



Training/Practice  
Health Policy and Promotion

# Identifying Patients With Atrial Fibrillation in Administrative Data

Karen Tu, MD, MSc,<sup>a,b,c</sup> Robby Nieuwlaat, MSc, PhD,<sup>d</sup> Stephanie Y. Cheng, BMath, MSc,<sup>a</sup>  
Laura Wing, BMath,<sup>a</sup> Noah Ivers, MD, PhD,<sup>a,b</sup> Clare L. Atzema, MD, MSc,<sup>a,c</sup>  
Jeff S. Healey, MD, MSc,<sup>d,f</sup> and Paul Dorian, MD, MSc<sup>g</sup>

<sup>a</sup> Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada

<sup>b</sup> Department of Family and Community Medicine, Department of Medicine, University of Toronto, Toronto, Ontario, Canada

<sup>c</sup> University Health Network-Toronto Western Hospital Family Health Team, Toronto, Ontario, Canada

<sup>d</sup> Department of Clinical Epidemiology & Biostatistics, McMaster University, Hamilton, Ontario, Canada

<sup>e</sup> Division of Emergency Medicine, University of Toronto, Toronto, Ontario, Canada

<sup>f</sup> Population Health Research Institute, Hamilton, Ontario, Canada

<sup>g</sup> Division of Cardiology, University of Toronto, Toronto, Ontario, Canada

## ABSTRACT

**Background:** Identifying patients with atrial fibrillation (AF) using administrative data is important for epidemiologic and outcomes research. Although administrative data cover large populations, it is necessary to assess their validity in identifying AF patients.

**Methods:** We used Ontario family physician electronic medical records from the Electronic Medical Record Administrative data Linked Database (EMRALD) as a reference standard to assess the accuracy of administrative data algorithms in identifying patients with AF. From a random sample of 7500 adult patients, patients with AF as recorded in family physician records were identified.

**Results:** The optimal algorithm consisted of any of: hospitalization or an emergency room code for AF or prescription for an AF-specific antiarrhythmic agent or billing code for cardioversion, or prescription for an anticoagulant that was accompanied by a physician billing code.

## RÉSUMÉ

**Introduction :** L'identification des patients atteints de fibrillation auriculaire (FA) à partir des données administratives est importante pour la recherche épidémiologique et l'analyse de résultat. Bien que les données administratives couvrent de vastes populations, il est nécessaire d'évaluer leur validité dans l'identification des patients atteints de FA.

**Méthodes :** Nous avons utilisé les dossiers médicaux électroniques de médecins de famille de l'Ontario qui proviennent de la banque de données EMRALD (Electronic Medical Record Administrative data Linked Database) comme étalon de référence pour évaluer l'exactitude des algorithmes fondés sur les données administratives dans l'identification des patients atteints de FA. À partir d'un échantillon aléatoire de 7500 patients adultes, nous avons identifié les patients atteints de FA d'après ce qui était enregistré aux dossiers des médecins de famille.

Atrial fibrillation (AF) is the most prevalent heart rhythm disorder, particularly among the elderly population and confers significant effects on patient outcomes and health care costs.<sup>1</sup> A systematic review on AF using electronic medical data reported that previous AF validation studies mostly used older data, assessed populations that might not be

representative of the general population, and had a disproportionate focus on inpatient data.<sup>2</sup> Studies that rely only on a diagnosis of AF in the hospital discharge record might miss many patients with AF who receive ambulatory medical care. We sought to determine AF disease burden and patterns of care over time using a validated algorithm incorporating in- and outpatient administrative data.

## Methods

The Electronic Medical Record Administrative data Linked Database (EMRALD) held at the Institute for Clinical Evaluative Sciences (ICES) was used as the reference standard for the diagnosis of AF for the health administrative data

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Corresponding author: Dr Karen Tu, c/o ICES, G1 06, 2075 Bayview Ave, Toronto, Ontario M4N 3M5, Canada. Tel.: +1-416-480-4055 ×3871; fax: +1-416-480-6048.

