



## Introduction of a community health worker diabetes coach improved glycemic control in an urban primary care clinic

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### ABSTRACT

The burden of diabetes is higher in urban areas and among racial and ethnic minorities. The purpose of this research was to evaluate the effectiveness of extending a diabetes intervention program (DIP) by engaging a team, including a community health worker (CHW), to provide care for patients to meet glycemic control, specifically in a predominantly urban, minority patient population. The DIP enrolled diabetic patients from an internal medicine clinic. A CHW facilitated the collection of glucose meter readings. The CHW coached patients on glycemic control while the CHW's registered nurse partner titrated the patient's recommended insulin dose. Subsequent HbA1c values for participants were compared to those seen at the same clinic who were not enrolled. The DIP was deployed for nine months. One hundred forty-four patients were enrolled in the DIP and 348 patients constituted the comparator group. Ninety-three DIP participants had pre- and post-intervention HbA1c values and were compared to 348 non-DIP participants. Propensity score weighted adjusted analyses suggest that participants were more likely to reduce their HbA1c values by at least 1.0% and have HbA1c values of less than 8.0% (64 mmol/mol) than non-participants (adjusted odds ratio = aOR = 1.47, 95% CI 1.26–1.71, and aOR = 1.23, 95% CI 1.06–1.43, respectively). CHW coaches as part of a team in a clinical setting improved glycemic control in a predominantly urban, minority patient population.

### 1. Introduction

More than 30.3 million people, or 9.4% of the U.S. population, have diabetes (Centers for Disease Control and Prevention, 2017). This estimate includes Type 1 and Type 2 diabetes, where the latter constitutes about 90–95% of all diabetes cases. Diabetes is a risk factor for ischemic heart disease, stroke, and cardiovascular disease (Centers for Disease Control and Prevention, 2017). In 2015, diabetes was the seventh leading cause of death in the United States, and in 2012, diabetes accounted for \$245 billion in total direct and indirect healthcare costs (Centers for Disease Control and Prevention, 2017).

Diabetes is more prevalent and creates an increased burden, including decreased quality of life, economic stress, and subsequent adverse health outcomes, in urban, minority, and low-income groups (Chow et al., 2012; Kumari et al., 2004; Maty et al., 2005; Robbins et al.,

2005; Spanakis and Golden, 2013). The Centers for Disease Control and Prevention estimate the age-adjusted prevalence of diagnosed diabetes is 7.1% for Non-Hispanic White individuals, 11.8% for Hispanic-Americans, and 12.6% of Non-Hispanic Black individuals (Spanakis and Golden, 2013). This statistic is in line with the Institute of Health report stating that there is a 50–100% higher burden of illness from diabetes amongst African Americans, Hispanics, and Native Americans compared with White Americans, meaning there are racial differences in rates of incidence and complications (Chow et al., 2012). The prevalence of diabetes is higher among individuals with lower educational and income levels, which is in line with prospective analyses showing those with higher education and income levels had a decreased onset risk of diabetes development (Lee et al., 2011). These disadvantaged groups also experience more difficulties in disease management and medication adherence (Scott et al., 2017; Shea et al., 2009).

**Abbreviations:** CHW, community health worker; DIP, diabetes intervention program; HbA1c, hemoglobin A1c; HFHS, Henry Ford Health System; RN, registered nurse.

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The National Committee for Quality Assurance (2019) has defined quality standards for comprehensive diabetes care. These standards define hemoglobin A1c (HbA1c) control as less than 8.0% (64 mmol/mol) in adults ages 18–75 years with Type 1 or Type 2 diabetes. Thus, individuals with HbA1c values less than 8.0% (64 mmol/mol) are classified as having achieved glycemic control.

