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Review Article

# Impact of telehealth on the current and future practice of lipidology: a scoping review

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**Abstract:** Telehealth services have been implemented to deliver care for patients living with many chronic conditions and have expanded greatly during the COVID-19 pandemic. Little is known about the current or future impacts of telehealth on lipid management practices. The PubMed database was searched from inception to June 25, 2021, with the keywords “lipids or cholesterol” and “telehealth,” which yielded 376 published articles. Telehealth was defined as a synchronous visit between a patient and clinician that replaced an in-office appointment. Studies that solely used remote monitoring, mobile health technologies, or callbacks of results, were excluded. Articles must have measured lipid values. Review articles and protocol papers were not included. After evaluation, 128 abstracts were included for full text evaluation, with 55 full-text articles eventually included. Of the articles, 29 were randomized clinical trials, 15 were pre-post evaluations, and 11 were other study designs. Telehealth had positive to neutral impacts on lipid management. Reported facilitators include easier implementation of multidisciplinary approaches to care, and utilization of patient-centered programs. Reported barriers to telehealth services include technological barriers, such as various skill levels with technology; systems barriers, such as cost and reimbursement; patient-related barriers, including patient non-adherence; and clinician-related barriers, such as difficulty standardizing care. Clinicians reported improved satisfaction among patients but had mixed feelings regarding their ability to deliver quality care. Telemedicine use

*Abbreviations:* ASCVD, atherosclerotic cardiovascular disease; HbA1c, hemoglobin A1c.

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to provide care for individuals with lipid conditions has expanded during the COVID-19 pandemic, but more research is needed to determine its potential as a sustainable tool for lipid management.


## Introduction

Clinicians have used telehealth services for decades and evidence shows that it reduces hospital readmissions, increases savings for both patients and providers, and enhances quality of patient care.[1] According to the World Health Organization, telemedicine is defined as the use of information and communication technologies to improve patient outcomes by increasing access to care and medical information.[2] The American Telemedicine Association considers telemedicine to be synonymous with telehealth.[3]

Prior to the COVID-19 pandemic, telehealth services were used sparingly and mainly addressed shortages of specialty care in rural areas, including care for neurology, psychiatry, and radiology.[1] However, once the COVID-19 pandemic began in 2020, Centers for Medicare and Medicaid Services (CMS) rules changed and states created telehealth law waivers. These changes allowed clinicians to utilize significantly more telehealth services to address public health crises and provide chronic disease management services.[4] While some states have reinstated telehealth restrictions since then, access to telehealth services remains much greater than prior to the pandemic. Telehealth services have been utilized by clinicians to eliminate barriers and improve care for patients living with many chronic conditions, including hypertension, gastrointestinal disease, diabetes, and hyperlipidemia.[5-8]

Lipid management includes a multi-faceted group of interventions that requires a shared responsibility between the clinician and patient to modify lipids to reduce atherosclerotic cardiovascular disease (ASCVD) risk and other sequelae.[9,10] As both the use of telehealth and the burden of lipid disorders grows, telehealth's impact on lipid management should be explored.[11,12] Lipid management includes lifestyle modifications, screening for serum lipids, assessing ASCVD risk, and pharmacological therapies.[9,13,14] Telehealth use within the practice of lipidology remains understudied, yet this modality may prove effective in managing patients with dyslipidemia. This review was performed to gain insight into the current state of telehealth in lipidology and its potential as a future tool for lipid management.

## Methods

A scoping review of the literature was performed to understand the current state of telehealth use in lipid management and to identify existing gaps in this field.[15] We defined telehealth as a synchronous visit between a patient and a clinician (defined as a physician, advanced practice clinician, pharmacist, dietician, or registered nurse) that replaces a traditional in-office appointment. Additionally, our definition of telemedicine does not include sole use of mobile health technology, remote monitoring systems, or telephone calls to patients for the return of testing results.

The PubMed database was searched from inception to June 25, 2021, using the terms "lipids OR cholesterol" and "telehealth" [Table 1]. This initial search yielded 376 published articles. Abstract screening was performed by a single member of the research team. Abstracts that measured lipid values and performed telehealth visits were included for full-text screening, whereas abstracts that did not fit our definition of telehealth (i.e. sole use of mobile health technologies or remote telemonitoring) or did not measure lipid values were excluded. Full-text exclusion criteria included: studies that did not fit our group's definition of telehealth; review articles, including systematic reviews and meta-analyses; articles that outlined study protocols; and studies that did not measure lipid values.

## Results

This process yielded 128 abstracts for full-text screening. In total, 55 studies (29 completed in the U.S., 26 completed in other countries) were included in our review of an analysis of the barriers, facilitators, and current and future impacts of telehealth in the practice of lipidology (Figure 1).[16] Of the 55 studies, 29 were randomized control trials, 15 were pre-post studies, and 11 were classified as other study designs. Specifically, the types of other study designs included: 4 evaluation studies, 2 cross-sectional studies, 2 comparative studies, 2 case-control studies, and 1 mixed-method study. To understand telehealth use and its relation to the COVID-19 pandemic, this search yielded 14 studies that were published during or after 2019, while 41 studies were published before 2019. Additional demographics of each included study are presented in Table 2.

### Health outcomes

Telehealth use in lipid management had a positive to neutral impact on improving composite lipid metrics, medication adherence to lipid-lowering therapies, or lipid management education among studies analyzed in this review. A commonality among studies in this review was that telehealth services can increase the amount of collected patient data, which provided clinicians with a more complete understand-

**Table 1** PubMed search strategy.

| 1st term: Lipids or Cholesterol | AND | 2nd term: Telehealth |
|---|---|---|
| ("lipids"[All Fields] OR "lipidate"[All Fields] OR "lipidated"[All Fields] OR "lipidates"[All Fields] OR "lipidation"[All Fields] OR "lipidations"[All Fields] OR "lipide"[All Fields] OR "lipides"[All Fields] OR "lipidic"[All Fields] OR "lipids"[MeSH Terms] OR "lipids"[All Fields] OR "lipid"[All Fields] OR "cholesterol"[MeSH Terms] OR "cholesterol"[All Fields] OR "cholesterols"[All Fields] OR "cholesterole"[All Fields] OR "cholesterols"[All Fields]) | | ("telehealth"[All Fields] OR "telemedicine"[MeSH Terms] OR "telemedicine"[All Fields] OR "telehealth"[All Fields]) |

