Supplementary Table 1. Perioperative Interruption and Resumption Intervals

Cohort		DOAC Preoperative Management		DOAC Postoperative Management	
		Preoperative Interruption; hours median (IQR)	*Adherence to Interruption Protocol* n (%)	*Postoperative Resumption;* hours median (IQR)	*Adherence to Resumption Protocol* n (%)
Apixaban	*Low bleeding risk* (n = 751)	39.4 (37.5, 41.5)	724 (96.4)	21.9 (19.1, 30.0)	651 (86.7)
	High bleeding risk (n = 335)	63.8 (61.0, 67.0)	313 (93.4)	68.0 (43.6, 91.2)	328 (97.9)
Dabigatran (CrCl ≥ 50 mL/min)	*Low bleeding risk* (n = 304)	39.9 (38.1, 42.2)	291 (95.7)	22.7 (20.5, 33.0)	290 (95.4)
	High bleeding risk (n = 162)	63.0 (61.5, 67.0)	149 (92.0)	66.5 (43.5, 81.9)	161 (99.4)
Dabigatran (CrCl < 50 mL/min)	*Low bleeding risk* (n = 48)	64.7 (62.1, 66.0)	44 (91.7)	22.1 (19.9, 33.4)	47 (97.9)
	High bleeding risk (n = 21)	110 (107.8, 114.1)	17 (81.0)	67.5 (54.0, 88.9)	21 (100.0)
Dabigatran (all patients)	*Low bleeding risk* (n = 352)	40.5 (38.4, 44.7)	335 (95.2)	22.7 (20.4, 33.1)	337 (95.7)
	High bleeding risk (n = 183)	63.8 (61.7, 74.3)	166 (90.7)	66.5 (44.9, 81.9)	182 (99.5)
Rivaroxaban	*Low bleeding risk* (n = 606)	48.0 (40.8, 51.0)	576 (95.1)	24.2 (20.6, 33.0)	539 (88.9)
	High bleeding risk (n = 314)	72.0 (66.1, 75.0)	296 (94.3)	69.6 (46.0, 95.5)	311 (99.0)

Supplementary Table 1 Perioperative Interruption and Resumption Intervals. DOAC = direct oral anticoagulant; CrCl = creatinine clearance.

Supplementary Table 2. Residual DOAC Levels – Stratified by Procedural Bleeding

DOAC	Procedural Bleeding Risk	Residual DOAC Level (ng/mL)		Association for residual level ≥ 30 ng/mL	Residual DOAC Level (ng/mL)		Association for residual level ≥ 50 ng/mL
		< 30 ng/mL *n (%)*	**≥ 30 ng/mL** *n (%)*		**< 50 ng/mL** *n (%)*	**≥ 50 ng/mL** *n (%)*	
Apixaban N = 1086	*High N=335*	312 (93.1%)	23 (6.9%)	High risk vs low risk OR=0.167, 95% CI 0.104-0.257; **p<0.001**	328 (97.9%)	7 (2.1%)	High risk vs low risk OR=0.146, 95% CI 0.061-0.295; **p<0.001**
	Low N=751	521 (69.4%)	230 (30.6%)		655 (87.2%)	96 (12.8%)	
Dabigatran N = 535	*High N=183*	181 (98.9%)	2 (1.1%)	High risk vs low risk OR=0.054, 95% CI 0.009-0.175; **p<0.001**	182 (99.5%)	1 (0.6%)	High risk vs low risk OR=0.072, 95% CI 0.004-0.343; **p=0.010**
	Low N=352	292 (83.0%)	60 (17.1%)		327 (92.9%)	25 (7.1%)	
Rivaroxaban N = 920	*High N=314*	268 (85.4%)	46 (14.7%)	High risk vs low risk OR=0.478, 95% CI 0.330-0.682; **p<0.001**	312 (99.4%)	2 (0.7%)	High risk vs low risk OR=0.137, 95% CI 0.022-0.462; **p=0.007**
	Low N=606	446 (73.6%)	160 (26.4%)		579 (95.5%)	27 (4.5%)	

Supplementary Table 2 Residual DOAC Levels – Stratified by Procedural Bleeding Risk. DOAC: direct oral anticoagulant. A greater proportion of patients undergoing low bleeding risk procedures (with shorter preprocedural interruption intervals) had residual preprocedural DOAC levels of ≥ 30 ng/mL and ≥ 50 ng/mL. The result was statistically significant across all DOAC types.

