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Eliminating Disparities among Latinos with Type 2 Diabetes: Effective eHealth Strategies

Lenny López^{1,2,3,4}, Aswita Tan-McGrory^{1,2}, Gabrielle Horner², and Joseph R. Betancourt^{1,2}

¹Disparities Solutions Center, Massachusetts General Hospital, Boston, MA

²Mongan Institute for Health Policy, Massachusetts General Hospital, Boston, MA

³Department of General Internal Medicine, Massachusetts General Hospital, Boston, MA

⁴Brigham and Women's Hospital, Boston, MA

Abstract

Latinos are at increased risk for obesity and type 2 diabetes (T2D). Well-designed information technology (IT) interventions have been shown to be generally efficacious in improving diabetes self-management. However, there are very few published IT intervention studies focused on Latinos. With the documented close of the digital divide, Latinos stand to benefit from such advances. There are limited studies on how best to address the unique socio-cultural-linguistic characteristics that would optimize adoption, use and benefit among Latinos. Successful e-health programs involve frequent communication, bidirectionality including feedback, and multimodal delivery of the intervention. The use of community health workers (CHWs) has been shown consistently to improve T2D outcomes in Latinos. Incorporating CHWs into eHealth interventions is likely to address barriers with technology literacy and improve patient activation, satisfaction and adherence. Additionally, tailored interventions are more successful in improving patient activation. It is important to note that tailoring is more than linguistic translation; tailoring interventions to the Latino population will need to address educational, language, literacy and acculturation levels, along with unique illness beliefs and attitudes about T2D found among Latinos. Interventions will need to go beyond the lone participant and include shared decision making models that incorporate family members and friends.

Introduction

The Latino population is a heterogeneous mix of persons born in and outside the U.S., with a diverse set of social, economic, and cultural perspectives and behaviors that may affect their health. This is further influenced by their country of origin, immigration history and settlement location in the U.S. Latinos are at increased risk for obesity and type 2 diabetes (T2D) and develop T2D at younger ages and with a lower body mass index (BMI) compared

Corresponding Author: Lenny López, MD, MPH, MDiv, Mongan Institute of Health Policy, Massachusetts General Hospital, 50 Staniford St., Ninth Floor, Boston, MA 02114. (lopezlenny77@gmail.com). Phone: 617-270-6600. Fax: 617-278-6906.

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with non-Hispanic whites (NHW).¹⁻⁶ The incidence of T2D and its long term sequelae are increasing in the U.S., especially among Latinos, even after controlling for adiposity.⁴⁻⁶ However, racial/ethnic differences in obesity and fat distribution do not fully explain differences in future incidence T2D.^{7,8}

The landmark Hispanic Community Health Study/Study of Latinos (HCHS/SOL) sheds particular light on this issue. HCHS/SOL is a population-based cohort study of 16,415 Latino women and men aged 18 to 74 years from Cuban, Dominican, Mexican, Puerto Rican, Central American, and South American backgrounds. Prior to the creation of the HCHS/SOL cohort, the Centers for Disease Control was unable to estimate the total prevalence of diabetes among Latinos.^{9,10} HCHS/SOL researchers found the prevalence of diabetes among all Hispanic groups was roughly 17% for both men and women, compared to 10% for non-Hispanic whites.¹¹ However, the diabetes prevalence rates varies among Latino subgroups with lower rates in South Americans (10%) and Cubans (13%) and higher rates in Central Americans, Dominicans, Puerto Ricans and Mexicans (18%).¹¹ Across groups, diabetes prevalence relates positively with increasing years of living in the U.S. This is an important proxy measure of acculturation-- the process whereby an immigrant culture adopts the beliefs and practices of a host culture.^{12,13} At the same time, diabetes prevalence was negatively related to education and household income.¹¹

The National Healthcare Disparities Report of 2013 has documented continued lack of improvement in diabetes quality of care indicators among Latinos.¹⁴ A recent analysis from the HCHS/SOL cohort found 52% of Latinos with diabetes were uninsured, only 59% were aware of having diabetes based on discordance between self-report and laboratory results, and only 48% demonstrated adequate glycemic control (A1c<7%, 53 mmol/mol).¹¹ Structural features of health care systems and high costs of treatment can contribute to poor diabetes outcomes for Latinos and other disadvantaged racial/ethnic minority patients.¹ Lack of access, financial and language barriers, poor health literacy and numeracy, and distrust of and perceived discrimination by health care providers are key causative factors.

