



Original Article

Despite Having Worse Risk Profiles, Northern Albertans Wait Longer for Specialist Follow-up After Emergency Department Visits for Atrial Fibrillation

Brian H. Rowe, MD, MSc,^{a,b,c,d} Finlay A. McAlister, MD, MSc,^{d,e} Michelle M. Graham, MD,^e
Brian R. Holroyd, MD, MBA,^{a,d} and Rhonda J. Rosychuk, PhD^{f,g}

^aDepartment of Emergency Medicine, University of Alberta, Edmonton, Alberta, Canada

^bSchool of Public Health, University of Alberta, Edmonton, Alberta, Canada

^cInstitute of Circulatory and Respiratory Health, Canadian Institutes of Health Research, Ottawa, Ontario, Canada

^dAlberta Health Services, Edmonton, Alberta, Canada

^eDepartment of Medicine, University of Alberta, Edmonton, Alberta, Canada

^fDepartment of Pediatrics, University of Alberta, Edmonton, Alberta, Canada

^gWomen & Children's Health Research Institute, Edmonton, Alberta, Canada

ABSTRACT

Background: Atrial fibrillation and flutter (AFF) are common arrhythmias diagnosed in the emergency department (ED), and prompt follow-up with specialists may yield better outcomes. This study examines time to first specialist outpatient visit following ED discharge for AFF. **Methods:** Alberta residents aged ≥ 35 years with ED presentations for AFF ending in discharge during 2017-2018 were extracted and linked with hospitalizations and physician claims. A spatial scan and multinomial logistic regression were performed. Regression model predictors included demographics, prior diagnoses, and prior health service use.

Results: ED presentations for 4387 patients (54% male; mean age 68 years) were analyzed. Two geographic areas were identified as clusters that had longer times than would be expected by chance: a north

RÉSUMÉ

Contexte : La fibrillation auriculaire (FA) et le flutter auriculaire sont des troubles arythmiques couramment diagnostiqués dans les services des urgences, et un suivi rapide par un spécialiste pourrait améliorer les résultats pour le patient. La présente étude examine l'intervalle entre le moment où le patient atteint de FA ou de flutter auriculaire obtient son congé du service des urgences et celui de la première consultation externe auprès d'un spécialiste.

Méthodologie : Les dossiers des patients albertains âgés de 35 ans ou plus qui se sont présentés au service des urgences pour cause de FA ou de flutter auriculaire et qui ont reçu leur congé en 2017-2018 ont été extraits et couplés aux données de facturation des hôpitaux et des médecins. Une analyse spatiale et une régression logistique multinomiale ont ensuite été réalisées. Le modèle de régression

Atrial fibrillation and flutter (AFF) are 2 of the most common arrhythmias seen in the emergency department (ED). Although the majority of patients with AFF seen in Canadian EDs are managed without the need for hospitalization, given its high frequency of recurrence, complications (eg, heart failure or stroke), investigations, and health service utilization (eg, primary care visits, consultations, hospitalization), AFF represents

a costly health care problem.¹ Moreover, studies have shown that prompt follow-up with specialists improves outcomes for patients with AFF,²⁻⁴ and thus it is frequently requested for AFF patients after an ED discharge. Finally, primary care coverage for patients seen in the ED has been shown to be deficient in many parts of Canada,^{5,6} and delayed in chronic diseases,^{7,8} so specialist referrals for follow-up are critically important for transitions in care for patients with AFF.

The aim of this study was to examine whether time to first specialist (cardiology or internal medicine) outpatient visit after discharge from the ED for an AFF presentation differed by geographic region in the province of Alberta, within a health care system with universal access and a single provincial health authority. Further, we aimed to determine variables that are associated with longer wait times to see a specialist.

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Ethics Statement: The present research has adhered to the relevant ethical guidelines.

Corresponding author: Rhonda J. Rosychuk, PhD, Department of Pediatrics, University of Alberta, 11405 87 Avenue NW, Edmonton, Alberta T6G 1C9, Canada. Tel.: +1-780-492-0318.

E-mail: rhonda.rosychuk@ualberta.ca

See page 617 for disclosure information.

cluster of northern areas with an estimated median time of 98 days (95% confidence interval [CI] 82,139), and an east cluster of eastern areas with a median of 57 days (95% CI 47, 68). Patients in the north cluster were more likely to be younger (adjusted odds ratio [aOR] = 0.76 per 5 years, 95% CI 0.62, 0.93) and have prior histories of AFF (aOR = 1.45, 95% CI 1.11, 1.90), congestive heart failure (aOR=1.51, 95% CI 1.15, 1.98), chronic obstructive pulmonary disease (aOR = 2.03, 95% CI 1.55, 2.65), and diabetes (aOR = 1.30, 95% CI 1.00, 1.67). They were less likely to have prior general practitioner outpatient visits (aOR = 0.65 per 5 visits, 95% CI 0.53, 0.81) and specialist outpatient visits (aOR = 0.39, 95% CI 0.30, 0.50) than other patients. **Conclusions:** Despite being at higher risk, patients in northern areas took longer to see a specialist after an ED presentation for AFF than those from other regions. Innovative strategies for promoting specialist follow-up should be explored.

