

**The CVDNOR project:**  
**Cardiovascular Disease in Norway 1994-2009**  
**Description of data and data quality**

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**Table 1: Abbreviations used in the text**

<b>Abbreviation</b>	<b>Explanation</b>
AA	Aorta aneurism
AAS	Aortic aneurism surgery
ACS	Acute Coronary Syndrome
AF	Atrial fibrillation/ flutter
AFP	Atrial fibrillation procedures; electro conversion, ablation and surgery
AMI	Acute myocardial Infarction
AS	Aorta stenosis
ASS	Aortic stenosis surgery
CABG	Coronay artery bypass surgery
CEREBRO	Cerebrovascular disease
CEREBRO	Cerebrovascular disease
CHD	Coronary Heart Disease
CongHeart	Congenital Heart Defects
CONOR	Cohort of Norway
CR	Coronary revascularization
CVD	Cardiovascular disease
CVDNOR	Cardiovascular disease in Norway
DM	Diabetes Mellitus
FS	Forskning i sykehus (=Research in hospitals)
FS-data	Data retrieved from the patient administrative systems at the hospitals
FS-system	System used to retrieve data from the patient administrative systems at the hospitals
HF	Heart Failure
HKS	The Western Norway Cardiovascular Registry (HKS-registeret)
HT	Hypertension
HVCAT	Left- or right-sided heart catheterizations
ISCHS	Ischemic stroke
PAS	Patient administrative system
PCI	Percutaneous coronary intervention
PRECL	Pre-eclampsia and eclampsia
TOTS	Total stroke
VECAT	Left-sided heart catheterization

## ***Project description and objectives***

CVDNOR is a collaborative project between the University of Bergen and the Norwegian Knowledge Center for the Health Services. It is a research project with retrospective collection of data on CVD and Diabetes hospitalizations in Norway for the time period 1994-2009 linked with several other data sources.

The main objectives of the project are to study:

1. Trends in incident and recurrent events, prevalence, mortality and prognosis for different sub-groups of cardiovascular disease (CVD) in the total Norwegian population
2. Risk Factors and Lifestyle factors as predictors of incident and recurrent events and mortality

## ***Data Sources***

### **Hospitalization data (FS-data)**

A system called FS (Forskning i Sykehus =Research in hospitals)<sup>1</sup> developed by Tomislav Dimoski at the Norwegian Knowledge Center for the Health Services was used to extract data from the electronic Patient Administrative Systems (PAS) at all somatic hospitals in Norway retrospectively for the years 1994 to 2009. Data included a unique ID-number for each patient (PS\_fnr), age, gender and municipality code for the patient, dates of hospitalization and discharge, hospital code, main and secondary diagnoses, procedure codes, codes for departments and wards, dates for transfers between departments and wards and information about type of hospitalization (acute or elective). All hospitalizations containing at least one of the diagnosis codes or procedure codes from the requirement specification given in Appendix A were extracted. If one code fulfilled the requirement, all other diagnosis codes and procedure codes from that hospitalization were extracted. Briefly, the requirement specification included coded related to cardiovascular disease, diabetes, congenital heart defects and complications during pregnancy and labor which can be associated with cardiovascular disease, for instance pre-eclampsia.

The hospitalization data were delivered as one record per hospitalization. The hospitalization records were generated by combining ward stays to department stays and then further combination of department stays to a hospital stay. The main diagnosis for the hospitalization was set to be equal to the main diagnosis(according to the DRG-system) from the first ward stay. All other diagnoses were set to be secondary diagnoses. In some cases this will cause the main diagnosis to be different from the main diagnosis reported in the Norwegian Patient Register (NPR) for the same hospitalization since the main diagnosis in NPR is selected as the main diagnoses for the total hospitalization based on DRG-rules, not only the first ward-stay.

A list of the hospitals included in the project is given in Appendix C.

## **The Cause of Death Registry**

Website: [www.fhi.no/helseregistre/dodsaarsakregisteret.no](http://www.fhi.no/helseregistre/dodsaarsakregisteret.no)

The cause of death data contains all deaths in Norway between 1994 and 2010. The data were delivered as one record per person and contains a unique ID-number for each person (PS\_Fnr), gender, age at death, residency at death (municipality code), underlying and contributing causes of death, date of death, diagnostic basis and place of death (inside or outside an institution).

## **Demographic data from Statistics Norway**

Website: [www.ssb.no/a/english/mikrodata\\_en.no](http://www.ssb.no/a/english/mikrodata_en.no)

The received file contains information about all persons with a permanent address in Norway at any time between 1994 and 2009 (7.9 million records). The information includes a unique ID-number for each person, gender, birth year, date of death, information about citizenship, country of birth and country of origin. For each of the years 1994 through 2009, information includes residency (municipality code) as of January 1<sup>st</sup>, marital status, income, highest completed educational level as well as status januar 1<sup>st</sup> for each year (alive and living in Norway/emigrated/ dead).

In addition we received a file containing the same information for the spouse for persons who were married or in a registered homosexual partnership.

## **CONOR – Cohort of Norway**

Website: [www.fhi.no/studier/cohort-of\\_norway.no](http://www.fhi.no/studier/cohort-of_norway.no)

Cohort of Norway (CONOR) is a collection of data from different regional health surveys in Norway carried out between 1994 and 2003<sup>2</sup>. Approximately 180 000 individuals participated in at least one of the surveys. Information includes data from physical examination, analyses of blood samples and questionnaires. The physical examination included measurements of height, weight, hip and waist circumferences and blood pressure. The questionnaire included 50 standard questions on health status, lifestyle and diet, use of specific medications, educational level and occupational status. Non-fasting blood samples were analyzed for lipids and glucose. CONOR-data linked to hospitalizations and death in the CVDNOR-project is thus a unique source to study associations between various risk factors and later development of CVD or diabetes.

## **Other sources**

The hospitalization data have also been linked to other data sources in various CVDNOR sub projects:

- The Medical Birth Registry
- BERTE Database
- The Cancer Registry
- WENBIT and NORVIT clinical trial data
- The Hordaland Health Studies and other health surveys

## ***Linkage of data and data security***

Data from the different sources were linked and encrypted by Statistics Norway and at the Norwegian Knowledge Center for the Health Services. The personal identification number (unique for each Norwegian resident) was replaced by a unique ID called PS\_fnr in all data files before these were sent to the University of Bergen.

Data from the different sources are stored as separate datasets on a secure windows server at the University of Bergen. The unique ID (PS\_fnr) makes it possible to link the different data sources. Researchers with given privileges can log on to the server from their local computer via a Remote Desktop solution. The Statistical packages SAS, SPSS, Stata and R are installed on the secure server in addition to standard software such as Microsoft Office. All data processing is done on the secure server. It is not allowed to transfer data out of the server to local computers. Output-files from statistical analyses and other non-sensitive files can be transferred from the server to a local computer via a secure file-transfer server.

## ***Ethics and approvals***

The retrieval of data from PAS and linkage with causes of death, demographic data and CONOR were approved by the Regional Ethics Committee. The University of Bergen has permission to store the data until December 31<sup>st</sup> 2018. In addition, all participants in CONOR have given written informed consent.

## ***Definitions of main disease groups***

**Table 2: Definitions of main disease groups**

<b>Short name</b>	<b>Name</b>	<b>ICD9-codes</b>	<b>ICD10-codes</b>
<b>CVD</b>	Cardiovascular disease	390-459	I00-I99
<b>CHD</b>	Coronary heart disease	410-414	I20-I25
<b>AMI</b>	Acute myocardial infarction	410	I21, I22
<b>ACS</b>	Acute coronary syndrome	410, 411	I20.0, I21, I22
<b>CEREBRO</b>	Cerebrovascular disease	430-438	I60-I69
<b>TOTS</b>	Total stroke	430-434, 436	I60-I61, I63-I64 except I63.6
<b>ISCHS</b>	Ischemic stroke	433,434	I63 except I63.6
<b>AA</b>	Aorta aneurism	441	I71
<b>HT</b>	Hypertension	401-405	I10-I15
<b>AS</b>	Aorta stenosis	424.1	I35.0, I35.2
<b>AF</b>	Atrial fibrillation/ flutter	427.3	I48
<b>HF</b>	Heart Failure	428	I50
<b>DM</b>	Diabetes Mellitus	250	E10-E14
<b>PRECL</b>	Pre-eclampsia and eclampsia	642.-642.7	O11, O14, O15
<b>CongHeart</b>	Congenital Heart Defects	745-747	Q20-Q28