The use of information technology (IT) can facilitate and improve patient activation in the self-management of T2D.¹⁵ In this paper we explore various electronic health (eHealth) technologies that have been developed and focus specifically on Latinos with T2D. eHealth for patients refers to the access and transfer of health information resources and the delivery of health care by electronic means. This includes traditional information exchanges, social networking, use of mobile text messaging and applications (mHealth), and telemedicine and telemonitoring, all of which allow for clinical diagnosis, treatment at a distance, and remote monitoring of patients' functions. In the past, eHealth-based-interventions may have been limited in their scope because of barriers to technology ownership faced by vulnerable populations often called the "internet divide."^{16,17} Most notable are the economic constraints that are still present, yet not insurmountable.^{18,19} In fact, a recent study of Latino migrant farm workers in California, among the most underserved populations in the U.S., found high rates of text-enabled mobile phones and willingness to use them for managing health issues.²⁰ With the documented close of the "internet divide," Latinos stand to benefit from such advances in technology especially when considering the surge in cell phone ownership and device activity among this subgroup.^{21,22}

eHealth-based-interventions may promote preventative and self-monitoring behaviors, assist in team-based care, and serve as a tool to enhance patient engagement in the self-management of T2D. For example, these technologies can be tailored (i.e. personalized) to relay health information through the use of reminders, physiologic monitoring (e.g. glucose finger stick values, blood pressure values, etc.), education, and motivational messaging.²³ In this paper, we will review the successful aspects of these interventions such as asynchronous communication, bidirectionality, and tailored messaging. Tailoring interventions will address the heterogeneity of the Latino population in terms of demographics, country of origin, SES, along with acculturation level and cultural attitudes and beliefs.

Components of Successful Traditional Non-IT Diabetes Self-Management

Education Programs

It is well established that diabetes self-management education (DSME), a complex health intervention comprised of 7 behaviors ([1] blood glucose self-monitoring; [2] taking medications; [3] healthy eating; [4] being active; [5] reducing risks; [6] healthy coping; and [7] problem solving), is generally effective at improving self-care behaviors, glycemic control and quality of life.^{24,25} The current gold standard for DSME is face-to-face group education classes, despite the risk of poor attendance.^{26,27} One way to optimize patient engagement in a DSME program is through cultural tailoring, and the few studies that have adapted health education material to be culturally appropriate have shown positive effects.^{28,29} Regardless, coordinating simultaneous, multi-faceted behavioral change is a challenging endeavor and technology may be used to deliver or enhance a DSME program.

Meta-analyses of non-IT based interventions have found the following features associated with a positive impact of DSME programming on secondary outcomes including HbA1c: group intervention format; situational problem-solving components; literacy and health literacy adapted material; high intensity (> 10 contact times during the intervention) delivered over a long duration (≥ 6 months); timely feedback from program staff; and incorporating dietitians as interventionists.^{30,31} In addition to these features, racial and ethnic minorities especially benefitted from interventions that incorporated community peer and/or health workers along with psychosocial coping strategies.³⁰ Importantly, active and participatory behavioral skill learning approaches were more effective than short-term, group-based didactic teaching aimed at improving diabetes knowledge, especially for long-term behavior change. These features will need to be incorporated into eHealth interventions either alone or in conjunction with clinical and non-clinical staff, such as community peer and/or health workers, to promote behavioral change.

eHealth Text Messaging Programs

Approaches that increase contact with patients (“high touch”) are essential for improving multidimensional T2D self-management. Labor intensive case management approaches with nurses, clinical pharmacists, and non-clinical personnel such as CHWs and peer coaches demonstrate improved process measures and outcomes.^{32,33} However, these methods have been limited by the need for staff and cost and therefore, there has been a search for sustainable, lower cost and long-term interventions. Thus, there is growing interest in

technology-based-interventions to not just activate, but also provide longitudinal support to patients in the self-management of T2D.

