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Does an all-condition case management program for high-risk patients reduce health care utilization in medicaid and medicare beneficiaries with diabetes?

Linh Phuong Bui [a,b], Felicia Hill-Briggs [a,c,d,e], Nola Durkin [c,d], Ariella Apfel [c,d], Patti L. Ephraim [a,c,d], Lindsay Andon [e], Hussain S. Lalani [a], Linda Dunbar [e], Lawrence J. Appel [a,c,d], Hsin-Chieh Yeh [a,c,d,*]

[a] Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA
[b] Center for Population Health Sciences, Hanoi University of Public Health, Hanoi, Viet Nam
[c] Department of Medicine, Johns Hopkins School of Medicine, Baltimore, MD, USA
[d] The Welch Center for Prevention, Epidemiology and Clinical Research, Johns Hopkins University, Baltimore, MD, USA
[e] Johns Hopkins HealthCareLLC, Glen Burnie, MD, USA

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ABSTRACT

Objective: To assess whether an all-condition case management program can improve health care utilization and clinical outcomes in patients with diabetes.
Research design and methods: 1342 patients with diabetes were enrolled in the Johns Hopkins Community Health Partnership (J-CHiP) Case Management program for high-risk patients with any chronic disease. We categorized participants into two intervention exposure categories based on the number of contacts with case manager (CM) and community health worker (CHW) per month: low contact (≤1 contact/month), and high contact (>1 contacts/month). The primary outcomes were rates of emergency department (ED) visits, hospitalizations, and 30-day hospital readmissions.
Results: In analyses adjusted for age, sex, race, risk score, and baseline health utilization rate, Medicaid participants in the high contact group had 42% (rate ratio (RR): 1.42; 95% CI: 1.08–1.86) and 64% (RR: 1.64; 95% CI: 1.08–2.48) higher risks for hospital admission and readmission, respectively, than the low contact group. Similar increases were seen in the Medicare participants with 20% (RR: 1.20; 95% 1.02–1.42) and 42% (RR:1.42; 95% 1.09–1.84) higher risks for admission and readmission, respectively. The associations were not statistically significant for ED visits. Subsidiary analysis of a subset with HbA1c available (n = 545) revealed a statistically significant decrease in HbA1c among Medicare participants (mean (SD): −0.17% (1.50%)), with a larger decrease in the high contact group (mean (SD): −0.23% (1.59%)).
Conclusion: In an all-condition case management program for high-risk patients, the higher intensity of contacts with CHW and CM was not associated with a reduced health care utilization in adults with diabetes.

1. Introduction

Diabetes mellitus is a complex condition with excess morbidity and burden in underserved populations.[1] The development and implementation of multifaceted, comprehensive approaches that go beyond the traditional paradigm of medical care are particularly needed. Case manager (CM) interventions that employ a health professional for the coordination of individualized care have been shown to be an effective management strategy for diabetic patients,[2–5] and the interventions provided by CM have been shown to improve glycemic control.[6] Similarly, community health workers (CHWs), or lay health workers, have played various roles, such as providing diabetes education and serving as liaisons between community members and the health care system.[7–10] Community health worker interventions have been shown to improve patient knowledge, physiological measures in some studies, and produce positive changes in the lifestyle and self-care of patients.[8,11,12] Still, few studies have integrated both CHWs and CMs into a patient-centered team-based model to enhance healthcare access in a real health care system.[13,14]

Comprehensive models of care, such as the chronic care model, advocate for evidence-based changes to the health care system to meet the needs of growing numbers of people who have chronic diseases.[15]

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* Corresponding author at: Welch Center for Prevention, Epidemiology, and Clinical Research, The Johns Hopkins University, 2024 East Monument Street, Suite 2-600, Baltimore, MD 21205.
E-mail address: hyeh1@jhmi.edu (H.-C. Yeh).

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While this model has been critiqued for not adequately meeting the needs of diverse patient populations with diabetes,[16] a systematic review provided qualitative evidence that supported chronic care model-based interventions were generally effective for managing diabetes in primary care settings in the US.[17] As many health care systems are considering system-level reorganization to broadly provide more comprehensive and coordinated care for high-risk patients, it is still not clear whether an all-condition case management program for high-risk patients can improve health outcomes and help control glycemia in patients with diabetes.