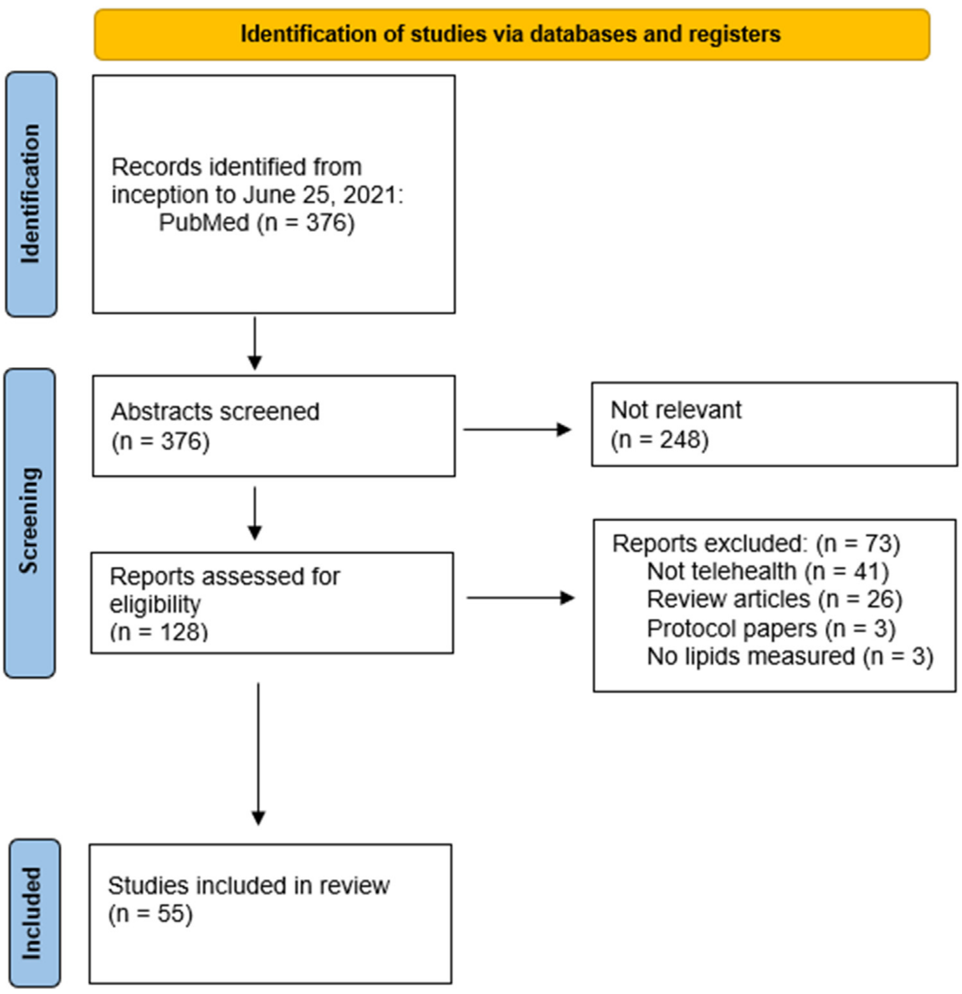


**Figure 1** PRISMA diagram.

ing of each individual patient. Examples of collected metrics that helped clinicians facilitate better individualized care for their patients included Hemoglobin A1c (HbA1c), diet, exercise, and lipids.[17-19] Personalized information and data among patients allowed clinicians to change therapeutic titrations and prescriptions according to the updated metrics they received from patients,[20] often through a streamlined communication medium facilitated by a telehealth intervention.[21-23] On a system-wide level, some telehealth interventions were shown to increase coordination with primary care centers and engage sometimes under-utilized advanced practice providers to share the clinical management of their patients.[24,25] Increased cooperation and communication between clinicians, their colleagues, and their patients likely contributed to the observed overall positive to neutral outcomes.

## Facilitators to delivering telehealth services

Current facilitators to telehealth services for lipid management exist in the categories of multidisciplinary approach to care, patient-centered programs, funding support.

### Multidisciplinary approach to care

Telehealth interventions were shown to promote the utilization of multidisciplinary healthcare professionals to care

**Table 2** Sources included in scoping review analysis.

| Authors | Year | Study design | N (Patients) | Study population | Study duration | Telehealth modality | Outcomes measured | Notable findings |
|---|---|---|---|---|---|---|---|---|
| Cheng et al.[19] | 2021 | Other: Cross-sectional | 375 | DM | N/A | Telephone, web messaging, telemonitoring | LDL-C, fasting plasma glucose, post-prandial glucose variability | Significant reduction in LDL-C levels and post-prandial glucose variability in telehealth group. |
| Russo et al.[43] | 2021 | Other: Evaluation | 203 | DM | 10 days | Telephone | Telehealth adherence, lipids, up-titration of lipids | Telehealth intervention revealed necessity of medical intervention in 46% of patients. |
| Alexander et al.[41] | 2020 | Other: Cross-sectional | 125 million visits | Primary care | N/A | Remote consult | BP, TC, prescription medication adherence | TC measurements decreased 36% in primary care telehealth visits during COVID-19 pandemic. |
| Baidwan et al.[44] | 2020 | Pre-post | 1709 CHCs | DM, CAD | 3 years | Telephone, telemonitoring | HTN, DM, body weight, lipids, lipid therapy, anti-platelet therapy | Limited evidence that telehealth improves cardiometabolic health in rural areas. |
| Davis et al.[69] | 2020 | Pre-post | 171 | DM | 1 year | Remote consult, telemonitoring | HbA1c, TC, LDL-C, BP, blood-urea nitrogen, microalbumin | Significant differences in HbA1c, TC, LDL-C, HDL-C, TGs, creatinine clearance, and potassium in telehealth group. |
| Kadoya et al.[34] | 2020 | Pre-post | 34 | HTN, lipids, DM | 6 months | Video consult | Changes in BP, LDL-C, HbA1c; safety of telehealth, control status of telehealth | No significant differences in LDL-C, HbA1c, or BP between groups. |
| Lee et al.[39] | 2020 | RCT | 240 | DM | 2 weeks to 2 months | Telephone, telemonitoring, BGMs | HbA1c, fasting plasma glucose, BP, lipids, health-related quality of life, diabetes self-efficacy | Telehealth intervention did not significantly improve glycemic control and HbA1c. |
| Majithia et al.[17] | 2020 | Pre-post | 55 | DM | 4 months | Video consult, mobile application, remote consult, connected BGMs and CGMs | HbA1c, blood glucose levels, BP, TC, HDL-C, TC/HDL ratio, LDL-C, TG | Significant improvements in LDL-C, TC/HDL ratio, TG, HbA1c, BMI, and SBP in telehealth group. |

