SUPPLEMENTAL MATERIAL

Table S1. Congenital heart disease diagnosis code groups (a) and congenital heart disease related procedures used to identify congenital lesions (b)

a. Heart defect group	ICD-9 code
Aortic valve stenosis/insufficiency	746.3, 746.4
Transposition of great arteries (TGA)	745.1
Atrial Septal Defect (ASD)	745.5
Mitral valve stenosis/insufficiency	746.5, 746.6, 746.7
Pulmonary Valve anomaly (PV) anomaly	746.0
Anomalies of the Aorta	747.1, 747.2
Ebstein anomaly of Tricuspid Valve	746.2
Tetralogy of Fallot (TOF)	745.2
Common/single ventricle	745.3, 746.01, 746.1
Ventricular septal defect (VSD)	745.4
Endocardial cushion	745.6
Patent ductus arteriosus (PDA)	747.0
Other defects	648.51, 648.52, 648.53, 746.9, 745.0, 745.11, 745.7, 747.3, 747.40, 747.49, 745.8, 745.9, 746., 746.8

b. Procedure

PROSTH REP HRT SEPTA NOS	35.50
PROS REP ATRIAL DEF-OPN	35.51
PROS REPAIR ATRIA DEF-CL	35.52
PROST REPAIR VENTRIC DEF	35.53
PROS REP VSD	35.55
GRFT REPAIR HRT SEPT NOS	35.60
GRAFT REPAIR ATRIAL DEF	35.61
GRAFT REPAIR VENTRIC DEF	35.62
HEART SEPTA REPAIR NOS	35.70
ATRIA SEPTA DEF REP NEC	35.71
VENTR SEPTA DEF REP NEC	35.72
ENDOCAR CUSHION REP NEC	35.73
TOT REPAIR TETRAL FALLOT	35.81
TOT COR TRANSPOS GRT VES	35.84
INTERAT VEN RETRN TRANSP	35.91
CONDUIT RT VENT-PUL ART	35.92
CONDUIT ARTIUM-PULM ART	35.94
CAVAL-PULMON ART ANASTOM	39.21

Table S2. Distribution of non-cardiac congenital defects.

	N	(%)
Neurologic	22	(0.2)
Cranio-Face	129	(1.1)
Respiratory	35	(0.3)
Gastrointestinal	24	(0.2)
Genitourinary	210	(1.8)
Muscoskeletal	297	(2.5)
Genetic syndromes		
Marfan syndrome	22	(0.2)
Down syndrome	46	(0.4)

Table S3. Characteristics and health service utilization frequency of 11,653 ACHD patients with congenital heart disease.

	Sex			Disease complexity			
	Men	**Women**	**p**	**Simple**	**Intermediate**	**Complex**	**p**
Cardiac Morbidity N (%)							
Arrhythmia	916 (16.5)	1154 (18.9)	0.0007	1512 (17.5)	431 (17.5)	127 (22.7)	0.007
Valve disease	916 (16.5)	1154 (18.9)	<.0001	527 (6.1)	351 (14.3)	113 (20.2)	<.0001
Ischemic HD	997 (18.0)	749 (12.3)	<.0001	1313 (15.2)	364 (14.8)	69 (12.3)	0.2
Heart failure	472 (8.5)	436 (7.1)	0.006	630 (7.3)	203 (8.3)	75 (13.4)	<.0001
Other HD	924 (16.6)	888 (14.6)	0.002	1176 (13.6)	501 (20.4)	135 (24.2)	<.0001
Other Morbidity N (%)							
Diabetes mellitus	728 (13.1)	808 (13.2)	0.8	1148 (13.3)	339 (13.8)	49 (8.8)	0.005
Hypertension	1773 (31.9)	1981 (32.5)	0.5	2799 (32.4)	829 (33.7)	126 (22.5)	<.0001
hyperlipidemia	1619 (29.2)	1718 (28.2)	0.2	2512 (29.1)	712 (29.0)	113 (20.2)	<.0001
Stroke/TIA	729 (13.1)	846 (13.9)	0.2	1289 (14.9)	240 (9.8)	46 (8.2)	<.0001
Kidney failure	30 (0.5)	14 (0.2)	0.006	34 (0.4)	9 (0.4)	1 (0.2)	0.7
Residence locality ethnicity N (%)							
Jewish / Other	3849 (69.4)	4246 (69.8)	0.2	565 (6.6)	167 (6.8)	60 (10.8)	0.003
Arab	403 (7.3)	389 (6.4)		5992 (69.6)	1732 (70.6)	371 (66.5)	