In response to the need for healthcare transformation, the Johns Hopkins Community Health Partnership (J-CHiP) initiative was awarded a Center for Medicare & Medicaid Innovation (CMMI) Healthcare Innovation Award (HCIA) for Complex/High-Risk Patient Targeting.[18] The initiative spanned the care continuum, with interventions delivered in acute care hospitals, skilled nursing facilities, ambulatory primary care sites, and within the Baltimore community.[19]

Using data from the primary care-embedded program within J-CHiP, we assessed the associations between the intervention intensity and healthcare utilization outcomes (emergency department visits, hospitalizations, and 30-day readmission rates) in adults with diabetes. We also evaluated changes in the HbA1c level as a secondary outcome. We hypothesized that a higher contact frequency would reduce health care utilizations and improve the HbA1c level in these patients.

2. Research design and methods

2.1. Study settings

A detailed description of the J-CHiP program has been published.[18,19] Briefly, J-CHiP was launched on July 1st, 2012 and includes two main components: acute care-based interventions and community-based interventions. These combined approaches sought to systematically improve the use of primary care and reduce the number of hospitalizations and total cost of care. To accomplish these goals, J-CHiP developed the primary care-embedded case management program to organize multidisciplinary healthcare teams that included a case manager, a community health worker, a health behavior specialist, and other members (doctors and nurses) to provide individualized care. The focus of this paper is the primary care-embedded care management program within J-CHiP, which is known as "J-CHiP Classic."

2.2. Participants

The J-CHiP Classic program focused on connecting underserved and high-risk patients with a high-quality multidisciplinary health care team that included a case manager, a community health worker, a health behavior specialist, and other members (doctors, nurses, etc.). To be eligible for the program, patients must be 18 years or older, have at least one chronic condition and not be pregnant. Patients must be enrolled in Priority Partners (Medicaid) or Medicare and must have received care from one of eight participating primary care practices in Baltimore.[20] Patients at high risk for hospitalization were identified through direct referrals from health care providers or through a risk prediction model (the Johns Hopkins University Adjusted Clinical Groups Case-Mix System (ACG)).[21]

Of the 4401 high-risk patients identified by referral or by the risk prediction model, 3665 patients (83.3% of the eligible individuals) were subsequently enrolled and received assessments from a CHW and/or CM. Among those, we identified 1342 diabetic patients based on the ICD9 codes 250.x, 357.2, 366.41, and 362.01–362.07 and the associated ICD10 codes, an HbA1c value ≥6.5% or the use of anti-diabetic medications based on the recommendation of Nichols et al.[22] A total of 575 patients with available data on the HbA1c values at baseline and after the intervention were included in our subsidiary analysis.

2.3. Intervention

After the clinical screeners from Johns Hopkins HealthCare verified a patient's eligibility (i.e., checking inclusion criteria, clinical data), the patient was assigned to a CHW and CM via the JCare system, a custom data system built on a Salesforce platform.[23] The CHWs were instructed to locate the patients within 30 days to complete an Intake (Barriers to Care) Assessment. The CHWs had 4 main responsibilities, including (1) locating and engaging the patients, (2) barrier mitigation, such as addressing resource insufficiency, transportation, communication, IDs, and documents, (3) self-management support, such as motivational interviewing, mentoring, monitoring, reminders, social supports, and health education reinforcement, and (4) navigation to community resources. The CHWs used all possible sources of contact information and made the initial contact with the patients. The CHW discussed the case with the CM, as needed, to find solutions.

Upon completion of the initial outreach by the CHW via phone and/or in-person at the time of a clinical visit, the CM (nurses or social workers) would proceed with a Care Management Assessment at the clinic or by phone. The CM reviewed demographic, socioeconomic characteristics, and clinical history of the patients. The CM worked with both the patient and the multidisciplinary care team at rounds to tailor an appropriate care plan for the patient. The CM was in charge of coordinating the care management services necessary for the patient. If needed, a health behavior specialist would be contacted for advice and any urgent behavioral issue.

