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Physician Financial Incentives to Reduce Unplanned Hospital Readmissions: A Propensity Score Weighted Cohort Study

John A. Staples, MD, MPH,[a,b,c] Ying Yu, PhD,[a] Mayesha Khan, MA,[a] Hiten Naik, MD,[a] Guiping Liu, PhD,[d] Jeffrey R. Brubacher, MD, MSc,[e] Ahmer Karimuddin, MD, MAEd,[f] Jason M. Sutherland, MSc, PhD[d,e]

[a]Department of Medicine, University of British Columbia, Vancouver, Canada; [b]Centre for Clinical Epidemiology & Evaluation (C2E2), Vancouver, Canada; [c]Centre for Health Evaluation & Outcome Sciences (CHÉOS), Vancouver, Canada; [d]Centre for Health Services and Policy Research (CHSPR), School of Population and Public Health, University of British Columbia, Vancouver, Canada; [e]Department of Emergency Medicine, University of British Columbia, Vancouver, Canada; [f]Department of Surgery, University of British Columbia, Vancouver, Canada.

ABSTRACT

BACKGROUND: Unplanned hospital readmissions are associated with adverse patient outcomes and substantial healthcare costs. It remains unknown whether physician financial incentives for enhanced discharge planning can reduce readmission risk.

METHODS: In 2012, policymakers in British Columbia, Canada, introduced a $75 fee-for-service physician payment to incentivize enhanced discharge planning (the "G78717" fee code). We used population-based administrative health data to compare outcomes among G78717-exposed and G78717-unexposed patients. We identified all nonelective hospitalizations potentially eligible for the incentive over a 5-year study interval. We examined the composite risk of unplanned readmission or death and total direct healthcare costs accrued within 30 days of discharge. Propensity score overlap weights and adjustment were used to account for differences between exposed and unexposed patients.

RESULTS: A total of 5262 of 24,787 G78717-exposed and 28,096 of 136,541 unexposed patients experienced subsequent unplanned readmission or death, suggesting exposure to the G78717 incentive did not reduce the risk of adverse outcomes after discharge (crude percent, 21.1% vs 20.6%; adjusted odds ratio, 0.97; 95% CI, 0.93-1.01; $P = .23$). Mean direct healthcare costs within 30 days of discharge were $3082 and $2993, respectively (adjusted cost ratio, 1.00; 95% CI, 0.95-1.05; $P = .93$).

CONCLUSIONS: A physician financial incentive that encouraged enhanced hospital discharge planning did not reduced the risk of readmission or death, and did not significantly decrease direct healthcare costs. Policymakers should consider the baseline prevalence and effectiveness of enhanced discharge planning, the magnitude and design of financial incentives, and whether auditing of incentivized activities is required when implementing similar incentives elsewhere.

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KEY WORDS: Cohort studies; Health care costs; Physician incentive plans; Propensity score; Unplanned hospital readmission

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Requests for reprints should be addressed to: Dr John A. Staples, MD, FRCPC, FACP, MPH, Vancouver General Hospital Research Pavilion, Room 276, 828 West 10th Avenue, Vancouver, BC V5Z1M9 Canada.

E-mail addresses: john.staples@ubc.ca yy20@mail.ubc.ca jason.sutherland@ubc.ca

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BACKGROUND

Unplanned hospital readmissions are associated with lower patient satisfaction, higher healthcare costs, and a 3-fold increase in the risk of death.[1-3] One in 11 hospitalized Canadians are readmitted within 30 days of discharge, resulting in $2.3 billion in additional health system costs per year.[3,4] About 25% of hospital readmissions may be preventable,[5] but effective strategies to avert unplanned hospital readmissions remain elusive despite over a decade of sustained focus by clinicians, administrators, and researchers.[6,7]

Several jurisdictions have attempted to reduce unplanned hospital readmissions using financial incentives. A $25 payment to primary care physicians in Ontario incentivizes follow-up within the first 14 days after hospital discharge, but despite annual expenditures of $2.1 million, one study suggests the payment has not increased early follow-up or reduced readmissions.[8] Since 2012, the U.S. Hospital Readmissions Reduction Program (HRRP) has imposed Medicare reimbursement penalties on hospitals with higher-than-expected 30-day readmission rates. The HRRP has reduced readmissions and has saved several billion dollars, but mortality after hospitalization for heart failure may have increased, penalties have been borne disproportionately by safety-net hospitals, and the perceived benefits of the HRRP might represent gaming by hospitals rather than improved health outcomes for patients.[9,10,11,12] Overall, it remains uncertain whether financial incentives are an effective way to reduce the risk of unplanned hospital readmission.

In 2012, policymakers in British Columbia (BC) introduced a G78717 fee-for-service physician payment claim code "to support clinical coordination leading to effective discharge and community-based management of complicated patients ... at risk of readmission."[13] The $75 fee-for-service payment could be claimed by a hospital physician if they attested to the development of a discharge care plan that reconciled prescription medications, outlined planned follow-up, and indicated reasons to seek further medical care; the care plan had to be shared with the patient and their primary care provider within 24 hours of discharge.[14] Elective hospitalizations, hospitalizations with a length of stay of less than 5 days, and clinicians other than specialist physicians (such as general practitioners and nurse practitioners) were initially ineligible for the payment (Appendix Item S1, available online). A previous analysis by our group suggested this incentive payment did not change the population-level risk of unplanned hospital readmission, yet the interrupted time series design meant that it was not able to determine whether the intervention was ineffective or whether it was effective but inadequately scaled.[14]

As a means to provide evidence on the effectiveness of physician financial incentives, we sought to examine whether individuals exposed to a G78717 physician payment claim and the enhanced discharge planning it implies exhibited a lower risk of unplanned hospital readmission or death and lower direct healthcare costs within 30 days of hospital discharge, relative to individuals without G78717 exposure.

CLINICAL SIGNIFICANCE

- A fee-for-service physician financial incentive payment for enhanced hospital discharge planning did not reduce the risk of readmission and death in the first 30 days after discharge.
- Incentive payments did not significantly alter direct healthcare costs.
- Policymakers should consider the baseline prevalence and effectiveness of enhanced discharge planning, the magnitude and design of the financial incentive, and whether auditing of incentivized activities is required.

METHODS

Setting

BC's universal health insurance provides unrestricted access to hospital and physician services at no cost to the patient. The vast majority of physicians work solely within the public healthcare system and are remunerated via fee-for-service payments.[15] We used BC's linked, de-identified, individual-level, population-based administrative data to identify eligible index hospitalizations, ascertain exposure to a G78717 fee code claim, identify medical outcomes, estimate direct healthcare costs, and account for baseline differences in patient demographics, comorbidities, prescription medication use, health services use, and socioeconomic status (Appendix Item S2, available online).[16]

Study Cohort

Our study cohort included all patients who were potentially eligible for the G78717 incentive payment: all urgent (nonelective) acute-care hospitalizations that ended between 1 June 2012 and 31 January 2017, had a length-of-stay (LOS) ≥5 days, and had a specialist physician as Most Responsible Provider (MRP; the provider "responsible for the care and treatment of the patient for the majority of the visit";[17] Appendix Item S1). We excluded patients <18 years old; hospitalizations where the Most Responsible Diagnosis (the diagnosis "most responsible for the greatest portion of the length of stay or greatest use of resources"[18]) corresponded to pregnancy, childbirth, or the puerperal and perinatal periods; hospitalizations that began or ended with a transfer from another hospital; and hospitalizations that ended in death, discharge against medical advice, or discharge to long-term care. Individuals could contribute multiple eligible hospitalizations to the analysis and we used robust standard errors clustered by individual to account for nonindependence of hospitalizations contributed by the same individual.

Exposure Status and Propensity Score Weighting

We used physician claims data to identify exposure to a G78717 incentive fee claim. We used logistic regression to develop a non-parsimonious propensity score that drew on baseline patient characteristics, features of the index hospitalization, and characteristics of the Most Responsible Provider to predict the likelihood of G78717 exposure during the index hospitalization, regardless of the actual exposure status. We used propensity score overlap weights to balance patient and hospitalization characteristics between the G78717-exposed and G78717-unexposed groups.[19,20] We interpreted a standardized mean difference >0.1 as suggesting meaningful covariate imbalance.[21]

Medical Outcomes

The primary medical outcome was the cumulative incidence of unplanned readmission or death within 30 days of the index discharge date (Appendix Item S3). Intra-class correlation suggested multilevel modeling was unnecessary because <5% of variation in outcome was explained by between-physician or between-hospital differences (Appendix Item S4). Accordingly, we used logistic regression to compare the risk of the primary medical outcome in G78717-exposed and unexposed patients after propensity-score weighting and after adjusting for potential confounders identified through literature review and retained after backward selection procedures (Appendix Item S5).