	Sex				Disease complexity			
	Men		**Women**	**p**	**Simple**	**Intermediate**	**Complex**	**p**
Mixed	1293	(23.3)	1444 (23.8)		2056 (23.9)	554 (22.6)	127 (22.8)	
Residence locality Peripherality N (%)								
Very peripheral	121	(2.2)	106 (1.7)	0.3	174 (2.0)	47 (1.9)	6 (1.1)	0.01
Peripheral	710	(12.8)	749 (12.3)		1052 (12.2)	334 (13.6)	73 (13.1)	
Medium	996	(18.0)	1097 (18.0)		1546 (18.0)	443 (18.1)	104 (18.6)	
Central	1140	(20.6)	1314 (21.6)		1890 (21.9)	451 (18.4)	113 (20.3)	
Very Central	2576	(46.5)	2813 (46.3)		3950 (45.9)	1177 (48.0)	262 (47.0)	
Service utilization Frequency/5 years Median (IQR)								
Primary care visits	28	(15-49)	36 (21-58)	<.0001	33 (18-55)	32 (16-54)	32 (17-57)	0.04
Outpatient Cardiology visits	3	(1-7)	3 (1-6)	0.03	3 (1-6)	3 (1-7)	3 (1-8)	0.0001
ED only visits	0	(0-2)	1 (0 -2)	<.0001	1 (0-2)	0 (0-2)	1 (0-2)	0.06
Hospital admissions	1	(0-2)	1 (0-2)	0.8	1 (0-2)	1 (0-2)	1 (0-3)	0.002
Days in hospital	7	(3-20)	6 (2-19)	0.0004	7 (2-19)	7 (2-19)	10 (2-33)	0.002
Days in ICU	0	(0-0)	0 (0-0)	<.0001	0 (0-0)	0 (0-0)	0 (0-1)	<.0001

ED-emergency department, HD- heart disease; ICU-intensive care unit, IQR-interquartile range; TIA-transient ischemic attack

Table S4. Health service utlization hazard under age and congenital heart disease complexity interaction.

