Supplemental Table 1. Characteristics of Inpatients Treated for Acute HF at Hospital Discharge

Variable	Missing (%)	Overall (n=8291)	No AVD (n=6814)	AS (n=539)	AR (n=659)	MAVD (n=279)	*P*-value
Characteristics							
EF, %*	1.4%	40 [30, 50]	38 [28, 50]	50 [35, 60]	40 [30, 50]	48 [35, 55]	<0.001
≤40%		4658 (57%)	4008 (60%)	192 (36%)	358 (55%)	100 (38%)	
41-49%		1056 (13%)	864 (13%)	71 (13%)	83 (13%)	38 (14%)	
≥50%		2462 (30%)	1863 (28%)	266 (50%)	207 (32%)	126 (48%)	
Age, years*		70 [60, 78]	68 [59, 77]	77 [71, 83]	73 [63, 80]	76 [68, 82]	<0.001
Sex, female, %*		3088 (37%)	2409 (35%)	277 (51%)	266 (40%)	136 (49%)	<0.001
Heart rate, beats/min*		86 [72, 105]	86 [72, 105]	86 [74, 104]	83 [70, 100]	90 [73, 110]	0.099
Systolic BP, mmHg*		130 [110, 150]	130 [110, 150]	130 [113, 150]	130 [115, 150]	130 [115, 150]	0.824
NYHA class, %*	0.4%						<0.001
II		1727 (21%)	1443 (21%)	80 (15%)	149 (23%)	55 (20%)	
III		4015 (49%)	3302 (49%)	263 (49%)	329 (50%)	121 (43%)	
IV		2515 (31%)	2037 (30%)	196 (36%)	179 (27%)	103 (37%)	
HF diagnosis >12 months, %*	8.2%	2330 (31%)	1857 (30%)	159 (32%)	226 (38%)	88 (34%)	<0.001
Previous HFH, %*	0.3%	2793 (34%)	2280 (34%)	187 (35%)	225 (34%)	101 (36%)	0.760
Geographic region, %							<0.001
Eastern		4432 (54%)	3567 (52%)	239 (44%)	446 (68%)	180 (65%)	
Northern		364 (4.4%)	291 (4.3%)	20 (3.7%)	44 (6.7%)	9 (3.2%)	
Southern		1721 (21%)	1360 (20%)	201 (37%)	88 (13%)	72 (26%)	
Western		306 (3.7%)	260 (3.8%)	23 (4.3%)	19 (2.9%)	4 (1.4%)	
Middle East		211 (2.5%)	186 (2.7%)	20 (3.7%)	5 (0.8%)	0 (0%)	
North Africa		1091 (13%)	1004 (15)	24 (4.5%)	51 (7.7%)	12 (4.3%)	
Other		166 (2.0%)	146 (2.1%)	12 (2.2%)	6 (0.9%)	2 (0.7%)	
Primary etiology, %	0.1%						<0.001
IHD		4818 (58%)	4116 (61%)	239 (44%)	322 (49%)	141 (51%)	

Hypertension		636 (7.7%)	547 (8.0%)	30 (5.6%)	45 (6.8%)	14 (5.0%)	
Dilated cardiomyopathy		1107 (13%)	975 (14%)	25 (4.6%)	94 (14%)	13 (4.7%)	
Valve disease		990 (12%)	495 (7.3%)	226 (42%)	168 (26%)	101 (36%)	
Other		731 (8.8%)	672 (9.9%)	19 (3.5%)	30 (4.6%)	10 (3.6%)	
Comorbidities/conditions, %							
AF/flutter*		3592 (43%)	2863 (42%)	246 (46%)	344 (52%)	139 (50%)	<0.001
DM*		3051 (37%)	2578 (38%)	197 (37%)	181 (28%)	95 (34%)	<0.001
Stroke/TIA*		954 (12%)	726 (11%)	118 (22%)	56 (8.5%)	54 (19%)	<0.001
Peripheral vascular disease*	0.1%	1223 (15%)	945 (14%)	134 (25%)	79 (12%)	65 (23%)	<0.001
CAD*	0.1%	4671 (56%)	3922 (58%)	277 (51%)	333 (51%)	139 (50%)	<0.001
MI		4463 (54%)	3741 (55%)	265 (49%)	323 (49%)	134 (48%)	<0.001
Hypertension	0.1%	5561 (67%)	4559 (67%)	417 (77%)	394 (60%)	191 (69%)	<0.001
COPD*	0.1%	1572 (19%)	1223 (18%)	147 (27%)	122 (19%)	80 (29%)	<0.001
Chronic kidney disease		2005 (24%)	1618 (24%)	143 (27%)	165 (25%)	79 (28%)	0.160
Anemia (hemoglobin <13 g/dL in males, <12 g/dL in females)*	1.6%	3470 (43%)	2780 (42)	260 (49%)	291 (45%)	139 (50%)	<0.001
BMI, kg/m²*	0.6%	28 [25, 31]	28 [25, 31]	27 [24, 30]	26 [24, 29]	26 [24, 29]	<0.001
Cancer	0.1%	371 (4.5%)	297 (4.4%)	30 (5.6%)	30 (4.6%)	14 (5.0%)	0.592
Depression	0.1%	597 (7.2%)	439 (6.5%)	78 (15%)	34 (5.2%)	46 (17%)	<0.001
Smoking	0.1%	1469 (18%)	1277 (19%)	61 (11%)	88 (13%)	43 (15%)	<0.001
Intervention, %							
CABG		853 (10%)	738 (11%)	51 (9.5%)	48 (7.3%)	16 (5.7%)	0.002
PCI	0.1%	1702 (21%)	1497 (22%)	80 (15%)	101 (15%)	24 (8.6%)	<0.001
Valvular surgery		482 (5.8%)	373 (5.5%)	42 (7.8%)	49 (7.4%)	18 (6.5%)	0.034
Devices	0.3%						<0.001
PM		512 (6.2%)	401 (5.9%)	51 (9.5%)	43 (6.5%)	17 (6.1%)	
CRT-P		62 (0.7%)	45 (0.7%)	3 (0.6%)	13 (2.0%)	1 (0.4%)	
CRT-D		258 (3.1%)	239 (3.5%)	2 (0.4%)	16 (2.4%)	1 (0.4%)	
ICD		389 (4.7%)	354 (5.2%)	5 (0.9%)	21 (3.2%)	9 (3.2%)	

ECG/Echocardiographic data							
QRS-duration, ms	11%	100 [80, 120]	100 [80, 120]	100 [84, 120]	105 [86, 127]	106 [88, 126]	0.026
QT duration, ms	18%	394 [344, 428]	392 [340, 427]	400 [360, 427]	390 [355, 422]	400 [360, 442]	0.002
LBBB, %	3.5%	1199 (15%)	971 (15%)	73 (14%)	103 (16%)	52 (19%)	0.215
LVEDD, mm	8.0%	58 [52, 65]	58 [52, 65]	54 [47, 60]	60 [52, 67]	56 [51, 63]	<0.001
Laboratory data							
eGFR, mL/min/1,73 m²*	1.7%	63% [44, 83]	64 [45, 85]	58 [40, 75]	59 [43, 79]	54 [39, 71]	<0.001
Sodium, mEq/L*	4.9%	139 [136, 141]	139 [136, 141]	139 [136, 141]	139 [136, 141]	138 [135, 141]	0.334
Fasting glucose, mg/dL	11%	110 [92, 148]	110 [92, 150]	113 [95, 151]	101 [87, 127]	108 [89, 138]	<0.001
Hemoglobin, g/dL	1.6%	13 [11, 14]	13 [12, 14]	12 [11, 14]	13 [11, 14]	12 [11, 14]	<0.001
BNP, pg/mL	89%	724 [312, 1391]	685 [294, 1332]	894 [450, 1756]	830 [381, 1684]	950 [440, 1600]	0.028
NT-proBNP, pg/mL	76%	3674 [1617, 8305]	3415 [1524, 7984]	5204 [2409, 11102]	4200 [2111, 9771]	6438 [3000, 10119]	<0.001
Medications, %							
RAASi/ARNi		5050 (61%)	4174 (61%)	307 (57%)	401 (61%)	168 (60%)	0.284
Beta blockers		6400 (77%)	5315 (78%)	378 (70%)	508 (77%)	199 (71%)	<0.001
MRA	0.1%	4892 (59%)	4057 (60%)	274 (51%)	390 (59%)	171 (61%)	0.001
Oral diuretics	0.1%	6762 (82%)	5551 (82%)	441 (82%)	548 (83%)	222 (80%)	0.596
Ivabradine		299 (3.6%)	266 (3.9%)	13 (2.4%)	15 (2.3%)	5 (1.8%)	0.019
Digitalis		2091 (25%)	1688 (25%)	124 (23%)	197 (30%)	82 (29%)	0.007
Anticoagulants		4836 (58%)	3899 (57%)	320 (59%)	428 (65%)	189 (68%)	<0.001

* Included in the multiple imputation models and logistic/Cox regressions.

Abbreviations: AVD = aortic valve disease; AR = aortic regurgitation; AS = aortic stenosis; MAVD = mixed aortic valve disease; EF = ejection fraction; BP = blood pressure; NYHA = New York Heart Association Functional Classification; HFH = heart failure hospitalization; AF = atrial fibrillation; DM = diabetes mellitus; TIA = transient ischemic attack; CAD = coronary artery disease; MI = myocardial infarction; COPD = chronic obstructive pulmonary disease; BMI = body masss index; CABG = coronary artery bypass graft; PCI = percutaneous coronary intervention; PM = pacemaker; CRT = cardiac resynchronization therapy; ICD = implantable cardioverter-defibrillator; IHD = ischemic heart disease; ECG = electrocardiogram; LBBB = left bundle branch block; LVEDD = left ventricular end-diastolic diameter; eGFR = estimated glomerular filtration rate; BNP = brain natriuretic peptide; NT-proBNP, = N-terminal proBNP; RAAS = renin-angiotensin-aldosterone system inhibitors; ARNIi = angiotensin receptor-neprilysin inhibitor; MRA = mineralocorticoid receptor antagonists.

