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ORIGINAL RESEARCH

Geriatric Conditions Are Associated With Decreased Anticoagulation Use in Long-Term Care Residents With Atrial Fibrillation

Ning Zhang, PhD; Jay Patel , BS; Zhiyong Chen, PhD; Yanhua Zhou, MS; Sybil Crawford, PhD; David D. McManus, MD, ScM; Jerry Gurwitz, MD; Theresa I. Shireman, PhD; Alok Kapoor , MD, MSc

BACKGROUND: Anticoagulation is the mainstay for stroke prevention in patients with atrial fibrillation, but concerns about bleeding inhibit its use in residents of long-term care facilities. Risk-profiling algorithms using comorbid disease information (eg, CHADS₂ and ATRIA [Anticoagulation and Risk Factors in Atrial Fibrillation]) have been available for years. In the long-term care setting, however, providers and residents may place more value on geriatric conditions such as mobility impairment, activities of daily living dependency, cognitive impairment, low body mass index, weight loss, and fall history.

METHODS AND RESULTS: Using a retrospective cohort design, we measured the association between geriatric conditions and anticoagulation use and type. After merging nursing home assessments containing information about geriatric conditions (Minimum Data Set 2015) with Medicare Part A 2014 to 2015 claims and prescription claims (Medicare Part D) 2015 to 2016, we identified 228 741 residents with atrial fibrillation and elevated stroke risk (CHA₂DS₂-VASc score ≥ 2) for our main analysis. Recent fall, activities of daily living dependency, moderate and severe cognitive impairment, low body mass index, and unintentional weight loss were all associated with lower anticoagulation use even after adjustment for multiple predictors of stroke and bleeding (odds ratios ranging from 0.51 to 0.91). Residents with recent fall, low body mass index, and unintentional weight loss were more likely to be using a direct oral anticoagulant, although the magnitude of this effect was smaller.

CONCLUSIONS: Geriatric conditions were associated with lower anticoagulation use. Preventing stroke in these residents with potential for further physical and cognitive impairment would appear to be of paramount significance, although the net benefit of anticoagulation in these individuals warrants further research.

Key Words: anticoagulation ■ atrial fibrillation ■ geriatric conditions ■ long-term care

Atrial fibrillation (AF) affects 5.2 million Americans and is particularly prevalent in long-term care (LTC) facilities, with estimates ranging from 7.5% to 17%.¹ Anticoagulation is the mainstay for stroke prevention in residents of LTC facilities, but concerns about bleeding inhibit the adoption of its use even in cases in which the benefit of treatment outweighs the risk. The advent of direct oral anticoagulants (DOACs) and issuance of the American College of Cardiology and American Heart Association recommendation of anticoagulation in low- to moderate-risk patients

(CHA₂DS₂-VASc ≥ 2) has reduced the gap, but >40% of eligible patients remain at elevated risk of stroke.²

To understand better the gap in anticoagulation use in the LTC population requires identification of which patient-level factors predict anticoagulation use in general and DOAC use in particular. Although the original CHADS₂ and ATRIA (Anticoagulation and Risk Factors in Atrial Fibrillation) stroke and bleeding risk scoring algorithms^{3,4} have been available for many years, in the LTC setting providers and residents may place more value on other unique factors. These include many

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CLINICAL PERSPECTIVE

What Is New?

- Geriatric conditions, including mobility impairment, activities of daily living dependency, cognitive impairment, low body mass index, weight loss, and fall history, are associated with lower anticoagulation use in long-term care residents with atrial fibrillation.

What Are the Clinical Implications?

- Professional societies and policymakers should provide greater guidance to clinicians treating these residents about which residents with geriatric conditions should receive anticoagulation.

Nonstandard Abbreviations and Acronyms

ATRIA	Anticoagulation and Risk Factors in Atrial Fibrillation
DOAC	direct oral anticoagulant
LTC	long-term care
MDS	minimum data set

of the conditions identified through a comprehensive geriatric assessment (hereafter called geriatric conditions) such as mobility impairment, activities of daily living (ADL) dependency, cognitive impairment, low body mass index (BMI) or morbid obesity, weight loss, and fall history recorded in the nursing home assessment database—that is, the minimum data set (MDS). In our previous work with the MDS, we found that geriatric conditions (especially fall history, severe ADL dependency, BMI <18.5 kg/m², and weight loss of 10%) predicted the discontinuation of anticoagulation using the MDS variable for anticoagulation.⁵ In the current article, we report the association between these conditions on prevalent anticoagulation use in general as well as DOAC use in particular through merging MDS with Medicare Part D medication records.

METHODS

Data Source

This study employed a merged data set of MDS of 2015, the Medicare Provider Analysis and Review 2014 to 2015, and prescription claims data (Part D) 2015 to 2016. MDS is a mandatory nursing home database containing comprehensive assessments of all residents, providing information on their sociodemographics, diagnoses, and physical and cognitive function.

MDS assessments are performed on all residents at admission quarterly, annually, and whenever there is a significant change in health status. The Centers for Medicare and Medicaid Services extracted the Medicare Provider Analysis and Review from inpatient claims submitted by hospitals for reimbursing care provided to Medicare beneficiaries. Medicare Part D data include comprehensive information on prescriptions, such as names of the drugs, dispense quantity, and the total number of refills for all Medicare Part D subscribers.

Population

Inclusion Criteria

We included residents of LTC with AF and CHA₂DS₂-VASc score ≥2, at least 1 MDS assessment between July 1, 2015, and December 31, 2015, diagnosis, and continuously enrolled in Medicare Part D for 7 months up to and including their index assessment.

Exclusion Criteria

We excluded residents with comatose status or on hospice at index assessment.

