Supplemental Material:

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Model Structure

The Markov model contains 29 states of health. **Appendix Figure 1a** shows the 7 strategies compared – no antithrombotic therapy, aspirin, warfarin (target INR 2-3), dabigatran, apixaban, rivaroxaban, and edoxaban – at the solid black, square decision node. The bracket after the 7 treatment strategies indicates that the sub-trees are attached to each strategy. A simplified list of the Markov states is shown next at the Markov node. The actual model contains 29 states. Many of the states not shown in this figure are additional combination states for several events, such as short-term symptoms after intracerebral hemorrhage and long-term symptoms after embolism, or temporary states that last a single cycle, such as the first month after an intracerebral hemorrhage or ischemic stroke. In addition, there are separate states for each level of functional outcome after intracerebral hemorrhage (that is, Glasgow Outcome Scale score of 3, 4, or 5). At the beginning of the Markov, patients start in the state appropriate to the treatment strategy. For instance, those receiving warfarin start in the state, “Well on Warfarin,” while those not receiving antithrombotic therapy start in the state, “Well off Warfarin.”

Appendix Figure 1b illustrates the chance events that may occur during each monthly cycle. Chance events are denoted by solid black, circular chance nodes. Patients face the same chance events during each monthly cycle of the simulation. Patient-specific decision analyses are performed by setting parameter values for these chance events based upon a given patient’s risk profile for ischemic stroke due to AF, major extracranial hemorrhage, and intracerebral hemorrhage, as well as the choice of

treatment. Chance events include thromboembolism and major bleeding events (intracerebral hemorrhage, subdural hematoma, or non-central nervous system bleeding). After both types of events, patients face death, permanent symptoms (severe or mild), or resolution of symptoms. Finally, patients may die from non-explicitly modeled causes (for example, demographic characteristics; age, gender, or race; excess risk for death following stroke or intracerebral hemorrhage; or excess mortality risk due to major comorbid diseases such as type II diabetes, congestive heart failure, or hypertension). At the end of each monthly cycle, there is a new distribution across the health states shown at the Markov node that reflects the effect of the initial intervention and outcomes of subsequent chance events.

Appendix Figure 2 – *Medication Cards*. As part of a shared decision-making discussion, clinicians can request “Anticoagulant Medication Details” by clicking a tab on the main results screen. The medication cards screen appears, containing information about factors not included quantitatively in the decision analytic model that describe important differences between the oral anticoagulant and antiplatelet agents. Patient focus groups informed the choice of issues to highlight, including factors such as out-of-pocket cost, frequency of necessary laboratory testing, dose frequency, availability of reversal agent, food restrictions, and common significant side effects (other than bleeding).

Appendix Figure 3 – *Clinical Risk Factors* screen. This screen appears within a Hyperspace frame, showing the clinical information that has been extracted from

Clarity® into the AF data mart for this patient. The information also includes their current antithrombotic therapy, if any, and the most recent estimated glomerular filtration rate (eGFR). The example shown is an 80-year old woman with hypertension, type II diabetes mellitus, and an eGFR of 70 ml/min/1.73m^2. Hovering over any risk factor (labile INR in this example) will highlight the relevant definition on the panel to the right. The clinician can add or remove risk factors if they are not correct. Once the clinician is satisfied with that the clinical information is correct she can click the tab labelled “GET RECOMMENDATIONS.” What next appears is the patient’s “personal risks” screen shown in appendix figure 4.

Appendix Figure 4 – *Personal Risk*s screen, displays the patient’s risk of ischemic stroke without oral anticoagulant therapy and their personalized risk of major bleeding while taking oral anticoagulants. The risks are shown both as text and as pictograms on two sides of the balance scale to project the notion of tradeoffs between strokes due to AF and bleeding due to treatment. Bleeding risks are based on treatment with warfarin, and so form an upper limit, as the risk of major hemorrhage with some of the DOACs is less. The CHA_2DS_2VASc and HAS-BLED scores are shown for the clinician’s benefit. When the clinician clicks on the tab labelled “CONTINUE” at the bottom of the screen, the *Results* screen shown in manuscript figure 1 appears.