Supplemental Table 2. Outcomes of excluded and included patients

Outcome	Excluded	Included	P-value
CV mortality/First HFH	833, 42, 19.9 (18.6-21.3)	2996, 15130, 19.8 (19.1-20.5)	0.400
CV mortality	328, 45, 7.3 (6.68.2)	1037, 163, 6.4 (6.0-6.8)	0.060
First HFH	634, 42, 15.1 (13.9-16.4)	2394, 151, 15.8 (15.2-16.5	0.900

Incidence = no events, sum py, rate/100py (95% CI)

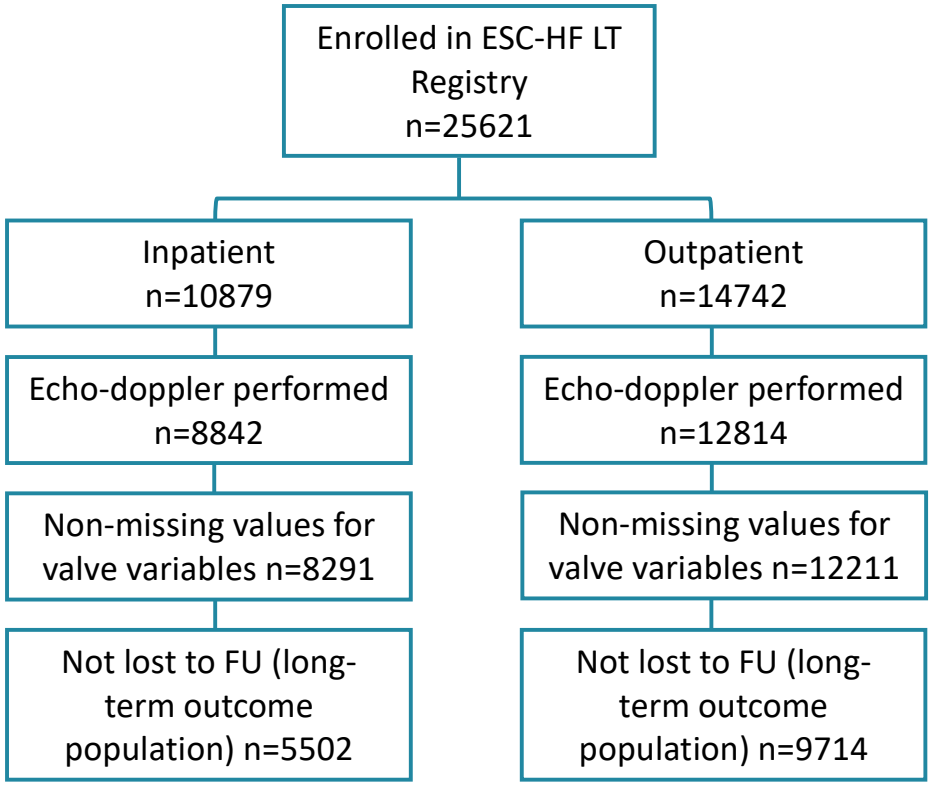
CV=Cardiovascular; HFH= Heart failure hospitalization

Supplemental Table 3. Outcomes of Patients with AVD in HFpEF, HFmrEF and HFrEF

	Outcome	Model	No AVD	AS	MAVD	AR
HFpEF	CV mortality or HFH	Incidence rate	389, 2741, 14.2 (12.8-15.7)	72, 212, 33.9 (26.5-42.7)	22, 79, 28.0 (17.5-42.4)	28, 162, 17.3 (11.5-24.9)
		Crude HR (95% CI), p-value	reference	1.67 (1.31-2.12), <0.001	1.84 (1.26-2.67), 0.001	1.24 (0.99-1.54), 0.06
	CV mortality	Incidence rate	118, 2896, 4.1 (3.4-4.9)	34, 240, 14.1 (9.8-19.8)	7, 89, 7.9 (3.2-16.2)	12, 171, 7.0 (3.6-12.2)
		Crude HR (95% CI), p-value	reference	3.44 (2.35-5.05), <0.001	1.96 (0.91-4.20), 0.09	1.72 (0.95-3.11), 0.08
	HFH	Incidence rate	325, 2741, 11.9 (10.6-13.2)	53, 212, 24.9 (18.7-32.6)	16, 79, 20.4 (11.6-33.1)	21, 162, 12.9 (8.0-19.8)
		Crude HR (95% CI), p-value	reference	1.55 (1.17-2.05), 0.002	1.87 (1.24-2.82), 0.003	1.11 (0.86-1.44), 0.41
HFmrEF	CV mortality or HFH	Incidence rate	196, 1787, 11.0 (9.5-12.6)	21, 51, 41.5 (25.7-63.4)	4, 19, 21.2 (5.8-54.2)	19, 105, 18.1 (10.9-28.3)
		Crude HR (95% CI), p-value	reference	1.67 (1.31-2.12), <0.001	1.84 (1.26-2.67), 0.001	1.24 (0.99-1.54), 0.057
	CV mortality	Incidence rate	67, 1862, 3.6 (2.8-4.6)	13, 57, 22.9 (12.2-39.1)	1, 21, 4.8 (0.1-26.8)	9, 110, 8.1 (3.7-15.5)
		Crude HR (95% CI), p-value	reference	6.68 (3.68-12.14), <0.001	1.50 (0.21-10.86), 0.69	2.13 (1.06-4.28), 0.04
	HFH	Incidence rate	155, 1787, 8.7 (7.4-10.2)	15, 51, 29.6 (16.6-48.9)	3, 19, 15.9 (3.3-46.4)	15, 105, 14.3 (8.0-23.6)
		Crude HR (95% CI), p-value	reference	1.55 (1.17-2.05), 0.002	1.87 (1.24-2.82), 0.003	1.11 (0.86-1.44), 0.41
HFrEF	CV mortality or HFH	Incidence rate	1625, 7438, 21.8 (20.8-22.9)	68, 188, 36.1 (28.0-45.8)	28, 71, 39.3 (26.1-56.9)	83, 307, 27.0 (21.5-33.5)
		Crude HR (95% CI), p-value	reference	1.67 (1.31-2.12), <0.001	1.84 (1.26-2.67), 0.001	1.24 (0.99-1.54), 0.06

	CV mortality	Incidence rate	524, 8076, 6.5 (5.9-7.1)	35, 209, 16.8 (11.7-23.3)	9, 79, 11.4 (5.2-21.6)	34, 334, 10.2 (7.0-14.2)
		Crude HR (95% CI), p-value	reference	2.49 (1.77-3.51), <0.001	1.70 (0.88-3.29), 0.12	1.56 (1.10-2.20), 0.01
	HFH	Incidence rate	1330, 7438, 17.9 (16.9-18.9)	51, 188, 27.1 (20.2-35.6)	23, 71, 32.3 (20.5-48.5)	61, 307, 19.9 (15.2-25.5)
		Crude HR (95% CI), p-value	reference	1.55 (1.17-2.05), 0.002	1.87 (1.24-2.82), 0.003	1.11 (0.86-1.44), 0.41

Supplemental Figure 1. European Society of Cardiology (ESC) Heart Failure Long-term 1-year follow-up flow diagram.

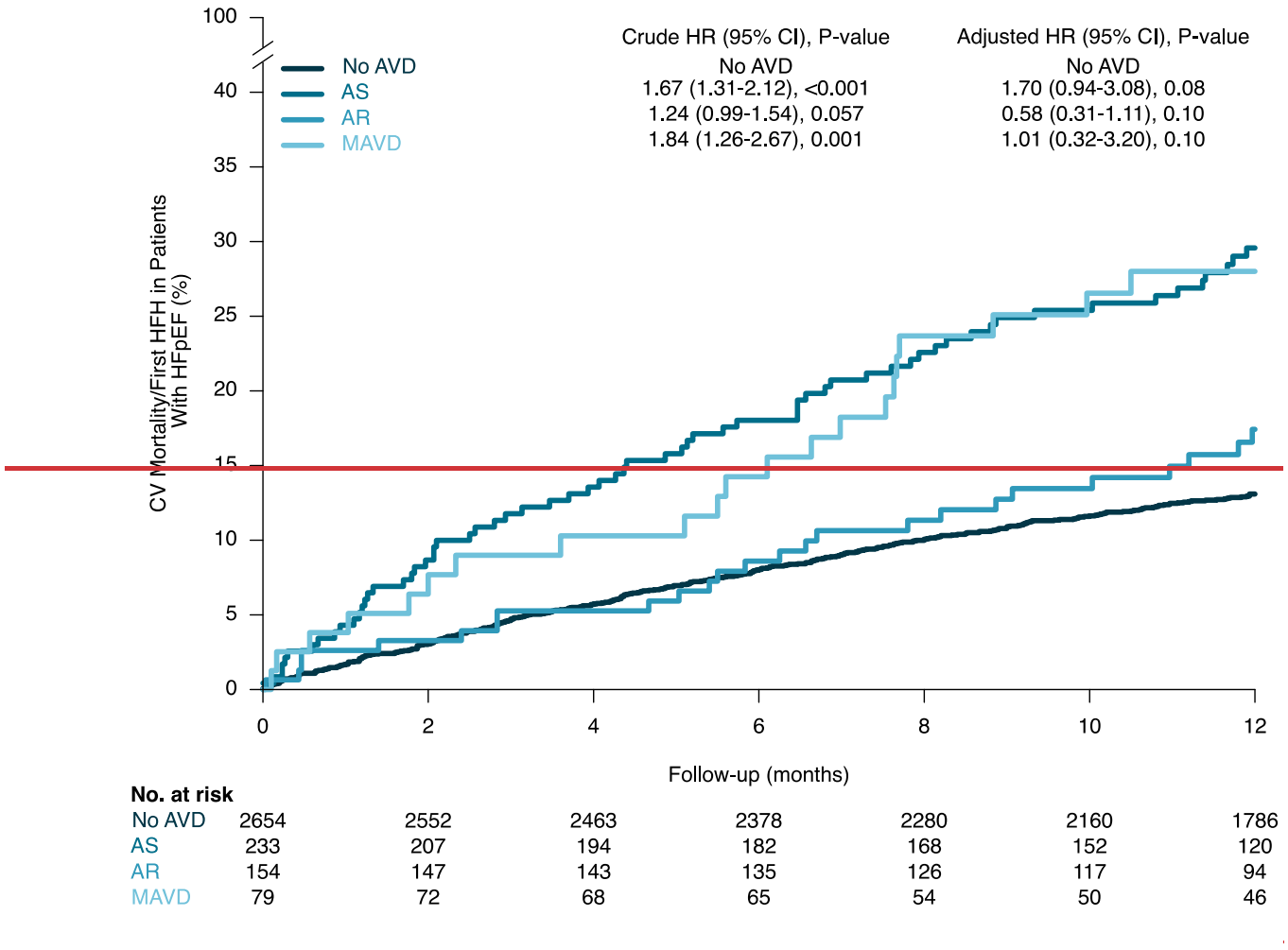


HF = heart failure; Inpatient = acute HF patients; Outpatient = chronic HF patients; FU = follow-up