Assembly of Analysis Population

We considered an individual to be part of the LTC population if they resided in a facility for at least 100 days before their index assessment. Residents were considered to have AF if they had a record of cardiac dysrhythmia recorded in the MDS or an *International Classification of Diseases* diagnosis code consistent with AF in MDS or Medicare Part A (Table S2) in the previous 6 months from the index assessment following previous examples in the literature.^{5,6} We also restricted our sample to those residents with a CHA₂DS₂-VASc score ≥2 given professional society guidelines^{2,7} recommending anticoagulation in these individuals (score further described below). We applied the criterion for continuous enrollment in Medicare Part D up to and including the index assessment to account for all potential medication fills (including those with 90-day supply) that may have accumulated in the days before the index assessment and accounted for exposure to anticoagulation further described below. We also omitted any assessment that occurred within 4 days of hospitalization. In such a case, we selected the next MDS assessment falling between July 1, 2015, and December 31, 2015 (if one existed). We applied this final filter because we noted represcription of medications including anticoagulation often occurred past the day of readmission to the LTC facility and continued over the first 3 days after return. This final population meeting all inclusion criteria became our “analysis population.”

Outcome

We tracked anticoagulation using Medicare Part D data. Specifically, we considered a patient on anticoagulation if the fill date for an eligible anticoagulation medication record plus days supplied in this record overlapped with the index assessment accounting for medication accumulation and recent hospitalization. To be eligible, an anticoagulation record had to be consistent with a total daily dosage typically used for prophylaxis against stroke (Table S2). We excluded records that implied dosages used for prophylaxis against venous thromboembolism. We accepted any dosage for warfarin given the inability to discern the intent of its use from medical records alone (Table S2).

Demographics

We analyzed several demographic characteristics including age in categories (≤ 69 years, 70–79 years, 80–84 years, 85–89 years, and ≥ 90 years), female sex, and race/ethnicity (Black non-Hispanic, Hispanic, White non-Hispanic, and Other [Other, Asian, North American Native, including those for whom race/ethnicity was unknown]).

Geriatric Conditions

We identified geriatric conditions prevalent at the time of the index assessment. Fall history indicated an event if a resident had a fall within the previous 6 months. We applied the ADLs long-form scale to represent dependency in performing ADLs following examples in the literature.⁸ In particular, we added together the score of each of 7 individual ADLs (bed mobility, transfer, locomotion, eating, bathing, dressing, and toileting) to arrive at a final score. As each ADL could contribute between 0 (independent) and 4 points (total dependence), the composite ADL variable had a score range of 0 to 28, with a larger number indicating a higher level of dependency in ADL assistance. We then divided our cohort of residents into 3 categories of mild (0–12), moderate (13–20), and severe ADL dependency (21–28). For mobility impairment, we used the categories of extensive or complete dependence on staff for walking in a room or a corridor.⁸ For cognitive impairment, we grouped the moderate and severe categories for the MDS variable “cognitive skills for decision making” if the resident had short-term memory problems and his or her cognitive skills for daily decision making were moderately or severely impaired.⁹ We also noted the frequency of residents who were underweight based on World Health Organization criteria for BMI < 18.5 kg/m².¹⁰ Finally, for weight loss, we categorized residents into those with weight loss occurring with being on a weight-loss regimen (ie, intentional) versus those with weight loss occurring without being on a weight-loss regimen (ie, unintentional).

Other Resident Characteristics

We first calculated stroke risk based on the CHA₂DS₂-VASc risk score, using variables from MDS, including congestive heart failure history (1 point), hypertension history (1 point), age of ≥ 75 years (2 points), diabetes mellitus history (1 point), prior stroke/transient ischemic attack/thromboembolism (2 points), vascular disease history (1 point), age of 65 to 74 years (1 point), and female sex (1 point). We also measured the frequency of the individual conditions that made up the score. Overall, the CHA₂DS₂-VASc score ranges from 0 to 9. At the time of our observation of the analysis population, major professional societies recommend the use of an anticoagulation to prevent stroke in individuals with a score of ≥ 2 ; we, therefore, excluded residents with CHA₂DS₂-VASc score of 0 and 1.²

We also assessed for the presence of the following bleeding predisposing conditions as defined by categorical variables available establishing the presence of each in MDS. These included cirrhosis, anemia, renal disease (ie, renal insufficiency, renal failure, or end-stage renal disease in the 7 days preceding index encounter), dialysis, and internal bleeding. Other comorbid conditions we analyzed included coronary artery disease, chronic obstructive pulmonary disease, arthritis, and cancer. Finally, we measured the use of oral antiplatelet medication (including aspirin, P2Y₁₂ inhibitors, and vorapaxar) given previous research suggesting that providers may elect not to prescribe anticoagulation for patients taking antiplatelet medications.¹¹ The MDS does not contain information about mechanical heart valve or pulmonary embolism, which also require anticoagulation. Although these conditions are available in Medicare Part A, they would be documented only for those individuals with a recent hospitalization where these conditions were relevant from a billing standpoint. MDS also contains limited information about deep vein thrombosis. We, therefore, elected to exclude the presence of mechanical heart valve, pulmonary embolism, or deep vein thrombosis from our analysis.

Statistical Analysis

We used univariate analysis to examine frequencies for demographic characteristics, geriatric conditions, and other resident characteristics for the sample of residents used in our main analysis compared with the overall sample of residents. We then compared each of these characteristics in the analysis population stratifying by anticoagulation status. Finally, we further stratified these characteristics by type of anticoagulation (warfarin versus DOAC).

To measure the adjusted association of each of the 6 geriatric conditions with anticoagulation use, we built 6 binomial logistic regression models with

generalized estimating equations, that is, 1 for each geriatric condition, with each model adjusting for the same demographic and other resident characteristics. We selected these variables for adjustment on the basis of the clinical expertise of our investigative team (A. K., J. G., D. M.) as well as our prior work.⁵ To account for clustering by the facility, we included a random effect at the facility level. We used the same approach to measure the adjusted association of the 6 geriatric conditions with DOAC use (compared with warfarin). We built our models with the goal of identifying markers as opposed to defining a mechanism of effect or mediators for the underlying conditions that explain the associations we found. In a sensitivity analysis, we included all 6 geriatric conditions in the same model to assess for the discrete effect of individual geriatric conditions.

