# A Guide for Using Telehealth Technologies in *Diabetes Self-Management Education and Support* and in the *National Diabetes Prevention Program Lifestyle Change Program*

## INTRODUCTION AND OVERVIEW

Numerous barriers to participation in the National Diabetes Prevention Program (National DPP) Lifestyle Change Program (LCP) and diabetes self-management education and support (DSMES) services have been identified.[1-3] Technological advances, increased web connectivity, and innovative funding solutions have made telehealth a viable option for addressing some of those barriers.[4-5] Telehealth is promising because:

- It holds the potential to **reach more participants** compared to traditional in-person programs. Telehealth technologies are less restricted by distance, geography, and time barriers, potentially **creating greater accessibility** for rural and underserved populations.[6-9]
- **Multiple service providers and independent vendors now offer the National DPP LCP and DSMES** using a variety of telehealth technologies.
- **Many potential participants have access to the internet or devices needed to enroll** in a telehealth program.[10]

**The purpose of this guidance document is to provide users with information about what is needed to implement different telehealth technologies** and to provide specific implementation considerations for each technology.

The **primary intended users of this guidance document are organizations interested in offering the National DPP LCP or DSMES using telehealth technologies**.

### *Telehealth vs. Telemedicine*

The Health Resources & Services Administration (HRSA) defines *telehealth* as "The use of electronic information and telecommunication technologies to support and promote long-distance clinical health care, patient and professional health-related education, public health, and health administration." [11] *Telemedicine* is a subset of telehealth that specifically involves a *clinician* providing *medical services* via telehealth technology.[12] Thus, though the terms are often used interchangeably, telehealth is not the same as telemedicine.

### *Telehealth Technologies*


A range of technologies that are covered in this document can be used to support telehealth delivery of programs and services. Technologies include text messaging, smartphone apps for mobile phones, websites and computers, standard and wireless telephones, live and asynchronous video virtual reality or artificial intelligence (AI), and combinations of multiple technologies thereof. Organizations can offer participants the opportunity to engage with instructors or coaches, health care providers, and other participants using the technologies shown above.

This document provides organizations with **(1) steps for getting started with telehealth and (2) additional details about each of the technologies.**

Centers for Disease Control and Prevention
National Center for Chronic Disease Prevention and Health Promotion
Division of Diabetes Translation

# GET STARTED

There are various resources available to get your National DPP LCP or DSMES services off and running using telehealth technology. The California Telehealth Resource Center (CTRC) developed a Telehealth Program Developer Kit[13] that incorporates telehealth best practices and is highly customizable. Some of the structure and guidance in this section is derived from the CTRC's Telehealth Program Developer Kit. The stages associated with beginning and sustaining your program, as described in the developer kit, are outlined below with some additional details for consideration.

## *Assess Needs and Define Your Telehealth Program*

1. **Assess Service Needs and the Environment**: Identify and document the need for a telehealth program and identify specific needs for the community or region of interest.
    - **Surveys or key informant interviews** with community coalitions, lifestyle coaches, and other stakeholders can help you better understand the community's needs and what technologies may be the most appropriate for your target populations.

Working with organizations and lifestyle coaches that are well established in the community and that understand the local culture and environment can help improve your program's credibility and buy-in from participants.

2. **Define the Program Model**: Define the National DPP LCP or DSMES services, population, and setting of your telehealth program. Also consider,
    - **Culturally relevant and tailored programming**. Specific strategies may include:
        - Working with coaches or instructors of the same ethnicity as program participants to support program delivery. If program participants prefer to speak in another language, bilingual coaches can provide appropriate support.
        - Tailoring educational materials to be culturally appropriate for program participants. For example, specific foods and recipes should be appropriate for and familiar to target populations.
    - **Needs of populations with lower-grade reading levels and limited math skills**.
        - Health coaches can help fill in any gaps in understanding, reinforce important principles, and tailor communications to individual participant needs.
        - Educational materials should be written at the reading level of the target population.
3. **Develop the Business Case**: Determine if there is a market for the proposed program and a mechanism to pay for it. This step is critical when planning for the long-term sustainability of your program once any initial funding or grants have run out. The section below provides additional guidance for understanding potential reimbursement pathways for your program. Then, follow the remaining steps for starting your telehealth program.

## UNDERSTAND REGULATORY REQUIREMENTS AND REIMBURSEMENT FOR TELEHEALTH

Reimbursement for in-person and telehealth delivery of the National DPP LCP and DSMES varies by specific payer (e.g., insurer or employer). However, opportunities for reimbursement for these programs are growing.

As of spring 2018, 39 states have telehealth parity laws that require private insurance companies to reimburse providers for care delivered remotely via telemedicine. However, care delivery often applies to specific conditions only[15] and may not include lifestyle change programs or disease management even if there is coverage related to prediabetes or diabetes. Moreover, states have different laws regarding the specific telehealth technologies for which they will provide reimbursement.[15]

Health plans will sometimes provide a telephone coach to provide disease management services, but this approach to disease management does not meet national standards for DSMES. **Regardless of whether you plan to offer the National DPP LCP or DSMES services using telehealth technologies, recognition or accreditation for your organization is required for reimbursement by Medicare and may be required by other payers (see box at right).**

Given this context, **you will want to learn**:

- **Whether any state laws are applicable to the reimbursement** of type 2 diabetes prevention or diabetes self-management education and support services via telehealth.
- **Whether applicable state laws specify which telehealth technologies are reimbursable**.