Supplemental Figure 2. Kaplan–Meier Time-to-First Event Analyses According to Aortic Valve Disease in Heart Failure Patients According to HFpEF, HFmrEF and HFrEF

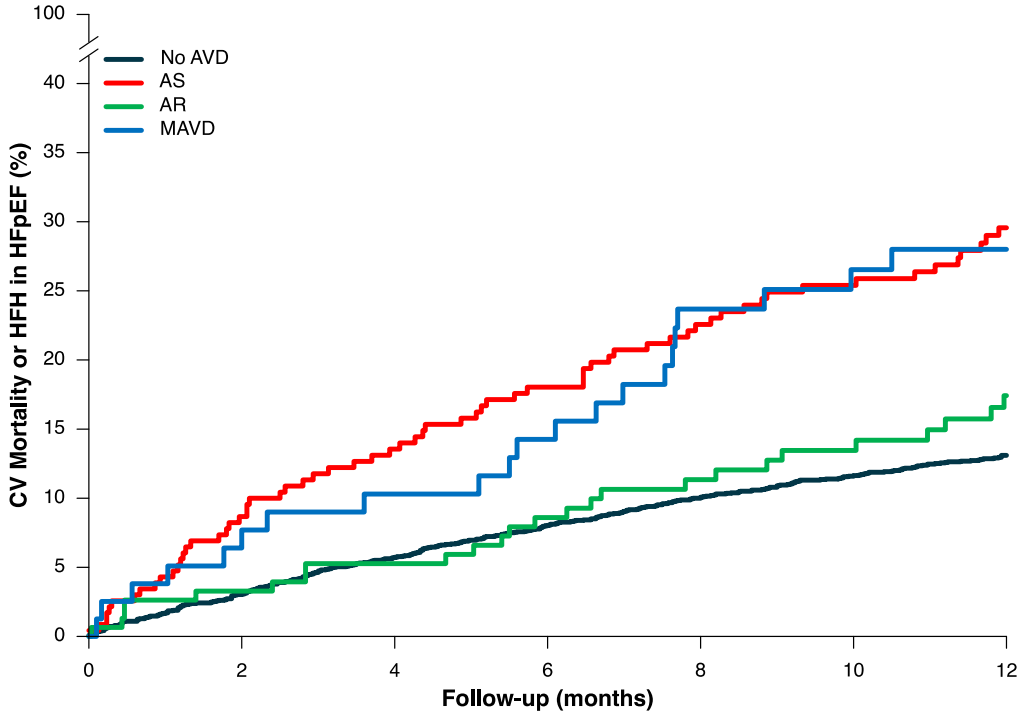
Cardiovascular mortality or heart failure hospitalization; B) Cardiovascular mortality; C) Heart failure hospitalization. CV= cardiovascular; HFH= heart failure hospitalization; CI = confidence interval; HR = hazard ratio; AS = aortic valve stenosis; AR = aortic valve regurgitation; HFmrEF= heart failure with mildly reduced ejection fraction; HFpEF= heart failure with preserved ejection fraction; AS = aortic valve stenosis; AR = aortic valve regurgitation

Figure 2A.



No. at risk

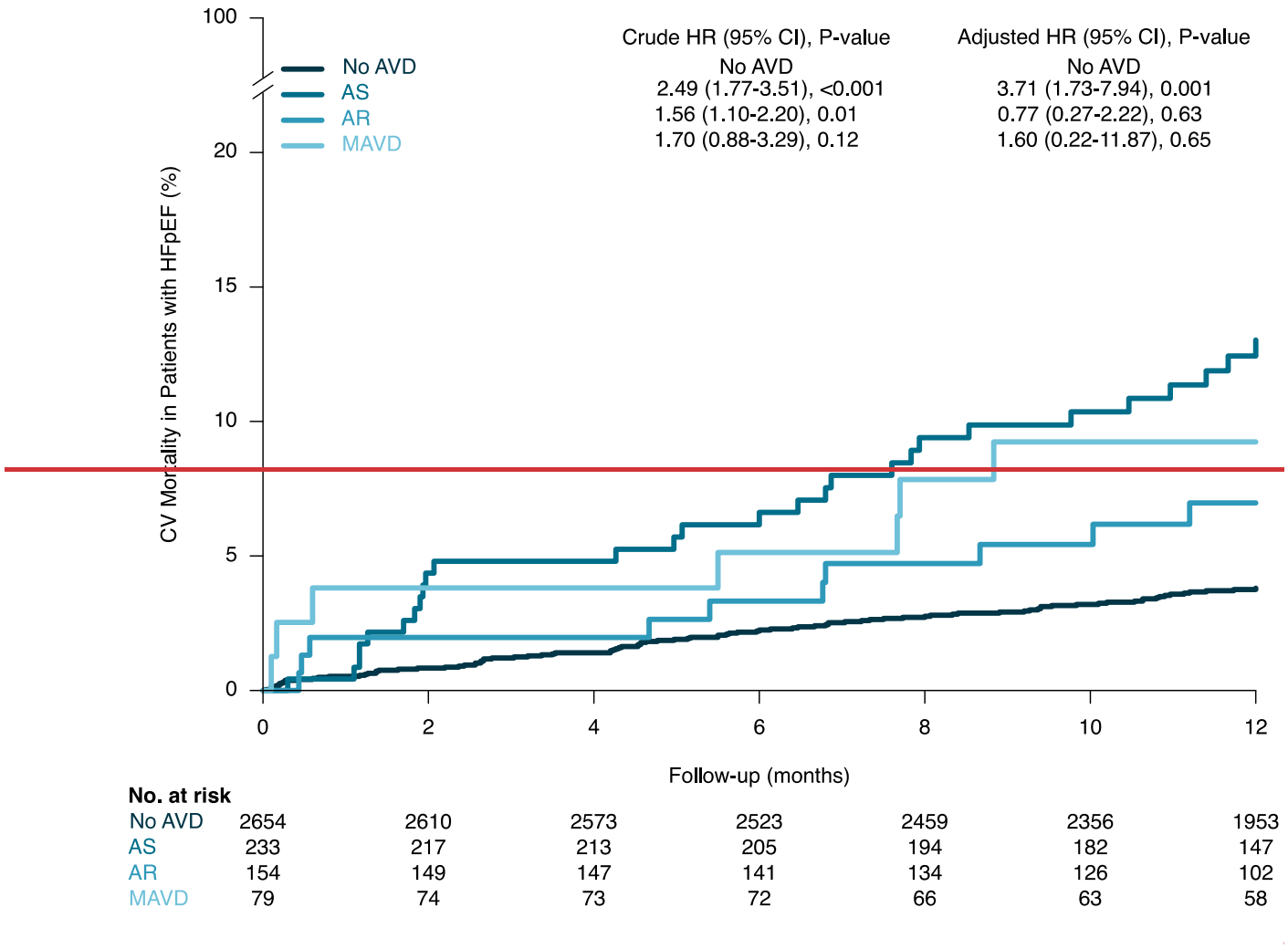
No AVD	2654	2552	2463	2378	2280	2160	1786
AS	233	207	194	182	168	152	120
AR	154	147	143	135	126	117	94
MAVD	79	72	68	65	54	50	46

