

# **Approaches to Engaging Low-Income Communities in Improving Their Diabetes Health: A Review of the Literature Published in the 21<sup>st</sup> Century**

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*Diabetes is a serious health condition and can lead to a variety of health complications and increased morbidity. For this reason, it is imperative that individuals with diabetes understand the seriousness of their condition and learn to self-manage this chronic disease. There are a number of diabetes interventions that can help individuals manage this condition; however, there are not many diabetes interventions specifically aimed at diabetics who live in low-income communities. The purpose of this paper is to review such interventions and to discuss the impact that these interventions have had on this population.*

## **INTRODUCTION**

Diabetes is the catapult from which other disease occurs such as heart disease (Almdal, Scharling, Jensen, & Vestergaard, 2004). Diabetes is more prevalent within low socioeconomic and minority communities (Kanaya, et al., 2012); Blacks and Latinos often experience a greater burden of diabetic complications than Whites (Spencer, et al., 2011). Since many people are living with diabetes, it becomes extremely important that they learn how to manage this chronic disease appropriately, especially to prevent diabetic complications. This is why disease self-management is so important (Ryan, Schwartz, Jennings, Fedders, & Vittoria, 2013). Community-based interventions that engage diabetic patients to control diabetes through education, self-management, and lifestyle changes have been implemented to address the issues and burdens caused by diabetes (Renders, Valk, Griffin, Wagner, & Assendelft, 2001). The purpose of this paper is to review extant literature published during the 21<sup>st</sup> century, to determine some of the approaches to engaging low-income-communities in improving their diabetes health.

Previous literature reviews or meta-analyses focused on a variety of specific diabetes interventions varying from exercise (Boulé, Haddad, Kenny, Wells, & Sigal, 2001), education (Ellis et al., 2004), and diet (Carter, Gray, Troughton, Khunti, & Davies, 2010), to overall self-management (Norris, Engelgau, & Narayan, 2001). Another literature review examined interventions that have taken place in a variety of

settings such as within the primary care setting, community environment, and outpatient care services as well as in different countries (Renders, et al., 2001). Another review has also looked at diabetes in conjunction with other diseases such as cardiovascular disease, hypertension, and obesity (Jenum, et al., 2006). Other reviews included randomized-controlled trials only (Norris et al., 2001), or cost-effectiveness analyses only (Loveman et al., 2003). Our study differs from previous reviews in that it reviews interventions with a major focus on diabetes. It reviews studies conducted in the US only, but it considers all the different community-based interventions, for a low-income diabetic population, that were published from January 2001 until August 31<sup>st</sup> 2013.

## **METHODOLOGY**

### **Identification of Interventions**

The search for published community-based interventions, from January 2001 until August 31, 2013, that addressed diabetes among a low-income population in the United States, was conducted using electronic databases PubMed, CINAHL, and ABI Inform. We originally used additional data bases such as ProQuest, EBSCO, Academic Search Premier and Google Scholar, but we found duplicated articles across all the databases. Therefore, it was deemed necessary to use PubMed, CINAHL, and ABI Inform. We used keywords “diabetes”, “low-income communities”, and “interventions”. Using keyword “diabetes” pulled up all the articles related to diabetes.

### **Study Selection**

We gathered a total of 199 articles, of which 53 articles were removed because they were duplicates. From the remaining 146 articles, 98 articles were removed because they did not meet our inclusion criteria. We excluded interventions that were not intended for low-income communities, interventions implemented in other countries, articles that reported only the process of subjects’ recruitment, interventions that did not directly address diabetes, studies that used secondary data and did not involve community intervention, and literature reviews. As a result our final sample consisted of 48 articles.