## Definitions of main medical procedure code groups

Table 3: Definitions of main medical procedure code groups

Short name	Name	SIF	NCSP/NCMP, versions 1994-2009
<b>PCI</b>	Percutaneous coronary intervention	3294,3236,3239	FNG02, FNG05, FNOB00
<b>CABG</b>	Coronary artery bypass grafting	3112-3129	FNA, FNB, FNC, FND, FNE, FNF
<b>CR</b>	Coronary revascularization	3112-3129, 3294,3236,3239	FNA, FNB, FNC, FND, FNE, FNF, FNG02, FNG05, FNOB00
<b>VECAT</b>	Left-sided heart catheterization	3235, 3238, 3291	XF911, XF912, XF914, FYDB
<b>HVCAT</b>	Left- or right-sided heart catheterizations	3235, 3238, 3290, 3291	XF9101-XF904, XF911-XF914, FYDB
<b>ASS*</b>	Aortic stenosis surgery		FDG00, FDG10, FDG96 FMA00, FMA10, FMA20, FMA32, FMA96 FMB00, FMB10, FMB20, FMB96 FMD00, FMD10, FMD12, FMD13, FMD20, FMD30, FMD33, FMD96
<b>AAS</b>	Aortic aneurism surgery	3138-3143,8807-8807	FCA, FCB, FCC, FCD, PCG10, PDG10, PDG20-24
<b>AFP**</b>	Atrial fibrillation procedures; electro conversion, ablation and surgery	3190-3199	TF924/FPGX24 1FP59AC, FPFE24, FPFE35, FPFE40, FPB20, FPB22, FBP32 FPD00, FPD96

\* The procedure codes are considered as aortic-stenosis surgery only if at least one of the following diagnosis codes is reported for the same patient: I060, I062, I350, I352, Q230, Q244, Q253.

\*\*Considered as treatment for atrial fibrillation only if the patient has atrial fibrillation as main or secondary diagnosis.

### Definition of a hospitalization stay, the 24 hour rule

The hospitalization data include transfers between hospitals, re-hospitalization at the same hospital shortly after the previous hospitalization and also some overlapping hospitalizations for the same patient.

When counting hospitalizations on the national level, a hospitalization stay for a patient is defined as a chain of hospitalizations in the following way: If a new hospitalization starts within 24 hours after the previous one ends, it should be classified as belonging to the first hospitalization, regardless of whether both hospitalizations occurred in the same hospital or not. The same should apply if the

current hospitalization overlaps partly or completely with the previous one. The hospitalizations are then merged and the hospitalization date is set to be equal to the hospitalization date for the first hospitalization in the chain while the discharge date for the last hospitalization in the chain is set to be the discharge date for the new merged hospitalization. If a new hospitalization starts more than 24 hours after the previous hospitalization ends, it should be defined as a new hospitalization. When applying this rule on all hospitalizations fulfilling the inclusion criteria in CVDNOR, the maximum number of hospitalizations in a merged chain was 144 hospitalizations, but 91% of the chains contained only one hospitalization and 99.9% of the chains had  $\leq 5$  hospitalizations.

When counting hospitalizations separately for each hospital, re-hospitalizations within 24 hours are only merged if both hospitalizations occur at the same hospital.

### ***Definition of an AMI event, the 28 day rule***

When counting AMI-events for a patient the first event is set to be the first AMI-hospitalization for this patient. The second event is the first hospitalization occurring  $>28$  days after the first event. If a patient has two or more hospitalizations with an AMI-diagnosis within 28 days, all count as being part of the same event. The third event is the first hospitalization occurring  $>28$  days after the second event etc. The number of AMI-events per year is given in Figure 1 and is always less than the number of AMI-hospitalizations per year.

### **AMI event with PCI**

If a patient has a PCI procedure code during the same hospitalization as the AMI-event or during another hospitalization within 28 days from the hospitalization date for the hospitalizations where the event occurred, the AMI event is defined as an AMI-event with PCI. If the patient has a hospitalization with PCI  $> 28$  days after the AMI-event or no PCI, the AMI event is defined as an AMI event without PCI.

### **AMI event with CABG**

If a patient has a CABG procedure code during the same hospitalization as the AMI-event or during another hospitalization within 8 weeks, the AMI event is defined as an AMI-event with CABG. If the patient has a hospitalization with CABG  $> 8$  weeks after the AMI-event or no PCI, the AMI event is defined as an AMI event without CABG.

### ***Definition of an incident AMI event, the 7-year rule***

An incident AMI event is defined as a hospitalization with AMI as main or secondary diagnosis or AMI as underlying cause of death without any AMI hospitalizations during the last 7 years before the hospitalization date or date of death.

The ideal definition of an incident AMI event is an AMI event without any previous AMI events for the patient. However, because we do not have information before 1994, the patient's earlier disease history is not known. In accordance with previous studies<sup>3,4</sup> we therefore decided to use a washout-period for all patients to look for previous AMI-events. In order to avoid bias when looking at time-trends<sup>5</sup> we used a fixed 7-year time window backwards in time for all patients, even though a longer look-back period than 7 years was available for patients with AMI events from 2002 and onwards.

Incident events could thus only be defined for the years 2001 through 2009 because patients with an AMI before 2001 did not have a 7 year look-back period to search for previous events. Incident AMI hospitalizations according to the 7-year rule are given in Table 4. The observed overall percentage of known recurrent events classified as incident events is 4.2%, but the true percentage is probably closer to the percentage in 2009, 7.5%. The percentage is only 0.6% in 2001, but the 12797 events classified as events with no previous AMI-hospitalizations are probably a mixture of true first-time AMIs and recurrent AMIs where the first event happened before 1994 and thus not included in CVDNOR. If we only include events in the first column of Table 4 as incident AMI hospitalizations we will introduce a bias in the time trend since we will have a mixture of first-time AMIs and recurrent AMIs the first years and almost 100% pure first-time AMIs in 2009, since we have 15 years of look-back-time available for events in 2009. Using only the first column would be equivalent to using an increasing sized look-back window to look for previous events, 7 years in 2001 and 15 years in 2009.

**Table 4: Incident AMI hospitalizations in Norway 2001-2009, according to the 7 year rule. The CVDNOR project.**

<b>Year</b>	<b>Incident AMI hospitalizations with no AMI-hospitalizations the previous 7 years</b>	<b>Incident AMI hospitalizations with previous AMI-hospitalization &gt;7 years ago</b>	<b>Total Incident AMI hospitalizations</b>
<b>2001</b>	12797	75 (0.6%)	12872
<b>2002</b>	12994	221 (1.7%)	13215
<b>2003</b>	13115	376 (2.8%)	13491
<b>2004</b>	12204	436 (3.5%)	12640
<b>2005</b>	12128	545 (4.3%)	12673
<b>2006</b>	12058	655 (5.2%)	12713
<b>2007</b>	11874	757 (6.0%)	12631
<b>2008</b>	12454	841 (6.3%)	13295
<b>2009</b>	12483	1018 (7.5%)	13501
<b>2001-2009</b>	<b>112107</b>	<b>4924 (4.2%)</b>	<b>117031</b>

The number of incident AMIs per year will be overestimated by maximum 7% by using the 7-year censoring rule, but the time-trends will be preserved and unbiased. The two bottom lines in Figure 1 show the difference between using the 7 –year rule and by using all available years to look for previous events. The gap between the two lines is increasing because the bottom line includes a mixture of recurrent events and fist-time events the first years, but not the last years.

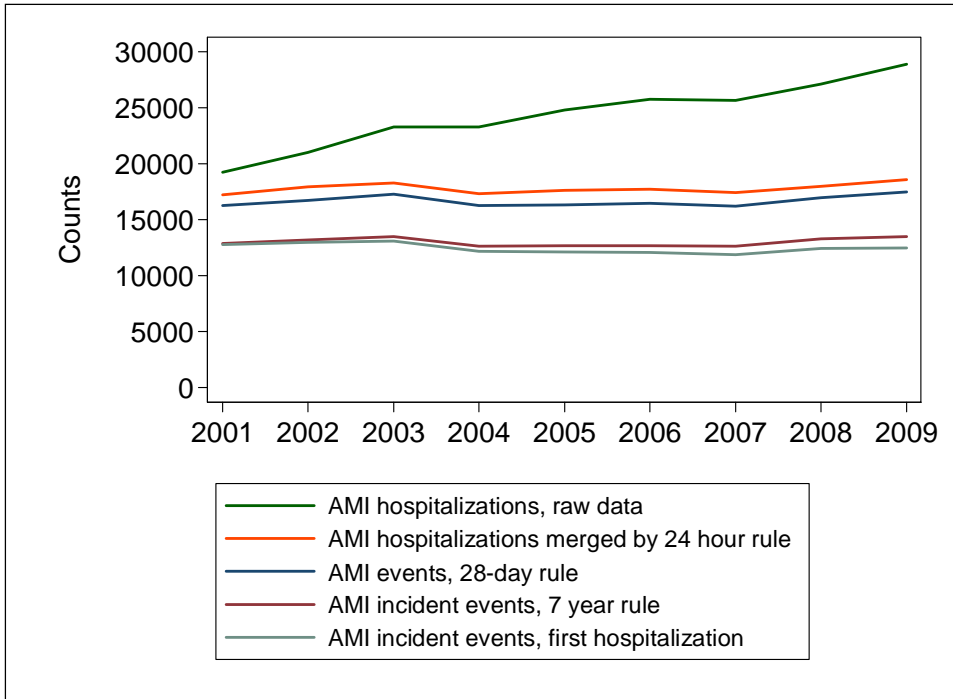


Figure 1: AMI-hospitalizations, AMI-events and incident AMI-events by calendar year

## Overview of hospitalizations (FS-Data)

Table 5: Overview of hospitalizations, 1994-2009. The CVDNOR project.

