Facilitators to referrals to CDC's National Diabetes Prevention Program in primary care practices and pharmacies: DocStyles 2016–2017

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Abstract

Despite evidence of the effectiveness of behavioral change interventions for type 2 diabetes prevention, health care provider referrals to organizations offering the National Diabetes Prevention Program (National DPP) lifestyle change program (LCP) remain suboptimal. This study examined facilitators of LCP referrals among primary care providers and pharmacists (providers). We analyzed data on 1956 providers from 2016 to 2017 DocStyles web-based surveys. Pearson chi-square or Fisher's exact tests were used for bivariate associations between facilitators, provider characteristics, and their self-reported referral and bi-directional referral (where they received patient status updates back from the LCPs) to an LCP. Multiple logistic regressions were used to estimate the effects of facilitators to referral practices, controlling for providers' characteristics. Geocoding was done at the street level for in-person, public LCP class locations and at the zip code level for survey respondents to create a density measure for LCP availability within 10 miles. Overall, 21% of providers referred their patients with prediabetes to LCPs, and 6.4% engaged in bi-directional referral. Provider practices that established clinical-community linkages (CCLs) with LCPs (AOR = 4.88), used electronic health records (EHRs) to manage patients (AOR = 2.94), or practiced within 10 miles of an in-person, public LCP class location

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(AOR = 1.49) were more likely to refer. Establishing CCLs with LCPs (AOR = 8.59) and using EHRs (AOR = 1.86) were also facilitators of bi-directional referral. This study highlights the importance of establishing CCLs between provider settings and organizations offering the National DPP LCP, increasing use of EHRs to manage patients, and increasing availability of in-person LCP class locations near provider practices.

Keywords

Diabetes prevention program; Type 2 diabetes prevention; Referral; Bi-directional referral; Clinical-community linkages; Electronic health records

1. Introduction

In the US, more than 34 million adults (13% of the adult population) have diabetes, of which 90–95% is type 2 diabetes (CDC, 2020). In 2017, diabetes was the seventh leading cause of death in the US (CDC, 2017) and was estimated to cost over $300 billion in total (American Diabetes Association, 2018). In addition, the Centers for Disease Control and Prevention (CDC) estimates as many as 88 million US adults have prediabetes, but only about 15.3% are aware of their health condition (CDC, 2020). Prediabetes is defined as blood glucose levels that are elevated, though not high enough to be diagnosed as type 2 diabetes (CDC, 2017). Prediabetes can lead to type 2 diabetes, heart disease, and stroke; however, it is reversible (CDC, 2020). Multiple studies, including the Diabetes Prevention Program (DPP), demonstrated that an intensive lifestyle change program (LCP) focusing on healthy eating, physical activity, and stress reduction is effective in preventing or delaying onset of type 2 diabetes among people with prediabetes or at high risk (Crandall et al., 2008; Knowler et al., 2002; Lindstrom et al., 2006; Tuomilehto et al., 2001; Zhuo et al., 2012). In addition, many translational studies showed that an intensive LCP is effective and feasible in community settings for type 2 diabetes prevention (Ali et al., 2012; Dunkley et al., 2014; Fianu et al., 2016; Van Name et al., 2016; Vojta et al., 2013).

In response to this compelling evidence, CDC established the National Diabetes Prevention Program (National DPP) in 2010. The National DPP is a partnership of public and private organizations working together to build a nationwide delivery system for the LCP proven effective for type 2 diabetes prevention in adults with prediabetes. The goal of the National DPP is to prevent or delay type 2 diabetes by increasing the supply of quality program delivery sites, increasing demand for the program among people at risk, increasing referrals from health care providers, and increasing coverage among public and private payers (Albright and Gregg, 2013). The National DPP LCP is a yearlong, structured lifestyle intervention consisting of a minimum of 16 weekly sessions in months 1–6 and a minimum of 6 monthly sessions in months 7–12 (CDC, 2018). The program can be offered in-person, online, via distance learning, or through any combination of these modalities (CDC, 2018). To assure quality and fidelity to scientific evidence, CDC also established the Diabetes Prevention Recognition Program (DPRP), the quality assurance arm of the National DPP. Through the DPRP, CDC recognizes organizations that successfully deliver the yearlong LCP consistent with national quality standards (CDC, 2018). As of September 2020, there

were over 1700 CDC-recognized organizations offering the National DPP LCP in all 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, and other US territories and freely associated states (CDC, 2020). However, there are many local areas with a high burden of prediabetes with few or no programs, and referrals from health care providers to the program remain suboptimal.