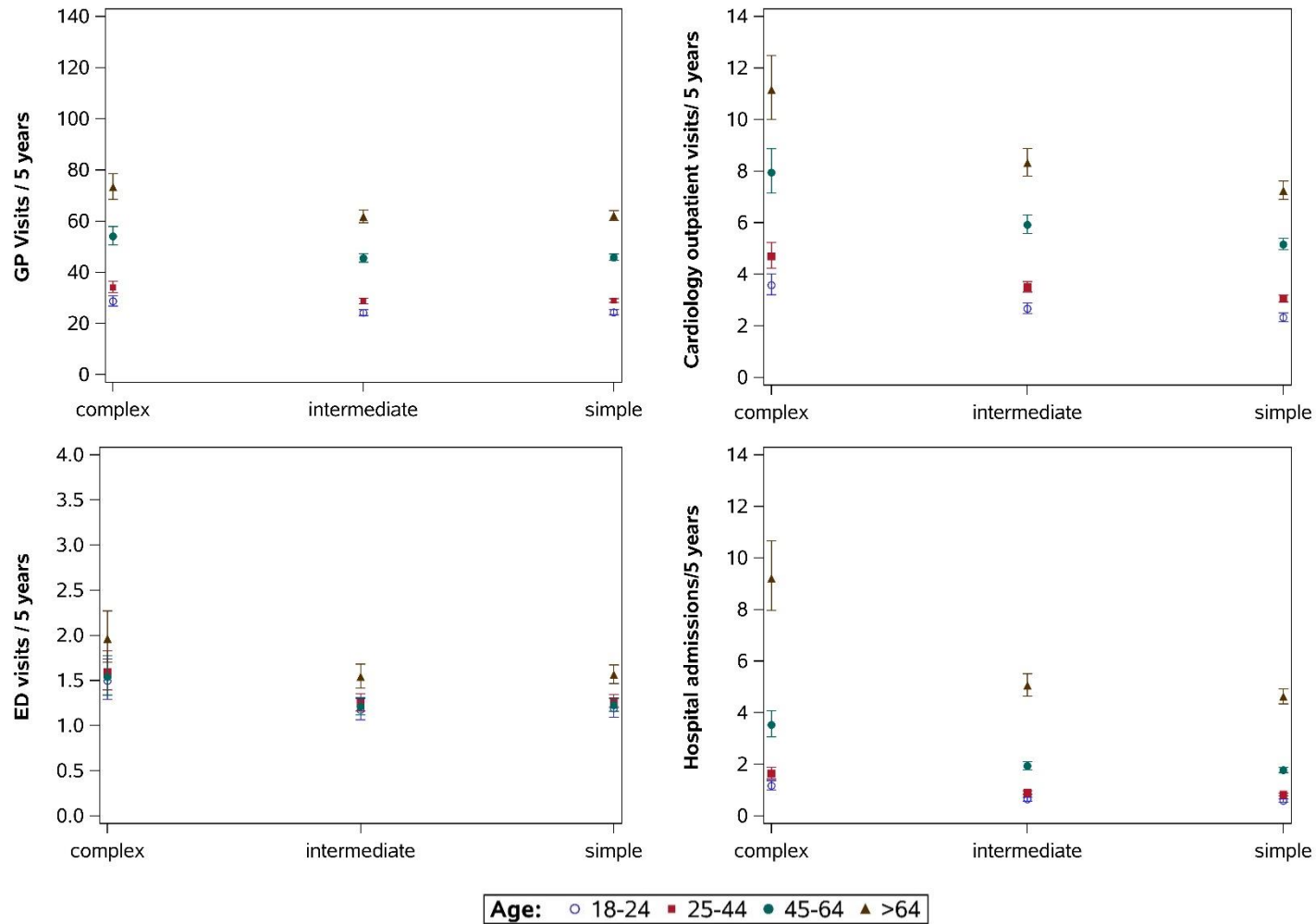| Age	Complexity (ref=simple)	Primary care visits		Cardiology outpatient visits	ED visits	Hospitalization
		HR	(95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
18-24	Complex	0.92	(0.86-0.97)	1.50 (1.33-1.69)	1.01 (0.82-1.26)	1.59 (1.17-2.18)
	Intermediate	0.96	(0.92-1.01)	1.15 (1.04-1.27)	0.90 (0.75-1.08)	0.90 (0.62-1.32)
25-44	Complex	1.04	(1.00-1.09)	1.21 (1.12-1.31)	1.11 (0.98-1.27)	1.45 (1.24-1.69)
	Intermediate	1.00	(0.98-1.02)	1.03 (0.97-1.09)	0.93 (0.85-1.01)	0.98 (0.86-1.11)
45-64	Complex	0.99	(0.93-1.06)	1.10 (0.98-1.23)	1.22 (0.99-1.50)	1.42 (1.19-1.69)
	Intermediate	0.99	(0.97-1.02)	1.02 (0.97-1.06)	1.00 (0.88-1.14)	1.04 (0.94-1.15)
>64	Complex	0.97	(0.91-1.04)	1.03 (0.92-1.15)	1.11 (0.86-1.44)	1.35 (1.11-1.64)
	Intermediate	0.98	(0.95-1.01)	0.99 (0.94-1.04)	0.99 (0.87-1.13)	0.94 (0.86-1.04)
P for Interaction		0.18		0.0004	0.5	0.99

CI- confidence interval, ED- emergency department, HR- hazard ratio in strata under interaction. Adjusted for: sex, residence peripherality, ethnicity, other congenital defects, comorbidity, health service provider, geographical periphery index, ethnicity, other congenital defects, and baseline comorbidity.