We also performed a sensitivity analysis to remeasure the association of geriatric conditions with anticoagulation use and type using a less stringent requirement for Part D coverage (4 months up to and including month of index assessment) given the large numbers of patients excluded on the basis of exclusion criteria.

We conducted all measurements using Statistical Analysis Software 9.4.¹² The University of Massachusetts medical school institutional review board approved our study. Although we are not able to share our data with other investigators, we have included an appendix with the codes we used to identify patients with AF and adequate dosing to suggest exposure to therapeutic AC (Table S2).

RESULTS

Analysis Sample Versus Excluded Sample

We identified 382 290 residents with AF who were part of the LTC population from July to December 2015. Of these, we included 222 935 residents in our main analysis (analysis population) and excluded 159 355 because either they did not have continuous Medicare Part D coverage or their index assessment occurred too soon after hospitalization (Figure).

Compared with the excluded population, the analysis population tended to be older, less often White non-Hispanic (81.8 versus 85.5), and women (67.5 versus 60.3). In terms of geriatric conditions, the analysis population had experienced significantly fewer falls than the excluded population (6.3 versus 13.4). The analysis population also less frequently had severe ADL dependency, mobility impairment, and intentional weight loss. Otherwise, the analysis population resembled the excluded population in terms of geriatric conditions and other resident characteristics (Table S1).

Analysis Sample

Resident Characteristics

In the analysis sample, 59 866 residents (26.9%) were taking anticoagulation at the time of their index assessments (Table 1). The majority of residents in our sample were White non-Hispanic, and women. In general, the age distribution was similar in residents on anticoagulation compared with those off anticoagulation except that the on-anticoagulation group had fewer residents aged ≥ 90 . Indeed, only 20.8% of the population of residents on anticoagulation were aged ≥ 90 versus 26.8% of the population off anticoagulation.

Geriatric Conditions

Fewer residents who were on anticoagulation had fallen in the past 180 days compared with those not on anticoagulation (3.8% versus 7.2%). Similarly, fewer residents on anticoagulation had severe ADL dependency (ADL score, 21–28) compared with the group off anticoagulation (21.6% versus 23.8%). There was a roughly equal percentage of residents on and off anticoagulation who had mobility impairment. The percentage of residents with severe cognitive impairment was lower among those on anticoagulation compared with those off anticoagulation (24.1% versus 28.2%). In terms of BMI, the group on anticoagulation had fewer residents in the underweight group compared with the group off anticoagulation (3.1% versus 5.9%). There was also a difference between groups on and off anticoagulation in terms of the percentage with unintentional weight loss (4.3% versus 5.1%). CHA₂DS₂-VASc score was higher among residents on anticoagulation. By contrast, fewer of the residents on anticoagulation had bleeding predisposing conditions. This included fewer residents with cirrhosis, anemia, renal disease, and dialysis (Table 1).

In terms of the comparison between residents on warfarin compared with residents on DOACs, we observed more residents aged ≥ 90 years old in the warfarin versus DOAC cohorts (22.1% versus 17.9%). Otherwise, there were no sizable differences between the 2 groups in the distribution of resident characteristics (Table 2).

Multivariable Analyses

Multivariable analyses (Table 3) demonstrated adjusted associations between many of the geriatric conditions and anticoagulation use. Residents who had a recent fall had 49% lower odds of any anticoagulation use (odds ratio [OR], 0.51; 95% CI, 0.48–0.53) compared with residents who had no falls recently. Compared with residents with mild ADL dependency, residents with moderate or severe ADL

Table 1. Demographics, Geriatric Conditions, and Other Resident Characteristics Among LTC Residents With AF on Anticoagulation Versus off Anticoagulation

	On anticoagulation N=59 866 (26.9)	Off anticoagulation N=163 069 (73.1)	P value
Demographics			
Age categories, y			<0.001
≤69	6465 (10.8)	15 804 (9.7)	
70–79	14 343 (24.0)	36 160 (22.2)	
80–84	12 097 (20.2)	29 901 (18.3)	
85–89	14 522 (24.3)	37 546 (23.0)	
≥90	12 439 (20.8)	43 658 (26.8)	
Race/Ethnicity			<0.001
White non-Hispanic	50 091 (83.7)	132 172 (81.1)	
Black non-Hispanic	5415 (9.0)	16 631 (10.2)	
Hispanic	2129 (3.6)	6699 (4.1)	
Other ^{††}	2231 (3.7)	7567 (4.6)	
Female sex	40 859 (68.3)	109 370 (67.1)	<0.001
Geriatric conditions			
Fall within past 180 d	2254 (3.8)	11 734 (7.2)	<0.001
ADLs*			<0.001
Mild (0–12)	13 652 (22.8)	29 988 (18.4)	
Moderate (13–20)	33 302 (55.6)	94 345 (57.9)	
Severe (21–28)	12 912 (21.6)	38 736 (23.8)	
Mobility impairment [†]	33 170 (55.4)	88 610 (54.3)	<0.001
Cognitive impairment [‡]			<0.001
None	26 614 (44.5)	66 559 (40.8)	
Moderate	18 494 (30.9)	49 324 (30.2)	
Severe	14 404 (24.1)	45 910 (28.2)	
Missing	354 (0.6)	1276 (0.8)	
BMI, kg/m ^{2§}			<0.001
<18.5	1861 (3.1)	9600 (5.9)	
18.5–29.9	34 138 (57.0)	105 048 (64.4)	
30–34.9 (class I obesity)	11 106 (18.6)	23 842 (14.6)	
35–39.9 (class II obesity)	5740 (9.6)	10 812 (6.6)	
≥40 (class III obesity)	5301 (8.9)	8671 (5.3)	
Missing	1720 (2.9)	5098 (3.1)	
Weight loss			<0.001
Intentional	850 (1.4)	1987 (1.2)	
Unintentional	2589 (4.3)	8385 (5.1)	
No weight loss	56 160 (93.8)	151 646 (93.0)	
Missing	267 (0.4)	1051 (0.6)	
Other resident characteristics			
CHA ₂ DS ₂ -VASc score, [¶] mean (SD)	5.07 (1.42)	4.74 (1.40)	<0.001
2–4	21 539 (36.0)	75 186 (46.1)	
5–6	28 675 (47.9)	69 398 (42.6)	
7+	9652 (16.1)	18 485 (11.3)	
Other comorbidities			
CAD	19 191 (32.1)	55 936 (34.3)	<0.001
COPD	19 381 (32.4)	50 990 (31.3)	<0.001
Arthritis	21 860 (36.5)	57 929 (35.5)	<0.001