Each patient was expected to be contacted by a team member at least once every 30 days. As the program primarily aimed to reduce health utilization, it provided general supportive services to all patients with chronic diseases but did not use diabetes-specific self-management education and support protocols. During home visits with patients on their caseload, a CHW would provide general follow-up on medical adherence and possible barriers. They provided immediate feedback, discussed the status of patients with a CM, and updated the care team on the status of the patient. For example, one CHW might help a patient who bypassed his or her insulin prescriptions due to vision problems with discussions with the CM for an eye examination.[19] A patient's case would be closed by the CM if the patient declined to participate or if the patient could not be contacted after 30 days of attempting to locate the patient.

2.4. Data collection

CMs and CHWs recorded all attempts to contact patients via phone or an in-person meeting in the JCare system. We obtained data on the number of successful contacts by the CHWs and CMs from this database from the beginning of the program on July 1st, 2012 and through December 31st, 2015. Johns Hopkins HealthCare (JHHC) provided data related to patient demographics (age, sex, and race), health care utilization (ED visits, hospitalizations, and readmissions), insurance type, ACG risk score (patient case-mix adjustment system indicating the probability of inpatient hospitalization in the upcoming 12 months, ranged between 0 and 1), and duration of participation in J-CHiP. Utilization data were based upon health care claims from the Center for Medicare and Medicaid Services (for Medicare patients) and JHHC (for Medicaid patients). From the Johns Hopkins electronic medical records, we abstracted data on the following variables: smoking, body mass index (BMI), blood pressure, and clinical measurements (HbA1c, HDL cholesterol, and creatinine levels).

2.5. Intervention frequency

We defined the intervention frequency based on the number of successful contacts with the CHW or CM. We grouped the average frequency of total contacts from both the CHW and CM during the intervention into 2 categories: low frequency of contact (1 or less

contact per month), and high frequency of contact (>1 contact per month).

2.6. Healthcare utilization

Patient-specific monthly utilization data were based on claims from CMS for Medicare patients and claims from Priority Partners for Medicaid patients. All utilizations were captured even when events occurred outside the Johns Hopkins system. The three healthcare utilization outcomes were the emergency department visit rate, hospital admission rate, and readmission rate within 30 days of previous discharge. These health care utilization data were captured up to 12 months prior to the start of the intervention based on each patient's enrollment date in J-CHiP and throughout the study period.

2.7. Statistical analysis

The baseline variables were compared among intervention groups using Kruskal-Wallis tests and one-way ANOVA tests. Since longitudinal data were available in patient-level, we used the generalized estimating equations (GEE) to account for within-patient correlations[13] rather than the time-series analysis, which is often used in policy research when only group-level, aggregated data (e.g. a hospital as a unit) are available.[24] For within-group health utilization rate changes before and after the intervention, we used GEE to calculate the percent change of the rate to account for patient (pre-post) clusters. To account for over-dispersion of the data, negative binomial regressions adjusting for age, sex, race, ACG risk score, and baseline rate were employed. We estimated the ratios of utilization rates (RRs) in models using the low contact group as the reference group. In the subsidiary analyses of the changes in HbA1c level, for the within-group changes in the HbA1c level, we employed a paired *t*-test to detect the pre-post differences. To compare between-group effects on the change in the HbA1c level, we used multivariable linear regression analysis adjusted for age, sex, race, and ACG risk score. Similar analyses were conducted to evaluate changes in blood pressure and high density cholesterol (HDL) level.

All of the analyses were performed using STATA/MP statistical software (version 13.0) and SAS 9.4. The Institutional Review Board at Johns Hopkins School of Medicine approved this study.

3. Results

3.1. Baseline characteristics of the study population

A total of 1342 diabetic patients in the J-CHiP Classic program were included in the analysis (Table 1), of whom 71.5% were insured by Medicare, and 29.5% were insured by Medicaid. Among the patients in the Medicaid population, approximately 70% were female, the mean age was 50 years (range 22 to 64), and >60% were African American. The baseline characteristics across the two contact frequency groups were similar, except for a higher systolic blood pressure in the high contact group. For the Medicare population, participants in the high contact group were younger, were more likely to be female, black race, and current smokers and had higher diastolic blood pressure, BMI, and HbA1c level. A higher contact frequency was associated with higher proportions of prior ED visits in Medicare group. In both the Medicaid and Medicare groups, health care utilization during the pre-enrollment period was common.