We evaluated secondary medical outcomes within 30 days of the index discharge date including death, unplanned readmissions, emergency department visits, and physician clinic visits. To assess whether the incentive and the medication reconciliation it implies improved prescribing patterns, we evaluated 1) the proportion of patients with an index admission for cardiovascular disease who received at least one prescription fill for an appropriate beta-blocking drug (i.e. bisoprolol, carvedilol, metoprolol) within 30 days after index hospital discharge, and 2) the proportion of patients aged ≥65 years who received at least one prescription fill for a potentially inappropriate medication (PIM) identified by Beers criteria within 30 days after index hospital discharge (Appendix Item S6).[22] We interpreted beta-blocker prescription fills in patients with cardiovascular disease as a higher quality prescribing practice,[23-25] and PIM prescription fills in older patients as a lower quality prescribing practice.[26,27]

Cost Outcome

We used linear regression to compare total direct healthcare costs within 30 days of discharge, again using propensity score weighting and adjustment for confounders (Appendix Item S5). We summed total direct healthcare costs from a healthcare funder perspective, including the cost of hospital readmissions (elective and nonelective; hospital costs were included if the subsequent admission date fell within the 30-day outcome window), emergency department visits, and physician services. We calculated the cost of hospitalizations and emergency visits by multiplying the standard hospitalization unit cost (hospitals' cost per weighted case) by the visit Resource Intensity Weight (a measure of patient resource use compared with average resource use; Appendix Item S7). The cost of physician services was estimated using physician fee-for-service claims and the published payment schedule. Because total costs in the 30 days after index discharge were right-skewed and often zero, we added $1 to all patients' total cost before log-transforming and using multivariable linear regression on the transformed variable to generate the ratio of costs in G78717-exposed patients to costs in G78717-unexposed patients. We accounted for inflation using BC's monthly Consumer Price Index (CPI) and expressed costs in 2018 Canadian dollars.

Additional Analyses

We repeated analyses in clinically relevant subgroups. We performed sensitivity analyses that: 1) varied the outcome interval; 2) omitted propensity score weighting; 3) included only one randomly selected G781717-eligible hospitalization per individual; and 4) included hospitalizations that involved a transfer from one hospital to another.

Statistical analyses used 2-sided tests and statistical significance was inferred from $P < .05$. Analyses were completed using R version 4.0.5 (Appendix Item S8). Data were rarely missing (Appendix Item S2).

Ethics

The University of British Columbia Clinical Research Ethics Board approved the study and waived the requirement for individual consent (certificate H17-01039). The study protocol was registered (ClinicalTrials.gov, NCT03256734). All inferences, opinions, and conclusions drawn in this manuscript are those of the authors, and do not reflect the opinions or policies of the Data Stewards.

RESULTS

Our final study cohort included a total of 161,328 index hospitalizations among 121,172 unique patients, 3842 unique providers, and 61 unique hospitals; 24,787 hospitalizations were G78717-exposed and 136,541 were unexposed (Figure 1). In the unweighted cohort and relative to G78717-unexposed patients, G78717-exposed patients were younger, more likely to reside in an urban neighborhood and one in the lowest quintile of household income, twice as likely to have prior medical visits for substance use, twice as likely to be admitted for a psychiatric diagnosis, and less likely to require intensive care during the index hospitalization (Table 1). Most responsible providers for the G78717-exposed group were more likely to be female, graduates of the regional medical school, and to have ≤14 years of clinical experience (Table 2). As expected,

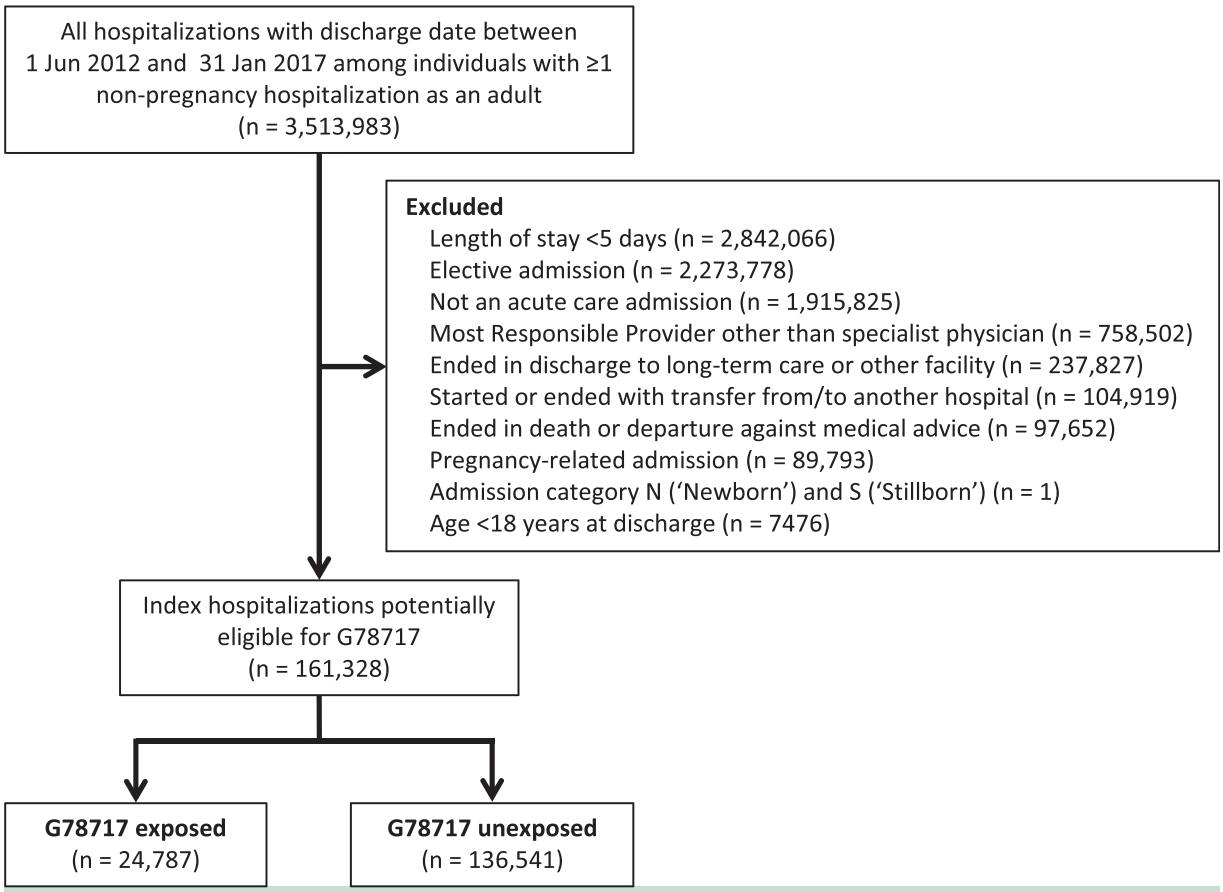

Figure 1 Patient flow diagram.

propensity-score weighting produced a similar distribution of baseline characteristics (Appendix *Item S9*).

A total of 5262 of 24,787 G78717-exposed and 28,096 of 136,541 unexposed patients experienced subsequent unplanned readmission or death, suggesting G78717 exposure did not reduce readmission risk (crude percent, 21.1% vs 20.6%; adjusted odds ratio, 0.97; 95% CI, 0.93-1.01; $p = .23$). Similarly, G78717-exposed patients were no less likely to experience secondary medical outcomes including physician clinic visits, emergency visits, hospital readmissions, or death within 30 days of the index discharge date (Table 3).

Among the subset of 12,470 patients hospitalized for cardiovascular disease, exposure to G78717 was not associated with a significant improvement in the subsequent prescription of beta-blockers (crude percent, 73.3% vs 72.5%; adjusted odds ratio, 1.08; 95% CI, 1.00-1.17; $P = .146$). Among the subset of 68,946 hospitalized patients ≥65 years, G78717 exposure was not associated with a reduction in prescription fills for potentially inappropriate medications (crude percent, 27.4% vs 25.6%; adjusted odds ratio, 1.04; 95% CI, 0.98-1.10; $P = .416$).

Mean direct healthcare costs within 30 days of discharge were $3082 among G78717 -exposed patients and $2993 among unexposed patients, suggesting no difference in direct healthcare costs (adjusted cost ratio, 1.00; 95% CI, 0.95-1.05; $p = .933$; Table 3).

