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REVIEW

Access to medications among adults with type 2 diabetes using pharmacy- or clinic-based medication assistance programs: A systematic review

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ABSTRACT

Objective: The purpose of this systematic review was to assess the literature regarding access to, and utilization of medication for type 2 diabetes (T2D) and pre-post improvements in diabetes outcomes for adults enrolled in clinic- or pharmacy-based medication assistance programs.
Data sources: The databases searched were PubMed, CINAHL, Scopus, Embase, Ovid HealthSTAR, PapersFirst, and OpenGrey.
Study Selection: Databases were searched from the beginning of each database to Feburary 29, 2020. Articles were included if (1) the population of interest was adults 18 years of age or older with a T2D diagnosis, (2) the study addressed access to medication for diabetes patients in a clinic- or pharmacy-based setting, and (3) the study was conducted in the United States.
Data extraction: Data extracted from the selected studies included location of study, patient inclusion criteria, sample size, medication assistance program description, and reported diabetes medication access and medication related adherence outcomes.
Results: Eleven articles met the inclusion criteria for the study. The mean reduction in glycated hemoglobin level following the use of medication assistance programs ranged from 0.45 to 0.8. Across studies, the mean number of antihyperglycemic medications used by patients in medication assistance programs ranged from 1 to 1.9. Medication adherence was reported at 45% across studies that reported adherence measures.
Conclusion: Among the 11 studies identified that assessed access to medication for adults with T2D using clinic- or pharmacy-based medication assistance programs, study findings indicated that many of these programs showed some positive changes in medication access and diabetes-related outcomes.

Background

Diabetes is one of the leading causes of morbidity and the seventh leading cause of mortality in the United States.[1,2] More than 30 million Americans have diabetes, with type 2 diabetes (T2D) accounting for 90%-95% of all cases.[3] Diabetes increases the risk of developing complications such as kidney failure, blindness, heart disease, stroke, and amputation, which account for estimated annual expenditures of $327 billion per year.[4,5] Medical expenditures for persons with diabetes are 2 times higher than for those without diabetes.[5]

A reduction in glycated hemoglobin (HbA1c) level with the use of antihyperglycemic medications is an important clinical outcome of focus for patients with T2D.[6] Properly managing T2D among uninsured or underinsured patients can be difficult with insufficient access to antidiabetic medications. For low-income, uninsured patients, the lack of resources to purchase medications can result in nonadherence to the prescribed medication therapies.[7] Furthermore, lack of insurance or inadequate insurance is a major barrier to health care access. Uninsured persons with diabetes have 60% fewer

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Key Points

Background:

- Not having access to needed medications among uninsured and underinsured patients with diabetes places such patients at substantial risk for higher morbidity and mortality.
- For many years, numerous pharmacies and medical clinics in the U.S. have provided uninsured and underinsured patients with medication assistance.
- This systematic review assessed the literature regarding access to and utilization of medication for type 2 diabetes and pre-post improvements in diabetes outcomes for adults enrolled in clinic-based or pharmacy-based medication assistance programs.

Findings:

- There were 11 studies identified that assessed access to medication for adults with type 2 diabetes mellitus utilizing clinic-based or pharmacy-based medication assistance programs; however, many of these programs showed positive changes in medication access and diabetes-related outcomes.
- In most studies, patients used about 1 to 2 antihyperglycemic medications, and patient costs associated with the pharmaceutical assistance programs ranged from as low as $0 to as much as $85 annually.
- Most studies reported that their medication assistance programs increased utilization of antihyperglycemic medications, as well as some clinically relevant improvements in glycated hemoglobin levels.

physician office visits and are prescribed 52% fewer medications than persons with insurance.[8] Not having access to needed medications among uninsured and underinsured patients with diabetes places such patients at substantial risk for higher morbidity and mortality. It further potentiates the risk of diabetes complications and associated costs owing to uncontrolled disease, resulting in increased visits to the emergency department (ED).[4] ED visits have been reported to be 168% higher for uninsured patients with diabetes than for insured patients, with most patients being treated for either hypoglycemic episodes or hyperglycemic crises.[3]

One of the goals of the Affordable Care Act (ACA) is to reduce the number of uninsured individuals by providing affordable insurance coverage options through health insurance marketplaces and Medicaid.[9,10] Despite the implementation of the ACA, there are several states in the United States that have not adopted the Medicaid expansion provision, leaving approximately 10.2% of Americans remaining uninsured, which continues to present a myriad of challenges to access prescription medications,[9,11] and approximately 25% of the patients experiencing difficulty paying for their prescribed medications.[12]

Medication assistance programs seek to improve patients' access to medications for no cost or at a discounted rate. Some of these programs are clinic- or pharmacy-based, with varying methods for providing medication access. Furthermore, 3 pharmaceutical companies that manufacture insulin have begun to provide solutions for the lack of universal access to diabetes medications and insulin through their pharmaceutical assistance programs (PAPs). Through these PAPs, pharmaceutical manufacturers "provide financial assistance or drug free product (through in-kind product donations) to low income individuals to augment any existing prescription drug coverage."[13] Another option for medication access is charitable medication distributors, such as Americares, Dispensary of Hope, and Direct Relief. These organizations receive medication from manufacturers and in turn supply their affiliated clinics and pharmacies with medications needed for their uninsured and underinsured patients.[14] Among uninsured and underinsured patients with diabetes, some of these types of medication access programs have resulted in increases in medication use, and improvements in adherence and health outcomes.[6,15] However, some patients do still experience other patient barriers, such as lack of or low health literacy, lack of transportation, or lack of social support.[16-18] Although pharmacy- and clinic-based medication assistance programs may be beneficial to patients who are eligible for such assistance programs, there has been limited literature about these programs and their impact on access to medication for patients with chronic diseases such as diabetes.

