminologies and operational considerations, the underlying principle of telemedicine is the provision of remote health-care services through digital tools. WHO also defines telehealth as [9]:

> *"Telemedicine is a component of **telehealth**, which is a broader application of technologies to distance education and other applications wherein electronic communications and information technologies are used to support health-care services"*

In essence, **telehealth** solutions incorporate a wide range of technologies and delivery modes, including monitoring, education, consultation services, coaching, and counseling (Consultations and remote monitoring). These solutions are often composed of various combinations of services, such as simple reminders via text messaging, video consultations, and transmission of patient data (including blood glucose levels, blood pressure, dietary and medication intake, physical activity levels, etc.) with feedback from healthcare professionals through web portals or telephone (transmission of medical data).

neue Informations- und Kommunikations-technologien (IKT) sind wesentlicher Bestandteil

There are high expectations associated with the implementation of telemonitoring: The frequency of communication and interaction between a patient/citizen and their treating medical professionals may be increased, thereby improving the continuity of care (as well as prevention and rehabilitation) for people with chronic conditions. This is expected to improve the quality of medical care for these patients while simultaneously reducing the frequency and duration of hospital stays and reduce costs for healthcare system. [10].

Kontakt zwischen Patient*innen und GDA soll intensiviert werden

1.2.2 Telehealth in Diabetes Care

The treatment of diabetes requires lifelong therapy with medical consultations and examinations. A recent (2023) AWMF-S3 (Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften) guideline recommends, among other things [11]:

AWMF-Empfehlungen (2023) beinhalten auch digitale Unterstützung:

- Initially and throughout the course of the disease, establishing and prioritizing individual therapeutic goals together (Recommendation grade: A),
- Regularly evaluating and adjusting therapeutic goals during treatment as needed (Recommendation grade: A),
- When therapeutic goals are not met, identifying and addressing the causes from both the patient and provider perspectives (Recommendation grade: A), and
- Only when non-medicinal measures have been exhausted does the AWMF-S3 guideline indicate additional drug therapies (Recommendation grade: A).
- Through technological advances, therapy and monitoring of health parameters such as blood pressure (BP), blood glucose (BG), and body weight for PwD is now possible remotely, particularly with digital support. This is expected to intensify therapeutic contact, improve self-management, and enable better overall achievement of individual therapeutic goals.

Intensivierung der therapeutischen Kontakte

TH in der Diabetes-Versorgung könnte dabei und Selbstmanagement verbessern

In addition to these therapeutic recommendations, promoting a healthy lifestyle is essential for T2DM management [7]. Therefore, self-management strategies are considered an important component of diabetes treatment and are associated with improved health-related outcomes [12]. One potential solution for continuously supporting T2DM self-management and treatment is the utilization of telehealth. As T2DM is a chronic disease requiring management both within healthcare facilities as well as in people's daily lives, telehealth is considered a viable approach to provide both PwD and Healthcare Professionals (HCPs) with appropriate treatment and self-management support [13, 14].

T2DM-Management: Lebensstil und Selbstmanagement zentral

Telehealth interventions for PwD range from simple reminder systems to complex digital applications. These complex digital applications enable PwD to share data collected at home – including blood glucose measurements, medication adherence, dietary habits, activity levels, and medical history – with HCPs, who can provide feedback on medication usage and lifestyle modifications [15]. Telehealth interventions implement various methodologies, including regular telephone or video consultations, telemonitoring of physical data, virtual training and remote coaching, and online nutritional and exer-

TH: von Erinnerungen bis Datenaustausch mit Gesundheitspersonal

cise guidance. Through these interventions, it becomes possible to evaluate and verify the effectiveness of self-monitoring blood glucose frequency, physical activity, and adherence to clinical dietary recommendations [16].

Telebiometrie: Übertragung von Blutzucker-, Blutdruck- und Gewichtswerten

The measurement, reliable transmission, and monitoring of patients' physical parameters (such as blood pressure, blood glucose levels, and weight) is also called "telebiometry" [17]. In blood glucose management specifically, this includes the utilization of Continuous Glucose Monitoring (CGM) systems and the transmission of Self-Blood Glucose Monitoring (SBGM) data, enabling remote assessment of glycemic control [16]. Additionally, mobile applications (m-apps) are widely employed in diabetes management. These applications incorporate features such as insulin administration recording tools (including bolus calculators), carbohydrate calculation information, and automated blood glucose feedback functions. The collected health data can be converted into transferable formats and shared with HCPs (subject to consent by the patients) [16]. Thus, telehealth for T2DM implements diverse interventions, and research is currently ongoing to validate their effectiveness on clinical outcomes [18].

Evaluation: zusätzlich zu klinischen Endpunkten auch Patient*innenerfahrungen

However, it is challenging to evaluate telehealth programs solely based on clinical indicators such as improvements in HbA1c or blood glucose levels. Therefore, it is recommended to measure patient experiences using tools such as Patient Reported Outcomes (PROMs) to complement these clinical assessments [19, 20].

1.3 Evaluation of complex interventions

komplexe Interventionen: durch breite Fragestellung größere Schwankungsbreite der Ergebnisse

Complex interventions play a vital role in the health and social care services, public health practice, and other areas of social and economic policy that have consequences for health [21]. Complex interventions are characterized by intricate interactions with their specific contexts – the particular circumstances in which they are conceived, developed, and implemented [22-25]. Telehealth interventions, incorporating the transmission of physical parameters, telemonitoring capabilities, and online educational systems, can be one of such complex interventions, and understanding these contextual interactions has become increasingly essential in contemporary healthcare research and implementation.

Wirksamkeit abhängig von verschiedenen Mechanismen und Kontextfaktoren

The effectiveness of complex interventions heavily depends on two fundamental aspects: the mechanisms of change that drive the intervention's impact and the contextual factors that influence its outcomes. This dual focus represents a significant shift from traditional research approaches, which primarily emphasized measuring effectiveness in controlled settings. Modern evaluation frameworks acknowledge that while measuring effectiveness remains important, it should not be the sole focus of intervention assessment. Instead, a more comprehensive approach is needed that examines how interventions function in real-world settings, what resources are required for successful implementation, and how different contexts affect outcomes. This broader perspective encompasses understanding the theoretical foundations of interventions, their mechanisms of change, and their interactions with wider systems [21].

This evolution in approach reflects a growing recognition that the questions relevant to healthcare decision-makers often extend beyond simple measures of effectiveness. Understanding how and why interventions work in different contexts provides more valuable insights than merely knowing whether they work under controlled conditions. This comprehensive understanding enables better design and implementation of healthcare interventions, ultimately leading to more effective and sustainable healthcare solutions [21].

Fokus auf Wirksamkeit unter realen Bedingungen

According to the UK Medical Research Council (MRC) guidelines for developing and evaluating complex interventions [21], the evaluation of complex interventions can be divided into the following phases, which need not necessarily be sequential:

Leitlinie des britischen Medical Research Council (MRC) empfiehlt

- Development or identification of an intervention
- Assessment of feasibility of the intervention and evaluation design
- Evaluation of the intervention
- Impactful implementation

In each phase, six core elements should be considered to answer the following questions:

Unterteilung der Evaluation in Phasen und Berücksichtigung des Kontexts

- How does the intervention interact with its context?
- What is the underpinning programme theory?
- How can diverse stakeholder perspectives be included in the research?
- What are the key uncertainties?
- How can the intervention be refined?
- What are the comparative resource and outcomes consequences of the intervention?

1.4 Aims of this study

So far, many digital health technologies (DHTs) for telehealth programs for T2DM have been developed and investigated. However, the landscape of programs being researched, developed, implemented, and reimbursed across Europe remains insufficiently understood and documented. The objective of this project is to comprehensively document and analyze telehealth programs for PwD throughout Europe.

Ziel des Berichts: Übersicht zu telemedizinischen Versorgungsprogrammen und Technologien in Europa

This study will update the previous report [26] and concentrate on programs that facilitate interaction and communication between PwD and HCPs, recognizing that these telehealth initiatives often employ DHTs with varying degrees of interactivity. These technologies may interact not only with HCPs but also with other healthcare systems and devices, creating a complex ecosystem of care.

We will summarize of the following aspects:

Fokus: organisatorische Rahmenbedingungen

- Organizational features, including the types and frequency of interactions between PwD and HCPs, as well as the integration of various DHTs.
- Process evaluation indicators, such as patient adherence, user satisfaction, and the extent of technology utilization.
- Reimbursement models of the adaptation of telehealth programs.

- Organizational outcomes, including any reduction in resource use or medical services.
- Patient- and clinician-reported outcomes, focusing on their experiences, acceptance of the technology, and perceived benefits.

By examining these elements, we aim to provide a comprehensive overview of the current state of telehealth programs for diabetes in Europe, highlighting best practices and areas for improvement. Therefore, our research questions (RQ) are:

4 Forschungfragen

- **RQ1:** What kind of telehealth programs for PwD that enable interactions between PwD and HCPs are being piloted, implemented and reimbursed in Europe?
- **RQ2:** What are the organizational characteristics of the programs and how are the programs evaluated?
- **RQ3:** How are telehealth programs for PwD remunerated?
- **RQ4:** What is the acceptance and experience of PwD and HCPs: how are the programs appraised by them?

Implementierung in Europa:

organisatorische Rahmenbedingungen und Refundierung

Akzeptanz und Erfahrung mit DHTs

2 Previous report on telehealth care for diabetes from AIHTA

In 2022, the Austrian Institute for Health Technology Assessment (AIHTA) published a systematic analysis of evaluation methods for telehealth care programs. In the initial AIHTA report, telehealth care programs in Austria were mapped and a systematic review of evaluation methods including evidence of potential health care effects (taking into account the organizational setting) of telemedicine-assisted diabetes care programs was conducted [26]. Herein, the results of the previous report aligning with the scope of this report are described.

Telemedizin in Österreich: systematische Analyse AIHTA-Bericht 2022

The AIHTA report 2022 [26] identified two diabetes telehealth programs operating in Austria.

- DiabCare (in Tyrol)
- Gesundheitsdialog Diabetes mellitus (mit DiabMemory)

The telehealth diabetes care program "**DiabCare**" was identified as a program serving the Tyrol region, accessible to patients who meet predetermined eligibility criteria. DiabCare consists of a treatment management system (main system) on PCs/smartphones and various measurement devices (peripheral devices). Through the digital health app of the same name, measurement data can be automatically transferred via Bluetooth or NFC technology, and this data is transmitted to Tyrol Clinics' IT infrastructure through a secure server. DiabCare is used by both patients and healthcare professionals, functioning as an "indirect" intervention system that continuously supports diabetes patients' self-management. The app allows users to record and manage health data including blood glucose levels, blood pressure, heart rate, step count, body weight, and general well-being.

DiabCare Tirol: regionales Programm

Bluetooth/NFC-Transfer Messwert-Übertragung Selbstmanagement

"**Gesundheitsdialog Diabetes mellitus** (GDDM)" is a care program that supports diabetes management and treatment throughout Austria. Through collaboration between BVAEB healthcare institutions and private practitioners, the program aims to stabilize blood glucose levels in PwD and to prevent complications. The program is available to BVAEB members diagnosed with T1DM or T2DM (excluding GDM), provided they possess adequate cognitive and communication abilities and have access to data transmission capabilities. The core component of the program, KIT **DiabMemory 2**, consists of a smartphone-based system and peripheral devices. Patients can record various health metrics, including blood glucose levels, blood pressure, and medication information, either through automatic transmission via NFC/BT technology or manual input. The frequency of data transmission varies based on insulin dependency: daily for insulin-dependent patients and weekly for non-insulin-dependent patients. Through DiabMemory 2, patients can record not only their vital data (blood glucose, blood pressure, medication, etc.) but also add comments through the diary application. The measured values can be transferred to the diabetes diary either through mobile phones (automatic transmission from measuring devices via NFC/BT) or through manual entry using the web application. The web application provides both patients and physicians access to the measurement data, allowing physicians to monitor values and provide weekly feedback along with treatment adjustments as necessary.

Gesundheitsdialog Diabetes:

tägliche/wöchentliche Datenübertragung, Tagebuchfunktion und Ärzt*innen-Feedback

Both interventions used in Austria are supported by digital health applications ("DiabCare" and "DiabMemory"). At present, however, these digital health applications are isolated solutions and must be compatible primarily with the doctor's software. A connection to the electronic health record (ELGA) is currently not possible but planned. Both telemedicine-assisted diabetes care programs have been or are being evaluated. A total of seven endpoints were measured in the evaluations with the help of standardized measuring instruments.

österreichische Programme: noch ohne Anbindung an elektronische Gesundheitsakte

Furthermore, the AIHTA report 2022 [26] identified 14 RCT. These studies incorporated telemonitoring (TMON) as a fundamental component, with many combining it with telecoaching (TCOACH) by HCPs. Regarding HCPs involvement, the previous report confirmed participation from various professionals, including physicians, nurses, diabetes specialists, and dietitians. The implementation methods varied across studies, particularly in terms of contact frequency between patients and HCPs. Some programs adopted a flexible approach based on individual needs, while others established regular contact schedules ranging from monthly to several times per year. Regarding equipment, all studies utilized blood glucose meters, with some studies additionally incorporating devices such as weight scales and blood pressure monitors. To ensure effective program implementation, training was provided for both patients on device usage and healthcare professionals on instruction methods, along with the establishment of continuous support systems.

14 RCTs zu Telemedizin bei Diabetes: Telemonitoring, Telecoaching durch Gesundheitspersonal, flexible Kontakte und Schulungen

Evidence for the potential social care effects of telehealth diabetes care programs was derived from nine RCTs. The results revealed statistically significant group differences in favor of the telehealth care group across several endpoints, including diabetes knowledge, adherence to treatment recommendations, satisfaction/acceptance with diabetes therapy, and psychological well-being. However, no statistically significant group differences were found in four other endpoints: experiences with medical care, adherence to therapy recommendations, frequency of blood glucose measurements, and self-management.

soziale Versorgungseffekte in 9 RCTs: signifikante Verbesserungen bei Wissen & Akzeptanz

Evidence for the organizational effects of the care programs was obtained from nine RCTs. Statistically significant group differences in favor of the care programs were identified in treatment adjustments and utilization of medical services. Additionally, substantial variations were observed in app usage patterns and program participation duration.

organisatorische Versorgungseffekte: u. a. Therapieanpassungen

The authors of the previous report concluded that the evaluation of tele-health programs for diabetes should extend beyond clinical outcomes to include organizational and social care effects. When selecting evaluation methods, priority should be given to validated measurement instruments that have demonstrated reliability across multiple studies. Additionally, the analysis of routine healthcare data can provide valuable insights. While the selection of measurement instruments should align with each program's specific objectives and intended outcomes, it is important to note that when conducting comparisons or benchmarking exercises, the evidence regarding healthcare effects is highly context-dependent (such as personnel resources for training).

Empfehlungen AIHTA Bericht 2022: validierte Instrumente, Routinedaten nutzen und Kontextabhängigkeit beachten

3 Methods

3.1 Contact experts in Europe

Methoden zur Beantwortung der 4 Forschungsfragen: Survey und Internetrecherche

An online survey was conducted through the IDF Europe (IDFE) in April 2024 to investigate available telehealth programs in Europe that enable interaction between PwD and HCPs. The survey items, shown in Table 3-1, were developed by AIHTA and reviewed by IDFE. IDFE distributed the online survey URL to its members through their newsletter. The survey was mainly intended to identify and map relevant DHTs or telehealth care programs in diabetes, that possessed features enabling interaction between HCPs and PwD, across Europe. Hence, the websites of identified DHTs or telehealth care programs were further consulted in case relevant information was missing.

Table 3-1: Questionnaire of the online survey conducted through IDF.

Introduction text	AIHTA team is trying to map existing telehealth care programs in diabetes in Europe. Use of telehealth application can be best described as applications allowing for interactions between users/patients and healthcare professionals using an app or web-platform as the mode of communication. Telehealth applications enable remote delivery of healthcare services such as medical consultations through for example video calls, voice call or messaging platforms, ongoing monitoring of data linked to the condition, interactive applications with live access to healthcare support, etc. Therefore, we would like to request your assistance with identifying such telehealth programs in diabetes in YOUR country. Are you aware of such telehealth application(s) for the management of diabetes in YOUR country? Please write the name of the telehealth application or website and contact details (if you know).
Question	Please write the name of the telehealth application or website.
Question	Who is the telehealth application target? ▪ People living with type 1 diabetes mellitus ▪ People living with type 2 diabetes mellitus ▪ People living with gestational diabetes mellitus
Question	If available, please provide the contact information of the telehealth. (e.g. Website URL)

3.2 Scoping review

We additionally performed an update scoping review to detect further telehealth program studies for diabetes in Europe. This scoping review protocol was registered in the Open Science Framework [27]. We performed this scoping review by using the PRISMA Extension for Scoping Reviews (PRISMA-ScR) guidelines [28].

Scoping Review zur Identifikation weiterer DHTs/ Versorgungsprogramme

3.2.1 Search strategy and databases

Search terms were generated based on the previous AIHTA report [26]. Search terms used in this study are listed in Appendix. Article extraction was conducted in May 2024. Studies published between 2014 and 2024 were initially detected. The databases defined as information sources were as follows:

systematische Update-Literatursuche in 5 Datenbanken

- MEDLINE
- EMBASE
- Cochrane Library
- PsycINFO
- INAHTA database

3.2.2 Eligibility criteria

Studies were included if they met the following criteria: (1) participants were people living with type 2 diabetes; (2) telehealth programs enabled interactions between PwD and HCPs; (3) Studies had comparison groups with standard care or no comparison groups; (4) outcomes included process evaluation indicators such as program adherence or usage, patient-reported outcomes such as self-efficacy or self-management, organizational outcomes such as medical costs or HCP burden, and acceptance and experience of PwD and HCPs through using telehealth programs; (5) study design included longitudinal cohort studies, qualitative studies, evaluations, randomized controlled trials, and pre-and post-test studies; and (6) included studies were written in English or German, with no sample size limit. Table 3-2 shows the inclusion and exclusion criteria. A telehealth program that enables interactions between PwD and HCPs refers to the capability of sending and receiving data, such as telemonitoring or sending messages. For instance, a patient's blood glucose levels can be transmitted via an application to healthcare professionals, who can then monitor these levels and, when necessary, take actions such as issuing alerts or modifying treatment plans. The transmitted data is not limited to blood data but also includes dietary information and exercise records.

Einschlusskriterien für Studienselektion: T2D-Patient*innen, Telehealth Programme, diverse Studiendesigns & Outcomes

Initially, we intended to include papers published from 2014 to 2024. Considering that AIHTA published a review on diabetes telehealth in 2022 [26], we opted to update this report, resulting in a search period between 2021-2024.

Literatursuche: Update des AIHTA Berichts 2022

Table 3-2: Inclusion and exclusion criteria of the literature review [32].

	Inclusion criteria	Exclusion criteria
Patient	■ People living with type 2 diabetes mellitus ■ Aged 18 years old or more	■ People living with type 1 diabetes mellitus or gestational diabetes mellitus ■ Aged less than 18 years old ■ People at risk of diabetes or with pre-diabetes
Intervention	A Telehealth program that enables interactions between PwD and HCPs refers to the capability of sending and receiving data and actions. For instance, a patient's blood glucose levels can be transmitted via an application to healthcare professionals, who can then monitor these levels and, when necessary, take actions such as issuing alerts or modifying treatment plans. The transmitted data is not limited to blood data but also includes dietary information and exercise records.	■ Programs target comorbidity of type 2 diabetes mellitus and other chronic or mental illness ■ Stand-alone programs (e.g. self-monitoring only or reminding only)
Comparator	■ Waitlist control ■ Treatment as usual ■ No intervention	Other telehealth programs
Outcomes	■ Organizational features (e.g., program structures, types of interactions, and involved HCPs) ■ Process evaluation indicators (e.g., adherence, usage, satisfaction, etc.) ■ Models of refunding ■ Patient-reported outcomes (e.g., self-efficacy, patients' experience, medication adherence, knowledge, quality of life, etc.) ■ Clinician-reported outcomes (e.g., burden, clinicians' experience, etc.) ■ Organiszational outcomes (e.g., reduction of resource use or medical services, etc.)	
Study design	■ Intervention study (randomized controlled trials, non-randomized controlled trials, pilot studies, feasibility studies, pre-posttest studies) ■ Observational study (longitudinal studies) ■ Qualitative study ■ Evaluation reports	Cross-sectional studies
Country	27 European Union countries, United Kingdom, Switzerland, Norway	Any other countries
Languages	English, German	Any other languages
Period	2021-2024	Before 2021*

* *The results before 2021 are to be found in the section "2 Previous report on telehealth care for diabetes from AIHTA" [26]*

3.2.3 Study Selection Process

Studienauswahl im Vier-Augen-Prinzip

Duplicate studies were excluded by TM using Deduklick before screening. The records included in the title/abstract screening were compiled and managed using Rayyan (Qatar Computing Research Institute, Hamad bin Khalifa University) [29]. Two researchers (YH and GG) independently performed title/abstract screening and excluded studies that did not meet the eligibility criteria. YH and GG then individually conducted the full-text screening. Discrepancies were resolved by consensus. Reasons for excluding studies during the full-text screening phase were recorded. In the phase of full-text screening, Microsoft Excel was used for data handling.

