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Perceptions of a mHealth Intervention for Improving Social Support and Diabetes Self-management for Emergency Department Patients in Southern California

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Abstract

Aims:

In this study, we conducted a qualitative analysis of an internet and communication technologies (ICT) social support intervention for low-income, inner-city patients with diabetes receiving care in the emergency department (ED).

Methods:

We conducted semi-structured interviews with patients and their supporters at the end of a trial of an ICT augmented social support intervention for patients in the ED with diabetes. The interview guides were designed to identify persuasive program aspects, changes in psycho-social factors and reasons supporter selection. We imported transcripts into a qualitative analysis program and iteratively analyzed using a constructivist grounded theory approach. Broad categorical themes arose from the initial codes.

Results:

Through the analysis of the transcripts, patients and supporters identified positive and motivating program components. Several additional themes emerged regarding the experience with the intervention: 1) Selection of Supporters, 2) Perceived Program Benefits, 3) Changes in Motivations for Diabetes Self-Management, and 4) Social Context Challenges to Self-Management.

Conclusions:

Augmenting a ICT diabetes intervention with social support messages to family members was well received and was perceived to change psychosocial factors. Social determinants of health, including access to care and medication affordability, may need to be simultaneously addressed to obtain maximal benefits.

Trial Registration

ClinicalTrials.gov (NCT03178773), registered 20170605.

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1. Introduction

Although diabetes is a nationwide epidemic, individuals from Latine backgrounds residing in the United States are a particularly vulnerable population. Individuals from Latine backgrounds are more likely than their counterparts from non-Latine White backgrounds to develop diabetes and have higher rates of diabetic complications and diabetes related mortality. [1,2] This disparity is amplified in Los Angeles

County, where almost half the residents identify as Latine and the prevalence of diabetes is 14.4%; much higher than the national prevalence of 8.6%. [3,4] The patients who rely on the Los Angeles General Medical Center Emergency Department (ED) for care are a high need population, [5,6] and require dedicated attention to address their barriers to care. Importantly, a visit to the ED presents a unique opportunity to reach both patients and families during a health crisis, when they are susceptible to behavior change. [7] ED-based interventions can also bridge gaps in access to care for patients until primary care can be established for those lacking primary care, or during the wait for the next visit for patients with limited access to care.

Culturally and linguistically appropriate interventions that emphasize improving self-efficacy can improve self-management. [8,9] Training family members and peers to support patients with diabetes has been shown to improve patient motivation, healthy behaviors and glycemic stability. [8,10–14] These interventions have been enthusiastically accepted in multiple populations from Latine backgrounds, potentially tapping into cultural strengths such as familismo. [15–18] However, existing research in developing interventions for social supporters has had inconsistent results. Additionally, these interventions have faced difficulties in recruiting family members and create financial, space and personnel burdens to implement and maintain. [19,20] These barriers have prevented widescale implementation of social support interventions for patients with diabetes but can be overcome using internet and communication technologies (ICT) to engage supporters. ICT interventions — including mHealth, telephone-based interventions and web-based interventions — can be used to train support persons, to prompt them to provide appropriate social support and as an avenue to offer that support to a person with diabetes. [21] ICT based social support interventions could reduce the need for family to travel to classes, or take time off work for synchronous video sessions, making social support interventions more accessible to populations in need. Individuals residing in the US from Latine backgrounds have the technological capacity to engage with ICT interventions and may even prefer these modalities for health information.[22,23]

While ICT based interventions are generally promising for individuals residing in the US from Latine backgrounds, these interventions may be even more feasible for patients from Latine backgrounds who come from households with limited resources. These patients are more likely to access the internet and health information specifically via mobile devices, and maybe less likely to have a “land phone” and/or personal computer. [22] Additionally, mobile applications are not widely used in communities with limited resources such as safety-net EDs. [24] While patients from low-resource settings have enthusiastically joined text-message and interactive voice-recording interventions to improve diabetes self-mangement,[25–28] there are few investigations of culturally and linguistically tailored ICT-based interventions to augment social support for diabetes self-management.

