Innovative Diabetes Interventions in the U.S. Hispanic Population

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■ **IN BRIEF** In the United States, Hispanics have a 66% greater risk of developing type 2 diabetes and, once diagnosed, exhibit worse outcomes than non-Hispanic whites. It is therefore imperative to ensure that interventions meet the specific needs of this at-risk group. This article provides a selective review of the evidence on innovative, real-world approaches (both live and technology-based) to improving behavioral, psychosocial, and clinical outcomes in underserved Hispanics with type 2 diabetes. Key aspects of successful live interventions have included multimodal delivery, greater dosage/attendance, and at least some in-person delivery; effective technology-based approaches involved frequent but intermittent communication, bi-directional messaging, tailored feedback, multimodal delivery, and some human interaction. Across modalities, cultural tailoring also improved outcomes. Additional research is needed to address methodological limitations of studies to date and pinpoint the most efficacious components and optimal duration of interventions. Future efforts should also attend to variability within the U.S. Hispanic population to ensure acceptability and sustainability of interventions in this diverse group.

Diabetes affects 14% of the U.S. population (1), and this prevalence is projected to grow to 21% (a 50% increase) by 2040 (2). Type 2 diabetes comprises the vast majority (90–95%) of these cases (3). Within the United States, socioeconomically disadvantaged, racial/ethnic minority populations experience significant type 2 diabetes disparities. Hispanics/Latinos (hereafter referred to as Hispanics), representing the largest and second-fastest-growing minority group in the country (4), have a 66% higher risk of developing type 2 diabetes (5). The 2013–2016 National Health and Nutrition Examination Survey reported a 19.8% total diabetes prevalence among Hispanics compared to 12.4% in non-Hispanic whites (1). The Hispanic Community Health Study/ Study of Latinos, a prospective, multicenter, population-based cohort of 16,145 Hispanics, reported an overall diabetes prevalence of 16.9% (6). In addition to having a higher diabetes prevalence, Hispanics exhibit poorer self-management and outcomes once diagnosed compared to non-Hispanic whites (6–9). For example, only 48% of Hispanics with type 2 diabetes in the Hispanic Community Health Study/Study of Latinos had an A1C <7% (6).

The causes of Hispanic diabetes disparities are multifactorial and multilevel and span biological, environmental (e.g., built environments not conducive to exercise and limited access to healthy foods), and health care system factors (e.g., differential access and quality of medical care and high treatment costs) (10). Low socioeconomic status and health literacy (6,11), language barriers (12,13), patient-provider mismatch (14), as well as prominent cultural values

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(15,16), beliefs (e.g., fatalism) (14), and attitudes toward diabetes and treatments also serve as powerful influences on adherence and outcomes in Hispanics (17).

Diabetes self-management education and support (DSME/S) is considered a cornerstone of effective care that can lead to improved clinical, quality of life, and health care cost outcomes (18,19). Two meta-analyses that synthesized findings from 65 trials in the overall population found DSME/S to achieve average A1C reductions of 0.70% (20) and 0.76% (21). Despite the potential clinical and other benefits, DSME/S utilization is low; <5% of eligible individuals with diabetes access DSME/S (22). Access to (23) and participation in (24) DSME/S is particularly low among underserved populations, such as Hispanics, because of practical (e.g., work schedules, caregiving responsibilities, and lack of transportation) and health system barriers (25–28). Given the unique socio-cultural experiences and barriers encountered by U.S. Hispanics (16), it is imperative to ensure that diabetes programs meet the specific needs of this large and growing at-risk group.

This narrative review summarizes the current literature with respect to innovative, real-world approaches for improving diabetes outcomes in the underserved U.S. Hispanic population. Research regarding the impact of both traditional ("live") and technology-based interventions on diabetes self-management behaviors (i.e., blood glucose monitoring, healthful eating, exercise, and medication adherence) and clinical control (i.e., glycemic, lipid, and blood pressure control) is reviewed. Additionally, given the growing and important consideration of emotional well-being in type 2 diabetes, this review also summarizes available evidence on the impact of these interventions on relevant psychosocial outcomes (i.e., depression, anxiety, and diabetes distress). Given the authors' extensive experience in developing and evaluating innovative interventions for underserved Hispanic adults with type 2 diabetes, examples from our work are included as illustrations to complement the broader literature review.