Methods

Study design

This retrospective cohort study used population-based administrative health databases in the province of Alberta, Canada. ED presentations with a most responsible diagnosis of AFF that ended in discharge directly from any of the 104 Alberta EDs from April 1, 2017, to March 31, 2018, were extracted for all Alberta residents aged ≥ 35 years. We focused on patients aged ≥ 35 years because events in the younger adult age group are infrequent and may differ in cause (eg, drug use, alcohol use, and exercise), and the risks of adverse outcomes are generally exceedingly low compared to those for older adults.

Study setting and population

Residents of Alberta have universal access to health care through a uniform, single-payer health system, without user fees at the point of service. This government-funded health plan maintains health databases as part of its activities. Emergency care is delivered in publicly funded hospitals, representing a wide range of settings varying from large, urban cities to small, remote, rural communities. Most urban and regional hospitals have high patient volumes and are staffed by full-time emergency physicians, whereas almost all rural hospitals have lower patient volumes and are staffed primarily by on-call primary care physicians.

Multiple databases⁹ were used for the data extraction: the National Ambulatory Care Records System for ED presentations; the Alberta Health Care Insurance Plan cumulative registry file for population counts and demographic data; the Physician Claims File for physician visits (called follow-up

comprendait les facteurs de prédiction suivants : caractéristiques démographiques des patients, diagnostics antérieurs et utilisation antérieure des services de santé.

Résultats : Les dossiers de consultation au service des urgences de 4 387 patients (proportion d'hommes : 54 % ; âge moyen : 68 ans) ont été analysés. Deux zones géographiques sont ressorties comme des grappes où l'intervalle était plus long que celui auquel on pourrait s'attendre du fait du hasard, soit une grappe de régions du nord où le temps d'attente médian a été estimé à 98 jours (intervalle de confiance [IC] à 95 % : de 82 à 139), et une grappe de régions de l'est où le temps d'attente médian a été estimé à 57 jours (IC à 95 % : de 47 à 68). Les patients de la grappe nord étaient plus susceptibles d'être plus jeunes (risque relatif approché corrigé [RRAc] = 0,76 par tranche de 5 ans; IC à 95 % : de 0,62 à 0,93) et d'avoir des antécédents de FA ou de flutter auriculaire (RRAc = 1,45; IC à 95 % : de 1,11 à 1,90), d'insuffisance cardiaque congestive (RRAc = 1,51; IC à 95 % : de 1,15 à 1,98), de maladie pulmonaire obstructive chronique (RRAc = 2,03; IC à 95 % : de 1,55 à 2,65) et de diabète (RRAc = 1,30; IC à 95 % : de 1,00 à 1,67). Ils étaient moins susceptibles que les autres patients d'avoir déjà consulté en externe un omnipraticien (RRAc = 0,65 par tranche de 5 visites; IC à 95 % : de 0,53 à 0,81) et un spécialiste (RRAc = 0,39; IC à 95 % : de 0,30 à 0,50).

Conclusions : Malgré le fait qu'ils soient exposés à un risque plus élevé, les patients de la grappe nord ont attendu plus longtemps que ceux des autres régions avant de consulter un spécialiste après s'être présentés au service des urgences pour cause de FA ou de flutter auriculaire. Il conviendrait d'explorer de nouvelles stratégies pour promouvoir l'importance du suivi par un spécialiste.

visits when they occurred in an outpatient setting after the ED presentation and excluding inpatient visits); the Discharge Abstract Database for hospitalization data; and Alberta Vital Statistics for data on deaths.

Trained and supervised medical records nosologists, using a uniform protocol, code each chart using the Canadian Enhancement of International Classification of Diseases, 10th revision (ICD-10-CA)¹⁰ diagnostic codes (since 2002). Each record represents a unique service and contains a unique identifier for each Albertan. The Alberta Health Care Insurance Plan file includes all persons registered in the plan (99% of the provincial population). The Physician Claims File provides data on the date of follow-up visit and has 3 diagnosis fields recording International Classification of Diseases, 9th revision—Clinical Modification¹¹ codes as entered by physicians or their billing agents. The Discharge Abstract Database provides data on hospitalizations and has up to 25 diagnosis fields using ICD-10-CA codes.

Study protocol

The National Ambulatory Care Records System database has a main diagnosis field and 9 (ICD-10-CA) additional fields to capture diagnosis data. To be considered an AFF presentation, the first diagnosis field had to have diagnostic codes ICD-10 I48.x (Atrial Fibrillation or Flutter).¹² All ED presentations for AFF made by individuals aged ≥ 35 years during April 1, 2017, to March 31, 2018, were extracted, and the ED presentations with a disposition recorded as discharged were retained. A case was defined as an individual with at least one ED presentation for AFF that ended in discharge from the ED during the study period and who was

an Alberta resident in the year of the ED presentation and the 2 prior years (to enable prior histories to be determined).

