Literature Review of Type 2 Diabetes Management and Health Literacy

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OBJECTIVE | The purpose of this literature review was to identify educational approaches addressing low health literacy for people with type 2 diabetes. Low health literacy can lead to poor management of diabetes, low engagement with health care providers, increased hospitalization rates, and higher health care costs. These challenges can be even more profound among minority populations and non-English speakers in the United States.

METHODS | A literature search and standard data extraction were performed using PubMed, Medline, and EMBASE databases. A total of 1,914 articles were identified, of which 1,858 were excluded based on the inclusion criteria, and 46 were excluded because of a lack of relevance to both diabetes management and health literacy. The remaining 10 articles were reviewed in detail.

RESULTS | Patients, including ethnic minorities and non-English speakers, who are engaged in diabetes education and health literacy improvement initiatives and ongoing follow-up showed significant improvement in A1C, medication adherence, medication knowledge, and treatment satisfaction. Clinicians considering implementing new interventions to address diabetes care for patients with low health literacy can use culturally tailored approaches, consider ways to create materials for different learning styles and in different languages, engage community health workers and pharmacists to help with patient education, use patient-centered medication labels, and engage instructors who share cultural and linguistic similarities with patients to provide educational sessions.

CONCLUSION | This literature review identified a variety of interventions that had a positive impact on provider-patient communication, medication adherence, and glycemic control by promoting diabetes self-management through educational efforts to address low health literacy.

Diabetes is the seventh leading cause of death in the United States, and 30.3 million Americans, or 9.4% of the U.S. population, are living with diabetes (1,2). For successful management of a complicated condition such as diabetes, health literacy may play an important role. Low health literacy is a well-documented barrier to diabetes management and can lead to poor management of medical conditions, low engagement with health care providers (HCPs), increased hospitalizations, and, consequently, higher health care costs (3–5).

The Healthy People 2010 report (6) defined health literacy as the "degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions." Diabetes health literacy also encompasses a wide range of skills, including basic knowledge of the disease state, self-efficacy, glycemic control, and self-care behaviors, which are all important components of diabetes management

(3–5,7). According to the Institute of Medicine's Committee on Health Literacy, patients with poor health literacy are twice as likely to have poor glycemic control and were found to be twice as likely to be hospitalized as those with adequate health literacy (8). Associations between health literacy and health outcomes have been reported in many studies, the first of which was conducted in 1995 in two public hospitals and found that many patients had inadequate health literacy and could not perform the basic reading tasks necessary to understand their treatments and diagnoses (9).

Evaluation of health literacy is vital to the management and understanding of diabetes. Several tools for assessing health literacy have been evaluated, and the choice of which to use depends on the length of the patient encounter and the desired depth of the assessment. One widely used literacy assessment tool, the Test of Functional Health Literacy in Adults (TOFHLA), consists of 36 comprehension questions

and four numeric calculations (10). Additional tools that assess patients' reading ability include the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Literacy Assessment for Diabetes. Tests that assess diabetes numeracy skills include the Diabetes Numeracy Test, the Newest Vital Sign (NVS), and the Single-Item Literacy Screener (SILS) (11).

Rates of both diabetes and low health literacy are higher in populations from low socioeconomic backgrounds (5,7,12). People living in disadvantaged communities face many barriers when seeking health care, including inconsistent housing, lack of transportation, financial difficulties, differing cultural beliefs about health care, and mistrust of the medical professions (13,14). People with high rates of medical mistrust tend to be less engaged in their care and to have poor communication with HCPs, which is another factor HCPs need to address when working with their patients with diabetes (15).

The cost of medical care for people with diabetes was $327 billion in 2017, a 26% increase since 2012 (1,16). Many of these medical expenditures are related to hospitalization and inpatient care, which accounts for 30% of total medical costs for people with diabetes (16).

People with diabetes also may neglect self-management tasks for various reasons, including low health literacy, lack of diabetes knowledge, and mistrust between patients and HCPs (7,15).