Most subgroup analyses yielded findings similar to the main analysis. However, exposure to G78717 was associated with a modest reduction in the risk of readmission or death for index hospitalizations with a shorter length of stay (5−7 days) or a Most Responsible Provider that was male or had ≥15 years of experience (Figure 2; Appendix Item S10). Sensitivity analyses suggested results were robust to changes in study design, including the use of alternate follow-up intervals (14, 90, or 365 days after index hospital discharge) and the use of regression models without propensity score weighting (Appendix Item S11).

INTERPRETATION

We performed a population-based propensity-score weighted cohort study of 161,328 nonelective hospital admissions to 61 hospitals over a 5-year study interval and found that exposure to a $75 physician financial incentive that encouraged enhanced hospital discharge planning was not associated with changes in the composite risk of readmission or death. There was also no difference in direct healthcare costs in the 30 days after discharge. A prior interrupted time series analysis by our group suggested the

Table 1 Index Hospitalization Characteristics

Characteristic	Patients With G78717 Claim n=24,787 (%)	Patients Without G78717 Claim n=136,541 (%)	SD for the Unweighted Cohort
Patient characteristics			
Age			0.175
18-49 Y	9339 (37.7)	40,524 (29.7)	
50-64 Y	6220 (25.1)	36,299 (26.6)	
≥65 Y	9228 (37.2)	59,718 (43.7)	
Sex			0.019
Female	11,285 (45.5)	63,425 (46.5)	
Male	13,498 (54.5)	73,091 (53.5)	
Rural residence	5984 (24.1)	48,689 (35.7)	0.258
Neighborhood household income			0.106
First (lowest)	7732 (31.2)	36,891 (27.0)	
Second	5084 (20.5)	28,030 (20.5)	
Third	4502 (18.2)	25,285 (18.5)	
Fourth	3731 (15.1)	23,012 (16.9)	
Fifth (highest)	3277 (13.2)	20,909 (15.3)	
Medical history			
≥ 1 hospitalizations in prior year	14,214 (57.3)	76,663 (56.1)	0.024
≥7 physician clinic visits in prior year	4197 (16.9)	22,196 (16.3)	0.018
Charlson co-morbidity score ≥2	7587 (30.6)	46,440 (34.0)	0.073
Comorbidities			
Myocardial infarction	1215 (4.9)	8928 (6.5)	0.071
Congestive heart failure	2839 (11.5)	14,656 (10.7)	0.023
Peripheral arterial disease	843 (3.4)	4247 (3.1)	0.016
Cerebrovascular disease	542 (2.2)	4606 (3.4)	0.072
Dementia	466 (1.9)	2595 (1.9)	0.002
Chronic pulmonary disease	2059 (8.3)	11,791 (8.6)	0.012
Rheumatic disease	238 (1.0)	1280 (0.9)	0.002
Peptic ulcer disease	526 (2.1)	2987 (2.2)	0.005
Diabetes with or without complications	5154 (20.8)	28,300 (20.7)	0.002
Paraplegia and hemiplegia	120 (0.5)	1163 (0.9)	0.045
Renal disease	2306 (9.3)	10,684 (7.8)	0.053
Liver disease	957 (3.9)	4676 (3.4)	0.023
Cancer or metastatic carcinoma	2061 (8.3)	16,365 (12.0)	0.122
HIV/AIDS	131 (0.5)	1084 (0.8)	0.033
Any substance use disorder	4843 (19.5)	14,097 (10.3)	0.261
Medication history			
Number of prescription medications			0.009
0	5298 (21.4)	28,695 (21.0)	
1	2784 (11.2)	15,391 (11.3)	
≥2	16,705 (67.4)	92,455 (67.7)	
Selected medications			
Antidepressants	7345 (29.6)	34,104 (25.0)	0.105
Antipsychotic agents	7289 (29.4)	23,946 (17.5)	0.283
Systemic antibacterials	6869 (27.7)	41,152 (30.1)	0.054
ACEis and ARBs	5315 (21.4)	33,256 (24.4)	0.069
Statins	5084 (20.5)	30,058 (22.0)	0.037
Proton pump inhibitors	4979 (20.1)	28,710 (21.0)	0.023
Diuretics	4543 (18.3)	26,871 (19.7)	0.034
Beta-blockers	4874 (19.7)	27,288 (20.0)	0.008
Calcium channel blockers	3321 (13.4)	19,641 (14.4)	0.029
Inhaled bronchodilators	3476 (14.0)	18,426 (13.5)	0.015
Benzodiazepines	5368 (21.7)	24,800 (18.2)	0.088
Non-benzo hypnotics	3429 (13.8)	16,307 (11.9)	0.056
Opioids	4862 (19.6)	32,256 (23.6)	0.097
Opioid antagonist therapy	221 (0.9)	665 (0.5)	0.049

Table 1 (*Continued*)

Characteristic	Patients With G78717 Claim n=24,787 (%)	Patients Without G78717 Claim n=136,541 (%)	SD for the Unweighted Cohort
Oral hypoglycemic agents	2912 (11.7)	15,616 (11.4)	0.010
Insulin	1443 (5.8)	7789 (5.7)	0.005
Anticoagulants	2373 (9.6)	13,415 (9.8)	0.008
Systemic corticosteroids	2218 (8.9)	14,059 (10.3)	0.046
Details of index hospitalization			
Sector and size of hospital			0.344
Teaching	15,064 (62.7)	79,906 (59.8)	
Community-Large	8394 (34.9)	39,836 (29.8)	
Community-Medium	571 (2.4)	11,597 (8.7)	
Community-Small	< 5 (0.0)	708 (0.5)	
Most responsible service			0.541
Medicine	12,827 (51.7)	68,489 (50.2)	
Psychiatry	8839 (35.7)	25,141 (18.4)	
Surgery	3089 (12.5)	42,091 (30.8)	
Most responsible diagnosis			
Mood disorders	3788 (15.3)	11,236 (8.2)	0.220
Schizophrenia and related disorders	4404 (17.8)	10,570 (7.7)	0.304
Other forms of heart disease	1842 (7.4)	9923 (7.3)	0.006
Ischemic heart diseases	907 (3.7)	7689 (5.6)	0.094
Other diseases of intestines	711 (2.9)	6169 (4.5)	0.088
Complications of medical care	517 (2.1)	5650 (4.1)	0.118
Disorders of biliary tract and pancreas	618 (2.5)	5361 (3.9)	0.081
Mental and behavioral disorders due to psychoactive substance use	1308 (5.3)	3717 (2.7)	0.131
Injuries to the hip and thigh	53 (0.2)	4826 (3.5)	0.247
Chronic lower respiratory diseases	688 (2.8)	3689 (2.7)	0.005
Arrival by ambulance	9137 (36.9)	50,320 (36.9)	<0.001
ICU stay during index hospitalization	2408 (9.7)	22,006 (16.1)	0.192
Index hospitalization length of stay			0.182
5 to 7 D	7943 (32.0)	54,865 (40.2)	
8 to 29 D	14,013 (56.5)	70,341 (51.5)	
≥30 D	2831 (11.4)	11,335 (8.3)	

SD = standardized difference.

Main finding is imbalance in characteristics between patients with and without a G78717 claim. These imbalances were addressed through propensity score weighting (Supplemental Appendix Item S9) and adjustment. Note that for brevity, not all categories of each characteristic are presented in this table.

Table 2 Physician Characteristics

Characteristic	Patients With G78717 Claim n = 24,787 (%)	Patients Without G78717 Claim n = 136,541 (%)	SD for the Unweighted Cohort
Physician sex			0.212
Male	16,316 (65.8)	97,471 (71.4)	
Female	7132 (28.8)	27,873 (20.4)	
Missing	1339 (5.4)	11,197 (8.2)	
Medical school attended			0.164
UBC	7420 (29.9)	31,876 (23.3)	
Other Canadian	9557 (38.6)	59,797 (43.8)	
Foreign	5604 (22.6)	30,183 (22.1)	
Missing	2206 (8.9)	14,685 (10.8)	
Years since medical school graduation			0.293
Few (≤14 Y)	10,650 (43.0)	40,003 (29.3)	
Many (≥15 Y)	12,798 (51.6)	85,331 (62.5)	
Missing	1339 (5.4)	11,207 (8.2)	

Main finding is imbalance in characteristics between Most Responsible Providers for hospitalizations with and without a G78717 claim. Imbalances were addressed through propensity score weighting (Supplemental Appendix Item S9) and adjustment. SD = standardized mean difference; UBC = University of British Columbia, the only medical school in British Columbia during the study interval.

