

Reducing Emergency Department Visits Among Patients With Diabetes by Embedding Clinical Pharmacists in the Primary Care Teams

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Background: Pharmacists are effective at improving control of cardiovascular risk factors, but it less clear whether these improvements translate into less emergency department (ED) use and fewer hospitalizations. The UCMRx program embed pharmacists in primary care.

Objective: The objective of this study was to examine if the integration of pharmacists into primary care was associated with lower ED and hospital use for patients with diabetes.

Design: This was a quasi-experimental study with a comparator group.

Subjects: The analytic sample included patients with diabetes with uncontrolled cardiovascular risk factors ($A1C > 9\%$, blood pressure $> 140/90 \text{ mm Hg}$, low-density lipoprotein–cholesterol $> 130 \text{ mg/dL}$) who had 1 or more visits in either a UCMRx (648 patients, 14 practices) or usual care practice (1944 patients, 14 practices).

Measures: Our outcomes were ED and hospitalization rates as measured before and after the consultations between UCMRx and usual care. Our predictor variable was the pharmacist consultation. Poisson generalized estimating equations model was used to estimate the adjusted predicted change in utilization before and after the

pharmacist consultation. The Average Treatment Effect on the Treated was estimated.

Results: In models adjusted, the adjusted mean predicted number of emergency department visits/month during the year before the consultation was 0.09 among UCMRx patients. During the year after initiating the care with the pharmacists, this rate decreased to an adjusted mean monthly rate of 0.07, with an Average Treatment Effect on the Treated = 0.021 ($P = 0.035$), a predicted reduction of 21% in emergency department visits associated with the clinical pharmacist consults. There was a nonsignificant predicted 3.2% reduction in hospitalizations over time for patients in the UCMRx program.

Conclusion: Clinical pharmacists are an important addition to clinical care teams in primary care practices and significantly decreased utilization of the ED among patients with poorly controlled diabetes.

Key Words: clinical pharmacists, primary care, diabetes, medication management

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Diabetes currently affects over 25 million people in the United States, making up 8.3% of the population.¹ Patients with diabetes account for 12% of emergency department (ED) visits and 26% of hospitalizations.² In California, up to a third of hospitalizations were linked to diabetes costing nearly \$2200 more per hospitalization than those for patients without diabetes, regardless of the primary reason for the hospitalization.^{3,4} There is some evidence that Patient-Centered Medical Homes (PCMH) who may use a multidisciplinary approach to chronic disease care can reduce costs by reducing hospital and ED utilization.^{5,6}

Although the PCMH care models use a team-based approach to improve quality of care and reduce health care costs, few nonintegrated large systems incorporate clinical pharmacists in the ambulatory primary care community office setting.^{7–9} Primary care pharmacy programs are indeed more mature in integrated systems such as the Veterans Administration and staff model health maintenance organizations.^{10,11}

Population-based studies^{12,13} and randomized controlled studies^{14–17} indicate that clinical pharmacists are effective at improving control of cardiovascular risk factors, but it is not clear

whether these improvements translate into cost-saving from less ED use and fewer hospitalizations.^{18,19} One randomized controlled trial conducted outside the United States found that a clinical pharmacist intervention was effective at reducing mortality.²⁰ Studies on the impact of clinical pharmacist interventions on utilization outcomes are scant.²¹

In 2012, the University of California Los Angeles (UCLA) Health implemented the UCMRx program that embedded clinical pharmacists in 14 of 28 geographically dispersed primary care offices in the Los Angeles basin.²² The UCMRx program provided an opportunity to assess whether clinical pharmacists who are integrated into primary care teams by seeing patients individually can decrease the use of the ED and hospital for patients with diabetes who have poor control of 1 or more cardiovascular disease risk factors.

Our objective was to test the value of embedding a clinical pharmacist into the care team in community-based primary care practices. We hypothesized that the clinical pharmacist intervention would reduce adjusted rates of hospital admissions and ED use compared with similar usual care patients.

METHODS

Study Design and Setting

We conducted a quasi-experiment, pre-post-retrospective cohort study with a usual care comparator group to estimate the difference-in-difference (DID) in utilization before and after a clinical pharmacist intervention (UCMRx) versus usual care.