## **RESULTS**

Of the 48 articles included in this review, 27 studies (56%) were published during the last three to four years of the study period (2010-2013), which might suggest a growing trend in the publication of community-based interventions related to low-income diabetics. These 48 articles were categorized according to the following variables: (1) purpose of the intervention, (2) target population, (3) type of intervention, (4) techniques used in the intervention, (5) healthcare providers involved in the intervention, (6) number of diseases addressed in the intervention, (7) geographic location of the intervention, (8) facilities used for the intervention, (9) study design to evaluate the effectiveness of the intervention, and the (10) results of the intervention.

### **Purpose of the Intervention**

The purpose of the intervention falls into three categories: interventions to prevent diabetes among populations at risk, interventions to treat and care for diabetics, and interventions that addressed diabetes complications such as amputation and depression. A total of 14 interventions were aimed at preventing diabetes, 31 interventions were aimed at controlling and caring for diabetics, and four interventions were aimed at preventing diabetes complications (McKee, 2011; Scollan-Koliopoulos, 2004; Spencer, 2013; Walker, 2001). One of these interventions combined both diabetes prevention and care (McCloskey, 2009). For the sake of saving space, we did not include in-text citation strings with more than six authors; however, tables with all the authors are provided to summarize our findings. The summary of this finding is presented in Table 1.

**TABLE 1  
PURPOSES OF THE INTERVENTIONS AND SUBJECTS' RACE/ETHNICITY**

AUTHOR	PURPOSE OF THE INTERVENTION			SUBJECT'S ETHNICITY									
	Prevention	Treatment, Care	Prevention of Complications	Hispanics		African American			Asian	All Races	All Races	All Races	Multiple Races
				Women	Men and Women	Women	Men and Women	Children	Adults	Elderly	Children	Adults	
Mayer-Davis et al. (2001)		X										X	
Walker, et al. (2001)			X									X	
Auslander, et al. (2002)	X					X							
Fanning (2002)		X			X								
Lorig et al. (2003)		X			X								
Scollan-Koliopoulos (2004)			X					X					X
Vetter et al. (2004)		X						X					
Rosal et al. (2005)		X			X								
Lujan (2006)		X			X								
Seliger, et al. (2006)	X				X								
Lujan et al. (2007)		X			X								
Batik, et al. (2008)		X								X			X
Culica, et al. (2008)		X			X								
Fischer, et al. (2008)		X			X								





## **Target Population**

The target population was divided into sub-categories such as race, gender and age. A total of 22 interventions were implemented for the Hispanic population, of which, 21 involved both males and females, and one intervention was targeted toward diabetic women (Sorkin, 2013). A total of six interventions targeted the African American population, of which, one intervention was aimed at African American women and another intervention was intended for African American children (Auslander, Haire-Joshu, Houston, Rhee, & Williams, 2002; Peek, 2012; Scollan-Koliopoulos, 2004; Sharma, 2012; Vetter, 2004). One intervention was for a low-income Asian American community based in California including men and women (Seto, 2012). In addition, regardless of race, we found another intervention aimed at the elderly population (Batik, 2008) and another intervention for all the children in the community. We found 20 interventions that targeted more than one race. Summary of the target population is found in Table 1.

## **Types of Interventions**

Our review found several interventions including weight management, diet, case management, self-care and lifestyle, physical activity, medication adherence, and process redesign. Some studies included more than one intervention. We found a total of four interventions on weight management (Mayer-Davis, 2001; Ockene et al., 2012; Parikh et al., 2010), 12 interventions on diet, nine interventions on case management, 24 interventions on self-care, 13 interventions on physical activity promotion, four interventions on medication adherence (Allen et al., 2011; Ell et al., 2010; Gerber et al., 2012; McKee et al., 2011), and one intervention focused on the redesign of point-of care HbA1c testing for glycemic control and diabetic regimen intensification rate (Rust et al., 2008). The summary of the interventions is found in Table 2.