Three resources can help you learn more about telehealth laws and reimbursement policies in your state:

1. **The Center for Connected Health Policy's (CCHP) website**.[19] CCHP helps users stay informed about telehealth-related laws, regulations, and Medicaid programs. By visiting the CCHP website,[19] you can:
    - Review CCHP's comprehensive assessment and compendium of state telehealth laws and reimbursement policies.[15]
    - Click on your state to learn about current private payer laws, if any, as well as any relevant Medicaid telehealth reimbursement laws and professional regulation or health and safety laws.

Medicare supports payments for DSMES services delivered using telehealth, but CDC-recognized organizations offering the National DPP LCP may only receive reimbursement for a limited number of virtual make-up sessions.[14]

For the National DPP, CDC provides guidance on achieving program recognition through their Diabetes Prevention Recognition Program (DPRP).[16]

DPRP standards allow for two potential delivery modes for the National DPP LCP other than in-person:[16]

**Online.** Yearlong LCP delivered 100 percent online for all participants; meaning, participants log into course sessions via a computer, laptop, tablet, or smartphone. Participants also must interact with lifestyle coaches at various times and by various communication methods, including online classes, emails, phone calls, or texts.

**Distance Learning.** Yearlong LCP delivered 100 percent by trained lifestyle coaches via remote classroom or telehealth (i.e., conference call or video) where the lifestyle coach is present in one location and participants are calling in or videoconferencing from another location is considered distance learning.

For DSMES, the American Diabetes Association's (ADA) Education Recognition Program[17] and the American Association of Diabetes Educators' (AADE) Diabetes Education Accreditation Program (DEAP)[18] provide guidance for meeting requirements for recognition or accreditation, respectively.

Visit the Find Grants[20] page on the HRSA website to see if there may be available grants to help your organization with startup costs associated with purchasing and setting up various telehealth technologies.

- Explore other resources on the website including bill analysis; fact sheets; legislative and regulatory updates; research catalogues; reports, publications, and policy briefs; and relevant telehealth news and newsletters.

2. **Find your Telehealth Resource Center.**[21] The National Consortium of Telehealth Resource Centers and affiliated regional telehealth resource centers provide assistance, education, and information to organizations and individuals who are actively providing or interested in providing remotely delivered health care. Regional telehealth resource centers may be able to help you understand whether and how state-specific laws might impact reimbursement for programs and services delivered via telehealth.

3. **CTRC Reimbursement Guide May 2019.**[22] This document includes useful information about federal reimbursement pathways and other commercial reimbursement as of 2018. The information should be used in consultation with your billing specialist and other advisers to help you understand and initiate billing for telehealth services.

Once you have assessed the need for telehealth services, defined your program, developed the business case, and researched avenues for billing and reimbursement, you are ready to develop and implement your telehealth program.

### *Develop and Plan Your Telehealth Program*

4. **Develop and Plan Your Program and Technology**: Use all the information collected in steps two and three to create a plan that details all the areas that require work during the implementation of your telehealth program. As part of your planning:

   - **Consider implications for the Health Insurance Portability and Accountability Act (HIPAA).** HIPAA requirements are no more or less stringent for telehealth providers compared to in-person providers. Ensure that the technologies you choose are implemented so that they are HIPAA compliant. The U.S. Department of Health and Human Services website contains some information and links to resources to help practitioners think about how using health information technology might impact HIPAA considerations.[23]

Explore the ADA and AADE websites for background resources and materials related to telehealth program implementation to help you further determine what technologies or approaches will work best for you. AADE offers, among other things, a 60-minute program called *Telehealth: Practice Considerations for Diabetes Educators Today*[24] that provides additional telehealth and telemedicine guidance for diabetes educators.

## IDENTIFY TELEHEALTH TECHNOLOGIES THAT MEET YOUR NEEDS

The next sections will explore infrastructure and staff needs for telehealth program implementation, covering each of the individual telehealth technologies introduced at the start of this document. These sections will also summarize available information about approaches to implementing each telehealth technology and offer implementation considerations. Organizations interested in implementing telehealth programs can use these overviews to consider what technologies fit best with their infrastructure and staff capacities.

These technology overviews are based on a review and synthesis of literature on telehealth. **The literature reviewed focused on a variety of programs using telehealth technologies to promote healthy living and prevent or manage chronic disease**. A small proportion of the literature focused on type 2 diabetes prevention or diabetes management programs. None of the articles reviewed focused specifically on DSMES services. However, the information drawn from the synthesis provides **important considerations and lessons learned regardless of the specific type of program implemented**. More information about the methods and approach of this review and synthesis can be found in Appendix A.

# Technology: Text message

## OVERVIEW

**Text message-based telehealth programs, accessible by mobile phone, are often:**

- **Automatically scheduled**.
- **Tailored**.
- Sometimes **interactive**, asking for specific responses.

## ORGANIZATIONAL NEEDS FOR IMPLEMENTATION

**Infrastructure needs**

- **Mobile phone(s)** capable of sending and receiving text messages
- **Text message database** to store messages that can be sent to participants

**Staff needs**

- **Trained program staff** to send tailored messages
- **Programmers** to create and run a text message database

## PARTICIPANT NEEDS FOR IMPLEMENTATION

- **Mobile phone** capable of sending and receiving text messages
- **Data plan** to support sending and receiving text messages

## IMPLEMENTATION CONSIDERATIONS

- Text-based programs are attractive because mobile phones are **low cost and widely available**, making these types of programs **readily scalable**.
- Text messaging may be an especially effective method for **enhancing participant enrollment**. In one study, 100 percent of participants who initiated enrollment in a program via text message completed the two-step enrollment process, compared to 5.5 percent of those that enrolled via the website.[25]
- Text-based programs may **increase self-efficacy for behavior change by providing performance feedback, encouragement, and praise**.
- Text-based programs that include **interactions with remote nurses or other trained coaches** can contribute to a **sense of increased social support**.
- Text-based programs can encounter challenges with **high attrition and low participation**, paired with **limited understanding of participants' motivations** for program enrollment. Consider **methods to keep participants engaged**, including the addition of new components and new content.