Alberta's provincial health ministry, Alberta Health, has divided the province into 5 health zones (North, Edmonton, Central, Calgary, and South) for administrative purposes, and 70 areas for geographic analyses. Alberta Health provided data geo-coded to the 70 areas, as well as latitudes and longitudes for each area's population-based centroid. As of March 31, 2018, Alberta had 2,496,546 residents aged ≥ 35 years, and the areas had diverse population sizes ranging from 3211 to 95,548, with a median of 31,481.

Variables collected from the ED presentations included sex, age in years, area of residence at fiscal year-end, triage level using the Canadian Triage and Acuity Scale (CTAS),¹³ and ED length of stay. All follow-up visits to October 31, 2018, were extracted. Data included the date of the visit and the specialty of the physician. To be considered a specialist outpatient visit, the visit had to occur on a date when the patient was an outpatient (ie, not during ED or inpatient periods), and the physician specialty had to be either cardiology or internal medicine. In addition, physician visits and hospitalizations in the 2 years prior to the ED presentations for AFF were also extracted to determine whether there was a prior history of AFF and consultation. All diagnosis fields from the prior physician visits and hospitalizations were also used to determine comorbidities according to a standard coding scheme and to calculate the Charlson Comorbidity Index based on the Deyo International Classification of Diseases, 9th revision—Clinical Modification coding scheme.¹² The University of Alberta Health Research Ethics Board approved this study prior to data extraction (#Pro00084099).

Data analysis

If a patient had more than one ED presentation for AFF that resulted in discharge, the last ED visit was used as the index visit. The time to first specialist outpatient visit was defined as the number of days between the ED visit end date and the first specialist outpatient visit. Data were censored if: (i) the first specialist claim occurred during an inpatient period (censored at the start of the inpatient period); (ii) a specialist outpatient visit did not occur before a patient died (censored at date of death); or (iii) a specialist outpatient visit did not occur before October 31, 2018 (if patient had a follow-up visit then data were censored at the last follow-up visit date; if no follow-up visit occurred, then data were censored at the end of the vital statistics data March 31, 2018).

Numerical summaries (eg, frequency, percentage, median, standard deviation, interquartile range [IQR] represented as 25th percentile, 75th percentile) describe the characteristics of the patient, and Kaplan-Meier estimates provide the median and 95% confidence intervals (CIs) for the time to first specialist outpatient visit. The spatial scan statistic with the exponential distribution¹⁴ and a maximum space window radius of 30% of the cases was used to identify aggregated geographic areas with longer-than-expected times to first specialist visit. These aggregated areas are termed clusters, and patients reside either inside the clusters or outside the clusters. Identified clusters had to be non-overlapping, with $P < 0.05$. The area of residence was the geographic unit of analysis. χ^2 tests and χ^2 tests compared characteristics of patients inside

and outside the clusters. Multinomial logistic regression analysis was conducted to assess predictors of the odds of a patient being in a cluster. The predictors were selected based on available data and author discussion. Predictors included age, sex, comorbidity score, prior history of a hospitalization, prior history of a hospitalization for which diagnoses included the following: AFF; prior history of an ED presentation; prior history of an ED presentation with a main diagnosis of AFF; prior history of AFF in physician claims; prior history of key medical conditions (eg, chronic obstructive pulmonary disease [COPD] defined by ICD-9 codes 490.x, 491.x, 492.x, 494.x, and 496.x; hypertension defined by codes 401.x, 402.x, 403.x, 404.x, and 405.x; other diagnoses defined in the Charlson index); number of prior general practitioner (GP) outpatient visits; prior history of specialist outpatient visit; and prior history of a specialist outpatient visit for diagnoses that included AFF. A prior history was considered to be within the 2 years prior to the ED presentation. Variables were removed from the full model to determine a reduced model using stepwise model selection by the Akaike Information Criterion.¹⁵ $P < 0.05$ was considered to be statistically significant. Odds ratios (ORs) and associated 95% confidence intervals (CIs) were reported. Data were analyzed using R¹⁶ and multiple packages including ggmap,¹⁷ icd,¹⁸ and rsatscan,¹⁹ which calls SatScan²⁰ for the cluster-detection analyses.

Results

During fiscal year 2017-2018, there were 8304 presentations for AFF made by individuals aged ≥ 35 years to Alberta EDs. A total of 5999 ED presentations for AFF were made by 4387 Alberta residents aged ≥ 35 years who had lived in the province during April 1, 2015, to March 31, 2018. By selecting the last ED visit for AFF per patient, 4387 patients and their last ED visits formed the cases for analyses.

The mean age of patients was 68.4 years (median = 69, standard deviation = 13.5); 63.0% (2,764) were aged ≥ 65 years, and 54.2% were men (Table 1). The majority of patients were from the urban health zones of Edmonton (30.1%) and Calgary (33.7%); only 19.4% (849) were considered to be rural. The vast majority of the ED presentations had CTAS 2-emergency (1863; 42.5%) and CTAS 3-urgent (2005; 45.7%) severity, whereas only 0.2% (10) were CTAS 1-resuscitation. The median length of stay in the ED was 4 hours, 17 minutes (IQR: 2 hours 42 minutes, 6 hours 28 minutes).