	Men	Women	Total
<b>Patients, n (%)</b>	640325 (48.7)	674692 (51.3)	1315057
<b>Age, mean (SD)</b>	64.0 (19.0)	66.0 (21.3)	64.9 (20.2)
<b>Count of hospitalizations*, n (%)</b>			
Hospitalizations in total	2 270 535 (53.2)	1 996 173 (46.8)	4 266 751
CVD hospitalizations	1 677 554 (54.1)	1 421 295 (45.9)	3 098 849
CHD hospitalizations	750 031 (61.1)	477 909 (38.9)	1 227 940
UAP hospitalizations	60 212 (63.3)	34 877 (36.7)	95 089
AMI hospitalizations	157230 (61.3)	99 272 (38.7)	256 502
ACS hospitalizations	205 154 (61.5)	128 718 (38.6)	333 872
CEREBRO hospitalizations	259 102 (52.8)	231 591 (47.2)	490 693
TOTS hospitalizations	152 473 (51.6)	142 991(48.4)	295 464
AA hospitalizations	51 878 (72.4)	19 736 (27.6)	71 614
HT hospitalizations	452 223 (48.0)	490 446 (52.0)	942 669
HF hospitalizations	252 522 (51.6)	237 376 (48.5)	489 898
AF hospitalizations	346 490 (55.0)	282 955 (45.0)	629 445
DM hospitalizations	340 537 (53.4)	297 208 (46.6)	637 745
PRECL hospitalizations		49 359 (100)	49 359
CongHeart hospitalizations	27 054	25 985	53 039
Hospitalizations with PCI	59 781 (74.7)	20 291 (25.3)	80 072
Hospitalizations with CABG	34 013 (76.4)	10 495 (23.6)	44 508
Hospitalizations with VECAT	115 405 (67.9)	54 589 (32.1)	169 994
Hospitalizations with HVECAT	121 328 (68.1)	56 840 (31.9)	178 168

\* Hospitalizations less than 24 hours apart are merged before counting. All counts are hospitalizations with the given disease/procedure are main or secondary diagnosis.

## ***Hospitalization-data linked with demographic data and the Cause of Death Registry***

**Table 6: Death by underlying cause of death. Hospitalized patients were followed until 31Dec2010.**

	<b>Men</b>	<b>Women</b>	<b>Total</b>
<b>Patients, n</b>	640 325	674 692	1 315 057
<b>Deaths among patients hospitalized 1994-2009</b>			
All-cause deaths	234 867	237 637	472 504
CVD deaths	104 607	111 584	216 191
Cancer deaths	59 434	48 146	107 580
Diabetes deaths	4 583	4 974	9 557
Deaths from other diseases	50 900	56 704	107 604
Accidents and violent deaths	9 157	8 540	17 697
<b>Deaths among persons not hospitalized 1994-2009</b>			
CVD deaths	31 374	37 613	68 987
Diabetes deaths	859	1 074	1 933

The high number of CVD deaths among persons not hospitalized in CVDNOR between 1994 and 2009 demonstrates the need for inclusion of deaths outside hospital when we want to estimate incidence rates for different subgroups of cardiovascular disease.

**Table 7: Sociodemographic data at first hospitalization between 1994 and 2009, only including patients >30 years at first hospitalization and with match in the Population Registry.**

	Men	Women	Total
<b>Patients</b>	570 428	585 171	1 155 599
<b>Age at first hospitalization, mean (SD)</b>	64.0 (14.9)	66.7 (16.9)	65.3 (16.0)
<b>Marital status, n (% within gender)</b>			
Married	369 111(64.7)	263 507 (45.0)	632 618 (54.7)
Widow(er)	52 897 (9.3)	191 791 (32.8)	244 688 (21.2)
Divorced/separated	66 502 (11.7)	64 949 (11.1)	131 451 (11.4)
Unmarried	78 987 (13.9)	62 636 (10.7)	141 623 (12.2)
Unspecified	2931 (0.5)	2 288 (0.4)	5219 (0.5)
<b>Residence by NUTS2-Region* , n(% within gender)</b>			
Oslo/Akershus	108 333 (19.0)	117 945 (20.2)	226 228 (19.6)
Hedmark/Oppland	53 206 (9.3)	52 499 (9.0)	105 705 (9.2)
Sør-Østlandet	117 953 (20.7)	122 035 (20.9)	239 988 (20.8)
Agder/Rogaland	74 434 (13.1)	73 002 (12.5)	147 436 (12.8)
Vestlandet	100 853 (17.7)	105 445 (18.0)	206 298 (17.9)
Trøndelag	49 327 (8.7)	49 330 (8.4)	98 657 (8.5)
Nord-Norge	63 382 (11.1)	62 621 (10.7)	126 003 (10.9)
Unspecified	2 940 (0.5)	2 294 (0.4)	5 234 (0.5)
<b>Highest completed education, n (%)</b>			
Basic education or less	210 063 (36.8)	271 051 (46.3)	481 114 (41.6)
Upper secondary education (Videregående)	254 005 (44.5)	220 243 (37.6)	474 248 (41.0)
Tertiary education, short (up to 4 years)	60 663 (10.6)	67 832 (11.6)	128 495 (11.1)
Tertiary education, long (more than 4 years)	29 644 (5.2)	10 070 (1.7)	39714 (3.4)
Unspecified	16 053 (2.8)	15 975 (2.7)	32 028 (2.8)
<b>Median income in 1000 NOK (q20-q25)</b>	219 (146-315)	135 (95-212)	174 (112-265)
<b>Country of birth, n (%)</b>			
Norway	540 853 (94.8)	553 666 (94.6)	1 094 519 (94.7)
Other Nordic countries	7 502 (1.3)	8 083 (1.4)	15585 (1.4)
Other European countries	9 958 (1.8)	9 933 (1.7)	19891 (1.7)
Countries outside Europe	12 053 (2.1)	13 406 (2.3)	25459 (2.2)
Unspecified	62 (0.0)	83 (0.0)	145 (0.0)
<b>Country of origin</b>			
Norway	531 856 (93.2)	545 471 (93.2)	1 077 327 (93.2)
Other Nordic countries	11 672 (2.1)	11 853 (2.0)	23 525 (2.0)
Other European countries	12 095 (2.1)	12 075 (2.1)	24 170 (2.1)
Countries outside Europe	14 743 (2.6)	15 689 (2.7)	30 432 (2.6)
Unspecified	62 (0.0)	83 (0.0)	145 (0.0)

\*NUTS= Nomenclature of Territorial Units for Statistics. Standard for geographical regions defined by Eurostat ([http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts\\_nomenclature/introduction](http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction))

## ***Data quality, hospital data***

### **Invalid personal identification numbers**

Among the 1,3 million patients with at least one hospitalization with a qualifying diagnosis or procedure code, 28357 (2,2%) did not match with the demographic data from the Population Registry, probably because of invalid personal identification number. 32% of these patients were registered with age 0 at the time of hospitalizations and are probably newborns. Most of the remaining patients are probably foreigners/tourists without a permanent address in Norway. These patients should be excluded from calculation of incidence rates since we don't know if the patient could be present several times in the data with different personal identification numbers (valid or invalid). They should also be excluded from follow-up analyses since we are not able to link them to the Cause of Death Registry or to any other data sources.

### **Missing or wrong year of birth/age**

36 patients had missing age or age less than 0 or above 110 at the time of hospitalization. After exclusion of patients with no demographic data match, this number was reduced to 23. Of these, 5 patients were not registered with a valid birth year in the demographic data, while for the other 18 the wrong age was caused by a 100-year difference between the year of birth registered in the hospital data and the year of birth registered in the Population Registry.

### **Missing and invalid municipality codes in hospital data**

Among the 4,7 million hospitalizations fulfilling the inclusion criteria in CVDNOR, 16637 (0.4%) did not have a valid municipality code registered for the patient in the patient administrative system. Of the 16637 hospitalizations, only 3220 had a valid personal identification number for the patient which made it possible to link to the demographic data from the Population Registry. When linking to the Population Registry a valid municipality code was found for 51% of the 3220.