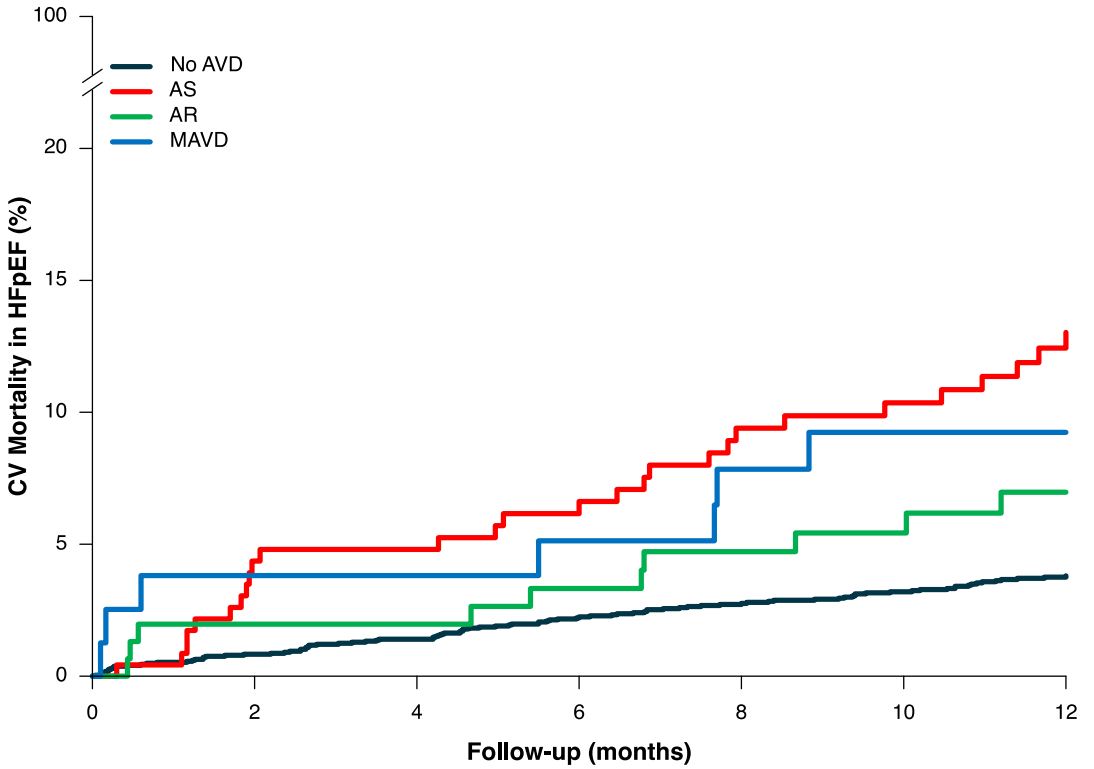


No. at risk

No AVD	2654	2552	2463	2378	2280	2160	1786
AS	233	207	194	182	168	152	120
AR	154	147	143	135	126	117	94

Figure 2B

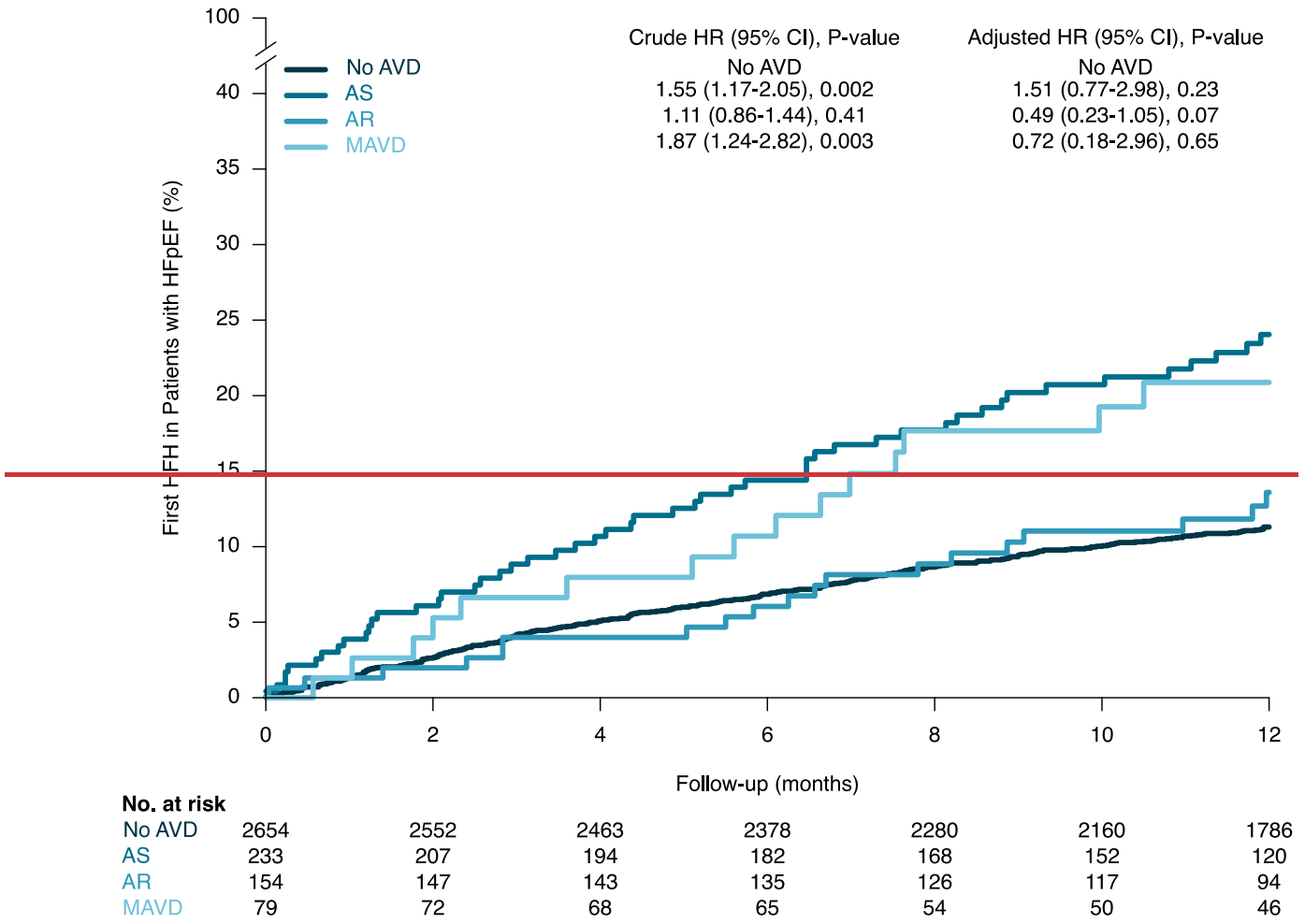

100
20
15
10
5
0
No AVD
AS
AR
MAVD
Crude HR (95% CI), P-value
No AVD
2.49 (1.77-3.51), <0.001
1.56 (1.10-2.20), 0.01
1.70 (0.88-3.29), 0.12
Adjusted HR (95% CI), P-value
No AVD
3.71 (1.73-7.94), 0.001
0.77 (0.27-2.22), 0.63
1.60 (0.22-11.87), 0.65
CV Mortality in Patients with HFpEF (%)
0
2
4
6
8
10
12
Follow-up (months)
No. at risk
No AVD 2654 2610 2573 2523 2459 2356 1953
AS 233 217 213 205 194 182 147
AR 154 149 147 141 134 126 102
MAVD 79 74 73 72 66 63 58



No. at risk

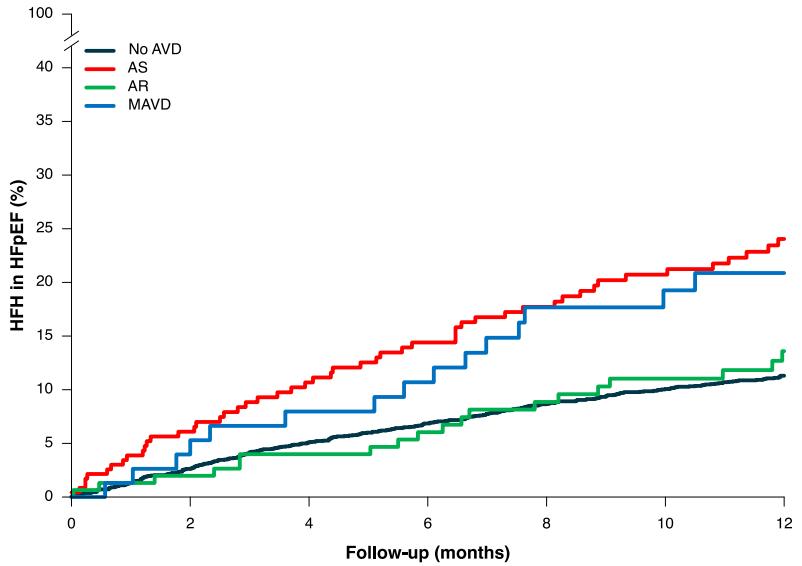
No AVD	2654	2610	2573	2523	2459	2356	1953
AS	233	217	213	205	194	182	147
AR	154	149	147	141	134	126	102
MAVD	79	74	73	72	66	63	58

Figure 2C.



No. at risk

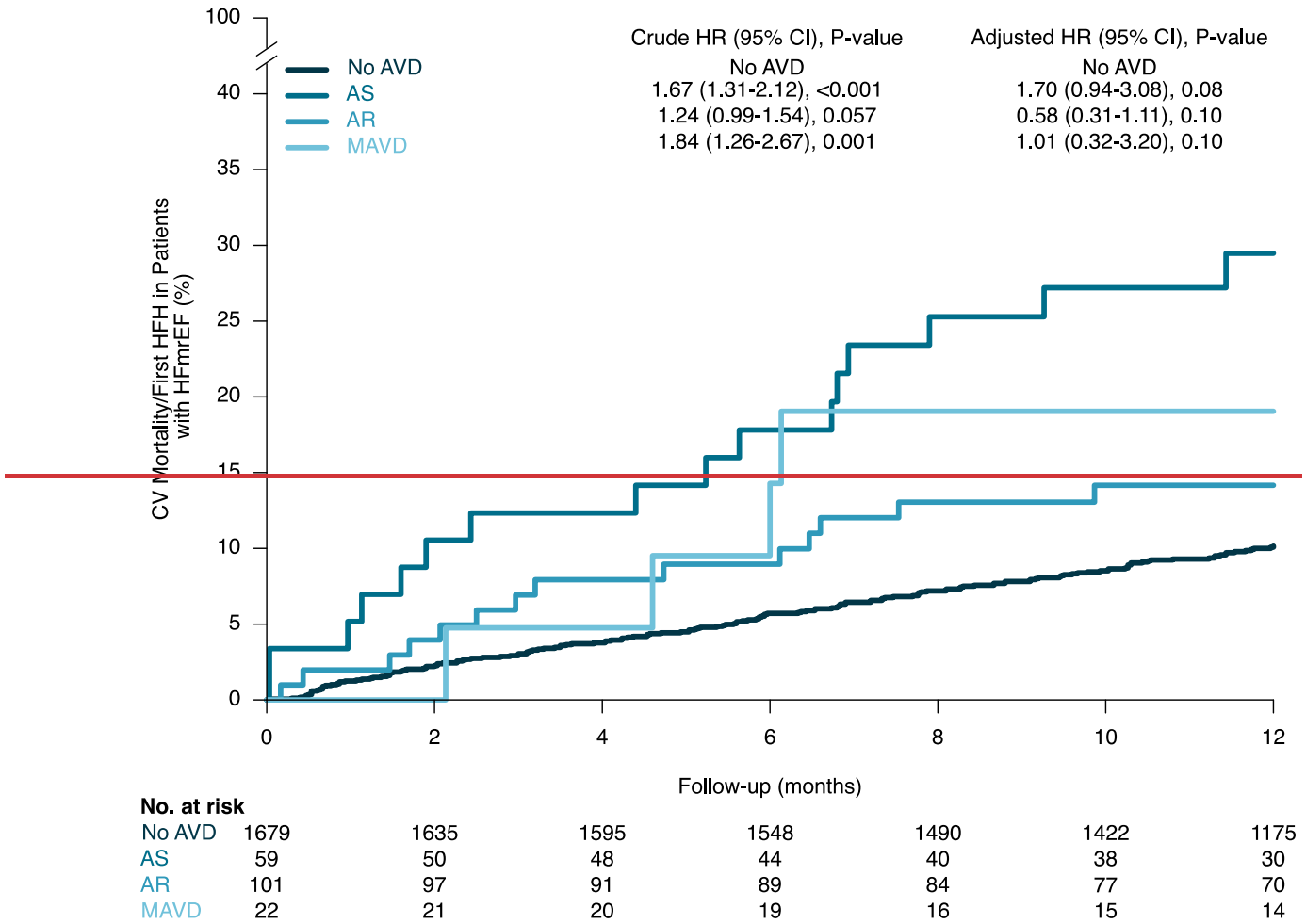
No AVD	2654	2552	2463	2378	2280	2160	1786
AS	233	207	194	182	168	152	120
AR	154	147	143	135	126	117	94
MAVD	79	72	68	65	54	50	46