Table S5. Sensitivity analysis- Multivariable adjusted recurrent health service hazard ratio- Excluding patients identified solely by ASD/PFO.

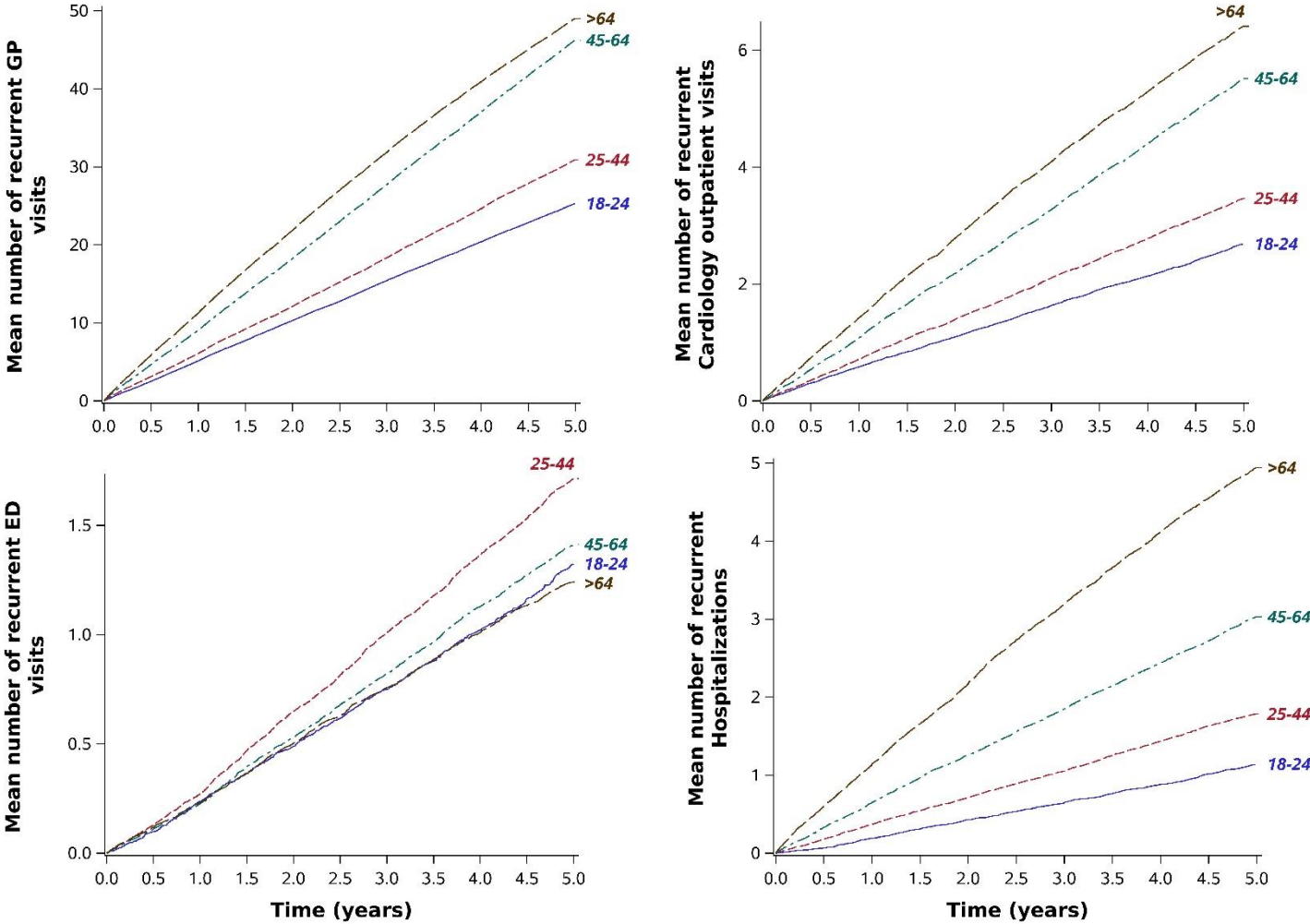|	Primary care visits	Outpatient Cardiology visits	ED visits*	Hospitalizations
	HR (95% CI)	HR (95% CI)	HR(95% CI)	HR(95% CI)
Age (ref=18-24)				
25-44		1.27 (1.14-1.41)		
45-64		2.15 (1.93-2.40)		
>64		2.56 (2.27-2.89)		
Men (Ref=Women)	0.81 (0.78-0.84)	1.16 (1.09-1.23)	0.79 (0.72-0.86)	1.06 (0.97-1.16)
Disease complexity (Ref=Simple)				
Intermediate	0.98 (0.94-1.02)	0.98 (0.92-1.05)	0.98 (0.88-1.09)	1.02 (0.91-1.14)
complex	1.15 (1.07-1.24)	1.39 (1.22-1.57)	1.21 (1.03-1.42)	1.75 (1.48-2.07)
Residence locality Peripherality (Ref=Very central)				