### **Overlapping hospitalizations**

Among the 4,7 million hospitalizations fulfilling the inclusion criteria in CVDNOR, 123 294 (2.6%) had an overlap in time with at least one other hospitalization. Among the hospitalizations with overlap, 17.9% had an overlapping hospitalization at the same hospital while 82.1% had an overlapping hospitalization at a different hospital.



## Hospitalizations close in time

A total of 660 989 hospitalizations (14.1% of all hospitalizations) occurred <24 hours after another hospitalization for the same patient. An overview of re-hospitalizations is given in Table 8. About 57% of re-hospitalizations within 24 hours occurred at a new hospital while 43 % occurred at the same hospital. When counting hospitalizations for different disease group we corrected for re-hospitalizations as described on page 9.

**Table 8: Count of hospitalizations occurring close in time for the same patient**

Type of re-hospitalization	n	% of total hospitalizations in CVDNOR
New hospitalization at the same hospital ≤ 10 minutes after previous hospitalization ended.	16 267	0.4
New hospitalization at different hospital ≤ 10 minutes after previous hospitalization ended.	13 879	0.3
New hospitalization at the same hospital 11-60 minutes after previous hospitalization ended.	35 520	0.8
New hospitalization at different hospital 11-60 minutes after previous hospitalization ended.	95 129	2.0
New hospitalization at the same hospital 1-8 hours after previous hospitalization ended.	65 557	1.4
New hospitalization at different hospital 1-8 hours after previous hospitalization ended.	250 006	5.3
New hospitalization at the same hospital 8-24 hours after previous hospitalization ended.	167 539	3.6
New hospitalization at different hospital 8-24 hours after previous hospitalization ended.	17092	0.4
<b>Total number of hospitalizations with re-hospitalization within 24 hours</b>	<b>660 989</b>	<b>14.1</b>
<b>Total number of hospitalizations in CVDNOR 1994-2009</b>	<b>4 686 072</b>	

## Missing hospitalization dates

Only 37 hospitalizations had missing hospitalization dates.

## Stays at technical wards

Some patients had one or more short stays at a technical ward during their hospitalization. These short stays were stored as separate data rows in the database. In some cases procedure codes and diagnosis codes were mentioned at the technical post without being mentioned at any other ward-stays during the hospitalization. In order to avoid any loss of information, 11 diagnosis codes and 20 procedure codes from technical wards during a hospitalization were added as extra variables to each hospitalization record. In most cases this was only a repetition of codes that were already present.

## ***Quality of Cause of Death Data***

472 504 of the 1.3 million patients with a qualifying diagnosis or procedure code during 1994-2009 had died by the end of 2010. Of these patients, 515 had at least one hospitalizations registered in CVDNOR after the date of death registered in the Cause of Death registry, indicating that either the date of death or the date of hospitalization must be wrong. Out of 515 cases 121 (23.5%) had a different date of death registered in the Population Registry than in the Cause of Death Registry The date in the Population Registry was larger or equal to the last hospitalization date. This suggests that the date of death registered in the Cause of Death Registry is wrong. The remaining 394 cases had the same date of death in both registries, which might indicate that the hospitalization date is wrong.

## ***Comparison with data from the Western Norway Cardiovascular Registry (HKS-registeret)***

An earlier research project on cardiovascular disease in Western Norway, the Western Norway Cardiovascular Registry (HKS-registeret)<sup>6-8</sup>, have complete data on Cardiovascular hospitalizations in Health Region West from 1992-2006. The extraction of hospitalization data in this project was done manually by IT-employees at each hospital without using the FS-system. We did a comparison of the count of patients in different disease groups between CVDNOR-data and data from HKS for the years between 1994 and 2006. In general the deviation between counts of patients in CVDNOR and HKS was small. The results for the disease groups AMI, CEREBRO and DM are given in Table 9, Table 10 and Table 11.

**Table 9: Number of unique persons with acute myocardial infarction (AMI) as main or secondary diagnosis in CVDNOR and the Western Norway Cardiovascular Registry (HKS)**

	<b>CVDNOR*</b>	<b>HKS</b>	<b>Absolute deviation</b>	<b>Deviation in % of CVDNOR-count</b>
<b>1994</b>	2578	2578	0	0.00
<b>1995</b>	2676	2675	1	0.04
<b>1996</b>	2463	2465	-2	-0.08
<b>1997</b>	2362	2364	-2	-0.08
<b>1998</b>	2444	2438	6	0.25
<b>1999</b>	2412	2412	0	0.00
<b>2000</b>	2406	2406	0	0.00
<b>2001</b>	2687	2686	1	0.04
<b>2002</b>	2989	2989	0	0.00
<b>2003</b>	3123	3124	-1	-0.03
<b>2004</b>	3175	3160	15	0.47
<b>2005</b>	3178	3157	21	0.66
<b>2006</b>	3133	3101	32	1.02

\* Hospitals in Health Region West only. See Appendix C.

**Table 10: Number of unique persons with cerebrovascular disease (CEREBRO) as main or secondary diagnosis in CVDNOR and the Western Norway Cardiovascular Registry**

	<b>CVDNOR*</b>	<b>HKS</b>	<b>Absolute deviation</b>	<b>Deviation in % of CVDNOR-count</b>
<b>1994</b>	3291	3282	9	0.27
<b>1995</b>	3400	3392	8	0.24
<b>1996</b>	3547	3548	-1	-0.03
<b>1997</b>	3545	3542	3	0.08
<b>1998</b>	3859	3853	6	0.16
<b>1999</b>	3378	3384	-6	-0.18
<b>2000</b>	3457	3458	-1	-0.03
<b>2001</b>	3622	3621	1	0.03
<b>2002</b>	3655	3655	0	0.00
<b>2003</b>	3854	3860	-6	-0.16
<b>2004</b>	3924	3923	1	0.03
<b>2005</b>	4061	4054	7	0.17
<b>2006</b>	4051	4052	-1	-0.02

\* Hospitals in Health Region West only. See Appendix C

**Table 11: Number of unique persons with diabetes mellitus (DM) as main or secondary diagnosis in CVDNOR and the Western Norway Cardiovascular Registry**

	<b>CVDNOR*</b>	<b>HKS</b>	<b>Absolute deviation</b>	<b>Deviation in % of CVDNOR-count</b>
<b>1994</b>	3018	3011	7	0.23
<b>1995</b>	3084	3083	1	0.03
<b>1996</b>	3096	3099	-3	-0.10
<b>1997</b>	3206	3209	-3	-0.09
<b>1998</b>	3757	3759	-2	-0.05
<b>1999</b>	3676	3706	-30	-0.82
<b>2000</b>	4117	4129	-12	-0.29
<b>2001</b>	4484	4485	-1	-0.02
<b>2002</b>	4665	4677	-12	-0.26
<b>2003</b>	5314	5318	-4	-0.08
<b>2004</b>	5694	5695	-1	-0.02
<b>2005</b>	6075	6067	8	0.13
<b>2006</b>	6369	6363	6	0.09

\* Hospitals in Health Region West only. See Appendix C

### ***Count of hospitalizations by main diagnosis***

In the following chapter count of hospitalizations with main diagnosis in different disease groups are given per calendar year both by hospital and for all hospitals in total. Hospitalizations occurring 24 hours or less apart for the same patient are merged and counted as one.

In graphs showing number of hospitalizations per hospital, hospitalizations within 24 hours are merged only if there is more than one hospitalization within 24 hours at the same hospital. If a patient has two hospitalizations within 24 hours at two different hospitals it counts as one hospitalization in each hospital.

The graphs with number of hospitalizations per hospital have been smoothed with median splines. The hospital-numbers are given at the top of each graph. A table with the full hospital name for each hospital number is given in appendix C. Hospitals with less than 5 hospitalizations per year for a given disease group has been left out of the graphs.