In this study, a qualitative, inductive approach was used to better understand an ICT intervention to augment social support for patients engaged in an ICT based diabetes self-management program. TExT-MED+FANS (Trial to Examine Text-Messaging in Emergency patients with Diabetes+ Family and friends

Network Support) is an intervention designed for ED patients with diabetes. The development of the program, randomized control trial and clinical outcomes are described previously.[29,30] TExT-MED+FANS adds a mobile social support module for family members and friend (FANS) to the existing patient-focused TExT-MED intervention. Over 6 months, 166 patients received twice daily text-messages and one patient-identified supporter per patient received one daily messages. For patients, messages emphasized basic disease management education, increased self-efficacy, calls to action for healthy behaviors, medication reminders and trivia challenges to measure engagement. For supporters, messages were synchronized to the patients' curriculum and provided basic education content, similar calls to action for healthy behaviors with the prompt to notify the patient they were engaging in the same behavior, as well as the trivia challenges to measure engagement.

In this qualitative analysis of the TExT-MED FANS intervention, we explored potential mechanisms that contribute to changes in behaviors and outcomes, including changes to self-efficacy, perceived barriers, perceived threat of diabetes and perceived benefits of glycemic stability. Additionally, the user experience was examined for the TExT-MED+FANS intervention for both patients and supporters, focusing on content of messages.

2. Methods

2.1 Interview guide development

The interview guide was developed from prior work by this research group,[27] with a focus on motivation, barriers to care, and perceptions of disease and disease management using a "think-back" approach to attempt to have participants recall their disease management before the intervention and compare to the time of interview. The guide went through two rounds of testing with research associates (RAs) and experienced qualitative researchers. The final guide was translated into Spanish by a RA who is a native Spanish speaker and back translated by two other RAs, with differences resolved by consensus.[31] (See Appendix 1 for final question guides)

2.2 Data Collection

This study was approved by the local Institutional Review Board prior to initiation. Data collection and analysis were designed in accordance with the Consolidated Criteria for Reporting Qualitative Research Guidelines (see Appendix 3).[32] Patients and supporters who completed the experimental arm of the TExT-MED+FANS randomized controlled trial were invited to complete one semi-structured interview and were compensated for the additional time. Interviews were conducted in the research offices or in a participant's home, with two RAs at a time, in the patient's preferred language. All interviews were conducted by JM, NRG, and AA, three natively Spanish English bilingual female with bachelor's degrees. They were professional research coordinators and associates at the time of the study. JM and AA had previously conducted semi-structured interviews and focus groups after training with, EB, the principal investigator.

Interviews were audio recorded and transcribed in the original language, then reviewed and corrected by a research coordinator. Spanish language transcriptions were translated into English by bilingual staff. In addition to the information extracted from the interviews, there were two other sources of data that that were not captured from interviews but provided important information and were therefore included in the coding process. One source was collected from the spontaneous text messages that patients and supporters sent to the mHealth platform. While not encouraged, a fair number of patients sent in messages to the system on a regular basis. Only texts that consisted of more than one word were aggregated with the interview transcripts. The second source was gathered from research associates notes that were compiled from interactions with the patients and in-person interviews. In these encounters, patients would share unprompted anecdotes about their diabetes management challenges.

2.3 Analysis

The analysis of the transcripts was conducted from the Constructivist Grounded Theory Framework which emphasizes generating themes and theories from the data gathered from participants rather than pre-existing frameworks. [33] The analysis of the interview was transcript-based to enhance rigor. The study team developed an initial set of codes after the first reading of 15 transcripts and line by line coding. This coding scheme was further developed through the analysis process. As further participant transcripts were coded and analyzed, concepts and phenomena were compared to one another in a constant, iterative process to ensure the coding structure continued to accurately represent the experiences of the patients.

The transcripts were analyzed using Dedoose™, a computer-based qualitative analysis tool that contains data organization tools necessary to complete an analysis of different subgroups.[34] After the development of the preliminary set of codes, multiple rounds of co-coding were conducted with iterative redefinition of the codes until consensus on codes definitions was achieved. The final tests of coders' agreement on code application reached Cohen's pooled Kappa coefficients of greater than 0.9, showing excellent inter-coder reliability.[35] NRG and JM then coded all transcripts through focused coding with the final codebook (See Appendix 2). Transcripts were reviewed as they were coded, developing overarching phenomenon categories ("axial coding") as per standard grounded theory techniques by generating memos and meeting regularly to discuss developing themes. These themes were reanalyzed and expanded with new categories that comprise the experience with TExT-MED+FANS [36]. Major themes were selected for salience in addition to frequency, and both were considered.