3.2.4 Data extraction and data synthesis

YH extracted the following relevant information from the selected studies: author, year of publication, country, number of participants, details of the intervention and control conditions, age of participants, proportion of females, duration of follow-up, measurement tool, and outcomes (process evaluation indicators, patient-reported outcomes, organizational outcomes and acceptance and experience of PwD or HCPs). For details not specified in the studies, such as reimbursement status and further information on features of each telehealth program, we consulted the official websites of the respective telehealth programs. All data was verified by GG.

Datenextraktion: Fokus auf organisatorische Rahmenbedingungen

4 Results

4.1 Survey

We received 26 responses from ten European countries. The composition of these ten countries is the UK (United Kingdom), Switzerland, Belgium, the Netherlands, France, Germany, Sweden, Croatia, Greece and Cyprus. Due to the survey distribution method via the IDF Europe newsletter, the total number of potential respondents could not be tracked, therefore the response rate could not be calculated. Recipients of the URL who expressed interest participated in the survey. Among the 26 responses, nine DHTs were processed for further analysis for this report (including duplicate answers) [30-38].

Umfrage via IDF (International Diabetes Federation): 26 Rückmeldungen aus 10 EU-Ländern: 9 relevante DHT identifiziert

Table 4-1: Diabetes Telehealth Products in Europe identified in IDFE survey (n=9)

	Country	Type of DHT	DHT-products	Cite
1	Netherlands Croatia Sweden Greece	Treatment Support	LibreView/Abott	[30]
2	Netherlands		Glooko	[31]
3	France		myDiabby	[32]
4	Sweden		Diabetes:M	[33]
5	Belgium		Mylife	[34]
6	Switzerland		MySugr/Roche	[35]
7	The UK	Behavioral change	Second nature (former name: Ourpath)	[36]
8	The UK		Oviva	[37]
9	The UK		Liva	[38]

The exclusions were as follows: three telehealth applications targeting Type 1 diabetes, three online clinics or prescription-issuing apps not limited to diabetes, one stand-alone app, one program under clinical trials, one online peer support (no healthcare professionals involved), and two apps not targeting people living with diabetes. The organizational features of those suggested telehealth programs are shown in the Table 4-3 and explained in the section 4.3.1.

diverse Ausschlussgründe

4.2 Scoping review

4.2.1 Selection studies

17 Studien neu identifiziert

Figure 4-1 shows the flowchart of study selection. A total of 1,881 studies were yielded through the initial database search. After removing 332 duplicates and 881 articles that were published before 2021, 671 studies were screened. We first screened these studies from the title and abstract, and 58 studies were included for a full-text review. Subsequently, 17 studies met the eligibility criteria, and the remaining 41 studies were excluded.

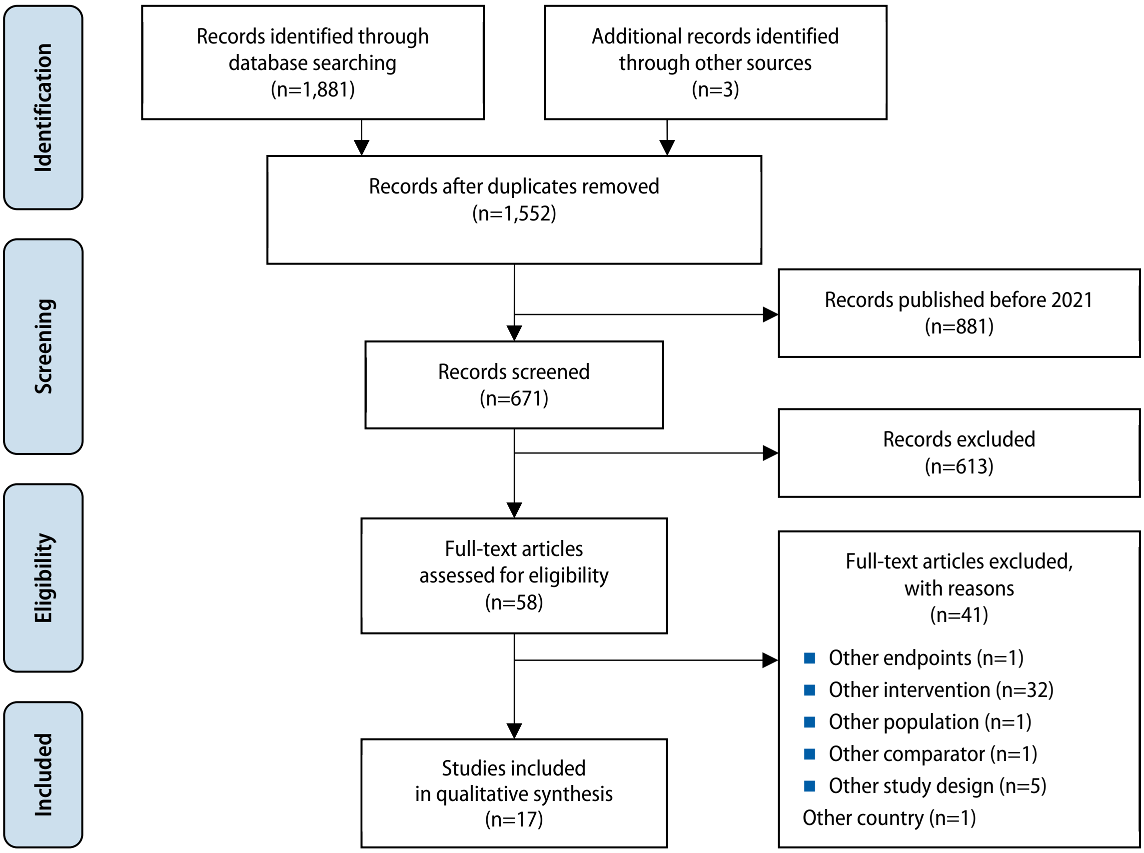

Figure 4-1: PRISMA flowchart diagram of update search (2021-2024)

4.2.2 Study characteristics

Studiencharackteristika: 17 Studien aus 8 Ländern 30-484 Patient*innen

A total of 17 studies met the eligibility criteria and were included. Two of these studies focused on the same DHT [39, 40], resulting in the identification of 16 unique DHTs. One of them (LibreView) was also identified in the survey [41]. The studies were reported from various European countries: six from Germany [41-46], three from France [47-49], two each from Italy [50, 51] and the United Kingdom [39, 40], and one each from Sweden [52], Greece [53], Denmark [54], and Belgium [55] (see Table 4-2). Regarding study design, 11 studies adopted a randomized controlled trial (RCT) design [39, 40, 42-44, 48, 49, 51-54], including pilot and feasibility studies, 3 were pre-post studies [41, 46, 55], and 3 were observational studies [45, 47, 50]. The sample sizes ranged from 30 to 484 participants. The follow-up duration ranged from two months to 24 months. Further extracted information is shown in Appendix Table A-1.

Table 4-2: Diabetes Telehealth Products in Europe identified in publications (n=16)

	Country	Type of DHT	DHT-products	Cite
1	Germany	Treatment Support	My Dose Coach	[42]
2		Treatment Support	LibreView	[41]
3		Behavioral Change	initiative.diabetes	[43]
4		Behavioral Change	TeLIPro	[44]
5		Behavioral Change	Vitadio	[45]
6		Behavioral Change	Changing Health app	[46]
7	France	Treatment Support	Insulia	[47]
8		Behavioral Change	EDUC@DOM	[48]
9		Other supportive care	DFU telemonitoring	[49]
10	Italy	Treatment Support	DiaWatch	[50]
11		Treatment Support	Glucoonline® system	[51]
12	The UK	Treatment Support	Healum Software	[39, 40]
13	Sweden	Treatment Support	The Sukaribit Smartphone App	[52]
14	Greece	Behavioral Change	Tele-rehabilitation	[53]
15	Denmark	Behavioral Change	LIVA 2.0	[54]
16	Belgium	Other supportive care	Comunicare platform	[55]

4.3 Results of individual programs

4.3.1 Organizational features of the included programs

Übersicht zu Telehealth-Versorgungsprogrammen und Technologien in Europa

Through the online survey and the scoping review, we identified 24 DHTs. However, we did not identify many care programs that those DHTs are embedded in. Table 4-3 and Table 4-4 show the organizational features of the included DHTs. Table 4-3 presents the organizational features of the DHTs that were identified through the online survey with IDFE. Table 4-4 presents the organizational features of the DHTs that were identified through the scoping review. Figure 4-2 shows the geographical locations of the Diabetes DHTs identified via the IDFE-survey mapping of those DHTs.

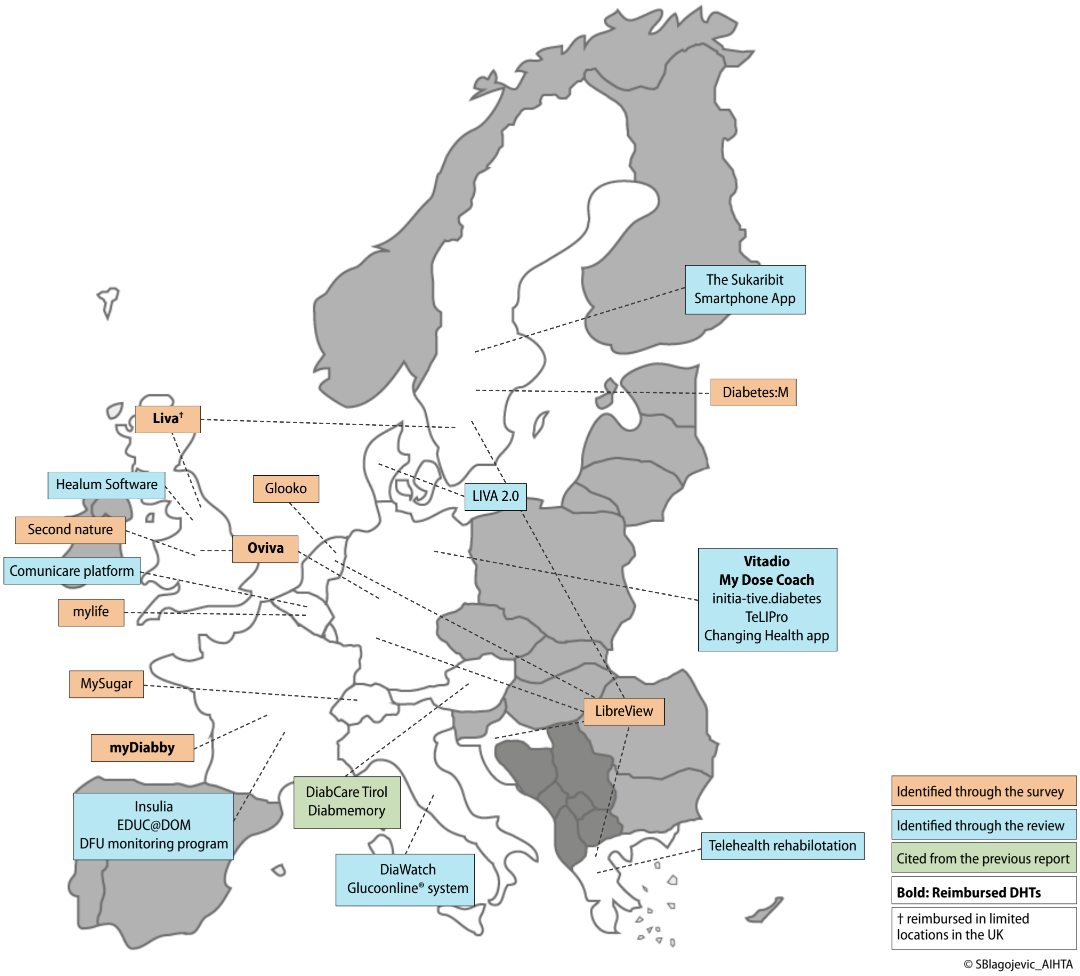

Figure 4-2: Mapping of the identified DHTs in Europe

Types of the DHTs

DHT-Typologie:

The identified Diabetes DHTs can be categorized according to their functions and aims: **supporting treatment**, those aimed at **changing lifestyle behaviors**, and **other supportive care**.

Therapieunterstützung,

DHTs aimed at **supporting treatment** aimed at supporting treatment primarily serve two key functions: clinical data telemonitoring and insulin dosage management. The system enables patients to transmit clinical parameters, particularly blood glucose measurements, to HCPs for remote monitoring and treatment optimization [30-35, 39, 40, 45, 48-52].

Lebensstilmodifikation, und …

DHTs aimed at **changing behaviors** primarily offered two intervention approaches: remote dietary management and physical activity support. The system integrates comprehensive monitoring functions for physiological parameters (e.g., blood markers, weight, blood pressure) and physical activity data. Some DHTs were equipped with additional features that allowed patients to transmit photographs of their meals for nutritional assessment by registered dietitians. There was also an intervention where physical therapists provided telerehabilitation services to promote exercise adherence [36-38, 41-44, 46, 53, 54].

DHTs aimed at **other supportive care** included two interventions: remote monitoring of diabetic foot ulcers (DFU) and telecoaching by pharmacists. One system enables HCPs to assess DFU through photographic monitoring. The other involved community pharmacists utilizing a remote communication platform to provide telecoaching such as medication support and motivational interviewing sessions. The system was designed to allow patients to input various data including mood states, hypoglycemic episodes, blood glucose levels, and medication intake into the platform. The pharmacists could then remotely monitor these parameters to deliver personalized support [47, 55].

… sonstige Interventionen (z. B. Fußulzera-Monitoring)

Involved HCPs

In DHTs aimed at supporting treatment, physicians were involved in almost all cases (n=11). Additionally, there was one instance of nurse involvement and one study where the healthcare professional's details were not specified and were referred to as HCPs. Physicians primarily took on the role of remotely reviewing patient-submitted data.

involviertes Personal: u.a., Ärzt*innen, Pflegekräfte, aber auch

In DHTs aimed at changing behaviors primarily involved dietitians (n=4). Other studies included professionals whose specific roles were not clearly defined, such as Diabetes Consultants or Diabetes Advisors (n=4), as well as one case involving a physical therapist and another involving a physician. Dietitians and Diabetes Consultants not only monitored patient-submitted data but also provided coaching, such as advice on dietary choices.

Ernährungs- bzw. Diabetesberater*innen mit Coaching (zur Verhaltensänderung), und

In DHTs focused on other supportive care, there was one case involving nurses and another involving pharmacists. The nurse in this case was a specialist in diabetic foot complications.

Apotheker*innen

Contact frequency

In DHTs aimed at supporting treatment, the frequency of contact with healthcare professionals was often not predetermined. Many DHTs adopted a format where patients could submit data at their discretion, allowing healthcare professionals to monitor or adjust treatment as needed (n=11). This approach is designed for scenarios where telehealth programs have been implemented but reimbursement regulations are not in place, enabling physicians to review patients' data and trends before or during consultations. Some other DHTs featured weekly or bi-weekly monitoring by healthcare professionals.

flexible Kontaktfrequenz bei Unterstützung zu Therapien

In DHTs focused on changing behavior followed different schedules: variable schedules (3 cases), monthly sessions (3 cases), and weekly interactions (2 cases). These frequencies reflect the provision of telecoaching. For the telerehabilitation intervention specifically, healthcare professionals provided coaching three times per week.

Kontaktfrequenz von wöchentlich bis monatlich bei Verhaltensänderung und anderen Interventionstypen

DHTs focused on other supportive care had either monthly or weekly contact schedules.

Main system and Platform

In this report, the term 'Main System' refers to the device used by healthcare professionals, while 'Platform' refers to the device through which patients transmit their data. In almost all programs, healthcare professionals used computers to view and manage data.

Hauptsystem: Computer und Smartphone

On the patient side, data transmission was typically done through smartphone applications. For example, in the case of LibreView, dedicated software was installed on the computer of HCPs, and an invitation link was sent to the patient to link the system. Patients downloaded a designated app on their smartphones, used their phones to scan the CGM via Bluetooth, and transmitted the data to HCPs through the app. In other cases, blood glucose meters were connected to computers or data transmission devices via a wired connection for data transfer. Additionally, some DHTs allow patients to manually input health-related data or send photos or activity log through the apps to healthcare professionals.

Plattformen: v. a. m-App

Peripheral devices

In DHTs aimed at treatment support, the following peripheral devices were available: blood glucose meters, continuous glucose monitors (CGM), insulin pumps, activity trackers, electronic medical record systems, and weight scales.

Peripheriegeräte: Diabetes-spezifische Messgeräte

DHTs focused on changing behavior offered the following devices: weight scales, activity trackers, blood glucose meters, blood pressure monitors, and pulse oximeters.

DHTs focused on other supportive care provided access to activity trackers and blood glucose meters.

Some DHTs only accepted their proprietary devices, while others were compatible with devices from a wide range of manufacturers.

Educational sessions

Among the DHTs aiming at supporting treatment, two programs provided self-guided learning content. The Healum Software allows healthcare professionals to share pre-existing educational content for chronic diseases with patients via the app or email, promoting individualized learning. Additionally, patients can access self-care educational materials on topics such as weight management and smoking cessation, enabling goal-setting, progress tracking, and data exchange between healthcare professionals and patients. DiaWatch offers 15 to 45-minute physical training sessions. Most of the DHTs for supporting treatment focused on data transmission from patients and data monitoring by physicians, without providing educational content.

Schulungen zu Beginn der Intervention, Dauer und konkrete Gestaltung variabel

Among DHTs focused on changing behaviors, as the primary function of these DHTs is education provision by professionals, all of them offered educational sessions. Most DHTs had telecoaching that included educational components. EDUC@DOM and Vitadio distributed self-study kits for participants to learn individually.

Among the DHTs for other supportive care, the DFU monitoring did not offer educational sessions. The pharmacy-based intervention provided counseling including motivational interview from pharmacists.