A study of health care providers' attitudes and behaviors toward prediabetes screening and treatment options showed low rates of prediabetes screening and referrals to appropriate behavioral interventions (Mainous 3rd et al., 2016). In addition, awareness of and familiarity with the National DPP LCP among providers remains low (Nhim et al., 2018). Gaps in providers' knowledge also contribute to inadequate diagnosis of prediabetes and referral to diabetes prevention interventions (Tseng et al., 2019). However, providers with positive attitudes toward prediabetes as a diagnosis were more likely to follow screening guidelines and prescribe treatment to patients (Mainous 3rd et al., 2016). Awareness of the National DPP LCP also increases the likelihood providers will screen for prediabetes and refer patients to an LCP (Nhim et al., 2018). A recent study on patient and clinician perceptions of prediabetes in primary care found that clear communication about prediabetes risk, treatment information, and linkage to CDC-recognized organizations offering the National DPP LCP as the suggested treatment plan facilitated the referral process (Roper et al., 2019). Providers who used an electronic health record (EHR) were twice as likely to refer patients with prediabetes to an LCP compared to those who did not use an EHR (Nhim et al., 2018). Practices that used retrospective queries via EHRs to identify eligible Medicare patients with prediabetes referred ten times more eligible patients than those who used a point-of-care method alone (Holliday et al., 2019).

A previous study found that primary care providers (PCPs) who practiced in areas with a high ratio of in-person National DPP LCP classes to total PCPs were almost twice as likely to refer patients with prediabetes to an LCP (Nhim et al., 2018). A study on the influence of distance on utilization of outpatient mental health aftercare found that patients who travelled 10 miles or less, compared with those who lived 50+ miles away, were more likely to obtain mental health aftercare following inpatient substance abuse treatment (Schmitt et al., 2003). Another study found that 60% of patients travelled less than 10 miles to opioid treatment programs, and only 6% travelled 50–200 miles to the treatment programs (Rosenblum et al., 2011). Other studies found that transportation is a significant barrier to primary care services (Syed et al., 2013), and geographic access to health care influences both health care utilization and disease burden (Billi et al., 2007; McLafferty, 2003). However, we are unaware of information on the impact of distance from PCP practices to National DPP LCP class locations on referrals.

For this study, we define a clinical-community linkage (CCL) as a formal relationship between clinical care organizations and community-based organizations involving defined roles and procedures associated with the management of health conditions or risk factors within a defined patient population. Creating linkages between primary care practices and community resources has the potential to benefit both patients and providers and reduce the burden associated with poor health behaviors (Etz et al., 2008; Fishleder et al., 2018). Clinical-community linkages have also been shown to facilitate type 2 diabetes prevention

and other public health interventions. One study found that delivering diabetes prevention services based on a collaboration of community pharmacists with general practices was key to providing integrated primary care services (Katangwe, 2019). A scoping review paper showed the positive role community health workers played in promoting preventive care at a population level (Lohr et al., 2018).

In this study, bi-directional referral is defined as a system that facilitates referral information going from the health care provider or pharmacy to the community-based program/ service and the return of information on patient participation and outcome data from the community-based program/service to the referring health care provider or pharmacy. Based on a CDC-funded project in collaboration with the American Medical Association (AMA) and YMCA of the USA to build and implement a bi-directional referral communication pathway with existing health care partners, we found an increase in referrals from providers, compared with baseline referrals (CDC, 2019). The project also found one of the incentives for providers to make referrals to prevention programs like the National DPP LCP is to show that the program provides value-based quality for their practices (CDC, 2019). The opportunity for an LCP to provide information back to providers on patients' health outcomes, such as weight loss, helps incentivize providers to make referrals. In addition, there is some anecdotal evidence from recipients of CDC's cooperative agreement funding that establishing bi-directional referrals with health care providers or systems facilitated or motivated providers to make referrals to the LCP. However, there is limited evidence in the literature on facilitators for bi-directional referral from the providers' perspective. This study is one of the few that attempts to study this topic and compare the differences among providers when looking at provider-level referrals vs. the bi-directional referral capabilities of their practices.

This study aims to examine facilitators for PCPs and pharmacists (providers) regarding referring patients with prediabetes and engaging in bi-directional referrals with CDC-recognized organizations offering the National DPP LCP. We hypothesized that providers who reported having CCLs with these organizations, using an EHR to manage patients, and being located within 10 miles of an in-person LCP class were more likely to make referrals and engage in bi-directional referral (Fig. 1).

2. Methods

2.1. Study sample

The primary data sources used for this study were the 2016 and 2017 waves of the DocStyles cross-sectional web-based survey administered by Porter Novelli.[2] The survey population included a main sample of PCPs and additional samples of other specialties drawn from SERMO's Global Medical Panel.[3] Physicians and nurse practitioners were included if they had been practicing for 3 years in the US, were actively seeing patients,

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[2]Porter Novelli Public Services, a public relations firm with a specialty practice in health and social marketing, developed and administered the DocStyles survey instrument with technical guidance provided by federal public health agencies and other non-profit and for-profit clients.