Strategies to maintain integrity and enhance validity of the qualitative findings were used, including consistent use of the discussion guide, audiotaping, employing of RAs from multiple ancestral backgrounds for data analysis, standardized coding and analysis processes, and used of a pooled Kappa measure to ensure coders were adequately trained.

3. Results

3.1 Participant characteristics:

We conducted 50 interviews with patients (63% of those initially enrolled) and 56 interviews with supporters (70% of those initially enrolled). The patient interviewees were 72% (n = 36) Spanish-speaking and 40% (n = 20) identified as female. The supporter interviewees were 59% (n = 33) Spanish speaking and 69% (n = 38) identified as female. Female patient interviewees had 42.11% female and 57.89% male supporter. Male patient interviewees had 95.92% female and 4.08% male supporter. All intervention group patients and supporters who completed their 12-month follow-up measures elected to stay for the semi-structured interview after the final visit. One audio file from a supporter who spoke English was corrupted and not able to be analyzed. Patient interviews lasted a mean of 7:56 minutes and supporter interviews lasted a mean of 7:15 minutes.

3.2 Main Themes:

Through the analysis of the transcripts patients and supporters identified program components that were positive and motivating. Several additional themes emerged regarding the experience with the TExT-MED+FANS intervention: 1) Selection of Supporters, 2) Perceived Program Benefits, 3) Changes in Motivations for Diabetes Self-Management, and 4) Social Context Challenges to Self-Management.

3.2.1 Selection of Supporters: *developed from patient interviews only; exemplary quotes in* Table 1

Despite identical instructions, patients identified diverse reasons for choosing specific supporters. Patients selected supporters based on their perceived ability to offer various forms of assistance: 1) Informational Support: Particularly valued if the supporter had personal experience with diabetes; 2) Emotional Support: Patients sought individuals who could offer motivation and emotional well-being 3) Instrumental Support: Patients sought those who would help with tasks like food preparation and transportation.

Many preferred close relatives or friends with some prior diabetes knowledge. Patients often cited their own lack of knowledge or confidence as a significant barrier to self-management. Choosing a supporter "who has already been through it" offered established guidance, experience, and an encouraging success story.

Emotional strength was another key factor in supporter selection. Some participants chose supporters with diabetes who could potentially benefit themselves, creating a mutual support dynamic. Interestingly, female supporters were frequently chosen for pre-existing emotional or instrumental support they provided the patient. Specifically, male patients often selected wives or life partners, identifying them as the driving force behind many self-management behaviors.

Table 1

Exemplary quotes of Selection of Supporters

Subtheme	Exemplary Quote	Context of Quote
Male Supporter Selected	“I choose him because he has the same illness, and we support each other. We say to each other “How are you? How’s your sugar levels? What is it that you’re doing?"	Participant 132, Patient, Female, Spanish Language Preference, age 46
Female Supporter Selected	“Because she's the woman who’s with me in the house and she is the person who helps me with everything. I didn’t choose her; it's how we live.”	Participant 152, Male, Patient, Spanish Language Preference, age 37
Female Supporter Selected	“Since the first time that she (patient’s wife) came, she was taught to make food a little more healthier.”	Participant 125, Male, Patient, Spanish Language Preference, age 46

3.2.2 Perceived Program Benefits: *from both patient and supporter interviews; Exemplary Quotes in* Table 2

Increased Activation of Support: Participants noted that the text-messages called the supporter’s attention to their loved one’s diabetes and also provided the initiative and content areas to begin conversations about health. Through the unprompted reminders, patients and supporters were more conscious of the need to constantly manage diabetes. Supporters felt that the messages were of sufficient variety in content, effectively disrupting any tendencies towards inattentiveness in both the patient and the supporter regarding diabetes management. Patients and supporters noted that the synchronized content in the text-messages stimulated conversations about health, initially superficial check-ins, but also transitioning to deeper discussions about health, social connections and behavior change.

Decreases in Maladaptive Coping Strategies: Patients and supporters noted that before the TExT-MED+FANS intervention, they often relied on maladaptive coping mechanisms to address the challenges of diabetes management. These included: 1) Inattention to Disease: Participants described a tendency to ignore diabetes prior to the program. 2) Avoidance: Both patients and supporters engaged in avoidance behaviors related to diabetes care. 3) Resistance to Advice: Patients often resisted informational support from loved ones or healthcare providers. The intervention was perceived to disrupt these maladaptive coping strategies. Patients and supporters reported increased attention to diabetes management, reduced avoidance, and a greater openness to advice. Supporters were sometimes specifically selected for their ability to help patients overcome resistance.

