Canadian Journal of Cardiology 35 (2019) 1412–1415

Training/Practice
Health Policy and Promotion

Empirical Insights When Defining the Population Burden of Atrial Fibrillation and Oral Anticoagulation Utilization Using Administrative Data

Nathaniel M. Hawkins, MD,[a,b] Patrick R. Daniele, BSc,[b] Karin H. Humphries, DSc,[a,b] Justin A. Ezekowitz, MBChB, MSc,[c,d] Finlay A. McAlister, MD, MSc,[d,e] Roopinder K. Sandhu, PhD,[c,d] and Padma Kaul, PhD[c,d]

[a] *Division of Cardiology, University of British Columbia, Vancouver, British Columbia, Canada*
[b] *BC Centre for Improved Cardiovascular Health, Vancouver, British Columbia, Canada*
[c] *Division of Cardiology and Mazankowski Alberta Heart Institute, University of Alberta, Edmonton, Alberta, Canada*
[d] *Canadian Vigour Centre, University of Alberta, Edmonton, Alberta, Canada*
[e] *Division of General Internal Medicine, University of Alberta, Edmonton, Alberta, Canada*

See editorial by Wilton et al., pages 1289–1290 of this issue.

ABSTRACT

Health administrative data are routinely used to assess disease burden, quality of care, and outcomes for atrial fibrillation (AF). Governments, administrators, and researchers define cohorts differently, based on 3 key factors: the case definition algorithm to identify AF, inclusion/exclusion of transient AF, and the lookback period to identify cases. We assessed the impact of varying these key factors on estimates of the use of guideline-indicated oral anticoagulation (OAC). Hospitalization, ED, and outpatient claim databases were linked in British Columbia. AF was defined by ICD-9 or 10 codes 427.3x or I48.x. We examined a specific (1 hospital or 1 ED or 2 outpatient) vs a sensitive (1 hospital or ED or outpatient) algorithm; inclusion/exclusion of AF associated with open-heart surgery; and lookback periods of 1 to 10 years. We found the more specific AF definition increased OAC utilization by 5% (58.7% vs 53.4%); excluding AF associated with open-

RÉSUMÉ

Les données administratives sur la santé sont couramment utilisées pour évaluer le fardeau de la maladie, la qualité des soins et les résultats de la fibrillation auriculaire (FA). Les autorités gouvernementales, les administrateurs et les chercheurs définissent différemment les cohortes en fonction des 3 facteurs principaux suivants : l'algorithme de définition de cas pour identifier la FA, l'inclusion et l'exclusion de la FA transitoire et la période antérieure pour identifier les cas. Nous avons évalué les conséquences de la variation de ces facteurs principaux sur les estimations de l'utilisation de l'anticoagulation orale (ACO) recommandée par les lignes directrices. Nous avons couplé les bases de données sur les réclamations liées aux hospitalisations, aux visites de SU et aux services de consultations externes de la Colombie-Britannique. La FA a été définie par les codes 427.3x ou I48.x de la CIM-9 ou CIM-10. Nous avons examiné un

Atrial fibrillation (AF) is increasing in prevalence and is a major cause of stroke and health care utilization. Electronic health data are used to assess disease burden, quality and variance in care, value of interventions, and prognosis. Algorithms to identify AF in health administrative data sources have varying accuracy, with few robust validation studies.[1] These use hospitalization, ED, ambulatory, or a combination of these data sources. Even in clinical trials, AF is variably defined, typically by electrocardiogram (ECG) at baseline or investigator-recorded history. High sensitivity enhances generalizability and is important to reduce misclassification of AF as non-AF, which attenuates the association with outcomes such as stroke. High specificity is important when adjudicating treatment uptake, which appears inappropriately low if non-AF is misclassified as AF.

Only 1 definition for AF has been validated in Canada against chart review including ECG.[1] This comprised a single hospitalization defined by ICD-9 code for AF in hospital health administrative data (the Discharge Abstract Database [DAD]).

Received for publication March 21, 2019. Accepted May 6, 2019.