With the goal of combating the challenges faced by primary care practices that experience high demand for diabetes care (Chen et al., 2009; Khunti et al., 2015; McGlynn et al., 2003; Saaddine et al., 2002), as well as the added stress introduced by populations with fewer resources to manage their disease, various care improvement strategies are needed to improve patient control of their diabetes. Results from a meta-analysis of quality improvement strategies suggest that case management, team changes (McGill et al., 2016), and promotion of self-management yielded significant reductions in HbA1c values by at least 0.50% (Tricco et al., 2012). In case management quality improvement strategies, a member of a collaborative team, in conjunction with the primary care physician, oversaw the diagnosis, treatment, and management of diabetes care. Team changes altered the primary health care team to include a non-physician team member and included this team member in diabetes care activities. Lastly, promotion of self-management provided equipment and home resources to monitor and change insulin dosages. Further, there is growing evidence for the effectiveness of including a community health worker (CHW) in care for patients with diabetes (Kim et al., 2016; Palmas et al., 2015; Shah et al., 2013).

We sought to utilize the aforementioned care improvement strategies of case management, team changes, and promotion of self-management to increase glycemic control among high-risk patients, defined as those with a HbA1c value greater than or equal to 8.0% (64 mmol/mol), in an urban primary care clinic at Henry Ford Health System (HFHS) based in Detroit, Michigan by creating a new diabetes intervention program (DIP). Specifically, we trained and integrated a CHW into an internal medicine care team with the purpose of improving glycemic control for diabetic patients seen at the clinic. The effectiveness of the program is presented here.

## 2. Materials and methods

### 2.1. Study design

A diagram of enrollment into and workflow of the DIP can be found in Fig. 1. Briefly, primary care physicians identified and referred patients from those seen in their daily clinical visits to the program via the electronic medical record. The registered nurse (RN) then reviewed the eligibility in the medical record and referred the patient to the CHW, who called the patient, explained the program and its requirements, and invited them to participate. Verbal informed consent was obtained over the telephone and documented. If the patient agreed to participate, the CHW collected fasting blood glucose values, and information about demographics and factors that could prevent them from successfully managing their glucose levels, such as access to prescription medication, food, or electricity to maintain refrigeration of insulin. This information was then reviewed by the RN, who contacted the patient with insulin dosage titration instructions. The CHW referred the participant to resources that could assist them in addressing their needs, such as local groups that provide food and utility resources or the HFHS pharmacy team who could help the participant obtain appropriate medications. The process of the CHW collecting fasting blood sugar levels and discussing barriers to control followed by RN review was repeated approximately every other week until the participant reached their fasting blood glucose goal.