## **Techniques Used in the Interventions**

Some techniques used in these interventions included one or a combination of the following: education and counseling, phone calls, report card, home visits, clinic visits, diabetes, and the Internet. A total of 23 interventions included education and counseling, five interventions used phone calls (Ell et al., 2010; Kanaya et al., 2012; Peek et al., 2012; Rosal et al., 2011; Spencer et al., 2011), one intervention used report cards to monitor the health status of patients (Fischer et al., 2011), two studies used home visits (Sorkin et al., 2013; Spencer et al., 2011), one study used clinic visits (Spencer et al., 2011), two studies used the diabetes registry to reach diabetic patients, and one study used the Internet whereby subjects posted and monitored their daily health metrics (Mayer-Davis, 2001; Seto, Turner, Champagne, & Liu, 2012). One study used group meetings for peer support (Sorkin et al., 2013), and one intervention was aimed at changing the environment to improve children's health lifestyle (Samuels et al., 2010). The summary of techniques used is found in Table 2.

## **Health Care Providers Involved in the Interventions**

Our review found interventions that included one or more of the following health care providers: community health workers or health promoters (12 studies), lay community workers (3 studies) (Lujan, 2006; Lujan, Ostwald, & Ortiz, 2007; Seliger, Simons, & Maida, 2006), and clinicians including physicians, nurses, pharmacists, dieticians, and specialists (12 studies). The summary of the healthcare providers involved in the intervention is found in Table 2.

**TABLE 2**  
**TYPES OF INTERVENTIONS AND HUMAN RESOURCES USED**

Authors	Weight Management, Diet	Case Management	Self-Management, Services Utilization, Health Behaviors	Physical Activity	Counseling, Education	Community Health Workers, Lay Workers	Clinicians: Physicians, Nurses, Pharmacists, Specialists, Dieticians
Mayer-Davis et al. (2001)	X						
Walker et al. (2001)					X		
Auslander et al. (2002)	X						
Fanning (2002)		X					
Lorig et al. (2003)			X				
Scollan-Koliopoulos (2004)					X		
Vetter et al. (2004)		X				X	
Rosal et al. (2005)			X				
Lujan (2006)			X			X	
Seliger et al. (2006)			X		X	X	
Lujan et al. (2007)					X	X	
Batik et al. (2008)				X	X		
Culica et al. (2008)			X		X	X	
Fischer et al. (2008)			X		X		X
Rust et al. (2008)							
Sekhobo et al. (2008)		X			X		
Gary et al. (2009)		X				X	
McCloskey (2009)						X	
Merriam (2009)	X			X	X		
Rosal et al. (2009)			X	X	X		
Whittemore et al. (2009)	X			X	X		X
Delgado et al. (2010)	X			X	X		
Ell et al. (2010)		X	X		X		X
Otero-Sabogal et al. (2010)			X			X	X
Parikh et al. (2010)	X		X	X	X		





### **Number of Diseases Addressed in the Interventions**

While the majority of the interventions were exclusively for diabetes (44 studies), another intervention was not age- or health-status specific as it was related to diabetes screening (Seliger et al., 2006), and three interventions involved diabetes and other chronic diseases such as lung disease, heart disease, cardiovascular disease, and hypertension (Allen et al., 2011; Lorig, 2003; McKee et al., 2011).

### **Geographic Locations of the Interventions**

Among the interventions that specified their respective geographic locations, we found three studies located in rural areas (Egede, Strom, Fernandes, Knapp, & Rojgobokan, 2011; Mayer-Davis, 2001; Millard et al., 2011) and 13 studies in urban areas.

### **Facilities Used for the Interventions**

We found a total of 13 interventions administered at community health centers and 10 interventions at primary care facilities or clinics. In addition, two interventions were church-based (Lujan, 2006; Scollan-Koliopoulos, 2004), three interventions were home-based (McKee et al., 2011; Peek et al., 2012; Vetter, 2004) and two interventions were administered at public health departments (Delgadillo et al., 2010; Kanaya et al., 2012).