# Number of hospitalizations in Norway by main diagnosis

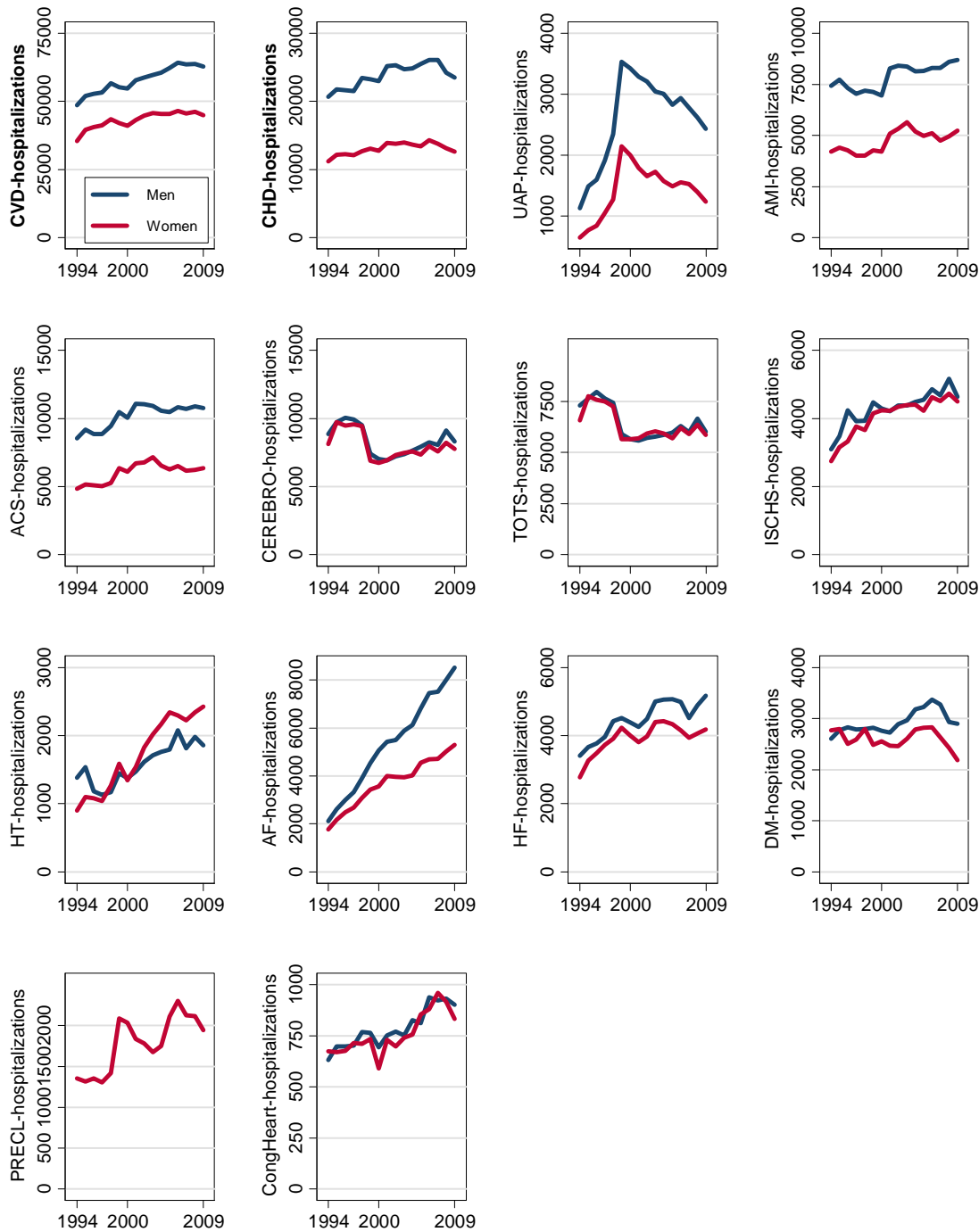


Figure 2: Total number of hospitalizations in Norway by main diagnosis. Hospitalizations in the same hospital occurring  $\leq 24$  hours apart have been merged before counting.

# Hospitalizations with cardiovascular disease (CVD) as main diagnosis by hospital

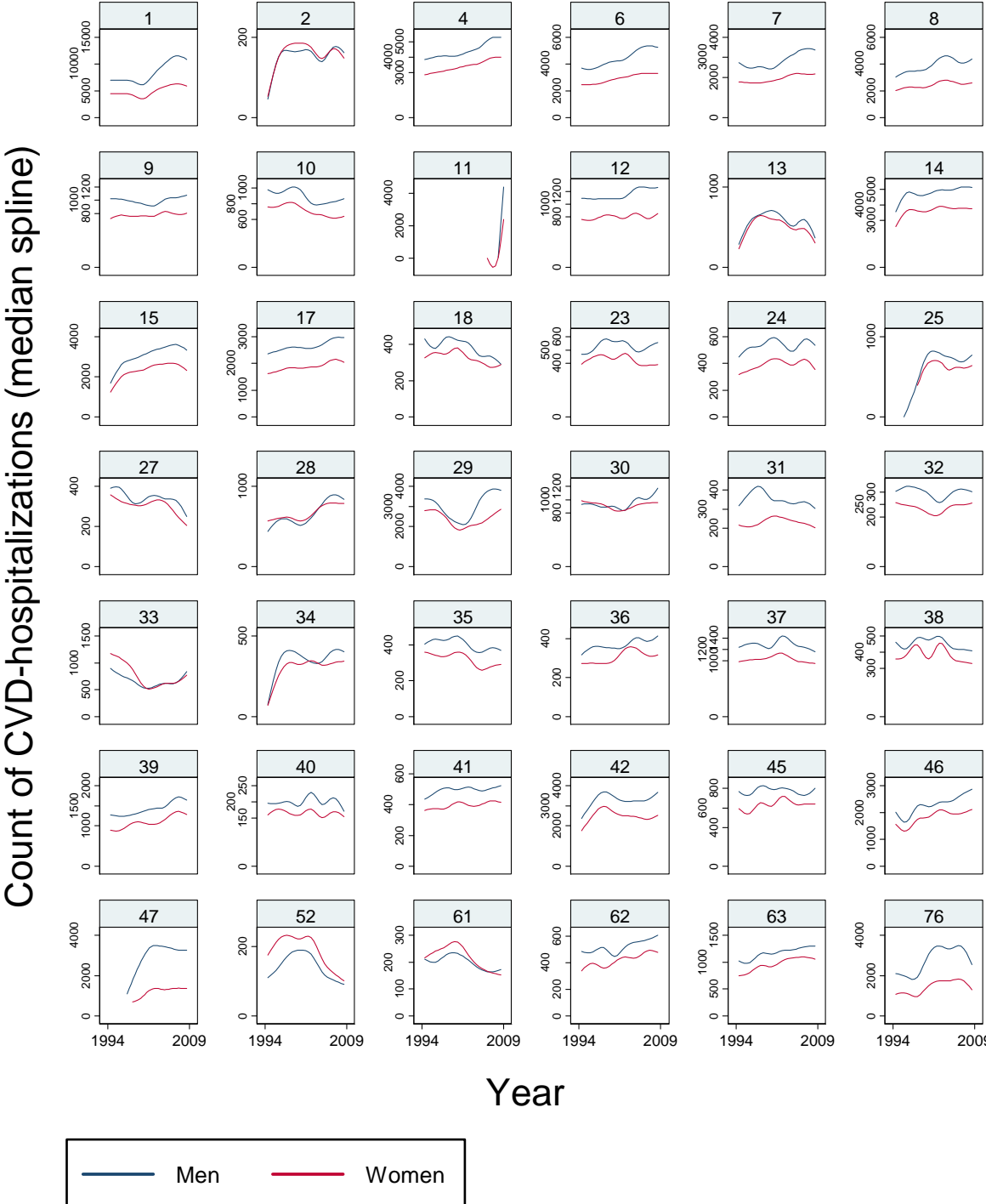


Figure 3: Count of hospitalizations with CVD as main diagnosis by hospital, 1994-2009