(Continued)

Table 1. (Continued)

	On anticoagulation N=59 866 (26.9)	Off anticoagulation N=163 069 (73.1)	P value
Cancer	3775 (6.3)	12 291 (7.5)	<0.001
Bleeding predisposing conditions			
Cirrhosis	223 (0.4)	1149 (0.7)	<0.001
Anemia	23 608 (39.4)	68 760 (42.2)	<0.001
Renal disease [#]	10 403 (17.4)	32 745 (20.1)	<0.001
Dialysis	770 (1.3)	3488 (2.1)	<0.001
Internal bleeding	880 (1.5)	2073 (1.3)	<0.001
Antiplatelet medication use**	1764 (2.9)	14 797 (9.1)	<0.001

Numbers in parenthesis indicate percentages (either of population on AC or off AC). In this box, the number would be "10.8% of population on anticoagulation in our study had an age of less than or equal to 69.

ADLs indicates activities of daily living; AF, atrial fibrillation; BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; and LTC, long-term care.

*Following an established method in the literature, we generated a score (range, 0–28) based on dependencies in 7 ADLs, including dressing, eating, toilet use, bathing, transfer, and continence.¹³

[†]Defined as resident has not walked in a room or a corridor in the 7 days before the index assessment date.⁸

[‡]Moderate to severe cognitive impairment is indicated if the resident had short-term memory problem and his or her cognitive skills for daily decision making are moderately or severely impaired, or the Brief Interview for Mental Status score of the resident is ≤ 12 .⁹

[§]BMI < 18.5 kg/m², as recommended by World Health Organization to correlate with being underweight.¹⁰

^{||}Weight loss of $\geq 5\%$ in the past month or $\geq 10\%$ in the past 6 months.

[¶]CHA₂DS₂-VASc score includes congestive heart failure, hypertension, age, diabetes mellitus, stroke, vascular disease, and sex, each of which is available within the minimum data set.

[#]Active diagnosis of renal insufficiency, renal failure, or end-stage renal disease in the 7 days preceding index encounter.

**Including oral agents (aspirin, P2Y₁₂ inhibitors, and vorapaxar).

††Other, Asian, North American Native, and unknown.

dependency were less likely to use anticoagulation (OR, 0.73; 95% CI, 0.71–0.75; and OR, 0.67; 95% CI, 0.65–0.69, respectively). Mobility impairment had no association with anticoagulation use. Severe and moderate cognitive impairment was associated with decreased anticoagulation use (OR, 0.91; 95% CI, 0.89–0.93; and OR, 0.75; 95% CI, 0.73–0.77, respectively). Being underweight (BMI < 18.5 kg/m²) was associated with a 46% reduction in the odds of being on anticoagulation (OR, 0.54; 95% CI, 0.51–0.56). Similarly, unintentional weight loss was associated with a 17% decrease in the odds of anticoagulation use (OR, 0.83; 95% CI, 0.79–0.87).

Geriatric conditions were also associated with choice of a DOAC use versus warfarin albeit to a lesser extent than the choice to be on or off anticoagulation (Table 3). Specifically, residents with a fall history, low BMI, and unintentional weight loss were more likely to be on a DOAC (odds ratios ranging from 1.11 to 1.26), whereas residents with moderate or severe ADL dependency were slightly less likely to be on a DOAC (OR, 0.92; 95% CI, 0.88–0.96; and OR, 0.90; 95% CI 0.85–0.95, respectively). There was no sizable relationship between the type of anticoagulation and mobility impairment or cognitive impairment. The sensitivity analysis in which we included all geriatric conditions in the same model did not differ from the associations we measured in the single condition model (Table S3). Examining the impact of reducing the number of months of Part D coverage required for

a resident to contribute to the analysis population also did not identify any significant changes.

DISCUSSION

We identified a large sample of LTC residents with AF and risk factors for which there are guideline recommendations for being on anticoagulation. Despite the recommendations, only 26.9% of residents were on anticoagulation. Geriatric conditions, including recent fall, ADL dependency, severe cognitive impairment, low BMI, and unintentional weight loss were all associated with lower anticoagulation use, even after adjustment for multiple, other resident characteristics. The type of anticoagulation was not as significantly associated with geriatric conditions although residents with a fall history, low BMI, and unintentional weight loss were more likely to be on a DOAC.

We found similarities between our study findings and those published in the literature. Specifically, multiple previous studies found that moderate and severe cognitive impairment were associated with lower anticoagulation use.^{14,15} Quilliam et al¹⁵ found that moderate cognitive impairment predicted a 7% lower odds of anticoagulation or antiplatelet use and severe cognitive impairment predicted a 37% lower odds of anticoagulation or antiplatelet use. Similarly, Gurwitz et al¹⁴ found that dementia (without specified severity) was associated with a 41% decrease in the odds of anticoagulation use. We did not find as large a magnitude decrease in anticoagulation

Table 2. Demographics, Geriatric Conditions, and Other Resident Characteristics Among LTC Residents With AF Who Took Warfarin, DOACs, or Other Anticoagulant Drugs