### **Study Designs Used to Evaluate the Interventions**

The majority of intervention evaluations used randomized controlled trials (28 interventions). Eight studies used non-randomized pre-post design, two studies used cost-effectiveness analysis (Brown et al., 2012; Fanning, 2002), one study used effectiveness analysis (Fischer, Mackenzie, McCullen, Everhart, & Estacio, 2008), and another study used retrospective design (Sekhobo, Wang, & Ferrari, 2008). In addition, four studies used surveys (Fischer et al., 2011; Otero-Sabogal et al., 2010; Parikh et al., 2010; Scollan-Koliopoulos, 2004) and another four studies were qualitative using case studies, interviews, or focus groups (Huckfeldt et al., 2012; McCloskey, 2009; Merriam et al., 2009; Peek et al., 2012). Among these studies, we found seven pilot studies, three feasibility studies (Culica, Walton, Harker, & Prezio, 2008; Rust et al., 2008; Ryan, Schwartz, Jennings, Fedders, & Vittoria, 2013), and one observational study (Fanning, 2002). The summary of the study designs is in table 3.

### **Results of the Interventions**

A total of 36 interventions reported significant improvement on their variables of interest, three interventions reported partially significant improvement, and two interventions generated partially significant results (McKee et al., 2011; Millard et al., 2011; Sharma & Fleming, 2012). The intervention that used a report card to monitor diabetes did not have a significant impact on the subjects (Fischer et al., 2011) and one intervention did not evaluate its effect on the subjects (Sorkin et al., 2013). A mid-point review of the intervention on changing childhood environment suggested some improvement in children's lifestyle, but no statistical analyses were performed (Samuels et al., 2010). We could not get the results from eight interventions because they are not yet completed.

Of the 22 completed interventions that used randomized controlled trials, 18 reported significant results (81%). In addition, seven of the eight non-randomized pre-post interventions reported significant results (Auslander, Haire-Joshu, Houston, Rhee, & Williams, 2002; Otero-Sabogal et al., 2010; Ruggiero, Oros, & Choi, 2011; Rust et al., 2008; Ryan, Jennings, Vittoria, & Fedders, 2013; Samuels et al., 2010; Seto et al., 2012). The intervention for the prevention of diabetes among African American children found that the intervention made a significant difference in the reduction of energy and fat intake between the boys in the intervention and control groups. No significant difference was found in the energy intake between girls in the intervention and control groups (Sharma & Fleming, 2012). The authors, Sharma and Fleming (2012), recommended future interventions to design a special study for girls only. The internet-based intervention produced significant results in terms of low-density lipoprotein (LDL) decrease but the levels of triglycerides increased among people who were more active using chat messages. The authors

suggested that an Internet-based intervention might be effective but costly to manage (Ryan, Schwartz, et al., 2013).

Some interventions focused on one or a combination of the following: weight management, diet, case management, self-management, and counseling or education yielded significant results. In addition, interventions that used community health workers only or community health workers coupled with clinicians also had significant results. The combination of phone calls and education also yielded significant results. Regardless of race, gender or age all the completed interventions that targeted the entire community or a certain group of the community produced significant results, except for the study on the use of a report card to control diabetes among adult diabetics which did not yield a significant effect (Fischer et al., 2011) and three studies that yielded partially significant effects (McKee et al., 2011; Millard et al., 2011; Sharma & Fleming, 2012).

Some authors who implemented interventions targeted toward Hispanic communities suggested that to be effective, the interventions need to be tailored to match the culture of the community (Lujan, 2006; Lujan et al., 2007; Rosal et al., 2011). In addition, they suggested that the use of community health workers or lay community workers were highly effective on interventions for the Hispanic population (Lujan, 2006; Lujan et al., 2007; Rosal et al., 2011; Spencer et al., 2011). Oftentimes it is difficult for a patient to spend a sufficient amount of time with a doctor and get all of their questions answered. Having a community health worker spend time with patients might help to alleviate this problem. Community health workers do a variety of things including patient education, identifying resources for patients, and providing case management (Spencer, et al., 2011). Thus, health care workers including doctors, nurses, and community health workers must be trained and culturally competent in order to relate to Latino individuals and to understand the patient's circumstances which may have a great bearing on their adherence to treatment (Sorkin, et al., 2013). Additionally, in order for some interventions to be successful, the entire family has to be involved. This is especially true with the Hispanic/Latino culture (Sorkin, et al., 2013).