### 2.2. Community health worker

The CHW completed three courses through the American Association

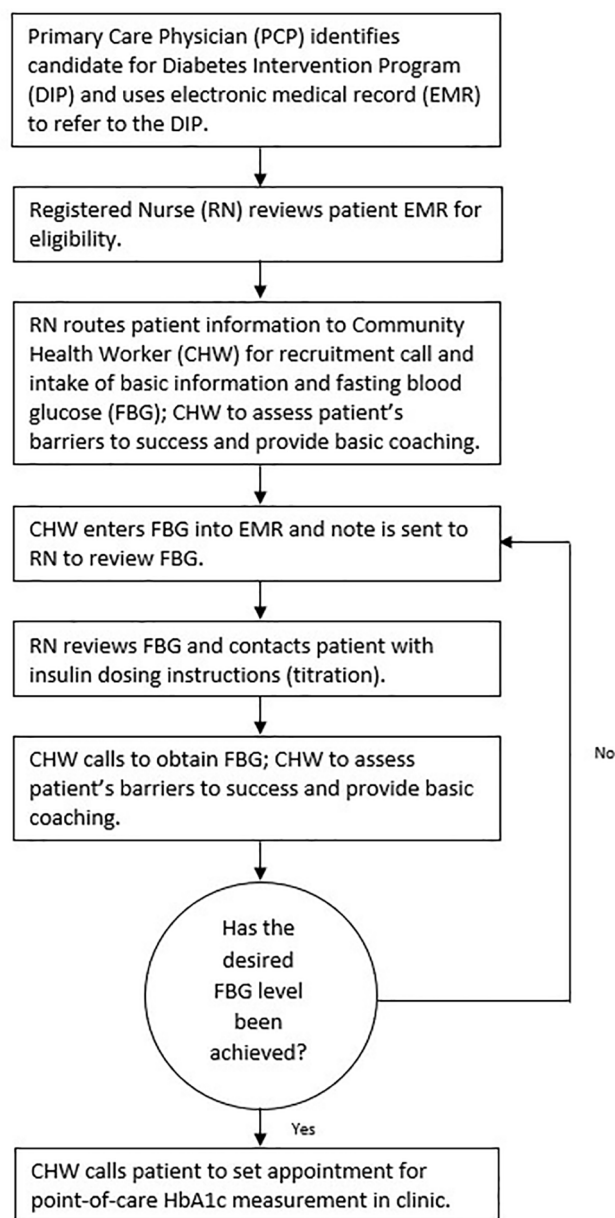


Fig. 1. Diabetes Intervention Program (DIP) Protocol. Participant enrollment and details of involvement in the DIP are outlined in the figure.

of Diabetes Educators and received certification as a “Certified Life Coach for Diabetes Prevention Programs.” The CHW training also included shadowing of another CHW who provided diabetes care in a different HFHS clinic and completion of outpatient education courses offered to patients with diabetes by HFHS. Upon completion of the training, the CHW worked under the direction of the clinic’s RN, who was focused on care for patients with diabetes. The CHW and RN worked together to enroll participants into the DIP, obtain weekly fasting blood glucose levels, and when applicable, titrate insulin dosages based on participant progress until the goal fasting blood glucose level was met. The CHW provided patients with diabetes coaching on medication, nutrition, physical activity, and other steps that the patient could take to understand their care plan and improve their glycemic control. She also addressed barriers such as guiding participants to community resources for food supplies and assisting with insurance applications.

### 2.3. DIP participants

Eligible DIP participants included those who had a primary care physician based in Henry Ford Hospital's Academic Internal Medicine Clinic in downtown Detroit, were between the ages of 18–75 years, and were new users of long-acting/basal insulin or were already using insulin but still had elevated blood sugar levels. Enrollment occurred between December 1, 2015 and December 1, 2016. Participants provided demographic data at the time of enrollment. Specifically, insurance status and type, employment status, marital status, highest achieved education level, race, cigarette smoking status, and comorbidities, including congestive heart failure, asthma, chronic obstructive pulmonary disease, chronic musculoskeletal pain, depression, bipolar disorder, obesity, high cholesterol, high blood pressure, chronic kidney disease, cerebrovascular disease, coronary artery disease, schizophrenia, and transplant status, were collected from the participant. Additionally, body mass index and HbA1c values prior to enrollment and throughout the study period were abstracted from the participants' electronic medical record. Lastly, participants completed an acuity barriers questionnaire, in which participants answered questions to assess barriers that may prevent them from meeting their fasting blood glucose goals. Questions included social determinants of health and revolved around the themes of overall medical status and stability, medication adherence, medical and health education, health insurance, employment/income, housing, basic life necessities and skills, support system, transportation, self-efficacy, mental health, substance and alcohol use, legal issues, oral health, and cultural/linguistic issues. These questions were selected as they are commonly included in questionnaires assessing social determinants of health (Campbell et al., 2019; McBrien et al., 2017; Nam et al., 2011; Zgibor and Songer, 2001). The results of this questionnaire provided the CHW with ideas for coaching the participants to address these potential barriers to glycemic control.

The study participants were compared to patients with diabetes in the same clinic who were not included in the CHW program ("comparator" group). These patients met the same eligibility criteria required for enrollment in the DIP and had both pre- and post-anchor date HbA1c values. December 1, 2016 was used as an anchor date for the comparator group (versus a study enrollment date), in which HbA1c values could be further identified for comparison to pre- and post-enrollment for study participants. Data for all individuals was collected through March 31, 2018.