Table 2
Exemplary quotes of *Perceived Program Benefits*

Subtheme	Exemplary Quote	Context of Quote
Increasing Supporter Activation	"There's times when one… forgets about the disease. And days pass by and nothing, but when the texts came that said 'Yeah I'll check' 'Yes I will remind her. Yes' in that form well, it is good help."	144S, Supporter, age 56, male, Spanish language preference
Increasing Supporter Activation	"It changed our relationship in that it caused us both to be more aware. Every message we received was different, but it was something good for him."	236S, Supporter, age 18, female, English language preference
Synchronized texts	One noted the real time check-ins that the supporter messages prompted: "When I would receive the messages, I would tell her, 'look at the what I got.' "	143S, Supporter, age 30, female, Spanish language preference
Synchronized texts	"She would constantly send me a text, even though I would get the same text message from you guys. She would text me afterwards and be like 'Hey, did you this today. Did you do that? Are you going to do this today?' So, you know, that prompted us to text more and more, through the texting came more conversations and then from conversations, it became more like 'Hey mom, this is what I did today.' So it became me opening up to her, as oppose to her having to come to me and check up on me."	282P, Patient, age 31, male, English language preference
Synchronized texts	"We're conversing more than we have in the past with regards to his health and I think with the study it has to do with it, because the messages. And then I would always get text messages and I would let him know I got a text message 'Was it the same as yours?" and I would explain it if he did or what mines said to help him out. So, he is starting to see the importance."	282S, Supporter, age 54, female, English language preference
Decrease in Avoidance	"[with diagnosis of diabetes] I thought that my life had changed; that I had nothing else to do in this world."	130P, Patient, Spanish Language Preference, Male, age 45
Decrease in Resistance to Support	[Interviewer] "That is why you chose him?" [Participant] "Yes, because I know I'm stubborn and I don't want to listen and I know that he's going to get, like, 'Leave that to others because I don't want you to eat it, but you know that you're going to relapse.' That's why."	246P, Patient, Spanish Language Preference, Female, age 53
Decrease in Resistance to	[Interviewer] " Thinking back before participating in the study TExT-MED+FANS, and now after the program, how have you	183P, Patient, Spanish

Subtheme	Exemplary Quote	Context of Quote
Support	changed the way you take care of yourself?“ [Participant] “Quite much, before well I wouldn’t even listen. (nervous laugh)”	Language Preference, Male, age 47
Increased Patient Attention to Diabetes	“It makes me aware of where I am at and what I am doing, and it is kind of a conscious thing.”	103P, Patient, English Preference, Male, age 49

3.2.3 Changes in Motivations for Diabetes Self-Management: *from both patient and supporter interviews*; *Exemplary Quotes in* Table 3

Patients and supporters identified multiple sources of intrinsic and extrinsic motivation in diabetes self-management that increased throughout the program and described changes in the balance of intrinsic and extrinsic motivation throughout the study.

Extrinsic motivation described was generally a fear of consequences that they had witnessed in family members or close friends, and the direct encouragement and praise they received from family members. The TExT-MED+FANS program was noted to increase this extrinsic source of motivation, as some supporters were more highly engaged in offering emotional and instrumental support during the program.

Intrinsic motivations revolved around living up to the identities patients held for themselves as well as valuing their own health and feeling stronger and healthier when their diabetes was managed. The desire and motivation to make changes to diabetes management were often driven by patients’ desires to live up to responsibilities in their families or the expectations of their family members. Generally perceived as a very positive force in their lives, patients believed their changes in diabetes self-management would result in happier and longer time together.

Some patients noted a change in the balance of extrinsic and intrinsic motivation; they identified the TExT-MED+FANS program and the behavior challenge messages as prompts to inspire them to make a healthy choice for themselves. This turned motivations from extrinsic fears of consequences to intrinsic motivations to show themselves they can make the healthy decisions necessary and be “strong” or “normal” despite their diabetes. While participants often noted that succeeding in their family roles was important to them, they ultimately desired improvements in their own health or identified the need to make one’s own health decisions as the mechanism of lasting behavior change.