Objective

The objective of this systematic review was to assess the literature regarding (1) access to, and use of, medication for T2D and (2) pre-post improvements in diabetes outcomes for adults enrolled in clinic- or pharmacy-based medication assistance programs.

Methods

A protocol was developed by following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations.[19]

Data sources and search strategy

A comprehensive literature search of 7 databases—PubMed, CINAHL, Scopus, Embase, Ovid HealthSTAR, PapersFirst, and OpenGrey—was conducted from the beginning of each database to February 29, 2020, for articles that addressed access to medication for adults with T2D using clinic- or pharmacy-based medication assistance programs. The initial keywords searched were diabetes, Type 2 diabetes, diabetes mellitus, prescription medication, prescription drugs, access to medication, uninsured, underserved, low income, poor, indigent, vulnerable, U.S., United States, medication assistance programs, charitable pharmacy, charitable pharmacy services, prescription assistance programs, PAPs, clinic-based medication assistance programs, safety-net clinic, federally qualified health center, FQHC, pharmacy-based medication assistance programs, and outpatient medication assistance programs. Medical subject headings terms identified from the initial keyword search were also used to identify relevant literature,

and the reference lists of the identified articles were searched to determine if any additional studies were missed in the previous searches. A complete search strategy for each database is listed in Appendix 1.

Study selection

Articles were included in the review if (1) the population of interest consisted of adults aged 18 years or older with a T2D diagnosis, (2) the study addressed access to medication for diabetes patients in a clinic- or pharmacy-based setting, and (3) the study was conducted in the United States. The outcomes of interest were antihyperglycemic medication use, co-pays and dispensing fees, medication adherence, and change in HbA1c levels. The studies were limited to English-language articles but were not limited by the year of publication. Conference abstracts, case reports, letters to editors, study protocols, briefs, dissertations, and theses were excluded.

In the initial search, a total of 426 articles were identified from the databases. After removing duplicates, 275 individual articles remained. The 275 potentially eligible articles were reviewed by title and abstract independently by 2 authors (LW and DP). Discrepancies in titles and abstract elimination were reviewed by 1 author (CC). There were 252 articles excluded after the title and abstract review. The full texts of 23 articles were retrieved for full-text article review. After the full-text article review, 12 additional articles were removed because they did not directly address the objectives of this review. No additional studies were identified by examining the reference lists of the articles in this process. Eleven articles remained for data extraction and synthesis. The PRISMA flow chart for article selection is outlined in Figure 1.

Data extraction and analysis

Data extracted from the selected studies included location of study, patient-inclusion criteria, sample size, medication assistance program description, and reported diabetes medication access and medication-related adherence outcomes. The specific diabetes medication access and medication-related outcomes extracted included antihyperglycemic medication use, co-pay or dispensing fees, medication adherence measures, and change in HbA1c levels.

Results

The 11 articles selected for inclusion are summarized in Table 1. Of the 11 studies, the oldest was published in 2005, and the most recent was published in 2016. All were retrospective studies, with the exception of the study by Bailey et al.,[20] which was a nonexperimental cross-sectional design using a self-administered survey. The study samples ranged from as few as 9 patients to as many as 22,624 patients. Eight of the 11 studies had fewer than 150 patients included in their sample,[7,15,20-25] and the remaining 3 studies had more than 200 patients.[6,26,27] Across the studies, a range of clinical outcomes were assessed, including HbA1c levels, cholesterol levels, blood pressure, and medication use. However, the outcomes of interest focused on in this study were antihyperglycemic medication use, co-pays and dispensing fees, medication adherence, and change in HbA1c levels. The assessment of the diabetes medication access and adherence outcomes are summarized in Table 2.

Description of pharmacy- and clinic-based medication assistance programs

Across the 11 articles included in this systematic review, 1 study was conducted in a community pharmacy,[20] 5 were conducted in a hospital or medical center outpatient pharmacy setting,[6,15,23,25,27] 4 were clinic-based with a pharmacist facilitating the medication assistance program processes,[7,21,22,24] and 1 was conducted in a multisite health system network that included multiple clinics or hospitals.[26] Most of the pharmacy- and clinic-based medication assistance programs coordinated on the patients' behalf for medication to be dispensed and picked up at their pharmacy or clinic.[6,7,15,21,22,24-26] However, 2 studies did not specify how the clinics or pharmacies accessed the medications dispensed to patients who met the criteria for their prescription medication assistance programs.[20,27]