Furthermore, in order to have successful interventions in a low-income community, there must be a sense of trust between the workers and community members. Community members should be involved to help design the intervention. There must also be collaboration among community organizations, and a way to track the progress of the intervention so that changes can be made if necessary (Parra-Medina, et al., 2004).

In general, the interventions had significant impact on the target populations. With respect to the purpose of the intervention, 9 of 11 completed interventions to prevent diabetes or reduce diabetes risk levels generated significant results. In addition, 26 of 27 completed interventions towards diabetes control and care yielded significant outcomes and 3 of 4 of the completed interventions that focused on diabetes complications provided significant results (Scollan-Koliopoulos, 2004; Michael S. Spencer, Hawkins, Espitia, Sinco, & et al., 2013; Walker, 2001). The summary of the results of the interventions is in Table 3.

**TABLE 3  
STUDY DESIGN AND OUTCOMES**

	RCT <sup>a</sup>	Pre-Post	CEA <sup>b</sup>	FBS <sup>c</sup>	OBS <sup>d</sup>	Surveys	QS <sup>e</sup>	RD <sup>f</sup>	Pilot study	Significant Outcomes	Partial Outcomes	No significant outcomes	Ongoing study
Mayer-Davis et al. (2001)	X								X	X			
Walker et al. (2001)	X									X			
Auslander, et al.(2002)	X	X								X			
Fanning (2002)			X		X					X			
Lorig et al. (2003)										X			
Scollan-Koliopoulos (2004)					X					X			
Vetter, et al. (2004)	X									X			
Rosal et al.(2005)	X								X	X			
Lujan (2006)	X									X			
Seliger et al. (2006)										X			
Lujan et al. (2007)	X									X			
Batik et al. (2008)	X									X			
Culica et al. (2008)				X						X			
Fischer et al. (2008)													X
Rust et al. (2008)		X		X					X	X			
Sekhobo et al. (2008)								X		X			
Gary et al. (2009)	X									X			
McCloskey (2009)							X			X			
Merriam (2009)	X												X
Rosal et al. (2009)	X												X
Whittemore et al.(2009)	X								X	X			
Delgadillo et al.(2010)	X												X
Ell et al. (2010)	X									X			
Otero-Sabagal et al. (2010)		X			X		X			X			
Parikh et al. (2010)					X				X	X			



## DISCUSSION

Our review showed that a significant amount of research has been conducted in the United States over the past 13 years that focused on diabetes, but far fewer have been conducted in low-income communities. Our review focused on 48 eligible studies - which represent approximately 25% of the number of articles originally identified for review. This percentage emphasizes the need for more studies of low-income populations with diabetes because the engagement of those populations will be important for better understanding how they are managing diabetes and whether or not effective strategies are being employed to decrease incidence rates.

Several techniques were found in this review to be successful from the standpoint of engaging diabetic patients. First, the use of intervention techniques including self-management, frequent utilization of health services and adoption of a healthy behavior using weight management, diet, and physical activities showed evidence that greater engagement of the subjects generates significant results. These findings suggest that practitioners may wish to use these types of engagement techniques with diabetic patients given their association with successful outcomes. Second, the review showed that approaches using community health workers and clinicians were associated with more successful outcomes. There is evidence in the literature supporting the use of community health workers in diabetes intervention. Jenkins, et al., (2010) reported that based on the Racial and Ethnic Approaches to Community Health (REACH), community health workers ensured that people were linked with health professionals in community sites who taught people how to correctly use glucose monitoring meters.