Table 3
Exemplary quotes of *Changes in Motivations for Diabetes Self-Management*

Subtheme	Exemplary Quote	Context of Quote
Fear of Consequences (Extrinsic)	“I tell her -that how I don’t want you to get sick, I don’t want that one day they cut your leg and that the wound won’t heal. I don’t want you to lose your vision. I don’t want to have you here in the bed sick because of diabetes. That you can’t walk I tell her. You have to get it together.”	Participant 129, Male, Supporter, Spanish Language Preference, age 55
Fear of Consequences (Extrinsic)	“And that is what I say, "I don't want to get to that point." Eh, it motivates my health, my life. I don't want to… inject insulin. It's my own health. My wife, I tell her, "We are going ...no matter what, we fight." And sometimes, like, the...treatment that you guys offered me, all the reminders, the dates, to put, like, challenges, which is what I would like to continue to do again.”	Participant 302, Male, Patient, Spanish Language Preference, age 45
Family Encouraging (Extrinsic)	“She would always send me texts and after getting out of work checking on me to see how I was doing. Because she did take it to heart being my mentor.”	Participant 178, Patient, Female, Spanish Language Preference, age 47
Transition of Extrinsic to Intrinsic Motivation	[Interviewer]: “In general, what motivates you to take control of your diabetes?” [Participant]: “I don’t’ want to be sick. I just want to be a normal person and you can be normal and still have diabetes. I know that now [after TExT-MED+FANS].”	Participant 237, Patient, Female, English Language Preference, age 49
Transition of Extrinsic to Intrinsic Motivation	[Interviewer]: “Before the program, a year ago, what did you think would happen if you didn’t manage your diabetes?” [Participant]: “I was almost certain, not that I’d be dead now, but that I would definitely be close to what my aunt and uncle were at, and they were pretty bad. So, to hear that my A1C is down, to see that my cholesterol is back down to normal or is, has been normal, is definitely given me more of that definite, like, sign of victory, so my confidence has gone up significantly since, you know, since a year ago.” [before starting TExT-MED+FANS]	Participant 282, Patient, Male, English Language Preference
To Fulfil Family Role (Intrinsic)	[Interviewer]: “And in general, what motivates you to take control of your diabetes? Participant]: “In general, well my family and also the family that I yet don’t have, that’s to say family I don’t have yet like grandchildren. And I want to be there when they come along.”	Participant 298, Patient, Male, Spanish Language Preference, age 49
To Feel Healthy (Intrinsic)	“Eh, my kids have always motivated me and if one takes care of oneself … you feel better too. But honestly the program is really good because it reminds you of your own care.”	Participant 109, Patient, Female, Spanish Language

Subtheme	Exemplary Quote	Context of Quote
		Preference, age 57
To Feel Healthy **(Intrinsic)**	“My [motivation to change comes from] family. Uh huh. And myself because I don’t want to get a leg amputated or end up with no eyesight or be receiving dialysis.”	Participant 125, Patient, Male, Spanish Language Preference, age 46

3.2.4 Social Context Challenges to Self-Management: *from both patient and supporter interviews*; *Exemplary Quotes in* Table 4

Another important theme in perceptions of the program is the social context in which they try to manage living with diabetes. While the TExT-MED+FANS program offered valuable support during the study, participants highlighted critical limitations: 1) Transportation and Access to Care: Many patients endured lengthy commutes and logistical challenges just to attend study appointments; 2) Primary Care Access: Finding and securing consistent primary care was a major hurdle for participants; 3) Financial Burden: The cost of medications and equipment created significant stress, forcing patients to choose between diabetes management and basic needs. 4) Nutritional Challenges: Cost of food and homelessness presented additional dietary difficulties. 5) Disability and Work: Diabetes complications leading to disability further added to the challenges, as participants lost jobs but lacked formal disability benefits. These social and financial realities, as identified by patients and supporters, significantly impacted their ability to maintain positive behavior changes and ultimately improve glycemic control. While the intervention motivated and encouraged participants, it could not address the persistent barriers stemming from their broader social and economic circumstances.