### 2.4. Statistical analyses

T-tests (continuous variables) and chi-square tests (categorical variables) were used to test differences between the DIP and comparator groups and those DIP participants with and without a pre- and post-HbA1c measure. The fully conditional specification method was used to impute missing values for both continuous and categorical variables in the data set used for modeling. The data set was imputed ten times. Inverse probability of treatment weight was estimated through propensity score modeling to account for bias by confounding (Austin, 2011). We calculated propensity scores by computing the conditional probability of being in the participant group given a series of covariates, including age, insurance type, employment status, sex, relationship status, and current smoking status. Linear regression models were used to ensure the balance of covariates after weighting. Weighted multivariate logistic regression using propensity scores as weights was subsequently performed to assess the effect of the DIP on the outcomes of HbA1c decreasing by at least 1.0% (i.e., at least a 1 "unit" decrease in HbA1c where HbA1c itself is expressed as a percentage) and having a HbA1c less than 8.0% (64 mmol/mol) after adjusting for covariates listed above. Adjusted odds ratios (aOR) and 95% confidence intervals (CIs) were calculated.

Any HbA1c result greater than 14.0% (130 mmol/mol) is recorded as ">14.0%" in the HFHS electronic medical record. These values were

coded as 14.1% (131 mmol/mol) for statistical analyses (n = 17 participants and 20 non-participants). Statistical analyses were conducted using SAS version 9.4 (SAS Institute, Inc., Cary, NC). All study protocols were approved through the HFHS Institutional Review Board.

### 3. Results

One hundred forty-four patients were screened as eligible and agreed to participate in the DIP and a group of 348 individuals was identified as a source for the comparator group. The DIP participants were younger, more likely to be employed full-time and be Black/African American, and less likely to have private insurance or Medicare/Medicaid than the comparator group (Table 1). Of the 144 enrolled DIP participants, 93 (64.6%) had both a pre- and post-DIP HbA1c value that could be used to measure the effectiveness of the program in reducing HbA1c. While the only statistically significant ( $\alpha = 0.05$ ) difference between the groups

**Table 1**

Characteristics of Diabetes Intervention Program (DIP) participants and members of the comparator group.\*

Characteristic	Response	Intervention Participants (n = 144)	Comparator Group (n = 348)	p-value
Age (years), mean $\pm$ SD		54.6 $\pm$ 10.2	60.0 $\pm$ 13.3	<0.001 <sup>†</sup>
BMI (kg/m <sup>2</sup> ), mean $\pm$ SD		34.0 $\pm$ 8.6	34.5 $\pm$ 8.8	0.63
Baseline HbA1c (%), mean $\pm$ SD		11.3 $\pm$ 2.5	9.9 $\pm$ 1.8	<0.001 <sup>†</sup>
Employment status, N (%)	Employed full-time	36 (31%)	86 (28%)	<0.001 <sup>†</sup>
	Employed part-time	2 (2%)	10 (3%)	
	Student and not working for pay	2 (2%)	0 (0%)	
	Unemployed and not a student	19 (16%)	51 (17%)	
	Retired	24 (20%)	111 (36%)	
	Disabled	35 (30%)	45 (15%)	
	Self-employed	0 (0%)	3 (1%)	
Race, N (%)	White	5 (4%)	24 (7%)	0.004 <sup>†</sup>
	Black/African American	114 (96%)	292 (91%)	
	Other	0 (0%)	5 (2%)	
Relationship status, N (%)	Married or living as married	41 (34%)	122 (36%)	0.13
	Single	58 (48%)	158 (46%)	
	Divorced	16 (13%)	32 (9%)	
	Widowed	6 (5%)	16 (5%)	
	Other	0 (0%)	15 (4%)	
Insurance type, N (%)	Medicare/Medicaid	69 (60%)	236 (68%)	<0.001 <sup>†</sup>
	Other public	9 (8%)	0 (0%)	
	Private	35 (30%)	110 (32%)	
	Not insured	2 (2%)	2 (1%)	
Sex, N (%)	Female	70 (49%)	186 (53%)	0.33
	Male	74 (51%)	162 (47%)	
Ever smoked, N (%)	No	56 (48%)	170 (49%)	0.50
	Yes	60 (52%)	174 (51%)	
Currently smokes, N (%)	No	77 (76%)	286 (83%)	0.16
	Yes	24 (24%)	58 (17%)	

BMI, body mass index.