*See Appendix B for a list of all studies of text message-based telehealth programs.*

*See Appendix C for more details about study designs, target populations, and types of outcomes for text message-based programs.*

# Technology: Smartphone Apps

## OVERVIEW

**Smartphone app-based telehealth programs use smartphone apps for:**

- **Self-monitoring** (with weight, nutrition, and physical activity trackers).
- **Education on lifestyle topics, such as nutrition and physical activity.** This can include **interactive features** such as video clips, reminders, games, and quizzes.

## ORGANIZATIONAL NEEDS FOR IMPLEMENTATION

**Infrastructure needs**

- **Smartphone application development** (if app does not already exist)
- **Capability to communicate in real-time or asynchronously**
- **Capability to tailor program content** and to tailor the timing and frequency of communication with participants
- **Wireless capability** of smartphone app to send data to a website or database, allowing opportunities for tailored feedback to the participant

**Staff needs**

- **Staff trained to support program delivery** via the mobile app (e.g., a lifestyle coach for the National DPP LCP)
- **Staff trained to provide technical support** to participants for use of the mobile app
- **Personnel with expertise to develop the mobile app**, if creating a new app

## PARTICIPANT NEEDS FOR IMPLEMENTATION

- **Access to a smartphone**, for each participant, with the ability to download the relevant application
- **A wearable device** (e.g., pedometer, armband, personal digital assistant), if using these to track physical activity or other activity
- **Data plan** to support app use

## IMPLEMENTATION CONSIDERATIONS

- **Smartphone app-based programs that can be implemented using an existing app** will have fewer infrastructure and staff demands than a custom app.
- Smartphone app-based programs that include **interactions with remote nurses or other trained coaches** may contribute to a **sense of increased social support**.
- **Smartphone apps are not always compatible with all types of smartphones.** For example, some apps might work only with a subset of common brands of smartphones, while others can work with multiple types and brands of smartphones. Consider how compatibility limitations may affect reach of your target population.
- Consider **methods to keep participants engaged** to avoid high attrition and low participation rates reported for some programs. The addition of new components and new content may help increase engagement of participants.
- **Smartphone app-based programs may not work well with all target audiences.** For example, some older participants may feel limited in their ability to use specific mobile phone technologies for telehealth programs. They may also express concerns about feelings of intrusiveness of smartphone app-based programs. Limited comfort or insufficient internet access may lead participants to more slowly log their data, which can affect a program's ability to develop tailored messaging.

*See Appendix B for a list of all studies of smartphone app-based telehealth programs.*

*See Appendix C for more details about study designs, target populations, and types of outcomes for smartphone app-based programs.*

# Technology: Website

## OVERVIEW

**Website-based telehealth programs include:**

- **Video or multimedia lessons** with a variety of curricula.
- **Online goal-setting and tracking tools** (such as for nutrition, physical activity, and weight tracking) with **visual summaries** provided to participants.
- **Social support and interactive features**, such as online forums and moderated chats, blogs, online chatting, social media platforms, and additional options to interact with a virtual lifestyle coach.
- **Virtual libraries** with access to menu and recipe ideas, informational articles, and tips.

## ORGANIZATIONAL NEEDS FOR IMPLEMENTATION

**Infrastructure needs**

- **Educational materials** and other resources provided on the website
- **Servers to host the website** or a website service used to create the website
- **Capability for the website to be linked to wearable devices** (e.g., a pedometer that shows step counts on the website)—for those programs with this need
- **Forum/message board capability**

**Staff needs**

- **Programmers** to develop and maintain the website
- **Staff trained to support program delivery** by providing program content for the website or moderating online forums and community groups

## PARTICIPANT NEEDS FOR IMPLEMENTATION

- **Internet access** for each participant (personal computer or smartphone)
- **Secure access to the website** or online social network
- **Self-monitoring tools** (e.g., online diary, scale, and pedometer)

## IMPLEMENTATION CONSIDERATIONS

- **Website-based programs can be efficient**, with automated features and minimal staff requirements, allowing organizations to deliver programs to large audiences at a relatively low cost.
- Website-based programs **delivering the National DPP LCP have used theoretical frameworks to adapt the *Prevent Type 2 Diabetes* (*PreventT2*) curriculum to website-based delivery**.
- **Website-based programs with online communities** may be important for their potential for social support among users. Online communities should be moderated to identify posts or comments that may decrease motivation.
- **Website-based programs should keep websites user-friendly and not too text-dense**. Dense content can make information difficult to digest. Work with skilled developers to make a user-friendly website or use simple templates.
- **Website-based programs should consider methods to engage participants and create a sense of accountability**. Examples include dynamic and interactive websites and media components, such as quizzes, a user forum, and notifications for content updates.
- **Website-based programs may not work well for all target audiences**, especially those with limited internet access.

*See Appendix B for a list of all studies of website-based telehealth programs.*

*See Appendix C for more details about study designs, target populations, and types of outcomes for website-based programs.*

# Technology: Phone

## OVERVIEW

**Phone-based telehealth programs primarily:**

- Use **15- to 30-minute phone calls**, usually delivered by trained coaches, health professionals, or educators.
- Focus on **one-on-one tailored calls** between an instructor and a participant to develop an action plan, reinforce healthy behavior concepts, set goals, problem-solve challenges, and promote accountability.