Appendix Figure 5 – Joint distribution of CHA_2DS_2VASc and HAS-BLED scores across UC Health AF cohort. The greatest concentration of patients is along a diagonal from

the upper left to the lower right hand corner of the figure, between HAS-BLED scores of 1 and 3 and CHA_2DS_2VASc scores between 1 and 5. This highlights the known association between clinical risk factors for both of these scores.

Scoring Details for CHA_2DS_2VASc

Ischemic stroke risk in patients with nonvalvular atrial fibrillation can be quantified by the CHA_2DS_2VASc scoring algorithm.(1) CHA_2DS_2VASc assigns 1 point for each of the following risk factors: **C**ongestive heart failure, **H**ypertension, **A**ge 65 - 74, **D**iabetes, **V**ascular disease (prior myocardial infarction, peripheral arterial disease, or aortic plaque), and female **S**ex **c**ategory (Appendix Table 1). Two points are assigned for a history of **S**troke or transient ischemic attack, and **A**ge ≥ 75 years.

Scoring Details for HAS-BLED

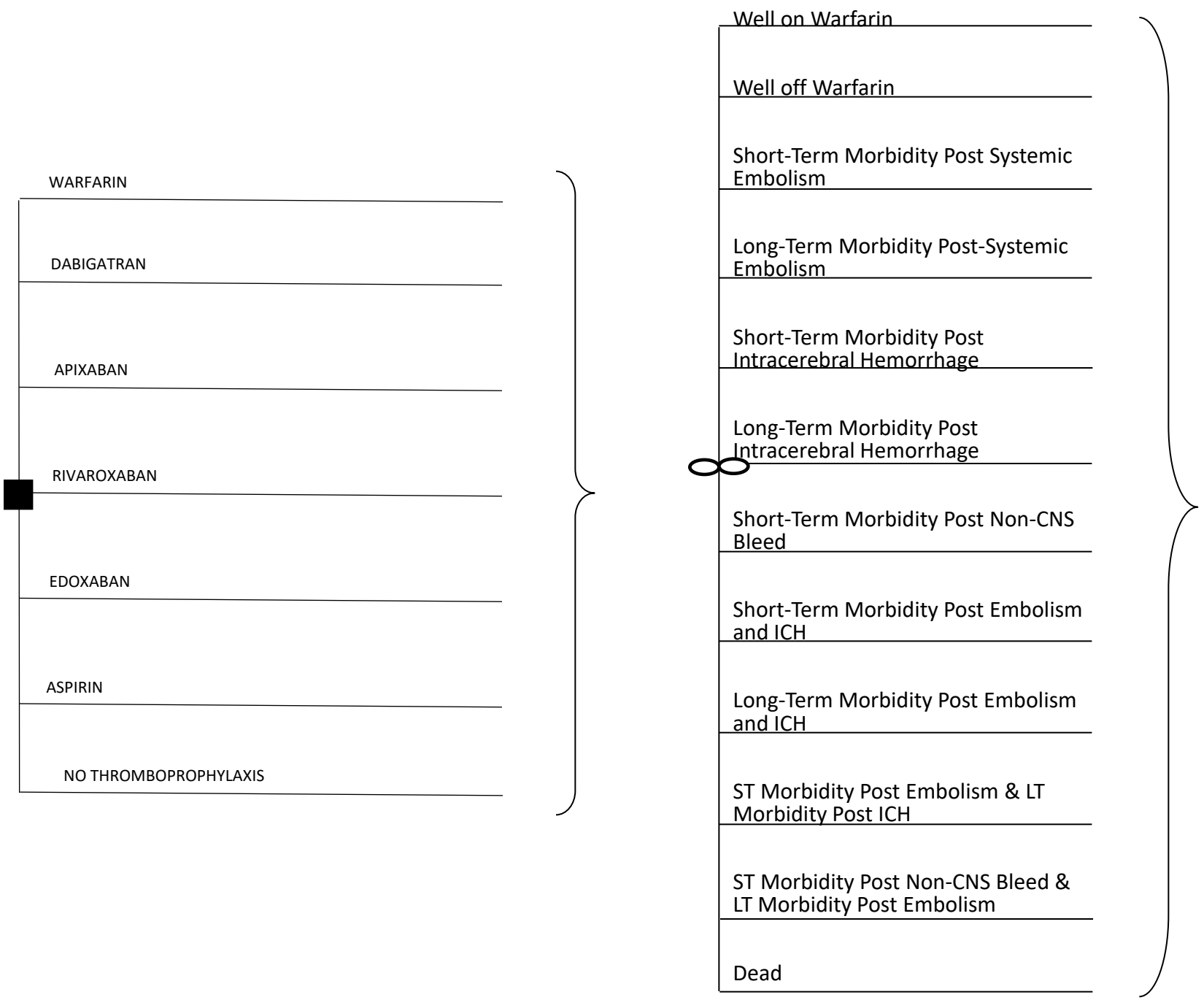
Risk of major bleeding in patients with nonvalvular atrial fibrillation receiving treatment with warfarin can be quantified by the HAS-BLED scoring algorithm.(2) HAS-BLED assigns 1 point for each of the following risk factors: poorly controlled **H**ypertension (systolic blood pressure ≥ 160 mmHg), **A**bnormal renal or liver function (one point each – renal transplantation or dialysis, or serum creatinine ≥ 2.26 mg/dl or 200 umol/L; chronic hepatitis or biochemical evidence of significant hepatic derangement – bilirubin > 2 x upper limit of normal in conjunction with AST/ALT > 3 x upper limit of normal), **S**troke history, **B**leeding history (history of previous bleed or predisposition to bleeding, **L**abile INR (time in therapeutic range < 60%), **E**lderly (age ≥ 65), **D**rugs or alcohol (one point each – alcohol abuse, or concomitant use of antiplatelet or non-steroidal anti-inflammatory drugs).