[3]SERMO is a global market research company Porter Novelli contracted with to verify their active panelists by telephone confirmation at place of work and send them invitations with a link to the web-based survey.

and were working in an individual or group outpatient practice or an inpatient practice. Panelists who did not participate in the previous year's DocStyles survey were prioritized above previous respondents. Quotas were set to reach 1000 primary care physicians, 250 pediatricians, 250 obstetricians/gynecologists, 250 nurse practitioners, 250 oncologists, 150 retail pharmacists, and 100 hospital pharmacists per each survey wave. Of the 9735 health professionals invited to participate in 2016 and 2017, 4266 (43.8%) completed the entire survey (Fig. 2). A subset of 3265 PCPs (physicians, internists, and nurse practitioners; n = 2765) and pharmacists (n = 500) were asked the diabetes-related questions. For PCPs who were respondents in both 2016 and 2017 (n = 250), only their responses from 2017 were included to assess providers' most recent behaviors toward referral and bi-directional referral to the National DPP LCP. PCPs and pharmacists who had not heard of the National DPP LCP (n = 1059) were excluded from all analyses to avoid confusion with providers who may not have differentiated between the National DPP LCP and other similar programs. Data from 1956 unique respondents (1635 PCPs and 321 pharmacists) who had heard of the National DPP LCP were included in descriptive and bivariate analysis; of these, 1717 who reported their practice/pharmacy used EHRs were included in the multivariate analyses (Fig. 2). No individual identifiers were included in the dataset, and this study was deemed exempt by CDC's Institutional Review Board.

A second data source, the CDC's DPRP registry, provided information on the locations of classes offered by CDC-recognized organizations from June 2016 to August 2017(Centers for Disease Control and Prevention and Diabetes Prevention Recognition Program, 2020). Geocoding was done at the street level address for in-person, publicly available LCP class locations from the DPRP database. This was combined with the zip code level centroid for the DocStyles survey respondents to create a density measure for LCP availability within a specified distance radius from providers' practices.

2.2. Measures

The DocStyles survey instrument was designed with multiple sub-parts based on providers' specialties and provides insight into their attitudes and counseling behaviors concerning a variety of health issues, allowing us to assess their use of available health information sources. The detailed survey questions used for this study are provided in Appendix A. The diabetes section provided a brief description of the National DPP LCP, then subsequently asked providers about their referral behavior with this question: "*Have you referred your patients to an in-person or online CDC-recognized lifestyle change program to prevent or delay type 2 diabetes like the one described previously?*". Providers who reported using EHRs were asked if their EHR systems were used to identify and manage patients with prediabetes. Then, after defining a bi-directional referral process, providers were asked the following question: "*Which services listed below best describe clinical services provided within your practice/pharmacy?*". Those who selected the response option "*bi-directional referrals to CDC-recognized lifestyle change programs*" were categorized as engaging in bi-directional referral.

Distance from practice zip code to the nearest in-person LCP class was dichotomized as 1 if the nearest in-person publicly available class was within 10 miles of the provider setting zip

code, and 0 if no in-person LCP classes were within 10 miles. This 10-mile threshold was selected based on literature on availability and distance from health care services and uptake of services. In addition, a sensitivity analysis was undertaken around the reference groups of 10, 20, and 50 miles, and results across all reference groups were not significantly different for any long-distance range categories defined beyond a local 10-mile range (results not reported).

2.3. Statistical analysis

Pearson chi-square or Fisher's exact tests were used to assess bivariate associations between provider-level characteristics, facilitators, and providers' self-reported behavior regarding referral and bi-directional referral to CDC-recognized organizations offering the National DPP LCP. Multiple logistic regressions were used to estimate the effects of facilitators on referral practices conditional on other factors, including provider demographics, provider setting characteristics, and the distance to the nearest LCP. The adjusted odds ratios (AORs) in relation to a reference category were reported with their respective 95% confidence intervals (CIs). All analyses were conducted using SAS, version 9.4.

3. Results

Table 1 provides bivariate associations between key facilitators and characteristics of providers and their referral practices. Overall, 21.0% of providers reported that they referred their patients with prediabetes to a CDC-recognized organization offering the National DPP LCP in-person or online, and 6.4% reported their provider settings engaged in bi-directional referral with an LCP delivery organization. Most providers were male (61.6%) and non-Hispanic White (66.0%) and had practiced medicine or pharmacy for <15 years (57.2%). The majority of provider practices had not established CCLs with LCPs (88.1%) and did not practice within 10 miles of an in-person, publicly available LCP class (89.4%). Only 47.3% of providers reported their practices used EHRs to manage patients with prediabetes.

There were significant differences in the proportion of providers who referred patients to organizations offering the National DPP LCP vs. those who did not refer based on having established CCLs with the LCPs (31.0% of those who referred had established CCLs vs. 6.9% of those who did not refer); using EHRs to manage patients with prediabetes (70.0% vs. 41.1%); and practicing within 10 miles of an in-person, publicly available LCP class (14.6% vs. 9.5%). There were no significant differences in providers' gender, race/ethnicity, provider type, years of practice, or patient household income between providers who did and did not refer patients.