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**Table 2** (*continued*)

| Authors | Year | Study design | N (Patients) | Study population | Study duration | Telehealth modality | Outcomes measured | Notable findings |
|---|---|---|---|---|---|---|---|---|
| Nyenwe et al.[59] | 2020 | Pre-post | 69 | DM | 36 months | Video consult | HbA1c, BP, lipid profile | No significant difference in lipid levels between groups. Telehealth group improved glycemic control. |
| Benson *et al.*[46] | 2019 | RCT | 118 | DM | 1 year | Telephone | HbA1c, BP, tobacco cessation, statin therapy, aspirin therapy, physical activity, exercise, LDL-C, medication adherence, BMI, diet | Significantly greater medication use and diabetes care practices in telehealth group. |
| Garza et al.[36] | 2019 | Pre-post | 71 | Obesity | 1 year | Telephone | Body fat percentage, TC, TG, LDL-C, HDL-C, physical fitness | 10-month aftercare telehealth intervention helped patients maintain significant reductions in LDL-C, TC, TGs, and increase in HDL-C. |
| Gulayin et al.[57] | 2019 | RCT | 357 | HLD, CVD, DM | 1 year | Telephone, mobile application | LDL-C, Framingham CVD risk score, statin therapy, mean annual primary care visits | No difference in LDL-C between groups, but 41.5% higher rate of participants receiving appropriate statin dose in telehealth group. |
| Maresca et al.[50] | 2019 | Pre-post | 22 | Mental health | 1 year | Telecounseling, telemonitoring | BP, blood glucose levels, TC, TG, BMI, mental health | Significant improvements in lipids and BMI that correlated with mental health in telehealth group. |
| Snoek et al.[65] | 2019 | RCT | 122 | CAD | 1 year | Telephone, telemonitoring | Peak VO2 max, quality of life, lipid panel, major adverse cardiovascular events | No significant differences in TCs among groups. |
| Barton et al.[60] | 2018 | RCT | 182 | DM | 1 year | Telephone | SBP, HbA1c, LDL-C | Despite better medication adherence, telehealth did not improve CVD risk factor control. |

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**Table 2** (*continued*)

| Authors | Year | Study design | N (Patients) | Study population | Study duration | Telehealth modality | Outcomes measured | Notable findings |
|---|---|---|---|---|---|---|---|---|
| Benson et al.[8] | 2018 | Pre-post | 102 | HTN, HLD | 20 months | Telecoaching | BP, BMI, TC, LDL-C, tobacco cessation | Telehealth group had higher proportion of participants who achieved LDL-C targets. |
| Bosworth et al.[51] | 2018 | RCT | 428 | HTN, HLD | 1 year | Telephone | Framingham CVD risk index, SBP, DBP, TC, LDL-C, HDL-C, BMI, HbA1c | Significant decline in TC in telehealth group. No other reduction in CVD risk observed. |
| Litke et al.[27] | 2018 | Other: Evaluation | 554 | DM, HTN, lipids | 3 months | Video consult, telephone | HbA1c, BP, statin therapy rate, tobacco cessation | All patients received lipid management education. 82% of patients prescribed goal-indicated statin dose. |
| Neubeck et al.[24] | 2018 | RCT | 203 | ACS | 24 months | Telephone | CVD risk, lipids | 24-month CHOICEplus or CHOICE program significantly improved cardiovascular risk profiles in ACS survivors. CHOICEplus telehealth program was not associated with any additional benefits compared to the original CHOICE program. |
| Nolan et al.[52] | 2018 | RCT | 264 | HTN, lipids | 12 months | Telecounseling | SBP, DBP, TC, LDL-C, non-HDL-C, TC/HDL ratio, Framingham 10-year CVD risk index | Men experienced improved DBP, non-HDL-C, TC, and TC/HDL-C ratio. |
| Ogren et al.[49] | 2018 | RCT | 871 | Brain injury | 36 months | Telephone | BP, LDL-C | Significant improvements in LDL-C and SBP in telehealth group. |
| Goldstein et al.[61] | 2017 | RCT | 428 | HTN, HLD | 1 year | Telephone | Primary: Satisfaction and confidence in cholesterol control Secondary: LDL-C, BP, health literacy | Women were less satisfied with their cholesterol control than men. |

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**Table 2** (*continued*)

| Authors | Year | Study design | N (Patients) | Study population | Study duration | Telehealth modality | Outcomes measured | Notable findings |
|---|---|---|---|---|---|---|---|---|
| Salisbury et al.[40] | 2017 | Other: Mixed methods | 609 | HTN, lipids, obesity | 1 year | Telephone | Response to treatment, anxiety, CVD risk factors, medication adherence, satisfaction with treatment, access to healthcare, perceptions of support | No significant differences in lipid measures between groups. Telehealth group reported better access to care and higher medication adherence. |
| Aytekin et al.[62] | 2016 | RCT | 88 | DM | 3 months | Telephone | Self-care score, HbA1c, TC, TG, LDL-C, BP | No significant differences in lipid measurements between groups. Telehealth improved diabetes self-management. |
| Basudev et al.[20] | 2016 | RCT | 208 | DM | 1 year | Video consult | HbA1c, lipids, BP, BIM, eGFR | No significant differences between control and telehealth groups in terms of lipids, weight, and renal function. Both groups had reduced HbA1c. |
| Maxwell et al.[31] | 2016 | Pre-post | 26 | DM | 6 months | Video consult | HbA1c, LDL-C, BP, patient satisfaction | No significant difference in LDL-C levels among both groups. However, the baseline LDL-C was low at 75 mg/dL and 81% of patients were using statins. High patient satisfaction. |
| Meng et al.[45] | 2016 | Pre-post | 5921 | DM | 4 years | Telephone | Patient ethnicity, HbA1c, LDL-C, retinal examination rates | Disparities between whites, African-Americans, and Latinos in rates of LDL-C screening existed even after the telehealth intervention. |
| Odnoletkova et al.[38] | 2016 | RCT | 287 | DM | 18 months | Telephone | HbA1c, TC, HDL-C, LDL-C, TG, BP, BMI | Significant improvements in LDL-C, BMI, and glycemic control in telehealth group. |