E-mail: [karen.tu@ices.on.ca](mailto:karen.tu@ices.on.ca)

See page 1565 for disclosure information.

for arrhythmia. The algorithm sensitivity was 80.7% (95% confidence interval [CI], 75.1-86.3), specificity 99.1% (95% CI, 98.9-99.3), positive predictive value 71.1% (95% CI, 65.1-77.1), and negative predictive value 99.5% (95% CI, 99.3-99.7). This algorithm, applied to the Ontario population, resulted in a calculated increase in AF prevalence from 1.68% to 2.36% over the years 2000-2014. Anticoagulation rates for AF patients increased from 53% in 2011 to 60% in 2014. Among AF patients receiving anticoagulants, novel oral anticoagulant utilization increased from < 5% in 2011 to > 50% in 2014.

**Conclusions:** Identifying patients with AF can be done using administrative data, and the algorithm can be used to assess trends in disease burden over time and patterns of care in large populations.

validation portion of this study. (For an expanded version of this article, including detailed validation procedures, additional display material, and a full reference list, see the [Supplementary Material](#).) EMERALD consists of all clinically relevant information in the patient chart of volunteering family physicians in Ontario using PS Suite (Telus Health, Ottawa, ON) electronic medical record (EMR) and can be linked to the health administrative data holdings for the province of Ontario held at ICES.

The data used in the validation portion of this study were extracted between June and November 2011. At the time of the study the data in EMERALD were contributed by 83 primary care physicians who had been using their EMR for at least 2 years and whose data met quality and completeness standards.<sup>3</sup> EMERALD patients and physicians are similar to all Ontario patients and physicians for most characteristics.<sup>3</sup>

A random sample of 7500 adult patients aged 20 years or older as of December 31, 2010 was drawn from 73,014 adult patients of EMERALD physicians. Patients with persistent or paroxysmal AF were identified using manual chart abstraction.

We used health administrative data comprised of hospitalizations, emergency department visits, physician billing, and drug benefits information. Hospital and emergency room visits have coding specifically for AF, whereas the physician billing code for AF is included in a general arrhythmia code. Because of the ambiguous nature of AF diagnostic codes in the physician billing database, we also tested procedure codes for cardioversion (electrical and/or chemical; Z437) and AF-related medications. Multiple algorithms using administrative data were examined, varying according to the administrative data sources used and the timeframe of the assessment. For algorithms that included multiple physician billings, a 30-day separation between billings was required.

The optimal algorithms were applied to the entire province of Ontario, using the initial years as a 'run-in' period. We calculated the crude, and age- and sex-standardized (to the Census 1991 population), annual incidence and prevalence of AF. Incident date was considered the date by which the

**Résultats :** L'algorithme optimal consistait en : l'hospitalisation, ou le code à la salle des urgences pour une FA ou la prescription d'un antiarythmique spécifique de la FA ou le code de facturation concernant une cardioversion, ou la prescription d'un anticoagulant qui était accompagnée d'un code de facturation du médecin concernant une arythmie. La sensibilité de l'algorithme était de 80,7 % (intervalle de confiance [IC] à 95 %, 75,1-86,3), la spécificité, de 99,1 % (IC à 95 %, 98,9-99,3), la valeur prédictive positive, de 71,1 % (IC à 95 %, 65,1-77,1), et la valeur prédictive négative, de 99,5 % (IC à 95 %, 99,3-99,7). Cet algorithme, appliqué à la population de l'Ontario, entraînait le calcul d'une augmentation dans la prévalence de la FA de 1,68 % à 2,36 % au cours des années 2000 à 2014. Les taux d'anticoagulation des patients atteints de FA augmentaient de 53 % en 2011 à 60 % en 2014. Parmi les patients atteints de FA qui recevaient des anticoagulants, l'utilisation du nouvel anticoagulant oral augmentait de < 5 % en 2011 à > 50 % en 2014.

**Conclusions :** L'identification des patients atteints de FA peut être réalisée à partir des données administratives, et l'algorithme peut être utilisé pour évaluer les tendances dans le fardeau de la maladie au fil du temps et les modèles de soins dans de vastes populations.

patient qualified as having AF as per the algorithm. All incident and prevalent cases were carried forward to the next year, unless the patient died or moved out of the province.

