Pharmacists' chronic disease management in chronic obstructive pulmonary disease: Effect on health services utilization

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Plain language summary

Patients with chronic obstructive pulmonary disease (COPD) can receive help from community pharmacists in the form of care plans. It is important to understand whether such care plans improve patients' health. In this article, we looked at patients with COPD who had pharmacist-provided care and those who did not and compared their health care appointments. We found that the number of COPD-related hospitalizations was lower in the group with pharmacist-provided care plans; however, it did not reach statistical significance when the sensitivity analysis was conducted, excluding 30 days before and after the implementation of the comprehensive annual care plan.

Implications for managed care pharmacy

Our study looked at the impact of pharmacist-provided care plans in Alberta, Canada, which is similar to comprehensive medication reviews provided in the Medicare program to patients with COPD on health care utilization. We identified no significant changes in COPD-specific events. There is a need to further understand how pharmacist care plans should be evaluated and what changes in policy are warranted.

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ABSTRACT

BACKGROUND: There is limited real-world evidence on evaluation of chronic disease management initiatives provided by pharmacists to patients with chronic obstructive pulmonary disease (COPD).

OBJECTIVE: To evaluate changes in COPD-related health care resource utilization between patients with COPD who had pharmacist-provided chronic disease management (comprehensive annual care plan [CACP]) vs those who did not have CACP.

METHODS: Patients with COPD who received a CACP in Alberta between 2012 and 2015 were identified within the Alberta Health administrative data. Each of these patients were matched with 2 control patients with COPD based on age, sex, provider, date of service, and qualifying comorbidities. Controlled interrupted time series analysis was used to evaluate changes in COPD-specific hospitalizations, emergency department (ED) visits, physician visits, and claims for pulmonary function test. Immediate and temporal changes were calculated for the difference in outcomes 1 year before and 1 year after receiving the CACP for the intervention group and matched controls.

RESULTS: Eligible patients (N = 74,365), of whom 28,795 (38.7%) had received CACPs, were matched to a total of 45,570 controls. In 1 year after the CACPs implementation, the number of COPD-related hospitalization visits decreased by 174 (95% CI = -270.8 to -76.5) per 10,000 patients per month, COPD-related ED visits decreased by 123 (95% CI = -294.9 to 49.6) per 10,000 per month, general practitioner visits decreased by 153.9 per 10,000 per month (95% CI = -293.3 to -14.5), and pulmonary function test claims decreased by 19.5 per 10,000 per month (95% CI = -70.1 to 31.2) when compared with the matched controls. However, significant difference between the 2 groups was found for COPD-related hospitalizations only, which was not confirmed by the sensitivity analysis.

CONCLUSIONS: In patients with COPD who were provided with care plans by their community pharmacists, there was no significant decrease in COPD-related hospitalizations or ED visits over 1 year compared with the matched controls who did not have a pharmacist-provided care plan. Physician visits and pulmonary function tests did not change significantly for those who had CACP compared with those who did not. There is a need to further understand how care plans can better impact other outcomes that are important in COPD management.

Chronic obstructive pulmonary disease (COPD) is a common and progressive lung disease with an estimated worldwide prevalence of 391.9 million cases.[1] In Canada, the population prevalence of COPD based on the multisite nationwide data from 2006 to 2011 was 16.2%.[2] Within the United States, there were an estimated 15 million people with COPD in 2020,[3] with annual direct and annual societal costs of $9,981 and $30,826, respectively.[4] Despite its prevalence, COPD Guidelines[5] and the Global Initiative for COPD standards for diagnosis, assessment, and management[6] report significant gaps in COPD care.