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**Table 2** (*continued*)

| Authors | Year | Study design | N (Patients) | Study population | Study duration | Telehealth modality | Outcomes measured | Notable findings |
|---|---|---|---|---|---|---|---|---|
| Rasmussen et al.[37] | 2016 | RCT | 40 | DM | 6 months | Video consult | HbA1c, blood glucose levels, BP, TC, LDL-C, albuminuria | Significant differences in HbA1c, mean blood glucose, and TC in telehealth group; no significant change in LDL-C. |
| Carallo et al.[64] | 2015 | Other: Case-control | 104 | DM | 4 years | Telephone, video consult | Blood glucose, HbA1c, LDL-C, BMI | GP empowerment and remote consultations are effective for standard outpatient treatment. |
| Lopez-Torres et al.[42] | 2015 | Other: Case-control | 82 | Metabolic syndrome | 1 year | Electronic portal, telemonitoring, messaging | SBP, DBP, TC, LDL-C, health status scores, patient satisfaction | Telehealth group had lower mean values in terms of SBP, DBP, and TC. Patient health status scores rose from baseline in telehealth group. |
| Liou et al.[55] | 2014 | RCT | 95 | DM | 6 months | Video consult | HbA1c, lipids | No significant difference in LDL-C, HDL-C, TC, or TGs among both groups. |
| Moores et al.[67] | 2014 | Pre-post | 76 | Mental health | 18 months | Telephone | BMI, TG, SBP | No significant differences in LDL-C among both groups. |
| Leichter et al.[23] | 2013 | RCT | 100 | DM | 2 years | Telephone, remote consult, telemonitoring | HbA1c, BP, BMI, lipids | Telehealth group had significantly greater reductions in body weight. |
| Levin et al.[28] | 2013 | Pre-post | 78 | DM | Retrospective | Telephone | HbA1c, BMI, BP, lipids | Telehealth did not improve diabetic or lipid control between groups. |
| Shea et al.[33] | 2013 | RCT | 1665 | DM | 5 years | Videoconferencing | HbA1c, LDL-C, SBP | LDL-C reduction was not impacted by patient's level of income. However, the range of income among study participants was too narrow to detect a difference. |

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for patients with complex medical conditions. A virtual telehealth clinic allowed professionals across multiple specialties to coordinate care, without the burdens of excess scheduling, travel, and other related obstacles that typically prevent coordinated specialty care.[26-28] Many of the telehealth interventions analyzed in this study used professionals from multiple areas of practice, including nutritionists, registered nurses, dieticians, psychiatrists, pharmacists, and cardiologists, to coach, counsel, and treat patients with chronic health conditions in a remote setting.[18,24,29,30] Notably, sup-

**Table 2** (*continued*)

| Authors | Year | Study design | N (Patients) | Study population | Study duration | Telehealth modality | Outcomes measured | Notable findings |
|---|---|---|---|---|---|---|---|---|
| Fischer et al.[48] | 2012 | RCT | 762 | DM | 20 months | Telephone | Proportion of patients with LDL-C < 100 mg/dL, hospital admissions, total hospital charges per patient, proportion of patients meeting goals | Significantly lower LDL-C observed in telehealth intervention. Average cost per patient was significantly less in telehealth group. |
| Bove et al.[22] | 2011 | RCT | 465 | CVD risk | 1 year | Telephone | Framingham 10-year CVD risk score, TC, TG, LDL-C, BP, medication adherence | Telehealth did not improve lipid management across both groups, as TC, LDL-C, and TGs both decreased significantly in each group. |
| Dalleck et al.[29] | 2011 | Other: Comparative | 226 | CAD, CABG, PCI | 12 weeks | Telephone, video consult | BP, lipid profiles, exercise, dietary intake, behavior | No significant differences between groups reported for BP, lipids, diet, and exercise levels were reported. |
| Fischer et al.[47] | 2011 | Other: Comparative | 1565 | DM | 1 year | Telephone, mailing | HbA1c, LDL-C, BP | Patients receiving telehealth intervention for diabetes care had improved LDL-C, HbA1C, and BP compared to non-intervention group. |
| Luchsinger et al.[63] | 2011 | RCT | 2169 | DM | 5 years | Video conferencing | HbA1c, SBP, LDL-C | Significant reduction in HbA1c in telehealth group, but no difference in LDL-C or SBP. |
| Nolan et al.[18] | 2011 | RCT | 680 | CAD | 6 months | Teleconferencing | Survey of adherence to exercise and diet, SBP, DBP, TC/HDL-C ratio, 10 year absolute CVD risk | Telehealth group had higher proportion of patients who adhered to exercise and diet behaviors, only after 6 weekly health telehealth sessions. |
| Anderson et al.[32] | 2010 | RCT | 295 | DM | 1 year | Telephone | BP, lipids, BMI, diet, exercise, tobacco | No significant differences in HbA1c, LDL-C, smoking, BP, BMI, or diet among both groups. |

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**Table 2** (*continued*)

| Authors | Year | Study design | N (Patients) | Study population | Study duration | Telehealth modality | Outcomes measured | Notable findings |
|---|---|---|---|---|---|---|---|---|
| Davis et al.[25] | 2010 | RCT | 165 | DM | 1 year | Video-conferencing | HbA1c, LDL-C, metabolic control, CVD risk | Significant improvement in LDL-C in telehealth group at 12 months. Significant improvement in HbA1c in telehealth group at 6 and 12 months. |
| Weinstock et al.[56] | 2010 | RCT | 1665 | DM | 5 years | Video-conferencing, web portal, messaging, telemonitoring | HbA1c, LDL-C, SBP, statin use | Telehealth group used significantly more statins (18%) versus control group (10%) over study duration. |
| Timmerberg et al.[68] | 2009 | RCT | 32 | DM | 16 weeks | Video-conferencing | HbA1c, TC | Telehealth and control group had non-significant TC reductions. |
| Trief et al.[58] | 2009 | RCT | 1443 | Mental health | 2 years | Telephone | HbA1c, BP, TC, LDL-C | No significant difference in LDL-C among both groups. |
| Nikkanen et al.[30] | 2008 | Pre-post | 101 | DM | 10 to 14 months | Telephone | HbA1c, LDL-C, BP, blood glucose | Significant reduction in LDL-C in telehealth group, related to prescribing statins. |
| Nakajima et al.[27] | 2007 | Other: Evaluation | 14 | Health promotion group | 12 weeks | Video consult | LDL-C, health locus of control score | Significant LDL-C reductions and higher health locus of control internal score in the telehealth group. Patients viewed intervention as highly acceptable. |
| Shea et al.[54] | 2007 | RCT | 1665 | DM | 1 year | Video-conferencing, web portal, messaging, telemonitoring | HbA1c, BP, LDL-C | Significant improvements in TC, LDL-C, and BP in telehealth group at 1 year. |
| Wister et al.[35] | 2007 | RCT | 305 | CAD, primary prevention, secondary prevention | 1 year | Telecounseling | Framingham 10-year CVD risk score, TC, SBP, nutrition level, health confidence | Significant reduction in TC in telehealth primary prevention group only. |
| Shea et al.[21] | 2006 | RCT | 1665 | DM | 1 year | Video-conferencing, web portal, messaging, telemonitoring | HbA1c, BP, LDL-C | Significant LDL-C reduction in telehealth group compared to control. |