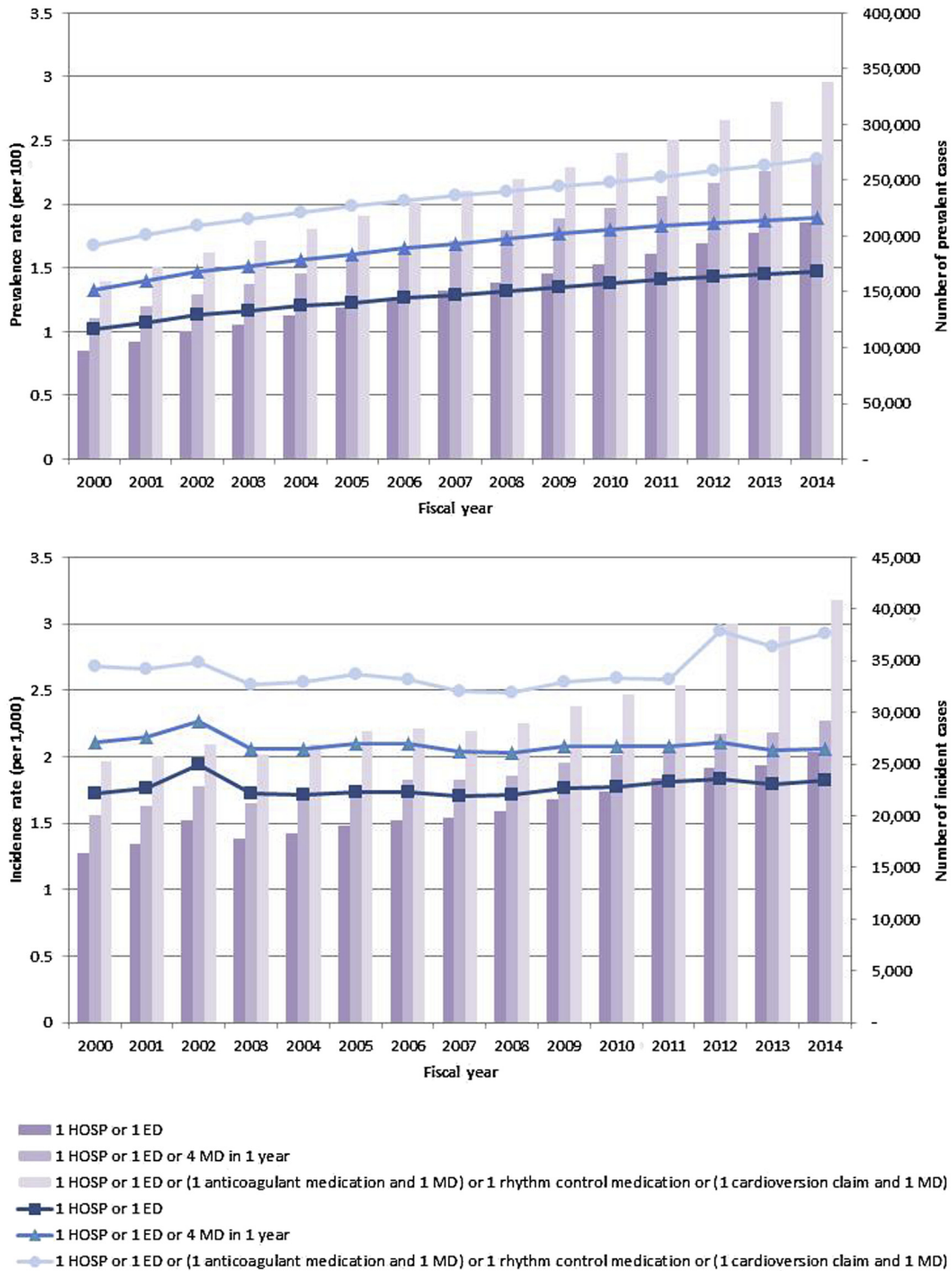
Last, we assessed the proportion of patients using oral anticoagulants measured in EMERALD from the patients determined via chart abstraction to have AF, and in administrative data through the drug benefit database. Patients prescribed warfarin and a novel oral anticoagulant (NOAC; apixaban, rivaroxaban, or dabigatran) were classified as receiving whichever type was most recently prescribed. We also examined the proportion of patients with AF who were dispensed an oral anticoagulant in the province of Ontario using our 2 most accurate administrative data algorithms: one that used medications to identify AF patients and one that did not, to assess for bias in anticoagulation rates using a case identification algorithm that included anticoagulants. Similarly, we looked in the administrative data in fiscal year 2014 to assess changes in rates and types of anticoagulants prescribed.

