Digital health tools to promote diabetes education and management of cardiovascular risk factors among under-resourced populations

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Tenes Paul, DO,* Jordy Mehawej, MD, ScM,* Athena Philis-Tsimikas, MD[†]

*From the *Department of Medicine, University of Massachusetts Medical School, Worcester, Massachusetts, and [†]Scripps Whittier Diabetes Institute, San Diego, California.*

Type 2 diabetes mellitus is a growing cause of significant morbidity and mortality in the United States and worldwide.[1] Among developed nations, the United States currently has the highest prevalence (11%) of type 2 diabetes. The Centers for Disease Control and Prevention estimates that by 2050 approximately 1 in 3 Americans will have type 2 diabetes. Moreover, this condition disproportionately affects ethnic minorities and individuals from low socioeconomic backgrounds, with Hispanic individuals experiencing both higher incidence of type 2 diabetes and poorer glycemic control than their white counterparts.[2] Diabetes is a major risk factor for the development of cardiovascular disease, the leading cause of death in the United States,[3] further highlighting the need for improved diabetes management, particularly among individuals from ethnic minorities or low socioeconomic status.

The content and implementation of any intervention aimed at improving diabetes management in these communities must be carefully orchestrated to ensure efficacy and the advancement of health equity. As such, culturally tailored, in-person education programs have been shown to improve outcomes in diabetes and cardiometabolic care among under-resourced populations.[4] These programs help patients overcome cultural barriers to care that may impede adherence to treatment plans, help fill in potential gaps in their knowledge, and empower patients to play a more active role in their health, thus improving their health outcomes.[4] Unfortunately, there are major limitations to these in-person programs: cost; logistical concerns, including transportation availability and difficulties in scheduling; and cultural or systemic barriers such as negative feelings toward the healthcare system and the perception that these programs are not crucial for their health.[5,6] These limitations, especially in the context of growing access to technology in the United States, yield an opportunity for the use of digital technology to increase accessibility and bring patient education programs to the populations most in need.

Project Dulce was launched in 1997 as a collaboration between San Diego State University, community clinics, and the county's public health department to deliver diabetes care and education to under-resourced and underserved populations throughout Southern California (Figure 1). The project relied on a team-based approach with a nurse-led clinical team and nonprofessional peers trained to deliver culturally tailored classes in diabetes education. The peer education program was American Diabetes Association certified, included 8 2-hour sessions with a curriculum suitable for broad literacy levels, and was adapted for different ethnic groups and cultures. *Project Dulce* recruited 153 participants with type 1 and type 2 diabetes over 2 years, 72% of whom identified as Hispanic. The cohort also included African American, Vietnamese American, and Filipino American individuals. The study group was 69% female with an average age of 51 years. Approximately two-thirds of participants had an annual income less than $10,000, and one-half had an eighth-grade education or less. The results of this program on diabetes care were impressive, demonstrating a 30% reduction in serum levels of HbA1c, 7% decrease in LDL-cholesterol levels, subjective improvement in diabetes knowledge, positive treatment satisfaction, and a shift toward a stronger internal locus of control when compared to a control group receiving usual care.[4]

Though in-person, culturally tailored diabetes self-management education could empower patients and provide improved outcomes, requiring physical study visits was a barrier to accessibility.[7] Digital solutions can help circumvent these issues. To promote use among older and low-income individuals and remain cognizant of the "digital divide," the *Dulce Digital* project was developed to use a low-cost short messaging service (SMS) program that did not require a smart phone to provide educational and motivational text messages, medication reminders, and blood glucose monitoring reminders.[5] The messages were offered in either English or Spanish, with the majority choosing Spanish-language texts. The project also included a blood glucose monitoring protocol, which requested patients track