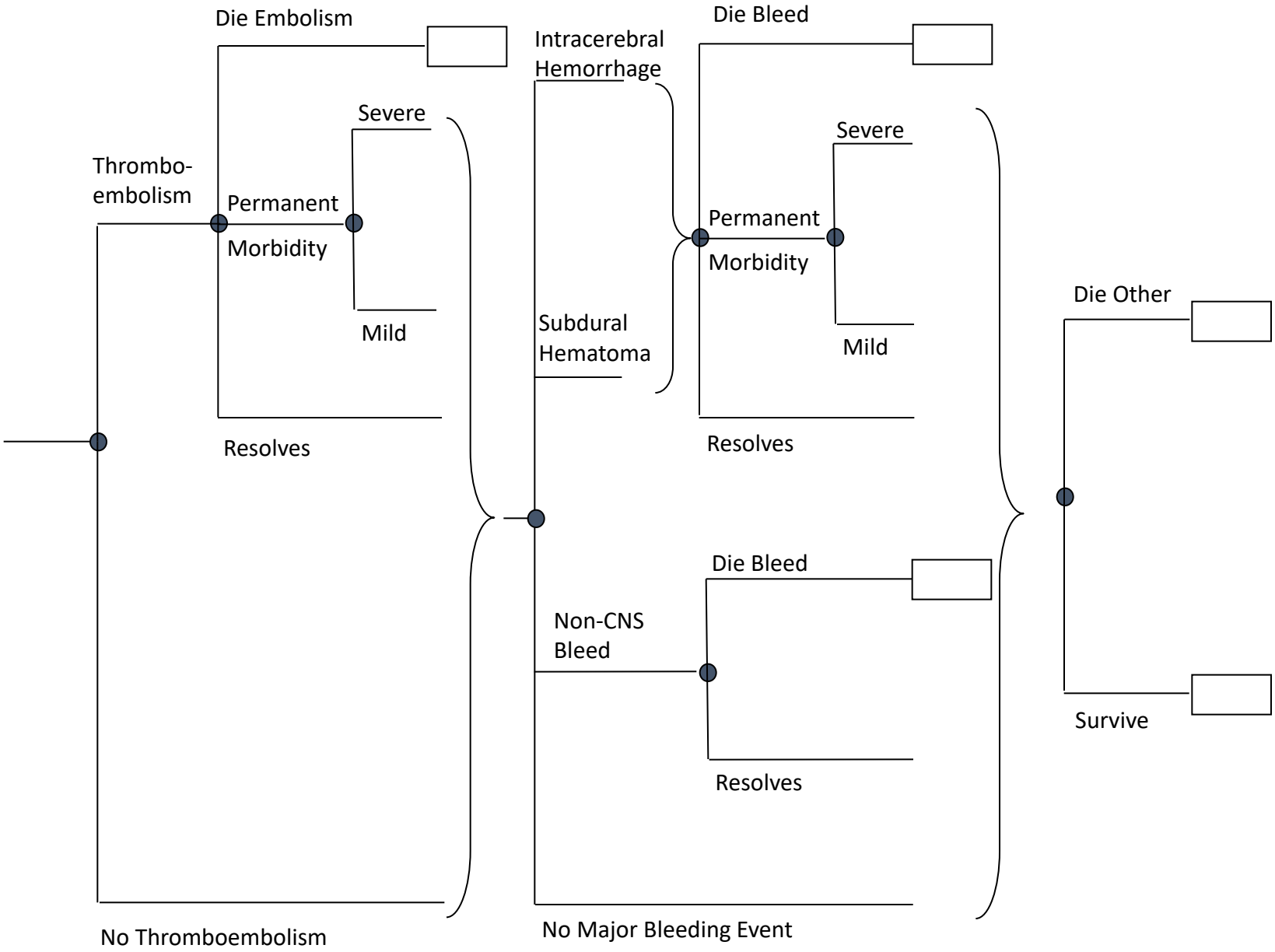
Appendix Table 1. Annual Rate of Ischemic Stroke based on CHA_2DS_2VASc Score.