## ORGANIZATIONAL NEEDS FOR IMPLEMENTATION

**Infrastructure needs**

- **Automated interactive voice response** (IVR) system that provides tailored responses to participants from a database of thousands of response options (optional: This can reduce or eliminate the need for trained staff to make calls to participants.)
- **Conference or group call capability** (for programs with group-based formats)

**Staff needs**

- **Trained clinical or program staff** to provide phone counseling.
- **Motivational interviewing training or experience**

## PARTICIPANT NEEDS FOR IMPLEMENTATION

- **Phone access** for each participant (landline or mobile)

## IMPLEMENTATION CONSIDERATIONS

- Phone-based programs are attractive because phones are **low cost and widely available**, making these programs **scalable**.
- Phone-based programs may work well **for those with limited health literacy, disabilities, or transportation or time barriers**.
- Phone-based programs **often start with one in-person meeting** to kick off the relationship between the instructor and participants before moving to phone-only communication.
- Some phone-based programs **use automated messaging systems that deliver five-minute educational modules** followed by Q&A or brief calls to promote participant adherence and provide participants with feedback on their progress. When combined with time with an instructor, these approaches may reduce provider time costs.
- **Phone-based program adaptations include development of scripts** to deliver the curriculum and to prompt discussion and inclusion of health professionals or health educators in calls.
- **Determine how to address potential scheduling conflicts**, especially for group calls. If too many scheduling conflicts emerge, delayed communication with participants could lead to reduced participation.
- Phone-based programs can experience high attrition and low participation rates. Thus, consider **methods to keep participants engaged**. For example, if the frequency of sessions decreases over the course of the program, this could affect group cohesion and commitment. The addition of new components and new content may help increase engagement of participants.
- **Phone-based programs may require a greater amount of trained clinical or program staff time** than other technologies. In two interventions using multiple technologies,[26, 27] phone calls had the highest staff time cost.

*See Appendix B for a list of all studies of phone-based telehealth programs.*

*See Appendix C for more details about study designs, target populations, and types of outcomes for phone-based programs.*

# Technology: Video

## OVERVIEW

**Video-based telehealth programs:**

- **Use various telehealth video conferencing platforms** and software.
- **Are delivered by trained staff** ranging from lifestyle coaches to health care providers including pharmacists, nurses, dietitians, physicians, and diabetes educators.
- **Are primarily offered via live video sessions** (as opposed to recorded video).
- **Primarily offer education sessions with a pre-set curriculum** related to lifestyle change.

## ORGANIZATIONAL NEEDS FOR IMPLEMENTATION

**Infrastructure needs**

- **Facility and space with technology** to develop a video-based telehealth program
- **Pre-recorded video content** created by trained program or clinical staff (if using a pre-recorded video format)

**Staff needs**

- **Clinical or non-clinical staff,** depending on requirements (examples include diabetes educator, dietitian, and exercise physiologist) to serve as lifestyle coach and deliver the program via live or pre-recorded video sessions
- **Site coordinator or technician** to control equipment, connect with the provider, and help participants when needed (This role can also be filled by clinical staff with appropriate training.)

## PARTICIPANT NEEDS FOR IMPLEMENTATION

- **Participant access to a DVD player (for recorded video) or internet (for live video)**.
- **Self-monitoring tools for each participant** to monitor physical activity, diet, and weight (e.g., pedometer, paper log book, scale).

## IMPLEMENTATION CONSIDERATIONS

- **Video-based programs may be less expensive than on-site programs**. Two studies[28,29] that involved video interventions, specifically video conferencing, found that per-participant cost was lower for video conference compared to on-site participation.
- **Video-based programs that can be viewed on television sets in the home** may make it easier for participants to integrate a program into their daily routines, especially for those with limited computer or internet access. One program developed a 16-episode video series mirroring the initial four- to six-month "core" phase of the National DPP LCP. Episodes followed an entertainment (reality TV) format and focused on the experiences of six men and women with prediabetes.[30]
- **Organizations offering video-based programs with a remote coach and participants gathering in one place** should plan ahead to address logistics of room arrangements and space for exercise. Some programs, especially in rural and frontier areas, had difficulty finding appropriate exercise options and spaces for classes.
- **Video-based programs may require a greater amount of trained clinical/program staff time** than other technologies.

*See Appendix B for a list of all studies of video-based telehealth programs.*

*See Appendix C for more details about study designs, target populations, and types of outcomes for video-based programs.*

# Technology: Virtual

## OVERVIEW

**Virtual-based telehealth programs:**

- Primarily use **Intelligent Tutoring System**, a web-based system using AI techniques to mimic one-on-one human tutoring (i.e., virtual coach avatar).
- Sometimes have the **capability of providing participants with a different sex or ethnicity for their avatars.**

## ORGANIZATIONAL NEEDS FOR IMPLEMENTATION

**Infrastructure needs**

- **Web-based virtual reality program**
- **Capability to integrate wearable device data** (e.g., step count) with the virtual reality program

**Staff needs**

- **Developers** who can work with and implement the technology

## PARTICIPANT NEEDS FOR IMPLEMENTATION

- **Access to a computer and internet** (If software must be installed, a personal computer is required.)
- **Software for the virtual reality program** installed on the participant's computer (if needed)
- **Self-monitoring tools** for each participant, such as a device to measure physical activity (e.g., pedometer) and weight

## IMPLEMENTATION CONSIDERATIONS

- **Virtual-based programs with opportunities for personalized feedback** (e.g., use of AI to tailor messaging based on participant profile) **and avatars with diverse characteristics** (e.g., female or male, different ethnicities) may facilitate connections with participants.
- **Virtual-based programs reduce the need for trained coaches to deliver the program** but increase the need for developers who can work with and implement the technology.
- **Virtual-based programs may not work well for all target populations.** Some participants experience challenges working with the virtual coach or avatar.
- Virtual-based programs may not create a uniform and realistic experience for participants. It is important to **make many realistic response options available in conversation and to realistically model the appearance of foods, for instance, within these programs.**
- **Because virtual-based programs only emulate human interactions, the lack of real personal contact** may lead to greater attrition or reduced engagement. Organizations might consider combining virtual-based programs with more personalized contact.