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**Table 2** (*continued*)

| Authors | Year | Study design | N (Patients) | Study population | Study duration | Telehealth modality | Outcomes measured | Notable findings |
|---|---|---|---|---|---|---|---|---|
| Palmieri et al.[66] | 2005 | Pre-post | 276 | DM, high risk primary prevention, secondary prevention | Retrospective | Telephone | LDL-C | Improvement in LDL-C goal attainment across patient groups in telehealth intervention. No control group. |
| Robinson et al. [53] | 2000 | Other: Evaluation | 2827 | CAD | 1 year | Telephone | LDL-C, statin use | Statin use increased from 47% to 85% of patients. Increased proportion of patients achieved LDL-C goals. |

Abbreviations: DM: Diabetes mellitus; T1D: Type 1 Diabetes; T2D: Type 2 Diabetes; ACS: Acute Coronary Syndrome; CAD: Coronary Artery Disease; SBGM: Self-blood glucose monitoring; CGM: Continuous glucose monitor; BP: Blood pressure; HLD: hyperlipidemia; CVD: Cardiovascular disease; SBP: Systolic blood pressure; DBP: diastolic blood pressure; HbA1c: Hemoglobin A1c; LDL-C: Low-density lipoprotein cholesterol; TC: total cholesterol; TG: triglycerides; Non-HDL-C: non-high density lipoprotein cholesterol; CABG: coronary artery bypass graft; PCI: percutaneous coronary intervention; BMI: Body-mass index; EHR: Electronic health record; PCP: Primary care provider; F/U: Follow-up; CHC: Community health center; VO2 max: maximum rate of oxygen consumption; eGFR: estimated glomerular filtration rate

port staff empowered the successful implementation and delivery of these interventions.

### Patient-centered programs

Patients largely had acceptable and satisfactory feelings to many of the telehealth interventions in the analyzed studies.[27,28,31] Specifically, patient-centered interventions that thoughtfully considered patient education level, possible language barriers, and comfort-level with technology yielded high patient satisfaction marks.[32,33] Culturally appropriate telehealth interventions that facilitated care in a timely manner also demonstrated evidence of a patient-centered design to telehealth interventions.[33,24,25] Patients across studies enjoyed the flexibility in scheduling their own telehealth appointments with the freedom of attending appointments from wherever they pleased, which minimized their travel burden and associated costs.[26,28,34] Many of the telehealth interventions practiced among the studies in this review encouraged self-empowerment and self-management principles that enabled patients to take ownership of their health and create strong habits. Telehealth interventions that emphasized self-efficacy in one's health facilitated a boost in patients' internal locus of health control.[32,35,36]

### Funding support

While cost currently exists as a barrier to delivering telehealth services, some studies revealed that the costs associated with technology installation, training, and hardware were covered by publicly funded health care systems, which promoted the delivery of telehealth services at reduced to no cost for patients in several studies.[33,34,37,38] This suggests that government funding could facilitate the delivery of future telehealth interventions in the U.S., as technology costs was reported as a barrier to implementation of telehealth services in studies conducted in the U.S.[21] Only a few studies in our analysis analyzed potential cost-savings for health systems, which yielded mixed results. Telehealth interventions could marginally reduce the cost of ward admissions and consultations.[39] Interestingly, one study found that the cost-effectiveness of telehealth interventions for health systems depends on the nature of the disease in question, as cost-effectiveness was achieved for patients with cardiovascular disease risk, but was not achieved for patients living with depression.[40]

## Barriers to delivering telehealth services

Current barriers to telehealth services for lipid management exist in the categories of technology, patient experience, clinician experience, and health systems.

### Technological barriers

In several studies, technology was identified as the most significant barrier to delivering telehealth services. Technology dexterity and comfortability varied across patient age ranges,[41] and if technological issues existed before or during a telehealth appointment, the infrastructure must exist for patients and/or providers to navigate this issue or obtain appropriate support.[42,43] Internet and broadband access dictated whether patients have the capabilities to use synchronous telehealth services.[39,44] Despite patients achieving internet access to their telehealth appointment, challenges may have persisted, including faulty video access and time spent attempting to troubleshoot.[39,44] These technological issues can sometimes hinder telehealth appointments from facilitating the best patient care.

### Patient-related barriers

Patients may provide direct or indirect resistance to using telehealth services. Many patients did not provide accurate or updated contact information in their records, and were difficult to reach for scheduling and conducting telehealth appointments,[45-48] while others were lost to follow-up.[26,47,48] Patients may also have cognitive or physical impairment that hindered their ability to participate in telehealth interventions.[49] Some studies noted that some patients simply choose not to participate in telehealth interventions.[8,43] Language and patient literacy barriers are also harder to address over telehealth visits.[45]

### Clinician-related barriers

Some providers believed that a telehealth setting did not allow for them to be as professional and react to patient nonverbal cues,[37,50] adding difficulty to integrated decision making between patient and provider.[20] Training providers to provide quality telehealth care requires time and it also was found to be difficult to standardize.[51,52] Lastly, various interstate licensure requirements restrict providers from being able to continue providing telehealth services to patients who move out of state.[21]

### Health-systems barriers

Historically, telehealth providers received limited reimbursement from insurances, yet as telehealth increased in prevalence when the COVID-19 pandemic began in 2020, federal and state agencies in the U.S. and other stakeholders modified their policies and procedures to grant more clinicians the capability to provide telehealth services and to receive reimbursement from agencies such as the CMS.[41] However, cost remains a significant barrier to providing quality telehealth services. These costs include: telehealth software; technology required to facilitate telehealth appointments;[17,21] training professionals to use telehealth services;[21] and adequate internet access or mobile data plans.[39] Furthermore, insurance policies limited clinicians on their ability to bill equally for in-person and telehealth visits, which culminates in missed earnings and may discourage clinicians from pursuing telehealth interventions.[21,53] Specifically within telehealth interventions, individual state policies dictate reimbursement across telephone-only and video telehealth interventions in the U.S., which creates inconsistencies in billing practices and may further isolate elderly patients or patients without access to video streaming services.[1]