3.2. Intervention intensity and healthcare utilization

We first compared the healthcare utilization before and after the J-CHiP Classic intervention. In the pre-enrollment period, in the Medicaid

Table 1
Baseline characteristics of 1342 patients with diabetes in J-CHiP by insurer and frequency of contacts[a].

Characteristics	n[b]	Medicaid (n = 383)			Medicare (n = 959)		p-value
		Low	High		Low	High	
		≤1 contact/m (n = 156)	>1 contacts/m (n = 227)	p-value	≤1 contact/m (n = 423)	>1 contacts/m (n = 536)	
Sociodemographics							
Age at enrollment, y	1342	49.29 ± 9.41	50.81 ± 9.35	0.12	72.05 ± 12.96	67.27 ± 13.36	<0.001
Female	1342	110 (70.5)	166 (73.1)	0.58	239 (56.5)	347 (64.7)	0.009
Race	1342			0.85			0.025
White		35 (22.4)	53 (23.3)		203 (48.0)	224 (41.8)	
Black		97 (62.2)	148 (65.2)		206 (48.7)	303 (56.5)	
Others/unknown		24 (15.4)	26 (11.5)		14 (3.3)	9 (1.7)	
Smoking	1329			0.82			<0.001
Current		60 (38.7)	90 (40.2)		50 (12.0)	117 (22.0)	
Former		49 (31.6)	64 (28.6)		211 (50.5)	252 (47.4)	
Never		46 (29.7)	70 (31.3)		157 (37.6)	163 (30.6)	
Clinical characteristics							
Systolic BP, mmHg	1255	126.92 ± 19.14	132.54 ± 21.19	0.018	135.71 ± 20.03	136.26 ± 21.29	0.69
Diastolic BP, mmHg	1255	78.28 ± 12.89	78.66 ± 12.06	0.79	71.25 ± 11.53	72.87 ± 12.66	0.042
BMI, kg/m^2	1215	34.47 ± 10.44	36.07 ± 10.16	0.19	31.58 ± 7.98	33.23 ± 8.53	0.003
HbA1C, %	1161	8.18 ± 2.44	8.30 ± 2.52	0.67	7.27 ± 1.66	7.67 ± 1.90	0.001
HbA1C, mmol/mol	1161	66 ± 26.7	67 ± 27.5	0.67	56 ± 18.1	60 ± 20.8	0.001
HDL-C level, mg/dl	1071	47.17 ± 17.97	48.38 ± 18.90	0.60	50.62 ± 17.89	48.77 ± 16.48	0.13
Creatinine, mg/dl	1101	1.04 ± 0.48	1.06 ± 0.65	0.75	1.26 ± 0.82	1.25 ± 0.69	0.85
Healthcare utilization at baseline							
ACG score	1342	0.26 ± 0.20	0.29 ± 0.21	0.15	0.27 ± 0.17	0.29 ± 0.20	0.073
Any ED visit	1342	92 (62.2)	145 (63.9)	0.74	191 (45.2)	315 (58.8)	<0.001
Any admission	1342	59 (37.8)	48 (44.5)	0.19	166 (39.2)	229 (42.7)	0.28
Any readmission	1342	14 (9.0)	23 (10.1)	0.71	37 (8.7)	59 (11.0)	0.25

Abbreviations: BP, blood pressure; HbA1c, hemoglobin A1C; ACG, adjusted clinical groups; ED, emergency department.
[a] The results are shown as the number (percentage) or as the mean ± SD.
[b] Number of subjects with data available.

Table 2
Health utilization rates for the J-CHiP patients with diabetes by insurer and frequency of contact (n=1342).