*See Appendix B for a list of all studies of virtual-based telehealth programs.*

*See Appendix C for more details about study designs, target populations, and types of outcomes for virtual-based programs.*

# Technology: Multiple Technologies

## OVERVIEW

**Multiple technology-based telehealth programs:**

- **Use two or more technologies to deliver their program**.
- Primarily involve **phone calls**, mostly for counseling purposes, **in combination with websites**. Some programs used educational videos in combination with phone calls or automated interactive voice response telephone calls.

## ORGANIZATIONAL NEEDS FOR IMPLEMENTATION

**Infrastructure needs**

- See needs related to each of the independent technologies.

**Staff needs**

- See needs related to each of the independent technologies.

## PARTICIPANT NEEDS FOR IMPLEMENTATION

- See needs related to each of the independent technologies.

## IMPLEMENTATION CONSIDERATIONS

- For multiple technology-based programs, **using older technologies (e.g., phone calls) in combination with newer ones (wearable devices)** may help to increase the **scalability** of the intervention.
- For multiple technology-based programs, **consider how using multiple technologies** might complicate or simplify various aspects of the program, from both the coach's and the participants' perspectives.

*See Appendix B for a list of all studies of multiple technology-based telehealth programs.*

*See Appendix C for more details about study designs, target populations, and types of outcomes for multiple technology-based programs.*

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**29.** Vadheim, L. M., Patch, K., Brokaw, S. M., Carpenedo, D., Butcher, M. K., Helgerson, S. D., & Harwell, T. S. (2017). Telehealth delivery of the diabetes prevention program to rural communities. *Translational Behavioral Medicine*, *7*(2), 286–291.

**30.** Ackermann, R. T., Sandy, L. G., Beauregard, T., Coblitz, M., Norton, K. L., & Vojta, D. (2014). A randomized comparative effectiveness trial of using cable television to deliver diabetes prevention programming. *Obesity (Silver Spring)*, *22*(7), 1601–1607.

# APPENDIX A: TELEHEALTH REVIEW AND SYNTHESIS METHODS

## *Background*

The Division of Diabetes Translation (DDT), which sits within National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP) at CDC, worked with a contractor, Deloitte, to identify literature related to the use of telehealth technologies to implement diabetes management and type 2 diabetes prevention programs in the United States. Deloitte identified literature through two main strategies: a machine learning analysis to identify peer-reviewed literature and an environmental scan (e-scan) to assess the state of the art of telehealth-relevant programs and services.

## *Methods*

A second contractor, ICF, developed research questions for a synthesis of the literature, focused on adapting telehealth technologies to different users, what types of logistical needs organizations should consider when implementing telehealth technologies, challenges and barriers that organizations have encountered in adopting telehealth technologies, approaches for successful implementation of telehealth technologies, and types of outcomes or purposes of using telehealth technologies in the delivery of programs and services.

The synthesis aimed to answer the research questions by: (1) conducting triage of the peer-reviewed publications identified by Deloitte, (2) abstracting relevant information from the peer-reviewed publications and the e-scan findings, and (3) summarizing key findings from the two sources of information.

## *Key Findings*

ICF identified 77 articles eligible for full abstraction out of the 127 identified through the machine learning landscape analysis by Deloitte. The selected papers examined diabetes management and type 2 diabetes prevention programs as well as interventions that addressed related risk factors if they utilized telehealth technologies as a primary delivery mode. A total of 22 of the 72 original research studies examined interventions that specifically used telehealth technologies to deliver diabetes management or type 2 diabetes prevention programs. The remaining 50 of the 72 original research studies primarily examined weight loss interventions of a very similar nature compared to those focused on type 2 diabetes (i.e., despite having different primary outcomes, most addressed telehealth technologies to change health-related behaviors such as diet and physical activity). Five papers were reviews.

The identified literature examined the use of the following telehealth modalities: text messaging (n=4), mobile/interactive smartphone apps (n=6), websites/forums (n=17), video/multimedia (n=5), phone calls (n=25), virtual reality (n=3), and multiple technologies (n=17).

# APPENDIX B: RESOURCES (ORGANIZED BY TECHNOLOGY)

## *Text Message*

Buis, L. R., Hirzel, L., Turske, S. A., Des Jardins, T. R., Yarandi, H., & Bondurant P. (2013). Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part I): Assessment of participant reach and adoption. *Journal of Medical Internet Research*, *15*(12). doi:10.2196/jmir.2928

Buis, L. R., Hirzel, L., Turske, S. A., Des Jardins, T. R., Yarandi, H., & Bondurant P. (2013). Use of a text message program to raise type 2 diabetes risk awareness and promote health behavior change (part II): Assessment of participants' perceptions on efficacy. *Journal of Medical Internet Research*, *15*(12). doi:10.2196/jmir.2929

Khurshid, A., Brown, L., Mukherjee, S., Abebe, N., & Kulick, D. (2015). Texting for health: An evaluation of a population approach to type 2 diabetes risk reduction with a personalized message. *Diabetes Spectrum*, *28*(4), 268–275.