Text messaging allows for an increase in the frequency of interaction and the potential for patient activation required for complex behavioral change. There are likely multiple reasons for the success of mobile phones for delivering eHealth interventions including: convenience of information delivery and reminders; the ability to have multiple daily contacts, thus increasing participant engagement; and the possibility of easy, rapid and real-time clinical and behavioral feedback, conducive to action planning. These unique features are consistent with behavioral change theory.^{34,35}

The use of unidirectional text messaging for T2D management has been studied in a low-income patient population with some success. The Trial to Examine Text message-based mHealth in Emergency department patients with Diabetes (TEXT-MED) program utilized a low-cost, unidirectional text messaging system that could be delivered in English or Spanish to participants recruited from the emergency department of a large, urban safety-net public hospital.³⁶ The intervention involved various types of texts: an educational/motivational text sent once per day, 3 medication reminders per week, 2 healthy living challenges per week, and 2 trivia questions per week. In total, participants in the intervention were sent 2 texts per day for a 6-month period. Although after 6 months there was no significant difference in HbA1c levels between the two groups, Spanish speakers had the greatest gains in terms of medication adherence and HbA1c reduction compared to controls. This study highlights the importance of utilizing a variety of different message content categories, sequence variation in the delivery of the different message types, and a moderately high message frequency.

Although no studies to date have focused solely on Latinos, bidirectional text messaging between the participant and either a computer response algorithm and/or a study staff member may be more beneficial for multidimensional behavior change as opposed to unidirectional programs such as TEXT-MED. Bidirectional programs have been shown to promote self-efficacy and behavior change, although there has been mixed results on glycemic control.³⁷⁻³⁹ However, interventions that involve direct feedback in response to participants' inputted measurements have demonstrated greater reductions in HbA1c levels, most likely due to the real-time adjustments in treatment.³⁹ Bidirectionality increases participants' engagement and also likely leads to the "sentinel effect." Studies have shown that when participants are aware someone is "on the other end of the line," they tend to be more activated, report a greater sense of self-efficacy, and demonstrate a larger reduction in HbA1c.^{22, 40-42} Finally, bidirectionality can also be tied to the intervention's modality. Information, whether educational or instructional, conveyed via a multi-modal approach appears to be more effective than a single delivery system. For instance, eHealth interventions accessible to the patient both through the phone and/or computer seem to encourage patient involvement and mitigate access barriers that may be associated with a single modality.^{18,38} In summary, successful e-health programs include frequent communication, bidirectionality including feedback, and multimodal delivery of the intervention.

Merging the Community Health Worker Model and eHealth

It is unlikely that “low touch,” non-intensive methods will facilitate long-term diabetes management. eHealth interventions can be embedded within clinical practice and used to expand the reach of clinical and non-clinical support personnel delivering an intervention. The use of community health workers (CHWs) and their many variants (i.e., peer counselors, lay health workers, peer leaders, health advisors, *promotoras*) have been shown consistently in RCTs to improve diabetes outcomes in Latinos.^{43,44} CHWs are defined as “individuals who serve as bridges between their ethnic, cultural, or geographic communities and health care providers, and engage their community to prevent diabetes and its complications through education, lifestyle change, self-management and social support.”⁴⁴ While many CHW programs involve the use of phone calls for follow-up and reinforcement purposes, few integrate mobile health (mHealth) technology as a communication and informational channel between the patient, CHW, and health care team. CHWs have been used successfully in intensive telemonitoring and videoconferencing interventions in the home setting (i.e., The Informatics for Diabetes Education and Telemedicine (IDEATel)⁴⁵) and in the clinical setting (i.e., Promotoras-Telemedicine Care Provider Interaction Model⁴⁶). These interventions demonstrate that literacy, health literacy, and computer/digital literacy barriers can be overcome with the involvement of CHWs. In addition, this hybrid model can address patient preferences for receiving their healthcare from health professionals and not only from lay educators. Given that interventions independently employing CHWs or eHealth tools have shown success in the Latino population, merging of both approaches may be of great value to addressing the multidimensional barriers of diabetes self-management.