Supplementary Table 3. Residual DOAC Levels – Stratified by DOAC Dosing

Low Bleeding Risk Procedures							
DOAC	**Dosing**	**Residual DOAC Level (ng/mL)**		**Association for residual level ≥ 30 ng/mL**	**Residual DOAC Level (ng/mL)**		**Association for residual level ≥ 50 ng/mL**
		< 30 ng/mL *n (%)*	≥ 30 ng/mL *n (%)*		< 50 ng/mL *n (%)*	≥ 50 ng/mL *n (%)*	
Apixaban N = 751	*5 mg po BID N = 620*	431 (69.5%)	189 (30.5%)	High dose vs low dose OR=0.96, 95% CI 0.64-1.46; **p=0.854**	537 (86.6%)	83 (13.4%)	High dose vs low dose OR=1.403, 95% CI 0.781-2.713; **p=0.283**
	2.5 mg po BID N = 131	90 (68.7%)	41 (31.3%)		118 (90.1%)	13 (9.9%)	
Dabigatran N = 352	*150 mg po BID N = 226*	193 (85.4%)	33 (14.6%)	High dose vs low dose OR=0.63, 95% CI 0.36-1.11; **p=0.104**	212 (93.8%)	14 (6.2%)	High dose vs low dose OR=0.690, 95% CI 0.304-1.603; **p=0.377**
	110 mg po BID N = 126	99 (78.6%)	27 (21.4%)		115 (91.3%)	11 (8.7%)	
Rivaroxaban N = 605	*20 mg po OD N = 520*	385 (74.0%)	135 (26.0%)	High dose vs low dose OR=0.84, 95% CI 0.51-1.42; **p=0.504**	495 (95.2%)	25 (4.8%)	High dose vs low dose OR=2.096, 95% CI 0.609-13.179; **p=0.320**
	15 mg po OD N = 85	60 (70.6%)	25 (29.4%)		83 (97.6%)	2 (2.4%)	
High Bleeding Risk Procedures							
DOAC	**Dosing**	**Residual DOAC Level (ng/mL)**		**Association for residual level ≥ 30 ng/mL**	**Residual DOAC Level (ng/mL)**		**Association for residual level ≥ 50 ng/mL**
		< 30 ng/mL n (%)	≥ 30 ng/mL n (%)		< 50 ng/mL *n (%)*	≥ 50 ng/mL *n (%)*	
Apixaban N = 334	*5 mg po BID N = 256*	238 (93.0%)	18 (7.0%)	High dose vs low dose OR=1.10, 95% CI 0.42-3.44; **p=0.85**	251 (98.0%)	5 (2.0%)	High dose vs low dose OR=0.757, 95% CI 0.160-5.359; **p=0.742**
	2.5 mg po BID N = 78	73 (93.6%)	5 (6.4%)		76 (97.4%)	2 (2.6%)	
Dabigatran N = 183	*150 mg po BID N = 105*	103 (98.1%)	2 (1.90%)	N/A	104 (99.1%)	1 (1.0%)	N/A
	110 mg po BID N = 78	78 (100%)	0		78 (100%)	0	
Rivaroxaban N = 314	*20 mg po OD N = 243*	209 (86.0%)	34 (14.0%)	High dose vs low dose OR=0.80, 95% CI 0.40-1.70; **p=0.542**	242 (99.6%)	1 (0.4%)	High dose vs low dose OR=0.289, 95% CI 0.011-7.377; **p=0.383**
	15 mg po OD N = 71	59 (83.1%)	12 (16.9%)		70 (98.6%)	1 (1.4%)	

Supplementary Table 3 Residual DOAC Levels – Stratified by DOAC Dosing. DOAC: direct oral anticoagulant. The proportion of patients with residual DOAC levels ≥ 30 ng/mL and ≥ 50 ng/mL according to DOAC dosing was assessed, stratified according to DOAC dosing. No statistically significant relationship between DOAC dosing and residual DOAC levels was found.

Supplementary Table 4. Clinical Parameters Associated with Residual DOAC Levels – Univariate Logistic Regression Analyses