These challenges can be even more pronounced in vulnerable populations because of language barriers and patient-provider mistrust (17–19). Rates of diabetes are higher among racial and ethnic minority groups; 15.1% of American Indians and Alaskan Natives, 12.7% of Non-Hispanic Blacks, 12.1% of Hispanics, and 8% of Asian Americans have diagnosed diabetes, compared with 7.4% of non-Hispanic Whites (1). Additionally, patient-provider relationship deficits can be attributed to challenges with communication, including HCPs' lack of attention to speaking slowly and clearly and checking for patients' understanding when providing education or gathering information from people who speak English as a second language (15). White et al. (15) demonstrated that patients with higher provider mistrust felt that their provider's communication style was less interpersonal and did not feel welcome as part of the decision-making process.

To the authors' knowledge, there is no current literature review evaluating interventions focused on health literacy and diabetes management. There is a pressing need for such a comprehensive review to provide a framework for future intervention design. The objective of this literature review was to gather and summarize studies of health literacy–based diabetes management interventions and their effects on

overall diabetes management. Medication adherence and glycemic control were considered secondary outcomes.

Research Design and Methods

Search Strategy

A literature review was conducted using the PubMed, Medline, and EMBASE databases. Search criteria included articles published between 2015 and 2020 to identify the most recent studies on this topic. The search included the phrases "diabetes" and "health literacy" to specifically focus on health literacy and diabetes management interventions and was limited to original research conducted in humans and published in English within the defined 5-year period. Search results were exported to Microsoft Excel for evaluation.

Study Selection

Initial screening of the articles' abstracts was conducted using the selection criteria to determine which articles to include or exclude (Figure 1). The initial search results were reviewed for the following inclusion criteria: original research (clinical trials, cohort studies, and cross-sectional studies) conducted in human subjects with type 2 diabetes in the United States, and published in English between 2015 and 2020. Articles were considered to be relevant if diabetes was included as a medical condition in the study
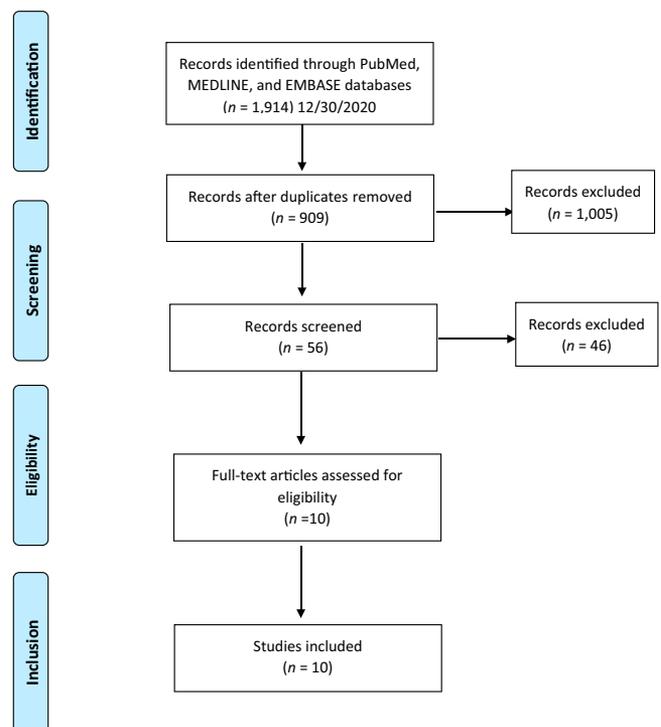

FIGURE 1 PRISMA diagram of the article selection process.

and an intervention was made to assess or improve health literacy. Studies involving type 1 diabetes or gestational diabetes and articles that were viewpoints, population surveys, commentaries, case reports, reviews, or reports of interventions conducted outside of the United States were excluded from further review. The criteria requiring articles to be from the past 5 years and from the United States were used because of the unique and quickly evolving nature of the U.S. health care system. Articles published more than 5 years ago or from other health care systems may have contributed information that was not applicable to or no longer relevant for HCPs in the United States. Articles were screened and reviewed independently by both authors. Disagreements were resolved through discussion to create the final list of articles for inclusion.

Data Extraction

A standard data extraction was performed for each included article to obtain information including author names, year of publication, journal, study design, type of intervention, primary outcome, tools used to assess health literacy or type 2 diabetes knowledge, and effects of intervention on overall diabetes management, glycemic control, and medication adherence.