The UCLA Health system embeds ambulatory residency trained clinical pharmacists in primary care practices as part of a Primary Care Innovation Model (PCIM).²² The PCIM redesigns primary care to include population health, care coordination, and medication management support. Currently, the clinical pharmacists provide health care services in 32 sites with in-office collaboration with physicians and are integrated into the practice team. Four sites were not included in the analysis, as they were recent additions to the program. Colocation with the primary care team provides the clinical pharmacist with the ability to routinely plan care with physicians and care coordinators and to see patients privately. Since 2012, the ambulatory clinical pharmacists have conducted almost 7000 patient consultations between 2012 and 2017.²³ This study was approved by the University of California, Los Angeles Institutional Review Board.

Participants

We analyzed UCMRx program data for adults with type 2 diabetes, age 21 years and above, and 2 office visits in the last 12 months. The unit of analysis was the patient. Patients were excluded if they had type 1 diabetes, lost their medical insurance and could not receive future care, for pregnancy, were homebound, lived in a nursing home, or were no longer being seen at one of the study primary care practices.

Among a total of 28 primary care practices, 14 were intervention sites and had a clinical pharmacist embedded working alongside physicians and their clinical teams. Patients in the usual care comparator group were receiving care in another 14 similar primary care practices without a clinical

pharmacist but in the same geographic distribution and same university network. Practices were included in the UCMRx program and received support from a clinical pharmacist if they were: (1) primary care; (2) part of UCLA Health; and (3) were part of primary care redesign. The same diabetes registry/administrative data that were used to identify usual care patients and all sites had all of the other features of our primary care redesign program.²⁴

We created a “proxy” intervention index date for each patient in the usual care comparator group to align study months between the pharmacy intervention population and usual care. With the data aligned using this approach, we then separately examined changes (pre-post) of utilization before the initial pharmacy visit or proxy index enrollment date (the 12-mo “pre” period) versus the 12-month “post” period.

Propensity-matched Comparators

Propensity scores were calculated using logistic regression to create a multivariate composite of the covariates.^{17,25} Selection of covariates for the propensity score calculations was based on what the literature and program supported as variables being related to selection into the UCMRx intervention program and with the outcomes variables.^{2,25,26} The models included preindex (utilization, age, sex, race-ethnicity, Charlson Comorbidity Index, diabetes severity, presence of serious mental illness (bipolar disorder, schizophrenia, major depression), having seen an endocrinologist (yes/no), total number of medications, and health insurance status (private, Medicare, Medicaid, Medicaid/Medicare).

After computing the propensity scores, we created a matched comparator and UCMRx intervention groups. Each UCMRx pharmacy intervention patient was matched to 3 usual care comparator patients (1:3) using the nearest neighbor propensity score-matching method with the caliper distance of 2.0.²⁰ Standardized differences were used to assess for postmatching balance between the UCMRx and usual care comparator patients.^{25,26} The propensity score matching helps ensure that the UCMRx and usual care comparator patients are balanced on variables that may influence how they would respond to the UCMRx program participation.

Pharmacy Intervention

The clinical pharmacists are trained in brief motivational interviewing (6 h plus quarterly 1.5 h for 1 y) by a clinical psychologist (PhD) with expertise in behavioral medicine. The UCMRx clinical pharmacists completed a year postdoctoral ambulatory pharmacy residency program (postgraduate year 1 pharmacy practice with an emphasis on ambulatory care). To be referred to the clinical pharmacy program, patients had to have poorly controlled diabetes or hypertension ($A1C \geq 9\%$ or systolic blood pressure ≥ 140 mm Hg) and any one of the following: (1) 5 or more prescribed medications; (2) taking anticoagulation; (3) age above 65 years; (4) recent hospital discharge; and/or (5) plus any patient the physician feels could benefit from the program.

One-on-one consultations with patients were conducted at the individual primary care practices. The pharmacists conducted medication therapy management collaboratively with physicians, provided in-office education, and corrected potential medication-related problems such as drug-drug and

drug-disease interactions. Initial consultations lasted for up to 60 minutes, ranging from 45–60 minutes and follow-up visits lasted ~15–30 minutes. The main components of the consultations were motivational interviewing for personal adherence barriers, medication reconciliation, and medication therapy management. The pharmacists make recommendations to the primary care physicians through the EHR, and the physician had the final say. Pharmacists preferably saw patients before or after the physician visit, or at another day and time depending on the patient's availability. Follow-up appointments consisted of assessing the efficacy of changes made in the previous visit, as well as identifying any new or continued side effects. The number of follow-up visits was left up to the discretion of the treating pharmacist and primary care doctor.