Low Bleeding Risk Procedures							
Clinical Parameter	**Comparison**	**Apixaban**		**Dabigatran**		**Rivaroxaban**	
		≥ 30 ng/mL OR [95% CI]	*≥ 50 ng/mL OR [95% CI]*	*≥ 30 ng/mL OR [95% CI]*	*≥ 50 ng/mL OR [95% CI]*	*≥ 30 ng/mL OR [95% CI]*	*≥ 50 ng/mL OR [95% CI]*
Age (years)	*≥ 75 vs < 75*	**1.68 [1.29-2.18] p = 0.0001**	**1.85 [1.23-2.79] p = 0.003**	**1.68 [1.01-2.78] p = 0.0452**	1.23 [0.56-2.72] p = 0.6031	1.15 [0.84-1.57] p = 0.3924	1.01 [0.47-2.18] p = 0.9737
Sex	*Female vs Male*	**1.51 [1.16-1.95] p = 0.0021**	**2.31 [1.55-3.45] p < 0.0001**	1.07 [0.61-1.85] p = 0.8230	0.78 [0.31-1.96] p = 0.6048	**1.5 [1.1-2.06] p = 0.0112**	0.9 [0.39-2.06] p = 0.8047
Weight (kg)	*70-90 vs < 70*	0.78 [0.56-1.1] p = 0.1553	0.67 [0.41-1.1] p = 0.1175	1.17 [0.53-2.58] p = 0.6996	1.66 [0.34-8.23] p = 0.5342	0.7 [0.46-1.05] p = 0.0865	0.73 [0.21-2.59] p = 0.6268
	> 90 vs < 70	**0.66 [0.47-0.92] p = 0.0149**	**0.49 [0.29-0.82] p = 0.0063**	1.45 [0.69-3.04] p = 0.3224	3.47 [0.8-15.03] p = 0.0959	0.72 [0.49-1.07] p = 0.1072	1.84 [0.62-5.47] P = 0.2725
Creatinine Clearance (ml/min)	*≥ 50 vs < 50*	**0.51 [0.38-0.68] p < 0.0001**	**0.42 [0.27-0.65] p = 0.0001**	0.63 [0.34-1.19] p = 0.1545	1.82 [0.43-7.7] p = 0.4184	0.81 [0.53-1.24] p = 0.3317	1.87 [0.44-7.91] p = 0.3928
P-Glycoprotein or CYP3A4 Inhibitor	*Presence vs Absence*	1.2 [0.73-1.96] p = 0.4787	1.36 [0.66-2.81] p = 0.4031	0.98 [0.39-2.44] p = 0.9581	0.93 [0.22-3.96] p = 0.9254	1.09 [0.57-2.06] p = 0.797	1.31 [0.31-5.51] p = 0.7170
Cancer	*Presence vs Absence*	0.9 [0.64-1.24] p = 0.5082	0.87 [0.52-1.46] p = 0.6038	0.92 [0.48-1.74] p = 0.7919	0.98 [0.82-1.18] p = 0.8426	1.0 [0.98-1.02] p = 0.8539	0.98 [0.81-1.17] p = 0.7883
Active Cancer	*Presence vs Absence*	0.92 [0.47-1.78] p = 0.7940	1.23 [0.5-3.04] p = 0.6464	1.11 [0.35-3.53] p = 0.8658	1.83 [0.43-7.75] p = 0.4140	0.91 [0.43-1.94] p = 0.8079	2.49 [0.75-8.26] p = 0.1368
DOAC Dosing	*Low Dose vs Standard Dose **	1.03 [0.73-1.76] p = 0.8785	0.74 [0.41-1.33] p = 0.3155	1.47 [0.88-2.44] p = 0.1394	1.41 [0.64-3.1] p = 0.3945	1.14 [0.74-1.74] p = 0.5606	0.49 [0.12-2.07] p = 0.3322
DOAC Interruption (hours)	*< 36 vs 36-48*	1.13 [0.73-1.76] p = 0.5869	1.3 [0.67-2.51] p = 0.4341	2.06 [1.0-4.28] p = 0.0513	1.89 [0.64-5.57] p = 0.2514	1.64 [0.89-3.0] p = 0.1099	2.1 [0.61-7.21] p = 0.2383
	> 48 vs 36-48	0.95 [0.54-1.66] p = 0.8568	1.66 [0.83-3.32] p = 0.1479	1.31 [0.71-2.42] p = 0.3881	0.58 [0.17-1.96] p = 0.3786	0.74 [0.53-1.02] p = 0.0659	0.47 [0.2-1.1] p = 0.0824
High Bleeding Risk Procedures							
Clinical Parameter	**Comparison**	**Apixaban**		**Dabigatran**		**Rivaroxaban**	
		≥ 30 ng/mL OR [95% CI]	*≥ 50 ng/mL OR [95% CI]*	*≥ 30 ng/mL OR [95% CI]*	*≥ 50 ng/mL OR [95% CI]*	*≥ 30 ng/mL OR [95% CI]*	*≥ 50 ng/mL OR [95% CI]*
Age (years)	*≥ 75 vs < 75*	**2.56 [1.01-6.49] p = 0.0478**				0.83 [0.46-1.49] p = 0.5320	
Sex	*Female vs Male*	**2.58 [1.12-5.96] p = 0.0265**				1.71 [0.96-3.04] p = 0.0698	
Weight (kg)	*70-90 vs < 70*	0.58 [0.25-1.36] p = 0.2095				**0.42 [0.21-0.82] p = 0.0106**	
	> 90 vs < 70	**0.15 [0.03-0.69] p = 0.0145**				**0.37 [0.17-0.76] p = 0.0073**	
Creatinine Clearance (ml/min)	*≥ 50 vs < 50*	**0.21 [0.09-0.48] p = 0.0002**				0.66 [0.34-1.3] p = 0.2308	
P-Glycoprotein or CYP3A4 Inhibitor	*Presence vs Absence*	1.9 [0.45-8.1] p = 0.3862				1.25 [0.3-5.16] p = 0.7559	
Cancer	*Presence vs Absence*	0.67 [0.27-1.62] p = 0.3701				0.84 [0.46-1.54] p = 0.5716	
Active Cancer	*Presence vs Absence*	0.47 [0.11-2.02} p = 0.3137				0.73 [0.33-1.63] p = 0.4423	
DOAC Dosing	*Low Dose vs Standard Dose **	0.92 [0.34-2.47] p = 0.8609				1.21 [0.63-2.33] p = 0.5737	
DOAC Interruption (hours)	*< 60 vs 60-72*	1.12 [0.38-3.32] p = 0.8323				1.55 [0.46-5.17] p = 0.4773	
	> 72 vs 60-72	0.65 [0.09-4.88] p = 0.6767				1.08 [0.6-1.97] p = 0.7913	