Antihyperglycemic medication use

Eight of the 11 studies reported some measure of antihyperglycemic medication use, that is, oral, insulin, or both.[6,7,15,20-22,25,27] Of the 8 studies, 4 reported a mean number of antihyperglycemic medications used, ranging from 1 to 1.9,[7,15,21,25] and the studies that reported pre- and postenrollment results reported a 0.3-0.67 increase in the mean number of antihyperglycemic medications used after enrollment in a medication assistance program.[7,15] Two of the 8 studies reported the total or mean number of unique medications used by patients with diabetes.[20,27] Prescription refill records were used to report the number of refills for antihyperglycemic medications for each patient 3 months before a post-HbA1c test, with the assumption that a higher number of refills equated to higher medication use, which could lead to improvements in adherence and HbA1c levels.[6] One study reported antihyperglycemic medication use by frequency of medications taken, with more than 50% of their sample taking 2 antihyperglycemic medications.[22]

Medication cost

Most of the medication assistance programs did not report information on medication-associated cost for the participating patients.[7,15,21,26,27] However, some of the programs did have a co-payment or dispensing fee. Three studies reported a co-pay or dispensing fee ranging from as low as $5 to as high as $85.[20,22,23] Two of these studies reported costs for a 3-month supply ranging from $5 to $10 per medication.[20,22] The study reporting an average annual co-payment of $85 per patient did not bill the prescription medication assistance program patients directly owing to donations from corporate sponsors and the associated hospital foundation.[23] Three other studies mentioned that there was no co-pay or dispensing fee for patients enrolled in their medication assistance programs.[6,24,25]

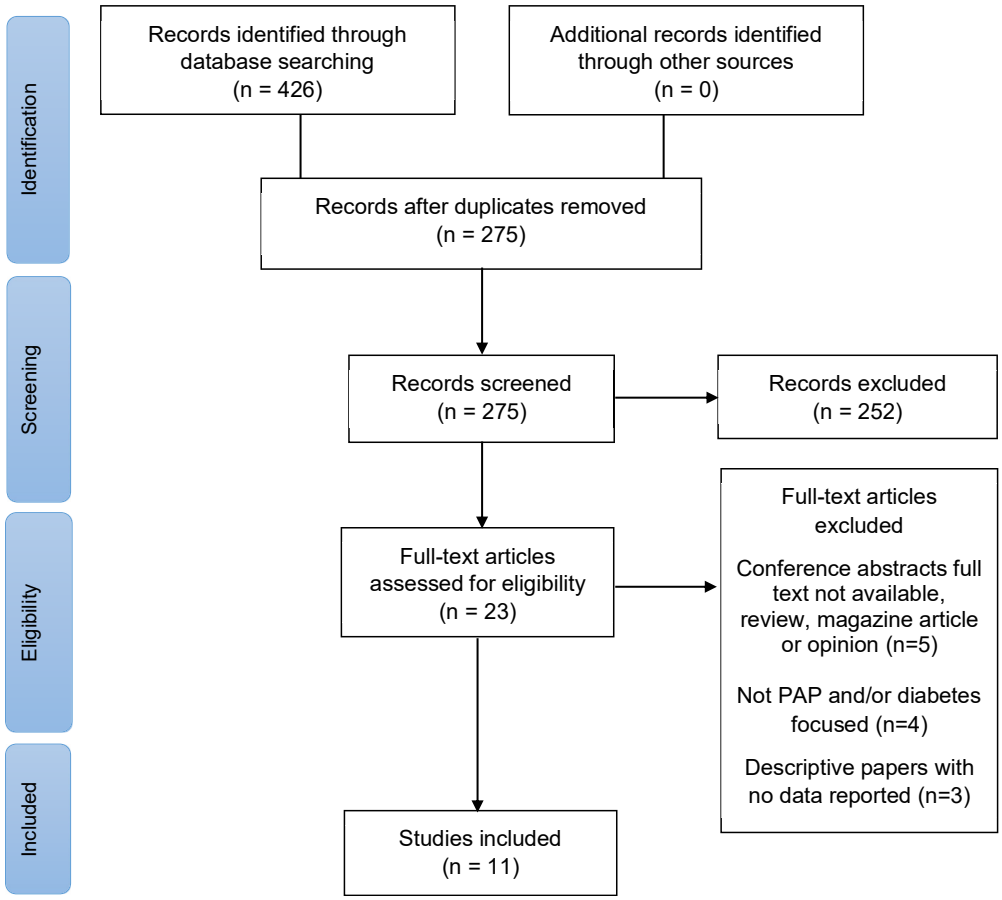

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow chart of the literature search process. Abbreviation used: PAP, pharmaceutical assistance program.

Medication adherence

Three of the 11 studies reported medication adherence measures.[20,23,27] One study used the self-reported Morisky medication adherence scale to examine adherence to all medications among patients with diabetes in their study, reporting that 44% of the sample was adherent to their medications.[20] The other 2 studies reported medication adherence by calculating the medication proportion of days covered (PDC) using pharmacy administrative records.[23,27] A PDC of 80% or more is the standard threshold for adherence. It indicates that medication is on hand for at least 80% of the measurement period, thus indicating adequate adherence to medication.[28] The mean PDC reported for these 2 studies was 67% and 71%,[23,27] with only 45% of the patients adherent to their antihyperglycemic medications on the basis of a PDC of 80% or more.