CHA_2DS_2VASc Score (3)	Annual rate of ischemic stroke (%/year)
0	0.0
1	1.3
2	2.2
3	3.2
4	4.0
5	6.7
6	9.8
7	9.6
8	6.7
9	15.2

Appendix Table 2. Annual Rate of Major Bleeding while receiving warfarin based on HAS-BLED Score.

HAS-BLED Score (2)	Annual rate of major bleeding (%/year)
0	0
1	0.7
2	1.9
3	2.4
4	3.4
5	5.7
6	15.5


WARFARIN
DABIGATRAN
APIXABAN
RIVAROXABAN
EDOXABAN
ASPIRIN
NO THROMBOPROPHYLAXIS
Well on Warfarin
Well off Warfarin
Short-Term Morbidity Post Systemic Embolism
Long-Term Morbidity Post-Systemic Embolism
Short-Term Morbidity Post Intracerebral Hemorrhage
Long-Term Morbidity Post Intracerebral Hemorrhage
Short-Term Morbidity Post Non-CNS Bleed
Short-Term Morbidity Post Embolism and ICH
Long-Term Morbidity Post Embolism and ICH
ST Morbidity Post Embolism & LT Morbidity Post ICH
ST Morbidity Post Non-CNS Bleed & LT Morbidity Post Embolism
Dead


Die Embolism
Thrombo-
embolism
Permanent
Morbidity
Severe
Mild
Resolves
No Thromboembolism
Intracerebral
Hemorrhage
Subdural
Hematoma
Die Bleed
Severe
Permanent
Morbidity
Mild
Resolves
Non-CNS
Bleed
Die Bleed
Resolves
No Major Bleeding Event
Die Other
Survive