Differences in the proportion of respondents whose practices engaged in bi-directional referral with an LCP vs. those that did not were seen based on the establishment of CCLs with LCPs (48.8% vs. 9.4%), use of EHRs to manage patients with prediabetes (67.0% vs. 45.7%), and patient household incomes (23.2% vs 34.7% for < $49,999; 36.8% vs. 33.0% for $50,000–$99,999; and 40.0% vs. 32.3% for $100,000). There were also significant differences in the proportion of providers practicing bi-directional referral based on provider type (96.8% vs. 82.7% among PCPs and 3.2% vs. 17.3% among pharmacists). There were no significant differences in the proportion of providers whose practices engaged

in bi-directional referral with an LCP based on location within 10 miles of an LCP or by providers' gender, race/ethnicity, or years of practice.

Table 2 shows the results of multivariate analyses with AORs and 95% CIs for provider-level referral and bi-directional referral. Among providers whose practices had established CCLs with LCPs, the odds of referring patients with prediabetes to an LCP were nearly 5 times more likely (AOR = 4.88; 95% CI = 3.58, 6.67), and the odds of engaging in bi-directional referral were 8 times more likely (AOR = 8.59; 95% CI = 5.66, 13.03), compared with those that did not establish CCLs with LCPs. Providers who used EHRs to manage patients with prediabetes had significantly higher odds of referring patients to an LCP (AOR = 2.94; 95% CI = 2.27, 3.81) and engaging in bi-directional referrals with an LCP (AOR = 1.86; 95% CI = 1.21, 2.86). The odds of referring were significantly higher among providers who had an in-person publicly available LCP within 10 miles of their practice zip code (AOR = 1.49; 95% CI = 1.02, 2.17).

4. Discussion

This study utilized the 2016–2017 waves of the DocStyles survey to examine facilitators for PCPs and pharmacists regarding referring patients with prediabetes to the National DPP LCP. Although a previous study found increasing awareness of benefits of the National DPP LCP among providers was associated with increases in the likelihood of providers screening and referring patients to an LCP (Nhim et al., 2018), in the current study, only 21.0% of providers who were aware of the National DPP LCP made referrals, and 6.4% engaged in bi-directional referral. Our results suggest the referral facilitators for providers included having a practice that established CCLs with an LCP, using EHRs to manage patients with prediabetes, or being located within 10 miles of an in-person LCP. Similarly, providers who had established CCLs with local LCPs and used EHRs to manage patients with prediabetes were more likely to engage in bi-directional referral.

Results from the current study are consistent with previous studies. Valaitis et al., 2020, found primary clinical care and public community-based health collaborations transform health care and access to services by establishing clear goals, inclusive relationships, strong leadership and coordination, and effective communication; and through optimal use of resources. Lebrun et al., 2012, showed expansion of health center services through development of an internal referral system for services offered exclusively by each collaborative party. Ádány et al., 2013, suggested that a general practitioner-centered cluster model for community-oriented services could address local population needs through new services including health promotion activities, health status assessments, lifestyle counseling, medical risk assessments, and chronic care rehabilitation services. Finally, a literature review of collaboration between primary care and public health (Martin-Misener et al., 2012) found improved chronic disease management and disease control despite the challenges in establishing such collaboration. In our study, establishment of CCLs was the strongest facilitator, associated with nearly five times higher odds of referral and more than 8 times higher odds of bi-directional referral. A randomized effectiveness trial, Clinical-Community Linkages to Prevent Diabetes, describes the development and implementation of an integrated framework to guide clinical-community linkages for the prevention of type

2 diabetes (Ackermann, 2010). In addition, the National DPP Customer Service Center (https://nationaldppcsc.cdc.gov/s/) provides organizations easy access to training materials, toolkits, and videos and opportunities to ask questions and receive technical assistance on all aspects of the National DPP LCP, including how to engage providers for program referrals.

Our study showed that providers who used EHRs to manage patients with prediabetes had nearly three times the odds of referring patients with prediabetes to CDC-recognized organizations offering the National DPP LCP and nearly twice the odds of engaging in bi-directional referral with these organizations. Similarly, a study of a large health care system partnering with a local YMCA delivering an LCP showed referrals increased over time after fully integrating the program within the health system, including configuring EHR templates/reports and creating clinical referral workflows and training guides (Rehm et al., 2017). A recent randomized controlled trial aimed at increasing diabetes prevention program referrals in a primary care setting (Keck et al., 2020) showed that clinicians participating in a targeted intervention were three times more likely to refer patients with prediabetes to the program than a control group. Intervention activities included clinician education and use of a prediabetes clinician champion and a custom EHR report identifying patients with prediabetes. In addition, the AMA Prevent Diabetes website (http://amapreventdiabetes.org/tools-resources) provides tools and resources including how to implement bi-directional referrals and optimize the EHR (AMA, 2020).

Finally, we found that proximity to an in-person LCP was another facilitator of provider-level referrals, although not bi-directional referral. This is consistent with the literature related to the uptake of health care services relative to their availability or travel distance. One study on distance and health care utilization among the rural elderly found that increased distance from the provider reduced health care utilization, and suggested that distance to the provider is a surrogate for location between residents and their local community services (Nemet and Bailey, 2000). Proximity to a health care facility was also found to be one of many factors determining utilization (Arcury et al., 2005; Mooney et al., 2000). A systematic literature review found that 77% of studies showed the farther patients lived from their health care facilities, the worse their health outcomes were (Kelly et al., 2016).