Health utilization (visit/month)	Contact	Pre-Intervention		Post-Intervention		Percent Change in rate		95% C.I.
		Count	Crude Rate per Month x 100*	Count	Crude Rate per Month x 100*			
Medicaid								
ED Visits	all	903	21.79	1808	21.11	-2.55	-15.9	12.9
	low	311	17.6	715	19.6	12.4	-12.9	45.0
	high	592	24.9	1093	22.2	-10.5	-24.7	6.4
Admissions	all	313	7.55	637	7.44	-0.21	-16.9	19.9
	low	111	6.3	195	5.3	-12.3	-35.4	19.0
	high	202	8.5	442	9.0	6.3	-15.7	34.1
Readmissions	all	79	1.91	188	2.19	16.26	-22.5	74.5
	low	23	1.3	56	1.5	20.6	-42.6	153.4
	high	56	2.4	132	2.7	14.3	-29.8	86.1
Medicare								
ED Visits	all	2136	18.65	3002	20.76	5.5	-3.1	14.9
	low	648	12.9	933	15.3	11.8	-2.6	28.4
	high	1488	23.2	2069	24.7	2	-8.2	13.4
Admissions	all	782	6.83	1169	8.08	17.66†	5.9	30.7
	low	320	6.4	408	6.7	5.2	-11.2	24.7
	high	462	7.2	761	9.1	25.3†	9.6	43.3
Readmissions	all	167	1.46	267	1.85	25.96	-2.2	62.3
	low	61	1.2	75	1.2	2.8	-27.9	46.7
	high	106	1.7	192	2.3	37.7	-1.5	92.3

† P<0.05

group, the average rates of emergency department (ED) visits, hospitalizations, and readmissions were 21.79, 7.55, and 1.91 per month per 100 persons, respectively. In the Medicare group, the rates were 18.65, 6.83, and 1.46 per month per 100 persons for ED visits, hospitalizations, and readmissions, respectively. As shown in Table 2, there were no significant changes in outcomes (ED visit, admission rate, and readmission rate) in the overall Medicaid group and when stratified by contact frequency during the intervention period compared to the baseline. In the Medicare group, participants with a high intensity of contact had a significantly increased admission rate compared to baseline, particularly in the high contact group. Otherwise, there were no statistically significant differences observed in the pre-post analyses.

In the analyses of the contact intensity and healthcare utilization (Fig. 1) adjusted for age, sex, race, baseline ACG risk score, and baseline healthcare utilization rate, Medicaid participants in the high contact group had 42% (rate ratio (RR): 1.42; 95% CI: 1.08–1.86) and 64% (RR: 1.64; 95% CI: 1.08–2.48) higher risks for hospital admission and readmission, respectively, than the low contact group. Similar increases were seen in the Medicare participants with 20% (RR: 1.20; 95% 1.02–1.42) and 42% (RR: 1.42; 95% 1.09–1.84) higher risks for admission and readmission. For ED visits, the associations with the contact frequency were not statistically significant. In the stratified analyses by sex, race, and median ACG risk score, the results were similar (data not shown).

3.3. Intervention intensity and clinical outcomes

Of the 1342 patients with diabetes, 545 (43%) had HbA1c data available at baseline and during follow-up. The remaining patients either had no HbA1c documented in the electronic health record (n = 119; 9%) or had an HbA1c value at only one-time point (n = 648; 48%). The baseline characteristics of this sub-population were similar to those of the original study population (Supplemental Table S1). There was some reduction in HbA1c after the intervention period (Table 3), but the