According to the Canadian Thoracic Society's COPD Guidelines[5] and the Global Initiative for COPD standards for diagnosis, assessment, and management,[6] the key evidence-based recommendations to address the gaps in COPD care are based on: (1) diagnosis of individuals at risk using spirometry, so that timely intervention can be attained; (2) proper assessment of patient comorbidities, smoking history, and exacerbation history; (3) appropriate therapy management with smoking cessation, vaccination, and pharmacotherapy; and (4) strategies to prevent and manage acute exacerbations through patient follow-up. However, COPD research suggests that gaps in care continue to be an issue globally. For instance, a retrospective analysis of medical records in Australia found that more than 55% of patients hospitalized with COPD were not prescribed any smoking cessation intervention.[7] In addition, a Canadian prospective study found that only 34% of patients with COPD received pharmacological treatment and only 9% retrieved a referral to pulmonary rehabilitation interventions.[8] With their expanding scope of practice, pharmacists may be instrumental in addressing some of the gaps in COPD care. For instance, a randomized controlled trial (RCT) measured the effectiveness of a pharmaceutical care intervention that included guidance in inhalation techniques and medication adherence for patients with COPD and found a significantly lower rate of hospitalizations among those who received the intervention.[9] Furthermore, a systematic review and meta-analysis of pharmacist-led interventions noted that pharmacist care can lead to significantly improved medication adherence among patients with COPD.[10]

To improve COPD care, pharmacists also provide clinical services, such as medication therapy management (MTM) services. MTM services are comprehensive, and consist of reconciling patients' medications, identifying drug therapy problems, recommending changes to therapy, and providing self-management education.[11] Various studies have demonstrated the effectiveness of MTM in patients with COPD. However, the results often vary by outcomes and study design. For example, a prospective quasi-experimental study of a community pharmacy–based transition of care program for patients with COPD, which involved the full scope of MTM services, found that a 30-day readmission rate was 13.1% lower in the intervention group than in the usual care group.[12] However, a similar RCT study, showed no significant reduction in hospital readmissions in the intervention group.[13] More evidence on pharmacy services and its effect on health care outcomes among patients with COPD can be a valuable source for decision-making in a changing pharmacy practice environment.

In the province of Alberta, Canada, pharmacists provide comprehensive annual care plans (CACPs) to qualified patients for a variety of chronic medical conditions including COPD.[14] These encounters are reimbursed by the provincial government. During provision of a CACP, a pharmacist ensures optimal therapy, addresses patient therapy concerns, and educates, identifies, and prioritizes health goals for their patients so they are well equipped to manage their chronic condition. To date, the impact of CACPs on COPD-related outcomes is not known. The purpose of our study is to assess the effectiveness of CACPs provided by pharmacists to patients with COPD in Alberta. The specific objectives for this aim are (1) to characterize (in terms of age, sex, and patterns of other qualifying chronic diseases) the population of patients with COPD in Alberta by comparing patients who received a CACP by a pharmacist (CACP group) with patients who did not (control group), and (2) to evaluate changes in health care utilization for CACP patients including COPD-related hospitalizations, emergency department (ED) visits, physician visits, and claims for pulmonary function test vs patients in a control group.

Methods

DATA SOURCE

An administrative claims database was provided by Alberta Health and contained deidentified information on a population of more than 4 million residents within the province of Alberta. The Alberta health system functions as a single payer health system. The database included (1) the Provincial Registry for basic demographic information, (2) the Discharge Abstract Database containing all hospitalizations, (3) the Ambulatory Care Classification System containing all ED visits, (4) Alberta physician claims data for all outpatient physician services, and (5) Alberta Blue Cross and Provincial Information Network data that records all prescription dispenses within community pharmacies, regardless of formulary status. The study included data from April 2008 to March 2016. Ethics approval was provided by the University of Alberta's Research Ethics Board.