DABIGATRAN (Pradaxa)

- **Cost:** $$$$
- **Labs:** Annually
- **Dose Frequency:** Twice a day
- **Reversal Agent**
- **Common Side Effect:** Upset stomach

APIXABAN (Eliquis)

- **Cost:** $$$$
- **Labs:** Annually
- **Dose Frequency:** Twice a day

RIVAROXABAN (Xarelto)

- **Cost:** $$$$
- **Labs:** Annually
- **Dose Frequency:** Daily
- **Take with Food**

WARFARIN (Coumadin)

- **Cost:** $$
- **Labs:** Monthly (or more)
- **Dose Frequency:** Daily
- **Food Restrictions**
- **Reversal Agent**

EDOXABAN (Savaysa)

- **Cost:** $$$
- **Labs:** Annually
- **Dose Frequency:** Daily

ASPIRIN

- **Cost:** $
- **Take with Food**
- **Dose Frequency:** Daily

CLINICAL RISK FACTORS

Items checked and in **bold** are set based on the patient's record in Epic. Please review the information provided. Click any that are incorrect to change them. When the list is correct, click the "Get Recommendations" button at the bottom of the page.

01234567

Joan Q. Patient

Current Treatments

- [ ] Warfarin
- [ ] Dabigatran
- [ ] Rivaroxaban
- [ ] Apixaban
- [ ] Edoxaban
- [ ] Aspirin (ASA)
- [ ] Clopidogrel
- [ ] Prasugrel
- [ ] Dipyridamole
- [ ] Ticagrelor

Clinical Risk Factors

- [80] Age
- [x] **Female**
- [ ] Congestive Heart Failure
- [x] **Hypertension**
- [ ] Poorly Controlled Hypertension
- [x] **Diabetes Mellitus**
- [ ] History of Stroke
- [ ] Bleeding History
- [ ] History of Intracranial Hemorrhage
- [ ] Labile INR
- [ ] NSAIDs (*other than ASA*)
- [ ] Coronary Artery Disease
- [ ] History of Myocardial Infarction
- [ ] Alcohol Abuse
- [ ] Vascular Disease
- [ ] Abnormal Liver
- [ ] Abnormal Renal
- [ ] End Stage Renal Disease
- [70] eGFR (*ml/min/1.73m²*)

Definitions

Congestive Heart Failure
Documented clinical history or L/V dysfunction.

Hypertension
Clinical diagnosis of hypertension.

Poorly Controlled Hypertension
Systolic BP ≥ 160 mmHg.

Diabetes Mellitus
Clinical diagnosis of diabetes mellitus.

History of Stroke
History of ischemic stroke, TIA, or thromboembolism.

Bleeding History
Previous bleeding history or predisposition to bleeding (e.g. bleeding diathesis, anemia, etc.).

History of Intracranial Hemorrhage
Intracerebral hemorrhage, subarachnoid hemorrhage, subdural hematoma.

Labile INR
Unstable/high INRs or poor time in therapeutic range (e.g., < 60%).

Vascular Disease
Prior myocardial infarction, peripheral artery disease or aortic plaque.

Abnormal Liver
Chronic hepatic disease (e.g. cirrhosis) or biochemical evidence of significant hepatic derangement (e.g. bilirubin ≥ 2x upper limit of normal, in association with elevations of AST, ALT, or ALP > 3x upper limit normal, etc.).

Abnormal Renal
Presence of chronic dialysis, renal transplantation or serum creatinine ≥ 200μmol/L (or creatinine ≥ 2.26 mg/dl).