No. at risk

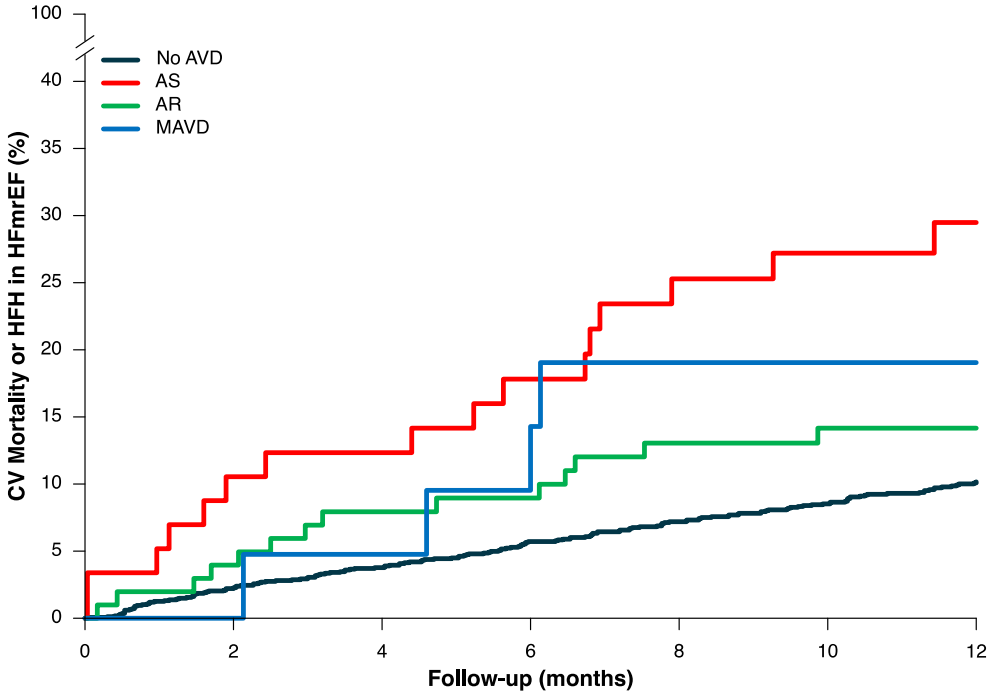
No AVD	2654	2552	2463	2378	2280	2160	1786
AS	233	207	194	182	168	152	120
AR	154	147	143	135	126	117	94
MAVD	79	72	68	65	54	50	46

Figure 2D.



No. at risk

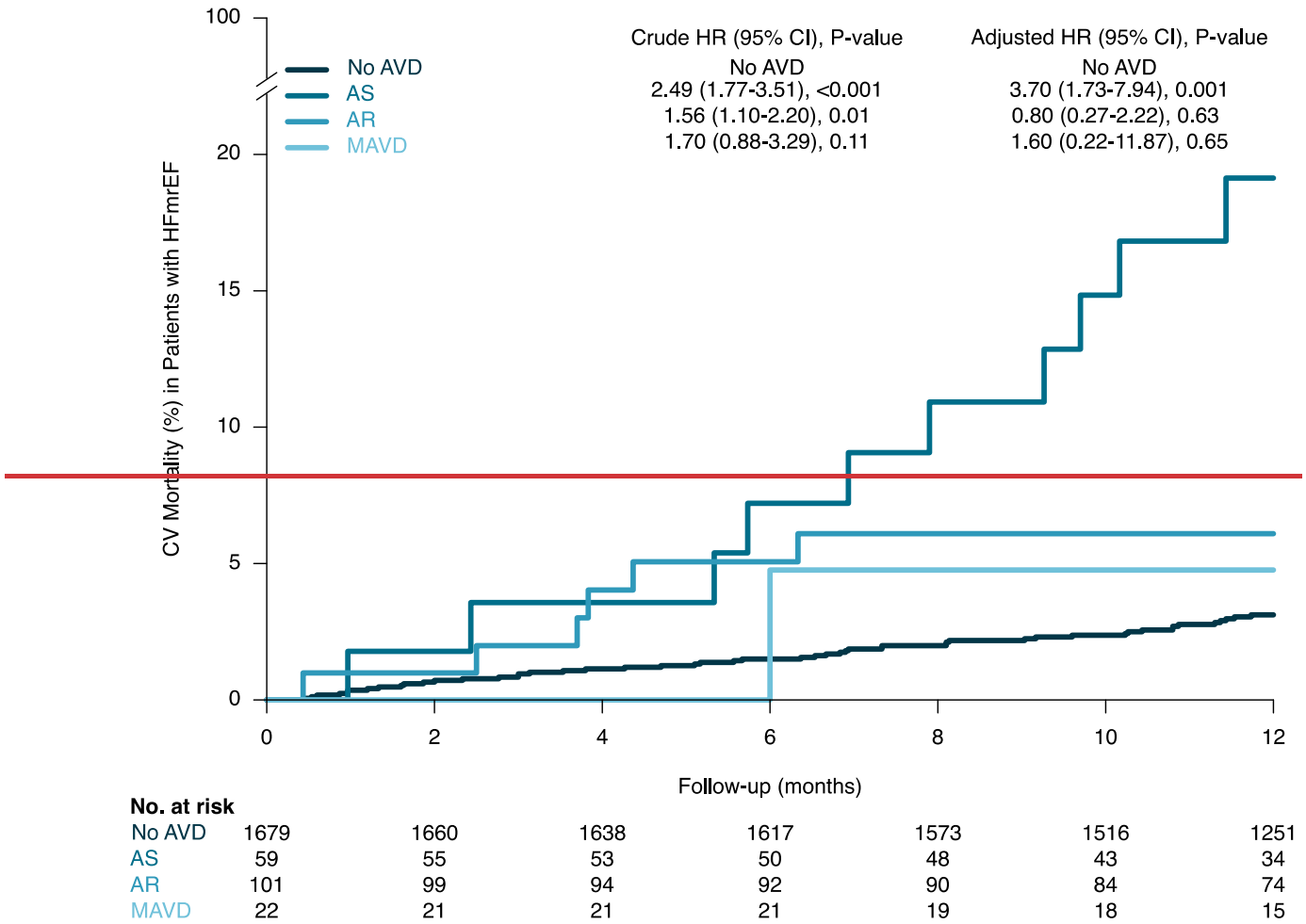
No AVD	1679	1635	1595	1548	1490	1422	1175
AS	59	50	48	44	40	38	30
AR	101	97	91	89	84	77	70
MAVD	22	21	20	19	16	15	14



No. at risk

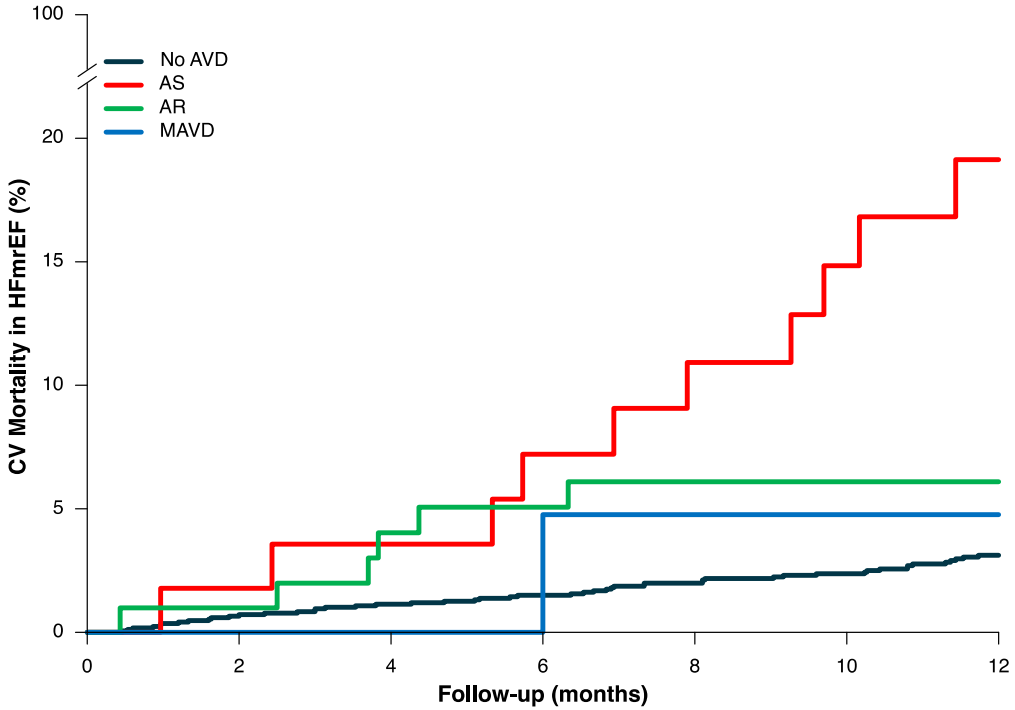
No AVD	1679	1635	1595	1548	1490	1422	1175
AS	59	50	48	44	40	38	30
AR	101	97	91	89	84	77	70
MAVD	22	21	20	19	16	15	14

Figure 2E.