\*Some data are missing for both DIP and comparator groups.

<sup>†</sup> Denotes statistical significance ( $\alpha = 0.05$ ).

was that those without both a pre- and post-program HbA1c had a higher rate of being a current smoker, other differences suggest a higher rate of disability and being married or living as married and a lower rate of Medicare/Medicaid usage in those without both pre- and post-DIP HbA1c measures (Table 2). Participants classified as without both a pre- and post-DIP HbA1c have a pre-DIP HbA1c but did not have a HbA1c measurement after DIP enrollment.

Propensity score weighted multivariate logistic regression models were used for the adjusted analyses (Table 3). Those individuals who participated in the DIP were more likely to decrease their HbA1c value

**Table 2**

Characteristics of diabetes intervention program (DIP) participants who did and did not have a hemoglobin A1c (HbA1c) measure before and after participating in the CHW program\*.

Characteristic	Response	Without pre- and post-CHW program HbA1c (n = 51)	With pre- and post-CHW program HbA1c (n = 93)	p-value
Age (years), mean $\pm$ SD		53.8 $\pm$ 9.5	55.0 $\pm$ 10.6	0.55
BMI (kg/m <sup>2</sup> ), mean $\pm$ SD		32.9 $\pm$ 7.7	34.7 $\pm$ 9.0	0.25
Employment status, N (%)	Employed full-time	10 (27%)	26 (32%)	0.28
	Employed part-time	0 (0%)	2 (2%)	
	Student and not working for pay	1 (3%)	1 (1%)	
	Unemployed and not a student	5 (14%)	14 (17%)	
	Retired	5 (14%)	19 (23%)	
Race, N (%)	White	1 (2%)	4 (4%)	0.14
	Black/African American	37 (73%)	77 (83%)	
	Unknown	13 (25%)	12 (13%)	
Relationship status, N (%)	Married or living as married	17 (45%)	24 (29%)	0.28
	Single	17 (45%)	41 (49%)	
	Divorced	3 (8%)	13 (16%)	
	Widowed	1 (3%)	5 (6%)	
Insurance type, N (%)	Unknown	15 (29%)	14 (15%)	0.20
	Medicare/Medicaid	21 (41%)	48 (52%)	
	Other public	2 (4%)	7 (8%)	
	Private	13 (25%)	22 (24%)	
	Not insured	0 (0%)	2 (2%)	
Highest education level achieved, N (%)	Less than high school	9 (25%)	15 (19%)	0.61
	High school graduate	13 (36%)	25 (32%)	
	Some college or technical	11 (31%)	22 (29%)	
	College graduate	3 (8%)	13 (17%)	
	More than college	0 (0%)	2 (3%)	
Sex, N (%)	Female	25 (49%)	45 (48%)	0.94
	Male	26 (51%)	48 (52%)	
Ever smoked, N (%)	No	17 (49%)	39 (48%)	0.97
	Yes	18 (51%)	42 (52%)	
Currently smokes, N (%)	No	19 (63%)	58 (82%)	0.048 <sup>†</sup>
	Yes	11 (37%)	13 (18%)	

BMI, body mass index.

\*Some data are missing.

<sup>†</sup> Denotes statistical significance ( $\alpha = 0.05$ ).

**Table 3**

Propensity score weighted logistic regression models adjusted for potential confounders. Odds ratios for the outcomes comparing diabetes intervention program (DIP) participants and the comparator group (n = 93 participants and n = 348 comparator group).