Corresponding author: Dr Nathaniel M. Hawkins, University of British Columbia, BC Centre for Improved Cardiovascular Health, St Paul's Hospital, 1081 Burrard Street, Vancouver, British Columbia V6Z 1Y6, Canada. Tel.: +1-604-875-4111; fax: +1-604-875-5504.
E-mail: nat.hawkins@ubc.ca
See page 1415 for disclosure information.

https://doi.org/10.1016/j.cjca.2019.05.009

heart surgery increased OAC utilization by 0.7% to 2.3%; and each additional lookback year identified more prevalent cases but reduced OAC utilization by approximately 1%. In 40 scenarios, generated by varying all 3 key factors, OAC utilization ranged from 52% to 72%. Assuming a ceiling of 90%, the estimated "treatment gap" therefore varied from 18% to 38%. The 2-fold variation in the OAC treatment gap was based entirely on cohort definition. This has significant implications for health policy and quality indicators.

algorithme spécifique (1 hôpital ou 1 ED ou 2 services de consultations externes) *vs* un algorithme sensible (1 hôpital ou ED ou service de consultations externes); l'inclusion et l'exclusion de la FA associée à l'opération à cœur ouvert; les périodes antérieures de 1 à 10 ans. Nous avons observé que la définition de la FA la plus spécifique augmentait l'utilisation de l'ACO de 5 % (58,7 % *vs* 53,4 %); que l'exclusion de la FA associée à l'opération à cœur ouvert faisait augmenter l'utilisation de l'ACO de 0,7 % à 2,3 %; chaque année antérieure supplémentaire permettait d'identifier les cas les plus prévalents, mais de réduire l'utilisation de l'ACO d'environ 1 %. Dans les 40 scénarios générés en faisant varier les 3 facteurs principaux, l'utilisation de l'ACO allait de 52 % à 72 %. En supposant un plafond de 90 %, l'« écart de traitement » estimé variait donc de 18 % à 38 %. Le doublement de la variation dans l'écart de traitement par ACO reposait entièrement sur la définition des cohortes. Cette constatation a des répercussions considérables sur les politiques de la santé et les indicateurs de qualité.

However, many provincial governments, epidemiological studies, and quality-indicator groups have adopted a more sensitive definition of any acute care diagnosis (DAD or the National Ambulatory Care Reporting System [NACRS]) or outpatient physician billing record (Medical Services Plan [MSP]), typically using either a single or 2 claims separated by a minimum time period. More complex case definitions were validated in Ontario against primary care electronic records, adding antiarrhythmic drugs, anticoagulants, and cardioversions to health administrative data. Only small differences were observed in oral anticoagulation (OAC) utilization using these different definitions, although filled OAC prescriptions were approximately 4% lower using health administrative data compared with the electronic medical record.[2] We examined the impact of 3 key factors in defining the prevalence of AF and the use of guideline-indicated OAC: case definition, exclusion or inclusion of transient AF, and varying the lookback period to define the prevalent population.

Methods and Results

The population included all patients $\geq$ 20 years of age in British Columbia between January 2005, and December 2016. AF was identified by ICD-9-CA code 427.3x or ICD-10 code I48.x (AF/flutter) in the DAD, NACRS, or MSP databases in any diagnostic field. Lookback periods ranging from 1 to 10 years were assessed for defining prevalent cases. OAC was considered indicated for all patients aged $\geq$ 65 years or with $CHADS_2$ score $\geq$ 1, based on Canadian Cardiovascular Society guidelines.[3] Comorbidities for thromboembolic risk were defined, using all health administrative databases (DAD, NACRS, MSP) using a 3-year lookback period, inclusive of the index episode. Oral anticoagulant utilization was defined as filling a prescription for warfarin, apixaban, rivaroxaban, or dabigatran within the year following a new AF diagnosis or within the calendar year (January 1 to December 31) for prevalent cases, extracted from the provincial Pharmanet database (Anatomical Therapeutic Chemical codes B01AA, B01AF02, B01AF01, and B01AE07).