All data sets were linked using unique encoded identifiers and all measures were calculated using the binomial approximation method and analyses were conducted using SAS version 9.2 (SAS Institute Inc, Cary, NC) at the ICES. This study received ethics approval from the Sunnybrook Research Ethics Board.

## Results

In the EMERALD cohort, 192 (2.6%) patients had AF. The average age of the EMERALD cohort was 49.2 years (SD, 16.7 years) and the average age of the patients with AF was 74.1 years (SD, 11.6 years).

Using hospitalizations, emergency room visits, and physician billings for AF, an algorithm of a hospitalization or emergency room record or 4 physician billing claims in 1 year provided the best balance of sensitivity (70.8%) and positive predictive value (70.8%), with excellent specificity (99.2%) and negative predictive value (99.2%), while providing the



HOSP=hospital claim, ED=emergency room visit, MD=physician billing claim

**Figure 1.** Crude and age- and sex-standardized atrial fibrillation, 2000-2014. Bars represent crude numbers; points and lines represent age- and sex-standardized prevalence and incidence rates.

same prevalence estimate for AF as our reference standard. An algorithm of 1 hospitalization, or an emergency room visit, or AF-related medications, or cardioversion (without physician billing codes), maximized sensitivity (80.7%) and positive predictive value (71.1%) and provided high specificity (99.1%) and negative predictive value (99.5%).

When these top-performing algorithms were applied to the entire province of Ontario, the estimated annual age- and sex-standardized prevalence and incidence (Fig. 1) for the algorithm that included medications and cardioversion, and the algorithm that included physician billings was < 1% and < 0.5% higher, respectively, than just using hospitalizations or emergency room visits. All algorithms resulted in a consistent increase in prevalence over the past decade and a half, with a highest adult prevalence estimate of 1.68% in 2000 to 2.36% in 2014. Incidence was relatively flat using all of the algorithms except for the algorithm that used medications and cardioversion, which showed a slight increase in incidence in the past 3 years and ranged from a low of 2.48 per 1000 in 2008 to a high of 2.95 per 1000 in 2012.

Approximately two-thirds of the patients with AF in our 2011 EMRALD cohort were receiving anticoagulants, with > 90% of those patients being prescribed warfarin rather than a NOAC (Table 1). These rates were similar when measured in the administrative data compared with the EMR data (64.1% vs 68.3% among the elderly patients) (Table 1). When we compared the anticoagulation rates of patients with AF across the province using our top 2 algorithms (one that included anticoagulants to identify AF patients and one that did not), we found that anticoagulation rates and proportion of warfarin to NOAC use was similar regardless of the algorithm

used. The overall anticoagulation rates increased from 2011 to 2014 (53.8% to 60.8%), with an increase in the proportion of anticoagulated patients filling a prescription for a NOAC from < 5% in 2011 to 51.4% in 2014.

## Discussion

We found that patients with AF could be identified with a reasonable degree of accuracy using administrative data. Our anticoagulation rate measured in administrative data is in keeping with previous findings whereby only approximately half of the patients with AF are receiving anticoagulants.<sup>4</sup> Because anticoagulant use was similar as measured in EMRALD compared with administrative data on the same cohort of patients, it appears that either data source would be suitable to measure rates of anticoagulation and types of anticoagulants used. Using administrative data in 2011, anticoagulation rates among AF patients was higher in EMRALD (64.1%) compared with anticoagulation rates among AF patients in the general population (53.8%). This higher rate measured in EMRALD might be because our participating physicians are more likely to prescribe anticoagulants or because EMRALD captures prescriptions only whereas administrative data captures medications actually dispensed.