Table 3 Outcomes Within 30 Days of Index Discharge Date

Outcome	Patients With Outcome Among Patients With G78717 n = 24,787* (%)	Patients With Outcome Among Patients *Without* G78717 n = 136,541* (%)	Unadjusted Effect Estimate	Adjusted Effect Estimate
Primary medical outcome			OR (95%CI), *P*	OR (95%CI), *P*
Readmission or death	5262 (21.2)	28,096 (20.6)	0.97 (0.93, 1.00), $p = .188$	0.97 (0.93, 1.01), $p = .233$
Secondary medical outcomes			OR (95%CI), *P*	OR (95%CI), *P*
Readmission	5112 (20.6)	27,299 (20)	0.97 (0.93, 1.00), $P = .174$	0.97 (0.93, 1.00), $P = .226$
Death	414 (1.7)	2081 (1.5)	1.07 (0.96, 1.20), $P = .396$	1.04 (0.93, 1.17), $P = .625$
Subsequent physician clinic visit	3406 (13.7)	18,391 (13.5)	0.98 (0.94, 1.03), $P = .583$	0.99 (0.94, 1.03), $P = .634$
Subsequent emergency department visit	6654 (26.8)	31,972 (23.4)	1.00 (0.97, 1.03), $P = .966$	0.99 (0.96, 1.03), $P = 0.825$
Prescription fills for beta-blockers†	1293 / 1765 (73.3)	7763 / 10705 (72.5)	1.06 (0.99, 1.13), $P = .224$	1.08 (1.00, 1.17), $P = 0.146$
Prescription fills for PIMS‡	2528 / 9228 (27.4)	15,304 / 59,718 (25.6)	1.01 (0.96, 1.06), $p = 0.805$	1.04 (0.98, 1.10), $p = .416$
Primary cost outcome			Cost ratio (95%CI), *P*	Cost ratio (95%CI), *P*
Total direct health system cost	$3082	$2993	1.00 (0.95, 1.06), $P = .970$	1.00 (0.95, 1.05), $P = .933$
Component cost outcomes			Cost ratio (95% CI), *P*	Cost ratio (95%CI), *P*
Readmission costs, nonelective	$2589	$2459	0.98 (0.93, 1.03), $P = .171$	0.97 (0.93, 1.02), $P = .129$
Readmission costs, elective	$246	$354	0.98 (0.96, 0.99), $P < .001$	0.98 (0.96, 0.99), $P < .001$
Physician costs	$91	$67	1.03 (1.00, 1.06), $P = .004$	1.03 (1.00, 1.06), $P = .004$
Emergency department costs	$157	$112	1.00 (0.96, 1.04), $P = .944$	1.00 (0.96, 1.03), $P = .723$

For analyses of secondary medical outcomes, the models were propensity score weighted and adjusted by the same set of variables generated from the backward selection in the primary analysis. For cost analyses, the models were propensity score weighted, but a separate backward selection was performed to obtain adjustment variables.

*Except where different denominator specified;

†Among 12,470 hospitalizations for cardiovascular disease (1765 with and 10,705 without G78717);

‡Among 68,946 hospitalizations of patients ≥65 years (9228 with and 59,718 without G78717).

introduction of the G78717 incentive payment policy in BC was not associated with changes in population-level readmission risk, but that study was unable to distinguish between an ineffective intervention and an effective but inadequately scaled intervention.[14] The present study suggests the G78717 incentive does not effectively reduce readmission risk, even among those exposed to the intervention.

Our study adds to existing knowledge on the effectiveness of physician financial incentives to improve transitions of care. As noted above, a $25 payment incentivizing primary care physicians in Ontario to complete an early post-discharge follow-up visit was not associated with significant improvements in early follow-up, hospital readmission or death.[8] Another Ontario study found that introduction of financial incentives for psychiatrists failed to improve the provision of timely outpatient care after a psychiatric hospitalization or suicide attempt.[28] A study in BC found that financial incentives for primary care physicians did not increase continuity of care, reduce hospitalizations, or constrain resource use among complex patients.[29] Another BC study found that introduction of disease-specific incentives for primary care physicians were associated with improvements in appropriate testing, drug treatment, and outcomes for patients with hypertension, but no changes in patient management or outcomes among patients with diabetes or emphysema.[30] An Australian study found that chronic disease management incentives for primary care physicians improved long-term survival after stroke.[31] Other studies imply that physician financial incentives have a limited impact on cancer screening rates and the quality of diabetes care.[32,33] These studies suggest that reducing readmission risk will likely require tactics beyond financial incentives for physicians.[34] When financial incentives for physicians are employed, policymakers should consider the baseline prevalence and effectiveness of enhanced discharge planning, the magnitude and design of the financial incentive, and whether auditing of incentivized activities is required.

Our findings also echo recently published studies that find limited impact of other interventions to prevent hospital readmissions. A Swiss multicenter randomized clinical trial found that a standardized multimodal care transition intervention targeting 1386 higher-risk patients failed to decrease subsequent unplanned readmission or death.[35] In Boston

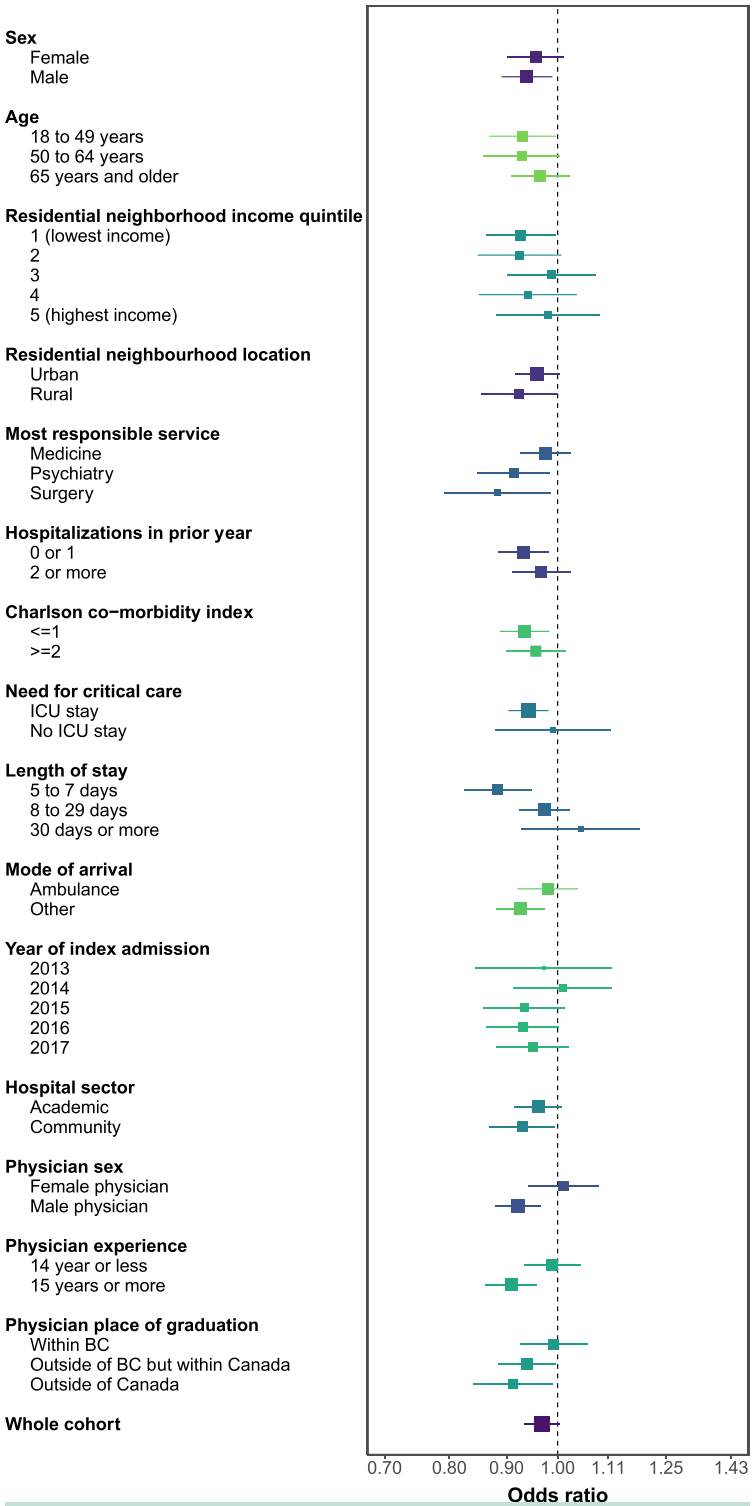

Figure 2 Forest plot of subgroup analysis results. Subgroup analyses generally yielded results similar to the main analysis. Squares depict adjusted odds ratio point estimate; square sizes, the inverse of the standard error; horizontal lines, the 95% confidence interval.