Address reprint requests and correspondence: Dr Tenes Paul, 55 Lake Ave North, Worcester, MA 01655. E-mail address: tenes.paul@umassmed.edu.
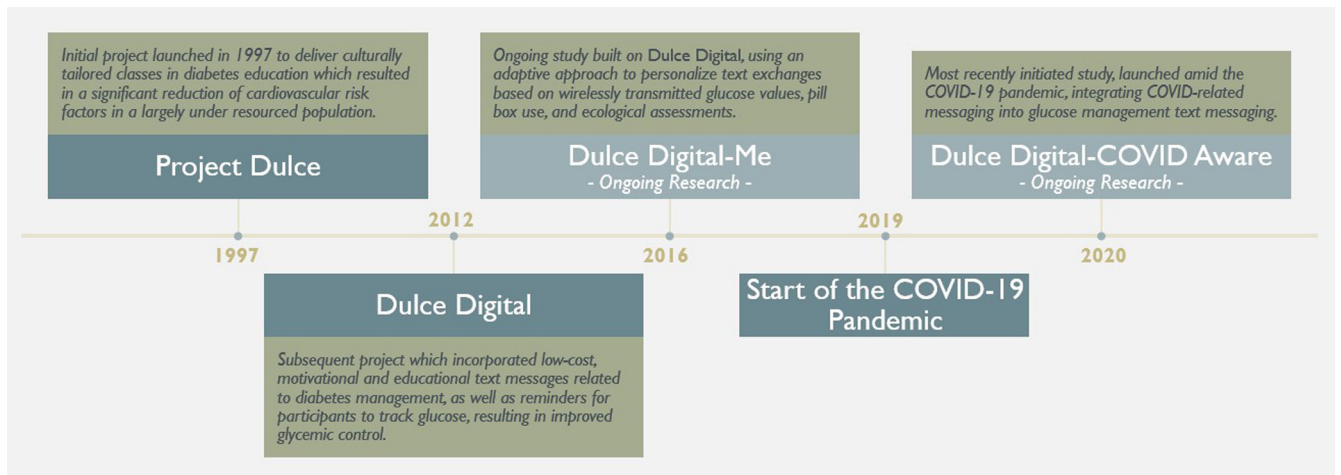
Figure 1   Timeline of Project Dulce's prior and ongoing studies.[4,5,7]

their blood glucose values via texts to the study team, with markedly elevated values, low values, or no values prompting a call from research coordinators, who would encourage a follow-up with the individual's primary care physician. Like the parent *Project Dulce* project, most *Dulce Digital* participants identified as Hispanic or Mexican, had less than a ninth-grade education, and had a combined monthly household income of less than $2,000. After 6 months, *Dulce Digital* achieved a statistically significant 1% reduction in serum HbA1c compared with the usual care group.[5] Notably, there was a general trend toward a greater reduction in HbA1c levels among participants who had higher levels of engagement with the program. Participants reported high satisfaction with the program, demonstrating that a simple and low-cost SMS-based diabetes management program is effective in improving glycemic control in patients with diabetes compared to usual care. However, post-study surveys suggested that participants would have preferred more tailored messaging for purposes of enhancing individualized content that better addressed their own needs and progress.[5] A subsequent study, *Dulce Digital-Me*, is underway and will evaluate an adaptive approach to personalize text exchanges with patients based on wirelessly transmitted glucose values, pill box use, and ecological momentary assessments of physical activity, diet, and stress.[8,9]

A recent extension of these projects was born of the dire need for addressing the major healthcare barriers that have arisen owing to the ongoing COVID-19 pandemic. The *Dulce Digital-COVID Aware* (DD-CA) trial was launched amid the pandemic with the aim of reducing these barriers in diverse, underserved Hispanic communities, improving glucose control, and lowering transmission of COVID-19 after hospital discharge. Critically, *DD-CA* integrated COVID educational messaging into the glucose management text messaging to offer information about testing, exposure, and resources to a community disproportionately affected by the pandemic.[10] The primary outcome will look at the rate of readmission over the subsequent 30 days and secondary outcomes will assess the rate of readmission over 180 days as well as changes in level of HbA1c. This ongoing effort further demonstrates the wide range of opportunities to apply digital health tools to address gaps in chronic care of patients with diabetes and address acute public health issues among highly vulnerable populations.

The studies and interventions under the umbrella of *Project Dulce* have demonstrated the potential for low-cost, digital translations of traditional, in-person, culturally tailored programs to increase accessibility to diabetes and cardiovascular education and improve meaningful outcomes for patients. Novel digital heath tools, such as continuous glucose monitors, insulin pumps that work synergistically with continuous glucose monitors to recommend insulin dosing and timing, and Bluetooth-connected insulin administration pens that show when and how much medication has been administered, are currently being incorporated into clinics that work with federally qualified health centers to complement the recent surge of telehealth visits required by the COVID-19 pandemic. These technologies allow more direct engagement between patients and their providers and place more knowledge and power into patients' hands.

The proliferation of technology provides a growing opportunity for digital solutions to enhance patient education and engagement, and ultimately leads to better prognoses, quality of life, and long-term outcomes. Tailoring these technologies in conjunction with culturally competent practices increases accessibility for our most vulnerable, historically under-resourced populations. Not only can this approach improve healthcare-related morbidity, but it can also help build a more inclusive digital community.

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N/A.

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