Similarly, Andrews, Felton, Wewers & Health (2004) provided evidence indicating that community health workers are effective in increasing access to health services, increasing knowledge, and promoting behavior change among ethnic minority women as well as providing social support and culturally competent, cost-effective care. Third, the review indicates that a focus on the culture of the community made a significant difference in effectiveness of interventions, particularly in Latino communities. This finding is consistent with that found in the literature. Osborn, Amico, Cruz, O'Connell, & Perez-Escamilla, (2010) reported that the use of the "information – motivation – behavioral skills" model when culturally tailored to diabetes interventions in Puerto Rican patients enhanced patients' knowledge, motivation, and behavior skills needed for self-care. Likewise, Deitrick, Paxton, Riviera, Gertner, & Biery (2010) articulated the importance of culture in diabetes education via the use of a "Promotora de Salud" (health educator) who was Latina and conducted diabetes education in the community in Spanish, resulting in program participant satisfaction, increased ability to self-manage diabetes, and strengthened connections with other Latino diabetics.

Technology is another factor worthy of consideration in this review. It has become an increasingly important part of healthcare services delivery (Chen, Chen, Weng, Shang, & Yu, 2012; McBride, Delaney, & Tietze, 2012), patient education (Alexander, Frith, O'Keefe, & Hennigan, 2011; Chiu, 2011; Theroux, 2009) and patient interventions (Gesler, Hayes, Arcury, Skelly, & Nash, 2004; Rockefeller, 2008). Increasingly, technology is also being used in the healthcare field for patient engagement (Graffigna, Barello, & Riva, 2013; Perna, 2012; Shapiro-Mathews & Barton, 2012).

In this review one intervention, Ryan, Jennings and Fedders (2013) used the Internet as a tool for self-management with the finding that LDL level decreased but triglyceride levels increased among people who used chat messages more frequently. However this study did not determine what other contributing factors may be responsible for this finding. Also, two studies, Mayer-Davis et al. (2001) and Seto et al. (2012), in this review noted the use of a diabetic registry. Disease registries are databases used to identify a patient population, track the disease process and coordinate care for that population, and using a diabetic registry can assist healthcare providers in coordinating care needed for individual patients (Halvorson, 2009). In a study, conducted by Seto, et al. (2012), of a community center in California serving primarily low-income Asian American immigrants, the authors found that the center's use of a diabetic registry resulted in 59% of patients achieving controlled diabetes – outperforming the average control rate reported by commercial carriers (43.3%), Medicare (43.4%) and Medicaid (32.9%).

Furthermore, other studies of diabetics have included the use of technology as a patient engagement component providing additional evidence of the role of technology in diabetes patient engagement (Grant et al., 2006; Jethwani et al., 2012; Warrise Turner et al., 2013). Given the prevalence of technology use in the healthcare field in the area of patient engagement, its use in engagement of diabetics and the aforementioned examples of the use of diabetic registries, it is surprising that more studies in this review did not include technology as a means of engaging diabetic patients. Perhaps the expense of such technologies is a factor. Adler-Millstein et al. (2007) found that an application service provider-based stand-alone diabetes registry with clinical reminders ranged from \$35,900 for a small practice to \$68,700 for a large practice and these costs do not include annual fees to maintain the software. Such costs can be prohibitive. Additionally, the level of technological literacy among low-income communities may explain the lack of technology use in studies in this review as some studies in the literature have shown lack of computer literacy in low-income communities (Mehra, Merkel, & Bishop, 2004; Shafir, Sinai, & Yuan, 2012). Perhaps the combination of both factors (technological expense and low technological literacy) explains these results.

While some studies focused on women, we did not find any studies specifically targeting men; however, men usually do not participate in regular provider check-ups (Courtenay, 2000). Since African American men and Native Americans, in general, are less likely to trust the medical institution (Shavers, Lynch, & Burmeister, 2002), a community-based intervention might offer a less intimidating environment in which they may be encouraged to participate.