This current study has several limitations. First, the data collected were self-reported, so results may be subject to recall bias and social desirability bias. Second, the results may not be generalizable to all providers, since the sampling methodology provided a specific quota per item to limit the number of responses. Third, the analysis excluded providers who were not aware of the National DPP LCP, so results may overestimate the proportion of providers who made referrals. Finally, the diabetes survey questions were not asked of certain provider specialties who might also see patients with blood glucose levels in the prediabetes range and have an opportunity to refer to the National DPP LCP.

5. Conclusions

This study highlights the importance of establishing CCLs between provider settings and CDC-recognized organizations offering the National DPP LCP. It emphasizes the benefits of

increasing the use of EHRs to manage patients with prediabetes and increasing availability of in-person LCP class locations near PCPs' and pharmacists' practice settings and awareness of other LCP modalities (online, distance learning, or combination) to promote referrals to the program to prevent or delay onsite of type 2 diabetes among those at highest risk.

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Appendix A.: DocStyles Survey Questions

A.1.   2016 and 2017 DocStyles Relevant Diabetes Survey Questions

PD01. The next section is about the Centers for Disease Control and Prevention (CDC)-recognized lifestyle change programs under the National Diabetes Prevention Program (National DPP). These year-long programs are designed to help people with prediabetes prevent or delay onset of type 2 diabetes by losing a small amount of weight. For the purposes of these questions, "your patient population" is defined as patients who have 1) been screened or tested positive for prediabetes using the CDC Prediabetes Screening Test (CDC Risk Test), the American Diabetes Association Diabetes Risk Test (ADA Risk Test), or one of the three recommended blood tests (fasting glucose, plasma glucose, or HbA1C); 2) been diagnosed with gestational diabetes mellitus (GDM) during a previous pregnancy; or 3) participated in an in-person or online CDC-recognized lifestyle change program.

Have you heard of the CDC-recognized lifestyle change program to prevent or delay type 2 diabetes?

Select one only.

1	Yes
2	No
3	Don' t know

PD09. Have you referred your patients to an in-person or online CDC-recognized lifestyle change program to prevent or delay type 2 diabetes like the one described previously?

Select one only.

1   Yes

2   No

3   Don' t know

EHRU. Do you use Electronic Health Records (EHRs) at your **[INSERT practice/ pharmacy]**?

Select one only.

1   Yes

2   No

PD010. The next few questions are about prediabetes. Do you use the capabilities of your integrated Electronic Health Record System to identify and manage your patients with prediabetes?

Select one only.

1   Yes

2   No

3   Don' t know

PD012. For the purposes of this survey, a clinical community linkage is defined as a formal relationship between clinical care organizations and community-based organizations involving defined roles and procedures associated with the management of health conditions or risk factors within a defined patient population. With which of the following partners have you established a clinical community linkage in the management of patients with prediabetes?

Select all that apply.

PD012a.	Community-based organizations
PD012b.	Community health workers
PD012c.	CDC-recognized lifestyle change programs
PD012d.	Fitness/wellness centers
PD012e.	Places of worship
PD012f.	Federally qualified health clinics/centers
PD012g.	Health departments
PD012h.	Others
PD012i.	None of the above **[SP]**

PD013. For the purpose of this survey, bi-directional referral is defined as a system that facilitates referral information going from the health care provider or pharmacy to the community-based program/service and the return of information on patient participation and outcome data from the community-based program/service to the referring health care provider or pharmacy. Which services listed below best describe clinical services provided within your **[INSERT practice/pharmacy]**?

Select all that apply.

PD013a.	Screening for prediabetes using the CDC Prediabetes risk test or ADA Diabetes risk test
PD013b.	Testing for prediabetes using one of the three recommended blood tests (fasting glucose, plasma glucose, or HbA1C)
PD013c.	Referring patients with prediabetes to a CDC-recognized lifestyle change program
PD013d.	Bi-directional referrals for the management of chronic disease
PD013e.	Bi-directional referrals to CDC-recognized lifestyle change programs
PD013f.	Medication therapy management (MTM) services
PD013g.	Medication synchronization program
PD013h.	Medication refill reminder system
PD013i.	Medication reconciliation at time of transition in care
PD013j.	Don' t know/not sure **[SP]**
PD013k.	None of these **[SP]**