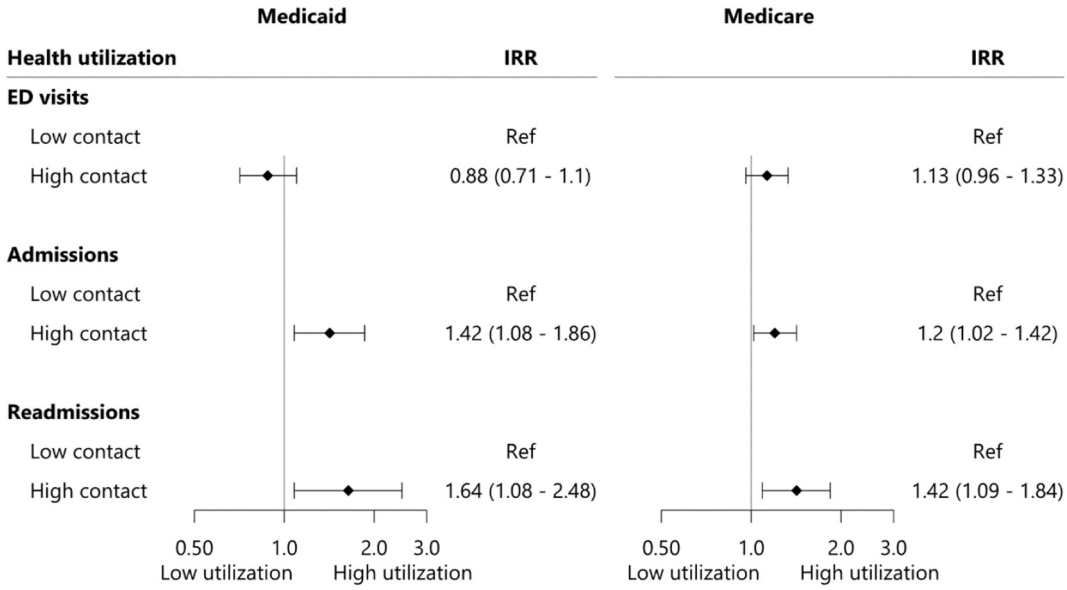

Fig. 1. The association between the intervention intensity and health care utilization in adults with diabetes enrolled in the J-CHiP program by insurer and frequency of contact.

Table 3
Association between intervention intensity and HbA1c change in a subset of 575 adults with diabetes who were enrolled in the J-CHiP program and had HbA1c data obtained at baseline and at the end of the study period.

Intervention (contact/month)	No. participants	HbA1c level[a]			p-value	Difference of change on HbA1c[b]	
		Baseline	After intervention	Within-group change		Crude β	Adjusted β[d]
Medicaid	175	8.27 (2.51)	8.03 (2.11)	−0.23 (2.24)	0.17		
Low contact (≤1)	61	7.90 (2.33)	7.56 (1.88)	−0.34 (2.46)	0.28	Ref	Ref
High contact (>1)	114	8.46 (2.59)	8.28 (2.19)	−0.18 (2.13)	0.20	0.17 (0.36)	0.20 (0.36)
Medicare	400	7.75 (1.89)	7.58 (1.76)	**−0.17 (1.50)**	**0.02**[‖]		
Low contact (≤1)	115	7.47 (1.70)	7.45 (1.62)	−0.02 (1.25)	0.84	Ref	Ref
High contact (>1)	285	7.87 (1.96)	7.64 (1.81)	**−0.23 (1.59)**	**0.01**[‖]	−0.21 (0.17)	−0.19 (0.17)

Abbreviations: HbA1c: hemoglobin A1C.
[a] The results are shown as the mean ± SD, %.
[b] The results are shown as the mean ± SE, %.
[d] Adjusted for age, sex, race, and ACG risk score using linear regression.
[‖] Significant difference by paired t-test (p-value < 0.05).

reductions were statistically significant in only the Medicare group (mean (SD): −0.17% (1.50%)), with a larger decrease in the high contact group (mean (SD): −0.23% (1.59%)).

There were no significant changes in the HDL (Supplemental Table S2). In patients with uncontrolled blood pressure at baseline (a systolic blood pressure of ≥140 mmHg or a diastolic blood pressure of ≥90 mmHg), there were statistically significant reductions in blood pressure at the end of the intervention period in all of the groups (Supplemental Table S3). However, these results should be interpreted with caution. No significant association between the frequency of contact and blood pressure change was observed.

4. Conclusion

In this study, we examined the associations between the intervention intensity and healthcare utilization in participants with diabetes enrolled in a case management program for high-risk patients with one or more chronic conditions. We observed that a higher frequency of contact was not associated with reduced subsequent health care utilization. In some instances, a higher contact intensity with interventionists was associated with a significantly increased risk for health care utilization. In none of the analyses did we identify a significant reduction in the outcomes from a higher intensity of contact. In the subsidiary analysis, we observed that the intervention resulted in reductions in the HbA1c levels in patients in the Medicare population. In patients with uncontrolled blood pressure at baseline, there were statistically significant reductions in blood pressure at the end of the intervention period in all of the groups.