Changes in HbA1c level

Nine of the 11 studies collected and reported some measure of HbA1c levels.[6,7,15,21-26] Six of the 11 studies reported the change in HbA1c levels before and after enrollment in their medication assistance program.[6,7,15,22,23,25] Across these 6 studies, the highest magnitude of change in HbA1c level was 0.8,[15,25] and the lowest magnitude was 0.45.[23] Two of the 11 studies reported the mean HbA1c level for medication assistance program participants.[21,24] One of these 2 studies reported a mean HbA1c level of 6.9 ± 1.1 for medication assistance program patients compared with 8.0 ± 2.0 for patients with prescription insurance.[21] The other study reported a mean HbA1c level of 8.01 ± 2.34 for medication assistance program patients compared with 7.51 ± 2.06 for patients not in the medication assistance program.[24] Furthermore, in this same study, medication assistance program patients who were established patients had a mean HbA1c level of 8.06 ± 2.37 compared with 8.37 ± 3.03 for medication assistance program patients who were new patients.[24] Information on the insurance status of patients not in the medication assistance program was not provided. One study reported the percentage of patients with HbA1c levels less than 7% in the first year of the disease management program implementation to the last year of the program,[26] noting a 10% increase in the percentage of patients meeting this measure over the 7-year existence of the program.

Discussion

The key findings of this systematic review were that in most studies the patients used approximately 1 to 2

Table 1
Characteristics of studies included in this systematic review

Author (year)	Location of study	Patient-inclusion criteria	Sample size	Outcomes assessed in study
Bailey et al.[20] (2012)	Travis County, TX	18 years or older with diabetes, receiving prescriptions at a local grocery store or community clinic for the underserved from December 2010 to February 2011	N = 59	Medication adherence measured using the self-reported Morisky medication adherence scale
Chisholm et al.[7] (2007)	Medical College of Georgia (MCG)	Adult renal transplant recipients who received their post-transplantation care from MCG between November 1999 and September 2005 and were enrolled in the medication access program for at least 1 year	N = 36 (in MAP); patients who received antidiabetic agents through MAP, n = 9	Decrease in fasting glucose concentration and decreased HbA1c levels
Horswell et al.[6] (2008)	Earl K. Long Medical Center, Baton Rouge, LA	Participating in a disease management program with adult diabetes	N = 22,624	HbA1c level, lipid testing, eye exams, renal assessment, use of aspirin, foot exams, BP control, and regular clinic visits
Horswell et al.[26] (2008)	Earl K. Long Medical Center, Baton Rouge, LA	Must have had at least 2 type 2 diabetes diagnoses (7 or more days apart) in the medical center administrative database before January 1, 2000; had used the MAP between January 1, 2000, and March 31, 2002; and had at least 1 HbA1c test before enrollment and 1 test 75 or more days after enrollment	N = 289	Pre- and post-MAP HbA1c; MAP dispensed diabetes oral medication
O'Dell et al.[24] (2008)	North Mississippi Residency Center	Patients with diabetes from March 2005 to November 2006	N = 926 patients with diabetes; N = 72 patients with diabetes enrolled in MAP	HbA1c levels, BP, and lipid levels
Patel et al.[25] (2006)	University of Connecticut–Hartford Hospital	Must have a diagnosis of type 2 diabetes and be eligible to receive at least 1 medication for the treatment of type 2 diabetes through the MAP between May 2003 and April 2005	N = 50	No. chronic medications taken by patient, no. antihyperglycemics, and no. dyslipidemics
Roberts et al.[27] (2014)	University of North Carolina (UNC)	Patients who participated in the UNC Health Care Pharmacy Assistance Program and received medications indicated for hypertension, diabetes, or hyperlipidemia between 2009 and 2011	N = 265 patients receiving oral glucose-lowering agents	Medication adherence for oral glucose-lowering agents; no. emergency department visits, inpatient admissions, and outpatient visits
Ryan et al.[23] (2014)	Miami, FL	18 years or older having at least 2 prescription fills for any diabetes medication over a 21-month period, with the first occurrence between August 2012 and April 2013	N = 103	HbA1c levels, cholesterol levels, triglycerides, medication adherence, incremental acquisition, and per-patient costs
Strum et al.[15] (2005)	University of Arkansas Medical Sciences (UAMS)	Adult patients in the UAMS internal medicine clinic who received an antihyperglycemic medication through the MAP during the first 6 months of 2003 and were followed at the clinic for 1 year before MAP enrollment	N = 52	HbA1c levels, total cholesterol, HDL, LDL, triglycerides, serum creatinine, SBP and DBP, no. medications, antihyperglycemics, antihypertensives, antilipemics, and ACE inhibitors
Toulouse and Kodadek[22] (2016)	Northern Virginia	Convenience sample of mobile health van patients who were aged 18 years or older with type 2 diabetes between January 1, 2006, and December 31, 2010	N = 65	HbA1c levels, LDL, SBP, and DBP
Trompeter and Havrda[21] (2009)	Shenandoah University, Winchester, VA	18 years or older with a diagnosis of diabetes, hypertension, or dyslipidemia, and prescribed at least 1 medication for 1 of the diseases	N = 139 patients with diabetes, n = 77 with prescription assistance	HbA1c and fasting blood glucose levels

Abbreviations used: MAP, medication assistance program; BP, blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; HbA1c, glycated hemoglobin; HDL, high-density lipoproteins; LDL, low-density lipoproteins; ACE, angiotensin-converting enzyme.