No. at risk

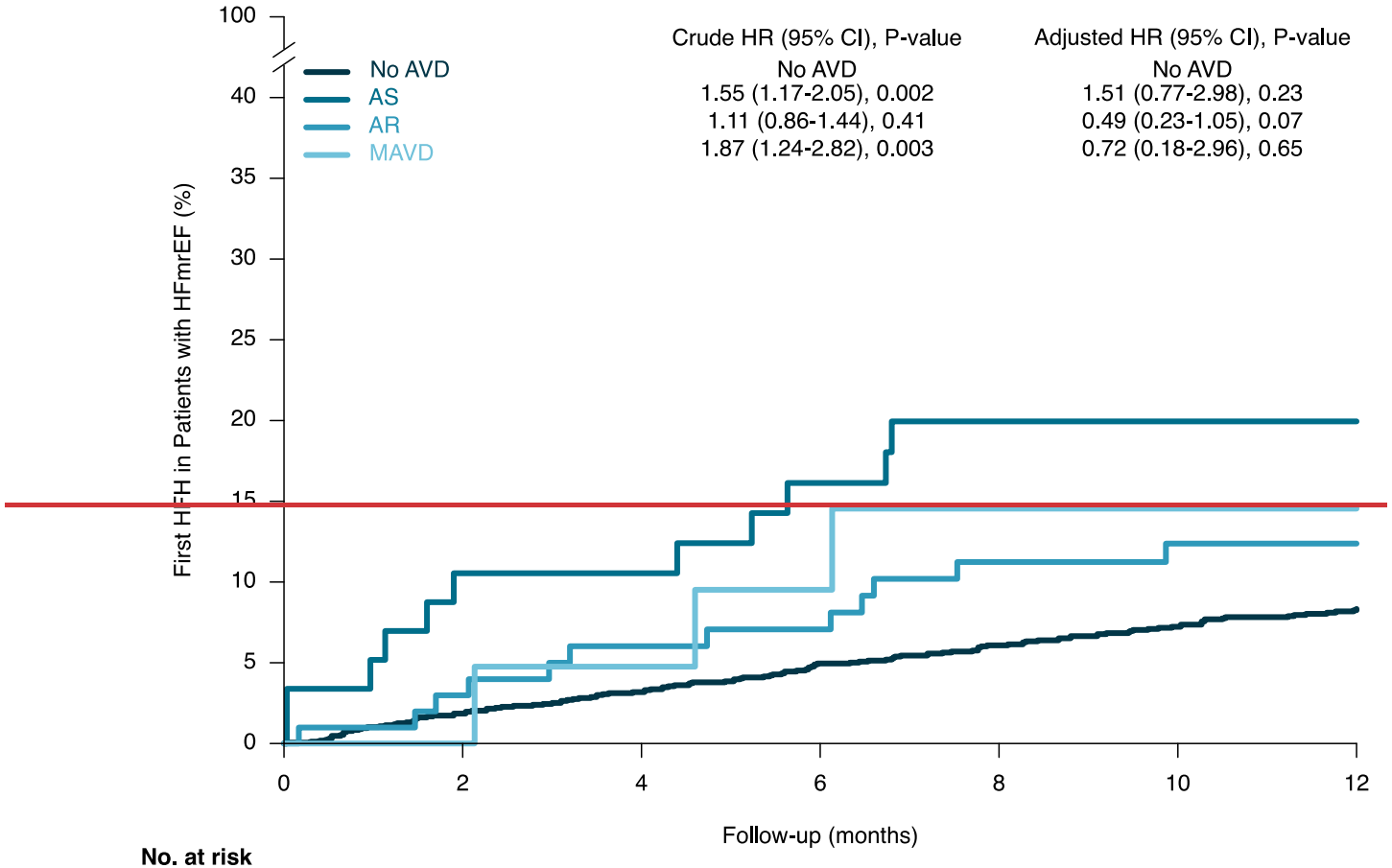
No AVD	1679	1660	1638	1617	1573	1516	1251
AS	59	55	53	50	48	43	34
AR	101	99	94	92	90	84	74
MAVD	22	21	21	21	19	18	15



No. at risk

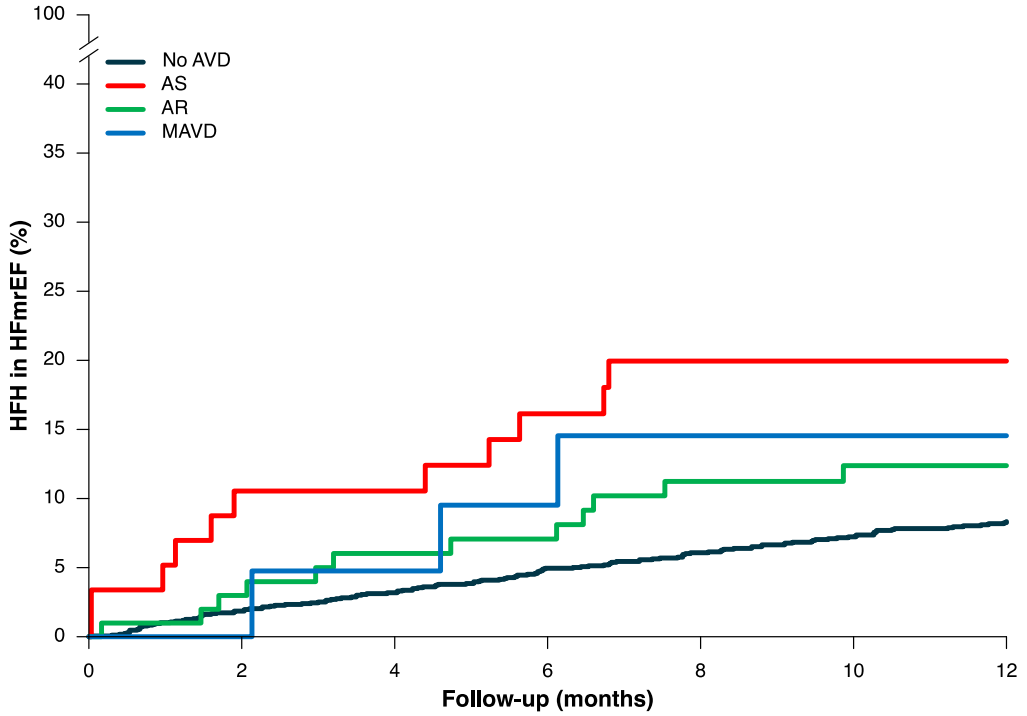
No AVD	1679	1660	1638	1617	1573	1516	1251
AS	59	55	53	50	48	43	34
AR	101	99	94	92	90	84	74
MAVD	22	21	21	21	19	18	15

Figure 2-F.



No. at risk

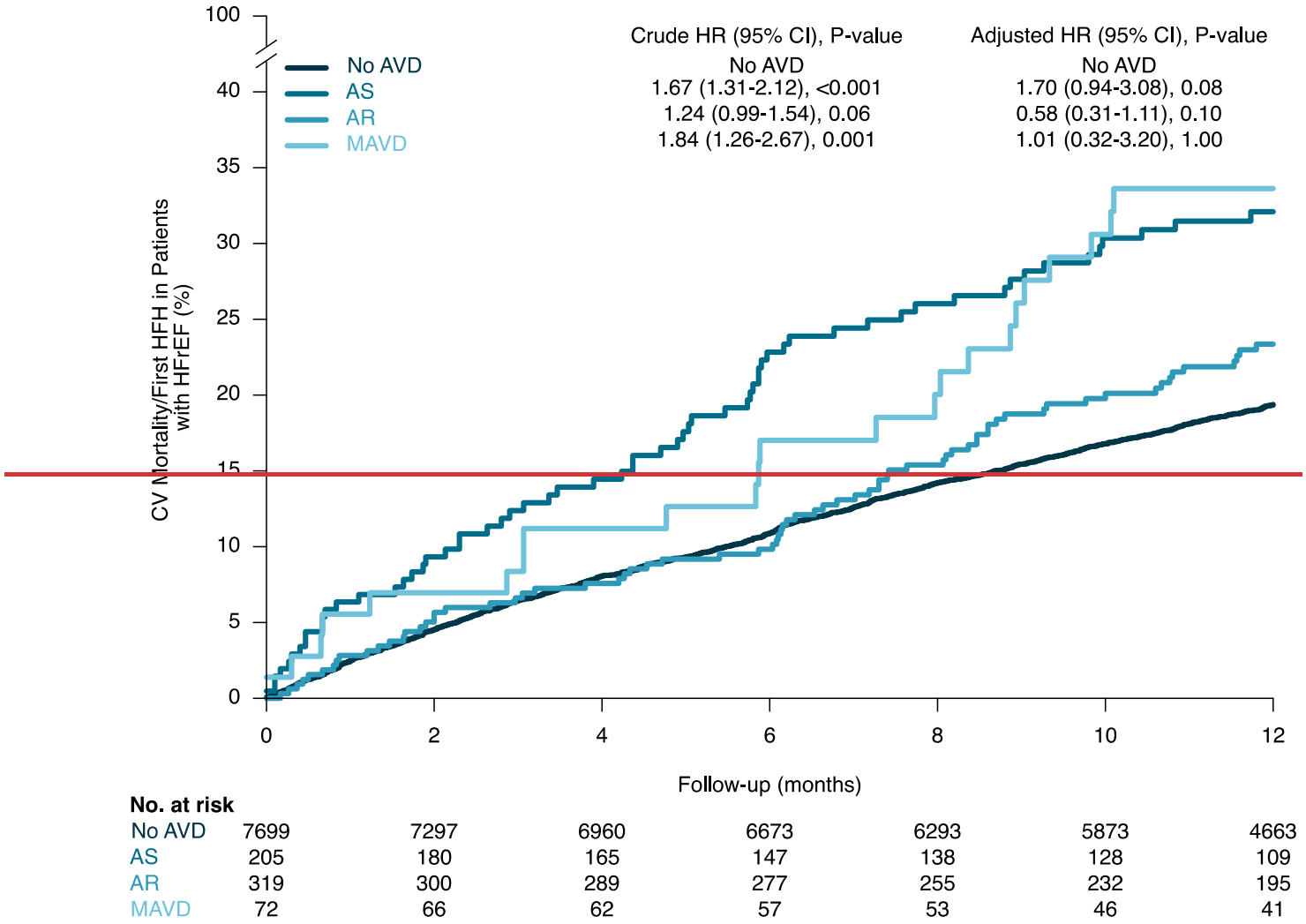
No AVD	1679	1635	1595	1548	1490	1422	1175
AS	59	50	48	44	40	38	30
AR	101	97	91	89	84	77	70
MAVD	22	21	20	19	16	15	14



No. at risk

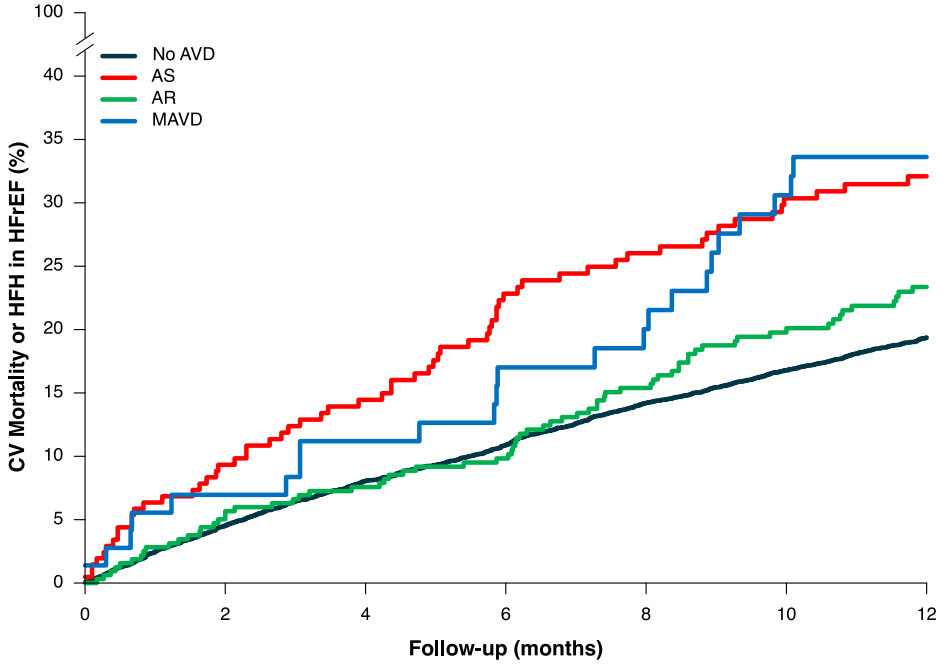
No AVD	1679	1635	1595	1548	1490	1422	1175
AS	59	50	48	44	40	38	30
AR	101	97	91	89	84	77	70
MAVD	22	21	20	19	16	15	14

Figure 2G.