Table 4-3: Organizational features of the telehealth program from the survey through IDFE (n=9)

Name of the DHTs/Survey countries	Reimburse-ment status	Type of DHTs	Contact Frequency	Involved HCPs	Main system	Peripheral devices	Platform	Educational session	Data transfer	Data input/ exchange	Functions	cite
Treatment Support												
LibreView/ Netherlands Croatia Sweden Greece	N.R.	TMON	variable	Physicians	Computer	Continuous glucose Monitor (Free style Libre)	Home device (Libre reader), App (FreeStyle Libre Link)	N.R.	Data is sent to the secured server through the Libre reader or App.	Automatic/ when patients scan the CGM using Libre Link or by connecting the Libre Reader to the PC.	■ "LibreView" supports the self-management of PwD and data-sharing with HCPs. ■ FreeStyle Libre (a CGM device) can be connected to Libre View to record and send daily data. ■ A reminder function available.	[30]
Glooko/ Netherlands	N.R.	TMON	variable	Physicians	Computer	Blood glucose meters, CGMs, insulin pumps, activity trackers	Glooko Uploader, App (Glooko Mobile App)	N.R.	Data is sent to the secured server through the App or the uploader.	Automatic/ when patients sync their device with the App.	■ "Glooko" is a diabetes management platform ■ Data tracking and managing blood glucose levels, insulin usage, food intake, and physical activity.	[31]
myDiabby/ France	Yes (France)	TMON	variable	Physicians	Computer	Blood glucose meters, CGMs, insulin pumps	Smartphone App, App myDiabby uploader	N.R.	Data is sent to the secured server through the App or the uploader.	Automatic/ when the patient scans the data from the devices.	■ "myDiabby" is a telemonitoring app ■ Telemonitoring is reimbursed by French insurance ■ 25 peripheral devices can be connected	[32]
Diabetes:M/ Sweden	N.R.	TMON	variable	Physicians	Computer (Diabetes:M Monitor)	Blood glucose meters, CGMs	Smartphone App	N.R.	Data can be shared with physicians with an access right via the Internet. Physicians can check data on an online monitoring platform.	Manual and Automatic/	■ "Diabetes:M" offers a logbook for tracking glucose, insulin, nutrition or medications. ■ Food data bank is available to track meal intake. ■ Diabetes:M Monitor allows physicians to monitor patients' data.	[33]
mylife/ Belgium	N.R.	TMON	variable	Physicians	Computer (mylife cloud)	Blood glucose meters, insulin pumps	Smartphone App (mylife app), Software (mylife Software online)	N.R.	Data is sent to the secured server through the App or the software.	Manual/ Connect devices to computers with cables or dongles.	■ "mylife" includes an app and software designed for both patients and healthcare professionals. ■ Data sharing enables users to track their glucose levels, insulin delivery, and lifestyle factors while facilitating communication with their healthcare teams.	[34]

Name of the DHTs/Survey countries	Reimburse-ment status	Type of DHTs	Contact Frequency	Involved HCPs	Main system	Peripheral devices	Platform	Educational session	Data transfer	Data input/ exchange	Functions	cite
MySugr/ Switzerland	N.R./partially free of charge to use	TMON	variable	Physicians	Computer (Roche diabetes care platform)	Blood glucose meters	Smartphone App	N.R.	Data is sent to the Roche diabetes care platform through the App.	Automatic/ When patients measure their blood glucose.	■ "mySugr" is a management app that can be connected to the Accu-Chek glucose meter. ■ Logging and tracking blood glucose levels, insulin doses, and lifestyle factors while providing insights and reports. ■ Bolus calculator and meal logging included.	[35]
Behavioral change												
Second nature (former name: Ourpath)/ The UK	N.R.	TCOACH	variable	Registered dietitians	Computer	A weighing scale, A wearable activity tracker	Smartphone App	one-to-one online health coaching	Data can be shared over the app.	Manual/when data entered on the App	■ "Second Nature" provides one-to-one health coaching from a registered dietitian. ■ Group chat functionality with peers ■ Structured education contents ■ Health tracking (self-monitoring) technology.	[36]
Oviva/ The UK	Yes, in the UK and Germany	TCOACH	two times in eight weeks	Registered dietitians	Computer	A weighing scale, Blood glucose meter, An activity tracker	Smartphone App	Telecoaching and Self-guided educational contents available	Data can be shared over the app.	Manual/when data entered on the App	■ "Oviva" provides motivation interview from a health coach ■ Two video (or telephone) calls with a trained diabetes specialist dietitian ■ Users can send food pictures to get feedback.	[37]
Liva/ The UK Sweden	Yes, in limited locations in the UK	TCAOCH	variable	Registered dietitians	Computer	A weighing scale, An activity tracker	Smartphone App	Online coaching	Data can be shared over the app.	Manual/when data entered on the App	■ "Liva" is a care program for controlling body weight. ■ This program consists of diet replacement and online health coaching.	[38]

Abbreviations: DMP … Disease Management Program, HCPs … Healthcare Professionals, TMON … telemonitoring, TCOACH … teleacoaching

Table 4-4: *The characteristics of the programs included in the Scoping review (n=16).*

Name of the DHTs/Countries	Reimburse-ment status	Type of DHTs	Contact Frequency	Involved HCPs	Main system	Peripheral devices	Platform	Educational session	Data transfer	Data input/ exchange	Functions	cite
Treatment Support												
Healum Software/ The UK	N.R.	TMON	variable	Practice nurses	Computer software	EMIS Web (an electronic patient record system), Wearable devices	Smartphone App	Self-guided educational contents available.	Data saved on the secured server.	Automatic (when the devices are connected to the Healum app)/ Continuous	▪ "Healum Software" provides a co-created personalized care plan. ▪ Data can be shared with HCPs. ▪ Care plans can be shared with patients through Healum.	[39, 40]
The Sukaribit Smartphone App/ Sweden	N.R.	TMON	weekly	Family medicine doctor	Computer	Blood glucose meter	Smartphone App	N.R.	Data is transferred and saved on a Web interface for HCPs.	Manual/when data entered on the App	▪ „The Sukaribit Smartphone App" provides a telemonitoring function. ▪ Data sharing and communication with HCPs are possible.	[52]
DiaWatch/ Italy	N.R.	TMON	variable	HCPs	Computer	Monitoring devices (glucometer, sphyg-momanometer, scale, smartwatch for heart rate monitoring and step counter)	Smartphone App	A self-guided physical training session available	Saved on an interoperable cloud-based system	Automatic/ Continuous	▪ "DiaWatch" self-management App ▪ Health-related data will be automatically sent from integrated medical devices. ▪ Data sharing and communication with HCPs over the platform are possible.	[50]
My Dose Coach/N.R. Germany	Yes Germany	TMON	variable	Physicians	Computer	Blood glucose meter	Smartphone App	N.R.	Data is sent to the web portal for HCPs	Manual/when data entered on the App	▪ "My Dose Coach" is an insulin titration support app ▪ Physicians can adjust insulin treatment over the app while monitoring. ▪ Participants received a text message informing them about the adjustments.	[42]
Insulia/ France	N.R.	TMON	variable	Physicians	Computer, Smartphone	Blood glucose meter	Smartphone App	N.R.	Secured platform	Manual/when data entered on the App	▪ "Insulia" is a digital solution for basal insulin management ▪ Data can be shared with physicians	[47]
Glucoonline® system/ Italy	N.R.	TMON	variable	Physicians	Computer/ Web-based electronic CRF	Blood glucose meter	Smartphone app	N.R.	A smartphone-connectable glucose meter, and a software-implemented smartphone for real-time BG data transmission are used.	Automatic from BG meter/every time after the SMBG test	▪ "Glucoonline® system" is a Decision Support Software (DSS) ▪ A web-based electronic CRF (Glucoonline™ eCRF) for the management of patients' logged data ▪ Alert function to detect uncontrolled diabetic status such as hypoglycemia.	[51]

Name of the DHTs/Countries	Reimburse-ment status	Type of DHTs	Contact Frequency	Involved HCPs	Main system	Peripheral devices	Platform	Educational session	Data transfer	Data input/ exchange	Functions	cite
LibreView/ Germany	N.R.	TMON	Weekly (only in the first month), Biweekly (from the second month to the last)	Physicians	Computer	Continuous glucose monitor	Home device (Libre reader), App (FreeStyle Libre Link)	N.R.	Web platform	Automatic from CGM/Continuous	■ "Free style Libre" is a continuous glucose monitor ■ "Libre view" is a web platform for HCPs for telemonitoring ■ Libre view has a reminder function for those who have not uploaded data for a while	[41]
Behavioral Change												
EDUC@DOM/ France	N.R.	TMON TCOACH	variable	Physicians	Computer	Scaler, Actimeter, BG meter	Secure web platform	Self-guided tele-educational software programs included	via home telemonitoring device	Automatically sent to the home device from peripheral devices. Patients send the collected data from the home device to the plat-form manually./ weekly	■ "EDUC@DOM" telemonitoring and tele-education device ■ A secured messaging system between patients and physicians in the platform	[48]
N.R. (Tele-rehabilitation)/ Greece	N.R.	TREHAB	3 times a week	Physiotherapists	Online conference system	Monitoring equipment (pulse oximeter, blood pressure monitor, glucose monitor, smartwatches, activity trackers)	Online conference system	Physical activity sessions	via sessions	Manual/at every session	■ Telerehabilitation ■ Sessions provided by using an online conference system ■ Health-related data was exchanged in the sessions manually	[53]
initiative. diabetes/ Germany	N.R.	TMON TCOACH	monthly (first 6 months), once every 6 to 12 weeks (the following 6 months)	Health specialists/ diabetes coaches	Computer	Pedometer, Blood glucose meter	Tablet PC	Tailored telephone coaching available	Sent from monitoring devices to the Tablet PC through Bluetooth functions	Automatic/Continuous	■ "initiative.diabetes" telecoaching program ■ Provide by German private insurance company ■ Tailored coaching based on the data possible	[43]
TeLIPro/ Germany	N.R.	TMON TCOACH	10-17 times over a year	Diabetes assistants/ diabetes consultants	Computer	Scale Step counter, Blood glucose meter	Online portal or App	Telecoaching provided	Data is saved on a secured online portal where the coaches and patients can access	Automatic/Continuous	■ "TeLIPro" is an online coaching program ■ Health-related data is automatically sent to the web platform where coaches have access ■ Coaching based on the data provided	[44]

Name of the DHTs/Countries	Reimburse-ment status	Type of DHTs	Contact Frequency	Involved HCPs	Main system	Peripheral devices	Platform	Educationa l session	Data transfer	Data input/ exchange	Functions	cite
Vitadio/ Germany	Yes Germany	TCOACH	variable	Personal advisors	Computer	Scaler, Blood glucose meter	Smartphone App	Self-guided educational contents available	via Internet	Manual/when data entered on the App	■ "Vitadio" one of DMP app for diabetes ■ Recording physical activity, food intake and health-related scores (weight, blood glucose etc) ■ Personal advisor support provided ■ A system of daily tasks and automated message	[45]
LIVA 2.0/ Denmark	N.R.	TCOACH	weekly (first 3 months), biweekly (last 3 months)	Health coaches	Computer, Smartphone	N.R.	App	Online coaching available	via Internet	Manual/when data entered on the App	■ "LIVA 2.0" telecoaching app ■ Patients set goals for diet, exercise, and sleep with their health coaches ■ Logged data can be shared with the coaches	[54]
Changing Health app/ Germany	N.R.	TCOACH	weekly	Dietitian	Computer	Scaler	App, online portal	Weekly coaching calls	App-guided digital education program	Patients uploaded pictures of food to the online portal/n.r.	■ "Changing Health app" provides online coaching from dietitians. ■ Uploaded food photos from patients were used for notorious evaluation.	[46]
Other supportive care												
N.R. (DFU tele-monitoring)/ France	N.R.	TMON	weekly	Expert nurses of DFU	Telemedicine software	N.R.	N.R.	N.R.	Pictures taken by nurses are sent to expert nurses through the telemedicine software	Manual/weekly	■ Telemonitoring for diabetic foot ulcer ■ Pictures are used for monitoring ■ Expert nurses of DFU are involved	[49]
Comunicare platform/ Belgium	N.R.	TMON TCOACH	monthly	Pharmacists	Computer, Smartphone	Monitoring equipment (blood glucose meter, activity tracker)	Web platform	Pharmacist counselling was performed monthly.	Data entered on the web platform will be transferred to the dashboard for pharmacists.	Manual/n.r.	■ "Comunicare platform" specifically tailored to the follow-up of diabetes ■ Secured online or Face-to-face coaching ■ Data can be shared with pharmacists	[55]

Abbreviations: DMP … Disease Management Program, HCPs … Healthcare Professionals, TMON … telemonitoring, TCOACH … teleacoaching

4.3.2 Reimbursement of DHTs in selected countries

For only five digital health technologies (DHTs), we were able to identify the remuneration scheme.

Erstattung undurchsichtig

In France, **myDiabby** is subject to reimbursement, with telemonitoring costs determined based on the patient's specific condition. Table 4-5 describes the target patients and telemonitoring costs with myDiabby. In this reimbursement system, telemonitoring can be performed by a single healthcare professional, a healthcare facility (hospital, health center, etc.), or by a multi-professional team in private practice. Telemonitoring is prescribed for a duration of 1 to 3 months and is renewable. At a minimum, telemonitoring requires a weekly connection by a member of the care team. A therapeutic support session must be conducted in the first month. For therapeutic support, at least one of the caregivers on the team must be trained in therapeutic education (University Diploma in Therapeutic Education, 40-hour training, or a Continuing Professional Development program on therapeutic education). Health Insurance pays healthcare establishments that practice Telemonitoring and covers the cost of Digital Medical Devices for telemonitoring.

Digitale Anwendungen (DiGA) in FR: 1 DiGA refundiert und in Versorgungsprogramm integriert

Such technologies are evaluated by the PECAN (prise en charge anticipée des dispositifs médicaux numériques) system in France. PECAN permits health insurance providers to cover costs for one year, during which time digital health developers can produce definitive clinical evidence of a positive healthcare effect, in addition to the mandatory clinical evaluation required by the MDR. Once this positive impact is demonstrated, the app is classified as 'important,' 'moderate,' or 'low.' After negotiations with the Social Security Fund, Caisse Primaire d'Assurance Maladie (CPAM), the app is reimbursed based on its classification [56].

Erstattung unter Evidenzgenerierung: PECAN-System in FR

Table 4-5: Target patients and cost for telemonitoring with myDiabby in France [32].

Level	Base	Level 1	Level 2
Target patients	■ Monitoring a patient with T1DM ■ Initiation of basal insulin in a patient with T2DM ■ Monitoring T2D under insulin ■ Non-insulin gestational diabetes	■ Discovery of T1DM in adults ■ Monitoring a patient on an insulin pump ■ Monitoring a child or adolescent with T1DM ■ Gestational diabetes under insulin ■ Situations of transient imbalances (corticosteroid therapy)	■ Initiation and monitoring of a semi-closed loop insulin pump ■ Initiation of insulin pump treatment ■ Discovery of T1DM in children or adolescents ■ Monitoring of adolescents who are deprived of care ■ Pregnant women with GDM
Cost	28 Euro/Month per patient	56 Euro/Month per patient	70 Euro/Month per patient

In Germany, **Vitadio**, **My Dose Coach** have been provisionally registered for reimbursement under DiGA (DiGA: Digitale Gesundheitsanwendungen ("Digital Health Applications" in English)). **Oviva** is permanently registered for reimbursement under DiGA. The quarterly manufacturer price was established as follows: € 224.01 for Viatdio, € 478.80 for My Dose Coach, and € 220.90 for Oviva.

digitale Diabetes-Anwendungen in DE: 3 DiGA refundiert

A direct comparison between the telemonitoring compensation in the French system and application reimbursement in Germany is not feasible due to the systematic differences.

DiGA Fast-Track in Deutschland

The evaluation of digital health applications is conducted through the Fast-Track process operated by Bundesinstitut für Arzneimittel und Medizinprodukte (BfArM: the Federal Institute for Drugs and Medical Devices) [57]. Developers submit necessary evidence for review. Applications that meet the criteria as medical devices and pass the evaluation are listed in the Digital Health Applications (directory, either provisionally or permanently. For provisional registrations, the listing becomes invalid if additional evidence is not provided within a specified period. BfArM's approval for inclusion in the DiGA directory signifies reimbursement approval for all applications prescribed to patients under the statutory health insurance system. For the first year after market launch, manufacturers' list prices are paid. Subsequently, reimbursement rates are determined through price negotiations between manufacturers and the national organization of statutory health insurers.

digitale Diabetes-Anwendungen in UK: 2 DiGA refundiert

Oviva is also reimbursed in the UK. Patients can download the app and receive support at no cost by submitting the prescription to the company. The **Liva**'s body weight management program is covered by NHS (National Health Service) insurance in selected regions in the UK. Individuals who meet specified criteria regarding age, BMI, and T2DM diagnose history, and who are registered with general practitioners in Lancashire and South Cumbria in the UK, are eligible to apply for this program.

UK: Evaluierung durch NICE vor Refundierung durch NHS

In the UK, after a digital health app receives a favorable recommendation from NICE (National Institute for Health and Care Excellence), it becomes eligible for purchase by integrated care boards, subject to negotiations. Patients can then access these digital health apps free of charge at the point of service [58]. Oviva has been recommended by NICE to deliver digital Tier 3 Weight Management services with weight loss medications within the NHS, allowing eligible patients to access Oviva's services at no cost through NHS coverage in the UK.

4.3.3 Process evaluation indicators

The following sections present program evaluation data extracted from studies included in the scoping review.

Prozessevaluation in 9 von 17 Studien: Programmadhärenz, Aktivität der GDA und Technologienutzung

Among the 17 studies included in the scoping review, 9 reported results related to process evaluation. As process evaluation indicators the following items were assessed:

- Program adherence
- HCPs activities
- Patients' technology use

Table 4-6 presents the overall findings on process evaluation from the included studies.

Program adherence

Program adherence was reported in five RCTs [42, 44, 49, 52, 53], one pre- and post-test study [55] and one observational study [47].

Adhärenz-Daten in 7 Studien:

Regarding the studies aimed at supporting treatment, one study [52] reported that 27 out of 28 participants in the intervention group were considered active users, inputting data via the application. A total of 2,299 data entries were recorded, including blood glucose levels, blood pressure, and medication logs. Of these, 211 entries (9.2%) were transmitted to a physician who was involved in this study. Although participants were recommended to send data to the physician weekly, only 3 out of 28 participants (11%) adhered to this recommendation by sending data eight times during the two-month intervention period.

Therapie-unterstützende Programme:

11-75 % Adhärenz

In the second study [42], 11 out of 128 participants (8.6%) assigned to the intervention group dropped out before receiving the intervention (due to withdrawal of consent, unexplained non-participation, or death), and 7 of the remaining 117 participants were unable to install the application due to technical reasons. For participants who successfully used the application, the median number of days with application activities was 87 days (Interquartile range: IQR 84 days – 95.5 days) out of the median 93.1-day follow-up period. This indicates that 75% of the intervention group used the application on at least 84.0 days during the follow-up period.

Drop-Outs und technische Schwierigkeiten

In the third study [47], compliant patients were defined as those who used the device for at least 6 months without interruption, with an average of at least 5 dose calculations per week during the study period, and for whom more than 80% of their injected insulin doses corresponded to the recommended doses. According to this definition, 91 participants (24.4%) were classified as compliant patients.

These studies [42, 47, 52] demonstrated a wide range of adherence to application usage, varying from 11% to 75%. Regarding application usage frequency, studies focusing on insulin dose management with telemonitoring capabilities [42, 47] tended to show higher usage rates compared to those primarily aimed at data recording and message-based communication with healthcare professionals [52]. None of the studies conducted investigations into the reasons for participant dropout during the intervention phase.

Regarding the DHTs aimed at changing behavior, one study [53], which focused on telerehabilitation, reported a participant dropout rate of 26.6%. The reasons for dropout, as reported, included loss of interest, low attendance, and disease (specifically COVID-19).

Verhaltensänderungs-Programme in 2 Studien

13,2 % Drop-Out Rate

In another study [44], out of 364 individuals who initially consented to participate, 316 (86.8%) completed the program. Among the 48 participants who dropped out, the reasons were categorized as loss of interest (n=15), health-related issues (n=8), technical problems (n=5), and other reasons (n=20). Other studies aiming at changing behavior in the review did not investigate the reasons for participant dropout.

In DHTs providing other supportive care, two studies [49] [55] investigated program adherence and reasons for dropout. In one study [49], 67 participants (74.4%) completed the program. Of the remaining 23 participants, 9 dropped out due to serious adverse events. The specific reasons for the other dropouts were not reported. In the other study [55], 46 participants (62.2%) completed the program, while 28 (37.8%) dropped out. Reasons for dropout

25,6 bzw. 37,8 % Dropout-Rate

included lack of time, loss of interest, sudden illness, and failure to visit the pharmacy. These studies did not specifically investigate technology use, including the frequency of telehealth utilization.

Technology use

Technology use was reported in three RCTs and one observational study [45]. Regarding DHTs aimed at supporting treatment, one study [52] reported app-mediated communication between the patients and the physician. The average number of messages sent per participant was 1 (range: 1-5), while the average number of messages received from physicians per participant was 3 (range: 0-6). In another study [42], the median number of days that the participants logged fasting glucose values was 84 days (IQR 78.0-87 days), and the median number of days that the patients were suggested insulin dose was 82 days (IQR 74-84 days).

Technologienutzung in 3 RCTs und 1 Beobachtungsstudie

Häufigkeit der Interaktionen

Regarding the DHTs aimed at changing behaviors, one study [45] examined the number of photographs uploaded to the application for meal recording. Participants uploaded an average of 215 photos during the three-month intervention period. In another study [48], participants connected to the data integration device an average of 104 times (Standard deviation: SD 78) over the 12-month intervention period. They accessed nutritional learning content 48 times (SD: 61) on average, indicating nearly weekly engagement. Participants sent an average of 14 messages (SD: 13) to healthcare professionals and received an average of 5 replies (SD: 5) from them.

HCPs' activities

HCPs' activity was reported in one study that aimed at supporting treatment [52]. The study measured the time physicians spent communicating with patients. The time spent on all participant responses per week was 2 hours, averaging 5 minutes per participant per week.

Zeitaufwand Gesundheitspersonal: 5 Min pro Patient*in/Woche

Table 4-6: Process Evaluation indicators reported in publications on Diabetes DHT

Author/ Study design	Program adherence	HCPs activities	Patients' technology use	Main results
Treatment support				
Josefsson, et al. 2024/ Randomized Controlled Feasibility Study [52]	x	x	x	■ Number of messages sent per participant, mean 1.0 messsage ■ Number of messages received from physicians per participant, mean 3.0 messages. ■ Only 3 patients (11%) constantly sent diagnostic data to the doctor. ■ The physician used 2 hours per week to monitor data and send responses to the patients.
Hermanns, et al. 2023/RCT [42]	x		x	■ A total of 117 patients received the intervention. Out of those, 7 could not install the app because of technical reasons and did not follow the protocol. ■ In the intervention group, the median number of days with application use was 87 out of 93.1 days during the follow-up period, with 75% using the app for at least 84 days. The median days with logged fasting glucose values was 84, and the median days with suggested insulin doses was 82.
Nevoret, et al. 2023/ Retrospective observational study [47]	x			■ A total of 91 individuals (24.4%) were identified as regular and compliant users.
Behavioral change				
Blioumpa, et al. 2023/ Pilot RCT [53]	x			■ Eight patients dropped out during the intervention period. The attrition rate was 26.6%. Reasons for dropping out included loss of interest (IG, N.=1; CG, N.=2), low exercise attendance (<50%) (IG, N.=1) and Covid-19 disease (IG, N.=2; CG, N.=2).
Kempf, et al. 2023/RCT [44]	x			■ A total of 364 agreed to participate and 316 (86.8%) individuals have completed the intervention.
Bretschneider, et al. 2022/ Prospective observational study [45]			x	■ Participants actively used meal photo logging, resulting in an average of 215 meal photos per participant.
Turnin, et al. 2021/RCT [48]			x	■ The mean number of connections to the device by patients was 104 ± 78 times (median value: 86) over the 12-month follow-up period.
Other supportive care				
Dardari, et al. 2023/RCT [49]	x			■ 67 participants (74.4%) of the intervention group completed the program.
Lallemand, et al. 2023/ Pre- and post-test study [55]	x			■ 83% of patients logged on to the application at least once during the study. All pharmacists used the dashboard to view and use patient follow-up data.