Deployment of Tablet Technology and the Community Health Worker Model

Tablet use is another important extension in low-resource settings, especially if there is no access to computer desktop hardware in the home. The iDecide/Decido is an interactive, tailored, web-based diabetes medication education and decision support tool delivered by CHWs on an iPad in participants' homes. The study population included African-American and Latino individuals with diabetes in Detroit and so the study material was offered in English or Spanish.⁴⁷ Some of the key tailoring variables in the iDecide/Decido program include lab values, medications, health insurance status, personal preferences, and medication adherence barriers. Importantly, the CHWs were intimately involved in the development of the content, presentation style, and visual images of the program material. Using techniques from motivational interviewing, the final tailored product allows participants to use the iPad to set personal treatment goals, identify treatment preferences and concerns, and understand treatment options for improving their glycemic control. The tablet may represent an opportunity for CHWs to deliver enhanced educational outreach using evidence-based, culturally-sensitive information tailored to both patients' health and computer-internet literacy. An ancillary randomized control trial compared a participant group that received the iDecido program on the tablet versus a group exposed to the same educational material in print form.⁴⁸ While both groups demonstrated improved self-efficacy, medication adherence, and HbA1c, additional benefits reported by the iDecido group included higher satisfaction with medication information and improvements in diabetes distress. It is possible that by delivering material via an interactive platform that

incorporated patients' specific goals and barriers to diabetes self-management, community health workers were able to more clearly convey information and behavior problem solving skills. This study also suggests that multimodal IT approaches (mobile texting, tablets, apps, internet based program, etc.) may show greater outcomes and reduced attrition when coupled with in-person support.

Tailoring eHealth Interventions for Latino Populations

Non-personalized messages are considered “generic” because they are mass-produced and lack specificity to any particular target audience or individual.⁴⁹ Targeted messages are those that use a low level of customization to increase the relevance of a message to a particular *population* (e.g., adolescents). Tailored messages are designed to increase the relevance for an *individual*, allowing a high degree of cultural saliency and concordance. Previous research has demonstrated that increasing specificity (i.e., generic < targeted < tailored) is associated with stronger positive outcomes.^{50,51} Tailoring utilizes individual level data to create personally salient health programming and takes into account individual behavior change needs and goals.⁵² Tailoring variables typically include the participant's name or nickname, age, gender, behavioral history, behavioral preferences and goals, behavioral barriers, previous text responses, and medical status (Table 1). Personalized messaging is linked to greater retention of participants.⁴¹ Although tailored messaging programs are more expensive to develop than targeted messaging, they can still be largely computer generated and so cost-effective and scalable.⁵³

Tailoring has been shown to be more effective than population targeted interventions across diverse populations, although few studies have explicitly examined tailoring to cultural variables.^{54,55} In T2D self-management, not all domains (i.e., knowledge, self-efficacy, social support, etc.) have the same relevance for all patients. In one study among well-educated African Americans, some participants found the knowledge they gained from informational texts more helpful for self-managing their diabetes than the reminders, while others found reminders a more valuable organizational tool.²² Differences in how health information is perceived affects the attention given to that information, with low saliency leading to health knowledge gaps, poor health behaviors and lower participation in health interventions.^{48,56} To enhance saliency of messages it is important to consider how the content is framed, especially among individuals with low general and health literacy. For example, gain-framed messages emphasize the benefits associated with adopting a health behavior while loss-framed messages focus on the costs of not adopting.⁵⁷ The impact of framing on saliency is not fully understood in behavioral interventions for racial and ethnic minorities and needs further research. This is especially true since saliency is likely not only limited to individual preferences but also cultural factors. The content and framing of messages could be designed in a culturally sensitive way, as certain types of messages and images may be more salient for some minority groups and not others.