Based on all diagnoses from physician visits and hospitalizations in the 2 years prior to the ED presentation for AFF, the median Charlson comorbidity score was 1 (IQR 0, 2). About 34% (1470) of patients had had a prior hospitalization for any reason, and 19.9% (873) of the hospitalizations had diagnoses that included AFF. The majority of patients had had prior physician claims for AFF (54.7%) or hypertension (58.4%). Patients had an average of 18.1 outpatient visits in the prior 2 years to a general practitioner, and 28.1% (1232) of patients had specialist outpatient visits with diagnoses including AFF.

There were 3214 (73.2%) patients who had a specialist outpatient visit after presenting to the ED for AFF and being discharged. The median time to first specialist outpatient visit was 27.5 days (IQR 10, 68). The estimated median time to

Table 1. Characteristics of AFF cases for the province and based on residence inside and outside the identified clusters in 2017-2018

Characteristic	Patient residence area								P
	All patients (n = 4387)		North cluster (n = 432)		East cluster (n = 466)		Outside clusters (n = 3489)		
Sex									0.008
Female	2010	(45.8)	168	(38.9)	211	(45.3)	1631	(46.7)	
Male	2377	(54.2)	264	(61.1)	255	(54.7)	1858	(53.3)	
Age at ED presentation									
Mean (SD)	68.4	(13.5)	66.8	(13.1)	70.1	(12.7)	68.4	(13.6)	0.001
Median (IQR)	69	(59, 78)	67.5	(58, 76)	72	(62, 79)	69	(59, 79)	
Rural	849	(19.4)	255	(59.0)	225	(48.3)	369	(10.6)	< 0.001
Health zone									< 0.001
North	568	(12.9)	432	(100.0)			136	(3.9)	
Edmonton	1323	(30.2)					1323	(37.9)	
Central	576	(13.1)			439	(94.2)	137	(3.9)	
Calgary	1479	(33.7)					1479	(42.4)	
South	441	(10.1)			27	(5.8)	414	(11.9)	
Comorbidity score									
Mean (SD)	1.3	(1.8)	1.5	(1.9)	1.3	(1.6)	1.3	(1.8)	0.070
Median (IQR)	1	(0, 2)	1	(0, 2)	1	(0, 2)	1	(0, 2)	
Hospitalization in prior 2 years, n %	1470	(33.5)	166	(38.4)	200	(42.9)	1104	(31.6)	< 0.001
Diagnoses included AFF	873	(19.9)	115	(26.6)	134	(28.8)	624	(17.9)	< 0.001
ED presentation in prior 2 years	3406	(77.6)	382	(88.4)	377	(80.9)	2647	(75.9)	< 0.001
Main diagnosis for AFF	1653	(37.7)	185	(42.8)	176	(37.8)	1292	(37.0)	0.064
Physician claim in prior 2 years, with diagnoses including:									
AFF	2400	(54.7)	267	(61.8)	266	(57.1)	1867	(53.5)	0.003
MI	254	(5.8)	33	(7.6)	37	(7.9)	184	(5.3)	0.015
CHF	770	(17.6)	102	(23.6)	99	(21.2)	569	(16.3)	<0.001
Stroke	291	(6.6)	27	(6.2)	35	(7.5)	229	(6.6)	0.701
COPD	617	(14.1)	95	(22.0)	67	(14.4)	455	(13.0)	<0.001
Diabetes	820	(18.7)	95	(22.0)	79	(17.0)	646	(18.5)	0.129
Hypertension	2564	(58.4)	255	(59.0)	281	(60.3)	2028	(58.1)	0.648
Renal disease	317	(7.2)	27	(6.2)	25	(5.4)	265	(7.6)	0.155
GP outpatient visits in prior 2 years									
Mean (SD)	18.1	(15.9)	16	(13.1)	16.9	(13.9)	18.5	(16.4)	0.002
Median (IQR)	14	(8, 23)	12	(7.8, 21)	13	(9, 21)	14	(8, 24)	
Specialist outpatient visit in prior 2 years,	3158	(72.0)	265	(61.3)	289	(62.0)	2604	(74.6)	< 0.001
diagnoses included AFF	1232	(28.1)	124	(28.7)	101	(21.7)	1007	(28.9)	0.005

Values are n (%), unless otherwise indicated.

AFF, atrial fibrillation or flutter; ED, emergency department; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disorder; GP, general practitioner; IQR, interquartile range; MI, myocardial infarction; SD, standard deviation.

first specialist outpatient visit was 42 days (95% CI 43, 50 days), when all patients with non-censored and censored times were included.

The exponential spatial scan identified 2 statistically significant clusters at the 5% level: one in the north and one in the east. The north cluster ($P = 0.001$; Fig. 1) had 432 patients (269 [62.3%] had a specialist outpatient visit) and was comprised of northern areas that are primarily rural. Patients in the north cluster had longer median times to specialist outpatient visit than patients living outside the cluster (98 days, 95% CI 82, 139 vs 42 days, 95% CI 39, 45; Fig. 2). The east cluster ($P = 0.002$) had 466 patients (306 [65.7%] had a specialist outpatient visit). These patients also had longer median times to specialist outpatient visit than did patients living outside the clusters (57 days, 95% CI 47, 68).