Results

A total of 1,914 articles were collected from a search of the PubMed, MEDLINE, and EMBASE databases, of which 1,858 were excluded based on the inclusion and exclusion criteria. Of the 56 articles that met criteria for abstract review, 46 were excluded because of a lack of relevance to both diabetes management and health literacy. The remaining 10 studies identified various diabetes management interventions, including diabetes education tools such as electronic medication instructions and text message–based interventions, technology-based education videos, enhanced prescription labels, learner-based education materials, and culturally tailored interventions (15,20–28). Figure 1 shows the PRISMA diagram of the article selection process, and Table 1 summarizes the findings of the article reviews (15,20–28).

Medical mistrust and poor communication are challenging variables in diabetes education. White et al. (15) examined the association between communication quality and medical mistrust in patients with type 2 diabetes. HCPs at five health department clinics received training in effective health communication and use of the PRIDE (Partnership to Improve Diabetes Education) toolkit in both English and Spanish, whereas control sites were only exposed to National Diabetes Education Program materials without training in effective communication. The study evaluated participant communication using several tools, including the Communication Assessment Tool

(CAT), Interpersonal Processes of Care (IPC-18), and the Short Test of Functional Health Literacy in Adults (s-TOFHLA). The authors found that higher levels of mistrust were associated with lower CAT and IPC-18 scores.

Patients with type 2 diabetes are also likely to benefit from personalized education delivery tools such as patient-centered labeling (PCL) of prescription drugs, learning style–based education materials, and tailored text messages (24,25,27). Wolf et al. (27) investigated the use of PCL in patients with type 2 diabetes and found that patients with low health literacy who take medication two or more times per day have higher rates of proper medication use when using PCL (85.9 vs. 77.4%, $P = 0.03$). The objective of the PCL intervention was to make medication instructions and other information on the labels easier to read to improve medication use and adherence rates. The labels incorporated best-practice strategies introduced by the Institute of Medicine for the Universal Medication Schedule. These strategies prioritize medication information, use of larger font sizes, and increased white space. Of note, the benefits of PCL were largely seen with English speakers. Spanish speakers did not have substantial improvement in medication use or adherence, which could be attributed to language barriers (27).

Nelson et al. (25) analyzed patients' engagement with an automated text message approach to supporting diabetes self-care activities in a 12-month randomized controlled trial (RCT) called REACH (Rapid Education/Encouragement and Communications for Health) (25). Messages were tailored based on patients' medication adherence, the Information-Motivation-Behavioral Skills model of health behavior change, and self-care behaviors such as diet, exercise, and self-monitoring of blood glucose. Patients in this trial were native English speakers, so further research to evaluate the impact of the text message intervention in patients with limited English language skills is still needed. However, participants in the intervention group reported higher engagement with the text messages over the 12-month period (25).

Patients who receive educational materials based on their learning style also show significant improvement in their diabetes knowledge and health literacy. Koonce et al. (24) developed and evaluated educational materials based on patients' learning style to improve health literacy in both English and Spanish languages. The materials were made available in multiple formats to target four different learning styles, including materials for visual learners, read/write learners, auditory learners, and kinesthetic learners. Spanish-language versions were also available. Researchers were primarily interested in measuring patients' health literacy and knowledge of diabetes. The intervention group

TABLE 1 Findings of the Article Reviews (15,20–28)