Few studies have been tailored to address the socioeconomic, cultural, and linguistic challenges that many Latinos face. For instance, foreign born, low income, and Spanish-language dominant Latinos are more likely to rely on television, family, and friends for health information rather than medical providers.^{58, 59} Thus, interventions need to be

tailored to address language and literacy levels, unique illness beliefs and attitudes (Table 2), as well as educational and shared decision making models that incorporate family members and friends. For example, a qualitative study of Latinos with diabetes and their family members in Chicago found that participants were most interested in peer-based diabetes self-management interventions in a group setting rather than a telephone-based one-to-one peer program.⁶⁰ Limited English proficient Latinos are most receptive to health messages that included visual aids, images of Latino-appearing people, and simple language.⁶¹

For eHealth to be successful in meeting the needs of Latino populations going forward, several key approaches for tailoring need to be considered as part of development and innovation:

1. Tailoring Involves More Than Linguistic Translation

Many culturally “tailored” interventions refer essentially to linguistic translation which is not sufficient. While language preference is the first step to cultural tailoring, simple translation fails to address the “deep structures” of cultural history, values, and norms (Table 2).⁶² Qualitative studies have found several important cultural domains relevant for T2D behavioral intervention design for Latinos. These domains include attention to family orientation (collective loyalty to the extended family that may supersede the needs of the individual); building a strong provider relationship (expectation of a warm relationship with the health care provider); fostering empowerment and sense of control (the individual may not be able to alter a disease process because it may be part of destiny); respect for religion, folk beliefs (intense fear/trauma as a cause of diabetes); the incorporation of folk healers; perspectives around body image (preference for larger than average body size).⁶³⁻⁶⁵ Importantly, these belief/value domains have been shown to vary by country of origin, region of the US, and level of acculturation. Many of these domains influence the patients' perception, understanding and experience of their illness and subsequently impact how they engage in self-management. Therefore, educational curricula and text content should be individually tailored, rather than population targeted, in order to enhance saliency.

2. Tailoring for Acculturation

Acculturation is a complex and dynamic process by which an immigrant culture adopts the beliefs and practices of a host culture (Table 2). Greater acculturation among Latinos is associated with negative effects on nutrition and a more sedentary lifestyle yet also positive effects on health with increased wealth and education.¹² One study has explored acculturation and diabetes-related beliefs and preferences among Mexican and Mexican-Americans using the Hazuda acculturation and assimilation scales.⁶⁶ These scales measure 3 constructs: Spanish use, value for preserving Mexican culture, and interaction with Mexican-Americans. This study demonstrates the three domains of acculturation measurements are not interchangeable and have different associations with diabetes-related beliefs and intervention preferences. Only one outcome—preference for a program for Mexican-Americans—was associated with all three acculturation variables. Value for preserving Mexican culture was related to a more holistic view of health, as evidenced by an increased likelihood of consulting a *curandero* (a traditional healer), use of prayer, and interest in a diabetes program with religious content. Value for cultural preservation was also related to

higher suspicion of free diabetes programs. Interaction with Mexican-Americans was associated with a belief that insulin causes blindness. The findings from this study exemplify the intricacies of the acculturation process and how nuanced cultural preferences may be even among Latinos with a shared country of origin. In addition, higher acculturated Latinos with stronger English language ability may prefer non-tailored initiatives.⁶⁷ Thus, tailoring requires individualized assessments of cultural dimensions and then modifications sensitive to varying degrees of acculturation, SES status, and language ability. Technology-based-interventions have the potential to create multiple modules (i.e., a suite of options) that the interventional clinical team can assemble for each patient in a truly personalized sense.