Patients residing inside and outside the clusters had different characteristics (Table 1)—notably, patients in the clusters with longer wait times were more likely to be male, have prior histories of hospitalization and ED presentations, and have prior histories of physician claims for AFF, myocardial infarction, congestive heart failure, and COPD

than the rest of the province. Patients in the long wait time clusters had fewer GP outpatient visits in the prior 2 years and were less likely to have a prior specialist outpatient visit in the prior 2 years than did patients residing outside the clusters.

When multivariable multinomial logistic regression was considered, the odds of being in the north cluster compared to the odds of being outside the clusters, and the odds of being in the east cluster compared to the odds of being outside the clusters, are estimated based on predictors (Table 2). In the full model, patients residing in the north and east clusters differed in many of the same ways from the patients who resided outside the clusters.

When the model was reduced to the key predictors (Table 2; Fig. 3), patients in the clusters were more likely to have had a hospitalization in the prior 2 years for which diagnoses included AFF (north cluster: OR = 1.32, 95% CI: 1.01, 1.73; east cluster: OR = 1.85, 95% CI: 1.43, 2.40), and more likely to have had a physician claim in the prior 2 years that included an AFF diagnosis (north cluster: OR = 1.45, 95% CI: 1.11, 1.90; east cluster: OR = 1.32, 95% CI: 1.03, 1.71) than patients who resided outside the clusters. The

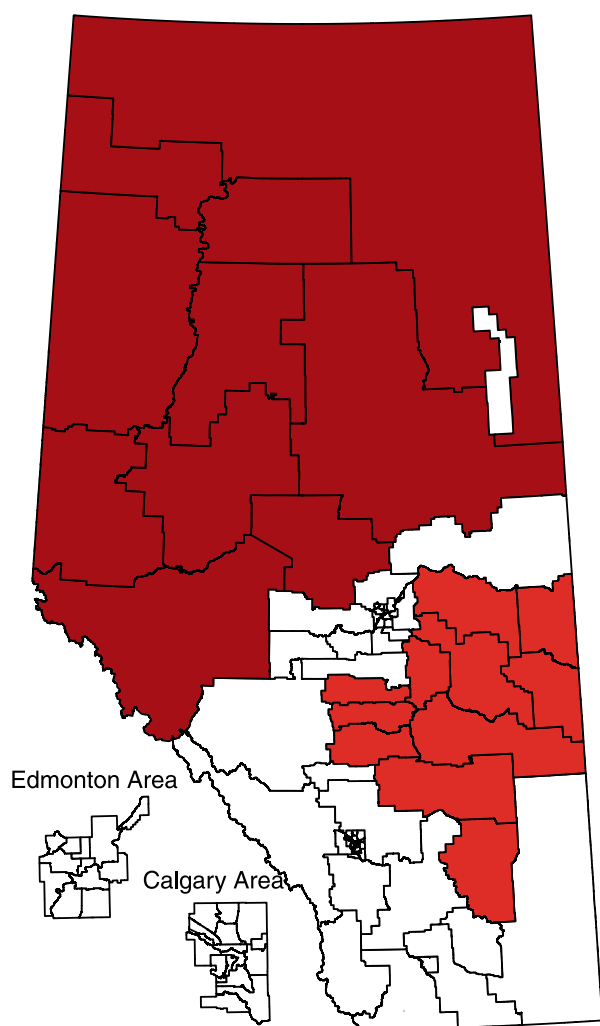


Figure 1. The north cluster (dark shaded) and east cluster (light shaded) identified with longer time to first specialist outpatient visit after emergency department discharge for atrial fibrillation or flutter in 2017-2018 than patients from the rest of the province. Insets show the urban areas of Edmonton and Calgary.

patients in the clusters also had fewer GP outpatient visits (north cluster: OR per 5 = 0.65, 95% CI: 0.53, 0.81; east cluster: OR per 5 = 0.76, 95% CI: 0.63, 0.91) and were less likely to have had a prior specialist outpatient visit (north cluster: OR = 0.39, 95% CI: 0.30, 0.50; east cluster 2: OR = 0.54, 95% CI: 0.43, 0.68) than patients who resided outside the clusters. For prior specialist outpatient visits where an AFF diagnosis was included, only patients in the east cluster differed from patients who resided outside the clusters by being less likely to have such a visit (OR = 0.65, 95% CI: 0.49, 0.87). The patients in the north cluster were more likely to have had an ED presentation in the prior 2 years (OR = 2.40, 95% CI: 1.73, 3.34) and more likely to have had a prior history of congestive heart failure (OR = 1.51, 95% CI: 1.15, 1.98), COPD (OR = 2.03, 95% CI: 1.55, 2.65) and diabetes (OR = 1.30, 95% CI: 1.00, 1.67) than those living outside the clusters. Notably, there was no evidence that patients in the east cluster were statistically different from patients who resided outside the clusters for

these predictors. Patient ages differed for patients who resided inside vs outside the clusters: patients in the north cluster were more likely to be younger than those who resided outside the clusters, and patients in the east cluster were more likely to be older than those who resided outside the clusters.