One pharmacist covered a different practice each weekday. The primary care practices include family medicine, internal medicine, and geriatric practice. The goal was to have one full-time pharmacist cover 5 practices that are geographically clustered or located very close to each other.

Measures and Data

The data sources for this study were encounter and administrative medical group data and electronic health record (EHR) data. The EHRs system was implemented at UCLA in March of 2013 and for this analysis, it was only feasible to include patients seen after this date. We used a 12-month preintervention and 12-month postintervention time period for the analysis. Because the program participants were referred to the UCMRx at different periods in time, the start (index dates) and end dates of the 12-month preintervention and postintervention windows vary by participant. The index date for each patient in the UCMRx group that determines the start of the intervention period was determined by the date of the first clinical pharmacist assessment. The pseudo or quasi-intervention index date (April 2, 2014) for the usual care comparator group was chosen to align with the first UCMRx patient consultation included in this analysis. The usual care comparator group preintervention period was from April 1, 2013, to April 1, 2014, and the postintervention period was from April 2, 2014, to April 1, 2015.

Our 2 primary outcomes were monthly rates of hospitalizations and ED use. Hospital admission and ED visits were reported as visits per month. We excluded hospitalizations that were same-day elective admissions, urgent care visits, pediatric hospital admissions, and hospitalizations related to pregnancy. Our primary predictor variable or "treatment" was defined as receipt of 1 or more visits with a clinical pharmacist.

From the EHRs system, we also captured age, sex, race-ethnicity (Latino, African American, White, or other), insurance status (private/Medicaid and/or Medicare), medical comorbidities (chronic kidney disease, coronary artery disease, congestive heart failure, atrial fibrillation, and hypertension), and diagnosis of mental illness (depression, chronic generalized anxiety, bipolar disorder, schizophrenia). International Classification of Diseases, Ninth/10th Revision (ICD-9/10) codes abstracted from the EHR were used to assign the comorbidities. We also included measures of the

patient's hemoglobin A1C (diabetes severity), systolic blood pressure, and low-density lipoprotein–cholesterol levels.

Analysis

SAS 9.3 (SAS Institute Inc., Cary, NC) statistical software was used for all analyses. We calculated rates of hospitalization and ED use for the intervention and comparator patients. Univariate and bivariate rates of hospitalization and ED use were calculated for each group. We compared the monthly ED and hospitalization rates before and after the initial pharmacy consultation between the pharmacy intervention group and the matched usual care comparator patients.

For each utilization outcome, we performed DID analyses to compare the change from premeasurement and postmeasurement between pharmacy intervention versus usual care matched comparator patients. A Poisson generalized estimating equations model with robust variance estimator was used to estimate the adjusted predicted change in hospitalization and ED monthly use rates before and after the pharmacist consultation. The models were adjusted for age, sex, insurance coverage, and race-ethnicity, comorbidities, matching groups, and exposure time (months in the program). The Average Treatment Effect on the Treated (ATET) were estimated, specifically the predicted rates of each outcome with exposure to UCMRx pharmacy program compared with the predicted rates had those same patients if they had not had a clinical pharmacist consultation.

RESULTS

Table 1 describes the demographic and clinical characteristics of the intervention ($n=648$) and the usual care patients ($n=1944$). Intervention patients had a mean age of 70 (± 13) years, 54% were females, 30% Latino, 15% African American, and 40% White. Among patients that received the clinical pharmacist comanagement, 18% had a hemoglobin A1C $\geq 9\%$, and 87% had a diagnosis of hypertension. The demographic and clinical characteristics of the matched usual care comparators were not significantly different than patients in UCMRx.

In models adjusted (Table 2) for the clinical and demographic differences between the pharmacy intervention patients and usual care, the adjusted mean (SD) predicted number of ED visits/month during the year before the consultation was 0.09 among UCMRx patients. During the year after initiating the care with the pharmacists, this rate decreased to an adjusted mean monthly rate of 0.07, with an ATET = 0.021 ($P=0.035$), a predicted reduction of ~21% in ED visits associated with the clinical pharmacist consults. There was a nonsignificant predicted reduction in hospitalizations over time for patients in the UCMRx program ATET = 0.03 ($P=0.67$), a predicted reduction of 3%.