Live Diabetes Interventions in the Hispanic Population

A variety of live interventions (i.e., those delivered in-person or by telephone without the assistance of mobile health [mHealth] or Internet technology) have been developed to improve outcomes in Hispanics with type 2 diabetes. These approaches have varied widely in terms of format, interventionist, and dosage. The majority have involved group-based sessions, whereas a smaller number have consisted of one-on-one visits delivered in person or by telephone or a blend of these strategies (29,30). Many interventions have been delivered by community health workers (CHWs; individuals of the same cultural background as participants, who are familiar with the community and have their own lived experience with diabetes [30,31]), whereas some have been delivered by certified diabetes educators (CDEs) or via a team approach (29). Session frequency has most commonly been weekly; however, duration has varied from 1 to 2.5 hours per session, and intervention periods have ranged from 6 weeks to 24 months (29–31).

Live interventions have achieved improvements in A1C, nutrition (32,33), physical activity (32,34), medication adherence (32), and overall diabetes self-care (35) among Hispanics with type 2 diabetes. However, few studies have reported positive effects for blood pressure, weight, BMI, or lipids (29–31). Overall, the specific aspects that were associated with more favorable outcomes in this population included multimodal implementation (e.g., a blend of in-person and telephone delivery), interdisciplinary approaches, longer intervention periods (34,35), tailoring for low literacy (32,36–39) and cultural relevance (29,33,34,39), social elements (e.g., invited family/friends or encouraged camaraderie among participants (32,33,37), and consideration of diabetes-related cultural beliefs (40).

Spotlight 1: Project Dulce
Project Dulce is an American Diabetes Association (ADA)-recognized program developed in 1997 by the Scripps Whittier Diabetes Institute in collaboration with San Diego federally qualified health centers (FQHCs), the County of San Diego, and San Diego State University to improve health and access to care of underserved, primarily Hispanic adults with type 2 diabetes. Informed by the Chronic Care Model (41,42), Project Dulce's nurse-led multidisciplinary team of registered dietitian/CDEs and medical assistants provides clinical management, while bilingual/bicultural peer educators (*promotoras*) deliver culturally tailored DSME/S. Project Dulce DSME/S consists of weekly, 2-hour classes and integrates key educational content (e.g., healthful eating, exercise, blood glucose monitoring, and medications) with evidence-based behavior change processes (e.g., goal-setting and problem-solving). Importantly, Project Dulce builds on cultural strengths/resources to motivate health behavior change (e.g., the high value that is placed on family and other interpersonal relationships in the Hispanic population), incorporates culturally relevant food and activity recommendations, and addresses the sociocultural context of this underserved population (e.g., healthy eating on a budget and cultural beliefs).

Studies evaluating Project Dulce have demonstrated positive effects on clinical, behavioral, and cost outcomes (40,43–46). To date, the program has reached >20,000 ethnically diverse patients at Southern California FQHCs (45), and its effectiveness has been replicated in other health systems across the United States and in Mexico, demonstrating program scalability.

Technology-Based/mHealth Diabetes Interventions in the Hispanic Population

Although most diabetes interventions in Hispanics have been conducted in person or on the phone, technology-based approaches have gained traction in recent years. mHealth or other technology-driven (e.g., Web-based) interventions are convenient to deliver, eliminate some of the logistical barriers that can interfere with the delivery of live interventions, and have the potential to increase patient engagement (47).

Technology platforms examined in Hispanics with type 2 diabetes have included text messaging, telemedicine, and Web-based tools. In one study that examined unidirectional, twice-daily text messaging (including educational/motivational content, medication reminders, healthy living challenges, and trivia questions), there were no differences between the intervention and a control group in behavioral or clinical outcomes at 6 months; however, intervention effects for A1C and medication adherence were larger for Spanish- versus English-speaking participants (48). An approach that evaluated CHWs' use of telemedicine and videoconferencing in a clinical setting to enhance diabetes care (49) achieved a significant mean A1C improvement (49). In another intervention, CHWs introduced participants to tablet technology to deliver a Web-based diabetes education and decision support tool with in-person support (50). The intervention was individually tailored for participants' laboratory values, medications, health insurance status, personal preferences, and adherence barriers. Compared to a control group that received printed materials, the CHW-plus-technology group showed improvements in A1C and medication adherence.