	Warfarin N=41 744 (69.7)	DOAC* N=17 418 (29.1)	Other anticoagulant regimens† N=674 (1.1)	P value
Demographics				
Age categories, y				<0.001
≤69	4385 (10.5)	1949 (11.2)	131 (19.4)	
70–79	9642 (23.1)	4491 (25.8)	210 (31.2)	
80–84	8238 (19.7)	3728 (21.4)	131 (19.4)	
85–89	10 260 (24.6)	4135 (23.7)	127 (18.8)	
≥90	9249 (22.1)	3115 (17.9)	75 (11.1)	
Race/Ethnicity				<0.001
White non-Hispanic	35 280 (84.5)	14 356 (82.4)	455 (67.5)	
Black non-Hispanic	3696 (8.8)	1605 (9.2)	114 (16.9)	
Hispanic	1322 (3.2)	750 (4.3)	57 (8.5)	
Other ^{§§}	1476 (3.5)	707 (4.1)	48 (7.1)	
Female sex	28 360 (67.9)	12 070 (69.3)	429 (63.6)	<0.001
Geriatric conditions				
Fall within past 180 d	1514 (3.6)	681 (3.9)	59 (8.8)	<0.001
ADLs [‡]				
Mild (0–12)	9405 (22.5)	4194 (24.1)	53 (7.9)	<0.001
Moderate (13–20)	23 405 (56.0)	9532 (54.7)	365 (54.2)	
Severe (21–28)	8964 (21.5)	3692 (21.2)	256 (38.0)	
Mobility impairment [§]	23 210 (55.6)	9480 (54.4)	480 (71.2)	<0.001
Cognitive impairment				<0.001
None	18 689 (44.7)	7602 (43.6)	323 (47.9)	
Moderate	12 904 (30.9)	5408 (31.0)	182 (27.0)	
Severe	9923 (23.8)	4320 (24.8)	161 (23.9)	
Missing	258 (0.6)	88 (0.5)	8 (1.2)	
BMI, kg/m ^{2¶}				<0.001
<18.5	1199 (2.9)	634 (3.6)	28 (4.2)	
18.5–40	35 678 (85.4)	14 727 (84.6)	579 (85.9)	
18.5–29.9	23 677 (56.7)	10 047 (57.7)	414 (61.4)	
30–34.9	7873 (18.8)	3126 (17.9)	107 (15.9)	
35–39.9	4128 (9.9)	1554 (8.9)	58 (8.6)	
≥40	3731 (8.9)	1532 (8.8)	38 (5.6)	
Missing	1166 (2.8)	525 (3.0)	29 (4.3)	
Weight loss [#]				<0.001
Intentional	592 (1.4)	247 (1.4)	11 (1.6)	
Unintentional	1710 (4.1)	829 (4.8)	50 (7.4)	
No weight loss	39 301 (94.1)	16 249 (93.3)	610 (90.5)	
Missing	171 (0.4)	93 (0.5)	3 (0.4)	
Other resident characteristics				
CHA ₂ DS ₂ -VASc Score (mean, SD)**	5.08, 1.41	5.06, 1.44	4.77, 1.49	<0.001
2–4	14 870 (35.6)	6354 (36.5)	315 (46.7)	
5–6	20 202 (48.4)	8191 (47.0)	282 (41.8)	
7+	6702 (16.0)	2873 (16.5)	77 (11.4)	
Other comorbidities				
CAD	13 535 (32.4)	5436 (31.2)	220 (32.6)	0.017

(Continued)

Table 2. (Continued)

	Warfarin N=41 744 (69.7)	DOAC* N=17 418 (29.1)	Other anticoagulant regimens† N=674 (1.1)	P value
COPD	13 306 (31.9)	5823 (33.4)	252 (37.4)	<0.001
Arthritis	15 630 (37.4)	5999 (34.4)	231 (34.3)	<0.001
Cancer	2690 (6.4)	1020 (5.9)	65 (9.6)	<0.001
Individual bleeding predisposing conditions				
Cirrhosis	159 (0.4)	60 (0.3)	4 (0.6)	0.514
Anemia	16 505 (39.5)	6792 (39.0)	311 (46.1)	<0.001
Renal disease††	7654 (18.3)	2627 (15.1)	122 (18.1)	<0.001
Dialysis	667 (1.6)	89 (0.5)	14 (2.1)	<0.001
Internal bleeding	605 (1.4)	263 (1.5)	12 (1.8)	0.678
Antiplatelet medication use††	1290 (3.1)	427 (2.5)	47 (7.0)	<0.001

Number in parenthesis refers to % of population of the given drug (Warfarin, DOAC, or Other) with X variable. In this box, 10.5 means 10.5% of the population on warfarin had an age of less than or equal to 69.

ADLs indicates activities of daily living; AF, atrial fibrillation; BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; DOACs, direct oral anticoagulants; and LTC, long-term care.

*DOACs included apixaban, rivaroxaban, dabigatran, and edoxaban at a total daily dosage consistent with stroke prophylaxis for patients with AF (technical appendix with dosage requirements available upon request).

†Included those taking multiple anticoagulants (n=10) in addition to those taking injectable anticoagulants.

‡Following an established method in the literature, we generated a score (range, 0–28) based on dependencies in 7 ADLs, including dressing, eating, toilet use, bathing, transfer, and continence.¹³

§Defined as resident has not walked in a room or a corridor in the 7 days before the index assessment date.⁸

||Moderate to severe cognitive impairment is indicated if the resident had short-term memory problem and his or her cognitive skills for daily decision making are moderately or severely impaired, or the Brief Interview for Mental Status score of the resident is ≤ 12 .⁹

¶BMI <18.5 kg/m², as recommended by World Health Organization to correlate with being underweight.¹⁰

#Weight loss of $\geq 5\%$ in the past month or $\geq 10\%$ in the past 6 months.

**CHA₂DS₂-VASc score includes congestive heart failure, hypertension, age, diabetes mellitus, stroke, vascular disease, and sex, each of which is available within the Minimum Data Set.

††Active diagnosis of renal insufficiency, renal failure or end-stage renal disease in the 7 days preceding index encounter.

‡‡Including oral agents (aspirin, P2Y₁₂ inhibitors, and vorapaxar).