STUDY DESIGN

A population-based cohort study was completed using a controlled interrupted time series (ITS) method to measure health care service utilization while comparing patients with COPD who received a CACP (CACP group) with a cohort of matched controls who had a COPD diagnosis and were eligible for the CACP but did not receive a CACP (control group). To clarify what controlled ITS is and is not, we would like to provide further background on this methodology. Traditional ITS method adopts comparison within a single population but at different points in time (time series or time trends). This design is well suited to evaluate health interventions that were introduced at a known point in time (eg, policy change), thus allowing to observe difference or lack of such within one population prior to the intervention and after the intervention. It does not have a comparison group, which makes this design not prone to selection bias or unmeasured confounders, which is common for controlled designs (experimental or observational) in which 2 groups are being compared–intervention vs control, or exposed vs nonexposed. However, the limitation of ITS is that it does not protect from time-varying confounders, such as other interventions or historical events occurring around the time of intervention and also might contribute to the changes of the assessed outcome. To address this challenge, it became common to add time series data from the nonequivalent comparison group over the same time period. This is called comparative (or controlled) ITS or CITS, and it helps to control for history bias. "The simplest CITS analysis entails a difference-in-difference estimate where the difference between the pre- and postintervention means in the comparison group is used as the counterfactual against which the mean difference in the treatment group is evaluated. In more complex CITS analyses, the means and slopes of the pretreatment values are used to assess not only changes in mean levels but also changes in trend, in the variation around these trends, or in the pattern of temporal variability."[15] To address validity of such quasi-experimental design, a number of within-study comparisons have been done (data from RCTs were compared with CITS designs) and concluded that CITS and ITS studies are able to produce findings comparable to experimental findings.[15] The ability to assess multiple time points (time series) before and after the intervention in both intervention and control groups increases validity, (ie, likelihood to observe the effect in the intervention group) that is due to the intervention and not due to confounding factors.[16]

Another consideration in CITS is the method of selecting a control group or control series. The main goal of the controlled series is for them to have the same exposure to possible co-interventions or external events as that the intervention group. From the 6 common types of control, characteristic-based controls can help to exclude effect of concurrent events that both groups would be exposed to.[16] CITS is not meant to compare the actual outcomes in the intervention vs control group, but rather compares predifferences and postdifferences, as well as changes in trends in intervention group vs changes in trends in control group. Thus, the matched comparison group is not expected to be similar in all characteristics. The purpose of control group is to exclude time-varying confounders.

PATIENT SAMPLE

Eligible patients were identified through pharmacy reimbursement billing codes between July 2012 and March 2016. All patients with COPD who received a CACP were first identified, then a pool of potential controls was identified who had a diagnosis of COPD based on a 5-year history within the Alberta Health administrative data but did not receive a CACP. From this potential pool, up to 2 controls were selected that were additionally matched on the basis of age (within 2 years), sex, pharmacy, date of service (within 6 months). Patients within the control group were assigned a pseudo-CACP index date, which was the index date of their matched CACP patient in the intervention group.

OUTCOMES

To characterize changes in health care utilization, we evaluated COPD-related (Supplementary Table 1, available in online article) hospitalizations, ED visits, general practitioner visits, specialist visits, respiratory medicine visits, and pulmonary function tests before and after the CACP index dates in both the CACP group and control group. We looked at data 1 year before and after the CACP index dates to evaluate any impact of the CACP of health care utilization.

DATA ANALYSIS

Descriptive statistics (means, proportions) were used to characterize the CACP and control groups with respect to age, sex, comorbidity burden, and qualifying conditions (to be eligible for CACP)[14] prior to the CACP index date (or pseudoindex date for controls). Comorbidity burden was determined using the well-validated Elixhauser comorbidity index, which has been shown to be effective in predicting future health care costs, health care utilization, and morbidity and is widely used because of its validity in measuring disease burden.[17] To understand the difference in mean and total number of COPD hospitalizations, ED visits, general practitioner visits, specialist visits, respiratory medicine visits, and PF tests before and after the index dates, we used ITS to model health care resource use within each group prior to the CACP index date (or pseudoindex date for controls) and up to 1 year after.[16,18-19]

TABLE 1 Study Population: Demographics, Qualifying Conditions, and Comorbidity Burden