3. Tailoring Includes Careful Consideration of Intervention Personnel

Since some Latinos may value personalismo, the tendency to value and trust the person-to-person connection highly in information gathering and decision making, intervention design should consider who might be preferred by participants when considering participating and remaining activated during an intervention. The complexities of Latino culture have been addressed in prior non-technology-based-interventions with positive outcomes using personnel and time intensive methods such as peer educators, community health workers, and educational programs using videos, telenovelas (health-based soap operas), and storytelling to address low literacy.⁶⁸ Contrary to some lay-educator model studies, some Latinos may prefer to receive health information from their physician and diabetes guidance from experts.⁶⁶ Interestingly, two randomized control trials (one targeting Mexican-Americans, the other Puerto Ricans) found it necessary to train health professionals to deliver the intervention due to participant preferences, as opposed to relying on community health workers.^{69,70} Although technological tools and gadgets may provide an interactive platform on which to deliver an intervention, maintaining a human support is necessary to increasing participant activation through providing feedback and answering questions. This point of contact is critical to avoid exacerbating or creating new communication barriers.

Conclusion

In summary, the literature suggests that computer and mobile technology interventions will need to be more personalized yet also standardized on multiple modalities in order to promote long-term reductions in T2D disparities. Future texting studies and other technology-based interventions should provide the content of the messaging and an analysis of the impact of different messaging frames on outcomes. In addition, behavior change-focused interventions will need to be closely tied to behavior theory in order to maximize what is known to be effective in other mediums.⁷¹ Specifically, with regard to racial and ethnic minorities and socially disadvantaged groups, effective features of not only the messaging system but also the text content itself that incorporates socio-cultural frames should be identified for future use.

Because the success of an intervention depends on long-term adherence, it is important to also consider how best to facilitate “treatment” fidelity while balancing participant burden. Several studies have reported participant attrition due to the burden of regular day-to-day usage or difficulties with using the technology itself.⁴⁰ Exploring which patients may most

benefit from mobile technologies is still unknown. It is also unknown which modalities of mobile technologies (i.e., text, phone calls, apps, etc.) or combinations of modalities would be most effective due to heterogeneity in prior study interventions. Finally, few cost analyses of eHealth programs are translatable to health settings that primarily serve racial and ethnic minority groups; so, while the cost-effectiveness of technology-based interventions is promising, it cannot be assumed and warrants further research.⁵¹

Prevalence rates of T2D among Latinos, in the presence of rising obesity, continue to rise. Eliminating disparities in T2D is of utmost importance and eHealth strategies will be an integral part of our armamentarium to engage patients and clinicians. eHealth-based-interventions may promote preventative and self-monitoring behaviors, assist in team-based care, and serve as a tool to enhance patient engagement in the self-management of T2D. Interventions will need to be tailored to address the heterogeneity of the Latino population in terms of language and literacy levels, unique illness beliefs and attitudes, as well as educational and shared decision making models that incorporate family members and friends. In addition, eHealth interventions can be embedded within clinical practice and used to expand the reach of clinical and non-clinical support personnel delivering an intervention with, for example, community health workers. At a time of significant clinical delivery change and innovation, eHealth for Latinos with T2D will be part of the solution for the elimination of healthcare disparities.

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Table 1
Factors for Personalizing Technology-Based Interventions

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Table 2
Culturally Relevant e-Health Design Components for Latinos

Cultural Concept	Definition	Implications on Intervention Design
Acculturation Status	A complex and dynamic process by which an immigrant culture adopts the beliefs and practices of a host culture.	More acculturated participants may prefer less tailored interventions
Personalismo	A tendency to value and trust the person-to-person connection highly in information gathering and decision-making.	Involvement of primary care physician or a trusted medical expert in the introduction and maintenance of the intervention
Fatalismo	A belief that individuals are powerless to change a preordained future. It may be associated with religious and spiritual beliefs.	Emphasis on changes in disease outcomes based on one's behavior and the self as locus of control
Susto	A belief that disease can be caused by a sudden frightening or traumatic experience.	Education on biological etiology of disease
Familismo	Cultural emphasis on strong bonds (responsibility, loyalty, reciprocity, and solidarity) with nuclear and extended family members throughout the life span resulting in a high level of perceived family support. Decisions by the individual are seen in light of the well-being of the family.	Involvement of family members to also participate in disease management and decisions
Religion		Group education classes held within church setting/ religious community context; consideration of religious beliefs about disease and physical health
Simpatía	An emphasis on personal connection with others	Emphasize personal connection with healthcare providers, their family and community in disease management interventions