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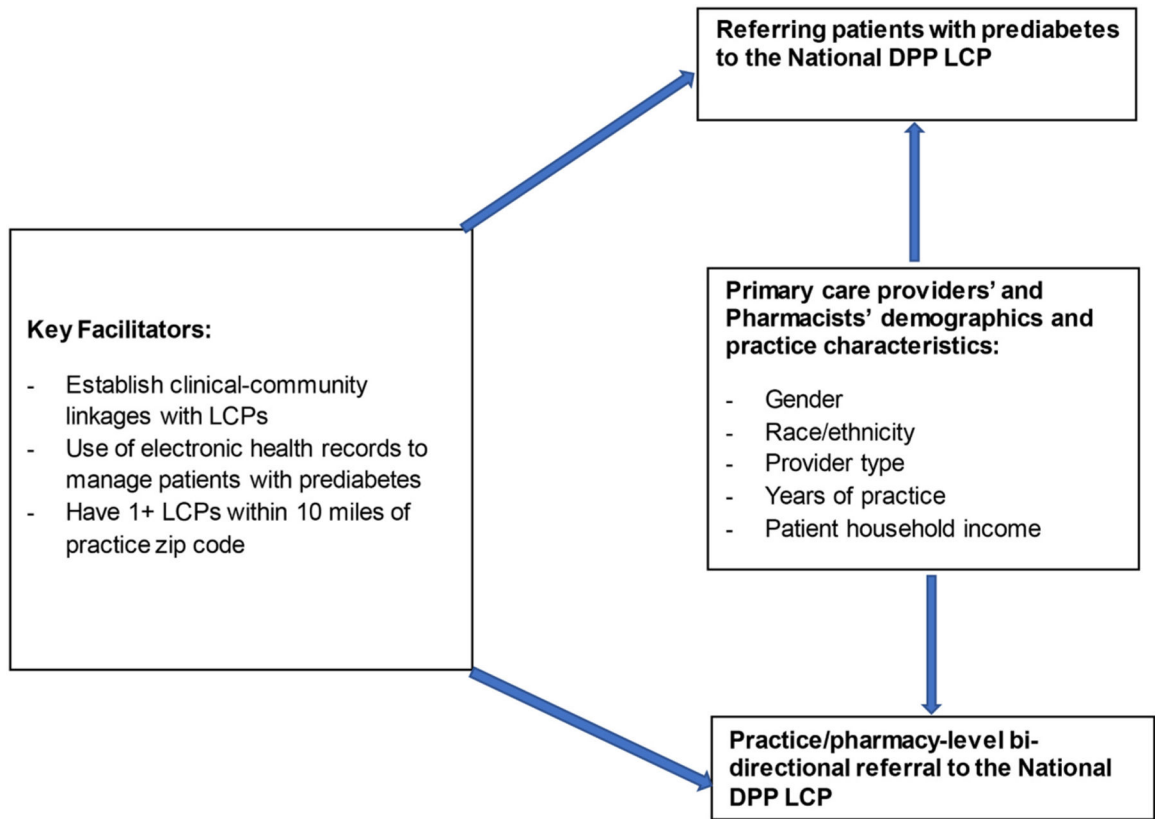**Fig. 1.**
Conceptual Model.
CDC: Centers for Disease Control and Prevention; National DPP LCP: National Diabetes
Prevention Program lifestyle change program.

9,735 health professionals were invited to participate in the 2016 and 2017 DocStyles survey.

5,469 incompletes: **352** did not complete the survey, **381** were terminated based on the screener questions, **472** were terminated due to filled quotas, and **4264** did not respond to the invitation or tried to respond after the survey closed.

4,266 (43.8%) health professionals completed the survey.

1,001 health professionals (500 pediatricians and **501** obstetricians/gynecologists) were not asked the diabetes questions.

Only 2,765 PCPs and 500 Pharmacists out of 4,266 health professionals were asked and completed the diabetes related questions.

250 PCPs were repeat survey respondents in 2016 and 2017 were excluded from all analyses of this study.

2,515 unique PCPs and 500 unique Pharmacists were asked and completed the diabetes related questions.

1,059 PCPs and Pharmacists had not heard of the National DPP LCP were excluded from all analyses of this study.

1,635 unique PCPs and 321 unique Pharmacists who had heard of the National DPP LCP were included in descriptive and bivariate analyses.

410 (21.0%) provider-level referrals of patients with prediabetes to the National DPP LCP, and **125 (6.4%)** practice/pharmacy-level bidirectional referrals.