Discussion

In 2017-2018, a total of 4387 patients who had been residents of Alberta for the previous 2 years had an ED visit for AFF that ended in discharge. The estimated median time from ED discharge to first specialist outpatient visit was long (42 days). The Wait Time Alliance recommends that patients wait no longer than 42 days for a scheduled initial specialist consult for cardiac care.²¹ Two regions of the province were identified as having even longer median times to first specialist outpatient visit than the rest of the province. The first cluster comprised of rural areas of northern Alberta had an estimated median time to first specialist outpatient visit of 98 days (95% CI: 82, 139)—over double the estimated median time for patients living outside identified clusters (42 days, 95% CI: 39, 45). Moreover, based on other information, these patients had more comorbidities (eg, prior history of AFF, congestive heart failure, COPD, diabetes) and less connection to primary care providers; it could be argued that there is a mismatch between need and services provided. The second cluster in the eastern part of the province also had a higher estimated median time to specialist follow-up (57 days, 95% CI: 47, 68) and shared many of the same characteristics as patients in the north cluster: more comorbidity and less connection to primary care providers. Geographic variation in the time to first specialist visit may represent less access to specialists or variation in specialist referral, either because of ED practices or illness severity in a geographic area. We did not adjust the cluster detection tests by age and sex, because differences in specialist follow-up times should not, in principle, differ by age and sex even though practically they might.

Although some studies have considered geographic variation for cardiac and cardiovascular conditions,²²⁻²⁷ there is little literature on geographic clustering. Most analyses have focused on the traditional application of cluster-detection tests to identify “hot spots” with higher than expected numbers of patients. In Alberta, we previously identified clusters of higher numbers of patients presenting to EDs in 2010-2011 for AFF, as well as clusters of higher numbers of patients who presented to the ED with AFF and had a subsequent physician claim for stroke or heart failure in the 365 days following the ED visit.²⁸ We also examined geographic clustering of higher numbers of patients presenting to Alberta EDs in 2010-2011 for acute coronary syndromes and heart failure.²⁹ Similar clusters were identified for the 2 conditions (northwest and southeast areas for acute coronary syndromes and north and southeast areas for heart failure). Most of the characteristics related to use of health care services (prior hospital admission, ED presentation, physician claims) were higher in number for patients in the clusters. Other authors have identified regional variations in Alberta for ischemic stroke, transient ischemic attack, intracerebral hemorrhage, subarachnoid hemorrhage, and in-hospital mortality in patients with a diagnosis of stroke who accessed the health care system.³⁰ For a northern region of France, Kihal-Talantikite and colleagues investigated neighbourhood characteristics to examine the geographic

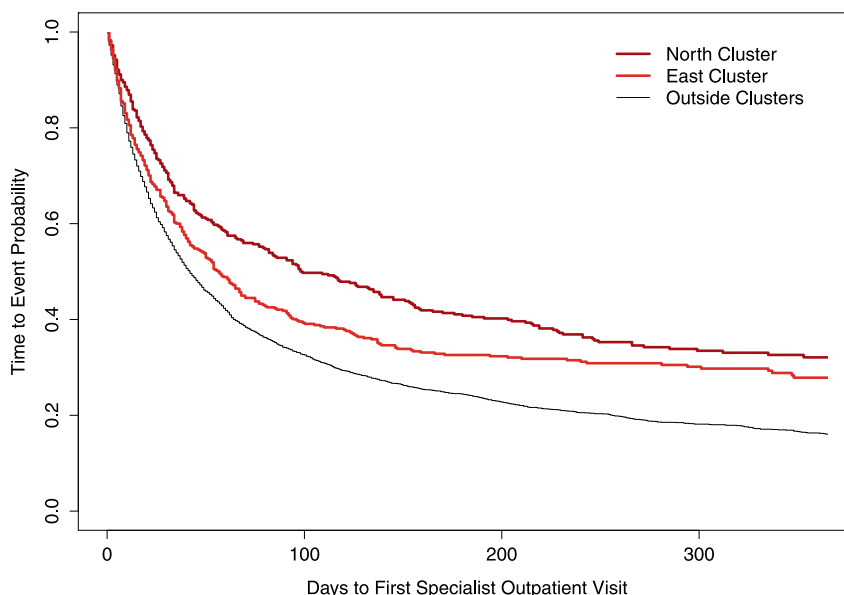


Figure 2. Kaplan-Meier estimates for time to first specialist outpatient visit after emergency department discharge for atrial fibrillation or flutter in 2017-2018 for patients who reside in the north cluster, east cluster, or outside the clusters.

distribution of the onset of myocardial infarction risk using a data-driven approach with the spatial scan.³¹ They found that areas of higher risk had high levels of socioeconomic deprivation. Columbus, Ohio census tracts with both a high incidence of out-of-hospital cardiac arrest and a low prevalence of bystander cardiopulmonary resuscitation were identified using 3 spatial methods, including the spatial scan.³²