No. at risk

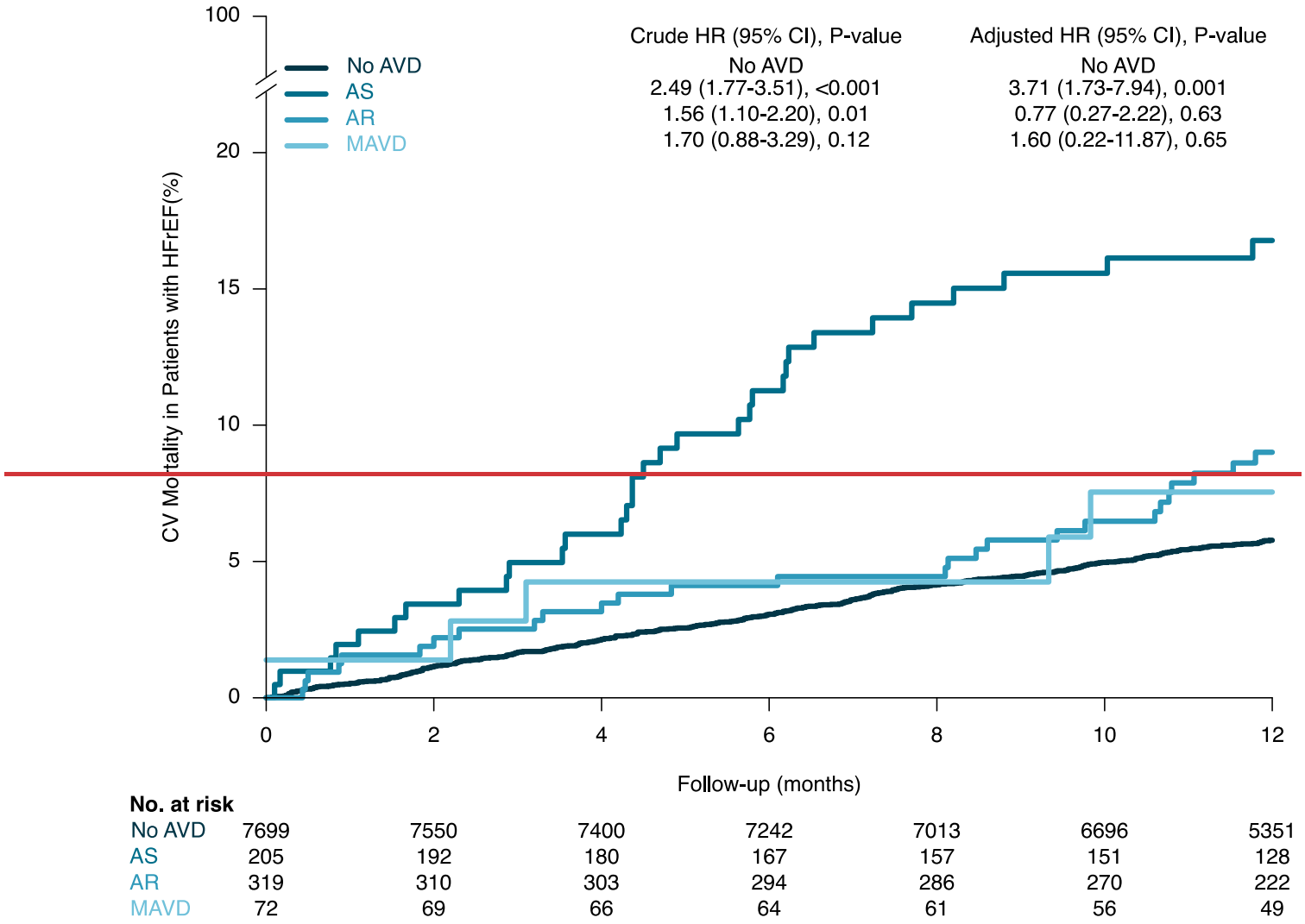
No AVD	7699	7297	6960	6673	6293	5873	4663
AS	205	180	165	147	138	128	109
AR	319	300	289	277	255	232	195
MAVD	72	66	62	57	53	46	41



No. at risk

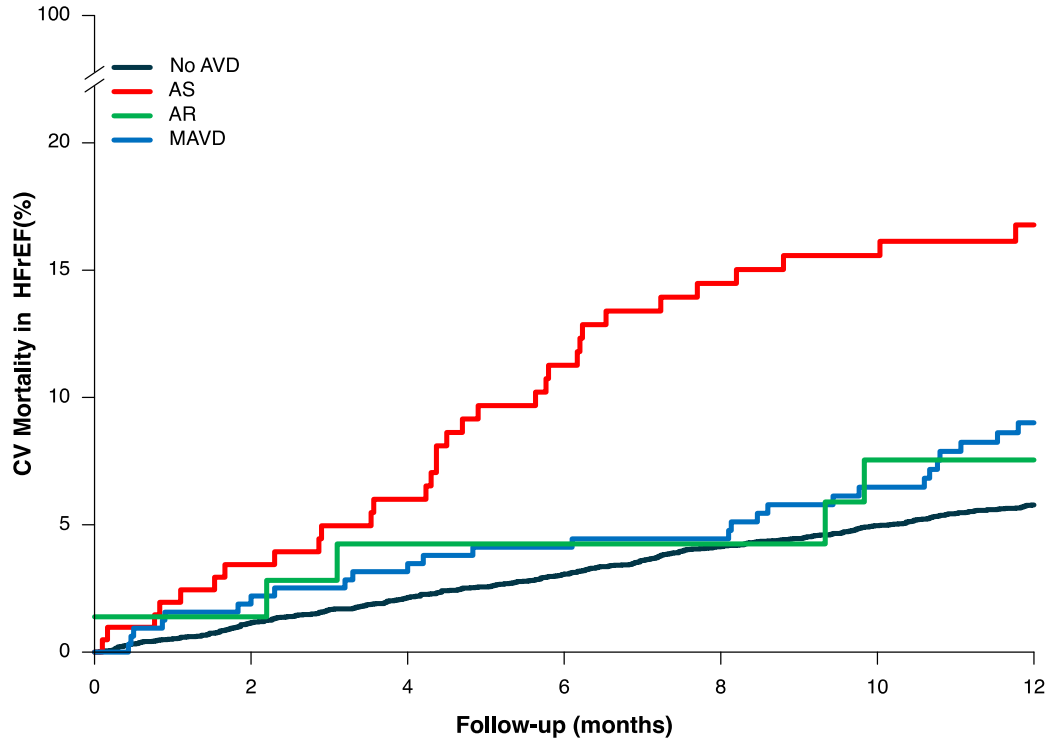
No AVD	7699	7297	6960	6673	6293	5873	4663
AS	205	180	165	147	138	128	109
AR	319	300	289	277	255	232	195
MAVD	72	66	62	57	53	46	41

Figure 2H.



No. at risk

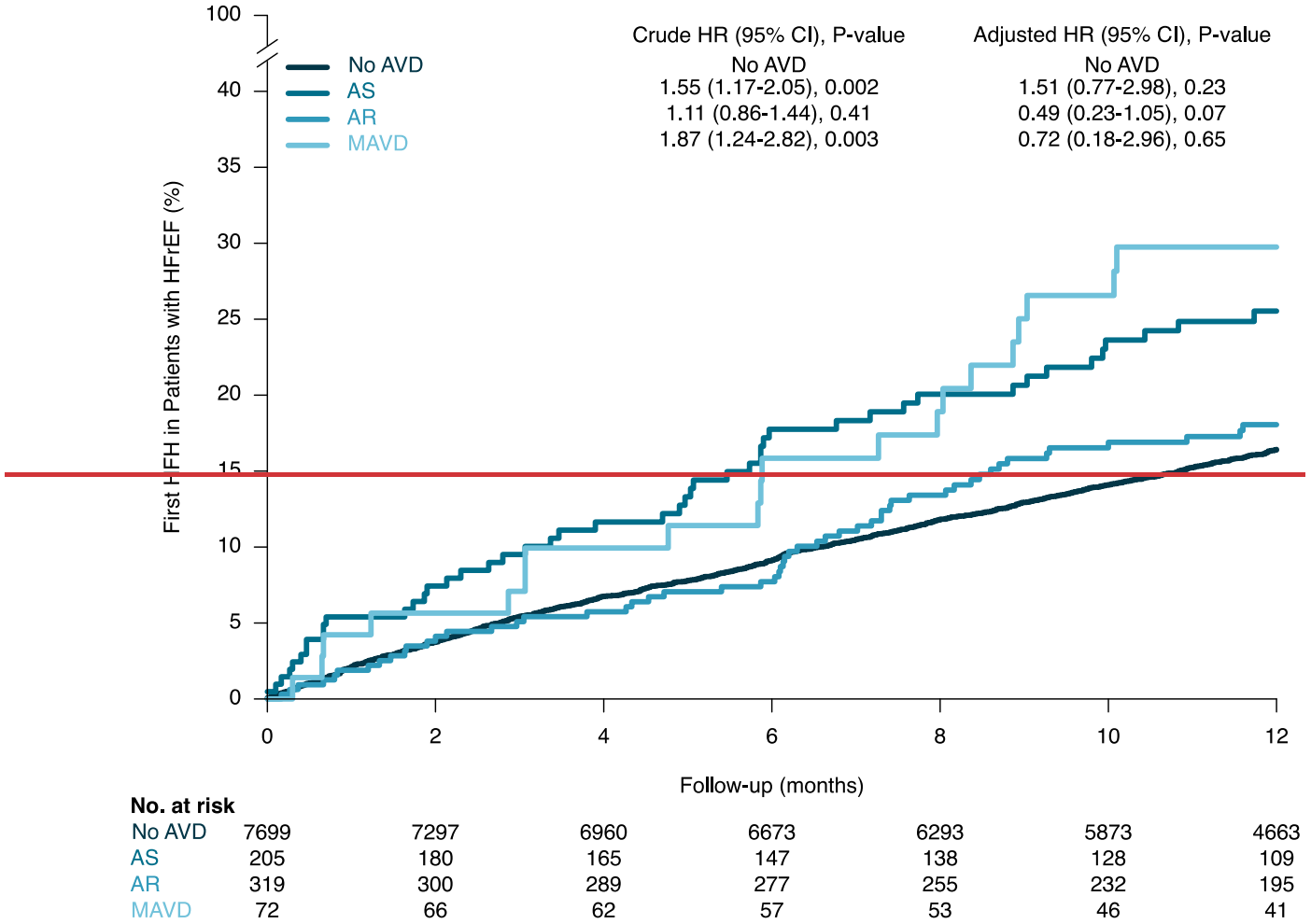
No AVD	7699	7550	7400	7242	7013	6696	5351
AS	205	192	180	167	157	151	128
AR	319	310	303	294	286	270	222
MAVD	72	69	66	64	61	56	49