Central	0.99 (0.95-1.04)	0.90 (0.83-0.97)	0.66 (0.58-0.74)	1.01 (0.89-1.14)
Medium	1.07 (1.01-1.13)	1.04 (0.95-1.13)	0.90 (0.79-1.02)	1.18 (1.04-1.35)
Peripheral	1.18 (1.10-1.27)	0.88 (0.79-0.99)	0.62 (0.54-0.72)	1.04 (0.90-1.22)
Very peripheral	1.26 (1.06-1.49)	0.86 (0.67-1.09)	0.79 (0.56-1.10)	1.07 (0.77-1.50)
Residence locality ethnicity (Ref=Jewish)				
Arab	1.40 (1.28-1.53)	1.16 (1.00-1.35)	1.26 (1.04-1.52)	1.49 (1.20-1.84)
Mixed	0.98 (0.93-1.03)	0.94 (0.87-1.01)	1.13 (1.00-1.26)	1.06 (0.95-1.19)
Other congenital defects	1.16 (1.10-1.22)	1.14 (1.04-1.25)	1.23 (1.04-1.44)	1.05 (0.87-1.26)
Charlson comorbidity score	1.10 (1.08-1.11)	1.08 (1.06-1.10)	1.13 (1.09-1.16)	1.21 (1.18-1.25)