Norman, G., Kolodziejczyk, J., Adams, M., Patrick, K., & Marshall, S. (2013). Fruit and vegetable intake and eating behaviors mediate the effect of a randomized text-message based weight loss program. *Preventive Medicine*, *56*(1), 3–7.

## *Smartphone App*

Chang, T., Chopra, V., Zhang, C., & Woolford, S. J. (2013). The role of social media in online weight management: Systematic review. *Journal of Medical Internet Research*, *15*(11). doi:10.2196/jmir.2852

Fukuoka, Y., Gay, C., Joiner, K., & Vittinghoff, E. (2015). A novel diabetes prevention intervention using a mobile app. *American Journal of Preventive Medicine*, *49*(2), 223–237.

Fukuoka, Y., Kamitani, E., Bonnet, K., & Lindgren, T. (2011). Real-time social support through a mobile virtual community to improve healthy behavior in overweight and sedentary adults: A focus group analysis. *Journal of Medical Internet Research, 13*(3). doi:10.2196/jmir.1770

Svetkey, L. P., Batch, B. C., Lin, P. H., Intille, S. S., Corsino, L., Tyson, C. C., . . . Bennett, G. G. (2015). Cell phone intervention for you (CITY): A randomized, controlled trial of behavioral weight loss intervention for young adults using mobile technology. *Obesity (Silver Spring)*, *23*(11), 2133–2141.

Vangeepuram, N., Mayer, V., Fei, K., Hanlen-Rosado, E., Andrade, C, Wright, S., & Horowitz, C. (2018). Smartphone ownership and perspectives on health apps among a vulnerable population in East Harlem, New York. *mHealth*, *4*. doi:10.21037%2Fmhealth.2018.07.02

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## *Website*

Ackermann, R. T., Sandy, L. G., Beauregard, T., Coblitz, M., Norton, K. L., & Vojta, D. (2014). A randomized comparative effectiveness trial of using cable television to deliver diabetes prevention programming. *Obesity (Silver Spring)*, *22*(7), 1601–1607.

Demment, M.M., Graham, M.L., & Olson, C.M. (2014). How an online intervention to prevent excessive gestational weight gain is used and by whom: A randomized controlled process evaluation. *Journal of Medical Internet Research, 16*(8). doi:10.2196/jmir.3483

Gow, R. W., Trace, S. E., & Mazzeo, S. E. (2009). Preventing weight gain in first year college students: An online intervention to prevent the "freshman fifteen." *Eating Behaviors*, *11*(1), 33–39.

Greene, G. W., White, A. A., Hoerr, S. L., Lohse, B., Schembre, S. M., Riebe, D., . . . Phillips, B. W. (2012). Impact of an online healthful eating and physical activity program for college students. *American Journal of Health Promotion*, *27*(2), e47–e58. doi:10.4278/ajhp.110606-QUAN-239

Harvey-Berino, J., Pope, L., Gold, B. C., Leonard, H., & Belliveau, C. (2012). Undergrad and overweight: An online behavioral weight management program for college students. *Journal of Nutrition Education and Behavior*, *44*(6), 604–608.

Lyden, J. R., Zickmund, S. L., Bhargava, T. D., Bryce C. L., Conroy, M. B., Fischer, G. S., . . . McTigue, K. M. (2013). Implementing health information technology in a patient-centered manner: Patient experiences with an online evidence-based lifestyle intervention. *Journal for Healthcare Quality*, *35*, 47–57.

Maon, S., Edirippulige, S., Ware, R., & Batch, J. (2012). The use of web-based interventions to prevent excessive weight gain. *Journal of Telemedicine and Telecare*, *18*(1), 37–41.

Mateo, K. F., & Jay, M. Access to a behavioral weight loss website with or without group sessions increased weight loss in statewide campaign. *Journal of Clinical Outcomes Management*, *21*(8), 345–349.

McIlhenny, C. V., Guzic, B. L., Knee, D. R., Wendekier, C. M., Demuth, B. R., & Roberts, J. B. (2011). Using technology to deliver healthcare education to rural patients. *Rural and Remote Health*, *11*(4), 1–11.

Nahm, E. S., Warren, J., Friedmann, E., Brown, J., Rouse, D., Park, K.P., & Quigley, K. W. (2014). Implementation of a participant-centered weight management program for older nurses: A feasibility study. *Online Journal of Issues in Nursing, 19*(3). doi:10.3912/OJIN.Vol19No03Man04

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Pappa, G. L., Cunha, T. O., Bicalho, P. V., Ribeiro, A., Silva, A. P. C., Meira Jr, W., & Beleigoli, A. M. R. (2017). Factors associated with weight change in online weight management communities: A case study in the LoseIt Reddit community. *Journal of Medical Internet Research*, *19*(1). doi:10.2196/jmir.5816

Poncela-Casasnovas, J., Spring, B., McClary, D., Moller, A. C., Mukogo, R., Pellegrini, C. A., . . . Nunes Amaral, L. A. (2015). Social embeddedness in an online weight management programme is linked to greater weight loss. *Journal of The Royal Society Interface*, *12*(104). doi:10.1098/rsif.2014.0686

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Sepah, S.C., Jiang, L., & Peters, A.L. (2015). Long-term outcomes of a web-based diabetes prevention program: 2-year results of a single-arm longitudinal study. *Journal of Medical Internet Research, 17*(4). doi:10.2196/jmir.4052

Smith, K., Lanningham-Foster, L., Welch, A., & Campbell, C. (2016). Web-based behavioral intervention increases maternal exercise but does not prevent excessive gestational weight gain in previously sedentary women. *Journal of Physical Activity & Health, 13*(6), 587–93.