Table 2
Assessment of diabetes medication access and adherence outcomes

Author (year)	Site for MAP	MAP methods of access to medication	Co-pays and dispensing fees	Antihyperglycemic medication use	Medication adherence	Change in HbA1c level
Bailey et al.[20] (2012)	Community pharmacy or clinic	Not provided	$0.00–$9.99	Total no. medications among individuals with diabetes: 38.6% = 1–2 38.6% = 3–4 22.8% ≥ 5	44.1% adherent Average MMAS score: 5.6 ± 2.1	N/A
Chisholm et al.[7] (2007)	Hospital clinic	Patient assistance programs through manufacturers	N/A	Mean no. antihyperglycemics Pre: 1.00 (±0.0) Post: 1.67 (±0.50)	N/A	Pre: 8.07 (±0.81) Post: 7.42 (±0.61)[a]
Horswell et al.[6] (2008)	Hospital outpatient pharmacy	Patient assistance programs through manufacturers	N/A	N/A	N/A	Increase in percentage of patients with HbA1c < 7%: Pre: 44% Post: 54%
Horswell et al.[26] (2008)	Medical center outpatient clinics (multisites)	Patient assistance programs through manufacturers	$0.00	Refills 3 months before post-HbA1c test (%): 0 refills: 10.9 1 refill: 15.1 2 refills: 31.9 3 refills: 42.1	N/A	Pre: 8.73 Post: 8.05[a]
O'Dell et al.[24] (2008)	Medical center clinic	Patient assistance programs through manufacturers	$0.00	N/A	N/A	Overall MAP participants: 8.01 (±2.34); new patients: 8.37 (±3.03) Established patients: 8.06 (±2.37)
Patel et al.[25] (2006)	Hospital outpatient pharmacy	Patient assistance programs through manufacturers	$0.00	Mean no. antihyperglycemics 1.3 (±0.5)	N/A	Pre: 8.6 (±2.2) Post: 7.8 (±2.0)[a]
Roberts et al.[27] (2014)	Medical center outpatient pharmacy	Not provided	N/A	Mean total no. unique medications filled among users of antihyperglycemics 9.2 (±4.8)	45% adherent to antihyperglycemics Mean PDC = 0.67 (±0.31)	N/A
Ryan et al.[23] (2014)	Hospital outpatient pharmacy	Hospital purchased medications (funded by a corporate sponsor and hospital foundation)	$0.00–$167.00	N/A	45.42% adherent to antihyperglycemics Mean PDC = 70.55 (±25.13)	Pre: 8.38 (±2.19) Post: 7.93 (±2.19)
Strum et al.[15] (2005)	Medical center outpatient pharmacy	Patient assistance programs through manufacturers	N/A	Mean no. antihyperglycemics Pre: 1.6 (±0.8) Post: 1.9 (±0.8)	N/A	Pre: 9.3 (±2.4) Post: 8.5 (±1.5)[a]
Toulouse and Kodadek[22] (2016)	Hospital clinic	Pharmaceutical company donations and hospital purchased medications	$0.00–$5.00	No. antihyperglycemics: 33.8% = 1 56.9% = 2 21.5% = 3 3.1% = 4	N/A	Pre: 8.96 (±2.29) Post: 8.26 (±1.63)[a]
Trompeter and Havrda[21] (2009)	Family practice clinic	Patient assistance programs through manufacturers	N/A	Mean no. antihyperglycemics 1.87 (±0.77)	N/A	Mean: 6.9 (±1.1)

Abbreviations used: HbA1c, glycated hemoglobin; N/A, not applicable; MAP, medication assistance program; PDC, proportion of days covered; MMAS, Morisky medication adherence scale.
[a] *P* value ≤0.05.

antihyperglycemic medications, and patient costs associated with the PAPs ranged from as low as $0 to as much as $85 annually. Some programs covered the co-payment costs for the program's patients through corporate donations or foundation support. Most studies reported that their medication assistance programs increased the use of antihyperglycemic medications, as well as some clinically relevant improvements in HbA1c levels.

The establishment of pharmacy- and clinic-based medication assistance programs has been an important way of assisting uninsured and low-income patients with obtaining the medications that they need. With regard to adherence, the studies that reported the mean number of antihyperglycemics showed an increase in the pre and post numbers of antihyperglycemic medications. This is important because it is an indicator of an increase in access to medication among patients with diabetes. Pharmacists are instrumental in assisting patients in accessing medications through various assistance programs. Not only do they assist in ensuring access, but they also have the responsibility of continued adherence monitoring and counseling of their patients who fill prescriptions through these programs.