## Clinician feedback on utility of telehealth services

Clinician attitudes toward telehealth services for lipid management remain unclear in the literature. Some clinicians expressed concern about licensing restrictions and reimbursement policies regarding telehealth services.[43] Others reported spending much less time with patients during telehealth visits than in-person encounters,[23] which provided additional time to consider changes in management of other patients.[28] Generally, clinicians reported higher satisfaction among patients who used telehealth services.[28]

## Future utility of telehealth services for lipid management

One consequence of the COVID-19 pandemic is the emerging interest in telehealth to deliver care.[41]As this interest grows, best practices for telehealth interventions regarding lipid management should be further explored. Many studies in this review suggested that future use of telehealth should include both in-person and virtual consultations.[34,55] Specifically, a complimentary hybrid model of both occasional telehealth and in-person consultations could optimize care for the management of proatherogenic dyslipidemias in diabetic patients.[19] Future telehealth interventions may focus on medication management and adherence to lifestyle modifications to prevent ASCVD, while in-person consultations could focus on obtaining lipid metrics and other screening measures.[18,51] Lipid-lowering therapies could be better adjusted and prescribed through telehealth interventions, as some telehealth interventions increased statin use and medication adjustment.[20,53,56,57] Additionally, studies in this review suggested that telehealth visits, when paired with self-monitoring devices, can be used to help increase patients' self-efficacy, which has been shown to improve patient outcomes.[58]

# Discussion

Telehealth provides opportunities to further enrich the patient-centered focus of healthcare, which can be beneficial to providing lipid management care. If telehealth visits became more ubiquitous, this would be more convenient for patients, as they can take less time off work, eliminate travel time, and reduce time spent for transportation coordination.[23] If patients believe they are managing their ASCVD risk well and have ample opportunities to check-in with their provider about their lipids, then this may lead to overall reductions in ASCVD risk for patients with dyslipidemia. Future telehealth practice should focus on integrating patients better when developing telehealth lipid management care plans, to not only help adopt this self-efficacy approach, but also to improve patient engagement.[20,39] To address patient-centered barriers to telehealth lipid management, clinicians should offer technology literacy programs for the elderly[43] and ensure that all telehealth materials are culturally competent.[25] Lipid management telehealth services should also place a strong focus on increasing communication between provider and patient, as this can help underserved patients with adherence and reduce their overall ASCVD risk.[22] Regardless of proposed mechanisms related to the future utility of telehealth for lipid conditions, implementation science will play a role in ensuring telehealth's uptake into clinical practice.[44]

### Strengths and weaknesses

This scoping review was performed to assess and describe the current landscape of telehealth utility for the practice of lipid management. The major strength of this study is that it provides a thorough understanding of the current state, barriers, and facilitators related to telehealth use for clinical lipidology, adding a lipid-specific focus to the rapidly growing field of telehealth. Two weaknesses present in this study include the inherent weakness that this is a scoping review, rather than an original project, in addition to the fact that only one author performed manuscript screening (Figure 1). However, by synthesizing the facilitators and barriers of telehealth use in lipid management with a detailed current state understanding, other groups may be able to better design, implement, and evaluate novel telehealth interventions for use in clinical lipidology.

## Conclusion

Telehealth services for lipid management have expanded during the COVID-19 pandemic. By addressing current barriers to telehealth for lipid management, such as technology dexterity, and leveraging existing facilitators, like access to multidisciplinary specialty care, health systems, clinicians, and patients alike may benefit from this modernized approach to lipid care. Further research is needed to discover best practices for optimizing lipid management via telehealth interventions.

## CRediT authorship contribution statement

**Tyler J. Schubert:** Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Katarina Clegg:** Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Dean Karalis:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – review & editing. **Nihar R. Desai:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – review & editing. **Joel C. Marrs:** Data curation, Conceptualization, Formal analysis, Methodology, Writing – review & editing. **Catherine McNeal:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – review & editing. **Guy L. Mintz:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – review & editing. **Katrina M. Romagnoli:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – review & editing. **Laney K. Jones:** Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Writing – original draft, Writing – review & editing.

## References

1. Hyder MA, Razzak J. Telemedicine in the United States: An Introduction for Students and Residents. *J Med Internet Res*. 2020;22:e20839.
2. World Health Organization. Recommendations on digital interventions for health system strengthening. June 6, 2019. Accessed June 21, 2022. https://www.who.int/publications/i/item/97892415505051.
3. American Telemedicine Association. Telehealth: defining 21st century care. 2020. Accessed June 21, 2022. https://marketing.americantelemed.org/hubfs/Files/Resources/ATA_Telehealth_Taxonomy_9-11-20.pdf
4. Ting DSW, Carin L, Dzau V, Wong TY. Digital technology and COVID-19. *Nat Med*. 2020;26:459–461.
5. Omboni S, McManus RJ, Bosworth HB, et al. Evidence and Recommendations on the Use of Telemedicine for the Management of Arterial Hypertension: An International Expert Position Paper. *Hypertension*. 2020;76:1368–1383.
6. Kernebeck S, Busse TS, Bottcher MD, Weitz J, Ehlers J, Bork U. Impact of mobile health and medical applications on clinical practice in gastroenterology. *World J Gastroenterol*. 2020;26:4182–4197.
7. Al-Badri M, Hamdy O. Diabetes clinic reinvented: will technology change the future of diabetes care? *Ther Adv Endocrinol Metab*. 2021;12 2042018821995368.
8. Benson GA, Sidebottom A, Sillah A, et al. Reach and effectiveness of the HeartBeat Connections telemedicine pilot program. *J Telemed Telecare*. 2018;24:216–223.
9. Grundy SM, Stone NJ, Bailey AL, et al. 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2019;73:e285–e350.
10. Authors/Task Force M, Guidelines ESCCfP, Societies ESCNC2019 ESC/EAS guidelines for the management of dyslipidaemias: Lipid modification to reduce cardiovascular risk. *Atherosclerosis*. 2019;290:140–205.
11. Hincapie MA, Gallego JC, Gempeler A, Pineros JA, Nasner D, Escobar MF. Implementation and Usefulness of Telemedicine During the COVID-19 Pandemic: A Scoping Review. *J Prim Care Community Health*. 2020;11:2150132720980612.
12. Pirillo A, Casula M, Olmastroni E, Norata GD, Catapano AL. Global epidemiology of dyslipidaemias. *Nat Rev Cardiol*. 2021;18:689–700.
13. Michos ED, McEvoy JW, Blumenthal RS. Lipid Management for the Prevention of Atherosclerotic Cardiovascular Disease. *N Engl J Med*. 2019;381:1557–1567.
14. Arnett DK, Blumenthal RS, Albert MA, et al. 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2019;140:e596–e646.
15. Peters MD, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc*. 2015;13:141–146.
16. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
17. Majithia AR, Kusiak CM, Armento Lee A, et al. Glycemic Outcomes in Adults With Type 2 Diabetes Participating in a Continuous Glucose Monitor-Driven Virtual Diabetes Clinic: Prospective Trial. *J Med Internet Res*. 2020;22:e21778.
18. Nolan RP, Upshur RE, Lynn H, et al. Therapeutic benefit of preventive telehealth counseling in the Community Outreach Heart Health and Risk Reduction Trial. *Am J Cardiol*. 2011;107:690–696.
19. Cheng PC, Kao CH. Telemedicine assists in the management of proatherogenic dyslipidemia and postprandial glucose variability in patients with type 2 diabetes mellitus: a cross-sectional study. *Endocr Connect*. 2021;10:789–795.