Characteristic	Total (N = 74,365)	Control group (n = 45,570)	CACP group (n = 28,795)	*P* value[a]	Standardized difference
Sex, n (%)					
Female	37,239 (50)	22,874 (50)	14,365 (50)	0.4129	0.0062
Male	37,126 (50)	22,696 (50)	14,430 (50)		
Age (in years), mean (SD)	70 (12)	71 (12)	68 (13)	<0.0001	-0.1758
Qualifying conditions, n (%)					
Hypertension	63,139 (85)	40,124 (88)	23,015 (80)	<0.0001	-0.2229
Diabetes mellitus	37,395 (50)	25,408 (56)	11,987 (42)	<0.0001	-0.2855
Asthma	38,488 (52)	26,529 (58)	11,959 (42)	<0.0001	-0.4340
Chronic heart failure	30,182 (41)	22,589 (50)	7,593 (26)	<0.0001	-0.3384
Ischemic heart disease	42,073 (57)	29,199 (64)	12,874 (45)	<0.0001	-0.4923
Mental health disorder	62,422 (84)	40,341 (89)	22,081 (77)	<0.0001	-0.3964
Obesity	11,226 (15)	11,374 (25)	7,347 (25)	0.0891	0.0128
Baseline Elixhauser score, mean (SD)	0.35 (0.56)	0.43 (0.61)	0.22 (0.46)	<0.0001	-0.3859

[a]*t tests and chi-square tests were conducted to explore the association.*
CACP = comprehensive annual care plan.

Within the model, all patient utilization data were aggregated into 12 monthly intervals in the year prior to and after the index dates. We included linear trend variables to represent the period of time before and after the CACP index date. All health care service utilization is presented as rates per 10,000 patients, and the rate difference within the CACP group was compared with the rate difference within the control group. Specification of the regression model was as follows:

$Y_t = \beta_0 + \beta_1 * time_t + \beta_2 * intervention_t + \beta_3 * time\ after\ intervention_t + e_t$.

Here, Y_t was the mean difference between CACP and control events per 10,000 patients in month t. Time was a continuous variable showing time in months from the beginning of the study period. Intervention was a dummy variable set at 0 (prior to CACP) and 1 (after CACP). Time after intervention is a continuous variable indicating the number of months after CACP. The estimate β0 was a measure of baseline level of utilization event at time 0. β1 estimated the monthly change in the mean number of utilization events per 10,000 patients before CACP. β2 estimated the immediate change in utilization (level change) occurring after CACP. β3 estimated the change in the monthly utilization trend (trend change) after CACP. The absolute effect was calculated by accounting for both the initial change in level and subsequent change in trend.[20-21] All regressions were performed using PROC AUTOREG within SAS version 9.3 (SAS Institute Inc.) assuming first-degree autocorrected errors.

Results

PATIENT CHARACTERISTICS

During the study period, we identified 74,365 eligible patients in which 28,795 (38.7%) had received a CACP (CACP group) and were matched to 45,570 controls (control group). The CACP group had an average age of 68 years, whereas the control group had an average age of 71 years ($P < 0.0001$) at the index date. Both groups were 50% female. Other than COPD, the most commonly occurring qualifying conditions in CACP and control groups were hypertension (80% and 88%, respectively) and mental health disorder (77% and 89%, respectively). Overall, the CACP group had a lower comorbidity burden, compared with the control group, based on the baseline Elixhauser score (0.22 vs 0.43). Although the difference is statistically significant ($P < 0.0001$), it may not be clinically significant because of the low comorbidity burden in both groups (Table 1).