Sensitive vs specific case definition

We examined 2 commonly used definitions: at least 1 DAD or NACRS or MSP claims vs at least 1 DAD or 1 NACRS or 2 MSP claims within a year but a minimum of 30 days apart. The definition using a single MSP claim created a larger population (n =184,247) with more patients identified only from the community (MSP claims 34.7%) than only from hospitalizations (25.3%) (Supplemental Table S1). Conversely, the more restrictive definition requiring 2 MSP claims reduced the overall population by 19% (n = 148,676) and shifted the population toward acute episodes of care (19.1% for community vs 47.3% for hospital diagnoses alone). As expected, the more specific definition increased the use of OAC. The net effect was a 5% increase in OAC utilization: 58.7% defined by DAD/NACRS/2MSP vs 53.4% defined by DAD/NACRS/1MSP. However, owing to the smaller absolute population, the specific compared with sensitive definition identified fewer patients overall with AF using OAC: 79,287 patients defined by DAD/NACRS/2MSP vs 87,127 patients defined by DAD/NACRS/MSP.

Inclusion/exclusion of transient AF

Many studies attempt to exclude acute transient episodes of AF with potentially reversible precipitants, particularly when defining suitability for long-term OAC. Varying comorbidities and definitions have been used to identify transient AF. The BC hospital administrative database (DAD) subclassifies each diagnosis as (1) pre-admit comorbidity, which is significant (defined as requiring treatment change, influencing concurrent treatment, or increasing length of stay); (2) post-admit comorbidity, which is significant; and (3) secondary diagnosis not fulfilling the aforementioned significance criteria. The Canadian Institute for Health Information Data Quality Study of the 2015−2016 DAD reported that 80% of comorbidities classified as pre-admit were confirmed in repeat chart review.[4] We examined these subcategories for coding AF among patients with isolated hospitalizations for AF and concurrent recognized precipitants (Fig. 1).

Several features are noteworthy. First, AF associated with open-heart surgery (coronary artery bypass grafting or valve surgery) was predominantly coded as post-admit or secondary. If intending to remove transient AF episodes, such patients could reasonably be excluded in jurisdictions or countries without the coding subclassification available in British Columbia. Second,

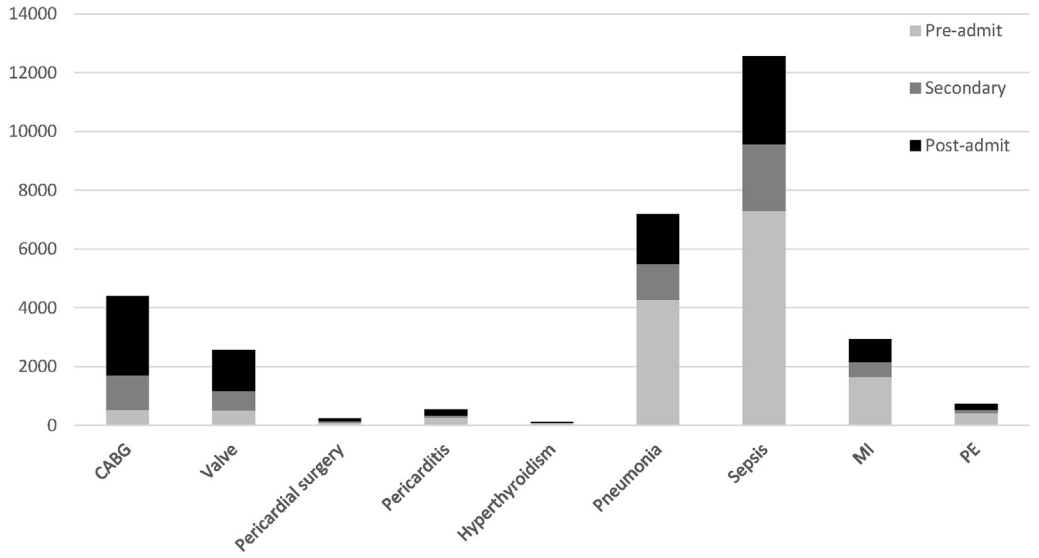

Figure 1. Subclassification of atrial fibrillation (AF) among patients hospitalized with AF and concurrent possible reversible precipitants, with no other record of AF in administrative databases.