Stewart, T., Han, H., Allen, H. R., Bathalon, G., Ryan, D. H., Newton Jr, R. L., & Williamson, D. A. (2011). HEALTH: Efficacy of an internet/population-based behavioral weight management program for the US Army. *Journal of Diabetes Science and Technology*, *5*(1), 178–187.

Thomas, J. G., Raynor, H. A., Bond, D. S., Luke, A. K., Cardoso, C. C., Wojtanowski, A. C., . . . Foster, G. D. (2017). Weight loss and frequency of body-weight self-monitoring in an online commercial weight management program with and without a cellular-connected 'smart'scale: A randomized pilot study. *Obesity Science & Practice*, *3*(4), 365–372.

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Allicock, M., Haynes-Maslow, L., Carr, C., Orr, M., Kahwati, L. C., Weiner, B. J., & Kinsinger, L. (2013). Training veterans to provide peer support in a weight-management program: MOVE! *Preventing Chronic Disease*, *10*. doi:10.5888/pcd10.130084

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Morey, M. C., Pieper, C. F., Edelman, D. E., Yancy Jr, W. S., Green, J. B., Lum, H., . . . Huffman, K. M. (2012). Enhanced fitness: A randomized controlled trial of the effects of home-based physical activity counseling on glycemic control in older adults with prediabetes mellitus. *Journal of the American Geriatrics Society*, *60*(9), 1655–1662.

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Tang, T. S., Nwankwo, R., Whiten, Y., & Oney, C. (2014). Outcomes of a church-based diabetes prevention program delivered by peers: A feasibility study. *The Diabetes Educator*, *40*(2), 223–230.

Terry, P. E., Seaverson, E. L., Grossmeier, J., & Anderson, D. R. (2011). Effectiveness of a worksite telephone-based weight management program. *American Journal of Health Promotion*, *25*(3), 186–189.

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## *Video*

Ahrendt, A. D., Kattelmann, K. K., Rector, T. S., & Maddox, D. A. (2014). The effectiveness of telemedicine for weight management in the MOVE! Program. *The Journal of Rural Health*, *30*(1), 113–119.

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Vadheim, L. M., Patch, K., Brokaw, S. M., Carpenedo, D., Butcher, M. K., Helgerson, S. D., & Harwell, T. S. (2017). Telehealth delivery of the diabetes prevention program to rural communities. *Translational Behavioral Medicine, 7*(2), 286–291.

## *Virtual*

Brust-Renck, P. G., Reyna, V. F., Wilhelms, E. A., Wolfe, C. R., Widmer, C. L., Cedillos-Whynott, E. M., & Morant, A. K. (2017). Active engagement in a web-based tutorial to prevent obesity grounded in Fuzzy-Trace Theory predicts higher knowledge and gist comprehension. *Behavior Research Methods*, *49*(4), 1386–1398.

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## *Multiple Technologies*

Block, G., Azar, K. M., Romanelli, R. J., Block, T. J., Hopkins, D., Carpenter, H. A., . . . Block, C. H. (2015). Diabetes prevention and weight loss with a fully automated behavioral intervention by email, web, and mobile phone: A randomized controlled trial among persons with prediabetes. *Journal of Medical Internet Research*, *17*(10). doi:10.2196/jmir.4897

Chang, M. W., Brown, R., & Nitzke, S. (2017). Results and lessons learned from a prevention of weight gain program for low-income overweight and obese young mothers: Mothers in Motion. *BMC Public Health*, *17*(1), 182. doi:10.1186/s12889-017-4109-y

Gerber, B. S., Schiffer, L., Brown, A. A., Berbaum, M. L., Rimmer, J. H., Braunschweig, C. L., & Fitzgibbon, M. L. (2013). Video telehealth for weight maintenance of African-American women. *Journal of Telemedicine and Telecare*, *19*(5), 266–272.

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Seidel, R. W., Pardo, K. A., Estabrooks, P. A., Wall, S., Davy, B., & Almeida, F. S. (2014). Beginning a patient-centered approach in the design of a diabetes prevention program. *International Journal of Environmental Research and Public Health*, *11*(2), 2003–2013.

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Wolin, K. Y., Steinberg, D. M., Lane, I. B., Askew, S., Greaney, M. L., Colditz, G. A., & Bennett, G. G. (2015). Engagement with eHealth self-monitoring in a primary care-based weight management intervention. *PLoS One*, *10*(10). doi:10.1371/journal.pone.0140455