Abbreviations: RCT … Randomized Controlled trial

4.3.4 Patient-reported outcomes

Among the 17 studies included in the review, 9 reported results related to patient-reported outcomes. As patient-reported outcomes, quality of life (QoL), engagement or empowerment, self-management, distress, self-efficacy, well-being, treatment satisfaction and mental health symptoms were assessed. Table 4-7 presents the overall findings on patient-reported outcomes from the included studies.

Patient*innenberichtete Endpunkte:

Lebensqualität, Empowerment, Symptome und Zufriedenheit

The studies employed various patient-reported outcome measurements:

- Quality of life (QoL)
- Engagement or empowerment
- Self-management
- Distress
- Self-efficacy
- Well-being
- Treatment satisfaction

Quality of life

QoL was reported in five RCTs [40, 44, 52-54] and one observational study [45].

Lebensqualität gemessen in 6 Studien:

Regarding the DHTs aimed at supporting treatment, two studies [40] [52] investigated the intervention's effectiveness on QoL. Both studies utilized the 5-level EuroQol 5-Dimension (EQ-5D-5L) instrument [59]. One study [52] employed the visual analog scale, and found no statistically significant effect of the intervention on QoL. The other [40] used the questionnaire format of the EQ-5D-5L and stated that the mean score of EQ-5D-5L increased in the IG while decreased in the CG, however the scores from the statistical analysis were not reported. Overall, these two studies could not find statistically significant group differences on QoL.

keine signifikanten Gruppenunterschiede bei digitalen Technologien als Therapieunterstützung

Regarding the DHTs aimed at changing behaviors, four study investigated effectiveness on QOL [53],[45],[54],[44]. Each study employed different measurement tools. The first study [53] utilized the 36-Item Short Form Health Survey (SF-36) [60]. Two of the eight SF-36 domains, Mental Health and General Health showed significant improvements in the IG. However, no significant between-group differences were observed. The second study [45] employed the 12-Item Short Form Health Survey (SF-12) [61]. Their results indicated a significant increase in the Physical Component Summary (PCS), suggesting improved QoL, while the Mental Component Summary (MCS) remained stable. The third study [54] used EQ-5D-5L [59], and did not detect significant changes. The fourth study [44] employed the Center for Epidemiological Studies Depression (CES-D) Scale [62]. Although the CES-D is primarily designed to measure depressive symptomatology, they used it to assess "impaired quality of life." Their study revealed a significant between-group difference (estimated treatment difference -2.3; 95% CI -0.9 to -3.7). In summary, three out of the four studies examining improvements in QoL outcomes reported some degree of program effectiveness.

signifikante Verbesserungen bei Verhaltensänderungs-programmen

Engagement/Empowerment

Engagement/Empowerment was reported in two RCTs [39, 42].

Empowerment in 2 Studien

Regarding the DHTs aimed at supporting treatment, two studies [39] [42] investigated the effectiveness on engagement/empowerment.

Verbesserung ohne signifikante Gruppenunterschiede

One study [39] used its own self-reported 10-item questionnaire. All items can be answered "yes" or "no" and a response of 'yes' indicated stronger engagement towards diabetes treatment. A comparison of pre- and post-trial responses to questions about individuals' involvement in their health showed that the active treatment group reported greater engagement. Among the control group, 64.4% of pre-trial responses were 'yes,' which dropped to 60.6% post-trial. In contrast, for the active treatment group, 60.6% of pre-trial responses were 'yes,' rising to 76.5% after the trial. The other study [42] used the diabetes empowerment scale (DES) [63, 64] to assess the empowerment of the patients. This study could also not yield significant effectiveness on patients' empowerment. Overall, the score of patients' engagement/empowerment increased but no study could detect significant group difference.

Self-management

Self-management was reported in two RCTs [52] [42] and one observational study [45].

Selbstmanagement in 3 Studien:

keine signifikanten Verbesserungen

Two studies [52] [42], that aimed at supporting treatment, employed the diabetes self-management questionnaire (DSMQ) [65] to assess the level of self-management. However, neither study demonstrated statistically significant improvements in self-management outcomes as a result of the intervention. One study[45], that aimed at behavioral changes, employed the Summary of Diabetes Self-Care Activities measure (SDSCA) [66], and did not detect significant changes before- and after the use of the program.

Distress

Distress was reported in two RCTs [52] [42], that aim at supporting treatment.

Diabetes-bezogene Belastung in 2 RCTs:

keine signifikanten Verbesserungen

One study [52] used The Diabetes Distress Scale (DDS) [67], while the other study [42] used the problem areas in diabetes (PAID) questionnaire [68] for assessing diabetes-related distress. However, neither study demonstrated a significant effect between groups on reducing diabetes-related distress in patients.

Self-efficacy

One RCT [42] investigated the effectiveness on self-efficacy. They used the general self-efficacy scale (GSE) [69] for assessing self-efficacy. No statistically significant effectiveness with group difference was observed in the study.

Selbstwirksamkeit: keine signifikanten Effekte in 1 RCT

Well-being

Well-being was reported in three RCTs [42] [54] [44].

Wohlbefinden

One study [42] used The WHO-5 well-being scale (WHO-5) [70] for assessing well-being. No statistically significant effectiveness was observed in the study. Two studies [54] [44] for changing behaviors investigated effectiveness on well-being: the first study [54] used the Short-Warwick-Edinburgh Mental-Well-being Scale (SWEMWBS) [71], and there was no significant effect. The second study [44] employed SF-12 [61] for assessing well-being, and they could not yield significant effectiveness.

in 3 RCTs: keine signifikanten Verbesserungen

Treatment satisfaction

Treatment satisfaction was reported in one RCT [42] and one observational study [41]. One study [42] employed the insulin treatment satisfaction scale (DSat) [72], and found no significant effect between groups. The other study [41] used Diabetes Treatment Satisfaction Questionnaire (DTSQ) [73], and observed a significant improvement in treatment satisfaction at the 6-month follow-up compared to baseline ($p < 0.001$).

Behandlungszufriedenheit: signifikante Verbesserung in 1 Studie

Mental health symptoms

One study [45] investigated effectiveness on mental health symptoms. They used the Patient Health Questionnaire (PHQ) [74], and did not find significant improvement before- and after- the use of the DHT.

psychische Symptome: keine signifikante Verbesserung in 1 Studie

Table 4-7: Patient-reported outcomes reported in publications on Diabetes DHT

Author/ Study design	Quality of life	Engagement/ empowerment	Self-management	Distress	Self-efficacy	Well-being	Treatment satisfaction	Mental health symptoms	Main results
Treatment support									
Heald, et al. 2024/RCT [39]		x							■ The intervention group showed increased engagement with their health post-trial, while the control group's engagement slightly decreased.
Josefsson, et al. 2024/ Randomized Controlled Feasibility Study [52]	Ø		Ø	Ø					■ In the intervention group, an increase in HRQOL (VAS EQ-5D) and a decrease in diabetes distress (DDS) were observed, but the diabetes self-management (DSMQ) score remained unchanged.
Heald, et al. 2023/RCT [40]	x								■ Quality of life (EQ-5D-5L) improved for patients in the active treatment group, while it slightly decreased for the control group.
Hermanns, et al. 2023/ RCT [42]		Ø	Ø	Ø	Ø	Ø	Ø		■ No significant effects were seen on empowerment, self-management, distress, self-efficacy, well-being and treatment satisfaction.
Neumann, et al. 2021/ Pre- and post-test study [41]							x		■ After 6 months of intervention, satisfaction showed a significant increase compared to the baseline.
Behavioral change									
Blioumpa, et al. 2023/ Pilot RCT [53]	x								■ Two domains (Mental Health and General Health (SF-36)) of HRQoL significantly improved over the 6-week intervention.
Kempf, et al. 2023/ RCT [44]	+					Ø			■ Significant effect with group difference on improving impairment of quality of life ■ No significant effect on well-being (SF12) was seen.
Bretschneider, et al. 2022/ Prospective observational study [45]	x		Ø					Ø	■ The Physical Component Summary (PCS: SF-12) was significantly increased (better QOL), while the Mental Component Summary (MCS: SF-12) remained the same. ■ No significant effect on improving depressive symptoms and self-management.
Christensen, et al. 2022/ RCT [54]	Ø					Ø			■ No significant effect on improving QoL ■ No significant effect on improving Well-being

Notes: +: Statistically significant effect with group differences, x: results without group differences, Ø: No statistically significant group difference

Abbreviations: RCT … Randomized Controlled Trial

4.3.5 Organizational outcomes

Among the 17 studies included in the review, 6 reported results related to organizational outcomes. As organizational outcomes, the following outcomes were assessed:

- Length of Stay
- Medication cost or use
- Doctor visit
- Medication adherence
- Medical Cost

organisatorische Endpunkte in 6 Studien:

Aufenthaltsdauer, Medikamentenkosten, Arztbesuche, Adhärenz und Behandlungskosten

Table 4-8 presents the overall findings on organizational outcomes from the included studies.

Length of Stay

One RCT [49] investigated the intervention's effectiveness on length of hospital stay. Cumulative hospital days over 12 months and diabetic foot ulcer (DFU)-related hospitalization days were assessed. The cumulative hospital days over 12 months were significantly lower in the intervention group (7.1 days; 95% CI 2.8-11.5) compared to the control group (13.4 days; 95% CI 9.0-17.8). The adjusted mean difference of 6.3 days (95% CI 0.1-12.4) was statistically significant (p=0.0458). The mean duration of DFU-related hospitalization was 3.3 (±0.8) days in the intervention group and 4.1 (±0.8) days in the control group. However, this difference did not reach statistical significance.

Krankenhaus-aufenthaltsdauer: signifikant kürzer (-6,3 Tage) in Interventionsgruppe

Medication cost or use

Medication cost or use was reported in two RCTs. One study [54] investigated effectiveness on medication use. The total of 11 out of 74 (15%) patients in the IG compared to 1 (2%) in the CG reduced their glucose-lowering medication (p=0.015). In total, 2 of 74 (3%) in the IG compared to 7 of 41 (17%) in the CG increased their use of glucose-lowering medication (p=0.021). In another study [43], program effect on costs for antidiabetics was assessed, however, no significant group difference was observed.

Medikamenteneinsatz: signifikant weniger Verordnungen in 1 Studie, nicht aber in anderer

Doctor visits

One RCT [43] investigated program effectiveness on the number of doctor's visit. No statistically significant effect between groups was observed.

Arztbesuche: keine signifikanten Unterschiede in 1 RCT

Medication adherence

Medication adherence was reported in one RCT [51] and one pre- and post-test study [55]. One RCT [51] measured frequency of blood glucose (BG) tensing. This could be recognized as a part of medical adherence. In the IG, the frequency of BG testing were 3.1 ± 1.3 times (14 days following V1), 3.1 ± 1.3 times (14 days preceding V2) and 3.0 ± 1.4 times (14 days preceding V3). However, there were no statistical changes observed. One study [55] investigated medication adherence. Thet employed the Medication Adherence Report Scale (MARS-5) [75], however, they did not detect a significant change before and after the intervention.

Medikamentenadhärenz in 2 Studien: keine signifikanten Verbesserungen

Medical Cost

Medical cost was assessed in one pre- and post-test study [41] and one RCT [49].

medizinische Kosten in 2 Studien:

One study [41] investigated the additional workload for doctors and diabetes consultants and its costs. During the intervention's six-month duration, the doctors spent around 6.3 hours more time per patient than in standard care. For the telemedical consultation itself, i.e. the diagnosis and data evaluation (117 minutes) and the patient consultations (101 minutes), 3.6 hours were spent per patient in the 6 months. Based on a net hourly rate of € 56.73 for medical services and € 34.05 for physician support services, the time required for the telemedical consultation (a total of 5.2 hours) resulted in an additional expense of € 259.16 per patient. With a total of 14 sessions in the 6 months, this amounts to approx. 22 minutes or € 18.51 per session.

Folgekosten in 1 Studie durch TH reduziert, aber höhere Personalkosten

One RCT [49] evaluated the cumulative DFU-related direct costs over 12 months. The intervention group demonstrated significantly lower costs (3,471 €; 95% CI 1,430-5,512) compared to the control group (7,185 €; 95% CI 5,144-9,226). The adjusted mean difference of 3,714 € (95% CI 827-6,600) was statistically significant (p=0.0120).

DFU: deutlich geringere direkte Kosten

The studies revealed two different aspects of medical costs: additional expenses occurred from increased physician workload and compensation for telemonitoring services, while DFU-related direct medical costs were lower in patients receiving telemonitoring.

Table 4-8: Organizational outcomes reported in publications on Diabetes DHT

Author/ Study design	Length of Stay	Medication cost or use	Doctor visit	Medication adherence	Medical Cost	Main results
Treatment support						
Molfetta, et al. 2022/RCT [51]				x		■ In IG, the frequency of BG testing were 3.1 ± 1.3 times (14 days following V1), 3.1 ± 1.3 time (14 days preceding V2) and 3.0 ± 1.4 times (14 days preceding V3). No statistical changes were observed.
Neumann, et al. 2021/ Pre- and post-test study [41]					x	■ Doctors spent an additional 6.3 hours per patient over six months compared to standard care, costing € 259.16 per patient, equating to approximately 22 minutes or € 18.51 per session.
Behavioral Change						
Dunkel, et al. 2023/RCT [43]		Ø	Ø			■ No significant effect on the number of doctor visits after the intervention. ■ Neither a significant main effect nor a significant interaction effect on costs for antidiabetic drugs was found.
Christensen, et al. 2022/RCT [54]		+				■ A total of 11 out of 74 (15%) patients in the intervention group compared to 1 (2%) in the control group reduced their glucose-lowering medication (p=0.015).
Other supportive care						
Dardari, et al. 2023/RCT [49]	+				+	■ Cumulative hospital days over 12 months were 13.4 days in the control group and 7.1 days in the intervention group. ■ The mean duration of DFU-related hospitalization days was 4.1 and 3.3 days in the control and intervention groups, respectively. ■ Cumulative direct costs over 12 months were 7185 € in the control group and 3471 € in the intervention group.
Lallemand, et al. 2023/ Pre- and post-test study [55]				Ø		■ No significant effect on medication adherence between pre- and post-intervention.

Notes: +: Statistically significant effect with group differences, x: results without group differences, Ø: No statistically significant group difference

Abbreviations: IG … Intervention Group, CG … Control Group, RCT … Randomized Controlled Trial

4.3.6 Acceptance and experience

Zufriedenheit/Akzeptanz in 4 RCTs und 2 Beobachtungsstudien

Quantitative and qualitative data on acceptability and experiences of telehealth use was reported in four RCT and two pre- and post-test studies.

One study [39] conducted interviews with five participants who completed the intervention. The interviews aimed to elucidate how participants used the app, what benefits they derived from its use, and what they found useful, as well as potential areas for improvement. However, the study did not provide detailed information about participant characteristics or the interview guide in the main text.

qualitative Interviews mit 5 Teilnehmer*innen: positive Erfahrung mit einer App

All respondents (5 out of 5) reported that the app (the Healum software) was simple to set up. A majority of the respondents (4 out of 5) found the tracking function useful, indicated that the app was motivational, and expressed willingness to continue using the app if given the opportunity. Three respondents (3 out of 5) stated that the app was easy to use. Also, the following statements from the users were obtained.

One respondent emphasized that their primary challenge had been the lack of active diabetes management steps. They described the app as a valuable tool, noting that it contained appropriate features for assistance and motivation. The respondent particularly highlighted the app's reminder function, explaining that simple reminders about dietary restrictions, such as avoiding cake, were especially helpful in maintaining proper diabetes management.

Another user reported increased motivation after using the app, contrasting their experience with traditional GP consultations. They noted that previous medical appointments had focused solely on medication, with minimal guidance on self-management strategies for diabetes.

A third respondent highlighted the app's effectiveness as a consistent reminder system. They characterized it as a form of conscience that helped maintain focus on health goals, particularly regarding weight management, and appreciated the constant reinforcement it provided.

1 zusätzliche qualitative Befragung innerhalb einer RCT

One RCT [52] conducted a qualitative study using telephone interviews with 20 patients and one physician, employing open-ended questions and a semi-structured interview guide. The study revealed several key findings from the patients' perspective:

Arztkontaktwunsch und technische Probleme als mögliche Barrieren

Regarding expectations for the app and study, the most frequent response (8 out of 20 participants, 40%) was **'the desire for contact with a physician or healthcare professional for feedback'**. In terms of app usability, more than half of the participants (12 out of 20, 60%) reported **experiencing technical problems**. A subset of participants (8 out of 20, 40%) found it difficult to add their medications to the list, while 6 out of 20 (30%) thought the app was generally difficult to use. Conversely, an equal number of respondents (8 out of 20, 40%) found the app easy to navigate. Concerning physician interaction, 45% of respondents (9 out of 20) reported receiving good and relevant replies. When asked about desired improvements, participants most frequently mentioned **direct communication between the app and blood glucose meter** (5 out of 20, 25%), the **ability to view historical values and access a graph function for learning purposes** (4 out of 20, 20%), and a desire for **a more user-friendly app** (4 out of 20, 20%). The results also indicated that more than half of the participants (11 out of 20, 55%) reported that the **application did not improve their self-care practices**.

In the same study [52], the physician's perspective highlighted several points: Lots of technical problems (messages, medicine list); The contact and work were fun when the app worked; Disadvantage not being their attending physician; The app as a good complement to diabetes care; could consider using it with her own patients; Varying participation of the participants; some very active but others never replied; Room for many improvements.

Kliniker*innen nannten u. a. ebenfalls technische Probleme als mögliche Barrieren

In one pre- and post-test study [41], the practicability of the telehealth approach was asked among the participating patients and physicians. On the part of the doctors (k=13), 60% of those surveyed were of the opinion that the telehealth approach could be implemented in everyday practice (answers "yes" [30%] and "rather yes" [30%]). Only 10% stated that in their opinion the approach could not be implemented at all. Overall, 80% of doctors stated that glucose monitoring and glucose control in their patients had improved. Patient-physician communication was perceived as improved by 70% and 80% reported improved empowerment. From the patient's point of view (k=88), the telehealth approach was easy to integrate into everyday life, with 98% answering "yes" or "rather yes", while only 2% said "rather no".

Implementierung im Alltag wurde in einer Studie von 60 % der Kliniker*innen und 98 % der Patient*innen als positiv eingestuft

One study [43] assessed the perspective of technology use among patients in the IG at the 6-month, 12-month and 24-month follow-up survey. They used 5-lickert scale questionnaire with 8 items: Perceived ease of use, Perceived usefulness, Technology self-efficacy, Relevance to everyday life, Perceived enjoyment, Subjective norm, Feeling of being controlled, Sense of security. Higher scores indicated better status for each item. The mean scores for all items, with the exception of Perceived enjoyment, exceeded 4 at all measurement points and were maintained through the 24-month follow-up. Based on these findings, the authors posit that the telehealth program implemented in this study was highly accepted by the participants.

Zufriedenheit mit der Nutzung in einer Studie, zunehmend positiv

Another RCT [48] evaluated intervention satisfaction using self-reported questionnaires among patients and physicians. At the end of the 12-month intervention period, 91.0% of telemonitored patients completed the satisfaction questionnaire, with 97.4% reporting being either completely or rather satisfied with the device use and telemonitoring data synthesis. Among physicians, the questionnaire response rate was 55%. Of these respondents, 85% reported having fully integrated the web application functions into their practice, while over 80% found the application easy or very easy to use for both accessing patient records and interpreting telemonitoring synthesis reports. Furthermore, 82.3% of the responding physicians expressed a willingness to continue using the device in their practice.

Zufriedenheit mit digitaler Technologie in 1 RCT: 97.4 % zufrieden oder voll zufrieden

A pre- and post-test study [55] conducted a round-table discussion with patients and pharmacists, revealing diverse perspectives on the intervention. In this study, pharmacists were involved as a telecoaching provider for the patients living with diabetes.