	Adjusted odds ratios (95% CI)*
Outcome of having a HbA1c decrease at least 1.0% Participants vs. Non-participants	1.47 (1.26, 1.71)
Outcome of having a HbA1c less than 8.0% (64 mmol/mol) Participants vs. Non-participants	1.23 (1.06, 1.43)

HbA1c, hemoglobin A1c.

\* Adjusted for the following factors: age, body mass index, employment status, relationship status, insurance type, sex of patient, and current smoking status.

by at least 1.0% compared with those in the comparator group (aOR = 1.47, 95% CI 1.26–1.71). DIP participants were also more likely to have a HbA1c value of less than 8.0% (64 mmol/mol) compared with those in the comparator group (aOR = 1.23, 95% CI 1.06–1.43).

#### 4. Discussion

These data demonstrate that in our urban, predominantly Black/African American clinic, patients with diabetes using insulin were more likely to improve their glycemic control when they were working with the CHW, who was trained as a diabetes coach, compared with those patients who did not receive coaching from the CHW. In part, because of the work presented here, the health system leadership retained the CHW in the clinic to provide care to all clinic patients. The CHW's integration was well accepted by the nursing and physician staff, and she continues to work in tandem with the clinical team to provide optimal diabetes care to patients seen in the clinic.

Several quality improvement techniques have been shown to significantly improve diabetes patient glucose control. Most effective in a meta-analysis were the following: (1) "team changes" which include adding a non-physician team member, use of multidisciplinary teams, or expansion of professional roles; (2) "case management" in which non-physicians coordinate diagnosis, treatment, or routine management; and (3) "promotion of self-management" in which home monitoring equipment is used to transmit home glucose measurements and patients receive insulin dose changes in return (Tricco et al., 2012). These yielded, respectively, reductions in HbA1c of 0.57% (95% CI 0.42%–0.71%); 0.50% (95% CI 0.36%–0.65%); and 0.57% (95% CI 0.31%–0.83%). In another similar review, interventions allowing medication adjustment without physician approval were even stronger (average HbA1c reduction, 0.8%) (Shojania et al., 2006). In multiple intervention designs, nurse case managers have been specifically shown to positively impact diabetes control; a recent meta-analysis of 8 studies showed a HbA1c reduction of 0.4% (95% CI 0.1%–0.7%) (Shaw et al., 2014; Watts and Lucatorto, 2014). In a recent review of publications reporting results from community health center-based interventions for people with diabetes, the authors reported that face-to-face interventions in "socio-economically disadvantaged" patients were generally effective in improving glucose control (Han et al., 2019). Our results are similar.

Evidence is increasing about the positive impact of team care and CHWs on the health of patients with diabetes (Kim et al., 2016; McGill et al., 2016; Palmas et al., 2015; Shah et al., 2013). In a small randomized controlled trial, an internet-based glucose monitoring system with bidirectional communication with a multidisciplinary care team improved HbA1c levels. Among patients with a baseline HbA1c greater than 7.0% (53 mmol/mol), HbA1c declined in the first 3 months by approximately 1.0% and continued to decline slowly over 30 months of follow-up (Cho et al., 2006). In a Chicago-area study of CHWs conducting house visits to coach individuals who reported ever having been told by a doctor that they have diabetes, participants were less likely to



forget to take their diabetes medication and reported higher diabetes knowledge after coaching (Hughes et al., 2016). Overall, HbA1c levels declined in participants who were coached by CHWs in the participants' homes as part of an intervention to reduce racial disparities in health and social outcomes in East/Central Harlem (Feinberg et al., 2019). Unlike these programs, our CHW was based in a clinic and relied on telephone communications or in-person contact when the participant was in the clinic.

A recent three-arm cluster-randomized trial of community health centers found no benefit to patients with diabetes after adding a CHW to the clinic team. Three clinics incorporated a medical assistant, 3 clinics incorporated a CHW and 10 clinics made no changes (Rodriguez et al., 2018). The authors suggested that benefits could be realized with the addition of the CHW if the clinical practice leaders did not use them to cover "shortages" in primary care practices, such as when the "regular" medical assistant was not in clinic. Our current work supports this statement and shows that when the CHW is incorporated directly into diabetes care, instead of used as coverage in the clinical setting, most patients are able to improve their glycemic control.