# APPENDIX C: TABLE WITH STUDY CHARACTERISTICS BY TELEHEALTH TECHNOLOGY

| Telehealth Technology | Study Design (NUM/DNM)[1] | Target Population (NUM/DNM) | Types of Health/ Behavior Outcomes | Types of Process/ Implementation Outcomes |
|---|---|---|---|---|
| **Text Messages (n=4)** | • Cross-sectional (1/4)<br>• Pre-post design (1/4)<br>• Retrospective (1/4)<br>• Randomized controlled trial (RCT) (1/4) | • Urban (4/4)<br>• Overweight/obesity (3/4)<br>• Minority (1/4)<br>• Diverse population (2/4)<br>• Predominantly female (2/4) | • Weight loss<br>• Behavior change (diet and physical activity)<br>• Behavioral (self-efficacy, health beliefs) | • Reach/enrollment<br>• Program completion<br>• Utilization: frequency and length of participation, attendance, adherence<br>• Program perception and satisfaction<br>• Slogan awareness |
| **Mobile Health/Apps (n=5)** | • Qualitative (1/4)<br>• Cross-sectional (1/4)<br>• RCT (2/4) | • Urban (4/4)<br>• Overweight/obesity (3/4)<br>• Young adults (1/4)<br>• Diverse population (1/4)<br>• Predominantly minority (1/4) | • Weight loss<br>• Behavior change (diet and physical activity)<br>• Clinical outcomes (e.g., glycemic control, lipid profile, blood pressure) | • Motivators and barriers for engagement in a mobile health program<br>• Access and interest in a mobile health program (formative reasearch) |
| **Website (n=18)** | • Qualitative (1/17)<br>• Cross-sectional (2/17)<br>• Pre-post design (5/17)<br>• Non-randomized trial (1/17)<br>• RCT (8/17) | • Urban (6/17)<br>• Rural (1/17)<br>• Urban and rural (1/17)<br>• Overweight/obesity (7/17)<br>• Inactive (1/17)<br>• Prediabetes/diabetes (2/17)<br>• College students (3/17)<br>• Military (2/17)<br>• Nurses (1/17)<br>• Pregnant (2/17)<br>• Female/predominantly female (7/17)<br>• Predominantly male (7/17) | • Weight loss<br>• Behavior change (diet and physical activity)<br>• Stress and health-related quality of life<br>• Knowledge<br>• Clinical outcomes (e.g., glycemic control, blood pressure) | • Reach/enrollment<br>• Program completion/engagement<br>• Web utilization: frequency and length of participation (e.g., # posts/comments, # log-ins, frequency of weight/behavior tracking); characteristics of web use (e.g., purpose, topics/resources of main interest/participation, use by population group)<br>• Web perception (e.g., expectations, usefulness, accessibility, ease of use/navigation, clarity, and satisfaction)<br>• Fidelity of implementation |

[1] NUM = numerator, DNM = denominator

| Telehealth Technology | Study Design (NUM/DNM)[1] | Target Population (NUM/DNM) | Types of Health/ Behavior Outcomes | Types of Process/ Implementation Outcomes |
|---|---|---|---|---|
| **Phone (n=25)** | • Case study (1/25)<br>• Cohort (1/25)<br>• Pre-post design (4/25)<br>• Non-randomized trial (2/25)<br>• RCT (17/25) | • Urban (7/25)<br>• Rural (2/25)<br>• Urban and rural (3/25)<br>• Overweight/obesity (18/25)<br>• Prediabetes/diabetes (3/25)<br>• Comorbidities/disability (3/25)<br>• Minority (5/25)<br>• Veterans (6/25)<br>• Pregnant (2/25)<br>• Young or older adults (2/25)<br>• Female/predominantly female (11/25)<br>• Predominantly male (4/25) | • Weight loss<br>• Behavior change (diet and physical activity)<br>• Behavioral (skills, self-confidence)<br>• Diabetes self-care<br>• Knowledge<br>• Clinical outcomes (e.g., glycemic control, blood pressure, depression, physical function, self-reported health status, diabetes/prediabetes status, change in the Framingham Risk Score) | • Enrollment, adherence, completion, cost, time (e.g., # call attempts, # calls completed, duration of calls)<br>• Program feasibility, acceptability, program satisfaction |
| **Video (n=5)** | • Pre-post design (2/5)<br>• Retrospective (1/5)<br>• Non-randomized trial (1/5)<br>• RCT (1/4) | • Rural/predominantly rural (4/5)<br>• Overweight/obesity(3/5)<br>• Type 2 diabetes/chronic condition (3/5)<br>• Veterans (2/5)<br>• Medically underserved (1/5)<br>• Predominantly female (2/5)<br>• Predominantly male (1/5) | • Weight loss<br>• Behavior change (diet and physical activity)<br>• Behavioral (goal achievement)<br>• Clinical outcomes (e.g., glycemic control, blood pressure, lipid profile) | • Enrollment, attendance/participation, adherence, completion, cost<br>• Program satisfaction |
| **Virtual (n=3)** | • Non-randomized trial (1/3)<br>• RCT (2/3) | • Urban (1/3)<br>• Overweight/obesity (1/3)<br>• Inactive (1/3)<br>• College students (1/3)<br>• Female (2/3) | • Weight loss<br>• Behavior change (diet and physical activity)<br>• Behavioral (skill level, confidence, commitment for behavior change, behavioral intentions, barriers)<br>• Knowledge | • Program feasibility, acceptability, program satisfaction/perception, difficulties |
| **Multiple Technologies (n=14)** | • Cohort (1/14)<br>• Non-randomized trial (1/14)<br>• RCT (12/14) | • Urban (6/14)<br>• Overweight/obesity (11/14)<br>• Minority (1/14)<br>• Diabetes/at risk (1/14)<br>• Female/predominantly female (7/14)<br>• Predominantly male (1/14) | • Weight loss<br>• Behavior change (diet and physical activity)<br>• Behavioral (self-efficacy, social support)<br>• Cardiorespiratory fitness<br>• Clinical outcomes (e.g., glycemic control, blood pressure)<br>• Physical function, health-related quality of life | • Enrollment, attendance/participation, adherence<br>• Use of telehealth technology: frequency of use<br>• Satisfaction with technology features (e.g., virtual coach)<br>• Cost/cost effectiveness |