Consistent access to medications has been an issue for uninsured and underinsured patients. Despite implementation of the Medicaid expansion provision of the ACA, there remains a need for prescription medication assistance programs to address the ongoing unmet need.[29] Among the studies included in this review, 5 were conducted in states that have not adopted Medicaid expansion.[9] The studies conducted in nonexpansion states show the importance of prescription medication assistance programs and how they continue to aid in improving medication access in these areas. Expansion of Medicaid has provided some improved access for the uninsured in some areas of the country but not for all.

All studies included in this review had some type of pharmacy- or clinic-based medication assistance program component. Programs such as these have provided linkages between the uninsured or low-income patient and medication from manufacturers or distributors. Although most of the programs included in this review provided medication at no cost to the patients, some of them had small to moderate co-pays or dispensing fees depending on the patient's income or the program requirements set by the pharmacy or clinic dispensing the medication to the patient.[20,22,23,30]

Participation in medication assistance programs has been associated with increases in medication access, improvements in health outcomes, and reductions in use of the ED.[6,15,31] With regard to persons with diabetes, participation in these medication assistance programs has increased medication use, indicating increased access. In this review, some studies showed an increase in medication use[6,7,15,22] and small decreases in HbA1c levels.[6,7,15,22,23,25,26] According to the American Diabetes Association's Standards of Medical Care in Diabetes—2019, the glycemic target for HbA1c levels for adults with diabetes is less than 7.0% (53 mmol/mol), which has been shown to have long-term benefits in reducing complications of diabetes.[32-34] Whereas the study by Trompeter and Havrda[21] met this goal, most of the studies did not; but some were very close to achieving the target.[7,23,25,26] In addition, 1 study had 10% more patients reach their HbA1c level goal with access to medication over time.[26] These findings indicated a clinically relevant benefit of these programs in improving access to medication and outcomes for uninsured and low-income patients with diabetes.

Although pharmacy- and clinic-based medication assistance programs are effective in increasing access to medication for uninsured and low-income patients, the use of charitable medication distribution networks can provide even greater access to essential medications needed to improve outcomes. Charitable medication distributors receive donations from pharmaceutical manufacturers and supply clinics and pharmacies with needed inventory for their medication assistance programs. Charitable medication distributors include nonprofit organizations such as Direct Relief, Americares, and Dispensary of Hope, each of which has collaborated with a pharmaceutical company to provide injectable insulin for distribution to their network of clinics and pharmacies across the country.[14] Currently, there are some clinic- and pharmacy-based medication assistance programs, such as St Thomas Health in Nashville, TN, that use the charitable medication distribution system and have been able to improve medication adherence and health outcomes among their uninsured and underinsured patients.[31] Consistent use of this type of distribution system may be a potential solution to addressing medication access for patients in an affordable and timely manner. Further research is needed for medication distribution programs such as these to assess their effectiveness in increasing access to medications and reduction in health care resource use and associated cost for uninsured and low-income patients with chronic diseases such as diabetes.

Limitations

There are limitations to the current review that should be noted. This study was limited to reviewing online databases and peer-reviewed literature; therefore, some literature that may not be indexed online may potentially have been missed in our search despite our efforts to review multiple databases. Second, this was a systematic review and did not include a meta-analysis; therefore, a comparison of findings across the studies is limited. Third, the diabetes-related outcome measures highlighted in this study were antihyperglycemic medication use, co-pays or dispensing fees, medication adherence, and change in HbA1c levels; however, there was limited information about these outcomes in the studies, and they were not measured in the same manner across the studies. In addition, the small changes in HbA1c level may have been related to the length of follow-up in these studies, which varied across the studies from 2.5 months to up to 1 year, with the exception of 1 study that had a program duration of 7 years. The length of follow-up for most of the studies may have limited the ability to show that with assured access to medication, patients could be treated effectively to reach the goal of HbA1c level less than 7.0%. Examining these outcomes over longer periods of time may potentially have shown greater changes in outcomes. In addition, many of the studies had a comparison group, but none had a true control group, that is, a group composed of those who did not have access to medication. This may have shown greater differences in HbA1c levels. Finally, only a limited number of studies were eligible for inclusion in the review. This could be an indication of the

lack of literature on the subject matter. Although there may potentially be more studies with a focus on medication use or adherence among patients with T2D, this systematic review indicates that there is limited literature focused on medication access among uninsured and underinsured patients with T2D. Despite these limitations, our findings indicate that pharmacy- and clinic-based medication assistance programs have improved access to medications for uninsured and low-income patients with T2D and have shown evidence of improvement in medication-related outcomes.

Conclusion

There were a limited number of studies identified that assessed access to medication among adults with T2D using clinic- or pharmacy-based medication assistance programs. However, participation in various types of medication assistance programs resulted in positive changes in medication access and diabetes-related outcomes.