pericarditis and hyperthyroidism were very uncommon causes of AF. Third, causes such as pneumonia and myocardial infarction were common, but the proportion of AF coded as pre-existing was considerable, and thus excluding these patients would be inadvisable. Finally, pre-existing AF was common despite the cohort being defined by a single hospitalization including AF, with no preceding documentation of AF in any other health administrative data source. The percentage of patients with pre-admit diagnoses of AF was coronary artery bypass grafting (11.9%), valve surgery (20.0%), pericardial surgery (38.6%), pericarditis (46.1%), hyperthyroidism (60.1%), pneumonia (57.7%), sepsis (56.2%), myocardial infarction (56.4%), and pulmonary embolus (55.7%). This suggests that a significant, unquantified volume of patients with AF is not identified from ambulatory claims. Excluding patients with hospital diagnoses of AF in the context of open-heart surgery increased estimates of overall OAC use by 0.7% to 2.3%, depending on the case definition algorithm (sensitive/specific) used and the duration of the lookback period.

Varying the lookback period

The reported incidence and prevalence are influenced by the lookback period. The AF patient journey involves ambulatory and acute contacts occurring at different times. Interrogating data sources over short time intervals may miss cases, especially if encounters are infrequent. The use of short lookback periods has 2 major consequences. First, the prevalent population appears

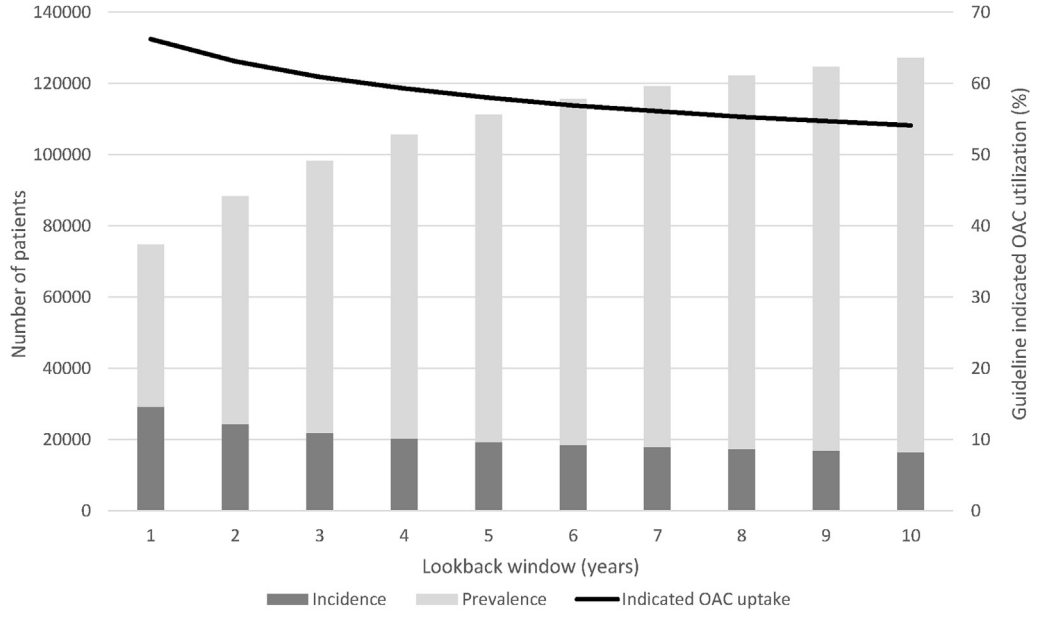

Figure 2. Impact of varying lookback periods on estimated incidence and prevalence of atrial fibrillation in 2015 and guideline-indicated oral anticoagulation utilization.

artefactually small. Second, prevalent cases can be misclassified as incident cases because a short lookback period may fail to identify a previous AF event. Extending the lookback detects more prevalent cases (Fig. 2). However, the additional cases identified per year of lookback plateaus with increasing lookback duration. At the same time, the proportion of incident to prevalent cases stabilizes, as fewer prevalent cases are misclassified as incident.