No. at risk

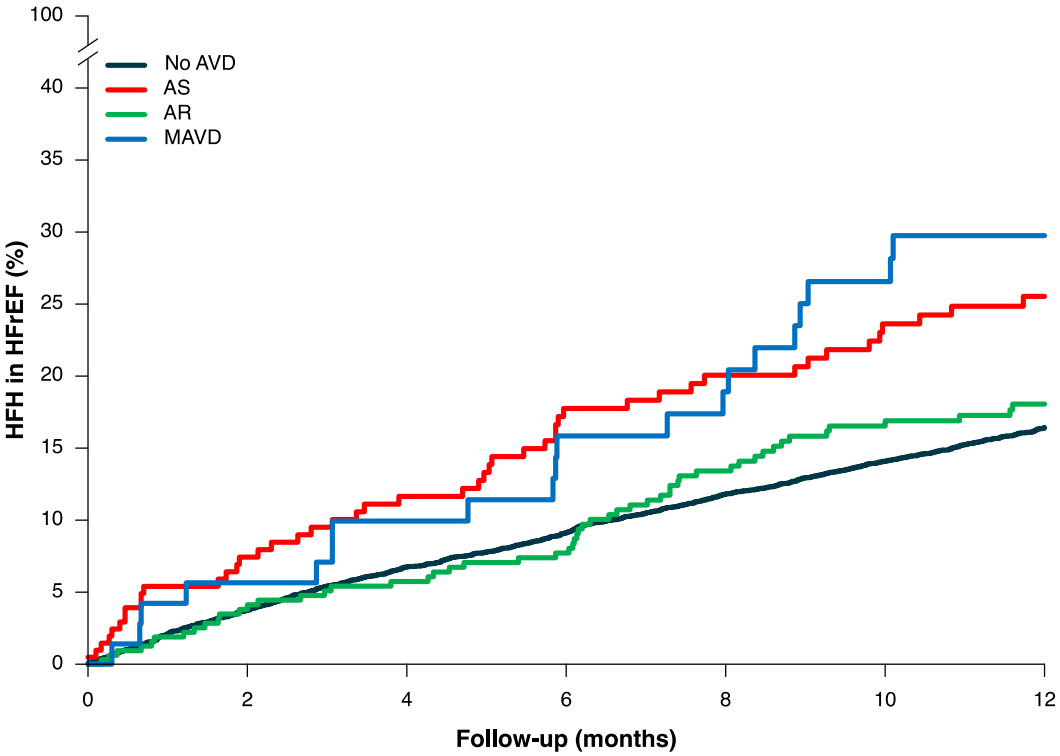
No AVD	7699	7550	7400	7242	7013	6696	5351
AS	205	192	180	167	157	151	128
AR	319	310	303	294	286	270	222
MAVD	72	69	66	64	61	56	49

Figure 2I.



No. at risk

No AVD	7699	7297	6960	6673	6293	5873	4663
AS	205	180	165	147	138	128	109
AR	319	300	289	277	255	232	195
MAVD	72	66	62	57	53	46	41

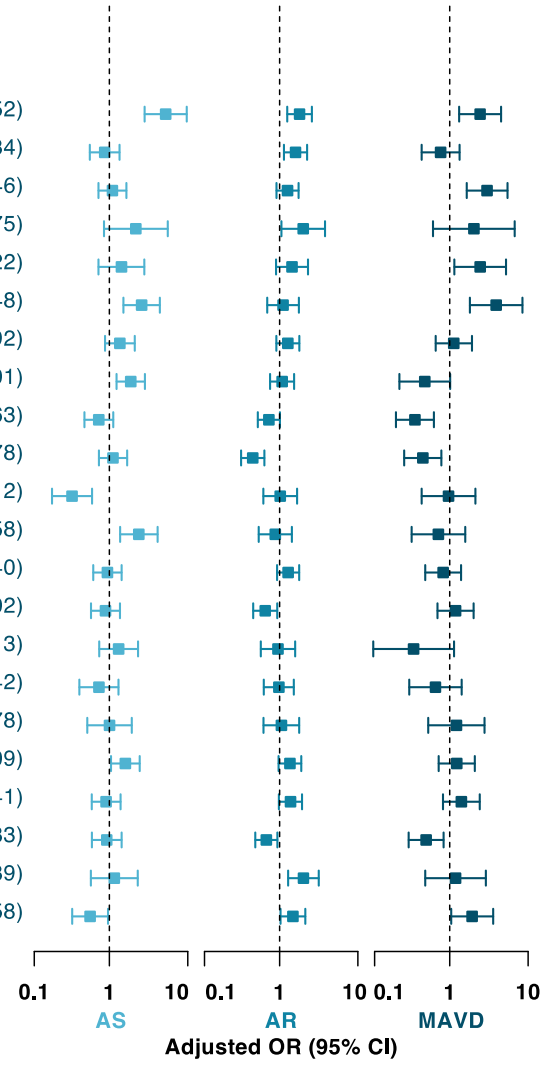


No. at risk

No AVD	7699	7297	6960	6673	6293	5873	4663
AS	205	180	165	147	138	128	109
AR	319	300	289	277	255	232	195
MAVD	72	66	62	57	53	46	41

Supplemental Figure 3. Adjusted Associations Between Patient Characteristics and Type of Aortic Valve disease

HFmrEF= heart failure with mildly reduced ejection fraction; HFpEF= heart failure with preserved ejection fraction; AS = aortic valve stenosis; AR = aortic valve regurgitation; OR= odds ratio; AS = aortic valve stenosis; AR = aortic valve regurgitation; OR = odds ratio; CI = confidence interval; HR = heart rate; SBP = systolic blood pressure; EF = ejection fraction; NYHA = New York Heart Association; HF = heart failure; HFH = heart failure hospitalization; IHD = ischemic heart disease; LVEDD = left ventricular end-diastolic diameter; COPD =chronic obstructive pulmonary disease; TIA = transient ischemic attach; BMI = body mass index; eGFR = estimated glomerular filtration rate.

Supplemental Figure 3.

	Adjusted OR (95% CI)		
	AS	AR	MAVD
Age ≥65 vs. <65 (years)	5.23 (2.82-9.70)	1.80 (1.25-2.59)	2.44 (1.32-4.52)
Female vs. Male	0.87 (0.56-1.35)	1.60 (1.14-2.24)	0.77 (0.44-1.34)
HR ≥70 vs. <70 (bpm)	1.09 (0.73-1.65)	1.26 (0.91-1.75)	3.00 (1.65-5.46)
SBP ≥100 vs. <100 (mmHg)	2.17 (0.85-5.56)	2.00 (1.05-3.81)	2.03 (0.61-6.75)
EF 41-49 vs. ≤40 (%)	1.42 (0.73-2.79)	1.44 (0.90-2.30)	2.45 (1.15-5.22)
EF ≥50 vs. ≤40 (%)	2.58 (1.51-4.40)	1.11 (0.69-1.76)	3.92 (1.81-8.48)
NT-proBNP ≥ vs. < median (pg/mL)	1.36 (0.88-2.10)	1.27 (0.91-1.79)	1.13 (0.66-1.92)
NYHA class III-IV vs. I-II	1.87 (1.23-2.84)	1.08 (0.76-1.53)	0.48 (0.23-1.01)
HF duration >12 months	0.73 (0.48-1.12)	0.73 (0.53-1.01)	0.36 (0.21-0.63)
Previous HFH	1.11 (0.73-1.68)	0.45 (0.32-0.64)	0.45 (0.26-0.78)
Primary etiology: IHD vs. No IHD	0.33 (0.19-0.60)	1.02 (0.62-1.67)	0.97 (0.44-2.12)
CAD	2.38 (1.37-4.12)	0.88 (0.54-1.43)	0.72 (0.33-1.58)
AF/flutter	0.94 (0.62-1.43)	1.28 (0.93-1.78)	0.82 (0.49-1.40)
DM	0.89 (0.58-1.36)	0.66 (0.46-0.93)	1.19 (0.70-2.02)
PVD	1.31 (0.74-2.32)	0.95 (0.58-1.58)	0.35 (0.11-1.13)
COPD	0.74 (0.41-1.31)	0.98 (0.63-1.52)	0.66 (0.30-1.42)
Stroke/TIA	1.01 (0.52-1.93)	1.05 (0.62-1.78)	1.22 (0.53-2.78)
Anemia	1.60 (1.05-2.43)	1.36 (0.97-1.89)	1.23 (0.72-2.09)
CKD	0.91 (0.60-1.39)	1.38 (0.98-1.94)	1.41 (0.82-2.41)
BMI ≥25 vs. <25 (kg/m²)	0.93 (0.60-1.43)	0.68 (0.49-0.94)	0.50 (0.30-0.83)
Sodium <135 vs. ≥135 (mmol/l)	1.15 (0.58-2.30)	2.02 (1.28-3.17)	1.19 (0.49-2.89)
LVEDD ≥60 vs. <60 (mm)	0.57 (0.34-0.96)	1.48 (1.03-2.13)	1.93 (1.04-3.58)