Our study had limitations typical of epidemiological studies. Missing participant characteristic data were due to lack of collection by clinic staff or the CHW during the clinic visit. Only 65% of the DIP participants had a pre- and post-DIP HbA1c measurement and the rate of disability was higher in those that did not. Future interventions should have an increased focus on overcoming suspected barriers to care and self-management. A larger sample size would have led to more precise estimates of measures of association. However, data trends were consistent in supporting the conclusion that the presence of a CHW positively impacts diabetes care and management. The funding period was limited and conclusions about changes over longer time periods (only 3–9 months in the DIP) are unknown; however, patients who continue to seek care at the clinic would be able to continue to work with the CHW if they had not yet reached their glycemic control goals or if they reached their goal but later moved out of their goal range. While randomization may have been ideal for purposes of reducing differences between the intervention and comparator groups, this was not feasible in this single practice where patients may have seen other doctors in the practice for care. Also, while some prior research of pharmacological intervention trials suggests stratification and/or adjustment of baseline HbA1c in statistical analyses of changes in HbA1c (Jones et al., 2016), we did not adjust for a baseline HbA1c in our observational study that focused on analyses of a "change score" (changed by at least 1% or 1 "unit") and a clinically meaningful cut point (less than 8.0%). Lastly, we were limited to HbA1c data only at HFHS, and test results from other clinics outside the health system could not be captured. However, it is rare that patients would seek care at other laboratories after being seen at HFHS for primary care.

Finally, it should be noted that throughout the program, the CHW came to be a valued member of the clinical care team whose value was appreciated by the clinic physicians. Beyond her efforts on the DIP, the CHW was asked by clinic physicians to meet in clinic with all patients who were receiving their first prescription for insulin. The CHW provided orientation for these patients in partnership with the RN. It allowed the RN to focus on other duties requiring licensure.

## 5. Conclusions

With high patient volume and short visit times in internal medicine clinics, it is challenging to provide the in-depth care required for patients with uncontrolled diabetes. With the additional demands for providing care to elevated risk groups of minorities and urban populations, achieving glycemic control can be difficult. Our study suggests that presence of a CHW in a clinical care team can improve glycemic control among patients with diabetes, especially those who are markedly difficult to reach. The salaries of CHWs are less than RNs and most other clinic staff, making them an affordable option for expanding the

reach of the clinical care team. Further, the training to become a diabetes coach was predominantly online and could be completed by those who are not proximal to major clinical institutions. These results are novel because they demonstrate success of a CHW in coaching patients in a predominantly urban, minority population. The CHW training was comprehensive and cost-effective and can easily be implemented in other primary care clinics. Also, the novel use of propensity score weighting in analyses demonstrate effectiveness of the program by utilizing a similar comparison group. The data presented here are evidence that nominal investments in the clinical care team can have a significant impact in clinics with high rates of patients with uncontrolled diabetes.

## 6. Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to institutional review board requirements and the sensitivity of individual-level protected health information from patients at Henry Ford Health System.

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## CRediT authorship contribution statement

**Chad M. Coleman:** Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Project administration, Visualization. **Andrew S. Bossick:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - review & editing, Project administration. **Yueren Zhou:** Software, Formal analysis, Data curation, Writing - review & editing, Visualization. **Linda Hopkins-Johnson:** Investigation. **Mira G. Otto:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing - review & editing, Supervision, Project administration. **Anupama S. Nair:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing - review & editing, Supervision, Project administration. **David E. Willens:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing - review & editing, Supervision, Project administration. **Ganesa R. Wegienka:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Writing - original draft, Writing - review & editing, Visualization, Supervision, Project administration, Funding acquisition.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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