OUTCOMES

COPD-Specific Hospitalizations. When evaluating the change, among the patients who received a CACP, there was a statistically significant immediate level decrease in the mean monthly number of COPD-specific hospitalizations by a rate of 83.8 per 10,000 patients (level change, $P = 0.0091$) (Table 2). Subsequently, there was a significant month-to-month trend decrease in the mean monthly number of COPD-specific

TABLE 2 Interrupted Time Series Analysis of Health Care Utilization Before and After CACP in Patients With COPD (1 year Pre-CACP and Post-CACP Index Date) per 10,000 Patients

Outcome	Difference in outcome (CACP group vs control group)						
	Intercept 12 months before index date	Preincentive trend	Immediate change		Temporal change		Overall effect
			β_1 (CI)	*P* value	β_2 (CI)	*P* value	Absolute diff (CI)
COPD hospitalizations	-205.40 (-249.89 to -160.90)	11.27 (5.78 to 16.75)	-83.80 (-140.39 to -27.22)	0.0091	-7.49 (-13.81 to -1.17)	0.0315	-173.68 (-270.81 to -76.55)
COPD ED visits	-244.0 (-296.5 to -191.51)	11.69 (6.12 to 17.26)	-69.37 (-168.37 to 29.63)	0.1696	-4.44 (-22.34 to 13.46)	0.6267	-122.68 (-294.91 to 49.56)
COPD general practitioner visits	-4.73 (-39.06 to 29.6)	12.24 (6.31 to 18.17)	-26.28 (-104.62 to 52.06)	0.5109	-10.63 (-21.98 to 0.72)	0.0664	-153.86 (-293.27 to -14.46)
COPD specialist visits	-19.14 (-52.03 to 13.76)	2.36 (-1.03 to 5.74)	-9.88 (-33.76 to 14.01)	0.4176	-0.94 (-5.31 to 3.42)	0.6714	-21.21 (-78.03 to 35.61)
COPD respiratory medicine visits	-17.06 (-41.18 to 7.06)	1.94 (-0.68 to 4.55)	-6.48 (-34.54 to 21.58)	0.6508	-1.46 (-5.75 to 2.83)	0.5053	-23.98 (-70.72 to 22.75)
Pulmonary function tests	-15.95 (-39.52 to 7.62)	3.43 (0.62 to 6.24)	-16.54 (-36.67 to 3.59)	0.1073	-0.24 (-3.66 to 3.17)	0.8889	-19.47 (-70.10 to 31.17)

CACP = comprehensive annual care plan; COPD = chronic obstructive pulmonary disease; ED = emergency department.

hospitalizations of 7.5 per 10,000 patients (slope change, P = 0.03) (Table 2; Figure 1). The overall effect of the program is characterized by the absolute difference which was statistically significant in favor of the CACP group of -173.7 (95% CI = -270.8 to -76.6) hospitalizations per 10,000 patients after the CACP implementation, which accounts for both the level and mean monthly change in the year following the CACP.

COPD-Specific ED Visits. When evaluating the change, among the patients who received a CACP, there was a nonsignificant immediate level decrease in the mean monthly number of COPD ED visits by a rate of 69.4 per 10,000 patients (P > 0.01). Similarly, there was a nonsignificant month-to-month trend decrease in the mean monthly number of COPD ED visits of 4.4 per 10,000 patients (P > 0.01) (Table 2; Supplementary Figure 1). A nonsignificant absolute difference of -122.7 (-294.9 to 49.6) ED visits per 10,000 patients after the CACP implementation was observed.