We believe we are the first to examine a time-to-event outcome after ED presentation using a cluster-detection

test. The spatial scan for time-to-event outcomes has been previously employed to examine survival of patients with tuberculosis³³; colorectal cancer patient survival³⁴; times to asthma, allergic rhinitis/hayfever, and eczema in the first 4 years of life³⁵; and times to first cases of West Nile virus in humans, crows, and mosquitoes in Ontario.³⁶ The spatial scan allows for geographic analyses to occur at a smaller geographic unit because it combines neighbouring areas and identifies the combination(s) that is (are) statistically significantly

Table 2. Multinomial logistic regression model odds of being in the cluster vs being outside the clusters for the full and reduced models

Variable	Full model				Reduced model			
	Patients residing in North cluster vs outside clusters		Patients residing in East cluster vs outside clusters		Patients residing in North cluster vs outside clusters		Patients residing in East cluster vs outside clusters	
Male	1.21	(0.97, 1.50)	1.12	(0.91, 1.38)				
Per 5 years of age	0.76	(0.62, 0.94)*	1.24	(1.00, 1.52)*	0.76	(0.62, 0.93)*	1.25	(1.03, 1.52)*
Per unit of comorbidity score	0.99	(0.90, 1.08)	0.94	(0.85, 1.02)				
Hospitalization in prior 2 years	0.89	(0.63, 1.25)	1.33	(0.98, 1.82)				
Diagnoses included AFF	1.44	(0.99, 2.11)	1.54	(1.09, 2.17)*	1.32	(1.01, 1.73)*	1.85	(1.43, 2.40)*
ED presentation in prior 2 years	2.56	(1.82, 3.59)*	1.27	(0.96, 1.69)	2.40	(1.73, 3.34)*	1.28	(0.97, 1.67)
Main diagnosis for AFF	0.85	(0.65, 1.11)	0.85	(0.65, 1.10)				
Physician claim in prior 2 years; diagnoses included:								
AFF	1.56	(1.15, 2.11)*	1.45	(1.09, 1.92)*	1.45	(1.11, 1.90)*	1.32	(1.03, 1.71)*
MI	1.34	(0.88, 2.05)	1.34	(0.89, 2.00)				
CHF	1.48	(1.10, 1.99)*	1.34	(1.00, 1.79)*	1.51	(1.15, 1.98)*	1.29	(0.98, 1.68)
Stroke	0.88	(0.56, 1.37)	1.06	(0.71, 1.58)				
COPD	2.01	(1.51, 2.67)*	1.12	(0.82, 1.52)	2.03	(1.55, 2.65)*	1.07	(0.80, 1.43)
Diabetes	1.27	(0.97, 1.66)	0.97	(0.73, 1.27)	1.30	(1.00, 1.67)*	0.95	(0.73, 1.23)
Hypertension	1.15	(0.92, 1.45)	1.12	(0.91, 1.40)				
Renal disease	0.85	(0.53, 1.37)	0.70	(0.43, 1.12)	0.86	(0.56, 1.32)	0.64	(0.41, 0.99)*
Per 5 GP outpatient visits in prior 2 years	0.66	(0.53, 0.82)*	0.76	(0.62, 0.92)*	0.65	(0.53, 0.81)*	0.76	(0.63, 0.91)*
Specialist outpatient visit in prior 2 years	0.38	(0.30, 0.49)*	0.53	(0.42, 0.67)	0.39	(0.30, 0.50)*	0.54	(0.43, 0.68)*
Diagnoses included AFF	1.00	(0.76, 1.33)	0.66	(0.49, 0.87)*	1.00	(0.75, 1.33)	0.65	(0.49, 0.87)*

Values are odds ratio (95% confidence interval).

AFF, atrial fibrillation and flutter; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disorder; ED, emergency department; GP, general practitioner; MI, myocardial infarction.

* $P < 0.05$; reduced model removed non-statistically significant variable from the full model.