§§Other, Asian, North American Native, and unknown.

use (only a 25% reduction in the odds) for residents with severe cognitive impairment. Differences in the outcome in the study by Quilliam et al, which included both antiplatelet and anticoagulant use and severity of cognitive impairment, and the study by Gurwitz et al, make comparisons across these studies difficult. In terms of fall history, Gurwitz et al found a trend toward a fall history predicting lower anticoagulation use (OR, 0.74; 95% CI, 0.53–1.01). The shorter time frame in our definition (ie, 6 months) may explain the greater decrease in anticoagulation use we found. Residents who had isolated or remote falls may be reoffered anticoagulation. The sample in the study by Gurwitz included 30 LTC facilities located in New England, Quebec, and Ontario, whereas our sample included 6634 facilities across the United States. Previous studies have noted regional variation in anticoagulation prescription.¹⁶ We did not measure the variation in prescription of anticoagulation across regions or the difference in the association of anticoagulation with geriatric conditions in these regions.

There are several implications to our study findings. Each of the geriatric conditions we studied (apart from mobility impairment) was associated with decreased use of anticoagulation. This included recent

falls. Although it is not clear exactly how many times each patient fell in our study, evidence from previously published work suggests that a patient would need to fall >300 times in a year to offset the benefit of anticoagulation.¹⁷ Although most clinicians and residents would not likely tolerate so many falls before discontinuing anticoagulation, the finding from that prior publication appears to warrant persistence with anticoagulation for residents with a limited number of falls. For residents with cognitive impairment, preventing stroke with potential for further cognitive impairment is of paramount significance. Ambulatory providers often discontinue anticoagulation for the reason of nonadherence.¹⁸ Adherence becomes virtually moot in the LTC population and in residents who previously struggled with adherence in the ambulatory setting. Clinicians should revisit anticoagulation use once a resident enters the LTC setting. Similar arguments may be made for ADL-dependent residents and those with malnutrition/weight loss for whom a new stroke may be catastrophic.

Professional societies like the American Heart Association do not have specific guidelines on how long to continue prescribing anticoagulation such

Table 3. Association of Geriatric Conditions With Anticoagulant Use With and Without Adjustment for Resident Characteristics*

Geriatric condition	OR for any anticoagulation use vs no use (95% CI) with/without adjustment	OR for DOAC vs warfarin use (95% CI) with/without adjustment
Model 1: recent fall 1–6 mo	0.51 (0.48–0.53)/0.51 (0.48–0.53)	1.11 (1.01–1.22)/1.08 (0.99–1.19)
Model 2: ADL dependency [†]		
Mild (0–12)	Ref	Ref
Moderate (13–20)	0.73 (0.71–0.75)/0.78 (0.76–0.79)	0.92 (0.88–0.96)/0.91 (0.87–0.96)
Severe (21–28)	0.67 (0.65–0.69)/0.73 (0.71–0.75)	0.90 (0.85–0.95)/0.92 (0.87–0.98)
Model 3: mobility impairment [‡]	1.01 (0.99–1.03)/1.04 (1.02–1.06)	0.95 (0.91–0.99)/0.96 (0.92–0.99)
Model 4: cognitive impairment [§]		
None	Ref	Ref
Moderate	0.91 (0.89–0.93)/0.94 (0.92–0.96)	1.01 (0.97–1.06)/1.03 (0.99–1.08)
Severe	0.75 (0.73–0.77)/0.78 (0.77–0.80)	1.04 (0.99–1.09)/1.07 (1.02–1.12)
Model 5: BMI, kg/m		
<18.5	0.54 (0.51–0.56)/0.53 (0.51–0.56)	1.26 (1.14–1.39)/1.28 (1.16–1.41)
18.5–40	Ref	Ref
≥40	1.67 (1.61–1.73)/1.68 (1.61–1.74)	1.00 (0.94–1.07)/1.00 (0.93–1.06)
Model 6: weight loss [¶]		
None	Ref	Ref
Intentional	1.13 (1.04–1.23)/1.16 (1.07–1.25)	1.04 (0.89–1.21)/1.01 (0.87–1.17)
Unintentional	0.83 (0.79–0.87)/0.83 (0.80–0.87)	1.18 (1.08–1.28)/1.17 (1.08–1.28)

ADL indicates activity of daily living; AF, atrial fibrillation; BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; DOAC, direct oral anticoagulant; and OR, odds ratio.

*These characteristics included race/ethnicity, CHA₂DS₂-VASc score, internal bleeding, cirrhosis, anemia, dialysis, kidney failure, cancer, coronary artery disease, arthritis, chronic obstructive pulmonary disease, and antiplatelet use. We did not include sex and age separately, as we had already accounted for them as part of the CHA₂DS₂-VASc score.

[†]Following an established method in the literature, we generated a score (range, 0–28) based on dependencies in 7 ADLs, including dressing, eating, toilet use, bathing, transfer, and continence.¹³

[‡]Defined as resident has not walked in a room or a corridor in the 7 days before the index assessment date.⁸

[§]Moderate to severe cognitive impairment is indicated if the resident had short-term memory problem and his/her cognitive skills for daily decision making are moderately or severely impaired, or the Brief Interview for Mental Status score of the resident is ≤12.⁹

^{||}BMI <18.5 kg/m², as recommended by World Health Organization to correlate with being underweight.¹⁰

[¶]Weight loss of ≥5% in the past month or ≥10% in the past 6 months.

as in those residents near the end of life. A separate panel of experts, the Screening Tool of Older Persons Prescriptions in Frail Adults With Limited Life Expectancy group, reviewed the issue and decided

not to include anticoagulation among a list of other drugs such as aspirin and cholesterol-lowering medication for which deprescription would be advisable.¹⁹ The panel found it difficult to determine when the risk

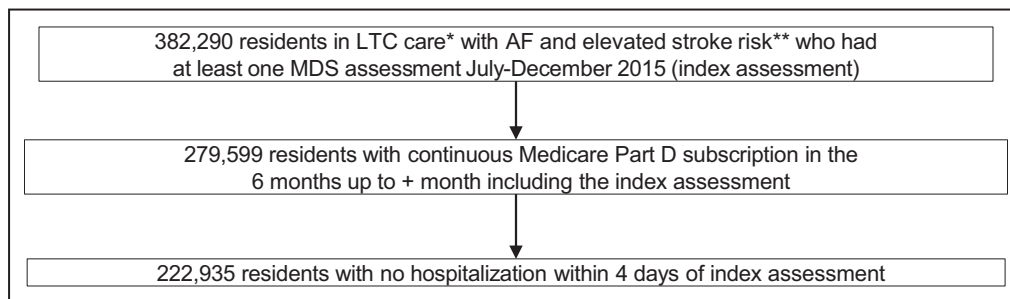


Figure 1. Flow diagram to illustrate process of assembling analysis sample.