DISCUSSION

We found that clinical pharmacists are an important addition to clinical care teams in primary care practices and independently and significantly decrease utilization of the ED among patients with poorly controlled diabetes. For UCMRx patients with diabetes, we found ~ 21% reduction in the use of the ED, compared with no change in the usual care

TABLE 1. Characteristics of Patients With Diabetes Who Received a Clinical Pharmacist Consultation and Matched Comparator Group Patients With Diabetes Who Did Not Receive a Clinical Pharmacist Consultation, Before and After Matching

Characteristics	Before Matching [n (%)]			After Matching [n (%)]		
	Pharmacy Enrollees (N = 648)	Full Comparator Pool (N = 7812)	SDiff	Pharmacy Enrollees (N = 648)	Comparator Patients* (N = 1944)	SDiff
Age [median (IQR)]	70 (60–79)	67.0 (57–76)	0.356	70 (60–79)	69 (60–79)	0.042
Sex						
Male	293 (45.2)	3813 (48.8)	0.086	293 (45.2)	883 (45.4)	0.007
Female	355 (54.8)	3999 (51.2)		355 (54.8)	1061 (54.6)	
Race/ethnicity						
Latino	191 (29.5)	1330 (17.0)	0.412	191 (29.5)	592 (30.5)	0.028
Black	100 (15.4)	874 (11.2)	0.081	100 (15.4)	291 (15.0)	0.021
White	256 (39.5)	3478 (44.5)	0.181	256 (39.5)	739 (38.0)	0.046
Other	101 (15.6)	2130 (27.3)	0.244	101 (15.6)	322 (16.6)	0.038
Medicaid	188 (29.0)	1311 (16.8)	0.256	188 (29.0)	577 (29.7)	0.025
Medicare	405 (62.5)	4312 (55.2)	0.193	405 (62.5)	1224 (63.0)	0.009
Hemoglobin A1C ≥ 9%	119 (18.4)	594 (7.0)	0.989	119 (18.4)	341 (17.5)	0.041
LDL-cholesterol ≥ 130 mg/dL	63 (9.7)	739 (9.5)	0.047	63 (9.7)	181 (9.3)	0.018
Systolic blood pressure ≥ 140 mm Hg	203 (31.3)	2108 (27.0)	0.183	203 (31.3)	602 (31.0)	0.012
Congestive heart failure	142 (21.9)	487 (6.2)	0.754	142 (21.9)	356 (18.3)	0.064
Hypertension	564 (87.0)	5136 (65.7)	0.515	564 (87.0)	1692 (87.0)	0.000
Chronic kidney disease	224 (34.6)	1669 (21.4)	0.314	224 (34.6)	637 (32.8)	0.052
Mental health condition† [median (IQR)]	0 (0–1)	0 (0–0)	0.000	0 (0–1)	0 (0–1)	0.000

*1:3 propensity score matching, caliper set at 0.2.

†Major depression, schizophrenia, bipolar disorder, chronic generalized anxiety disorder.

IQR indicates interquartile range; LDL, low-density lipoprotein; SDiff, standardized difference.

group. Our results indicate that clinical pharmacists in community practices are an important addition to clinical care teams and may decrease ED utilization among patients with diabetes who have poorly controlled cardiovascular risk factors. This study extends our knowledge about the association of clinical pharmacist comanagement, in nonintegrated health systems, of patients with diabetes and utilization rates of ED and hospital use. The UCMYRx program is embedded in a primary care PCMH model and our findings are consistent with previous research that found that robust primary care is associated with lower ED utilization^{27–29} including benefits for those with chronic conditions such as diabetes.³⁰

Potential mechanisms for our findings include the expansion of access to care for patients who saw the pharmacist instead of presenting to the ED.³¹ Having the clinical pharmacists on the primary care teams also enhances coordination of care that may prevent complications or delays in medical

treatment especially those that are medication-related.³² The use of diabetes medications among older adults have been associated with high rates of ED use.³³ Colocation of the pharmacist with physicians in the office and use of the same EHR enhance coordination and access, but also reduce medication-related problems.²³