Gruppendiskussion in 1 Studie: telemedizinischer Kontakt, Beziehung und individueller Support von Pat. positiv bewertet

Regarding the coaching aspect, the study found that patients valued their interactions with, particularly appreciating the close relationships formed, personalized follow-up care, and support in achieving their objectives.

From the pharmacists' perspective, they observed high levels of motivation among patients, noting their eagerness to learn about their condition and adopt healthy behaviors. The pharmacists reported feeling that their involvement made a meaningful contribution to the project.

Concerning the application usage, patients generally evaluated the app and its content as interesting and beneficial. However, the study revealed that some patients, particularly those who considered themselves well-informed about their condition, expressed lower willingness to utilize the application.

App als interessant bewertet, aber geringere Nutzungsbereitschaft bei gut informierten Patient*innen

The pharmacists' experience with the application revealed several operational challenges. They reported that irregular application usage by some patients limited the availability of dashboard parameters for discussion during consultations. Additionally, they encountered technical difficulties with videoconferencing implementation, which necessitated deviations from the study protocol through the use of alternative communication methods such as phone calls or face-to-face interviews.

Barrieren aus Sicht der GDA: unregelmäßige Nutzung und technische Probleme

5 Discussion

This report aims to provide a summary of telehealth programs for Type 2 diabetes mellitus (T2DM) across Europe, with a focus on understanding the current landscape of researched, developed, implemented, and reimbursed initiatives. The identification of T2DM telehealth programs focusing on patient-healthcare professional interactions in Europe was conducted through two primary methods: an online questionnaire distributed through the International Diabetes Federation (IDFE), and a scoping review. Data of the identified programs were collected from the websites of the developers and published literature, with particular emphasis on organizational features and telehealth service content. Studies identified through the literature review were summarized in implementation outcomes, including patient-reported outcomes, organizational outcomes, and technology acceptance and experience.

Ziel:
Übersicht zur Telehealth Programme bei Diabetes in Europa

Summary of the findings

Through online surveys and literature review, we identified 24 Digital Health Technologies (DHTs) for T2DM that enable interactions between people living with diabetes (PwD) and Healthcare Professionals (HCPs) and are currently developed and available in Europe. All the DHTs identified through the survey were already implemented and available for use. On the other hand, those identified through the scoping review included some that were still in the research phase.

24 DHTs (Digital Health Technologies) identifiziert

These DHTs for T2DM can be broadly classified into three categories, with most focusing on **supporting treatment** through blood glucose monitoring and data sharing with HCPs, or **changing lifestyle behaviors**, particularly targeting dietary education and telecoaching, and **other supportive care**.

Interventionstypen: Therapieunterstützung, Lebensstilmodifikation, und sonstige Interventionen (z. B. Überwachung von Fußgeschwüren)

Table 5-1: List of DHTs identified through the survey and the scoping review.

	Country	Type of DHT	DHT-products	Cite
1	Netherlands Croatia Sweden Greece Germany	Treatment Support	LibreView	[30, 41]
2	Netherlands	Treatment Support	Glooko	[31]
3	France	Treatment Support	myDiabby	[32]
4	Sweden	Treatment Support	Diabetes:M	[33]
5	Belgium	Treatment Support	Mylife	[34]
6	Switzerland	Treatment Support	MySugr	[35]
7	The UK	Behavioral Change	Second nature (former name: Ourpath)	[36]
8	The UK	Behavioral Change	Oviva	[37]
9	The UK	Behavioral Change	Liva	[38]
10	Germany	Treatment Support	My Dose Coach	[42]
11		Behavioral Change	initiative.diabetes	[43]
12		Behavioral Change	TeLIPro	[44]
13		Behavioral Change	Vitadio	[45]
14		Behavioral Change	Changing Health app	[46]

	Country	Type of DHT	DHT-products	Cite
15	France	Treatment Support	Insulia	[47]
16		Behavioral Change	EDUC@DOM	[48]
17		Other supportive care	DFU telemonitoring	[49]
18	Italy	Treatment Support	DiaWatch	[50]
19		Treatment Support	Glucoonline® system	[51]
20	The UK	Treatment Support	Healum Software	[39, 40]
21	Sweden	Treatment Support	The Sukaribit Smartphone App	[52]
22	Greece	Behavioral Change	Tele-rehabilitation	[53]
23	Denmark	Behavioral Change	LIVA 2.0	[54]
24	Belgium	Other supportive care	Comunicare platform	[55]

The DHTs identified in current studies resemble those from our previous project [26]. Both reviews indicate that telehealth primarily involves physicians, with data monitoring as a central function. Additionally, both reviews highlight the extensive involvement of healthcare professionals in diabetes telehealth, including roles for registered dietitians, diabetes specialist coaches, and physiotherapists. As with our previous review, most of the telehealth programs are complex interventions, with varying degrees of interconnectivity between both devices and between PwD and HCPs.

This review indicates the adoption of DHTs in community-based interventions. For instance, pharmacists and nurses are now participating in community-centred care programs (DHTs classified as other supportive care). These changes, including remote dietary education by dietitians, suggest that telehealth is extending its reach beyond hospital-patient connections to support community-based diabetes care.

verschiedene HCPs GDA involviert

Diabetes is also known to lead to secondary complications, such as neuropathy, nephropathy, retinopathy and diabetic foot ulcers [76-78]. In this review, a study has been included on using telehealth to monitor diabetic foot ulcers, which was not found in previous report. This addition suggests that telehealth's role in diabetes care is expanding from supporting self-management of blood glucose level or lifestyle to broader clinical applications. These insights from features of European telehealth programs could be valuable for enhancing telehealth services in Austria.

neben Selbstmanagement auch Monitoring von Fußulzera

Our report found five DHTs that are currently reimbursed in three countries: Germany, France, and the UK (United Kingdom) (including some with regional or provisional coverage). In France, myDiabby's telemonitoring costs are determined by patient condition and require management by healthcare institutions or professional teams. In Germany, Oviva has a permanent approval and Vitadio and My Dose Coach have provisional approval under DiGA. In the UK, Ovia is also reimbursed and Liva's weight control program is covered by NHS insurance in selected regions. We could only identify the reimbursement of 5 DHT-interventions, however the coverage of DHT in integrated care models might be assumed.

5/24 DHTs erstattet in DE, FR und UK

The DHTs were evaluated across three assessment dimensions with the following endpoints. Process evaluation metrics (program adherence, HCP activities, technology utilization), patient-reported outcomes (Quality of Life (QoL), engagement/empowerment, self-management, distress, self-efficacy, well-being, treatment satisfaction), and organizational outcomes (length of hospital stay, medication costs/usage, physician consultations, medication adherence, healthcare costs). However, our review found that telehealth interventions for diabetes have a wide variety of content, and their effectiveness on endpoints appears to be highly dependent on contextual factors such as human resources involved in the intervention, frequency of contact, and technological usability. Furthermore, adherence-related metrics such as program completion rates, dropout rates, and reasons for discontinuation were reported in seven studies, which can be recognized as important factors for telehealth interventions.

Evaluierung in 3 Dimensionen und vielen Endpunkten:

Prozesse: Adhärenz, GDA-Tätigkeiten, etc.

Erfahrungen der Patient*innen: Selbstmanagement etc.

Organisation: Kosten und Folgekosten

Data on the acceptance and experiences of both PwDand HCPs primarily focused on program satisfaction and opinions regarding the program. Studies that assessed satisfaction reported high ratings from both PwD and HCPs [41, 48]. Additionally, in studies that measured usability and usefulness, high scores were maintained throughout long-term follow-ups [43]. These results suggest that several telehealth programs for diabetes are well accepted. However, the data obtained from the studies included in this review were not qualitative data collected through methods such as interview guides. Meanwhile, telephone survey responses also identified functional challenges with digital health technologies (DHTs), such as issues with peripheral device connectivity and historical data display [52]. Therefore, a review of qualitative studies specifically focused on the acceptance of telehealth could provide new insights and contribute to the further implementation of these programs.

hohe Zufriedenheit mit Programmen trotz technischer Probleme

Discussion to the findings

The landscape of telehealth delivery platforms has evolved significantly in recent years. While the previous report predominantly featured telehealth systems where patients transmitted data through web applications, a key distinction in our project was the identification of a larger number of telehealth programs utilizing smartphone applications as their primary platform. With the high rate of smartphone ownership today, programs in which patients send their data to healthcare professionals via apps or receive coaching through these apps have become mainstream. The prevalence of smartphone-based solutions is likely due to the devices' portability and patients' familiarity with their use. This trend suggests that future telehealth developments, especially app-based solutions, will continue to play a significant role in diabetes management.

Telehealth-Plattformen: Wandel von Web- zu Smartphone-Apps

The review revealed considerable variability in adherence rates across different telehealth interventions. In one pilot RCT [52], adherence was particularly low, while telehealth programs aimed at insulin titration demonstrated higher adherence rates [41, 47]. This disparity might be attributed to the nature of interventions; unlike basic monitoring programs, insulin titration programs included features for daily dose adjustments, potentially driving higher engagement. Furthermore, programs focused on behavioral changes tended to show higher technology use rates compared to those centered on treatment support. This higher engagement could be attributed to the more intensive intervention approach of behavioral change programs, which typically involved frequent contact with healthcare professionals and individualized feedback.

Adhärenz-Raten: stark unterschiedlich je nach Intervention

Several barriers to effective telehealth implementation were identified across studies. Technical issues emerged as a significant challenge, with half of the participants in Josefsson's study [52] reporting technical difficulties or usability issues, suggesting that poor app functionality may have contributed to low usage rates. Communication challenges also emerged as a notable barrier. Feedback from participating physicians highlighted difficulties in managing patients who were not their regular patients, while patients potentially felt resistant to communicating with unfamiliar HCPs. These findings suggest that the relationship between HCPs and patients plays a crucial role in telehealth engagement.

Hauptbarrieren: Technische Probleme und Kommunikationsschwierigkeiten

Conversely, certain factors appeared to enable higher engagement. Programs incorporating personalized coaching and regular individual feedback demonstrated stronger intervention intensity and subsequently higher adherence rates. The success of these programs highlights the importance of maintaining active interaction between HCPs and patients. This observation was particularly evident in behavioral change programs, where frequent professional contact and tailored feedback appeared to enhance user engagement compared to basic treatment support programs.

Erfolgsfaktoren für höhere Adhärenz durch personalisierte Betreuung

Drop-out rates were calculated in several studies and 'Loss of interest' was consistently identified as a primary factor for discontinuation [53, 55]. Austrian evaluations of diabetes telehealth programs also reported high dropout rates of approximately 41%, with lack of motivation (31.9%), technical issues (24.4%), and inadequate medical care (15.6%) cited as key reasons [79, 80]. These dropouts directly impact the effectiveness of telehealth monitoring and can lead to insufficient care. To enhance telehealth effectiveness, previous studies have suggested several strategies, including combining telemonitoring with regular in-person visits, providing personalized feedback, ensuring user-friendly technology, and maintaining content relevance [81, 82]. Specific technological improvements requested by participants, such as direct communication between apps and blood glucose meters and access to historical data visualization, underscore the potential for enhanced adherence through improved usability.

Interessensverlust als Ursache für Drop-Out

Strategien zur Verbesserung der Adhärenz durch Programmevaluation und technische Optimierung.

Moreover, among the studies included in this review, none evaluated the telehealth programs themselves using reliable and validated methods. For example, in recent years, scales have been developed to measure the usability and functionality of mobile applications [83]. Therefore, it would be beneficial to assess patient evaluations of the telehealth programs, especially mobile applications, for improvement of the technology. While this review identified various adherence patterns and dropout factors, qualitative information regarding telehealth usage barriers remains limited. Future research should focus on developing and evaluating strategies to maintain patient motivation through improved technology and program delivery methods.

Verwendung von validen und erprobten Evaluationsmethoden sind selten

Overall, there were not a lot of studies that investigated organizational outcomes. When evaluating the effectiveness of telehealth, clinical outcomes such as blood data and Patient-reported outcomes (PROMs) are often used. This is because clinical outcomes and PROMs are generally easier to measure and quantify compared to organizational outcomes. It is considered that because blood tests, patient surveys, and other clinical data can be relatively easily collected within the scope of a study. In contrast, organizational outcomes such as long-term cost reduction and overall system efficiency improvements often require more extensive data collection and longer follow-up periods. Additionally, there may be a lack of appropriate evaluation tools for measur-

organisatorische Endpunkte selten untersucht, trotz Relevanz

ing organizational outcomes. The importance of evaluating organizational outcomes is also suggested in an earlier study [84]. Therefore, it is desirable to include organizational outcomes as part of telehealth evaluation in future studies.

Mehraufwand außerhalb Sprechzeiten für Auswirkungen auf das Gesundheitspersonal

One study measured the time healthcare professionals spent supporting patients via telehealth [41]. Telemonitoring and responding to medical inquiries often took place outside of regular consultation hours. Also, it is desirable to assess the impact of telehealth on the healthcare system, especially when healthcare professionals are involved, and particularly when telemonitoring is used as part of diagnostic support. For example, it would be beneficial to evaluate whether telemonitoring increases the response time of doctors and nurses, or whether improved patient self-management leads to a reduction in the number of consultations and prescriptions. Moreover, since healthcare professionals are also users of telehealth, in addition to patient usability assessments, it is important to consider evaluations from healthcare professionals as well.

Kostenerstattung und Strategien zu Implementierung

One of the challenges in implementing telehealth is the issue of reimbursement [85]. When considering the implementation of telehealth reimbursement in Austria, careful consideration must be given to what should be covered: whether to reimburse the applications themselves, as seen in the models in Germany or the UK, or to provide compensation for telemonitoring services as well, following the French approach.

Limitations

Limitierungen: keine Qualitätsbewertung der Studien, heterogene Studiendesigns

There are several limitations to this study. The purpose of this study was to narratively summarize the organizational features of telehealth for diabetes conducted in Europe. Therefore, we did not assess the quality or risk of bias of the included studies. The study designs of the included research varied widely, ranging from longitudinal studies to randomized controlled trials with comparison groups, and it is possible that the findings from each study could contain bias. This study was a combination of a survey and a literature review using databases. While we were able to identify the DHTs for diabetes telehealth that are available or piloted in Europe, we did not extend the identification to the care programs in which these DHTs are embedded, nor did we identify evaluation reports on these programs, which is a limitation.

Lastly, it should be noted that the telehealth interventions included in this review may undergo continuous functional updates, and their reimbursement status may change in the future.

6 Conclusions

Telemedizin: zunehmend multiprofessionell

In the implementation of telemedicine for diabetes, it must be considered that various approaches exist – not only DHTs for data transfer between healthcare professionals and people living with diabetes, but also innovative approaches such as nutritional counselling via apps.

Erstattung: neben Technologie auch Monitoring-Leistungen

Regarding the reimbursement of telehealth services, a fundamental decision is required on whether to reimburse only the applications themselves (as in the German model) or to also compensate for telemonitoring services provided (as in the French approach). The choice of reimbursement model can impact the acceptance and adoption of telehealth programs and should therefore be carefully considered. It may be desirable to incorporate it into a care program rather than a separate reimbursement.

Monitoring von Adhärenz, Patient*innenerfahrung und technischen Problemen

Given the variable therapy adherence and barriers identified in studies (including technical problems), continuous monitoring of adherence, patient experience, and technical performance of digital technologies is essential. Only through such monitoring can problems be identified and addressed promptly to ensure the effectiveness and acceptance of interventions in practice.

Analyse der organisatorischen Auswirkungen wichtig

As recommended in the previous report regarding the measurement of organizational and social effects of telemedicine, attention should be focused on the impacts of telemedicine implementation on healthcare systems, such as medical staff response times, consultation patterns, and changes in overall healthcare costs. The measurement of these organizational outcomes is important for understanding the broader implications of telemedicine integration into the healthcare system.

7 References

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Appendix

Data extraction tables

Table A-1: Data extraction table part 1/6

Author, Year [Ref]	Heald, et al. 2024, Heald, et al. 2023 [39, 40]		Josefsson, et al. 2024 [52]
Country	The UK		Sweden
Study design	RCT		Randomized Controlled Feasibility Study
Telehealth intervention	Telemonitoring	Telemonitoring	Telemonitoring
Settings, medical sectors, service providers	Primary care; Physicians	Primary care; Physicians	Primary care; Family medicine doctor
Type of diabetes	T2DM	T2DM	T2DM
Study Objective	The study investigated how a personalized care-planning software and linked mobile app may aid people to manage their diabetes more effectively and determined the way that the intervention might influence an individual's experience of having T2DM in relation to their QoL and self-management.	This study aimed to evaluate whether personalized care planning software and a patient-facing mobile app could improve health outcomes amongst patients with T2DM through the delivery of personalized plans of care, support and education to allow patients to self-manage their diabetes more effectively, all accessible on a mobile device.	The purpose of this study was to investigate the feasibility of the study. Our research questions were as follows: (1) Are the study procedures feasible and effective? (2) Is the Sukaribit smartphone app (version 1.1) usable and accepted by people with type 2 diabetes? (3) How large are the effect sizes for the use of the Sukaribit smartphone app on HbA1c and other potential outcomes?
Study period	6 months	6 months	2 months
No. of patients (IG vs. CG)	24 (extracted from the whole participants of #17)	115 vs. 82	28 vs. 31
Loss-to-follow up	-	n.r.	21
Age	n.r.	IG: µ 61.1 CG: µ 65.2	IG: µ 60.2 (12) CG: µ 61.8 (9)
Female gender (%)	n.r.	IG: 38.3% CG: 25.6%	IG: 11 (39.3%) CG: 6 (19.4%)
Data collection	t0= baseline t1= 6 months from the baseline	t0= baseline t1= 6 months from the baseline However, due to the COVID-19 pandemic, the patients had a range of times between their t0 (baseline) and t1 (follow-up) health outcomes measurements; their t1 HbA1c ranged from 134 to 418 days (median 188) after their first.	T0= baseline t1= 2 months from the baseline (at the end of the program)

Author, Year [Ref]		Heald, et al. 2024, Heald, et al. 2023 [39, 40]		Josefsson, et al. 2024 [52]
Study (Program) interventions		Through Healum Software, patients were provided with a co-created personalized care plan. The co-created personalized care plan involved daily lifestyle prompts and a range of recommended resources, including educational content and self-management tools, as well as addressing patient objectives and concerns. Through Healum, healthcare providers can monitor health data that patients agree to send. Healum analyzes the data, which can be used to improve individual care plans and treatments. Care plans can be sent to patients online.		The Sukaribit smartphone app store and displays health data, facilitates 2-way communication between patients and physicians or nurses, and provides individualized feedback and education. This interactive feature aims to enhance patient self-monitoring, improve blood glucose control, and complement standard care by allowing remote feedback from HCPs. The doctors checked the blood glucose levels sent by the patient and provided feedback through the app at least once a week.
Control settings		-	Standard care	Standard care
Process evaluation	**Indicators**	N.R.	N.R.	(1) Patients' activity (2) Physician's activity (3) (Usability and Acceptability
	Measurement instruments			(1) Patients' app log (2) Physicians' app log (3) Usability: The number of those initially interested and eligible actually started participating. Acceptability: The number of those who participated in the intervention sent at least 8 blood glucose measurements during the 2-month intervention (about 1per week).
	Results			(1) - Of the 28 participants in the IG, 27 were active users of the app (ie, they completed 2299 data entries in total [blood glucose value, blood pressure value, and medications] in the app and sent 211 of the entries to the physician at some point). - Number of messages sent per participant: mean (range) 1.0 (1-5) - Number of messages received from physicians per participant: mean (range) 3.0 (0-6) - Only 3 patients (11%) constantly sent diagnostic data to the doctor. - Time spent on all participant responses per week: 2 hours - Time spent on participant responses per week per participant: 5 minutes (2) Usability: 76% (59/78) Acceptability: 11% (3/28; based on the "Number of sent diagnostic data")
Patient-reported outcomes	**Indicators**	Program Engagement	QOL	(1) General self-rated health (2) Diabetes self-management (3) Diabetes-related distress

Author, Year [Ref]		Heald, et al. 2024, Heald, et al. 2023 [39, 40]		Josefsson, et al. 2024 [52]
Patient-reported outcomes *(continuation)*	**Measurement instruments**	Self-reported question	EQ-5D-5L	(1) Visual analogue scale (EQ-5D) (2) The Diabetes Self-Management Questionnaire (DSMQ) (3) The Diabetes Distress Scale (DDS)
	Results	A comparison between pre- and post-trial responses to questions related to individuals' engagement with their health indicated that members of the active treatment group reported higher engagement.	The mean score of EQ-5D-5L was increased in the IG, while that of the CG decreased. However, the results of the statistical test are not documented.	(1) No significant group difference (2) No significant group difference (3) No significant group difference
Organizational outcomes	**Indicators**	N.R.	N.R.	N.R.
	Measurement instruments			
	Results			
Acceptance and experience	**Participants**	5 individuals who had completed the program	N.R.	20 patients and 1 physician answered telephone interview
	Indicators	(1) (How they use the app (2) What benefits they have derived from use (3) What they find useful and how the app may be improved		open-ended questions with semi structured questions
	Answers	(1) 5/5 responders said that the app was simple to set up, 3/5 said the app was easy to use, 4/5 said that the tracking function was useful, 4/5 said the app was motivational, and 4/5 said they would continue to use the app if given the opportunity. (2) 'The main problem for me before was that I wasn't taking active steps to manage my diabetes. I think the app is a very useful tool – it has the right things on there to help and motivate you. Quite often all you need is a reminder – for example I forget that I shouldn't be eating cake. The app reminds me to do certain things and keep on top of my management.' (3) 'Having the app has made me feel more motivated. Before, whenever I went to the GP it was all about the drugs I must take and that was it. I was never really told about the things I could do myself to help my diabetes management.' 'I did find it quite useful as a sort of nag, a little bit of conscience sitting on your shoulder saying you really need to get your weight down – so in that sense that constant reminder was quite useful.'		Most frequent answer to each question from the patients **Expectations for the app and study** ■ Want to have contact with a physician or health care professional (feedback) 8 **Thoughts about the app** ■ Technical problems 12 **Contact with the physician** ■ Good and relevant replies 9 **Desired improvements** ■ Wish for an easier app 4 ■ See old values and a graph function (to be able to learn) 4 **Overall impression** ■ The application did not improve self-care. 11 Physicians' evaluation of this app ■ Lots of technical problems (messages, medicine list) ■ The contact and work were fun when the app worked. ■ Disadvantage not being their attending physician. ■ The app as a good complement to diabetes care; could consider using it with her own patients. ■ Varying participation of the participants; some very active but others never replied. ■ Room for many improvements. ■ Part of the future.