(USA), a cluster-randomized trial enrolling 1679 adults found that a multicomponent post-discharge intervention reduced adverse events but did not improve 30-day readmission risk.[36] A trial in Toronto (Canada) randomized 1923 high-risk patients and found that adding care coordination and multidisciplinary clinical support to usual care did not reduce the risk of readmission or death within 30 days.[37] A propensity-matched study of 9003 rural residents admitted

to one of eleven urban US Veterans Administration hospitals found that a multimodal discharge intervention facilitated by a trained transitions nurse did not change readmission risk.[38] However, this intervention reduced 30-day mortality by two-thirds, suggesting readmissions alone are an insufficient measure of health system performance. Two decades of research have similarly emphasized that advanced discharge planning, medication reconciliation, patient education, bridging interventions, strengthened communication between hospital- and community-based clinicians, and improved access to timely follow-up medical care can all improve patient outcomes.[6,7,39,40] Given the shortcomings we observed in postdischarge prescribing practices, these topics deserve ongoing attention.

Our study has many strengths. It is population-based, has a large sample size, spans a 5-year period, and uses objective data to evaluate process measures (markers of prescription quality), medical outcomes (readmissions, mortality), and costs. Our retrospective cohort design and detailed health services data allowed us to assess the effectiveness of the financial incentive at the patient level after accounting for patient-, physician-, and hospital-level confounders.

Our study also has limitations. First, there was no auditing of enhanced discharge planning tasks among G78717 claimants, so claims might have been submitted without task completion, and tasks might have been completed in the absence of a claim. Such exposure misclassification would bias our results toward the null. Second, although we used propensity weighting and adjustment to account for differences between exposed and unexposed patients, residual confounding may affect our results. Third, our study did not capture potentially relevant process measures such as physician-to-physician communication or time spent on discharge planning, which precluded us from identifying clear mechanistic explanations for our results. Fourth, our study focused on a specialist physician payment model in a single jurisdiction and may not be generalizable to other contexts.

Physician financial payments for enhanced discharge planning might achieve a number of worthwhile policy objectives including paying clinicians for essential but previously unremunerated work and reducing income disparities between procedure-focused and cognitive-focused clinical specialists. However, our findings suggest the G78717 incentive was not associated with improved patient outcomes or reduced direct healthcare costs.

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SUPPLEMENTARY DATA

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.amjmed.2024.04.042.

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Conflict of Interest: JAS has received clinical income from the incentive payment. As a co-funder of this work, the Specialist Services Committee might be perceived as having a political or financial interest in demonstrating the effectiveness of the fee code. As recipients of operational support from SSC for this project, JAS and JMS might be perceived as incentivized to produce findings that lend support to claims of the effectiveness of the fee code. All authors report no other competing interests.

Authorship: JAS, MK, DY, and JMS were responsible for study concept and design. JAS was responsible for acquisition of the data. JAS, MK, HN and DY drafted the manuscript. DY had full access to all study data was responsible for the integrity of the data and the accuracy of the data analysis. All authors were responsible for critical revision of the manuscript.

Data Availability: Access to data provided by the Data Stewards is subject to approval, but can be requested for research projects through the Data Stewards or their designated service providers. All inferences, opinions, and conclusions drawn are those of the authors and do not reflect the opinions or policies of the Data Stewards.

SUPPLEMENTS

Item S1: Published description of the $75 "Discharge Care Plan for Complex Patients" (G78717) fee code (2012)

This fee is intended to support clinical coordination leading to effective discharge and community-based management of complicated patients. It is to be billed for patients who require community support upon discharge and are otherwise at risk of readmission.

NOTES: For the purpose of creating and ensuring complex patients have a detailed care plan following discharge.

i) Payable to the Specialist Physician who is the MRP for the majority of the patient's in-hospital care and writes the care plan.
ii) Payable for the communication and clinical oversight of a patient care plan for complex patients.
iii) Primary care provider must be notified of admission by phone, fax, or electronic means within 24 hours for patients with an estimated length of stay greater than 4 days.
iv) Patient must be an admitted in-patient with length of stay greater than 4 days.
v) Not applicable for patients admitted for elective procedures.
vi) The written Discharge Care Plan must be completed and shared with:
    a) the patient at time of discharge, and
    b) the patient's primary health care provider within 24 hours of discharge.
vii) Care plan must:
    a) be developed in consultation with the providers identified in the plan, as necessary;
    b) include record of appropriate clinical information, interventions, co-morbidities and safety risks;
    c) include re-referral triggers and description of arranged follow-up care;
    d) include expectation of symptom progression / remission and patient progress;
    e) be included in the patient's medical record.
viii) Payable once per patient per discharge from hospital.
ix) Claim on the day of discharge.
x) Out-of-Office Hours Premiums may not be claimed in addition.
xi) Cannot be billed simultaneously with salary, sessional, or service contract arrangements.

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A subsequent revision of the fee code requirements on 1 November 2015 added a requirement that the patient have at least one of the following:

a) Multiple medical needs or complex co-morbidities (two or more distinct but potentially interacting problems) where care needs to be coordinated over a period of time between several health disciplines ...
b) Diagnosis of malignancy (excluding non-melanoma skin cancer) ...
c) One morbidity plus a minimum of one of the following non-medical conditions: poor socioeconomic status, unstable home environment, dependency on family/caregiver for daily living tasks, accessibility/mobility issues, under care of [Ministry of Children and Family Development] Protection Services, received Tertiary or Acute level of care related to psychiatric condition within the previous 6 months, frail elderly, >75 years old, BMI > 35 or high readmission rate.

A full description of all fee code revisions over the study interval is provided in the Supplemental Appendix to Staples *et al* JGIM 2021.[1]

Item S2: Data sources and missing data

We accessed de-identified individual-level longitudinal administrative health data on all BC residents through Population Data BC, a university-based data repository.[2] These data have been used extensively in prior research.

Hospital admission data were obtained from the Discharge Abstract Database (DAD).[3] Patient age, sex and vital status were established using the Consolidation and Vital Statistics files.[4,5] Residential neighbourhood socioeconomic status was estimated using Statistics Canada Income Band data.[6] Physician billing data were obtained from the BC Medical Service Plan (MSP).[7] Emergency department visit data were obtained from the National Ambulatory Care Reporting System (NACRS).[8] Prescription data were obtained from PharmaNet, a provincial database that captures all outpatient prescriptions filled in a community pharmacy in BC.[9] De-identified physician data were obtained from the College of Physicians and Surgeons of British Columbia.[10] Hospital-level data were obtained from publicly-available Canadian Institutes of Health Information data files.[11]

Missing data

Data on exposure (a G78717 fee code claim by a specialist physician) was available for all index hospitalizations through the MSP billing data. If there was no record of a G78717 claim, then we assumed the patient was unexposed. There was thus no missing data on exposure.

The primary medical outcomes (e.g., hospital admission, death) are highly complete provided they occurred in BC. If there was no record of a hospital admission or death, then we assumed these events did not occur. There was thus no missing data on outcome.

Data for most other model covariates were rarely missing because they were deemed present if identified in administrative data and were otherwise deemed absent. For example, a patient with a hospitalization for myocardial infarction in the year prior to index discharge would be identified as having myocardial infarction as a comorbidity. A patient that had no hospitalization or clinic visit in the 1-

year lookback interval with a diagnostic code for myocardial infarction would be identified as not having myocardial infarction as a comorbidity. No patient would be identified as having "missing" data for this variable.

Age was not missing for any patient. Sex was 'unknown' or missing for <0.02% hospitalizations. Neighbourhood income quintile was missing for 1.8% of hospitalizations. Rurality of residential neighbourhood was missing for 0.4% of hospitalizations. Missing values were coded as missing in all analyses.

The NACRS database record ~70% of all emergency department visits in BC. NACRS thus captures the majority of, but not all, the emergency department visits for our study cohort. We thus underestimate emergency department visits and costs. We have no reason to believe that there was differential ascertainment of emergency visits among G78717-exposed and unexposed patients. We acknowledge this as a limitation of our study and have interpreted our results accordingly.