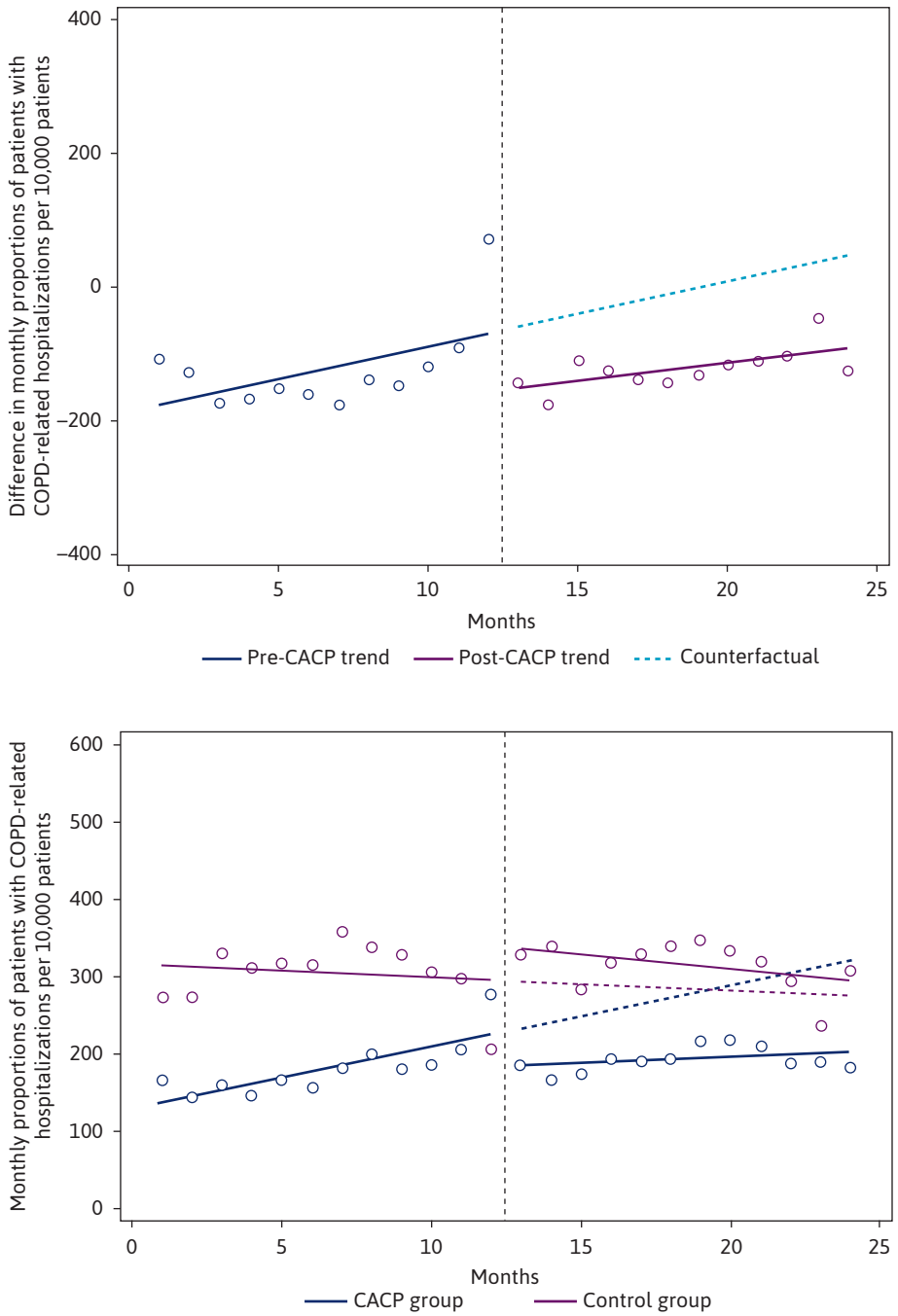
COPD-Specific General Practitioner Visits. When evaluating the change, among the patients who received a CACP, there was a nonsignificant immediate level decrease in the mean monthly number of COPD general practitioner visits by a rate of 26.3 per 10,000 patients (P > 0.01) (Table 2). Similarly, there was a nonsignificant month-to-month trend decrease in the mean monthly number of COPD general practitioner visits of 10.6 per 10,000 patients (P > 0.05) (Table 2; Supplementary Figure 2). The absolute difference of -153.9 (95% CI = -293.3 to -14.5) general practitioner visits per 10,000 patients after the CACP implementation was observed in favor of the CACP group.