# Hospitalizations with coronary heart disease (CHD) as main diagnosis by hospital

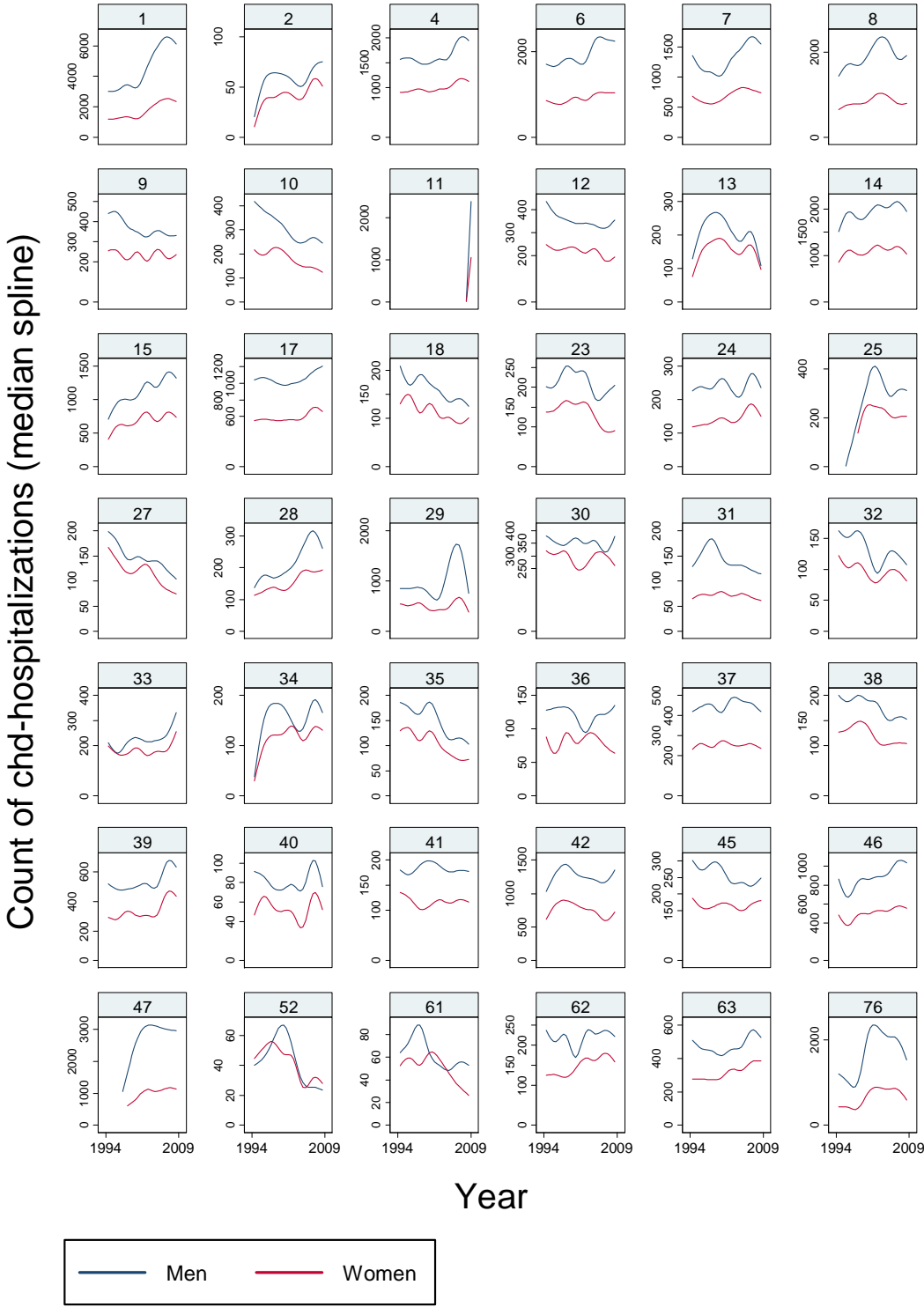


Figure 4: Count of hospitalizations with CHD as main diagnosis by hospital, 1994-2009

# Hospitalizations with acute myocardial infarction (AMI) as main diagnosis by hospital

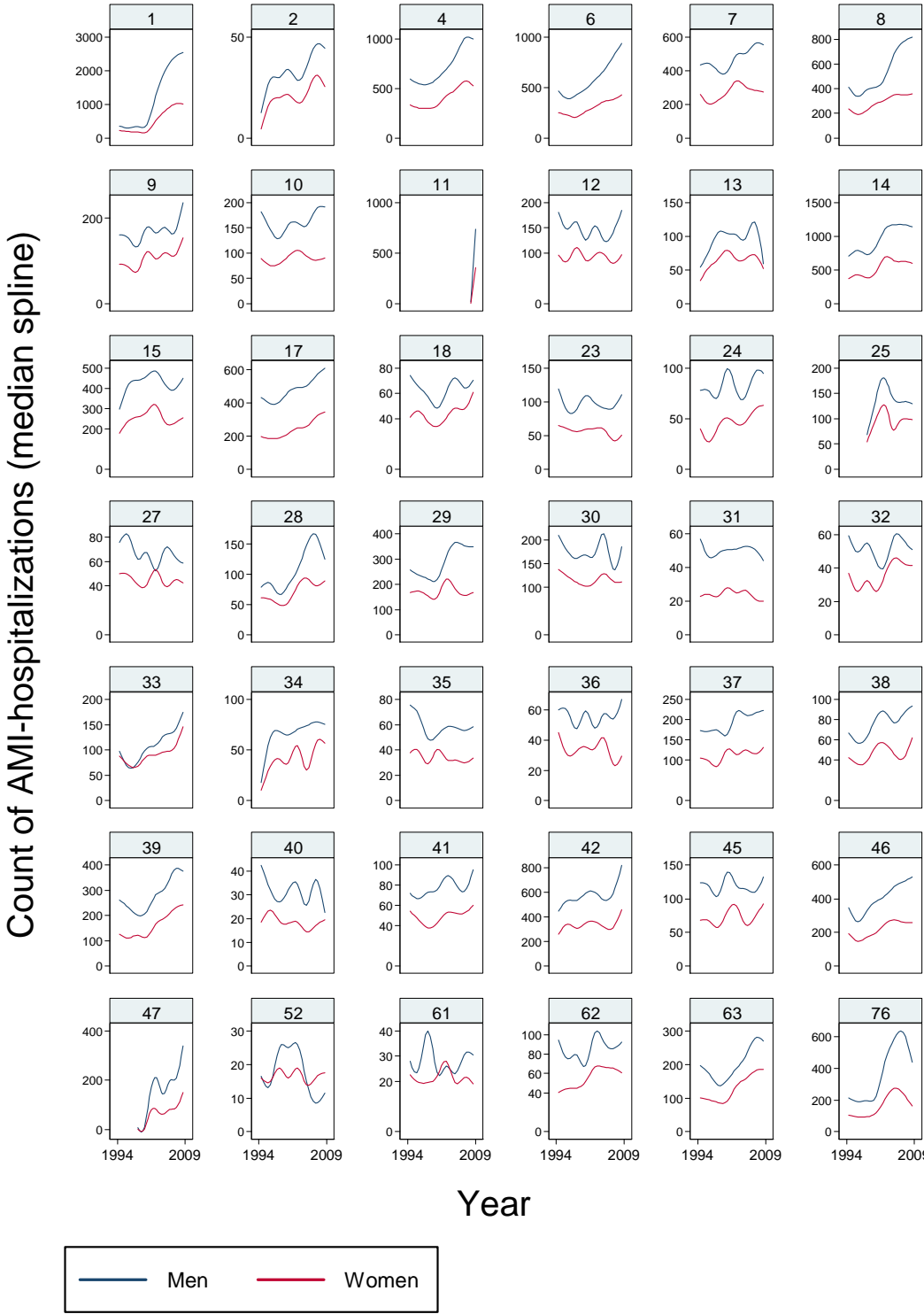


Figure 5: Count of hospitalizations with AMI as main diagnosis by hospital, 1994-2009