CI- confidence interval; ED-emergency department; HR- Hazard ratios for recurrent visits and hospitalization, computed with cox proportional hazard models accounting for the competing risk of death (see methods); ICU-intensive care unit; Ref-reference. Models were stratified by age groups when the proportional hazard assumption was violated (GP visit, ED visits and hospitalization). In addition to the variables in the table, models were also adjusted for: Health service provider, geographical periphery index, ethnicity, other congenital defects, and baseline comorbidity.

Figure S1. **Health service utilization (number of visits) by age and congenital disease complexity.**
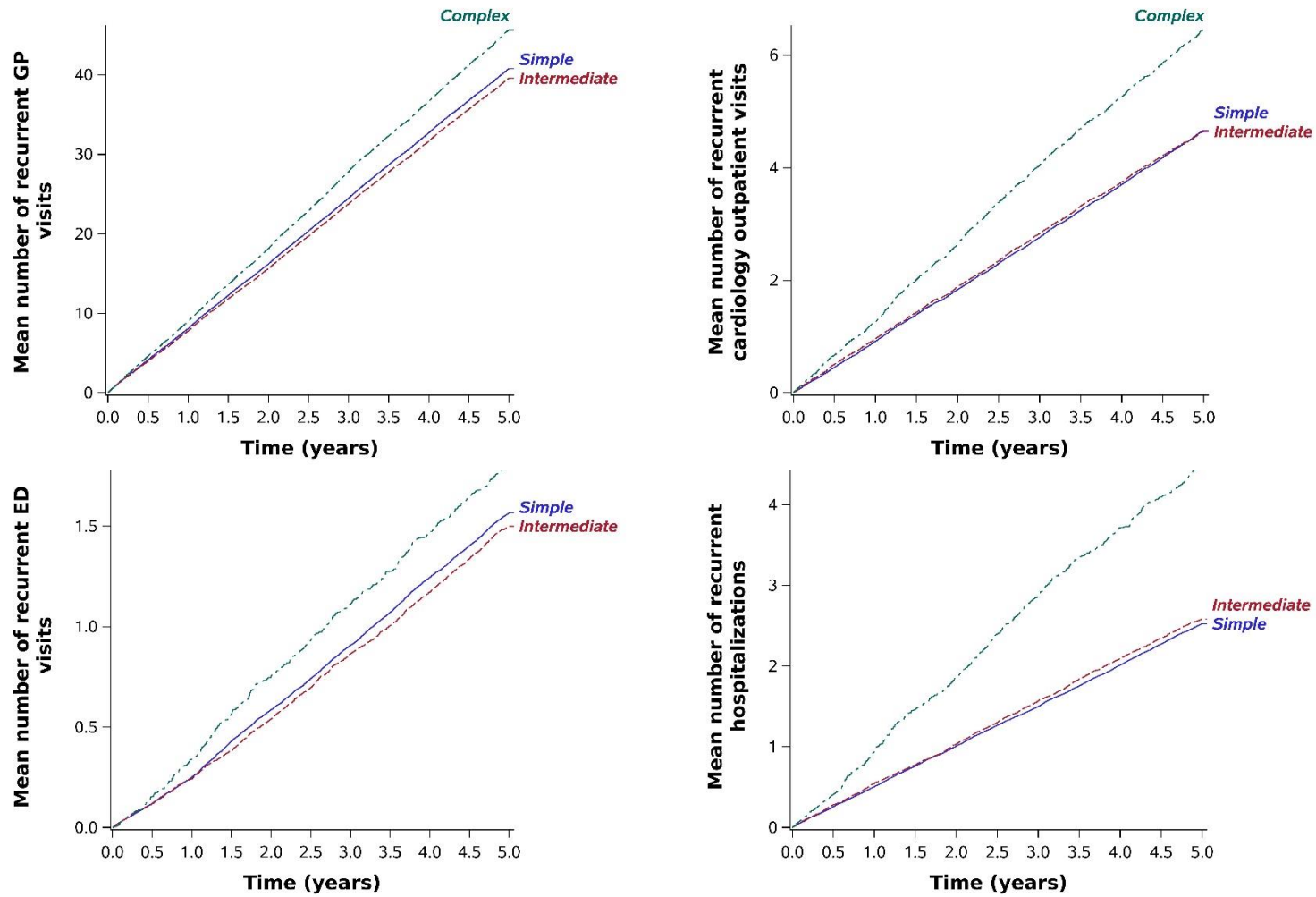

GP- general practice, ED- emergency department.