239 PCPs and Pharmacists did not use EHRs in their practices/pharmacies were excluded from multivariate analysis.

1,717 PCPs and Pharmacists reported their practices/pharmacies used EHRs and were included in the multivariate analysis.
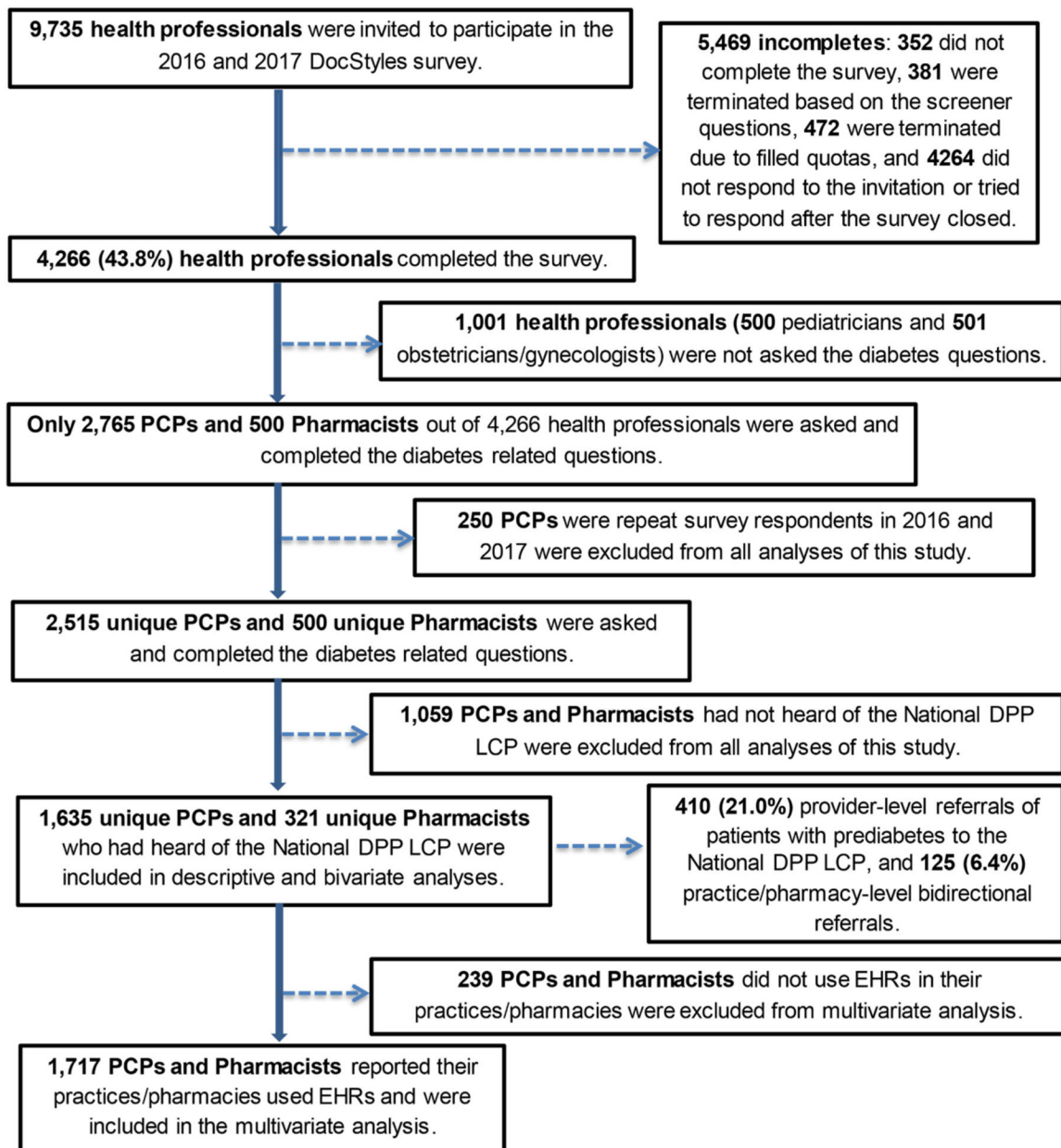
Fig. 2.
Flow chart for survey sample.
CDC: Centers for Disease Control and Prevention; EHRs: electronic health records;
National DPP LCP: National Diabetes Prevention Program lifestyle change program; PCPs:
primary care providers.

Table 1

Bivariate association between facilitators, provider-level characteristics and behaviors regarding their referrals, and bi-directional referrals to the National DPP LCP.