Article	Study Design; Sample	Intervention	Assessment Tools	Primary Outcome	Other Outcomes	Effects on Glycemic Control	Effects on Medication Adherence
Graumlich et al. (20)	RCT; 674 people with type 2 diabetes	Comparison of the use of a medication planning tool (Medtable) vs. standard care to improve diabetes management	REALM and DKT	Medication knowledge	Satisfaction with medication information, medication adherence, A1C	No difference noted between intervention and control groups at 6 months	No difference noted between the intervention and control groups
Goessl et al. (21)	RCT; 442 people with type 2 diabetes	Comparison of lifestyle-based diabetes prevention education provided in either a recorded DVD format or in-person sessions designed for people with low health literacy to assess comprehension; curriculum covered physical activity, food choices, and portion sizes, followed by provision of a personalized plan for weight loss	NVS	Information comprehension	None	Not assessed	Not assessed
Hofer et al. (22)	RCT; 176 Hispanics and African Americans with type 2 diabetes	Participants received a CHW-led medication self-management intervention consisting of a home visit and two follow-up phone calls	SILS	Type 2 diabetes self-efficacy, type 2 diabetes distress, and health literacy	None	Not assessed	Increase in satisfaction with medication information was correlated with improved medication adherence for women
Kim et al. (23)	RCT; 250 Korean Americans with type 2 diabetes	Culturally tailored type 2 diabetes intervention that included a series of behavioral education sessions, training for self-monitoring of glucose, and individualized counseling sessions using motivational interviewing	DKT	A1C, total cholesterol, and LDL cholesterol	Diabetes Quality of Life measure	Change in A1C was significantly higher in intervention group	Not assessed
Koonce et al. (24)	RCT; 160 English- or Spanish-speaking people with type 2 diabetes	Education materials based on learning style and health literacy level; material used for the intervention group were developed to reflect content of the DKT	DKT, three-item assessment for health literacy	Change in DKT score	None	Not assessed	Not assessed
Nelson et al. (25)	RCT; 256 people with type 2 diabetes	A 12-month program of text messages using an electronic interface called MEMOTEXT to support diabetes self-care interventions; messages were tailored based on participants' medication adherence and the Information-Motivation-Behavioral Skills model of health behavior change, and self-care behaviors such as diet, exercise, and glucose monitoring	Brief Health Literacy Screen	Patient engagement	None	Not assessed	Not assessed

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TABLE 1 Findings of the Article Reviews (15,20–28)

Article	Study Design; Sample	Intervention	Assessment Tools	Primary Outcome	Other Outcomes	Effects on Glycemic Control	Effects on Medication Adherence
Sharp et al. (26)	Cross-over trial; 244 African Americans and Hispanics with type 2 diabetes	Assessment of the effect of having access to a clinical pharmacist and CHW on glycemic control; all participants received care from a clinical pharmacist for 2 years and were randomized to receive CHW support either for the first year or the second year	Three-item assessment for health literacy, Spoken Knowledge in Low Literacy in Diabetes Scale	A1C	Changes in systolic and diastolic blood pressure, HDL cholesterol, LDL cholesterol, BMI, quality of life, and perceived social support	Patients enrolled into the sequence with both a CHW and pharmacist had a significant decrease in A1C vs. patients enrolled in the pharmacist-only sequence in year 1	No change noted in medication adherence in either group
White et al. (15)	RCT; 410 English- or Spanish-speaking people with type 2 diabetes	Providers in half of 10 clinics were trained on effective health communication and how to communicate with patients with low health literacy; those from the intervention sites were also given the PRIDE toolkit	s-TOFHLA	Association between communication quality and medical mistrust	None	Glycemic control was not correlated with mistrust scores	Not assessed
Wolff et al. (27)	RCT; 845 English- or Spanish-speaking people with type 2 diabetes who were taking ≥2 oral medications	Participants received PCL for their oral diabetes medication in an effort to improve proper medication use and adherence	REALM, SAHLSA	Proper medication use	Medication adherence	Not assessed	Patients with limited health literacy and those taking medications ≥2 times daily showed significant improvement in medication adherence
Yeung et al. (28)	Matched, quasi-experiment; 68 people with type 2 diabetes, hypertension, and congestive heart failure	Use of online flashcards and educational videos to improve medication adherence and disease state understanding	REALM, SAHLSA, NVS	Medication adherence	90-day proportion of days covered	Not assessed	Participants in the intervention group had significantly higher 180-day medication adherence than their matched control subjects

SAHLSA, Short Assessment of Health Literacy for Spanish Adults.

received materials in their preferred learning style and language, whereas the control group received standard of care education materials. The intervention group showed significant improvement in diabetes knowledge and health literacy, as indicated by Diabetes Knowledge Test (DKT) scores. More participants in the intervention group reported looking up information about their condition during week 2 of the intervention and showed an overall improvement in understanding symptoms of nerve damage and types of food used to treat hypoglycemic events. However, the study had limited enrollment of Spanish speakers, making the applicability of the results to Spanish-speaking patients highly variable.