To our knowledge, the impact of the lookback window on estimates of OAC utilization has not been studied. Conceptually, extending the lookback may decrease the apparent use of guideline-indicated OAC for several reasons. First, the proportion of isolated, transient AF episodes with no recurrence may increase, and false positive cases will accumulate. This will partly be counterbalanced by detecting prevalent AF cases of patients who have infrequent interactions with the health care system. Second, the proportion of patients with genuine contraindications, such as bleeding, may increase. The impact of varying lookback periods on incidence, prevalence, and OAC utilization is illustrated in Figure 2, using a population defined by a single hospital or emergency department or outpatient code. The overall use of guideline-indicated OAC declines from 66% to 54%, moving from 1- to 10-year lookback periods. The decline is greatest within the first 3 years and then reduces by approximately 1% annually. We suggest empirically using a lookback of 5 years to balance these factors, acknowledging that—ideally—this approach requires validation against a gold standard of chart review.

Combined Impact of Key Factors

These 3 key factors in cohort definition are applied differently across jurisdictions, both national and international, in research, policy, and health-services administration. We estimated OAC utilization in 40 scenarios by combining the 2 case definitions, inclusion/exclusion of AF arising from cardiac surgery, and varying lookback from 1 to 10 years. The minimum and maximum estimates of guideline-indicated OAC utilization ranged from 52% to 72% (DAD/NACRS/1MSP without cardiac surgery exclusion and 10-year lookback vs DAD/NACRS/2MSP with cardiac surgery exclusion and 1-year lookback, respectively). If we assume that 10% of patients do not receive OAC because of personal preference or contraindications,[5] the "treatment gap" therefore varies from 18% to 38%, a more than 2-fold difference.

Conclusion

These findings have important implications for system planning, disease surveillance, and assessment of quality of care and outcomes. There is a marked disconnect between the volume of publications in these domains and those examining the underpinning data. Further research is needed to validate existing—and derive new—case definition algorithms. Study cohorts must be rigorously and consistently defined to compare quality across jurisdictions and over time. Health-service administrators and researchers should be mindful of these factors when developing quality indicators and national guidelines.

Funding Sources

This work was funded by the Heart and Stroke Foundation, Project Number: F16-03786.

Disclosures

Dr Hawkins is supported by a Vancouver Coastal Health Clinician Scientist Award, and is the UBC Dr Charles Kerr Distinguished Scholar in Heart Rhythm Management. Dr McAlister is supported by the Alberta Health Services Chair in Cardiovascular Outcomes Research.

References

1. Yao RJR, Andrade JG, Deyell MW, et al. Sensitivity, specificity, positive and negative predictive values of identifying atrial fibrillation using administrative data: a systematic review and meta-analysis. Clin Epidemiol 2019;11:753-67.
2. Tu K, Nieuwlaat R, Cheng SY, et al. Identifying patients with atrial fibrillation in administrative data. Can J Cardiol 2016;32:1561-5.
3. Verma A, Cairns JA, Mitchell LB, et al. 2014 focused update of the Canadian Cardiovascular Society Guidelines for the management of atrial fibrillation. Can J Cardiol 2014;30:1114-30.
4. Canadian Institute for Health Information: Data Quality Study of the 2015−2016 Discharge Abstract Database. Ottawa, Ontario: CIHI, 2016. Available at: https://secure.cihi.ca/free_products/DAD_15_16_Reab_Report_EN.pdf. Accessed March 1, 2019.
5. Ogilvie IM, Newton N, Welner SA, Cowell W, Lip GY. Underuse of oral anticoagulants in atrial fibrillation: a systematic review. Am J Med 2010;123:638-645.e634.

Supplementary Material

To access the supplementary material accompanying this article, visit the online version of the *Canadian Journal of Cardiology* at www.onlinecjc.ca and at https://doi.org/10.1016/j.cjca.2019.05.009.