# Hospitalizations with unstable angina pectoris (UAP) as main diagnosis by hospital

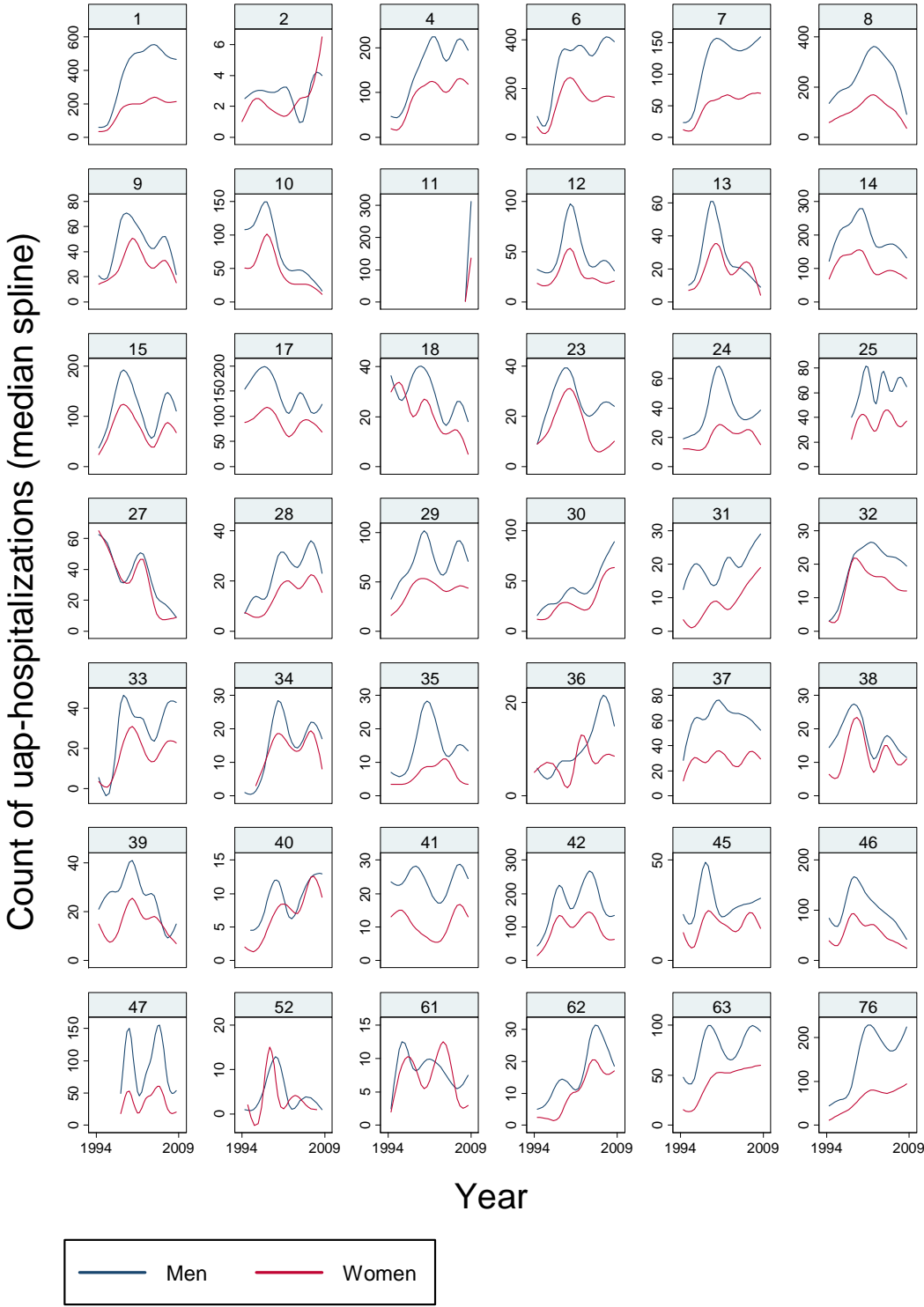


Figure 6: Count of hospitalizations with UAP as main diagnosis by hospital, 1994-2009

# Hospitalizations with acute coronary syndrome (ACS) as main diagnosis by hospital

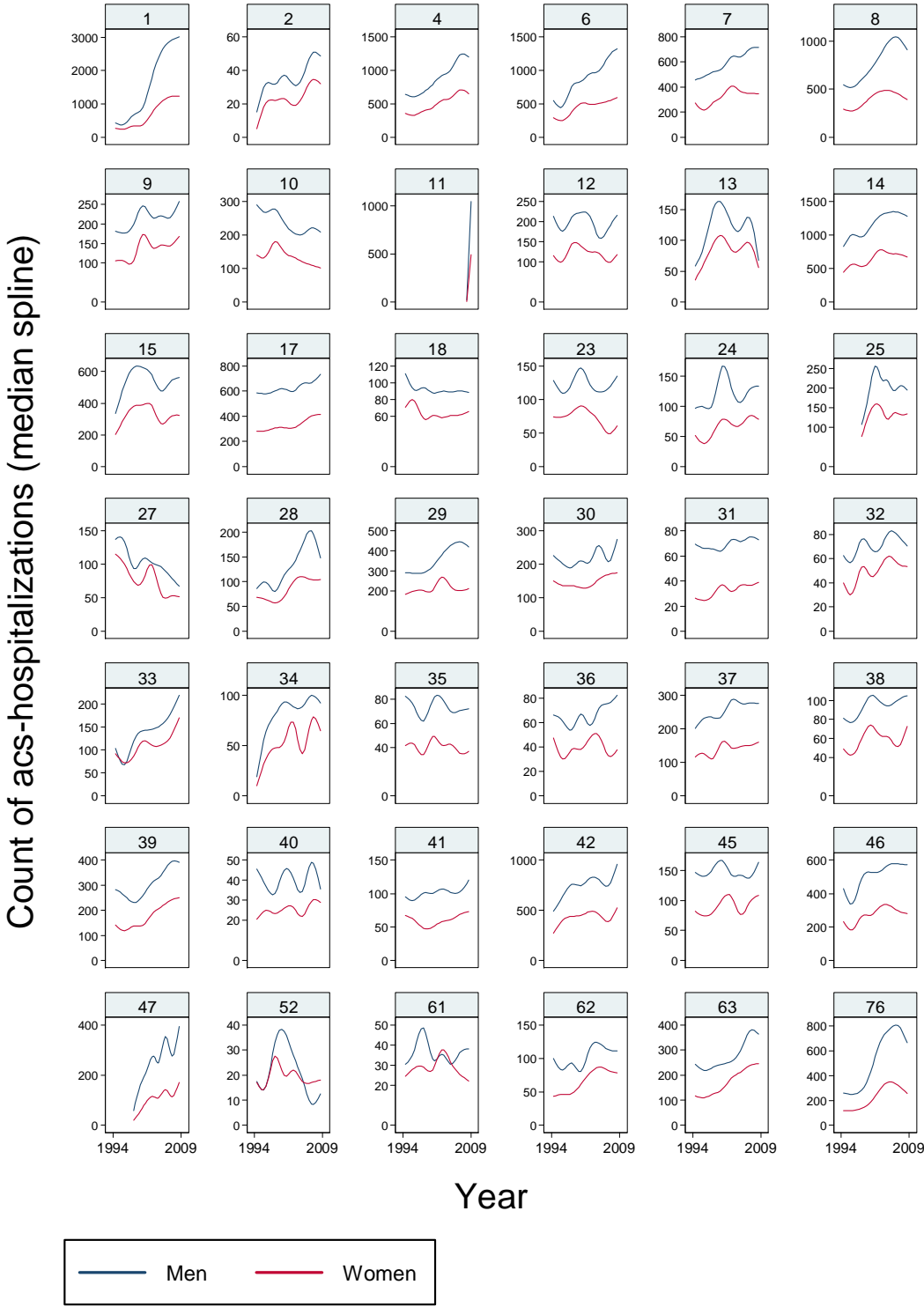


Figure 7: Count of hospitalizations with ACS as main diagnosis by hospital, 1994-2009

# Hospitalizations with cerebrovascular disease (CEREBRO) as main diagnosis by hospital

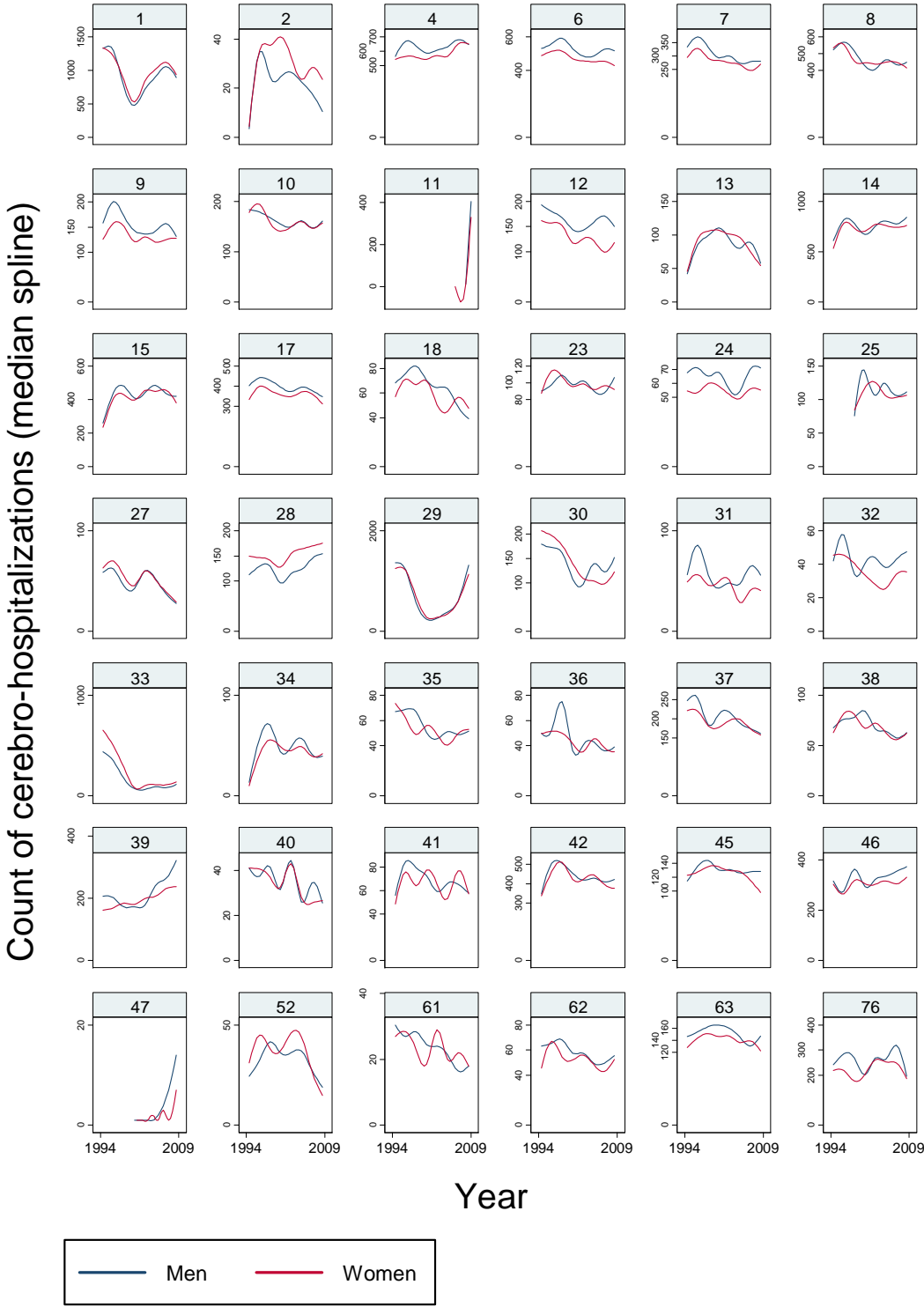


Figure 8: Count of hospitalizations with CEREBRO as main diagnosis by hospital, 1994-2009