Additionally, findings by Hofer et al. (22) suggest that patients with high A1C levels may benefit from interventions led by community health workers (CHWs) to bridge gaps in health literacy and equip patients with the tools to make health decisions. In this study, Hispanic and African American patients with low health literacy and diabetes not controlled by oral therapy benefited from education sessions led by CHWs. The CHWs led culturally tailored support groups to compare the effects of educational materials provided in an electronic format (via iDecide) and printed format on medication adherence and self-efficacy. The study found increased adherence with both formats, and women, specifically, had a significant increase in medication adherence and self-efficacy. One of the important aspects of this study was that the CHWs shared cultural and linguistic characteristics with the patients and HCPs, leading to increased trust and satisfaction with the information presented (22).

Kim et al. (23) found that Korean-American participants benefited greatly from group education sessions that provided integrated counseling led by a team of nurses and CHW educators. The intervention also had a health literacy component that focused on enhancing skills such as reading food package labels, understanding medical terminology, and accessing health care services. This intervention led to a significant reduction of 1–1.3% in A1C levels in the intervention group. The intervention established the value of collaboration between CHW educators and nurses to improve health information delivery and disease management.

A collaboration between CHW educators and pharmacists was also shown to reinforce diabetes knowledge and improve health literacy. Sharp et al. (26) conducted a cross-over study in four primary care ambulatory clinics that provided care for low-income patients. The study found that patients with low health literacy had more visits with pharmacists and CHWs than those with high health literacy. The CHWs provided individualized support to reinforce diabetes self-management education and referrals to resources such as food, shelter, and

translation services. The translation services in this study were especially important for building trust with non-English speakers and helping patients understand their therapy. Similar to other studies, the CHWs shared cultural and linguistic characteristics with their populations, which helped to overcome communication-related and cultural barriers (23,26).

The use of electronic tools or educational videos yielded inconclusive results with regard to medication adherence. Graumlich et al. (20) implemented a new medication planning tool called Medtable within an electronic medical record system in several outpatient clinics serving patients with type 2 diabetes. The tool was designed to organize medication review and patient education. Providers can use this tool to search for medication instructions and actionable language that are appropriate for each patient's health literacy level. The authors found no changes in medication knowledge or adherence, but the intervention group reported higher satisfaction. On the other hand, Yeung et al. (28) showed that pharmacist-led online education videos accessed using QR codes affixed to the patients' medication bottles and health literacy flashcards increased patients' medication adherence in an academic medical hospital.

Goessl et al. (21) found that patients with low health literacy had significantly higher retention of information when receiving evidence-based diabetes education through a DVD recording than through an in-person group class. This 18-month RCT randomized participants to either the DVD or in-person group education and assessed their information retention through a teach-back strategy. The curriculum consisted of diabetes prevention topics such as physical exercise, food portions, and food choices. Participants in the DVD group had significantly higher retention of information than those in the control (in-person) group. The authors suggested this may have been because participants in the DVD group have multiple opportunities to review the education material.

Discussion

Management of type 2 diabetes remains a challenge for HCPs and patients, in part because of the challenges discussed in this review, including communication barriers between patients and HCPs and knowledge deficits about medications and disease states (29). HCPs can have a positive impact on the health outcomes of their patients with diabetes by improving patients' disease state and medication knowledge.

One of the common themes identified in this literature review was the prevalence of culturally tailored diabetes

education interventions. This is an important strategy that could improve diabetes outcomes and provide an alternative approach to diabetes self-management education when working with patients from culturally diverse backgrounds. HCPs might benefit from using culturally tailored educational approaches to improve communication with patients and overcome the medical mistrust many patients feel. Although such mistrust was not directly correlated with diabetes management, it was noted that patients who feel mistrustful tend to have poor communication with HCPs (20). Additionally, Latino/Hispanic patients who have language barriers tend to have poor glycemic control (19). Having CHWs work with HCPs might mitigate some patient-provider communication barriers. As noted earlier, CHWs who share cultural and linguistic characteristics with their patient populations have ongoing interactions and more frequent one-on-one encounters (12).