Table A-1: Data extraction table part 2/6

Author, Year [Ref]	#13: DeLuca, et al. 2023 [50]	#18: Hermanns, et al. 2023 [42]	#26 Nevoret, et al. 2023 [47]
Country	Italy	Germany	France
Study design	Observational study with control cohort	RCT	Retrospective observational study
Telehealth intervention	Telemonitoring	Telemonitoring	Telemonitoring
Settings, medical sectors, service providers	Primary care; Medical centers; Healthcare professionals at the medical centers	Primary care; Physicians	Primary care; Physicians
Type of diabetes	T2DM	T2DM with once-daily basal insulin therapy combined with oral antidiabetic agents or non-insulin injectables	T2DM
Study Objective	The study aimed to assess how the DiaWatch affected key metabolic parameters relevant to the management and prognosis of T2D patients.	This study aimed to evaluate whether titrating the basal insulin dose with this digital health tool reduces HbA1c values.	This study aims to analyze this database to determine how the glycemic control of Insulia users has evolved when using the app in a real-life setting in France.
Study period	6 months	12 weeks	5.5 to 6 months (retrospective)
No. of patients (IG vs. CG)	100 vs. 100	123 vs. 123	484 (enrolled as users of the app) in analysis: 373
Loss-to-follow up	n.r.	IG: 19 CG: 7	111
Age	IG: µ 61.1 (SD 9.4) CG: µ 66.5 (SD 9.0)	IG: µ 60.0 CG: µ 59.5	µ 55.8 (SD 11.9)
Female gender (%)	IG: 17 (17.0%) CG: 30 (30.0%)	IG: 48 (37.5%) CG: 43 (35%)	152 (40.8%)
Data collection	t0= baseline t1= at 6 months or 8 months (Due to the COVID-19 pandemic, data could not be obtained at the same point)	t0= baseline t1= at 12 weeks	Between 5.5 and 6 months following the initiation of the device use.
Study (Program) interventions	DiaWatch and DM4all are telehealth solutions. Patients collect clinical data using smartphones linked to medical devices (such as glucometer, sphygmomanometer, smartwatch for heart rate monitoring and step counter), which is automatically sent to a shared care plan accessible to both patients and healthcare professionals. The shared care plan, accessed through the patient and the professional profiles, includes information on lifestyle, treatment plan, and disease-related data. HCPs can monitor health data and adherence sent by patients. HCPs can communicate with patients over the platform.	Participants in the intervention group used the My Dose Coach app, which synced with an online platform where physicians could set titration algorithms, monitor therapy, and adjust insulin doses. Participants entered daily fasting blood glucose measurements into the app, which calculated recommended insulin doses based on the physician's settings. Physicians were able to monitor the patient's therapy at any time and make any necessary adjustments, which were automatically transferred to the application, and participants received a text message informing them about the adjustments.	Insulia is a digital solution that combines a smartphone app for basal insulin dose suggestions and a web portal accessible to professionals to personalize and manage patients' treatments remotely. Beyond remote monitoring of basal insulin therapy, the app uses the data entered by the patients to calculate the recommended basal insulin dose according to the objectives set by the patient's physician.
Control settings	Standard care	Usual treatment with a written titration chart to titrate their basal insulin.	-

Author, Year [Ref]		#13: DeLuca, et al. 2023 [50]	#18: Hermanns, et al. 2023 [42]	#26 Nevoret, et al. 2023 [47]
Process evaluation	**Indicators**	N.R.	(1) Program adherence (2) Technology use	(1) Program adherence
	Measurement instruments		(1) The number of patients who completed intervention (2) The median number of days with application activities	(1) The number of the compliant users
	Results		(1) A total of 117 patients received the intervention. Out of those, 7 could not install the app because of technical reasons and did not follow the protocol. (2) In IG, the median number of days with application activities was 87 days (IQR 84 days–95.5 days) of the median 93.1 days in the follow-up period.	91 individuals (24.4%) were identified as regular and compliant users. Compliant patients are those who have used the device for at least 6 months without interruption with at least 5 dose calculations per week on average during the study period and for whom more than 80% of their injected insulin doses corresponded to the recommended doses.
Patient-reported outcomes	**Indicators**	N.R.	(1) Diabetes distress (2) Self-management (3) Empowerment (4) Self-efficacy (5) Therapy satisfaction (6) Well-being	N.R.
	Measurement instruments		(1) The problem areas in diabetes (PAID) (2) The diabetes self-management questionnaire (DSMQ) (3) The diabetes empowerment scale (DES) (4) The general self-efficacy scale (GSE) (5) The insulin treatment satisfaction scale (DSat) (6) WHO-5 well-being scale	
	Results		(1) No significant group difference (2) No significant group difference (3) No significant group difference (4) No significant group difference (5) No significant group difference (6) No significant group difference	
Organizational outcomes	**Indicators**	N.R.	N.R.	N.R.
	Measurement instruments			
	Results			
Acceptance and experience	**Participants**	N.R.	N.R.	N.R.
	Indicators			
	Answers			

Table A-1: Data extraction table part 3/6

Author, Year [Ref]	#36 Molfetta, et al. 2022 [51]	#49 Neumann, et al. 2021 [41]	#7: Blioumpa, et al. 2023 [53]
Country	Italy	Germany	Greece
Study design	RCT	Pre and posttest study	Pilot RCT
Telehealth intervention	Telemonitoring	Telemonitoring	Telerehabilitation
Settings, medical sectors, service providers	Primary care	Primary care; Clinic; Physicians	General Hospital, Private diabetic clinics; the Regional Association of Diabetic Patients; Physiotherapist
Type of diabetes	Insulin-treated diabetes (T1DM or T2DM)	T1DM or T2DM with conventional insulin therapy or insulin pump therapy	T2DM
Study Objective	This study evaluates whether a web-based telemedicine system (the Glucoonline® system) is effective in improving glucose control in insulin-treated patients with type 1 and type 2 diabetes compared to the standard of care.	The aim of the study was to investigate the extent to which providing patients with type 1 or type 2 diabetes with a system for intermittent continuous glucose monitoring (iscCGM) (FreeStyle Libre 1st generation, Abbott GmbH), including the use of the telemedicine approach, can improve their glucose control.	The purpose of this study was to determine the effects of Telerehabilitation program on glycemic control, functional capacity, muscle strength, PA, quality of life and body composition.
Study period	24 weeks (6 months)	6 months	6 weeks
No. of patients (IG vs. CG)	62 vs. 61	93	15 vs. 15
Loss-to-follow up	IG: 7 CG: 19	5	IG: 4 CG: 4
Age	IG: µ 47.2 (SD 14.5) CG: µ 45.2 (SD 14.8)	µ 58.3 (SD 41.4)	IG: µ 60.3 (SD 9.3) CG: µ 60.8 (SD 13.6)
Female gender (%)	56 (45.5%)	39 (42.0%)	IG: 3 (27.3%) CG: 4 (36.4%)
Data collection	V1=baseline V2=3 months after the beginning of the program (in the middle of the program) V3=6 months after the beginning of the program (at the end of the program)	t0=baseline t1=3 months (in the middle of the intervention, medical parameter only) t2=6 months (at the end of the program)	t0= baseline t1= at 12 weeks
Study (Program) interventions	Glucoonline® is a diabetes telemedicine program that includes a smartphone-connectable glucose meter, real-time BG data transmission via smart-phone software, and a Decision Support Software (DSS)-assisted remote server for comprehensive data analysis and feedback. This system supports various aspects of diabetes management, such as patient adherence to SMBG, overall glucose control evaluation, and emergency intervention for hyper- or hypoglycemia.	The intervention program involves the use of the FreeStyle Libre and LibreView systems. Patients received training on these devices and telemedicine intervention. Over the next 6 months, patients used the iscCGM system, performing at least 10 scans daily to monitor current glucose levels and recording all insulin doses (for both Type 1 and Type 2 diabetes), carbohydrate amounts in bread units (for Type 1 diabetes), and other events. Patients regularly uploaded their data to the cloud-based data management system LibreView, compatible with the iscCGM system, and forwarded this data to their treating physicians.	Under the supervision of a physiotherapist, patients attended an initial educational session. Aerobic and resistance exercises were individually prescribed, and patients' vital signs were recorded. Following initial training, patients participated in a 6-week telerehabilitation program (TR) with thrice-weekly, 60-minute exercise sessions (60 minutes per session) via video conferencing. This program included real-time supervision, feedback, and exercise modifications by a physiotherapist.

Author, Year [Ref]		#36 Molfetta, et al. 2022 [51]	#49 Neumann, et al. 2021 [41]	#7: Blioumpa, et al. 2023 [53]
Study (Program) interventions *(continuation)*		The program features a web-based electronic CRF (Glucoonline™ eCRF) for multiple assessments including SMBG frequency, overall glucose control quality, graphical BG visualization, and specific BG value thresholds. Patients in the intervention group received educational sessions on using the meter and eCRF, with regular follow-up visits every 3 months. The DSS-supported server provided alerts for sub-optimal SMBG, extreme BG values, and recurrent hypoglycemia or sustained hyperglycemia, enabling prompt interventions such as patient counseling or medical visits.	The medical team reviewed the data and reports, focusing on the "snapshot" outputs with average values over several days, daily logs, low glucose events, carbohydrate entries, insulin doses, and daily glucose trends. Physicians then provided feedback and therapy recommendations to patients either by phone, in writing, or in person. During the first month, telemedicine support was provided weekly, and from the second month, it was bi-weekly. Quarterly in-person visits were conducted to discuss the data. If improvements in time-in-range (70-180 mg/dl) and hypoglycemia reduction were not as expected, additional phone contacts or practice visits could occur in the first month, continuing with bi-weekly contacts in the second month.	
Control settings		Standard of Care for diabetes.	-	Standard care
Process evaluation	**Indicators**	N.R.	N.R.	(1) (1) Program adherence
	Measurement instruments			(1) (1) Attrition rate
	Results			(1) Eight patients (IG, N.=4; CG, N.=4) dropped out during the 6-week intervention period. The attrition rate was calculated 26.6%. Reasons for dropping out included loss of interest (IG, N.=1; CG, N.=2), low exercise attendance (<50%) (IG, N.=1) and Covid-19 disease (IG, N.=2; CG, N.=2).
Patient-reported outcomes	**Indicators**	N.R.	(1) The patients' satisfaction with the diabetes treatment	(1) QoL
	Measurement instruments		(1) Diabetes Treatment Satisfaction Questionnaire (DTSQ)	(1) SF-36
	Results		(1) After 6 months of intervention, satisfaction showed a significant increase compared to the baseline (p < 0.001).	(1) In the IG, two aspects (Mental Health and General Health) out of the eight aspects in the SF-36 significantly improved. No significant group difference was examined.
Organizational outcomes	**Indicators**	(1) Frequency of BG testing	(1) The additional workload for doctors and diabetes consultants and costs	N.R.
	Measurement instruments	(1) Log data on the app	(1) Self-reported questionnaire	
	Results	(1) In IG group, the frequency of BG testing were 3.1 ± 1.3 times (14 days following V1), 3.1 ± 1.3 times (14 days preceding V2) and 3.0 ± 1.4 times (14 days preceding V3). No statistical changes were observed.	(1) During the project's six-month duration, the doctors spent around **6.3 hours** more time per patient than in standard care. For the telemedical consultation itself, i.e. the diagnosis and data evaluation (117 minutes) and the patient consultations (101 minutes), **3.6 hours** were spent per patient in the 6 months.	

Author, Year [Ref]		#36 Molfetta, et al. 2022 [51]	#49 Neumann, et al. 2021 [41]	#7: Blioumpa, et al. 2023 [53]
Organizational outcomes *(continuation)*			Based on a net hourly rate of € 56.73 for medical services and € 34.05 for physician support services, the time required for the telemedical consultation (a total of 5.2 hours) resulted in an additional expense of € 259.16 per patient. With a total of 14 sessions in the 6 months, this amounts to approx. 22 minutes or € 18.51 per session.	
Acceptance and experience	**Participants**	N.R.	Physicians and Patients	N.R.
	Indicators		Practicability of the telemedicine approach	
	Answers		On the part of the doctors, 60% of those surveyed were of the opinion that the telemedicine approach could be implemented in everyday practice (answers "yes" [30%] and "rather yes" [30%]). Only 10 % stated that in their opinion the approach could not be implemented at all. Overall, 80% of doctors stated that glucose monitoring and glucose control in their patients had (greatly) improved. Patient-physician communication was perceived as improved by 70% and 80% reported improved empowerment. From the patient's point of view, the telemedicine approach was easy to integrate into everyday life, with 98% answering "yes" or "rather yes", while only 2% said "rather no".	

Table A-1: Data extraction table part 4/6

Author, Year [Ref]	#56 Turnin, et al. 2021 [48]	#58 Zaharia, et al. 2021 [46]	#14: Dunkel, et al. 2023 [43]
Country	France	Germany	Germany
Study design	RCT	Pre and posttest study	RCT
Telehealth intervention	Telemonitoring, Telecoaching	Telecoaching	Telemonitoring, Telecoaching
Settings, medical sectors, service providers	Primary care; Hospitals, public and private health; Establishments, private clinic; Physicians	Primary care; Dietitians	Outside of the hospital treatment; A private German health insurance company, "health specialists" or "diabetes coaches"
Type of diabetes	T2DM	T2DM	T2DM
Study Objective	The aim of this study was to assess the efficacy of an at-home interventional program incorporating electric devices and lifestyle education software on diabetes control compared to standard care.	The study investigated the effects of a novel approach incorporating a regular 'whole food-based' low-calorie diet combined with app-based digital education and behavioral change program on glucose metabolism and disease management.	The objectives of the present study were to investigate the long-term effects of the initiative.diabetes programme and the long-term maintenance of these effects after 12 and 24 months.

Author, Year [Ref]		#56 Turnin, et al. 2021 [48]	#58 Zaharia, et al. 2021 [46]	#14: Dunkel, et al. 2023 [43]
Study period		12 months	12 weeks	24 months
No. of patients (IG vs. CG)		141(75: HbA1c ≥ 7.5%) vs. 141 (76: HbA1c ≥ 7.5%)	29 (intervention group only)	86 vs. 65
Loss-to-follow up		IG:13 CG: 6	5	IG: 23 CG: 15
Age		IG: µ 59.8 (9.2) CG: µ 59.3 (10.0)	µ 58.0 (SD 8.0) *Single group	IG: µ 59.66 (SD 6.24) CG: µ 58.80 (SD 7.33)
Female gender (%)		IG: 46 (35.9%) CG: 51 (37.8%)	14 (58.3%) out of 24 individuals who completed the program	IG: 17 (19.8%) CG: 11 (16.9%)
Data collection		t0=baseline t1=12 months from the baseline (at the end of the program)	t0=baseline t1=at the end of the program (12 weeks)	t0=Baseline t1=At 6 months t2=At 12 months t3=At 24 months
Study (Program) interventions		The home telemonitoring program Integrates biomedical data sensors (scale with impedancemetry, actimeter, and blood glucose meter) with educational software available on tablets. Participants in the telemonitoring group (TMG) used three tele-educational software programs: Nutri-Kiosk for nutritional knowledge quizzes, Acti-Kiosk for physical activity support, and Nutri-Educ for personalized nutritional education based on AI algorithms. Nutri-Educ helps patients improve their nutritional balance by analyzing meal details and suggesting corrections according to individual profiles and preferences. Data from the TMG participants were sent weekly to a secure web platform accessible to both patients and investigators. Investigators received monthly email reminders to review the data, which included summaries and alerts for events like hypoglycemia, hyperglycemic tendencies, and significant weight changes. The secure messaging system allowed for ongoing interactive discussions between investigators and patients, enabling personalized follow-up and adjustments to health targets. Investigating physicians monitored blood glucose, body weight, and physical activity, providing regular reports on telemonitoring progress to general practitioners.	The 12-week diabetes telemedicine program involves a real food-based low-calorie diet supported by an app-guided digital education program and a low-calorie recipe book. Participants follow a balanced low-calorie diet (average 850 kcal/day) focusing on high-protein, low-glycemic index foods. Weekly coaching calls are provided by specifically trained dietitians. Participants document every food item consumed by photographing them via a smartphone app, with images uploaded to an online portal for evaluation by dietitians. Portion size and caloric intake are estimated by dietitians based on these images, randomly selected for two days during the study. During weekly coaching calls, dietitians offer structured behavior change advice, motivation, and guidance on maintaining a healthy diet, documenting dietary intake, and tracking body weight weekly through the app. This program combines nutritional guidance with continuous support and monitoring to help participants adhere to a low-calorie diet and manage their diabetes effectively. Patients used the app (Changing Health App) throughout the study and adherence was monitored based on logins.	The initiative.diabetes program is a 12-month structured lifestyle intervention that combines telemonitoring with personalized telephone coaching by health specialists. Participants receive a tablet, pedometer, and blood glucose meter, which automatically sync data via Bluetooth for continuous monitoring and feedback. The program supports but does not replace usual medical care. Patients send health data, and the diabetes coach continuously monitors it. Diabetes coaches use the data for personalized telephone coaching. Coaching sessions includes several modules that address key T2DM issues, such as nutrition, physical activity, self-monitoring, medication, emergency management, clinical management, and stress management. This program consists of an intensive six-month phase with monthly calls and a stabilization phase with calls every 6 to 12 weeks (a total of 12-month program).
Control settings		Standard of Care for diabetes.	-	Standard care
Process evaluation	Indicators	(1) Compliance with the device	N.R.	N.R.
	Measurement instruments	(1) Log data		

Author, Year [Ref]		#56 Turnin, et al. 2021 [48]	#58 Zaharia, et al. 2021 [46]	#14: Dunkel, et al. 2023 [43]
Process evaluation *(continuation)*	**Results**	(1) Over the 12-month follow-up period, patients connected to the device an average of 104 ± 78 time. Mean data synthesis (TMGs) and Nutri-Educ software (TMGn) access figures were 44 ± 49 times (median value: 29) and 48 ± 61 times (median value: 31), respectively, demonstrating almost weekly use. On average, TMG patients sent 14 ± 13 messages (median value: 11) to the investigators, i.e., about one message per month. The mean messaging frequency from the investigators to the participants was 5 ± 5 (median value: 3).		
Patient-reported outcomes	**Indicators**	N.R.	N.R.	N.R.
	Measurement instruments			
	Results			
Organizational outcomes	**Indicators**		N.R.	(1) Physician contacts (2) Costs for antidiabetics
	Measurement instruments			(1,2) The health insurance company data
	Results			(1) No significant main effect of time on physician contacts between group. (2) No significant main effect of time on costs of antidiabetics between group.
Acceptance and experience	**Participants**	Patients and physicians	N.R.	(1) Patients (n=60, 62)
	Indicators	Satisfaction, self-reported questionnaire		(1) 5-lickert scale questionnaire with 8 items (higher score indicates better acceptance of technology)
	Answers	Patients ■ At the end of the 12-month intervention period, 91.0% of telemonitored individuals completed the satisfaction questionnaire; 97.4% were completely satisfied or rather satisfied with device use and telemonitoring data synthesis. Physicians ■ Fifty-five percentage of the physicians completed the satisfaction questionnaire; 85% of them reported having completely integrated the web application functions and over 80% found it easy to very easy to use, in terms of both patient records and telemonitoring synthesis reports. Finally, 82.3% were keen to continue using the device.		(1) Perceived ease of use, Perceived usefulness, Technology self-efficacy, Relevance to everyday life, Perceived enjoyment, Subjective norm, Feeling of being controlled, Sense of security were assessed. The average values for all items except "Perceived enjoyment" exceeded 4.0 through the survey.