Table 4
Exemplary quotes of *Social Context Challenges to Self-Management*

Subtheme	Exemplary Quote	Context of Quote
Housing	"My brother [name removed], has been homeless, and he was homeless when enrolled in the program. And right now, he's at a shelter, so that's improving, but because he's homeless, and because even at the shelter, it's very hard for him to take care of his food, right?"	Participant 114, Supporter, English Language Preference, Female, age 64
Housing	"I got sick and then she [wife] got sick too and we were both sick, well there's just one more thing on top of it all." (referring to losing home when both could not work per RA notes; now lives in family member's living room with their 2 dogs)	Participant 112, Patient, Spanish Language Preference, Male, age 48
Primary Care Access	From interviewer notes on small talk prior to recorded interview: Patient does not have primary care provider and has not been taking her insulin for more than 5 months. She noted that she was tired of having a new doctor every 3 months.	Participant 293, Patient, Spanish Language Preference, Male, age 43
Primary Care Access	"It's good, the program is good, it helps us, but like I mentioned earlier some of us don't have a primary care doctor…hopefully I can get a primary care doctor right now so that my diabetes can be better. "	Participant 104, Patient, Spanish Language Preference, Female, age 34

4. Discussion

This qualitative study of predominantly adult patients from Latine backgrounds and their family members who completed a mHealth diabetes self-management intervention with mHealth activated social support revealed key themes related to the TExT-MED+FANS intervention: 1) Selection of Supporters, 2) Perceived Program Benefits, 3) Changes in Motivations for Diabetes Self-Management, and 4) Social Context Challenges to Self-Management.

In the current study, patients identified increased "consciousness" of diabetes and motivations to behavior change as mechanisms of successful change in diabetes self-management. Increasing awareness of the disease and the daily reminder about self-management decisions changed patients' intrinsic motivations and emphasized extrinsic motivations such as family expectations. Cues to action, as conceived in the Health Belief Model, have traditionally been thought to increase a person's perceived risk of a disease or complication. [37,38] As the patients in this study are all people with glycemic variability, their pre-program insight into their risk of complications arising from diabetes may have been low, due to coping strategies of avoidance and denial. The daily messages may serve as novel cues to action that overcome these maladaptive coping strategies. SMS-text message interventions have also been conceptualized as a moderator of the relationship between motivation and behavior change by lowering "activation energy" to make a new and uncomfortable health decision. [39,40] By increasing perceived threat of diabetic complications, the TExT-MED+FANS intervention may increase intrinsic

motivation for change. In addition to motivation for themselves, patients in this study also reported being more aware of how glycemic variability would impact their families. The needs and expectations of their family were a preeminent extrinsic motivation for behavior change. While patients all reported increases in motivation, the reasons that some patients internalize that desire for change and others continue to rely on external motivators such as fear of consequences and family approval are not fully defined. Future interventions may benefit from targeted programming to emphasize intrinsic motivation over extrinsic motivation.

Many diabetes experts and clinical diabetes educators encourage support from family members to improve self-management behaviors, acknowledging the powerful influence of loved ones over patients.[41–43] Traditionally, familial and social support has been viewed as positive, with associations between increased social support and improved self-management behaviors and glycemic stability.[44–46] In addition to encouraging good self-management, strong relationships with family have been found to improve psychological and emotional well-being of patients, which are independently associated with improved self-management and glycemic stability.[47,48] In this study, patients shared that they selected a supporter who would either provide emotional or instrumental support to them or who could provide peer support and potentially benefit from the program in addition to the patient.

In this supporter selection process, there was a potential gender pattern in supporter selection, with women selecting supporters for emotional support or to benefit the supporter, while men selected supporters based on instrumental support. Prior research into diabetes behavioral intervention for individuals immigrating to the United States from Latine backgrounds have found similar patterns, with women identifying more social and emotional barriers to motivation and self-management, while those who identify as men identified structural barriers that require a concerted effort to overcome. [49] Supporters were much more often women than men; this may be due to gendered social expectations regarding health and attending to the health of family members. Women from Latine backgrounds are more likely to informally share diabetes knowledge and have higher baseline disease knowledge than do their men counterparts[50] and may be seen as more effective supporters for this reason. Gender differences in the type of social support desired by a patient and in the type of support they expect to receive from a supporter of a particular gender make sense in this context. Men and women perceive different support needs in themselves and are also perceived to have different strengths in offering social support. Additionally, women and men may respond differentially to mobile interventions to increase social support.[51] Intervention designers may need to consider that activating the family may require different approaches based on gender.