Medication adherence and glycemic control are important components of diabetes self-management, and we noted that the integration of CHWs into the diabetes health care team and the use of simplified medication label interventions were both successful in improving medication adherence (23,24). The use of culturally tailored education sessions and the integration of pharmacists and CHWs into the management of diabetes appear to be successful in reducing A1C levels (12,26). Electronic education tools and educational videos alone did not have an impact on medication knowledge or information retention in patients with low health literacy, but a combination of education tools and individualized sessions has the potential to improve diabetes medication knowledge and overall self-management (20,22,30).

There were several limitations to our literature review. We restricted our search criteria to articles published in English and studies conducted within the United States to ensure that the results would be relevant to U.S. HCPs. However, these limitations may have excluded important work on this topic. Additional research expanding this search beyond the United States and including articles published in other languages may demonstrate different outcomes. Additionally, this literature review did not focus on A1C as the primary outcome, although A1C is an important indicator of diabetes self-management. A1C was chosen as the method of evaluating the impact of health literacy interventions in patients with diabetes, but other considerations such as medication adherence, impact on comorbid conditions, and quality of life are also important factors.

The results of this work show that implementing health literacy interventions to help patients manage type 2 diabetes can have beneficial results. However, such interventions can have

significant time and monetary costs. The potential financial and time costs of diabetes education interventions were not evaluated in this review and should be taken into account when designing interventions. The American Diabetes Association estimated the cost of medical care for people with diabetes to be $327 billion in 2017, with the majority of the expenditure related to hospitalizations and nursing home facilities (16). Another substantial cost of diabetes that can be difficult to measure is treatment for comorbid conditions and complications such as cardiovascular and renal diseases.

Interventions designed to address low health literacy and provide education about type 2 diabetes could be a valuable asset in preventing complications and reducing medical expenditures. Results of this work show that clinicians who are considering implementing new interventions may benefit from the following strategies: using culturally tailored approaches, creating materials for different learning styles and in patients' languages, engaging CHWs and pharmacists to help with patient education, using PCLs for medications, and engaging education session instructors who share patients' cultural and linguistic characteristics.

Conclusion

Diabetes self-management is crucial to improving health outcomes and reducing medical costs. This literature review identified interventions that had a positive impact on provider-patient communication, medication adherence, and glycemic control by promoting diabetes self-management through educational efforts to address low health literacy. Clinicians seeking to implement diabetes care and education interventions for patients with low health literacy may want to consider drawing on the strategies described in this article. Providing culturally sensitive education that is tailored to patients' individual learning styles, spoken language, and individual needs can improve patient outcomes and build patients' trust.

REFERENCES

1. Centers for Disease Control and Prevention. Statistics about diabetes. Available from https://www.diabetes.org/diabetes-basics/statistics. Accessed 17 July 2020

2. Centers for Disease Control and Prevention. New CDC report: more than 100 million Americans have diabetes or prediabetes. Available from https://www.cdc.gov/media/releases/2017/p0718-diabetes-report.html. Accessed 17 December 2020

3. Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association. Health literacy: report of the Council on Scientific Affairs. JAMA 1999;281:552–557

4. Schillinger D, Grumbach K, Piette J, et al. Association of health literacy with diabetes outcomes. JAMA 2002;288:475–482

5. Baker DW, Parker RM, Williams MV, Clark WS. Health literacy and the risk of hospital admission. J Gen Intern Med 1998; 13:791–798

6. Centers for Disease Control and Prevention. Healthy People 2010. Available from https://www.cdc.gov/nchs/healthy_people/hp2010.htm. Accessed 21 January 2021

7. Osborn CY, Bains SS, Egede LE. Health literacy, diabetes self-care, and glycemic control in adults with type 2 diabetes. Diabetes Technol Ther 2010;12:913–919

8. Institute of Medicine (US) Committee on Health Literacy. Health Literacy: A Prescription to End Confusion. Nielsen-Bohlman L, Panzer AM, Kindig DA, Eds. Washington, DC, National Academies Press, 2004

9. Williams MV, Parker RM, Baker DW, et al. Inadequate functional health literacy among patients at two public hospitals. JAMA 1995;274:1677–1682