Item S3: Study schematic

Item S4: A multi-level modeling approach is not necessary

We considered using a multi-level model where level 1 would be eligible hospitalizations, level 2 would be the Most Responsible Provider for each eligible hospitalization, and level 3 would be the hospital at which the eligible hospitalization occurred.

To evaluate whether a multilevel model was necessary, we calculated intra-class correlation (ICC) for the following three scenarios, using calculations suggested by Sommet et al:[12]

1. ICC for level 1 = patients, level 2 = physicians: 0.038
2. ICC for level 1 = patients, level 2 = hospitals: 0.013
3. ICC for level 1 = patients, level 2 = physicians, level 3 = hospitals: 0.034 and 0.007

Based on the calculated ICC values, less than 5% of the variation in readmission or death within 30 days of discharge was explained by between-physician or between-hospital differences. This indicated that a random-intercept multilevel model was not necessary. We decided to use a flat model for our analysis.

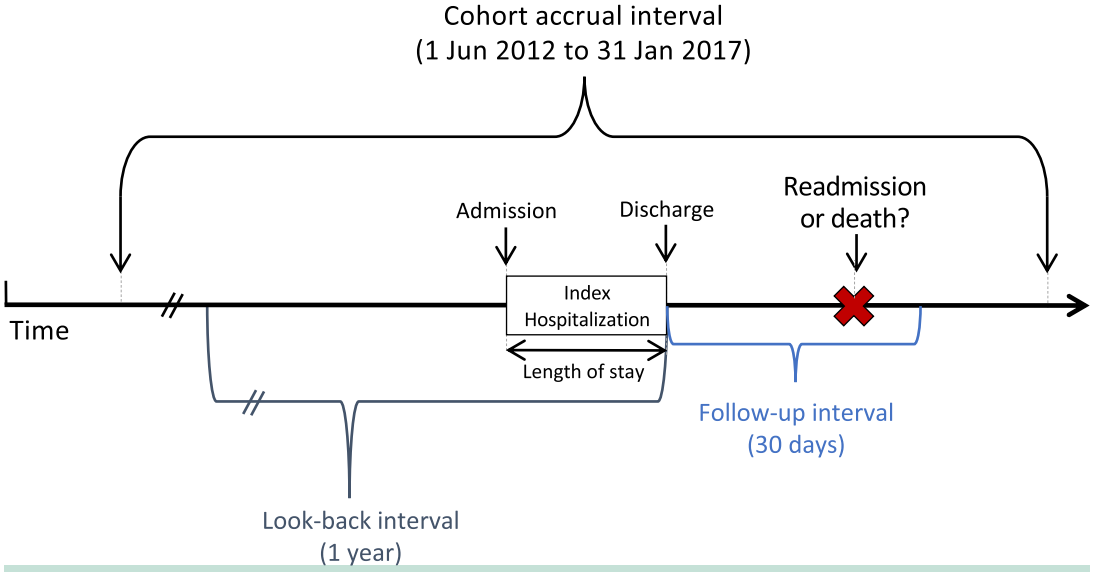

Figure: Index hospitalizations were eligible for inclusion if the index discharge date occurred between June 1, 2012 and January 31, 2017. A look-back interval extending 1 year prior to the index discharge date was used to identify hospitalizations, clinic visits, and comorbidities. A prescription medication look-back window of 90 days from index admission date was used to identify baseline prescription medications (not depicted here). Medical outcomes and costs were identified in the 30 days after index discharge date.

Item S5: Variables considered in the global model and variables backward selected for the reduced model

Variable	In reduced model for medical outcomes	In reduced model for cost outcomes
Patient characteristics		
Age	+	+
Sex	+	+
Neighbourhood household income		+
Neighbourhood population density		+
Number of days in hospital in prior year	+	+
Number of clinical visits in prior year	+	+
Charlson comorbidity score $\geq$2	+	+
Number of prescription medications	+	+
Baseline comorbidities		
Myocardial infarction		
Congestive heart failure	+	+
Peripheral vascular disease	+	+
Cerebrovascular disease	+	
Dementia		
Chronic pulmonary disease	+	
Connective tissue disease / rheumatic disease	+	
Peptic ulcer disease		
Diabetes without complications		
Diabetes with complications		
Paraplegia and hemiplegia		
Renal disease	+	+
Cancer	+	+
Mild liver disease	+	+
Moderate or severe liver disease	+	+
Metastatic cancer	+	+
HIV/AIDS	+	+
Psychiatric disease	+	+
Alcohol misuse	+	+
Drug misuse	+	+
Traumatic brain injury	+	
Seizure		+
Obstructive sleep apnea		
Baseline comorbidities (continued)		
Hypertension		+
Chronic ischemic heart disease		+
Unstable angina		
Ventricular tachycardia / ventricular fibrillation		+
Cardiac arrest		
Atrial fibrillation	+	+
Other arrhythmia		+
Syncope		
Implantable automated defibrillator	+	
Pacemaker	+	
Baseline medications		
Diuretics	+	+
ACE inhibitors and ARBs		+
Beta-blockers		
Calcium channel blocking agents		
Other antihypertensive agents		+
Combination antihypertensive agents		
Antiarrhythmic agents (Class I and III only)		
HMG-CoA reductase inhibitors (statins)	+	+
Anticoagulants		
Antiplatelet agents	+	

(*Continued*)

Variable	In reduced model for medical outcomes	In reduced model for cost outcomes
Oral hypoglycemic agents	+	+
Insulin	+	+
Proton pump inhibitors	+	+
H2 blocking agents	+	+
Hormonal contraceptive agents		
Thyroid supplementation		+
Osteoporosis treatments	+	
Benign prostatic hypertrophy treatments	+	+
Antidepressants	+	
Antipsychotic agents	+	+
Benzodiazepines	+	+
Non-benzo hypnotics	+	+
Anti-seizure medications		+
Alzheimer disease agents	+	+
Parkinson disease agents		+
Systemic antibacterials	+	+
Systemic corticosteroids	+	+
Immunosuppressants		+
Non-steroidal anti-inflammatories		+
Opioids	+	+
Opioid antagonist therapy		
Inhaled bronchodilators		+
Antineoplastic and immunomodulating agents		
Charateristics of the index hospitalization		
Arrival by ambulance	+	+
Admission via the emergency department	+	+
Most responsible service	+	+
Surgery	+	+
ICU stay	+	+
Alternate Level of Care days	+	
Total length of stay in hospitalization	+	+
Discharge disposition	+	+
Hospital size	+	+
Characteristics of the Most Responsible Provider		
Sex		
Year of birth		
Years since graduation	+	
Place of graduation	+	+

Within the weighted cohort, we compared the risk of the primary medical outcome in G78717-exposed and unexposed patients. We created a global model that included all potential confounders identified through literature review. We then used backward selection to develop a more parsimonious reduced model. We used the same global model variables and a separate backward selection procedure to develop the model for the primary cost outcome. We used the same model for the component cost outcomes.

Item S6: Analysis of post-discharge prescription medication fills

Medication group	Medications
Indicated medications after index hospitalization for cardiovascular disease (i.e. Most Responsible Diagnosis of acute coronary syndrome, heart failure, or chronic ischemic heart disease)	
Beta-blockers	Bisoprolol, Carvedilol, Metoprolol
Contraindicated (potentially inappropriate) medications after index hospitalization among patients aged ≥65 years	
Benzodiazepines	Alprazolam, Estazolam, Lorazepam, Oxazepam, Temazepam, Triazolam, Clorazepate, Chlordiazepoxide (alone or in combination with amitriptyline or clidinium), Clonazepam Diazepam, Flurazepam, Quazepam

(*Continued*)

Medication group	Medications
Non-benzodiazepine hypnotics	Meprobamate, Eszopiclone, Zolpidem, Zaleplon
Barbiturates	Amobarbital, Butabarbital, Butalbital, Mephobarbital, Pentobarbital, Phenobarbital, Secobarbital
Selected antidepressants	Amitriptyline, Amoxapine, Clomipramine, Desipramine, Imipramine, Nortriptyline, Paroxetine, Protriptyline, Trimipramine
Long-acting sulfonylureas	Chlorpropamide, Glyburide
Centrally acting alpha-2 agonists	Clonidine, Guanabenz, Guanfacine, Methyldopa
First generation anti-histamines	Brompheniramine, Carbinoxamine, Chlorpheniramine, Clemastine, Cyproheptadine, Dexbrompheniramine, Dexchlorpheniramine, Dimenhydrinate, Diphenhydramine (oral), Doxylamine, Hydroxyzine, Meclizine, Promethazine, Triprolidine
Antispasmodics	Atropine (excludes ophthalmic), Belladonna alkaloids, Clidinium-Chlordiazepoxide, Dicyclomine, Hyoscyamine, Propantheline, Scopolamine
Skeletal muscle relaxants	Carisoprodol, Chlorzoxazone, Cyclobenzaprine, Metaxalone, Methocarbamol, Orphenadrine

As a marker of prescription of indicated medications, we examined prescription fills for beta-blockers after index hospitalizations for cardiovascular disease. In this context, beta-blockers are Class I, II or III recommendations according to contemporary guidelines. This approach has been used as a measure of quality of care in a number of prior studies.[13]

As a marker of prescription of relatively contraindicated medications, we examined prescription fills for medications identified by the Beers criteria as potentially inappropriate for older adults.[27] We excluded peripheral alpha-1 blockers (because they are commonly and appropriately used to treat benign prostatic hypertrophy and the indication for prescription is not apparent from PharmaNet records), sliding scale insulin (because prescription fills may occur at irregular intervals depending on dose, and could thus be missed in the 90-day post-discharge prescription fill period) and non-steroidal anti-inflammatories (NSAIDS; because temporary use may be acceptable, because we were unable to distinguish appropriate acute use from inappropriate chronic use, and because many NSAIDS can be purchased without a prescription).