Supplementary Table 4 Univariate Analyses. DOAC: direct oral anticoagulant; univariate analyses were not possible for patients undergoing high bleeding risk procedures with residual levels ≥ 30 ng/mL on dabigatran and for patients with residual levels ≥ 50 ng/mL due to the low number of patients in these categories. *****Greyed boxes represent variables that were omitted from the multivariate model due to small sample sizes and minimal impact on the model.

Factors Associated with Residual Apixaban Levels

With respect to patients on apixaban undergoing low risk procedures, factors associated with a greater likelihood of residual levels ≥ 30 ng/mL were age ≥ 75 ($p = 0.0001$), female sex ($p = 0.0021$), a weight of < 70 kg as compared to > 90 kg ($p = 0.0149$) and a creatinine clearance < 50 mL/min ($p < 0.0001$). These same clinical parameters were also found to be associated with residual levels ≥ 50 ng/mL among patients undergoing low risk procedures.

Age ≥ 75 ($p = 0.0478$), female sex ($p = 0.0265$), a weight of < 70 kg compared to > 90 kg ($p = 0.0145$) and a creatinine clearance < 50 ml/min ($p = 0.0002$) were also associated with residual levels of ≥ 30 ng/mL for patients on apixaban undergoing high risk procedures. We were unable to perform analyses with respect to patients on apixaban undergoing high bleeding risk procedures due to the low number of high-risk patients with residual levels ≥ 50 ng/mL. Progressively shorter preprocedural interruption intervals (< 36 vs 36-48, 36-48 vs > 48) were not significantly associated with an increased likelihood of residual levels ≥ 30 ng/mL or ≥ 50 ng/mL.

Factors Associated with Residual Dabigatran Levels

Age ≥ 75 ($p = 0.0452$) was the only factor identified by univariate analysis that was significantly associated with residual dabigatran levels ≥ 30 ng/mL among patients undergoing low risk procedures. An interruption interval of < 36 hours (vs 36-48, $p = 0.0513$) was of borderline statistical significance with respect to residual levels ≥ 30 ng/mL. We were unable to identify any clinical parameters that were associated with residual dabigatran levels of ≥ 50 ng/mL.

There were not enough patients on dabigatran undergoing high risk procedures with residual levels ≥ 30 ng/mL or ≥ 50 ng/mL to perform meaningful analyses.

Factors Associated with Residual Rivaroxaban Levels

Among patients on rivaroxaban undergoing low-risk procedures, the only factor identified by univariate analysis that was associated with residual levels ≥ 30 ng/mL was female sex ($p = 0.0112$). An interruption interval of > 48 hours (vs 36-48 hours) achieved borderline statistical significance ($p = 0.0659$) with respect to a lower likelihood of residual rivaroxaban levels ≥ 30

ng/mL among low-risk patients. Decreasing weight demonstrated a trend towards higher residual levels ≥ 30 ng/mL (weight < 70 kg vs 70-90 kg, p = 0.0865; weight < 70 kg vs > 90 kg, p = 0.1072). We were unable to identify any significant factors via univariate analysis that were associated with residual rivaroxaban levels ≥ 50 ng/mL for low-risk procedures, although an interruption interval of 36-48 hours (vs > 48 hours) was of marginal statistical significance (p = 0.0824).

With respect to high-risk patients, lower weight was associated with a higher likelihood of residual levels ≥ 30 ng/mL (< 70 kg vs 70-90 kg p = 0.0106; < 70 kg vs > 90 kg p = 0.0073). There were not enough high-risk patients with residual levels ≥ 50 ng/mL to perform meaningful analyses.