Flow diagram that shows the process by which the analysis sample was selected. *We defined LTC patients as the ones with at least 100 days in skilled nursing facility before index encounter. **Stroke risk based on CHA₂DS₂-VASc score ≥2; in these individuals, the American Heart Association and other professional societies recommend anticoagulation.² AF indicates atrial fibrillation; LTC, long term care; and MDS, minimum data set.

and burden of anticoagulation outweighs the benefits of preventing a stroke. We encourage further research on the net clinical benefit of anticoagulation (accounting for strokes and bleeding) in different residents in the LTC population including subsets based on geriatric conditions. Although we found that clinicians were somewhat more likely to prescribe DOACs in residents with geriatric conditions, the explanation is not certain. We encourage further research to further understand prescriber decision making with regard to anticoagulation type for patients with geriatric conditions.

We acknowledge several limitations of our study. Detailed clinical data on the type of AF and AF disease history were not available in our administrative data sets. We had no means of validating the basic diagnosis of AF. Some providers may choose not to treat AF that occurred in the distant past or was short lasting. Nevertheless, evidence has emerged that even isolated AF recurs frequently and predicts a higher rate of stroke compared with residents without any AF.^{20,21} Another limitation is that we did not have access to medications reimbursed through alternate payers. Given that residents covered by Part D pay premiums for medication coverage, we anticipate the number of residents being covered by Part D but having an alternate payer to be low. Our approach follows other recent examples in the literature.⁶ Our results from the analysis population represent a distinct portion of the LTC population who had continuous Part D coverage in the 7 months leading up to and including anticoagulation use. We identified several differences in this population, but these differences did not uniformly represent a sicker or more frail population. Rather, we noted some evidence of greater comorbid disease and frailty and other evidence of less of each. Our sensitivity analysis reducing the continuous enrollment did not meaningfully change the associations we found. Another limitation is that we did not have information about access or use of specialty consultation such as with a cardiologist. Previous studies^{13,22} have indicated that cardiology providers are more likely to prescribe anticoagulation, but the exact relationship in nursing home residents is not known. Finally, we did not have information regarding adherence to an anticoagulation regimen and did not have detailed clinical information including laboratories, surgical history (such as history of left atrial appendage closure procedure), or clinician documentation about stroke risk factors. Absence of these data may have excluded some residents with elevated stroke risk from our analysis set (particularly those aged <75) and included others with contraindications to anticoagulation such as those with a history of intracranial bleeding of intralobar location. Nevertheless, the MDS data set we used contains a comprehensive set of comorbid data

including the most prevalent conditions that predict stroke and bleeding. These data contain rich physical and cognitive status information that is distinctive compared with electronic health record–based analyses. Moreover, these data are available for millions of nursing home residents, and we were able to link these assessments to medication and usage data to describe the experience of >200 000 residents with AF and elevated stroke risk across the United States, bolstering the generalizability of our results.

CONCLUSIONS

In conclusion, in our national sample of LTC residents with AF and elevated stroke risk, we found that geriatric conditions including recent fall, ADL dependency, cognitive impairment, low BMI, and unintentional weight loss were associated with lower anticoagulation use. Professional societies and policymakers should provide greater guidance to clinicians treating these residents about which residents with geriatric conditions should receive anticoagulation.

ARTICLE INFORMATION

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Supplementary Material

Tables S1–S3

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SUPPLEMENTAL MATERIAL

Table S1. Comparison of Characteristics between LTC Residents in the Analysis Population vs. those Excluded from the Analysis Population.

	Analysis Population N = 222,935 (58.3)	Excluded from Analysis Population N = 159,355 (41.7)	P value
Demographics			
Age categories			<0.001
<= 69	22,269 (10.0)	15,443 (9.7)	
70-79	50,503 (22.7)	35,036 (22.0)	
80-84	41,998 (18.8)	30,524 (19.2)	
85-89	52,068 (23.4)	38,273 (24.0)	
>=90	56,097 (25.2)	40,079 (25.2)	
Race/Ethnicity			<0.001
White non-Hispanic	182,263 (81.8)	136,287 (85.5)	
Black non-Hispanic	22,046 (9.9)	12,239 (7.7)	
Hispanic	8,828 (4.0)	4,221 (2.6)	
Other	9,798 (4.4)	6,608 (4.1)	
Female Sex	150,229 (67.4)	96,148 (60.3)	<0.001
Geriatric Conditions			
Fall within past 180 days	13,988 (6.3)	21,326 (13.4)	<0.001
ADL*			<0.001
Mild (0-12)	43,640 (19.6)	18,563 (11.6)	
Moderate (13-20)	127,647 (57.3)	102,895 (64.6)	
Severe (21-28)	51,648 (23.2)	37,897 (23.8)	
Mobility impairment†	121,780 (54.6)	89,379 (56.1)	<0.001
Cognitive impairment‡			<0.001
None	93,173 (41.8)	78,762 (49.4)	
Moderate	67,818 (30.4)	44,683 (28.0)	
Severe	60,314 (27.1)	34,142 (21.4)	
Missing	1,630 (0.7)	1,768 (1.1)	
BMI, kg/m ² §			<0.001
< 18.5	11,459 (5.1)	10,215 (6.4)	
18.5 - 40	190,684 (85.5)	134,053 (84.1)	
18.5-29.9	139,186 (62.4)	100,543 (63.1)	
30-34.9 (Class I)	34,948 (15.7)	22,671 (14.2)	