Overall, frequent but asynchronous communication, bi-directional messaging, tailored feedback, and cultural tailoring have improved outcomes in Hispanics (47). Notably, maintaining human interaction as part of the technology intervention can facilitate engagement.

Spotlight 2: Dulce Digital

The Dulce Digital intervention included culturally tailored, educational, and supportive text messages derived from the Project Dulce curriculum. In contrast to the text message intervention described above (48), Dulce Digital encouraged patient monitoring and transmission of blood glucose values, which were remotely monitored by study staff for safety reasons. In a randomized, controlled trial including 126 Hispanic participants, Dulce Digital improved A1C over 6 months relative to usual care (51).

Participants reported high satisfaction but expressed a preference for a more personalized intervention (52). Thus, our in-progress trial compares Dulce Digital to Dulce Digital-Me, an adaptive intervention that adds real-time feedback and goal-setting messaging based on participants' wirelessly transmitted blood glucose values and self-reported adherence (National Institutes of Health/ National Institute of Diabetes and Digestive and Kidney Disease grant 5R01DK112322-03; authors A.P.-T. and L.C.G. principal investigators). The adaptive feedback is delivered via algorithm-driven messaging to half of the Dulce Digital-Me participants and by the care team medical assistant to the remaining half to determine the feasibility and acceptability, cost-differential, and comparative effectiveness of each delivery method. This research is being conducted as a collaboration between Scripps Whittier Diabetes Institute, San Diego State University, the University of California San Diego, and Neighborhood Healthcare, a Southern California FQHC system.

Spotlight 3: Glucose as a Vital Sign

The Scripps Whittier Diabetes Institute is also examining the utility of remote blood glucose monitoring in the hospital. Optimally, in the inpatient setting, blood glucose monitoring should occur continuously, similar to the observation of other vital signs. There are several continuous glucose monitoring (CGM) systems available in the outpatient setting that facilitate rapid, real-time monitoring of patients' subcutaneous interstitial fluid glucose values, although these are not yet approved for use in U.S. hospitals. This in-progress trial examines the utility of CGM versus point-of-care testing in reducing hyper- and hypoglycemia and increasing time in the target glycemic range among predominantly Hispanic, high-risk patients with type 2 diabetes at Scripps Mercy Hospital, a large, safety-net hospital in the U.S./Mexico border region of San Diego. CGM devices are placed on all participants, and bedside values are blinded. In the point-of-care testing group, CGM data are used for evaluation purposes only. In the CGM group, CGM data are wirelessly transmitted to a management team that follows protocols designed for early intervention to prevent hypo- and hyperglycemia.

Preliminary analysis showed the CGM group to exhibit fewer hyper- and hypoglycemia values. Although the small sample size ($n = 45$) precluded significance testing, effects were small to moderate in size. Preliminary results also demonstrated that CGM-based remote monitoring by glucose management teams in the hospital is feasible, safe, and acceptable in this underserved, predominantly Hispanic group (53).

Psychosocial Outcomes in Type 2 Diabetes in the Hispanic Population

Although the impact of innovative diabetes interventions on clinical outcomes has been widely researched, less is known about the impact of these programs on psychosocial outcomes. Psychosocial factors such as general distress (i.e., depression [54] and anxiety [55]) and health-specific emotional distress (i.e., diabetes distress [56]) are prevalent in the general type 2

diabetes population (56) and even higher among Hispanics compared to non-Hispanic whites (57,58). The presence of emotional distress adversely affects diabetes self-care and glycemic control (59–61) and has also been linked to reduced quality of life (62) and self-efficacy (63). The ADA's position statement on psychosocial care for people with diabetes (64) calls for routine psychosocial screenings and DSME/S as the first line of treatment for diabetes-related distress.

Two systematic reviews conducted to date have reported positive effects of DSME/S on depression symptoms (65) and other psychosocial outcomes (66) in the overall population of people with type 2 diabetes. However, in their recent systematic review of the literature, Gutierrez et al. (67) did not observe the same strength of evidence for the effects of DSME/S on psychosocial outcomes in Hispanics. The 15 studies included in the review examined general emotional distress (i.e., depression and anxiety), health-specific emotional distress (i.e., diabetes distress), or a combination thereof and used group or individual formats. The majority of studies targeted emotional distress directly by incorporating elements of cognitive behavioral therapy, mindfulness, or stress management exercises. This review reported a lack of methodologically robust evidence that culturally tailored DSME/S interventions are effective in reducing emotional distress in Hispanics. However, interventions that were relatively more effective commonly incorporated *1)* content directly targeting emotional distress and *2)* cultural tailoring beyond language alone (e.g., community venues, group format, or delivery by CHWs).