Provider-level characteristics	Total providers N (%)	Provider-level referral		Provider-level bi-directional referral	
		Yes n (%)	No/Don't know n (%)	Yes n (%)	No/Don't know n (%)
Total respondents	1956 (100)	410 (21.0)	1546 (79.0)	125 (6.4)	1831 (93.6)
Facilitators Clinical-community linkages with LCPs					
Yes	**233 (11.9)** ***	**127 (31.0)** ***	**106 (6.9)** ***	**61 (48.8)** ***	**172 (9.4))** ***
No/Don't know	**1723 (88.1)**	**283 (69.0)**	**1440 (93.1)**	**64 (51.2)**	**1659 (90.6)**
Used EHR to manage patients with prediabetes					
Yes	**812 (47.3)** *	**257 (70.0)** ***	**555 (41.1)** ***	**80 (67.0)** ***	**732 (45.7)** ***
No/Don't know	**905 (52.7)**	**110 (30.0)**	**795 (58.9)**	**36 (31.0)**	**869 (54.3)**
Had 1+ LCPs[a] within 10 miles of practice zip code					
Yes	**207 (10.6)** ***	**60 (14.6)** *	**147 (9.5)** *	16 (12.8)	191 (10.4)
No	**1749 (89.4)**	**350 (85.4)**	**1399 (90.5)**	109 (87.2)	1640 (89.6)
PCPs' and Pharmacists' characteristics:					
Gender					
Male	**1204 (61.6)** ***	249 (60.7)	955 (61.8)	76 (60.8)	1128 (61.6)
Female	**752 (38.5)**	161 (39.3)	591 (38.2)	49 (39.2)	703 (38.4)
Race/ethnicity Hispanic	**81 (4.1)** ***	23 (5.6)	58 (3.8)	7 (5.6)	74 (4.1)
Non-Hispanic Black	**61 (3.1)**	13 (3.2)	48 (3.1)	6 (4.8)	55 (3.0)
Non-Hispanic Other[b]	**523 (26.7)**	121 (29.5)	402 (26.0)	43 (34.4)	480 (26.2)
Non-Hispanic White	**1291 (66.0)**	253 (61.7)	1038 (67.1)	69 (55.2)	1222 (66.7)
Provider type					
Primary care providers	**1635 (83.6)** ***	343 (83.7)	1292 (83.6)	**121 (96.8)** ***	**1514 (82.7)** ***
Pharmacists	**321 (16.4)**	67 (16.3)	254 (16.4)	**4 (3.2)**	**317 (17.3)**
Years of practice					
< 15 years	**1119 (57.2)** ***	231 (56.3)	888 (57.4)	63 (50.4)	1056 (57.7)
15+ years	**837 (42.8)**	179 (43.7)	658 (42.6)	62 (49.6)	775 (42.3)
Patient household income					
< $49,999	665 (34.0)	130 (31.7)	535 (34.6)	**29 (23.2)** *	**636 (34.7)** *
$50,000–$99,999	650 (33.2)	135 (32.9)	515 (33.3)	**46 (36.8)**	**604 (33.0)**
$100,000 or more	641 (32.8)	145 (35.4)	496 (32.1)	**50 (40.0)**	**591 (32.3)**

Note: Boldface indicates statistical significance (*$p < 0.05$, **$p < 0.01$, ***$p <$ using Pearson Chi-Square or Fisher's Exact Test of difference between each category of independent variables among total PCPs and providers who referred patients with prediabetes or whose practice/pharmacy engaged in bi-directional referral with a CDC-recognized organization offering the National DPP LCP vs. providers who did not.

CDC: Centers for Disease Control and Prevention; EHRs: electronic health records; LCP: National DPP lifestyle change program; PCPs: primary care providers (family practitioners, internists, and nurse practitioners).

[a]In-person publicly available national DPP LCP class locations.

[b]Non-Hispanic other race/ethnicity includes participants self-reporting as multiracial, non-Hispanic Asian, non-Hispanic Native Hawaiian or other Pacific islander, non-Hispanic American Indian or Alaska Native, and other race.

Table 2

Impact of facilitators on provider-level and bi-directional referral to the National DPP LCP.

	Provider-level referral (*n* = 1717)	Bi-directional referral (n = 1717)
	AOR (95% CI)	AOR (95% CI)
Facilitators:		
Clinical-community linkages with LCP		
Select	**4.88 (3.58, 6.67)**	**8.59 (5.66, 13.03)**
Not select (ref)	1.00	1.00
Used EHR to manage patients with prediabetes		
Yes	**2.94 (2.27, 3.81)**	**1.86 (1.21, 2.86)**
No/Don't know (ref)	1.00	1.00
Had 1+ LCPs[a] within 10 miles of practice zip code		
Yes	**1.49 (1.02, 2.17)**	0.88 (0.47, 1.66)
No (ref)	1.00	1.00
PCPs' and Pharmacists' characteristics:		
Gender		
Female	1.05 (0.81, 1.36)	1.11 (0.73, 1.69)
Male (ref)	1.00	1.00
Race/ethnicity		
Hispanic	1.13 (0.62, 2.06)	1.05 (0.38, 2.85)
Non-Hispanic Black	1.01 (0.50, 2.04)	2.39 (0.91, 6.24)
Non-Hispanic Other[b]	1.11 (0.84, 1.46)	1.24 (0.80, 1.94)
Non-Hispanic White (ref)	1.00	1.00
Years practicing medicine or pharmacy		
15 years	1.11 (0.86, 1.44)	1.35 (0.90, 2.03)
<15 years (ref)	1.00	1.00
Patient household income		
$49,999	0.83 (0.61, 1.12)	0.60 (0.35, 1.00)
$50,000–$99,999	0.83 (0.61, 1.12)	0.86 (0.54, 1.37)
$100,000 (ref)	1.00	1.00

Note:. Data are presented as adjusted odds ratios, AOR (95% CI).

CDC: Centers for Disease Control and Prevention; EHRs: electronic health records; National DPP LCP: National Diabetes Prevention Program lifestyle change program; PCPs: primary care providers (family practitioners, internists, and nurse practitioners).

[a]
In-person publicly available national DPP LCP class locations.

[b]
Non-Hispanic other race/ethnicity includes multiracial, non-Hispanic Asian, non-Hispanic Native Hawaiian or other Pacific islander, non-Hispanic American Indian or Alaska Native, or other race.