Item S7: Use of predictive mean matching to impute missing emergency department Resource Intensity Weights

In cost analyses of emergency department visits, Resource Intensity Weights (RIWs) were missing for some Comprehensive Ambulatory Classification System (CACS) codes. We used predictive mean matching (PMM) to multiply impute missing RIWs based on year, CACS age category (cacs_agecat), CACS ED partition (cacs_partition), and CACS code (cacs).[33] Major Ambulatory Classification (MAC) was not used as a predictor because mac = EV (emergency visit) for all index hospitalizations.

The PMM algorithm can be split into 7 steps[34,35]:

1. Estimate a linear regression model:
   - Use the variable we want to impute as Y, in our case RIW.
   - Use a set of good predictors as X: year, cacs_agecat, cacs_partition, and cacs.
   - Use only the observed values of X and Y to estimate the model.
2. Draw randomly from the posterior predictive distribution of $\widehat{\beta}$ and produce a new set of coefficients $\widehat{\beta}^*$.
   - Typically this would be a random draw from a multivariate normal distribution with mean $\widehat{\beta}$ and the estimated covariance matrix of $\widehat{\beta}$.
   - This step is needed to create some random variability in the imputed values.
3. Calculate predicted values for observed and missing Y.
   - Use $\widehat{\beta}$ to calculate predicted values for observed Y.
   - Use $\widehat{\beta}^*$ to calculate predicted values for missing Y.
4. For each case where Y is missing, find the closest predicted values among cases where Y is observed. For example:
   1. Y_i is missing, and its predicted value is 10 (based on $\widehat{\beta}^*$).
   2. Our data consists of ten observed cases of Y with the values 7, 2, 11, 9, 1, 6, 7, 3, 14, and 8.
   3. In step 3, we predicted the values 6, 3, 10, 8, 0, 5, 8, 2, 16, and 9 for these ten observed cases (based on $\widehat{\beta}$).
   4. Then we select the closest predicted values (typically five cases) to our missing value Y_i. Hence, the algorithm selects the values 6, 10, 8, 8, and 9 (the closest values to 10).
5. Draw randomly one of these five close cases and impute the missing value Y_i with the observed value of this close case.
   - Example continued:
     1. The algorithm draws randomly from 7, 11, 9, 7, and 8 (the observed values that correspond to the predicted values 6, 10, 8, 8, and 9).
     2. The algorithm chooses 9 and substitutes this value to Y_i.
6. Perform multiple imputation by repeating steps 1-5 five times.
   - Each repetition of steps 1-5 creates a new imputed data set.
7. Take the average of the five imputed values as the final value for the missing data.

Item S8: Key R packages used in the analysis

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Item S9: Love plot for the propensity score weighted study cohort

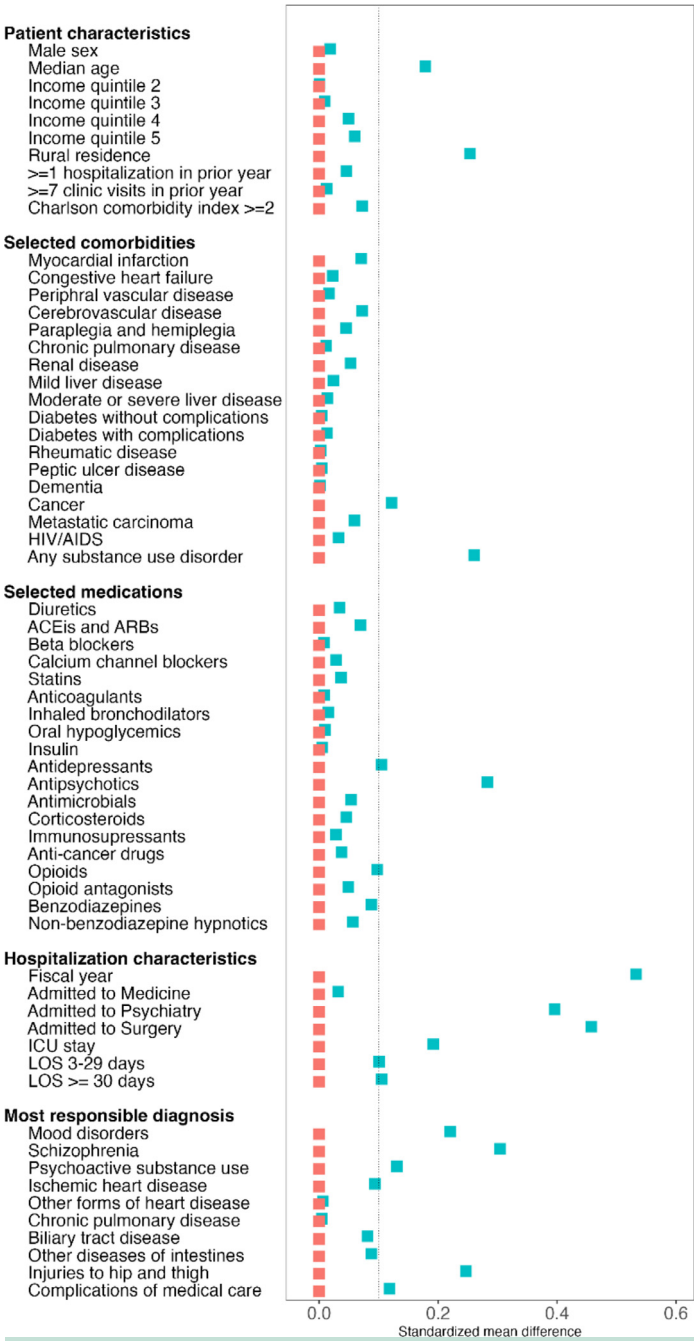

Figure: Love plot for the propensity score weighted study cohort. X-axis depicts the absolute standardized mean difference (SMD), a measure of distance between covariate means in G78717-exposed and G78717-unexposed patients. SMDs close to zero indicate good balance (i.e., the variable has a similar frequency in both groups); SMDs >0.1 indicate poor balance (i.e., there is a substantial difference in variable frequency between the groups). Y-axis depicts key characteristics of the cohort. Blue squares depict SMD for the unweighted study population; red squares depict SMD for the weighted study cohort. Main finding is that weighting drastically improved balance. We addressed remaining imbalances through adjustment.