We did not find differences in rates of hospitalizations among patients who received a UCMYRx clinical pharmacist consultation compared with matched usual care patients from similar practices and comorbidities. Although the UCMYRx program targeted high-risk patients that met certain criteria in primary care, the clinical pharmacists did not focus strictly on posthospital discharged patients or preventing readmissions. Despite our best propensity matches, we believe we still had important baseline differences in comorbidities that affect hospital utilization and bias towards the null hypothesis. Despite this, we were able to see a predicted 3% pre-post

TABLE 2. Propensity-matched Monthly Emergency Department and Hospital Use Rates for UCMYRx Intervention and Comparator Group Patients With Diabetes

Patients With Diabetes	Pharmacy (Preintervention) (N = 648)	Pharmacy (Postintervention) (N = 648)	Pharmacy (ATET)* (N = 648)	Comparator (Premeasurement) (N = 1944)	Comparator (Postmeasurement) (N = 1944)	Difference-in-difference <i>P</i>
Emergency department use†	0.096 (0.0091)	0.070 (0.0050)	0.091 (0.0065)	0.048 (0.0022)	0.049 (0.0023)	0.021 (0.0098) 0.035
Hospitalizations†	0.066 (0.0067)	0.057 (0.0044)	0.060 (0.0046)	0.045 (0.0022)	0.044 (0.0021)	0.003 (0.0076) 0.674

*Average Treatment Effect on the Treated (ATET), mean predicted utilization rates for UCMYRx intervention group if they had not received the intervention, using out of sample control group.

†Monthly rates. Models are adjusted for age, sex, race-ethnicity, insurance type, cardiovascular disease diagnosis, congestive heart failure, chronic kidney disease, chronic mental health condition, systolic blood pressure (> 140, < 140, unknown), and hemoglobin A1C.

decrease in hospitalization rates in the UCMRx group, compared with the matched usual care comparator group ($P=0.67$). The DID for rates of hospital use trended in the expected direction but was not statistically significant. We could not obtain an exact match due to the real-world nature of the UCMRx program where services were directed to the sickest patients in the health system.

The greatest study limitation is the potential for bias due to the comparability of the intervention and matched the usual care group on both measured and unmeasured characteristics. The UCMRx intervention was a complex real-world intervention that involved other practice staff for referrals and required significant engagement to achieve physician and system-level buy-in. The selection of the 14 intervention practices could have a bias, as these practices might have been more willing to change and accept changes in primary care and the inclusion of a clinical pharmacist. In addition, not all health systems have access to clinical pharmacists who have completed a 1-year residency in a primary care setting. For these reasons, our results may not be generalizable to other health systems or to patients without diabetes. Because we used EHR data, some claims-based measures might be proxies for our intended measures. EHR and claims data does not contain reliable patient-level factors such as education levels and income status which may be associated with utilization. We were unable to measure all practice level variables such as staffing levels and intensity of ancillary support services at the primary care practice level. Also, we were not able to measure or account for variation in utilization due to community, local practice patterns, or other geographic factors.

Our study results have clinical and practice implications for primary care and health systems looking to improve the delivery of care for patients with diabetes and poorly controlled cardiovascular risk factors. The results from our study suggest that the integration of a clinical pharmacist into primary care teams can produce reductions in ED utilization therefore improving quality of care. The goal of similar interventions should be to improve medication management without creating more work for the primary care physicians and include pharmacists in primary care teams that are part of local PCMH system models of care.²² We note that at baseline, the percent of patients with poorly controlled diabetes (A1C > 9%) is lower than national population-based estimates.

A future extension of this work could include an investigation of what exact pharmacist interventions are found to be most meaningful in helping prevent unnecessary ED use by patients with diabetes.²³ Previous research studies have found that the use of insulin and oral hypoglycemic medications are associated with higher levels of utilization of the ED among older Medicare patients.³³ It is also important to explore the role of collaborative practice agreements and collaborative drug therapy management on utilization outcomes.

In summary, our analysis showed a statistically significant 21% reduction in the monthly rates of any ED utilization post-UCMRx intervention. We found no evidence of any significant impact of UCMRx on inpatient hospital utilization postintervention. Our results support the inclusion

of clinical pharmacist in primary care practice teams in the setting of local patient-centered medical homes.

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