Table A-1: Data extraction table part 5/6

Author, Year [Ref]	#20: Kempf, et al. 2023 [44]	#33 Bretschneider, et al. 2022 [45]	#35 Christensen, et al. 2022 [54]
Country	Germany	Germany	Denmark
Study design	RCT	Prospective observational study	RCT
Telehealth intervention	Telemonitoring, Telecoaching	Telecoaching	Telecoaching
Settings, medical sectors, service providers	Outside of the hospital treatment; An Institute for Telemedicine and Healthcare; Diabetes assistants or diabetes consultants employed at the German Institute for Telemedicine and Healthcare	Primary care	Primary care; Health coaches are educated as nurses, physiotherapists, dietitians, or occupational therapists
Type of diabetes	T2DM	T2DM and being enrolled in the disease management program for diabetes	T2DM
Study Objective	The aim of the current study was to evaluate the potential impact of TeLIPro focusing on telemedical coaching without using a formula diet on metabolic control in real life.	The aim of the study was to provide preliminary evidence for Vitadio in patients with T2DM, with the intention of obtaining preliminary approval as a DiGA by the BfArM.	The study aimed to investigate whether individualized digital lifestyle coaching enabled by an eHealth and mHealth solution could increase health for T2D patients by supporting them to lose weight, decrease BMI and hip and waist circumference, and improve blood glucose management compared to a control group receiving standard care with 6-month follow-up.
Study period	18 months	3 months	6 months
No. of patients (IG vs. CG)	364 vs. 453	60	100 vs. 70
Loss-to-follow up	IG: 89 CG: 261	18 (No HbA1c data submitted) 23 (No Patient-reported outcome submitted)	25 (IG) 17 (CG)
Age	IG: µ 55.0 (SD 9.0) CG: µ 54.0 (SD 9.0)	µ 57.0 (SD 7.4) *Single group	IG: µ 56.12 (SD 7.32) CG: µ 57.07 (SD 9.94)
Female gender (%)	IG: 35% CG: 38%	45%	81 (47.6%)
Data collection	t0=Baseline t1=At 12 months t2=At 18 months	t-1= 3 months before the baseline (retrospective) t0= baseline at the beginning of the program t1= 3 months after the baseline	t0=baseline at the beginning of the program t1=6 months from the beginning of the program
Study (Program) interventions	The intervention group (TeLIPro group) received routine care and basic telemedical devices such as a scale (for weighing at least once/week), a step counter (to be used on each day) and access to a secured online portal or App. The also received a blood glucose meter, 10-17 telemedical coaching calls over 12 months. This coaching included diabetes education, lifestyle advice, and data monitoring.	Vitadio is a digital care program designed to empower patients with effective self-management and lifestyle change. It consists of a three-month intensive phase followed by a sustained phase. The mobile application guides patients throughout the program using a system of daily tasks and automated messages. Patients follow educational courses, including topics ranging from motivation to diet, physical activity, sleep hygiene, mental well-being, and social aspects of life with diabetes.	All patients in the intervention group met with a health coach after their medical examination and received the LIVA 2.0 digital lifestyle coaching program. This began with a one-hour motivational interview, after which the same health coach guided the patient throughout the period. If the coach was unavailable due to short-term illness or vacation, sessions were postponed; for long-term absences, a new coach was assigned.

Author, Year [Ref]		#20: Kempf, et al. 2023 [44]	#33 Bretschneider, et al. 2022 [45]	#35 Christensen, et al. 2022 [54]
Study (Program) interventions *(continuation)*		0-17 times over a year, depending on patients' needs. (e.g., weekly in month 1, every second week in month 2-3, monthly in month 4-6, quarterly in month 7-12)	Personal weekly goals help to select relevant habits and track them daily. The Vitadio app enables monitoring of metabolic (e.g., body weight, waist circumference, glycemia) and lifestyle (e.g., steps, diet, mood) parameters. To track dietary habits, the patients can use a feature designated to upload photos of their meals. The program is enhanced by a set of communication features employing human support. To ensure patient safety and enhance effective use of the program, a personal advisor is available by chat to answer patient questions. To improve adherence, patients can participate in a peer support group. Vitadio complements therapy set by a physician and is certified as a class I medical device.	Patients received login details for the LIVA 2.0 app and set personalized goals for diet, exercise, sleep, and other lifestyle areas. They tracked their progress daily and communicated with their coach through the app, receiving weekly coaching for the first three months, then biweekly for the next three months. This program utilized behavior change techniques and SMART goal-setting, ensuring goals were specific, measurable, attainable, relevant, and timely. Coaches identified beneficial health initiatives and helped patients overcome personal barriers, providing ongoing support and feedback to keep them motivated.
Control settings		Standard care	Standard of Care for diabetes. (individual control/data from 3 months before the beginning of the program)	Standard of Care for diabetes. Follow-up examination at the same time as the intervention group.
Process evaluation	**Indicators**	(1) Program adherence	(1) Technology use	N.R.
	Measurement instruments	(1) Completion rate	(1) Meal photo logging on the App	
	Results	(1) A total of 364 agreed to participate and 316 (86.8%) individuals have completed the intervention. The reasons of withdrawal are (n=48): ■ No more interest/time (n=15) ■ Health reason (n=8) ■ Technical problems (n=5) ■ Other reasons (n=20)	(1) Participants actively used meal photo logging, resulting in an average of 215 meal photos per participant.	
Patient-reported outcomes	**Indicators**	(1) Impairment of Quality of life (2) Well-being	(1) Quality of life (2) Self-management (3) Depressive symptom	(1) Quality of Life (2) Mental Well-Being
	Measurement instruments	(1) CES-D (2) SF-12	(1) SF-12 (2) The Summary of Diabetes Self-Care Activities measure (SDSCA) (3) The Patient Health Questionnaire 9 (PHQ9)	(1) EQ-5D-5L (2) Short-Warwick-Edinburgh Mental Well-being Scale (SWEMWBS)
	Results	(1) Significant group difference: -2.3 (95%CI: -0.9; -3.7) (2) No significant group difference	(1) The Physical Component Summary (PCS) was significantly increased (better QOL), while the Mental Component Summary (MCS) remained the same. (2) No significant effect was seen (3) No significant effect was seen	(1) No significant group difference (2) No significant group difference

Author, Year [Ref]		#20: Kempf, et al. 2023 [44]	#33 Bretschneider, et al. 2022 [45]	#35 Christensen, et al. 2022 [54]
Organizational outcomes	**Indicators**	N.R.	N.R.	(1) Medication use
	Measurement instruments			(1) Asking patients at the 6-month follow-up visit or pharmacological registration data (Fælles medicinkort)
	Results			(1) The total of 11 out of 74 (15%) patients in the IG compared to 1 (2%) in the CG reduced their glucose-lowering medication (p=0.015). In total, 2 of 74 (3%) in the IG compared to 7 of 41 (17%) in the CG increased their use of glucose-lowering medication (p=0.021).
Acceptance and experience	**Participants**	N.R.	N.R.	N.R.
	Indicators			
	Answers			

Table A-1: Data extraction table part 6/6

Author, Year [Ref]	#12: Dardari, et al. 2023 [49]	#23 Lallemand, et al. 2023 [55]
Country	France	Belgium
Study design	RCT	Pre- and post-test study
Telehealth intervention	Telemonitoring	Telemonitoring, Telecoaching
Settings, medical sectors, service providers	Primary care; Hospitals; Study nurses with extensive experience in DFU and trained in remote monitoring	Pharmacy; Pharmacists
Type of diabetes	T1DM or T2DM with a current or recurrent diabetic foot ulcer (DFU)	T2DM
Study Objective	This study aimed to investigate whether telemonitoring, provided by an expert nurse, reduces the hospital stay and the associated costs for a patient with DFU.	The purpose of this study was to explore the benefits of community pharmacist follow-up supported by the use of the Comunicare mobile application for patients with type 2 diabetes. Specifically, the impact on medication adherence level as well as clinical outcomes, considered markers of the patient's overall health and cardiovascular risk factors, were investigated.
Study period	12 months	6 months
No. of patients (IG vs. CG)	90 vs. 90	66 (intervention group only)
Loss-to-follow up	IG: 23 CG: 18	20

Author, Year [Ref]		#12: Dardari, et al. 2023 [49]	#23 Lallemand, et al. 2023 [55]
Age		IG: µ 69.3 (SD 13.0) CG: µ 66.2 (SD 14.3)	µ 56.7 (SD 14.0) *Single group
Female gender (%)		IG: 29.0 (32.2%) CG: 24.0 (26.2%)	37 (56.1%)
Data collection		t0=Baseline t1=At 12 months	t0= baseline t1= 3 months after the beginning of the intervention t2= 6 months after the beginning of the intervention (post intervention)
Study (Program) interventions		The intervention group received telemedicine follow-ups, where weekly photos of DFUs (diabetic foot ulcer) were sent to an expert nurse for evaluation and care plan adjustments. Both intervention and control groups received regular home care by community nurse. Patients in the intervention group or their community nurses used a provided tablet to take weekly photos of their DFUs and send them to the expert nurse for evaluation. The expert nurse monitored the photo and adjusted care plans.	Pharmacist counselling included monthly in-person or video sessions, focusing on medication adherence, proper use, diet, and physical activity for diabetes management. A diabetes-specific configuration of the "Comunicare platform" was created with sections like "My medication", "My follow-up" and "My feelings". Patients input data such as mood, hypoglycemic episodes, blood glucose levels, medication intake, and physical activity, which pharmacists use to personalize care. The app also provides educational resources and appointment scheduling. The six-month intervention comprised four in-person and three video sessions, with patients using the app daily as needed.
Control settings		Standard care	-
Process evaluation	**Indicators**	(1) (Program adherence	(1) Program adherence
	Measurement instruments	(1) Completion rate	(1) Completion rate and drop-out reasons
	Results	(1) A total of 67 patients (74.4%) have completed until the follow-up. The reasons of withdrawal are (n=23): ■ Lost to follow up (n=9) ■ Serious adverse event (n=9) ■ Others (n=5)	(1) Of those 74 who initially agreed to participate, 28 patients (37.8%) did not complete the program. Their reasons for non-completion included lack of time, loss of interest, sudden illness, and failure to visit the pharmacy.
Patient-reported outcomes		N.R.	N.R.
Organizational outcomes	**Indicators**	(1) Cumulative number of days spent in hospital (due to DFU) over 12 months (2) Cumulative direct costs over 12 months (3) DFU-related hospitalization days	(1) Medication adherence
	Measurement instruments	(1,2,3) Hospital records	(1) The Medication Adherence Report Scale (MARS-5)

Author, Year [Ref]		#12: Dardari, et al. 2023 [49]	#23 Lallemand, et al. 2023 [55]
Organizational outcomes *(continuation)*	**Results**	(1) Cumulative hospital days over 12 months were 13.4 days (95% CI 9.0–17.8) in the control group and 7.1 days (95% CI 2.8–11.5) in the intervention group. The adjusted mean difference (6.3 days; 95% CI 0.1-12.4) was statistically significant (p=0.0458) (2) Cumulative direct costs over 12 months were 7.185 € (95% CI 5.144-9.226) in the control group and 3.471 € (95% CI 1.430-5.512) in the intervention group: the adjusted mean difference (3.714 € [95% CI 827-6.600]) was statistically significant (p=0.0120). (3) The mean duration of DFU-related hospitalization days was 4.1 (0.8) and 3.3 (0.8) days in the control and intervention group, respectively. (n.s.)	(1) No significant effect was seen.
Acceptance and experience	**Participants**	N.R.	Patients and pharmacists in this study
	Indicators		Spontaneous testimonials or round-tables
	Answers		Patients' opinion about the coaching ■ Patients appreciated the contact with the healthcare provider and the close relationship, the individualized follow-up and the support in pursuing their goals. Pharmacists' opinion about the coaching ■ Pharmacists noted that patients were motivated, eager to learn about their condition and healthy behaviors and to achieve positive outcomes. Pharmacists therefore felt their usefulness in the project. Patients' opinion about the use of the application ■ When asked about the application, patients found it and its content interesting and useful. However, some of them reported less interest in using the app, as they considered themselves already well informed about their condition. Pharmacists' opinion about the use of the application ■ Some patients did not use the application regularly, so pharmacists sometimes had few dashboard parameters to discuss during interviews. They also noted technical problems as some videoconferences could not be implemented, so they deviated from the study protocol and used phone calls or even face-to-face interviews.

Search Strategies

Embase

Search date: 10. 5. 2024		
No.	Query Results	Results
#45.	#43 NOT #44	703
#44.	#43 AND 'Conference Abstract'/it	522
#43.	#40 AND #41 AND [2014-2024]/py	1,225
#42.	#40 AND #41	1,438
#41.	albania'/exp OR 'andorra'/exp OR 'armenia'/exp OR 'austria'/exp OR 'azerbaijan'/exp OR 'belarus'/exp OR 'belgium'/exp OR 'baltic states'/exp OR 'bosnia and herzegovina'/exp OR 'bulgaria'/exp OR 'croatia'/exp OR 'cyprus'/exp OR 'estonia'/exp OR 'kazakhstan'/exp OR 'kosovo'/exp OR 'latvia'/exp OR 'lithuania'/exp OR 'czech republic'/exp OR 'hungary'/exp OR 'poland'/exp OR 'slovenia'/exp OR 'france'/exp OR 'germany'/exp OR 'united kingdom'/exp OR 'england'/exp OR 'northern ireland'/exp OR 'scotland'/exp OR 'wales'/exp OR 'greece'/exp OR 'ireland'/exp OR 'italy'/exp OR 'luxembourg'/exp OR 'malta'/exp OR 'moldova'/exp OR 'monaco'/exp OR 'montenegro'/exp OR 'netherlands'/exp OR 'portugal'/exp OR 'scandinavian and nordic countries'/exp OR 'denmark'/exp OR 'finland'/exp OR 'iceland'/exp OR 'norway'/exp OR 'sweden'/exp OR 'republic of north macedonia'/exp OR 'romania'/exp OR 'russia'/exp OR 'san marino'/exp OR 'serbia'/exp OR 'slovakia'/exp OR 'spain'/exp OR 'ukraine'/exp OR 'switzerland'/exp OR 'vatican city'/exp OR 'europe'/exp OR 'european union'/exp OR europe* OR eec:ti,ab OR eu:ti,ab OR uk:ti,ab OR albania OR andorra OR armenia OR azerbaijan OR austria OR belarus OR belgium OR 'bosnia and herzegovina' OR 'czech republic' OR czechia OR denmark OR estonia OR finland OR france OR germany OR greece OR hungary OR iceland OR italy OR kazakhstan OR kosovo OR latvia OR lithuania OR luxembourg OR macedonia OR malta OR moldova OR monaco OR montenegro OR netherlands OR norway OR poland OR portugal OR romania OR russia OR 'russian federation' OR 'san marino' OR 'serbia slovak republic' OR slovenia OR spain OR sweden OR switzerland OR turkey OR 'united kingdom' OR england OR ireland OR scotland OR wales OR ukraine OR vatican	27,250,010
#40.	#34 AND #39	2,054
#39.	#35 OR #36 OR #37 OR #38	3,103,150
#38.	project$	498,638
#37.	scheme*	197,348
#36.	program*	2,540,542
#35.	program'/exp	203
#34.	#4 AND #33	
#33.	#5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32	561,417
#32.	((online OR web OR internet OR digital* OR phone* OR telephone* OR smart$phone* OR 'smart-phone*' OR cell$phone* OR 'cellphone*' OR smart$watch* OR 'smart-watch*' OR mobile OR app OR apps OR m$health OR 'm-health' OR e$health OR 'e-health') NEAR/3 diabet*):ti	1,047
#31.	(diabet* NEAR/3 (tele$medic* OR 'tele-medic*' OR tele$monitor* OR 'tele-monitor*' OR tele$metr* OR 'tele-metr*' OR tele$manag* OR 'tele-manag*' OR tele$health OR 'tele-health' OR tele$surveil* OR 'tele-surveil*')):ti,ab,kw,de,lnk	789
#30.	'tele-surveil*':ti,ab	8
#29.	'tele$surveil*':ti,ab	40
#28.	'tele-manag*':ti,ab	44
#27.	'tele$manag*':ti,ab	123
#26.	'tele-monitor*':ti,ab	397
#25.	tele$monitor*:ti,ab	3,837
#24.	(mobile* NEAR/3 (based OR application* OR intervention* OR device* OR technolog*)):ti,ab	29,236
#23.	(('mobile health' OR m$health OR 'm-health' OR e$health OR 'e-health' OR e$mental OR 'e-mental') NEAR/3 (based OR application* OR intervention* OR program* OR therap*)):ab	7,121
#22.	'e mental health'/exp	12
#21.	mobile health':ti OR m$health:ti OR 'm-health':ti OR e$health:ti OR 'e-health':ti OR e$mental:ti OR 'e-mental':ti	10,242
#20.	((phone* OR telephone* OR smart$phone* OR 'smart phone*' OR cell$phone* OR 'cell phone*' OR smart$watch* OR 'smart watch*') NEAR/3 (based OR application* OR intervention* OR program* OR therap*)):ab	24,494
#19.	phone*:ti OR telephone*:ti OR smart$phone*:ti OR 'smart-phone*':ti OR cell$phone*:ti OR 'cell phone*':ti OR smart$watch*:ti OR 'smart-watch*':ti	34,72

#18.	((online OR web OR internet OR digital*) NEAR/3 (based OR application* OR intervention* OR program* OR therap*)):ab	115,775
#17.	online:ti OR web:ti OR internet:ti OR digital*:ti	184,023
#16.	app:ti,ab OR apps:ti,ab	66,804
#15.	'computer assisted therapy'/exp/mj	7,979
#14.	'personal digital assistant'/exp	1,887
#13.	'mobile phone'/exp	133,507
#12.	'internet'/exp	133,507
#11.	'mobile application'/exp/mj	14,229
#10.	'tele-health'	706
#9.	tele$health	31,6
#8.	'telehealth'/exp	94,584
#7.	'telemetry'/mj	5,998
#6.	'telemonitoring'/exp	6,269
#5.	'self-monitoring blood glucose'/exp	117
#4.	#1 OR #2 OR #3	428,703
#3.	t2d$:ti,ab	92,519
#2.	diabet* NEAR/2 ('type 2' OR ii OR 'insulin resistant' OR 'non insulin dependent')	423,96
#1.	'non insulin dependent diabetes mellitus'/exp	359,055

Medline via Ovid

Search date: 10. 5. 2024	
1	exp Diabetes Mellitus, Type 2/(179970)
2	(diabet* adj3 (type 2 or II or insulin-resistant or non-insulin-dependent)).mp. (256734)
3	T2D?.ti,ab. (53750)
4	1 or 2 or 3 (258089)
5	exp Blood Glucose Self-Monitoring/(10574)
6	4 and 5 (3029)
7	Telemedicine/(39792)
8	Telemetry/(10280)
9	tele?health.mp. (16000)
10	tele-health.mp. (330)
11	Mobile Applications/(12524)
12	exp Internet/(100597)
13	exp Cell Phone/(23626)
14	exp Computers, Handheld/(13915)
15	Medical Informatics Applications/(2552)
16	Therapy, Computer-Assisted/(6983)
17	(app or apps).ti. (12731)
18	(online or web or internet or digital*).ti. (149619)
19	((online or web or internet or digital*) adj3 (based or application* or intervention* or program* or therap*)).ab. (86299)
20	(phone* or telephone* or smart?phone* or smart-phone* or cell?phone* or cell-phone* or smart?watch* or smart-watch*).ti. (28901)
21	((phone* or telephone* or smart?phone* or smart-phone* or cell?phone* or cell-phone* or smart?watch* or smart-watch*) adj3 (based or application* or intervention* or program* or therap*)).ab. (18471)
22	(mobile health or mhealth or m-health or ehealth or e-health or e?mental or e-mental).ti. (9360)
23	(mobile* adj3 (based or application* or intervention* or device* or technolog*)).ti,ab. (23950)
24	tele?monitor*.ti,ab. (2382)
25	tele-monitor*.ti,ab. (205)