35-39.9 (Class II)	16,552 (7.4)	10,843 (6.8)	
≥40 (Class III)	13,972 (6.3)	9,384 (5.9)	
Missing	6,818 (3.1)	5,699 (3.6)	
Weight Loss**			<0.001
Intentional	2,837 (1.3)	2,648 (1.7)	
Unintentional	10,974 (4.9)	9,756 (6.1)	
No weight loss	207,806 (93.2)	145,869 (91.5)	
Missing	1,318 (0.6)	1,082 (0.7)	
Other Resident			
CHA ₂ DS ₂ -VASc Score - mean (SD) ^{††}	4.83 (1.42)	4.68 (1.37)	<0.001
2-4	96,725 (43.4)	75,796 (47.6)	
5-6	98,073 (44.0)	67,865 (42.6)	
7+	28,137 (12.6)	15,694 (9.8)	
Other Comorbidities			
CAD	75,127 (33.7)	60,357 (37.9)	<0.001
COPD	70,371 (31.6)	53,297 (33.4)	<0.001
Arthritis	79,789 (35.8)	53,428 (33.5)	<0.001
Cancer	16,066 (7.2)	16,081 (10.1)	<0.001
CHF	96,557 (43.3)	74,775 (46.9)	<0.001
Hypertension	201,141 (90.2)	141,197 (88.6)	<0.001
Diabetes	88,514 (39.7)	62,779 (39.4)	0.055
Prior Stroke	54,127 (24.3)	31,304 (19.6)	<0.001
Vascular Disease	39,287 (17.6)	24,962 (15.7)	<0.001
Individual Bleeding			
Cirrhosis	1,372 (0.6)	1,442 (0.9)	<0.001
Anemia	92,368 (41.4)	66,207 (41.5)	0.480
Renal disease ^{‡‡}	43,148 (19.4)	39,355 (24.7)	<0.001
Dialysis	4,258 (1.9)	6,023 (3.8)	<0.001
Internal bleeding	2,953 (1.3)	2,447 (1.5)	<0.001

AC, anticoagulation; ADL, activity of daily living; AF, atrial fibrillation; BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; LTC, long term care.

* Following an established method in the literature, we generated a score (range = 0-28) based on dependencies in seven ADLs, including dressing, eating, toilet use, bathing, transfer, and continence.²¹

† Defined as resident has not walked in a room or a corridor in the 7 days before the index assessment date.⁸

‡ Moderate to severe cognitive impairment is indicated if the resident had short-term memory problem and his/her cognitive skills for daily decision making are moderately or severely impaired, or the Brief Interview for Mental Status score of the resident is 12 or less.⁹

§ BMI less than 18.5 kg/m², as recommended by World Health Organization to correlate with being underweight.¹⁰

** Weight loss of 5% or more in the last month or 10% or more in the last 6 months

†† CHA₂DS₂-VASc score includes congestive heart failure, hypertension, age, diabetes, stroke, vascular disease, and sex, each of which is available within the Minimum Data Set.

‡‡ Active diagnosis of renal insufficiency, renal failure or end-stage renal disease in the 7 days preceding index encounter.

Table S2.**Definition of Anticoagulation (AC) Status as “on AC”**

Anticoagulants	Exposure Definition (TDD or Total Daily Dose)
Apixaban	TDD \geq 5 mg qd
Warfarin	Any active dose
Rivaroxaban	TDD \geq 15 mg
Dabigatran	TDD \geq 150
Edoxaban	TDD \geq 30
Enoxaparin	TDD $>$ 40
Dalteparin	TDD $>$ 5,000

ICD-Diagnosis Codes for Atrial Fibrillation and Flutter

ICD-10-CM codes	I48.x
ICD-9-CM codes	427.3x

Table S3. Association of All Six Geriatric Conditions in a Single Model with Anticoagulant Use Adjusting for Resident Characteristics*

Geriatric Condition	OR for any AC Use Vs. no Use (95% CI)	OR for DOAC Vs. Warfarin Use (95% CI)
Recent fall 1-6 months	0.52 (0.49-0.54)	1.13 (1.02-1.24)
ADL Dependency [†]		
Mild (0-12)	Ref	Ref
Moderate (13-20)	0.72 (0.70-0.74)	0.92 (0.87-0.97)
Severe (21-28)	0.67 (0.65-0.70)	0.89 (0.83-0.95)
Mobility impairment [‡]	1.13 (1.11-1.16)	0.98 (0.93-1.02)
Cognitive impairment [§]		
None	Ref	Ref
Moderate	0.97 (0.95-1.00)	1.01 (0.97-1.06)
Severe	0.84 (0.81-0.86)	1.06 (1.01-1.11)
BMI, kg/m ^{2**}		
< 18.5	0.56 (0.53-0.59)	1.24 (1.12-1.37)
18.5-40	Ref	Ref
Weight loss ^{††}		
None	Ref	Ref
Intentional	1.09 (1.00-1.19)	1.03 (0.88-1.20)
Unintentional	0.90 (0.86-0.94)	1.18 (1.08-1.29)

AC, anticoagulation; ADL, activity of daily living; AF, atrial fibrillation; BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease, DOAC = direct oral anticoagulant, OR = odds ratio

* These characteristics included race/ethnicity, CHA2DS2-VASc score, internal bleeding, cirrhosis, anemia, dialysis, kidney failure, cancer, coronary artery disease, arthritis, chronic obstructive pulmonary disease, and antiplatelet use. We did not include sex and age separately as we had already accounted for them as part of the CHA2DS2-VASc score.

[†] Following an established method in the literature, we generated a score (range = 0-28) based on dependencies in seven ADLs, including dressing, eating, toilet use, bathing, transfer, and continence.²¹

[‡] Defined as resident has not walked in a room or a corridor in the 7 days before the index assessment date.⁸

[§] Moderate to severe cognitive impairment is indicated if the resident had short-term memory problem and his/her cognitive skills for daily decision making are moderately or severely impaired, or the Brief Interview for Mental Status score of the resident is 12 or less.⁹

** BMI less than 18.5 kg/m², as recommended by World Health Organization to correlate with being underweight.¹⁰

^{††} Weight loss of 5% or more in the last month or 10% or more in the last 6 months