Discussion and Conclusions

Racial/ethnic disparities in the prevalence and outcomes for chronic conditions, including diabetes, were estimated to cost the U.S. health care system $4.5 billion in 2009, and these costs have been projected to increase to $22 billion by 2050 if disparities are not addressed (68). Innovative, culturally appropriate interventions are needed to address these disparities and improve quality and quantity of life among Hispanics. This selective review identified several promising intervention approaches, while also highlighting important areas for future research.

Recent systematic reviews and meta-analyses show that DSME/S interventions delivered in person or by phone are effective in enhancing diabetes self-management and clinical outcomes, and particularly glycemic control, among Hispanics. Although the ADA recommends DSME/S for individuals experiencing diabetes distress, there is no compelling evidence that this approach improves psychosocial outcomes in U.S. Hispanics with type 2 diabetes. Thus, additional research is needed to develop interventions with a greater emphasis on emotional well-being, and in turn increased potential to improve psychosocial outcomes in this population.

Characteristics or processes that appear to enhance behavioral and clinical effectiveness in Hispanics with type 2 diabetes include multimodal interventions, at least some in-person delivery (versus telephone only), and greater adherence to the intervention (high attendance and low attrition). From a cultural perspective, specific tailoring of these programs, including linguistic translation, tailoring to literacy levels and socioeconomic context, delivery by a peer educator or CHW, consideration of cultural values and beliefs, and a social emphasis through a group format or inclusion of family and friends, may facilitate program engagement and augment effects. However, additional research using robust designs is needed to address methodological limitations of the research to date, which include small samples, high attrition in some studies, and uncontrolled designs. Furthermore, given the heterogeneity in content and dosage across interventions, studies that pinpoint the efficacious components and optimal duration of interventions would be valuable.

The high attrition rates, poor adherence rates, and overall low access to and utilization of these types of programs by U.S. Hispanics, combined with the increasing use of cell phones and the Internet in low-income and Hispanic populations (i.e., the close of the "digital divide" [69]) underscore the need to move beyond traditional delivery approaches to overcome utilization barriers. Recent studies that incorporate a focus on mHealth and remote monitoring to improve access to self-management support interventions show promise. In addition to the cultural tailoring strategies noted above, technology-based interventions that integrated frequent but asynchronous communication, bi-directionality of messages, and tailored feedback were noted to be effective in improving diabetes self-management and clinical control in Hispanic adults.

In summary, the reviewed literature indicates that live and technology-based interventions largely improve behavioral and clinical outcomes in Hispanics with type 2 diabetes, and to a greater extent than psychosocial outcomes. Future research is needed to determine how to best leverage the value inherent in both live and technology-based approaches, while incorporating individual patients' unique preferences, resources, and barriers. Hybrid approaches that capitalize on the value of live interventions (especially among Hispanics), while minimizing the number of sessions (and burden and cost) by incorporating technology to deliver a portion of the intervention warrant consideration. Incorporating CHWs or other personnel into mHealth interventions (an approach currently under evaluation as part of Dulce Digital-Me) may help overcome barriers of technology literacy and improve patient activation, satisfaction, and adherence (47).

Additionally, and consistent with the ADA's call for ongoing DSME/S, future investigations should consider extending the duration of support provided by incorporating technology for the maintenance period.

Regardless of modality, cultural tailoring must go beyond linguistic translation to maximize relevance to participants' socio-cultural context (14–16). Although this review summarizes findings for U.S. Hispanics, it is important to note that the pan-ethnic term "Hispanics" describes a large, heterogeneous group originating from multiple Spanish-speaking nations and that evidences substantial variability in socio-cultural characteristics, beliefs, behaviors, and attitudes toward health and health care. Thus, the incorporation of community-engaged research approaches and formative methods will be imperative to accommodate within-group variability and ensure the acceptability, feasibility, and sustainability of future approaches in the U.S. Hispanic population.

Acknowledgments

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FROM RESEARCH TO PRACTICE