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20. Basudev N, Crosby-Nwaobi R, Thomas S, Chamley M, Murrells T, Forbes A. A prospective randomized controlled study of a virtual clinic integrating primary and specialist care for patients with Type 2 diabetes mellitus. *Diabet Med*. 2016;33:768–776.
21. Shea S, Weinstock RS, Starren J, et al. A randomized trial comparing telemedicine case management with usual care in older, ethnically diverse, medically underserved patients with diabetes mellitus. *J Am Med Inform Assoc*. 2006;13:40–51.
22. Bove AA, Santamore WP, Homko C, et al. Reducing cardiovascular disease risk in medically underserved urban and rural communities. *Am Heart J*. 2011;161:351–359.
23. Leichter SB, Bowman K, Adkins RA, Jelsovsky Z. Impact of remote management of diabetes via computer: the 360 study–a proof-of-concept randomized trial. *Diabetes Technol Ther*. 2013;15:434–438.
24. Neubeck L, Freedman B, Lowres N, et al. Choice of Health Options in Prevention of Cardiovascular Events (CHOICE) Replication Study. *Heart Lung Circ*. 2018;27:1406–1414.
25. Davis RM, Hitch AD, Salaam MM, Herman WH, Zimmer-Galler IE, EJ Mayer-Davis. TeleHealth improves diabetes self-management in an underserved community: diabetes TeleCare. *Diabetes Care*. 2010;33:1712–1717.
26. Litke J, Spoutz L, Ahlstrom D, Perdew C, Llamas W, Erickson K. Impact of the clinical pharmacy specialist in telehealth primary care. *Am J Health Syst Pharm*. 2018;75:982–986.
27. Nakajima R, Nakamura K, Takano T, Seino K, Inose T. Improvements in health by consultations using mobile videophones among participants in a community health promotion programme. *J Telemed Telecare*. 2007;13:411–415.
28. Levin K, Madsen JR, Petersen I, Wanscher CE, Hangaard J. Telemedicine diabetes consultations are cost-effective, and effects on essential diabetes treatment parameters are similar to conventional treatment: 7-year results from the Svendborg Telemedicine Diabetes Project. *J Diabetes Sci Technol*. 2013;7:587–595.
29. Dalleck LC, Schmidt LK, Lueker R. Cardiac rehabilitation outcomes in a conventional versus telemedicine-based programme. *J Telemed Telecare*. 2011;17:217–221.
30. Nikkanen T, Timonen M, Ylitalo K, Timonen O, Keinanen-Kiukaanniemi S, Rajala U. Quality of diabetes care among patients managed by teleconsultation. *J Telemed Telecare*. 2008;14:295–299.
31. Maxwell LG, McFarland MS, Baker JW, Cassidy RF. Evaluation of the Impact of a Pharmacist-Led Telehealth Clinic on Diabetes-Related Goals of Therapy in a Veteran Population. *Pharmacotherapy*. 2016;36:348–356.
32. Anderson DR, Christison-Lagay J, Villagra V, Liu H, Dziura J. Managing the space between visits: a randomized trial of disease management for diabetes in a community health center. *J Gen Intern Med*. 2010;25:1116–1122.
33. Shea S, Kothari D, Teresi JA, et al. Social impact analysis of the effects of a telemedicine intervention to improve diabetes outcomes in an ethnically diverse, medically underserved population: findings from the IDEATel Study. *Am J Public Health*. 2013;103:1888–1894.
34. Kadoya Y, Hara M, Takahari K, Ishida Y, Tamaki M. Disease Control Status and Safety of Telemedicine in Patients With Lifestyle Diseases- A Multicenter Prospective Observational Study in Japan. *Circ Rep*. 2020;2:351–356.
35. Wister A, Loewen N, Kennedy-Symonds H, McGowan B, McCoy B, Singer J. One-year follow-up of a therapeutic lifestyle intervention targeting cardiovascular disease risk. *CMAJ*. 2007;177:859–865.
36. Garza C, Martinez DA, Yoon J, Nickerson BS, Park KS. Effects of Telephone Aftercare Intervention for Obese Hispanic Children on Body Fat Percentage, Physical Fitness, and Blood Lipid Profiles. *Int J Environ Res Public Health*. 2019;16.
37. Rasmussen OW, Lauszus FF, Loekke M. Telemedicine compared with standard care in type 2 diabetes mellitus: A randomized trial in an outpatient clinic. *J Telemed Telecare*. 2016;22:363–368.
38. Odnoletkova I, Goderis G, Nobels F, et al. Optimizing diabetes control in people with Type 2 diabetes through nurse-led telecoaching. *Diabet Med*. 2016;33:777–785.
39. Lee JY, Chan CKY, Chua SS, et al. Telemonitoring and Team-Based Management of Glycemic Control on People with Type 2 Diabetes: a Cluster-Randomized Controlled Trial. *J Gen Intern Med*. 2020;35:87–94.
40. Salisbury C, O'Cathain A, Thomas C, et al. An evidence-based approach to the use of telehealth in long-term health conditions: development of an intervention and evaluation through pragmatic randomised controlled trials in patients with depression or raised cardiovascular risk. *Southampton (UK)*. 2017.
41. Alexander GC, Tajanlangit M, Heyward J, Mansour O, Qato DM, Stafford RS. Use and Content of Primary Care Office-Based vs Telemedicine Care Visits During the COVID-19 Pandemic in the US. *JAMA Netw Open*. 2020;3:e2021476.
42. Lopez-Torres J, Rabanales J, Simarro MJ, Group P-A. Effectiveness of a telemedicine programme for patients with metabolic syndrome. *Technol Health Care*. 2015;23:161–169.
43. Russo V, Cassini R, Caso V, et al. Nursing Teleconsultation for the Outpatient Management of Patients with Cardiovascular Disease during COVID-19 Pandemic. *Int J Environ Res Public Health*. 2021;18.
44. Baidwan NK, Davlyatov G, Mehta T. Telehealth Use among Community Health Centers and Cardio-Metabolic Health Outcomes. *Healthcare (Basel)*. 2020;8.
45. Meng YY, Diamant A, Jones J, et al. Racial and Ethnic Disparities in Diabetes Care and Impact of Vendor-Based Disease Management Programs. *Diabetes Care*. 2016;39:743–749.
46. Benson GA, Sidebottom A, Hayes J, et al. Impact of ENHANCED (diEtitiaNs Helping pAtieNts CarE for Diabetes) Telemedicine Randomized Controlled Trial on Diabetes Optimal Care Outcomes in Patients with Type 2 Diabetes. *J Acad Nutr Diet*. 2019;119:585–598.
47. Fischer HH, Villacres A, Durfee MJ, McCullen K, Mackenzie TD. Diabetes population management by telephone visits. *Telemed J E Health*. 2011;17:396–398.
48. Fischer HH, Eisert SL, Everhart RM, et al. Nurse-run, telephone-based outreach to improve lipids in people with diabetes. *Am J Manag Care*. 2012;18:77–84.
49. Ogren J, Irewall AL, Soderstrom L, Mooe T. Long-term, telephone-based follow-up after stroke and TIA improves risk factors: 36-month results from the randomized controlled NAILED stroke risk factor trial. *BMC Neurol*. 2018;18:153.
50. Maresca G, De Cola MC, Caliri S, et al. Moving towards novel multidisciplinary approaches for improving elderly quality of life: The emerging role of telemedicine in Sicily. *J Telemed Telecare*. 2019;25:318–324.
51. Bosworth HB, Olsen MK, McCant F, et al. Telemedicine cardiovascular risk reduction in veterans: The CITIES trial. *Am Heart J*. 2018;199:122–129.
52. Nolan RP, Feldman R, Dawes M, et al. Randomized Controlled Trial of E-Counseling for Hypertension: REACH. *Circ Cardiovasc Qual Outcomes*. 2018;11:e004420.
53. Robinson JG, Conroy C, Wickemeyer WJ. A novel telephone-based system for management of secondary prevention to a low-density lipoprotein cholesterol $<$ or $=$ 100 mg/dl. *Am J Cardiol*. 2000;85:305–308.
54. Shea S, Consortium ID. The Informatics for Diabetes and Education Telemedicine (IDEATel) project. *Trans Am Clin Climatol Assoc*. 2007;118:289–304.
55. Liou JK, Soon MS, Chen CH, et al. Shared care combined with telecare improves glycemic control of diabetic patients in a rural underserved community. *Telemed J E Health*. 2014;20:175–178.
56. Weinstock RS, Izquierdo R, Goland R, et al. Lipid treatment in ethnically diverse underserved older adults with diabetes mellitus: statin use, goal attainment, and health disparities in the informatics for diabetes education and telemedicine project. *J Am Geriatr Soc*. 2010;58:401–402.
57. Gulayin PE, Lozada A, Beratarrechea A, et al. An Educational Intervention to Improve Statin Use: Cluster RCT at the Primary Care Level in Argentina. *Am J Prev Med*. 2019;57:95–105.
58. Trief PM, Teresi JA, Eimicke JP, Shea S, Weinstock RS. Improvement in diabetes self-efficacy and glycaemic control using telemedicine in a sample of older, ethnically diverse individuals who have diabetes: the IDEATel project. *Age Ageing*. 2009;38:219–225.