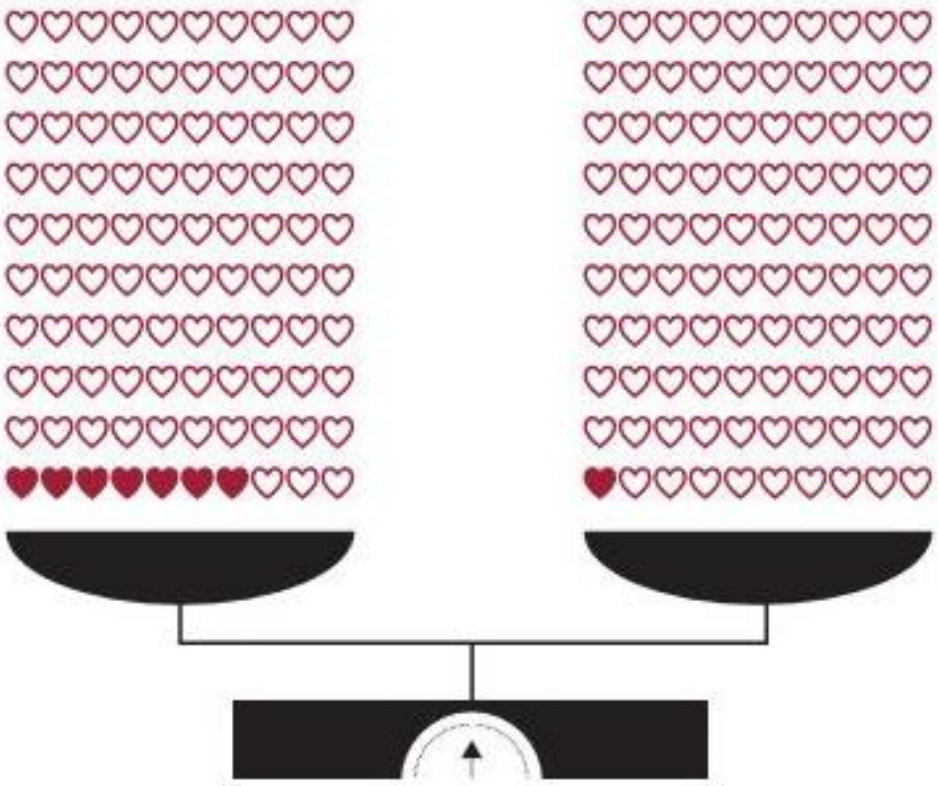
GET RECOMMENDATIONS

RESET

PERSONAL RISKS

Your stroke risk **without** blood-thinning treatment is 6.7% per year.

Your bleeding risk **with** blood-thinning treatment is 0.7% per year. *



* This risk represents the upper range of bleeding based on the use of warfarin compared to the other blood-thinning medications.

CHA_2DS_2-VASc = 5

HAS-BLED = 1

CONTINUE

CHA_2DS_2VASC \ HAS-BLED	0	1	2	3	4	5	6	7
0	81	148	58	25	4	1	0	0
1	98	222	105	42	24	9	2	0
2	72	273	272	132	50	19	1	0
3	35	260	358	205	99	34	3	0
4	5	185	361	271	115	52	10	3
5	1	66	218	220	114	63	23	4
6	0	21	88	144	98	62	15	9
7	0	1	33	71	70	35	21	9
8	0	0	8	22	24	11	11	4
9	0	0	3	3	6	4	3	0

References

1. Olesen JB, Lip GY, Hansen ML, et al. Validation of risk stratification schemes for predicting stroke and thromboembolism in patients with atrial fibrillation: nationwide cohort study. *BMJ.* 2011;342:d124.
2. Friberg L, Rosenqvist M, Lip GY. Evaluation of risk stratification schemes for ischaemic stroke and bleeding in 182 678 patients with atrial fibrillation: the Swedish Atrial Fibrillation cohort study. *Eur Heart J.* 2012;33:1500-1510.
3. Lip GY, Frison L, Halperin JL, Lane DA. Identifying patients at high risk for stroke despite anticoagulation: a comparison of contemporary stroke risk stratification schemes in an anticoagulated atrial fibrillation cohort. *Stroke.* 2010;41:2731-2738.