It is possible that the association between the high intensity of contact and higher health care utilization was due to reverse causality, in which the highest risk status triggered more intervention contacts. There were also unobserved factors related to health care seeking behaviors. For example, higher risk patients may be more receptive to assistance offered by CHW or CM, while lower risk patients may not.

Few studies have tested the effect of diabetes-specific CM and CHW interventions on utilization in high-risk African Americans with type 2 diabetes.[13,14] In a randomized clinical trial of diabetes management delivered by an NCM/CHW team, compared with the minimal intervention group, those in the intensive intervention group were 23% less likely to have ER visits (RR, 0.77; 95% CI, 0.59–1.00) after 24 months.[13] Unlike the all-condition case management model in our study, this RCT followed pre-specified clinical algorithms that allowed interventionists to triage participants based on their level of diabetes control and guided frequency and intensity of follow-up. This suggests a diabetes-specific program is more effective in reducing health care utilization.

A recent systematic review of diabetes-specific programs showed that CHW interventions, with or without a CM component, resulted in a statistically significant reduction of the mean HbA1c level by 0.21% (95% CI: 0.11–0.32), which was comparable to our study.[25] We observed a decreasing trend in the blood pressure in patients with high blood pressure from baseline and slight increases in the HDL in the Medicaid patients after the intervention. Still, these data could also be due to the regression to the mean. The modest changes in these clinical indicators suggested that the health status of the participants improved during the intervention period but such improvement may not be sufficient to reduce health care utilization.

This evaluation has several strengths. It evaluated a population-based program in a high-risk setting. Baltimore City has a 40% higher diabetes mortality rate than the rest of the state of Maryland, and life expectancy varies up to twenty years between neighborhoods in the city. Another strength of our study was the monitoring of a program that was being implemented in real-time, by a health system and payer organization, with their staff and enrolled patient populations, rather than in a controlled research setting. Moreover, the availability of patient-level data during the three years of the program allowed us to track individual patients longitudinally and link the relevant clinical data and utilization data. Our study also demonstrated a sustainable model for forming a primary care team that includes case management.

Nonetheless, there were several limitations in our study. First, there was no non-intervention control group. Therefore, we were not able to determine the true effectiveness of the J-CHiP Classic program on health care utilization. Second, the contact frequency is an indicator of intervention quantity but not of intervention quality. It is possible that the degree of care coordination cannot be measured by the intervention intensity. Third, as is often the case in the actual health care setting, not all patients had HbA1c data available at both time points for inclusion in the HbA1c analyses. Consequently, the low proportion of the patients with pre-post HbA1c change that was shown by the analysis is a concern for the generalizability of the HbA1c reduction. Finally, we did not have data on other confounders (e.g., medication adherence, and alcohol,). Therefore, potential residual confounding effects cannot be ruled out.

Our results indicated that diabetic patients with a higher frequency of contact with the CHWs and CMs using a generic, all-condition case management approach did not reduce healthcare utilization. In context with prior research, case management incorporating diabetes-specific protocols and goals may be more effective for an underserved, high-risk population.

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Author contributions

Conception and design: H.C. Yeh, L.P. Bui, F. Hill-Briggs, L. Appel

Acquisition of data: F. Hill-Briggs, L. Appel, N. Durkin, L. Andon, P.L. Ephraim, and L. Dunbar

Analysis and interpretation of the data: H.C. Yeh, L.P. Bui, F. Hill-Briggs, L. Appel, N. Durkin, A. Apfel

Statistical expertise: H.C. Yeh, A. Apfel, and L.P. Bui

Drafting of the manuscript: L.P. Bui and H.C. Yeh

Critical revision for important intellectual content: All authors

Final approval of the article: All authors

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Administrative, technical, or logistic support: L. Dunbar, N. Durkin, P.L. Ephraim, L. Andon, and H.S. Lalani

Guarantor's name: H.C. Yeh

Additional contributions

See Supplementary Material.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jdiacomp.2018.12.011.

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