26	tele?manag*.ti,ab. (78)
27	tele-manag*.ti,ab. (15)
28	tele?surveil*.ti,ab. (31)
29	tele-surveil*.ti,ab. (5)
30	6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 20 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (333600)
31	4 and 30 (5652)
32	(diabet* adj3 (tele?medic* or tele-medic* or tele?monitor* or tele-monitor* or tele?metr* or tele-metr* or tele?manag* or tele-manag* or tele?health or tele-health or tele?surveil* or tele-surveil*)).mp. (536)
33	((online or web or internet or digital* or phone* or telephone* or smart?phone* or smart-phone* or cell?phone* or cell-phone* or smart?watch* or smart-watch* or mobile or app or apps or mhealth or m-health or ehealth or e-health) adj3 diabet*).ti. (713)
34	31 or 32 or 33 (6437)
35	("36424340" or "31287736").ui. (2)
36	exp albania/or exp Andorra/or exp Armenia/or exp austria/or exp Azerbaijan/or exp Belarus/or exp belgium/or exp baltic states/or exp "Bosnia and Herzegovina"/or exp Bulgaria/or exp Croatia/or exp Cyprus/or exp Czech Republic/or exp estonia/or exp Kazakhstan/or exp Kosovo/or exp latvia/or exp lithuania/or exp czech republic/or exp hungary/or exp poland/or exp slovakia/or exp slovenia/or exp france/or exp germany/or exp united kingdom/or exp england/or exp northern ireland/or exp scotland/or exp wales/or exp greece/or exp ireland/or exp italy/or exp luxembourg/or exp Malta/or exp Moldova/or exp Monaco/or exp Montenegro/or exp netherlands/or exp portugal/or exp "scandinavian and nordic countries"/or exp denmark/or exp finland/or exp iceland/or exp norway/or exp sweden/or exp "Republic of North Macedonia"/or exp Romania/or exp Russia/or Russian Federation.mp. or exp San Marino/or exp Serbia/or exp Slovakia/or exp spain/or exp Ukraine/or exp switzerland/or exp Vatican City/or exp Europe/or exp European Union/or Europe*.mp. or (eec or eu or uk).ti,ab. or (Albania or Andorra or Armenia or Azerbaijan or Austria or Belarus or Belgium or "Bosnia and Herzegovina" or "Czech Republic" or Czechia or Denmark or Estonia or Finland or France or Germany or Greece or Hungary or Iceland or Italy or Kazakhstan or Kosovo or Latvia or Lithuania or Luxembourg or Macedonia or Malta or Moldova or Monaco or Montenegro or Netherlands or Norway or Poland or Portugal or Romania or Russia or Russian Federation or San Marino or "Serbia Slovak Republic" or Slovenia or Spain or Sweden or Switzerland or Turkey or "United Kingdom" or England or Ireland or Scotland or Wales or Ukraine or Vatican).mp. (2336402)
37	34 and 36 (812)
38	limit 37 to yr="2014-2024" (529)
39	remove duplicates from 38 (525)

INAHTA Database

Search Name: Telehealth in Type 2 Diabetes	
Last Saved: 14.05.2024 17:13:29	
ID	Search
#1	MeSH descriptor: [Diabetes Mellitus, Type 2] explode all trees
#2	(diabet* NEAR/3 (type 2 OR II OR insulin-resistant OR non-insulin-dependent)) (Word variations have been searched)
#3	(T2D?):ti,ab,kw
#4	#1 OR #2 OR #3
#5	MeSH descriptor: [Blood Glucose Self-Monitoring] explode all trees
#6	#4 AND #5
#7	MeSH descriptor: [Telemedicine] this term only
#8	MeSH descriptor: [Telemetry] this term only
#9	(tele*health) (Word variations have been searched)
#10	tele-health (Word variations have been searched)
#11	MeSH descriptor: [Mobile Applications] this term only
#12	MeSH descriptor: [Internet] explode all trees
#13	MeSH descriptor: [Cell Phone] explode all trees
#14	MeSH descriptor: [Computers, Handheld] explode all trees
#15	MeSH descriptor: [Medical Informatics Applications] this term only
#16	MeSH descriptor: [Therapy, Computer-Assisted] this term only
#17	(app OR apps):ti
#18	(app OR apps):ab

#19	(online OR web OR internet OR digital*):ti (Word variations have been searched)
#20	((online OR web OR internet OR digital*) NEAR/3 (based OR application* OR intervention* OR program* OR therap*)):ab (Word variations have been searched)
#21	(phone* OR telephone* OR smart*phone* OR smart-phone* OR cell*phone* OR cell-phone* OR smart*watch* OR smart-watch*):ti (Word variations have been searched)
#22	((phone* OR telephone* OR smart*phone* OR smart-phone* OR cell*phone* OR cell-phone* OR smart*watch* OR smart-watch*) NEAR/3 (based OR application* OR intervention* OR program* OR therap*)):ab (Word variations have been searched)
#23	(mobile health OR m*health OR m-health OR e*health OR e-health OR e*mental OR e-mental):ti
#24	((mobile health OR m*health OR m-health OR e*health OR e-health OR e*mental OR e-mental) NEAR/3 (based OR application* OR intervention* OR program* OR therap*)):ab (Word variations have been searched)
#25	(mobile* NEAR/3 (based OR application* OR intervention* OR device* OR technolog*)):ti,ab,kw (Word variations have been searched)
#26	(tele*monitor*):ti,ab,kw (Word variations have been searched)
#27	(tele-monitor*):ti,ab,kw (Word variations have been searched)
#28	(tele*manag*):ti,ab,kw (Word variations have been searched)
#29	(tele-manag*):ti,ab,kw (Word variations have been searched)
#30	(tele*surveil*):ti,ab,kw (Word variations have been searched)
#31	(tele-surveil*):ti,ab,kw (Word variations have been searched)
#32	#6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 #27 OR #28 OR #29 OR #30 OR #31
#33	#4 AND #32
#34	(diabet* NEAR/3 (tele*medic* OR tele-medic* OR tele*monitor* OR tele-monitor* OR tele*metr* OR tele-metr* OR tele*manag* OR tele-manag* OR tele*health OR tele-health OR tele*surveil*)):ti,ab,kw (Word variations have been searched)
#35	((online OR web OR internet OR digital* OR phone* OR telephone* OR smart*phone* OR smart-phone* OR cell*phone* OR cell-phone* OR smart*watch* OR smart-watch* OR mobile OR app OR apps OR m*health OR m-health OR e*health OR e-health) NEAR/3 diabet*):ti,ab,kw (Word variations have been searched)
#36	#33 OR #34 OR #35
#37	[mh albania] OR [mh Andorra] OR [mh Armenia] OR [mh austria] OR [mh Azerbaijan] OR [mh Belarus] OR [mh belgium] OR [mh "baltic states"] OR [mh "Bosnia and Herzegovina"] OR [mh Bulgaria] OR [mh Croatia] OR [mh Cyprus] OR [mh "Czech Republic"] OR [mh estonia] OR [mh Kazakhstan] OR [mh Kosovo] OR [mh latvia] OR [mh lithuania] OR [mh "czech republic"] OR [mh hungary] OR [mh poland] OR [mh slovakia] OR [mh slovenia] OR [mh france] OR [mh germany] OR [mh "united kingdom"] OR [mh england] OR [mh "northern ireland"] OR [mh scotland] OR [mh wales] OR [mh greece] OR [mh ireland] OR [mh italy] OR [mh luxembourg] OR [mh Malta] OR [mh Moldova] OR [mh Monaco] OR [mh Montenegro] OR [mh netherlands] OR [mh portugal] OR [mh "scandinavian and nordic countries"] OR [mh denmark] OR [mh finland] OR [mh iceland] OR [mh norway] OR [mh sweden] OR [mh "Republic of North Macedonia"] OR [mh Romania] OR [mh Russia] OR "Russian Federation":ti,ab,kw OR [mh "San Marino"] OR [mh Serbia] OR [mh Slovakia] OR [mh spain] OR [mh Ukraine] OR [mh switzerland] OR [mh "Vatican City"] OR [mh Europe] OR [mh "European Union"] OR Europe*:ti,ab,kw OR (eec:ti,ab OR eu:ti,ab OR uk:ti,ab) OR (Albania:ti,ab,kw OR Andorra:ti,ab,kw OR Armenia:ti,ab,kw OR Azerbaijan:ti,ab,kw OR Austria:ti,ab,kw OR Belarus:ti,ab,kw OR Belgium:ti,ab,kw OR "Bosnia and Herzegovina":ti,ab,kw OR "Czech Republic":ti,ab,kw OR Czechia:ti,ab,kw OR Denmark:ti,ab,kw OR Estonia:ti,ab,kw OR Finland:ti,ab,kw OR France:ti,ab,kw OR Germany:ti,ab,kw OR Greece:ti,ab,kw OR Hungary:ti,ab,kw OR Iceland:ti,ab,kw OR Italy:ti,ab,kw OR Kazakhstan:ti,ab,kw OR Kosovo:ti,ab,kw OR Latvia:ti,ab,kw OR Lithuania:ti,ab,kw OR Luxembourg:ti,ab,kw OR Macedonia:ti,ab,kw OR Malta:ti,ab,kw OR Moldova:ti,ab,kw OR Monaco:ti,ab,kw OR Montenegro:ti,ab,kw OR Netherlands:ti,ab,kw OR Norway:ti,ab,kw OR Poland:ti,ab,kw OR Portugal:ti,ab,kw OR Romania:ti,ab,kw OR Russia:ti,ab,kw OR "Russian Federation":ti,ab,kw OR "San Marino":ti,ab,kw OR "Serbia Slovak Republic":ti,ab,kw OR Slovenia:ti,ab,kw OR Spain:ti,ab,kw OR Sweden:ti,ab,kw OR Switzerland:ti,ab,kw OR Turkey:ti,ab,kw OR "United Kingdom":ti,ab,kw OR England:ti,ab,kw OR Ireland:ti,ab,kw OR Scotland:ti,ab,kw OR Wales:ti,ab,kw OR Ukraine:ti,ab,kw OR Vatican:ti,ab,kw)
#38	#36 AND #37 with Cochrane Library publication date Between Jan 2014 and Apr 2024
#39	#36 AND #37 with Publication Year from 2014 to 2024, in Trials
#40	#38 OR #39
#41	(conference proceeding):pt
#42	(abstract):so
#43	(clinicaltrials OR trialsearch OR ANZCTR OR ensaiosclinicos OR Actrn OR chictr OR cris OR ctri OR registroclinico OR clinicaltrialsregister OR DRKS OR IRCT OR Isrctn OR rctportal OR JapicCTI OR JMACCT OR jRCT OR JPRN OR Nct OR UMIN OR trialregister OR PACTR OR R.B.R.OR REPEC OR SLCTR OR Tcr):so
#44	#41 OR #42 OR #43
#45	#40 NOT #44
Total Hits: 431	

Cochrane Library

Date of search: 14.05.2024	
ID	Search
33	((((tele-surveil*) OR (telesurveil*) OR (tele-manag*) OR (telemanag*) OR (tele-monitor*) OR (telemonitor*) OR ((mobile*) AND (based OR application* OR intervention* OR device* OR technolog*)) OR (("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[Title] OR ("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[abs]) OR ((phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[Title] OR (phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((app)[abs] OR (apps)[abs]) OR ((app)[Title] OR (apps)[Title]) OR ("Therapy Computer-Assisted"[mhe]) OR ("Medical Informatics Applications"[mhe]) OR ("Computers Handheld"[mhe]) OR ("Cell Phone"[mhe]) OR ("Internet"[mhe]) OR ("Mobile Applications"[mhe]) OR (tele-health*) OR (telehealth*) OR ("Telemetry"[mhe]) OR ("Telemedicine"[mhe])) AND ((T2D*) OR ((diabet*) AND ("type 2" OR II OR insulin-resistant OR non-insulin-dependent)) OR ("Diabetes Mellitus Type 2"[mhe]))) OR (((tele-surveil*) OR (telesurveil*) OR (tele-manag*) OR (telemanag*) OR (tele-monitor*) OR (telemonitor*) OR ((mobile*) AND (based OR application* OR intervention* OR device* OR technolog*)) OR (("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[Title] OR ("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[abs]) OR ((phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[Title] OR (phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((app)[abs] OR (apps)[abs]) OR ((app)[Title] OR (apps)[Title]) OR ("Therapy Computer-Assisted"[mhe]) OR ("Medical Informatics Applications"[mhe]) OR ("Computers Handheld"[mhe]) OR ("Cell Phone"[mhe]) OR ("Internet"[mhe]) OR ("Mobile Applications"[mhe]) OR (tele-health*) OR (telehealth*) OR ("Telemetry"[mhe]) OR ("Telemedicine"[mhe])) AND ("Blood Glucose Self-Monitoring"[mhe]))) FROM 2014 TO 2024,"55","2024-05-14T17:18:29.000000Z"
32	(((tele-surveil*) OR (telesurveil*) OR (tele-manag*) OR (telemanag*) OR (tele-monitor*) OR (telemonitor*) OR ((mobile*) AND (based OR application* OR intervention* OR device* OR technolog*)) OR (("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[Title] OR ("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[abs]) OR ((phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[Title] OR (phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((app)[abs] OR (apps)[abs]) OR ((app)[Title] OR (apps)[Title]) OR ("Therapy Computer-Assisted"[mhe]) OR ("Medical Informatics Applications"[mhe]) OR ("Computers Handheld"[mhe]) OR ("Cell Phone"[mhe]) OR ("Internet"[mhe]) OR ("Mobile Applications"[mhe]) OR (tele-health*) OR (telehealth*) OR ("Telemetry"[mhe]) OR ("Telemedicine"[mhe])) AND ((T2D*) OR ((diabet*) AND ("type 2" OR II OR insulin-resistant OR non-insulin-dependent)) OR ("Diabetes Mellitus Type 2"[mhe]))) OR (((tele-surveil*) OR (telesurveil*) OR (tele-manag*) OR (telemanag*) OR (tele-monitor*) OR (telemonitor*) OR ((mobile*) AND (based OR application* OR intervention* OR device* OR technolog*)) OR (("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[Title] OR ("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[abs]) OR ((phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[Title] OR (phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((app)[abs] OR (apps)[abs]) OR ((app)[Title] OR (apps)[Title]) OR ("Therapy Computer-Assisted"[mhe]) OR ("Medical Informatics Applications"[mhe]) OR ("Computers Handheld"[mhe]) OR ("Cell Phone"[mhe]) OR ("Internet"[mhe]) OR ("Mobile Applications"[mhe]) OR (tele-health*) OR (telehealth*) OR ("Telemetry"[mhe]) OR ("Telemedicine"[mhe])) AND ("Blood Glucose Self-Monitoring"[mhe])),"88","2024-05-14T17:18:11.000000Z"
31	((tele-surveil*) OR (telesurveil*) OR (tele-manag*) OR (telemanag*) OR (tele-monitor*) OR (telemonitor*) OR ((mobile*) AND (based OR application* OR intervention* OR device* OR technolog*)) OR (("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[Title] OR ("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[abs]) OR ((phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[Title] OR (phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((app)[abs] OR (apps)[abs]) OR ((app)[Title] OR (apps)[Title]) OR ("Therapy Computer-Assisted"[mhe]) OR ("Medical Informatics Applications"[mhe]) OR ("Computers Handheld"[mhe]) OR ("Cell Phone"[mhe]) OR ("Internet"[mhe]) OR ("Mobile Applications"[mhe]) OR (tele-health*) OR (telehealth*) OR ("Telemetry"[mhe]) OR ("Telemedicine"[mhe])) AND ((T2D*) OR ((diabet*) AND ("type 2" OR II OR insulin-resistant OR non-insulin-dependent)) OR ("Diabetes Mellitus Type 2"[mhe])),"75","2024-05-14T17:18:01.000000Z"
30	((tele-surveil*) OR (telesurveil*) OR (tele-manag*) OR (telemanag*) OR (tele-monitor*) OR (telemonitor*) OR ((mobile*) AND (based OR application* OR intervention* OR device* OR technolog*)) OR (("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[Title] OR ("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[abs]) OR ((phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[Title] OR (phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((app)[abs] OR (apps)[abs]) OR ((app)[Title] OR (apps)[Title]) OR ("Therapy Computer-Assisted"[mhe]) OR ("Medical Informatics Applications"[mhe]) OR ("Computers Handheld"[mhe]) OR ("Cell Phone"[mhe]) OR ("Internet"[mhe]) OR ("Mobile Applications"[mhe]) OR (tele-health*) OR (telehealth*) OR ("Telemetry"[mhe]) OR ("Telemedicine"[mhe])) AND ("Blood Glucose Self-Monitoring"[mhe]),"23","2024-05-14T17:17:43.000000Z"

29	(tele-surveil*) OR (telesurveil*) OR (tele-manag*) OR (telemanag*) OR (tele-monitor*) OR (telemonitor*) OR ((mobile*) AND (based OR application* OR intervention* OR device* OR technolog*)) OR (("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[Title] OR ("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[abs]) OR ((phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[Title] OR (phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs]) OR ((app)[abs] OR (apps)[abs]) OR ((app)[Title] OR (apps)[Title]) OR ("Therapy Computer-Assisted"[mhe]) OR ("Medical Informatics Applications"[mhe]) OR ("Computers Handheld"[mhe]) OR ("Cell Phone"[mhe]) OR ("Internet"[mhe]) OR ("Mobile Applications"[mhe]) OR (tele-health*) OR (telehealth*) OR ("Telemetry"[mhe]) OR ("Telemedicine"[mhe]),"5310","2024-05-14T17:08:09.000000Z"
28	tele-surveil*,"0","2024-05-14T17:00:45.000000Z"
27	telesurveil*,"0","2024-05-14T17:00:34.000000Z"
26	tele-manag*,"0","2024-05-14T17:00:14.000000Z"
25	telemanag*,"0","2024-05-14T17:00:03.000000Z"
24	tele-monitor*,"1","2024-05-14T16:59:43.000000Z"
23	telemonitor*,"27","2024-05-14T16:59:38.000000Z"
22	(mobile*) AND (based OR application* OR intervention* OR device* OR technolog*),"70","2024-05-14T16:59:07.000000Z"
21	("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[Title] OR ("mobile health" OR mhealth OR m-health OR ehealth OR e-health OR e-mental)[abs],"4715","2024-05-14T16:57:44.000000Z"
20	(phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[Title] OR (phone* OR telephone* OR smartphone* OR smart-phone* OR cellphone* OR cell-phone* OR smartwatch* OR smart-watch*)[abs],"139","2024-05-14T16:55:55.000000Z"
19	(online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs],"437","2024-05-14T16:53:38.000000Z"
18	(online OR web OR internet OR digital*)[Title] OR (online OR web OR internet OR digital*)[abs],"437","2024-05-14T16:53:25.000000Z"
17	(app)[abs] OR (apps)[abs],"20","2024-05-14T16:51:50.000000Z"
16	(app)[Title] OR (apps)[Title],"6","2024-05-14T16:50:45.000000Z"
15	"Therapy Computer-Assisted"[mhe],"196","2024-05-14T16:50:09.000000Z"
14	"Medical Informatics Applications"[mhe],"409","2024-05-14T16:49:38.000000Z"
13	"Computers Handheld"[mhe],"16","2024-05-14T16:49:05.000000Z"
12	"Cell Phone"[mhe],"20","2024-05-14T16:48:32.000000Z"
11	"Internet"[mhe],"61","2024-05-14T16:48:03.000000Z"
10	"Mobile Applications"[mhe],"27","2024-05-14T16:47:38.000000Z"
9	tele-health*,"0","2024-05-14T16:47:17.000000Z"
8	telehealth*,"43","2024-05-14T16:47:04.000000Z"
7	"Telemetry"[mhe],"29","2024-05-14T16:46:42.000000Z"
6	"Telemedicine"[mhe],"197","2024-05-14T16:46:22.000000Z"
5	"Blood Glucose Self-Monitoring"[mhe],"75","2024-05-14T16:43:58.000000Z"
4	(T2D*) OR ((diabet*) AND ("type 2" OR II OR insulin-resistant OR non-insulin-dependent)) OR ("Diabetes Mellitus Type 2"[mhe]),"370","2024-05-14T16:43:05.000000Z"
3	T2D*,"15","2024-05-14T16:42:58.000000Z"
2	(diabet*) AND ("type 2" OR II OR insulin-resistant OR non-insulin-dependent),"329","2024-05-14T16:42:28.000000Z"
1	"Diabetes Mellitus Type 2"[mhe],"275","2024-05-14T16:39:24.000000Z"
Total Hits: 55	

PsycINFO

#	Query	Limiters/Expanders	Last Run Via	Results
S1	(diabetes type 2 or diabetes mellitus type 2 or diabetes 2) AND (e-health or ehealth or digital health or telemedicine or telehealth or internet-based intervention)	Limiters – Publication Year: 2014-2024 Expanders – Apply equivalent subjects Search modes – Boolean/Phrase	Interface – EBSCOhost Research Databases Search Screen – Advanced Search Database – APA PsycInfo	167

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