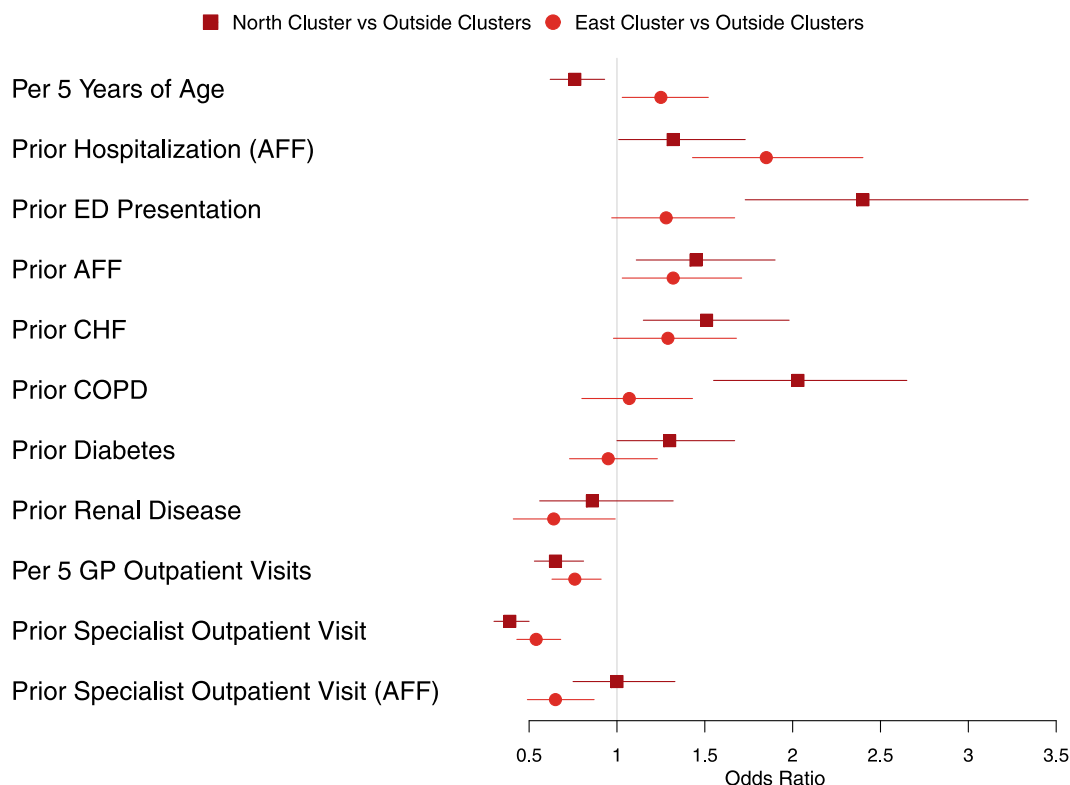


Figure 3. Odds ratios and 95% confidence intervals for predictors in the reduced multinomial logistic regression model. AFF, atrial fibrillation and flutter; ED, emergency department; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disorder; GP, general practitioner.

different than the rest of the province. Simply examining each of the 70 areas individually would lead to low power to detect differences, and such analyses would not incorporate the geographic closeness of the areas. Furthermore, the use of larger geographic areas, such as zones, would not provide the spatial resolution that can be obtained by combining small areas.

When additional factors were considered, patients in the north cluster were more likely to be younger, but more likely to have had a prior history of AFF, congestive heart failure, COPD, and diabetes, and they were more likely to have had a prior hospitalization with AFF or prior ED presentation than patients outside the cluster. Thus, patients in the north cluster appeared to have more complex and chronic health conditions despite being younger. These patients also had fewer GP outpatient visits and were less likely to have prior specialist outpatient visits than patients outside the clusters. It is likely that these patients have less access to health services rather than having less need for them. The integration of GPs and specialists has been advocated for the management of complex and chronic health conditions, and these data would expand that call for innovative clinic options (eg, telehealth and nurse practitioners) for more-remote areas. This study demonstrates the value of analytics in linking disparate data sets to evaluate health care provided for a population, and specifically equity in access to health care based on a patient's location. During the coronavirus disease 2019 pandemic, innovative virtual strategies for specialist follow-up have been created and employed, and these alternative modalities represent opportunities to address clinical disparities in the future.

Study limitations include the possibility that our study sample may not be representative of all patients with AFF, as some may seek care from health services other than EDs. The administrative datasets do not contain information on the treatment received in the ED or the recommendations provided to the patient upon discharge, including whether or not a referral was made to a specialist directly by the ED physician, or whether the primary care physician was provided with a recommendation directly by the ED physician. Patients may not have seen a specialist because they were not referred to one, did not see one even after being referred, or could not access a specialist within the time frame. Geographic variation in either instance is important, as it signals variation in referral practices (or severity of illness) and specialist access, respectively. The prior histories and comorbidities may not perfectly classify patients, as only about one third had had a prior hospitalization; however, the study patients had an average of 18.1 outpatient visits in the prior 2 years, which ameliorates this concern, as there were ample other opportunities to detect comorbidities. Also, these databases do not provide granular sociodemographic (eg, smoking/vaping history, diet, body mass index) and treatment (eg, clinician adherence to evidence-based management guidelines, outpatient medications prescribed during the ED presentation, patient adherence to treatment) details that may be important confounders for follow-up. Finally, as our data extract ended in 2018, we could not assess whether patients inside the cluster with longer times to first specialist outpatient visit also subsequently had poorer health outcomes (eg, hospitalizations, ED presentations, deaths).

In conclusion, this study illustrates that even within a universal-access integrated provincial health care system, with no user fees at the point of service, geographic variation exists in the time to first specialist outpatient visit in patients discharged from the ED after presenting for AFF. Two clusters of patients with longer times to first specialist visit were identified, with the longest delays seen in northern Alberta. Patients living in this cluster were younger but were more likely to have prior histories of AFF, congestive heart failure, COPD, or diabetes, and were less likely to have GP and specialist outpatient visits. Further research is necessary to explore the factors identified in these analyses, the association of specialist follow-up with health outcomes, and the potential impact of virtual models to provide follow-up in underserved areas.

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Disclosures

All the authors have no conflicts of interest to disclose.

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