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Appendix 1

Search strategy for each database included in the systematic review

PubMed: 64 results (searched 8/30/2018), 71 results (updated search 2/29/2020)

1. "Diabetes Mellitus, Type 2"[Mesh] OR “Type 2 Diabetes” OR “Type II Diabetes” OR "Diabetes Mellitus"[Mesh] OR "Diabetes Mellitus, Type 1"[Mesh] OR “Type 1 Diabetes” OR “Type I Diabetes” OR diabetes OR diabetic OR “glycemic control” OR “diabetic treatment” OR insulin OR “diabetic assistance” OR diabetic suppl* OR "Insulin"[Mesh]
2. “Charitable pharmacy” OR “safety-net clinic” OR “safety net clinic” OR “safety-net hospital” OR “safety net hospital” OR “federally qualified health center” OR “FQHC” OR “hospital pharmacy” OR “independent pharmacy” OR “clinic pharmacy” OR “community pharmacy” OR “community health center” OR "Pharmacies"[Mesh] OR "Pharmacy Service, Hospital"[Mesh] OR "Community Pharmacy Services"[Mesh] OR "Safety-net Providers"[MeSH] OR "Safety-net Provider” OR "Safety net Provider" OR "Outpatient Clinics, Hospital/economics"[MeSH] OR "Hospitals, Public/economics"[MeSH] OR "Medically Uninsured"[MeSH] OR uninsured OR underserved OR vulnerable OR poor OR “low income” OR indigent OR "Poverty"[MeSH] OR "Vulnerable Populations"[MeSH] OR "Health Services Accessibility/economics"[MeSH] OR "Community Health Centers/economics"[MeSH] OR "Community Health Centers/organization and administration"[MeSH] OR "Health Services Accessibility/organization and administration"[MeSH] OR "Hospital Costs"[MeSH] OR “medically underserved”
3. “medication assistance program” OR “medication assistance programs” OR “access to medication” OR “access to medications” OR “prescription assistance program” OR “prescription assistance programs” OR “clinic-based medication assistance programs” OR “pharmacy-based medication assistance programs” OR “financial assistance” OR coupon OR “free insulin” OR “donated insulin”
4. 1 AND 2 AND 3
5. Limit to English language

CINAHL: 38 results (searched 8/30/2018), 47 results (updated search 2/29/2020)

1. (MH "Diabetes Mellitus+") OR (MH "Diabetic Patients") OR “Type 2 Diabetes” OR “Type II Diabetes” OR “Type 1 Diabetes” OR “Type I Diabetes” OR diabetes OR diabetic OR “glycemic control” (MH "Glycemic Control") OR “diabetic treatment” OR insulin OR (MH "Insulin+") OR “diabetic assistance” OR diabetic suppl*
2. “Charitable pharmacy” OR “safety-net clinic” OR (MH "Safety-Net Providers") OR “safety net clinic” OR “safety-net hospital” OR “safety net hospital” OR “federally qualified health center” OR “FQHC” OR “hospital pharmacy” OR “independent pharmacy” OR “clinic pharmacy” OR “community pharmacy” OR “community health center” OR (MH "Community Health Centers") OR (MH "Pharmacy Service") OR (MH "Pharmacy, Retail") OR (MH "Hospitals, Public") OR (MH "Medically Uninsured") OR uninsured OR (MH "Medically Uninsured") OR (MH "Medically Underserved") OR (MH "Medically Underserved Area") OR underserved OR vulnerable OR (MH "Special Populations") OR poor OR “low income” OR indigent OR (MH "Indigent Persons") OR (MH "Health Services for the Indigent") OR (MH "Poverty") OR (MH "Health Services Accessibility") OR (MH "Health Facility Costs") OR “medically underserved”
3. “medication assistance program” OR “medication assistance programs” OR “access to medication” OR “access to medications” OR “prescription assistance program” OR “prescription assistance programs” OR “clinic-based medication assistance programs” OR “pharmacy-based medication assistance programs” OR “financial assistance” OR (MH "Financial Support") OR coupon OR “free insulin” OR “donated insulin”
4. 1 AND 2 AND 3
5. Limit to English language

Scopus: 187 results (searched 8/30/2018), 199 results (updated search 2/29/2020)

1. TITLE-ABS-KEY("Diabetes Mellitus, Type 2" OR {Type 2 Diabetes} OR {Type II Diabetes} OR {Diabetes Mellitus} OR "Diabetes Mellitus, Type 1" OR {Type 1 Diabetes} OR {Type I Diabetes} OR diabet* OR {glycemic control} OR {diabetic treatment} OR insulin OR {diabetic assistance} OR "diabetic suppl*")
2. TITLE-ABS-KEY({Charitable pharmacy} OR {safety-net clinic} OR {safety net clinic} OR {safety-net hospital} OR {safety net hospital} OR {federally qualified health center} OR {FQHC} OR {hospital pharmacy} OR {independent pharmacy} OR {clinic pharmacy} OR {community pharmacy} OR {community health center} OR pharmac* OR "Pharmacy Service, Hospital" OR {Community Pharmacy Services} OR {Safety-net Provider} OR {Safety net Provider} OR {Medically Uninsured} OR uninsured OR underserved OR vulnerable OR poor OR {low income} OR indigent OR poverty OR {Vulnerable Populations} OR {Hospital Costs} OR {medically underserved})
3. TITLE-ABS-KEY(“medication assistance program*” OR “access to medication*” OR “prescription assistance program*” OR {clinic-based medication assistance programs} OR {pharmacy-based medication assistance programs} OR {financial assistance} OR coupon OR {free insulin} OR {donated insulin})
4. 1 AND 2 AND 3
5. Limit to English language