10. Parker RM, Baker DW, Williams MV, Nurss JR. The test of functional health literacy in adults: a new instrument for measuring patients' literacy skills. J Gen Intern Med 1995; 10:537–541

11. Wallace A. Low health literacy: overview, assessment, and steps toward providing high-quality diabetes care. Diabetes Spectr 2010;23:220–227

12. White RO, Eden S, Wallston KA, et al. Health communication, self-care, and treatment satisfaction among low-income diabetes patients in a public health setting. Patient Educ Couns 2015; 98:144–149

13. Nam S, Chesla C, Stotts NA, Kroon L, Janson SL. Barriers to diabetes management: patient and provider factors. Diabetes Res Clin Pract 2011;93:1–9

14. Vest BM, Kahn LS, Danzo A, et al. Diabetes self-management in a low-income population: impacts of social support and relationships with the health care system. Chronic Illn 2013; 9:145–155

15. White RO, Chakkalakal RJ, Presley CA, et al. Perceptions of provider communication among vulnerable patients with diabetes: influences of medical mistrust and health literacy. J Health Commun 2016;21(Suppl. 2):127–134

16. American Diabetes Association. Economic costs of diabetes in the U.S. in 2017. Diabetes Care 2018;41:917–928

17. Zheng Y, Lamoureux EL, Chiang PC, et al. Language barrier and its relationship to diabetes and diabetic retinopathy. BMC Public Health 2012;12:781

18. Fernandez A, Schillinger D, Warton EM, et al. Language barriers, physician-patient language concordance, and glycemic control among insured Latinos with diabetes: the Diabetes Study of Northern California (DISTANCE). J Gen Intern Med 2011; 26:170–176

19. Karter AJ, Ferrara A, Darbinian JA, Ackerson LM, Selby JV. Self-monitoring of blood glucose: language and financial barriers in a managed care population with diabetes. Diabetes Care 2000; 23:477–483

20. Graumlich JF, Wang H, Madison A, et al. Effects of a patient-provider, collaborative, medication-planning tool: a randomized, controlled trial. J Diabetes Res 2016;2016:2129838

21. Goessl C, Estabrooks P, You W, Britigan D, DeAlba A, Almeida F. Effectiveness of DVD vs. group-initiated diabetes prevention on information uptake for high & low health literacy participants. Patient Educ Couns 2019;102: 968–975

22. Hofer R, Choi H, Mase R, Fagerlin A, Spencer M, Heisler M. Mediators and moderators of improvements in medication adherence. Health Educ Behav 2017;44: 285–296

23. Kim MT, Kim KB, Huh B, et al. The effect of a community-based self-help intervention: Korean Americans with type 2 diabetes. Am J Prev Med 2015;49:726–737

24. Koonce TY, Giuse NB, Kusnoor SV, Hurley S, Ye F. A personalized approach to deliver health care information to diabetic patients in community care clinics. J Med Libr Assoc 2015;103:123–130

25. Nelson LA, Spieker A, Greevy R, LeStourgeon LM, Wallston KA, Mayberry LS. User engagement among diverse adults in a 12-month text message-delivered diabetes support intervention: results from a randomized controlled trial. JMIR Mhealth Uhealth 2020;8:e17534

26. Sharp LK, Tilton JJ, Touchette DR, et al. Community health workers supporting clinical pharmacists in diabetes management: a randomized controlled trial. Pharmacotherapy 2018;38:58–68

27. Wolf MS, Davis TC, Curtis LM, et al. A patient-centered prescription drug label to promote appropriate medication use and adherence. J Gen Intern Med 2016;31:1482–1489

28. Yeung DL, Alvarez KS, Quinones ME, et al. Low-health literacy flashcards & mobile video reinforcement to improve medication adherence in patients on oral diabetes, heart failure, and hypertension medications. J Am Pharm Assoc (2003) 2017;57:30–37

29. Zgibor JC, Songer TJ. External barriers to diabetes care: addressing personal and health systems issues. Diabetes Spectr 2001;14:23–28

30. Rosal MC, Ockene IS, Restrepo A, et al. Randomized trial of a literacy-sensitive, culturally tailored diabetes self-management intervention for low-income Latinos: Latinos en Control. Diabetes Care 2011;34:838–844