Although the accuracy of our optimal algorithms were at the lower end of positive predictive value and midrange for sensitivity compared with other studies identifying AF patients from electronic medical data,<sup>2</sup> the methods used in our study might be more generalizable than that used in other studies because our primary care reference standard population is likely more reflective of the general population. A

**Table 1. Anticoagulation rates and types for adult patients with AF as identified in EMR and administrative data**

|  | AF patients alive during anticoagulation time frame assessed | Filled a prescription for an anticoagulant |      | Filled a prescription for warfarin |        | Filled a prescription for a NOAC |      |
|--|--|--|------|------------------------------------|--------|----------------------------------|------|
|  |  | n  | %    | n                                  | %      | n                                | %    |
| Anticoagulation rates in 2011 measured using the EMR   |  |  |      |                                    |        |                                  |      |
| AF patients from 7500 chart abstraction sample (age ≥ 20 years*)   | 188  | 118  | 62.8 | 110                                | 93.2   | 8                                | 6.8  |
| AF patients from 7500 chart abstraction sample (age ≥ 66 years*)   | 145  | 99   | 68.3 | †                                  | < 98%† | ≤ 5†                             | < 7† |
| Anticoagulation rates in 2011 measured using administrative data   |  |  |      |                                    |        |                                  |      |
| AF patients from 7500 chart abstraction sample (age ≥ 66 years*)   | 145  | 93   | 64.1 | †                                  | < 98%† | ≤ 5†                             | < 7† |
| AF in all of Ontario using rule 1 HOSP or 1 ED or 4 MD in 1 year (age ≥ 66 years*)   | 168,623  | 90,692                                     | 53.8 | 87,713                             | 96.7   | 2979                             | 3.3  |
| AF in all of Ontario using rule 1 HOSP or 1 ED or (1 anticoagulant medication and 1 MD) or 1 rhythm control medication or (1 cardioversion claim and 1 MD) (age ≥ 66 years*) | 222,489  | 118,793                                    | 53.4 | 113,901                            | 95.9   | 4892                             | 4.1  |
| Anticoagulation rates in 2014 measured using administrative data   |  |  |      |                                    |        |                                  |      |
| AF in all of Ontario using rule 1 HOSP or 1 ED or 4 MD in 1 year (age ≥ 66 years†)   | 192,374  | 116,880                                    | 60.8 | 56,749                             | 48.6   | 60,131                           | 51.4 |
| AF in all of Ontario using rule 1 HOSP or 1 ED or (1 anticoagulant medication and 1 MD) or (1 rhythm control medication or 1 cardioversion claim and 1 MD) (age ≥ 66 years‡) | 262,673  | 157,885                                    | 60.1 | 74,123                             | 46.9   | 83,762                           | 53.1 |

AF, atrial fibrillation; ED, emergency room visit; EMR, electronic medical record; HOSP, hospital claim; MD, physician billing claim; NOAC, novel oral anticoagulant.

\*Age calculated as of December 31, 2010.

†Exact numbers suppressed because of small cell size regulation.

‡Age calculated as of December 31, 2013.

Swedish study conducted from 2004 to 2010 reported an AF prevalence of 3.0%.<sup>3</sup> This higher prevalence than what we found might be explained by their use of an electrocardiogram database and by their definition of AF, which included a single or transient episode, such as AF that occurred perioperatively.

However, there are some limitations to our reference standard in that we were only able to identify patients with AF who were recognized by physicians and although EMR records used met data quality and completeness standards,<sup>3</sup> it is possible that some information was missing. Additionally, our anticoagulation rates might be underestimated because our drug benefit database is primarily for patients older than age 65 years, and NOACs require a limited use code for coverage in the Ontario Drug Benefit plan.

This work enables future studies to use administrative data to measure changes in AF detection or treatment in large populations or over time, and has the potential to be applied in other provinces across Canada that have similar administrative databases.

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### Disclosures

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### Supplementary Material

To access the supplementary material accompanying this article, visit the online version of the *Canadian Journal of Cardiology* at [www.onlinecjc.ca](http://www.onlinecjc.ca) and at <http://dx.doi.org/10.1016/j.cjca.2016.06.006>.