COPD-Specific Specialist Visits. When evaluating the change, among the patients who received a CACP, there was a nonsignificant immediate level decrease in the mean monthly number of COPD specialist visits of 9.9 per 10,000 patients (P > 0.05) (Table 2). Similarly, there was a nonsignificant month-to-month trend decrease in the mean monthly number of COPD specialist visits of 0.94 per 10,000 patients (P > 0.05) (Table 2; Supplementary Figure 3). A nonsignificant absolute difference of -21.2 (95% CI = -78.0 to 35.6) specialist visits per 10,000 patients after the CACP implementation was observed.

Respiratory Medicine Visits. When evaluating the change, among the patients who received a CACP, there was a nonsignificant immediate level decrease in the mean monthly number of COPD respiratory medicine visits by a rate of 6.5 per 10,000 patients (P > 0.05) (Table 2). Similarly, there was a nonsignificant month-to-month trend decrease in the mean monthly number of COPD hospitalizations of 1.5 per 10,000 patients (P > 0.05) (Table 2; Supplementary Figure 4). A nonsignificant absolute difference of 24.0 (95% CI = -70.7 to 22.8) respiratory medicine visits per 10,000 patients after the CACP implementation was observed.

Pulmonary Function Tests. When evaluating the change, among the patients who received a CACP, there was a nonsignificant immediate level decrease in the mean monthly number of pulmonary function tests of 16.5 per 10,000 patients (P > 0.05) (Table 2). Similarly, there was a nonsignificant month-to-month trend decrease in the mean

FIGURE 1 Difference and Overall Trend in Mean Monthly COPD-Related Hospitalizations per 10,000 Patients in CACP Group Compared With the Control Group



CACP = comprehensive annual care plan; COPD = chronic obstructive pulmonary disease.

monthly number of pulmonary function tests of 0.24 per 10,000 patients ($P > 0.05$) (Table 2; Supplementary Figure 5). A nonsignificant absolute difference of -19.5 (95% CI = -70.1 to 31.2) pulmonary function tests per 10,000 patients after the CACP implementation was observed.

Sensitivity Analysis. After presenting analyses, we noticed that in the CACP group for almost all outcomes we observed a particularly higher number of the events in the month preceding the intervention. To address this observation we re-ran all the analyses excluding 30 days before and after the index date. All the sensitivity analyses results were consistent with the previously presented results, except for the COPD-related hospitalizations, which fail to demonstrate significant difference, (ie, the overall decrease in mean number of hospitalizations by 173.7 in the previous analysis compares to the overall decrease in mean number of hospitalizations by 25.23 per 10,000 patients) (Supplementary Table 2, Supplementary Figures 6-11).

Discussion

Our study is the first to determine the impact of pharmacist-provided CACPs to patients with COPD within the province of Alberta, Canada, on health care utilization. Our study identified significant reduction in COPD-specific hospitalizations, but no significant decrease in COPD-specific ED visits. It is important to note that once we removed data points for 30 days prior to and immediately after CACP from the analysis the reduction in hospitalizations was in place but not significant. The elevated number of events (hospitalizations and ED visits in particular) 1 month prior to the CACP might be explained by the fact that the CACP provision was triggered by such event, and thus the sensitivity analysis was warranted.

There were also no statistically significant changes in general practitioner visits, specialist visits, respiratory medicine visits, or pulmonary function tests. Continuous care provided by primary care and specialists is critical in chronic disease management, such as the higher index of family physician–specialist continuity of care is associated with the reduced hospitalizations in COPD.[22] We did not observe increase in general practitioner visits or specialist visits, which is not surprising as other factors might have a greater influence on access to physicians than care plan provided by pharmacists. However, we were interested to see whether there is an effect of CACPs on physician appointments and pulmonary function tests.