Item S10: Subgroup analyses

Subgroup analyses	Patients with G78717 claim n=24,787 (%)	Patients without G78717 claim n=136,541 (%)	Unadjusted model OR, 95% CI, p-value	Adjusted model OR, 95% CI, p-value
Sex				
Male	13,498 (54.5)	73,091 (53.5)	0.957, (0.912, 1.004), 0.202	0.939, (0.891, 0.989), 0.095
Female	11,285 (45.5)	63,425 (46.5)	0.980, (0.929, 1.033), 0.591	0.956, (0.901, 1.014), 0.285
Age				
18-49 years	9339 (37.7)	40,524 (29.7)	0.968, (0.909, 1.030), 0.465	0.930, (0.868, 0.997), 0.144
50-64 years	6220 (25.1)	36,299 (26.6)	0.940, (0.875, 1.009), 0.226	0.928, (0.858, 1.004), 0.190
≥65 years	9228 (37.2)	59,718 (43.7)	0.980, (0.928, 1.035), 0.612	0.965, (0.908, 1.025), 0.414
Neighborhood household income				
First (lowest)	7732 (31.8)	36,891 (27.5)	0.965, (0.905, 1.029), 0.439	0.927, (0.863, 0.996), 0.140
Second	5084 (20.9)	28,030 (20.9)	0.947, (0.876, 1.024), 0.332	0.924, (0.848, 1.008), 0.206
Third	4502 (18.5)	25,285 (18.9)	0.994, (0.915, 1.079), 0.919	0.987, (0.901, 1.081), 0.847
Fourth	3731 (15.3)	23,012 (17.2)	0.959, (0.875, 1.050), 0.521	0.940, (0.849, 1.040), 0.399
Fifth (highest)	3277 (13.5)	20,909 (15.6)	0.981, (0.890, 1.080), 0.780	0.980, (0.881, 1.090), 0.792
Residential neighbourhood				
Urban	18,753 (75.8)	87,281 (64.2)	0.982, (0.943, 1.023), 0.541	0.959, (0.916, 1.004), 0.201
Rural	5984 (24.2)	48,689 (35.8)	0.925, (0.861, 0.993), 0.122	0.923, (0.854, 0.998), 0.153
Most responsible service				
Medicine	12,827 (51.7)	68,489 (50.2)	0.972, (0.928, 1.019), 0.401	0.975, (0.925, 1.026), 0.490
Psychiatry	8839 (35.7)	25,141 (18.4)	0.979, (0.916, 1.046), 0.656	0.914, (0.848, 0.984), 0.089
Surgery	3089 (12.5)	42,091 (30.8)	0.912, (0.824, 1.009), 0.201	0.883, (0.791, 0.986), 0.119
Others	32 (0.1)	820 (0.6)	1.232, (0.555, 2.734), 0.723	4.360, (0.763, 24.925), 0.431
Hospitalizations in prior year				
≤1	16,703 (67.4)	93,645 (68.6)	0.962, (0.917, 1.009), 0.260	0.933, (0.886, 0.983), 0.064
≥2	8084 (32.6)	42,896 (31.4)	0.985, (0.932, 1.041), 0.700	0.966, (0.910, 1.026), 0.427
Charlson Co-morbidity Index				
≤1	17,098 (69)	89,553 (65.6)	0.970, (0.926, 1.017), 0.368	0.934, (0.888, 0.983), 0.063
≥2	7689 (31)	46,988 (34.4)	0.961, (0.908, 1.016), 0.319	0.956, (0.899, 1.017), 0.313
ICU stay				
Yes	2408 (9.7)	22,006 (16.1)	0.958, (0.860, 1.067), 0.577	0.991, (0.880, 1.115), 0.913
No	22,379 (90.3)	114,535 (83.9)	0.968, (0.932, 1.005), 0.231	0.942, (0.903, 0.982), 0.044
Length of stay				
5 to 7 days	7943 (32)	54,865 (40.2)	0.947, (0.890, 1.007), 0.217	0.883, (0.824, 0.947), 0.013
8 to 29 days	14,013 (56.5)	70,341 (51.5)	0.971, (0.926, 1.018), 0.384	0.973, (0.924, 1.025), 0.471
≥30 days	2831 (11.4)	11,335 (8.3)	1.012, (0.907, 1.129), 0.882	1.048, (0.927, 1.185), 0.592
Arrival by ambulance				
Yes	9137 (36.9)	50,320 (36.9)	0.989, (0.934, 1.047), 0.785	0.980, (0.920, 1.043), 0.652
No	15,650 (63.1)	86,221 (63.1)	0.953, (0.911, 0.998), 0.143	0.927, (0.881, 0.974), 0.035
Year of index admission				
FY 2012-2013	1770 (7.1)	25,733 (18.8)	1.031, (0.915, 1.163), 0.722	0.972, (0.845, 1.119), 0.776
FY 2013-2014	3299 (13.3)	31,050 (22.7)	1.047, (0.957, 1.146), 0.477	1.011, (0.913, 1.119), 0.882
FY 2014-2015	5134 (20.7)	29,707 (21.8)	0.975, (0.904, 1.053), 0.652	0.933, (0.858, 1.016), 0.260
FY 2015-2016	7043 (28.4)	27,811 (20.4)	0.929, (0.868, 0.994), 0.135	0.931, (0.864, 1.003), 0.187
FY 2016-2017	7541 (30.4)	22,240 (16.3)	0.937, (0.876, 1.003), 0.180	0.950, (0.882, 1.023), 0.335
Index hospital sector				
Academic	15,064 (62.7)	79,906 (60.5)	0.992, (0.949, 1.038), 0.813	0.961, (0.915, 1.009), 0.260
Community	8966 (37.3)	52,141 (39.5)	0.901, (0.848, 0.958), 0.017	0.929, (0.869, 0.994), 0.129
Most Responsible Provider (MRP) characteristics				
Physician sex				
Male	16,316 (69.6)	97,471 (77.8)	0.956, (0.915, 0.999), 0.154	0.921, (0.879, 0.965), 0.014
Female	7132 (30.4)	27,873 (22.2)	0.996, (0.931, 1.065), 0.932	1.012, (0.941, 1.089), 0.814
Physician experience				
Few (<15 years)	10,650 (45.4)	40,003 (31.9)	1.021, (0.967, 1.078), 0.596	0.989, (0.934, 1.048), 0.795

(*Continued*)

Subgroup analyses	Patients with G78717 claim n=24,787 (%)	Patients without G78717 claim n=136,541 (%)	Unadjusted model OR, 95% CI, p-value	Adjusted model OR, 95% CI, p-value
Many (≥15 years)	12,798 (54.6)	85,331 (68.1)	0.926, (0.881, 0.973), 0.031	0.909, (0.862, 0.959), 0.013
Physician place of graduation				
UBC	7420 (32.9)	31,876 (26.2)	0.996, (0.933, 1.063), 0.926	0.992, (0.925, 1.063), 0.868
Other Canadian university	9557 (42.3)	59,797 (49.1)	0.934, (0.883, 0.988), 0.093	0.938, (0.884, 0.996), 0.136
Foreign	5604 (24.8)	30,183 (24.8)	0.960, (0.888, 1.037), 0.458	0.912, (0.841, 0.990), 0.123

Main finding is that results are fairly consistent among all tested subgroups. Subgroup analyses are exploratory, but we found that exposure to G78717 was associated with a reduced risk of readmission or death within 30 days among patients with a shorter length of stay (5-7 days), and among hospitalizations with a physician who was male or who had ≥15 years of clinical experience. The latter might suggest that male physicians and older physicians are more susceptible to the G78717 financial incentive, or that these physicians had more opportunity to improve outcomes compared to baseline performance. For subgroup analyses, the models were propensity score weighted and adjusted by the same set of variables as for the primary analysis.

Item S11: Sensitivity analyses

Analysis	Patients with G78717 claim, outcome / eligible (%)	Patients without G78717 claim, outcome / eligible (%)	Unadjusted model Odds ratio, (95% CI), p-value	Adjusted model Odds ratio, (95% CI), p-value
Alternate follow-up intervals				
14 days	3286 / 24,787 (13.3)	17,686 / 136,541 (13.0)	0.95, (0.91, 1.00), 0.126	0.96, (0.92, 1.00), 0.162
90 days	9142 / 24,787 (36.9)	49,278 / 136,541 (36.1)	0.98, (0.95, 1.01), 0.370	0.98, (0.95, 1.01), 0.437
365 days	14,400 / 24,787 (58.1)	80,187 / 136,541 (58.7)	0.99, (0.96, 1.02), 0.544	0.99, (0.96, 1.02), 0.545
Alternate analytic approach				
Regression model on cohort data without propensity score weighting	5262 / 24,787 (21.2)	28,096 / 136,541 (20.6)	1.04, (1.01, 1.08), 0.020	0.97, (0.94, 1.00), 0.075
Alternate unit of analysis				
Cohort with patient as unit of analysis (one randomly selected eligible hospitalization per individual)	2915 / 17,040 (17.1)	17,719 / 104,132 (17.0)	0.97, (0.93, 1.02), 0.365	0.97, (0.93, 1.02), 0.414
Cohort with 'episode of care' as the unit of analysis (joins hospitalizations linked by transfer instead of excluding hospitalizations beginning or ending in transfer)	2242 / 24,787 (9.0)	12,069 / 163,137 (7.4)	1.02, (0.97, 1.07), 0.563	0.89, (0.76, 1.03), 0.262

For sensitivity analyses, the models were propensity score weighted and adjusted by the same set of variables as for the primary analysis.

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