59. Nyenwe EA, Ashby S, Tidwell J. Diabetes consultation versus diabetes education in patients with poor glycaemic control: A telemedicine intervention study. *J Telemed Telecare*. 2020 1357633X20959213.
60. Barton AB, Okorodudu DE, Bosworth HB, Crowley MJ. Clinical Inertia in a Randomized Trial of Telemedicine-Based Chronic Disease Management: Lessons Learned. *Telemed J E Health*. 2018;24:742–748.
61. Goldstein KM, Stechuchak KM, Zullig LL, et al. Impact of Gender on Satisfaction and Confidence in Cholesterol Control Among Veterans at Risk for Cardiovascular Disease. *J Womens Health (Larchmt)*. 2017;26:806–814.
62. Aytekin Kanadli K, Ovayolu N, Ovayolu O. Does Telephone Follow-Up and Education Affect Self-Care and Metabolic Control in Diabetic Patients? *Holist Nurs Pract*. 2016;30:70–77.
63. Luchsinger JA, Palmas W, Teresi JA, et al. Improved diabetes control in the elderly delays global cognitive decline. *J Nutr Health Aging*. 2011;15:445–449.
64. Carallo C, Scavelli FB, Cipolla M, et al. Management of Type 2 Diabetes Mellitus through Telemedicine. *PLoS One*. 2015;10:e0126858.
65. Snoek JA, Meindersma EP, Prins LF, et al. The sustained effects of extending cardiac rehabilitation with a six-month telemonitoring and telecoaching programme on fitness, quality of life, cardiovascular risk factors and care utilisation in CAD patients: The TeleCaRe study. *J Telemed Telecare*. 2021;27:473–483.
66. Palmieri J, Redline S, Morita R. Goal attainment in patients referred to a telephone-based dyslipidemia program. *Am J Health Syst Pharm*. 2005;62:1586–1591.
67. Moores JD, Uppal S, Hernandez AM, Wilansky P. Telemedicine as a tool to mitigate cardiometabolic risk associated with serious mental illness. *J Telemed Telecare*. 2014;20:436–440.
68. Timmerberg BD, Wurst J, Patterson J, Spaulding RJ, Belz NE. Feasibility of using videoconferencing to provide diabetes education: a pilot study. *J Telemed Telecare*. 2009;15:95–97.
69. Davis TC, Hoover KW, Keller S, Replogle WH. Mississippi Diabetes Telehealth Network: A Collaborative Approach to Chronic Care Management. *Telemed J E Health*. 2020;26:184–189.

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