The minimal effect of providing pharmacist-led care plans to patients with COPD on health care utilization outcomes creates a venue for discussion regarding the overall methods of evaluating pharmacist-provided professional services (eg specific outcomes, consideration of the interprofessional care). It is important to note that pharmacy services, especially for older comorbid patients with COPD, is only one part of team care; hence, effect on high-level utilization outcomes associated with pharmacist-provided care might be challenging to observe. Besides, physicians may not implement pharmacist-recommended changes; although many pharmacists have authority to prescribe in Alberta, not all do, and some may seek physician collaboration rather than taking over prescribing. At the same time, pharmacy services incorporated in health care team effort can improve overall care process, including patient outcomes.[23] Importantly, community pharmacists are accessible health care professionals; patients with COPD have a median of 16 visits to their community pharmacy vs a median of 12 visits to their general practitioner per person-year[24] and, therefore, are well placed to assist in COPD management for patients.

There is limited research that evaluates the impact of pharmacist-provided care plans on health care utilization among patients with chronic conditions, including COPD.[25-26] Available studies do not necessarily provide evaluation of pharmacy care services for a specific chronic condition; however, the findings can be instrumental in understanding and interpreting the results in this study. Similar to our study, Necyk, et al. found limited overall impact on major health care utilization among patients with various chronic diseases who received a CACP within the province of Alberta.[27] A recent systematic review explored the impact of pharmacist-led chronic disease management initiatives on clinical outcomes, health system utilization, and economic outcomes within the United States.[28] Although it was found that pharmacists are able to improve clinical outcomes for a wide variety of chronic conditions, the review confirmed a lack of evaluation research on the impact of pharmacist-led initiatives on health care utilization and economic outcomes.

Because lack of remuneration is one of the major barriers to provide clinical services by community pharmacists, there are studies that specifically looked at remunerated patient care services, provided by pharmacists. For instance, a systematic review, which identified remunerated pharmacist clinical care services internationally, noted that pharmacist services were effective for blood pressure management, cholesterol management, and smoking cessation.[29] In addition, when evaluating MTM programs within the United States, returns on investment ranged from $1.29 per dollar spent to $2.50 per dollar spent.[29] Another overview of systematic reviews evaluating pharmacist-led medication reviews

confirmed the positive effect of medication reviews on clinical outcomes (symptom control and lung function) in COPD and asthma.[30] In terms of health care utilization, however, significant reductions in medication and/or health care costs were found in a quarter of primary research studies. Similarly, conflicting findings were presented regarding reduction in hospitalization admissions.[30-31] As pharmacist remuneration programs continue to grow with mainly fee-for-service models in place, future research should explore how to effectively measure pharmacists' contribution to patient care and consequent outcomes in chronic disease management, in which interprofessional care is a basis of a system and care process.

LIMITATIONS

This study should be interpreted with consideration for several limitations. First, we were unable to determine if the severity of COPD had an impact on health care service utilization. Thus, it is difficult to understand if the severity of disease influenced the small differences in health care utilization rates. We can assume that the low rate of hospitalizations in both groups signals that populations with a milder disease were presented. Also, although there was a statistically significant difference in the comorbidity burden between the CACP group and control group, the difference is not likely to be clinically significant, as the Elixhauser comorbidity index was low within both groups. Secondly, as we analyzed administrative data, we were not able to measure the quality of the CACP itself or the frequency or quality of pharmacist follow-up. As such, it is possible that patients with COPD continue to rely on major health care services to manage their condition, limiting the ability to measure the impact of the CACP. Finally, we were not able to account for factors that could influence why someone would be offered a CACP over another person and why someone may accept vs refuse it. This also should be further explored in the future with primary data. Another subject of future research could be a focus on medication utilization, including adherence, as an indicator of measuring effectiveness.

Conclusions

The health care for patients with COPD continues to be a significant cost for the provincial health system, particularly hospitalizations and ED visits. Pharmacist-provided care plans to patients with COPD did not demonstrate significant decrease in hospitalizations or ED visits, nor did it affect number of appointments with physicians (general practitioners and specialists) or pulmonary function tests during the 12 months following CACP provision. As the payer continues to identify opportunities to improve health care efficiencies, the provincial pharmacist remuneration model may need further evaluation overall, as well as strategies in care provision/evaluation in COPD specifically.

DISCLOSURES

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