Social context is likely critical in the diabetes self-management of patients at a safety-net emergency department, given the high level of social stress they face daily. The patients and supporters interviewed in this study identified social stressors as significant barriers to managing their diabetes, specifically housing and access to regular medical care. Achieving glycemic stability requires intense daily efforts at self-management to maintain a healthy diet, achieve a high level of physical activity, and follow a

complicated medication regimen. Alone, diabetes self-management can be an overwhelming task, even without the added burden of socioeconomic stressors. Patients who face additional challenges of securing sufficient food and crowded housing are at higher risk of poor disease outcomes; people who live in economically distressed neighborhoods are more likely to have complications from diabetes, with higher rates of renal failure, dialysis, and amputations after osteomyelitis. [52–55] These social stressors can play a role in nutrition choices, particularly for those with food insecurity or lack of adequate housing to prepare nutritious foods.

This study has several limitations. This is not an entirely comprehensive view of the experience of patients and supporters in the intervention. Patients and supporters were recruited for interviews after completing a 6-month educational intervention and 6-month post intervention phase study that was delivered via mobile text messages to encourage and challenge patients to make positive behavior changes. Active controls from this trial were not interviewed, and those who returned for interviews after the completion of the trial may represent a biased sample of the initial study population. Patients and supporters who come to the interviews are likely those who are most engaged in the intervention. The overall positive assessment of the intervention must be understood in that context. There is also the risk of recall bias given the 12-month time gap in the initial enrollment in the study and these interviews, as well as a 6-month gap between the final text message and these interviews. However, as this qualitative study is additional to the clinical trial of the intervention, we elected to wait until the trial was over to conduct deeply personal semi-structured interviews to avoid tampering with estimate of intervention effectiveness. Also, these interviews were conducted with an inductive goal and purposive sampling; the findings are not generalizable in isolation and require an understanding of context. While the results of this study come from limited resourced Latine patients in a safety net institution, the findings contribute to a deeper understanding of mHealth diabetes management in underserved communities, as well as persistent barriers that are not resolved by a low-touch intervention, that could be applied to other marginalized communities. Further investigations into how to best activate patients and their loved ones to engage in healthy disease-specific behaviors, and to face the environmental and social contexts they continue to face may benefit all.

This qualitative analysis of a novel mHealth-based social support intervention for Latine patients with diabetes and limited financial resources from safety-net emergency departments is critical for understanding how behavior change occurs within this population. It sheds light on the complex interplay of self-management, motivation, social support, and social context, all of which significantly influence intervention outcomes for high-risk patients. These findings are key to understanding this and future ICT and mHealth based interventions. By using an inductive approach to coding, areas of intervention impact and barriers to success were identified that were not anticipated in the initial intervention or trial design. And lastly, this analysis directs areas of intervention improvement so that TExT-MED+FANS can be further refined before it is implemented in a larger population and so similar interventions can be designed with these considerations.

Abbreviations

a. ED
Emergency Department
b. ICT
internet and communication technologies
c. mHealth
mobile health
d. RAs
Research Associates
e. TExT
MED+FANS-Trial to Examine Text-Messaging in Emergency patients with Diabetes+ Family and friends Network Support

Declarations

Ethics and consent to participate: Institutional review board approval for this study was obtained before study initiation from the University of Southern California Health Sciences Institutional Review Board (HS-17-00406). Informed consent to participate was obtained from all participants. Patients were consented in the language of their choice (Spanish or English) using written consent documents. Patients repeated back understanding of the study purpose to confirm understanding. Supporters were verbally consented in the language of their choice. All participants had the opportunity to ask questions and obtain clarification on the study purpose.

Consent for publication: Not applicable

Availability of data and materials: De-identified data is available by contacting the corresponding author at eburner@usc.edu and making appropriate plans for sharing with permission of the local institution review board.

Competing interests: Drs. Arora and Burner have received compensation as consultants and on advisory boards from Agile Health on separate SMS-based interventions for patient self-care, the company which hosted the intervention examined in this study. Agile Health has had no participation in the data collection, analysis or writing.

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Authors' contributions: EB designed the study, conducted the analyses, drafted the manuscript, and led manuscript revisions. JG, JS, and JM conducted interviews, contributed to data analyses, and assisted with manuscript writing. DH contributed to the data analyses and critically reviewed the manuscript. SA contributed to the study design and critically reviewed the manuscript. SW contributed to the study

design, conducted analyses, and critically reviewed the manuscript. All authors read and approved the final manuscript.

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