Figure S2. **Multivariable adjusted cumulative expected number of health service utilizations by age.**
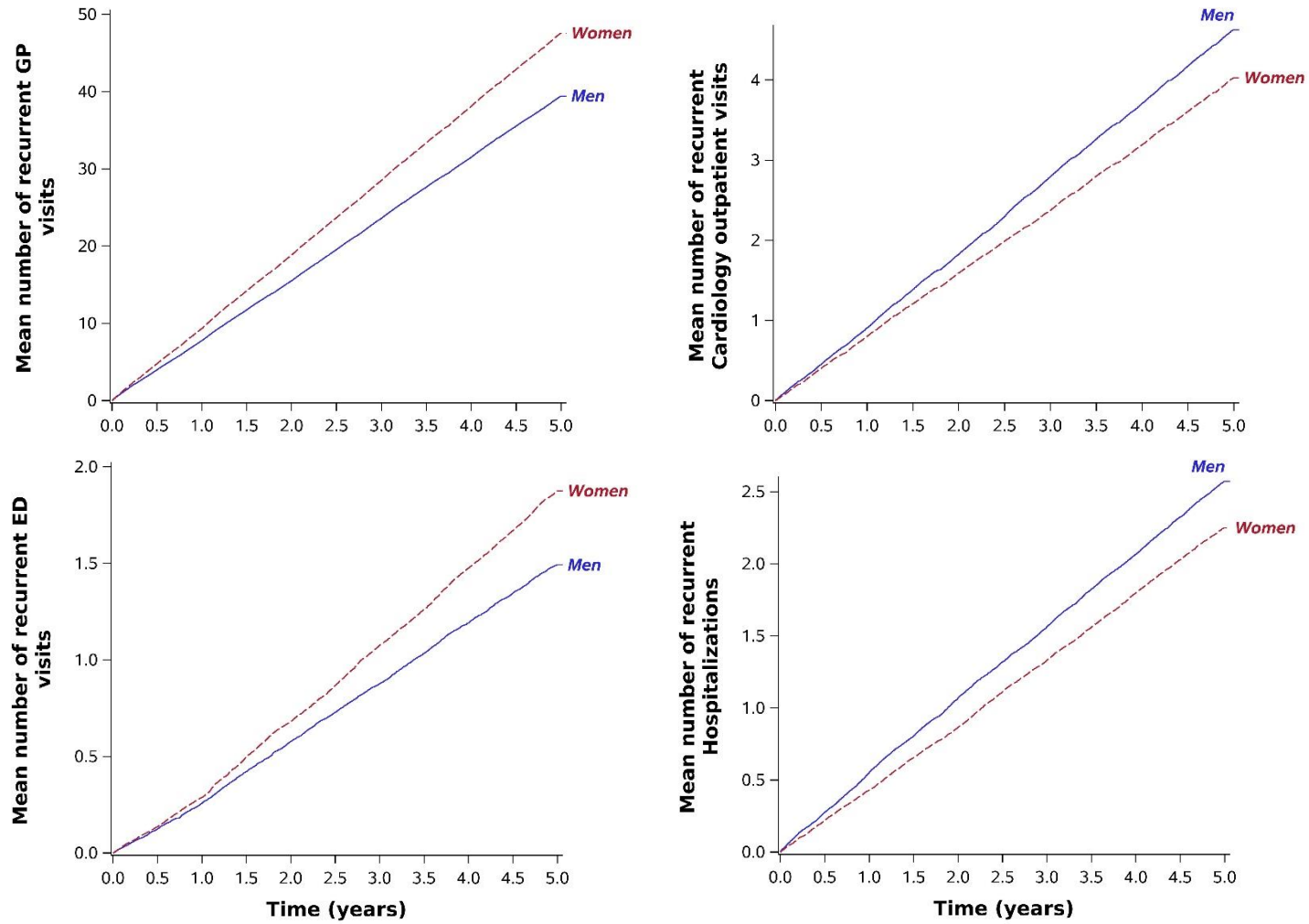

GP- general practice, ED- emergency department.

Figure S3. **Multivariable adjusted cumulative expected number of health service utilization by congenital heart disease complexity.**

GP- general practice, ED- emergency department

Figure S4. **Multivariable adjusted cumulative expected number of health service utilization by sex.**

GP- general practice, ED- emergency department.