Embase: 53 results (searched 8/30/2018), 61 results (updated search 2/29/2020)

1. “Type 2 Diabetes” OR “Type II Diabetes” OR “Type 1 Diabetes” OR “Type I Diabetes” OR diabetes OR diabetic OR 'diabetes mellitus'/exp OR 'non insulin dependent diabetes mellitus'/exp OR 'insulin dependent diabetes mellitus'/exp OR 'glycemic control'/exp OR 'insulin'/exp OR 'diabetic treatment' OR 'diabetic assistance' OR 'diabetic suppl*'
2. “Charitable pharmacy” OR “safety-net clinic” OR “safety net clinic” OR “FQHC” OR “independent pharmacy” OR “clinic pharmacy” OR “community pharmacy” OR “community

health center" OR "Safety-net Provider" OR "Safety net Provider" OR uninsured OR underserved OR vulnerable OR poor OR "low income" OR indigent OR 'safety net hospital'/exp OR 'hospital pharmacy'/exp OR 'federally qualified health center'/exp OR 'pharmacy'/exp OR 'health center'/exp OR 'hospital pharmacy service'/exp OR 'medically uninsured'/exp OR 'medically underserved'/exp OR 'vulnerable population'/exp OR 'lowest income group'/exp OR 'indigent'/exp OR 'socioeconomics'/exp OR 'poverty'/exp OR 'hospital cost'/exp
3. "medication assistance program" OR "medication assistance programs" OR "access to medication" OR "access to medications" OR "prescription assistance program" OR "prescription assistance programs" OR "clinic-based medication assistance programs" OR "pharmacy-based medication assistance programs" OR "financial assistance" OR coupon OR 'free insulin'/exp OR "donated insulin"
4. 1 AND 2 AND 3
5. Limit to English language

Ovid HealthSTAR: 37 results (searched 8/30/2018), 48 results (updated search 2/29/2020)

1. Type 2 Diabetes.mp. OR Type II Diabetes.mp. OR Type 1 Diabetes.mp. OR Type I Diabetes.mp. OR DIABETES MELLITUS, TYPE 2/OR diabetes.mp. OR DIABETES MELLITUS, TYPE 1/OR DIABETES MELLITUS/OR diabetic$.mp. OR glycemic control.mp. OR diabetic treatment.mp. OR exp INSULIN/OR insulin.mp. OR diabetic assistance.mp. OR diabetic suppl$.mp.
2. charitable pharmac$.mp. OR safety net clinic$.mp. OR safety net hospital$.mp. OR federally qualified health center$.mp. OR FQHC.mp. OR Pharmacy Service, Hospital/OR hospital pharmac$.mp. OR Pharmacies/OR independent pharmac$.mp. OR clinic pharmac$.mp. OR Community Pharmacy Services/OR community pharmac$.mp. OR community health center$.mp. OR Community Health Centers/OR safety net provider$.mp. OR Safety-net Providers/OR Medically Uninsured/OR medically uninsured.mp. OR uninsured.mp. OR Vulnerable Populations/OR MEDICALLY UNDERSERVED AREA/OR underserved.mp. OR vulnerable.mp. OR poor.mp. OR Poverty/OR low income.mp. OR Poverty Areas/OR indigent.mp. OR Hospital Costs/OR medically underserved.mp.
3. medication assistance program$.mp. OR access to medication$.mp. OR prescription assistance program$.mp. OR clinic-based medication assistance program$.mp. OR pharmacy-based medication assistance program$.mp. OR Financial Support/or financial assistance.mp. OR coupon.mp. OR free insulin.mp. OR donated insulin.mp.
4. 1 AND 2 AND 3
5. Limit to English language

PapersFirst: 0 results (searched 8/30/2018), 0 results (updated search 2/29/2020)

1. diabetes OR diabetic OR insulin
2. "Charitable pharmacy" OR "safety-net clinic" OR "safety net clinic" OR "safety-net hospital" OR "safety net hospital" OR "federally qualified health center" OR "FQHC" OR "hospital pharmacy" OR "independent pharmacy" OR "clinic pharmacy" OR "community pharmacy" OR "community health center" OR "Safety-net Provider" OR "Safety net Provider" OR uninsured OR underserved OR vulnerable OR poor OR "low income" OR indigent OR poverty
3. "medication assistance program" OR "medication assistance programs" OR "access to medication" OR "access to medications" OR "prescription assistance program" OR "prescription assistance programs" OR "financial assistance" OR coupon OR "free insulin" OR "donated insulin"
4. 1 AND 2 AND 3
5. Limit to English language

OpenGrey: 0 results (searched 8/30/2018), 0 results (updated search 2/29/2020)

diabetes AND ("medication assistance program" OR "medication assistance programs" OR "prescription assistance program" OR "prescription assistance programs" OR "access to medication" OR "financial assistance" OR coupon OR "free insulin" OR "donated insulin") AND (charitable OR "safety net" OR "federally qualified health center" OR pharmacy OR underserved)