### **Limitations**

This review has some limitations with respect to the generalization of the interventions, the information from the studies, the community engaged in the interventions, and the conclusion from the studies. Since all the interventions in this review were implemented at community level, generalization is only possible towards the community in which the interventions were implemented. Implementing an intervention that was successful in a county in rural Alabama might not get the same results if it is implemented in another county in rural Oregon because of differences in the macro environment. In addition, while ten variables pertinent to the interventions were presented here there are other areas related to engagement that were not included because they were not available. These include the total cost of each intervention and the source of funding. Given the scarcity of financial resources, knowing the cost of each intervention and the source of funding might help other communities to realize if an intervention is worth trying or not.

In addition, it is possible that culture may be a factor leading to the lack of interventions towards other ethnic communities. Because of past negative experiences with outside researchers, American Indian and Native Alaskan communities, for example, do not always view health research favorably (Tom-Orme, 2006); they might be reluctant to participate in a community-based intervention. This may have contributed to the lack of published interventions on these populations. Finally, another limitation is that not all interventions are published, thus we can only report on what has been published in the literature. It is possible that other studies have been conducted, which were not published, giving us only a partial view of the total number of studies conducted on diabetes engagement techniques in low-income communities and the conclusion with respect to the effectiveness of these studies.

### **Recommendations for Future Interventions**

Based on our review we offer several recommendations for the research and health practitioner communities. First, while there was ample representation of the Latino communities in our study (46%), there is a paucity of studies in our review focusing on other ethnicities such as African American, Asian, American Indian /Alaskan, or Native Hawaiian/Pacific Islander, including men. The age-adjusted percentages of diabetes among persons 18 and over in 2010 in these communities are 12.9, 9.1, 17.5, 23.7, respectively (CDC, 2010) thus offering support for the need for more diabetes research in these communities.

Second, the use of technology as a twenty-first century approach for engaging low-income communities must be further explored. The evidence shows that health information technology interventions have been shown to be helpful in improving provider-patient communication and care in general but the cost of these interventions can be cost-prohibitive in settings focusing on care for low-income patients (Ngo-Metzger, Hayes, Chen, Cygan, & Garfield, 2010). But as the prices for technologies decrease over time and as the rest of the population's use of technology increases, practitioners should selectively determine which technologies are affordable enough to incorporate into practice. Failure to do so may widen the digital divide – a concept defined as “the gap that exists between individuals advantaged by the Internet and those individuals relatively disadvantaged by the Internet” (Rogers, 2002).

Finally, in engaging diabetic patients there may be a role for tailoring therapies (based on income), personalization of educational materials, and/or feedback from patients. Research by Gilmer et al. (2007) shows the cost-effectiveness of Project Dulce – a culturally specific diabetes case management and self-management program administered in low-income populations. Additionally, Bosma, Lamers, Jonkers, & van Eijk, (2011) found positive effects on depression, health-related quality of life and self-efficacy in diabetes self-management based on education level. The evidence from these studies suggests that tailoring interventions may be associated with positive outcomes.

## CONCLUSION

Diabetes is a chronic disease that can lead to early death or trigger the onset of other health issues and complications. Some community-based interventions have been conducted to address this epidemic. The purpose of this study was to review low-income community-based interventions to reduce diabetes risk, control diabetes, and prevent diabetes complications based on literature published during the 21<sup>st</sup> century. The majority of the interventions focused on diabetes control through self-management, education, lifestyle change, and the use of community health workers and/or clinicians. We also found that interventions for Hispanic/Latino communities outnumbered those intended for African American and other race/ethnic minorities. Most of the interventions resulted in significant improvement, from baseline, of the variables of interest; randomized controlled trials were the most used study design. Future interventions should consider the use of technologies, customization of the interventions to fit the specific profiles of the subjects, and target other race/ethnic groups.

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