# Hospitalizations with ischemic stroke (ISCHS ) as main diagnosis by hospital

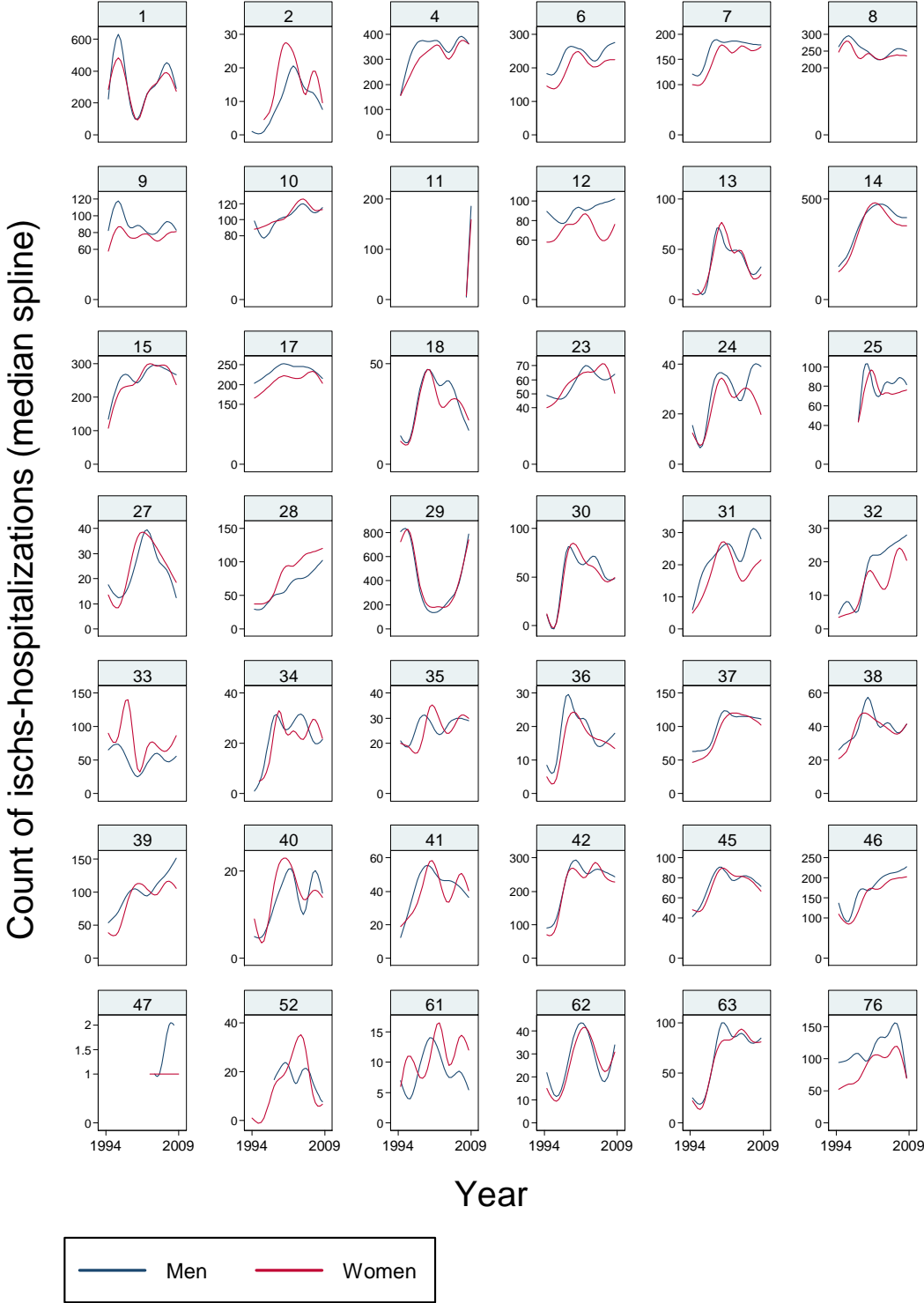


Figure 9: Count of hospitalizations with ISCHS as main diagnosis by hospital, 1994-2009

# Hospitalizations with total stroke (TOTS) as main diagnosis by hospital

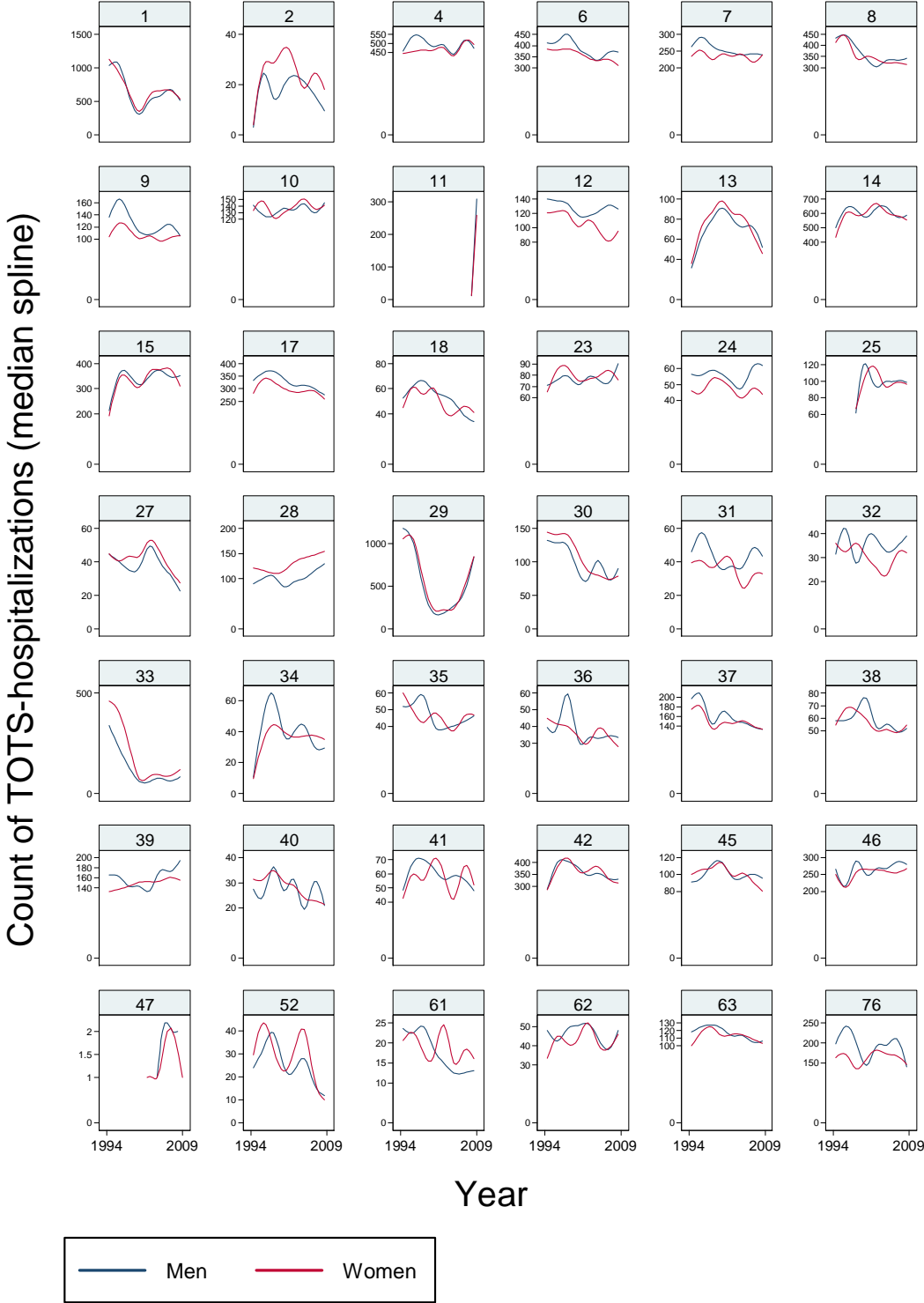


Figure 10: Count of hospitalizations with TOTS as main diagnosis by hospital, 1994-2009

# Hospitalizations with diabetes (DM) as main diagnosis by hospital

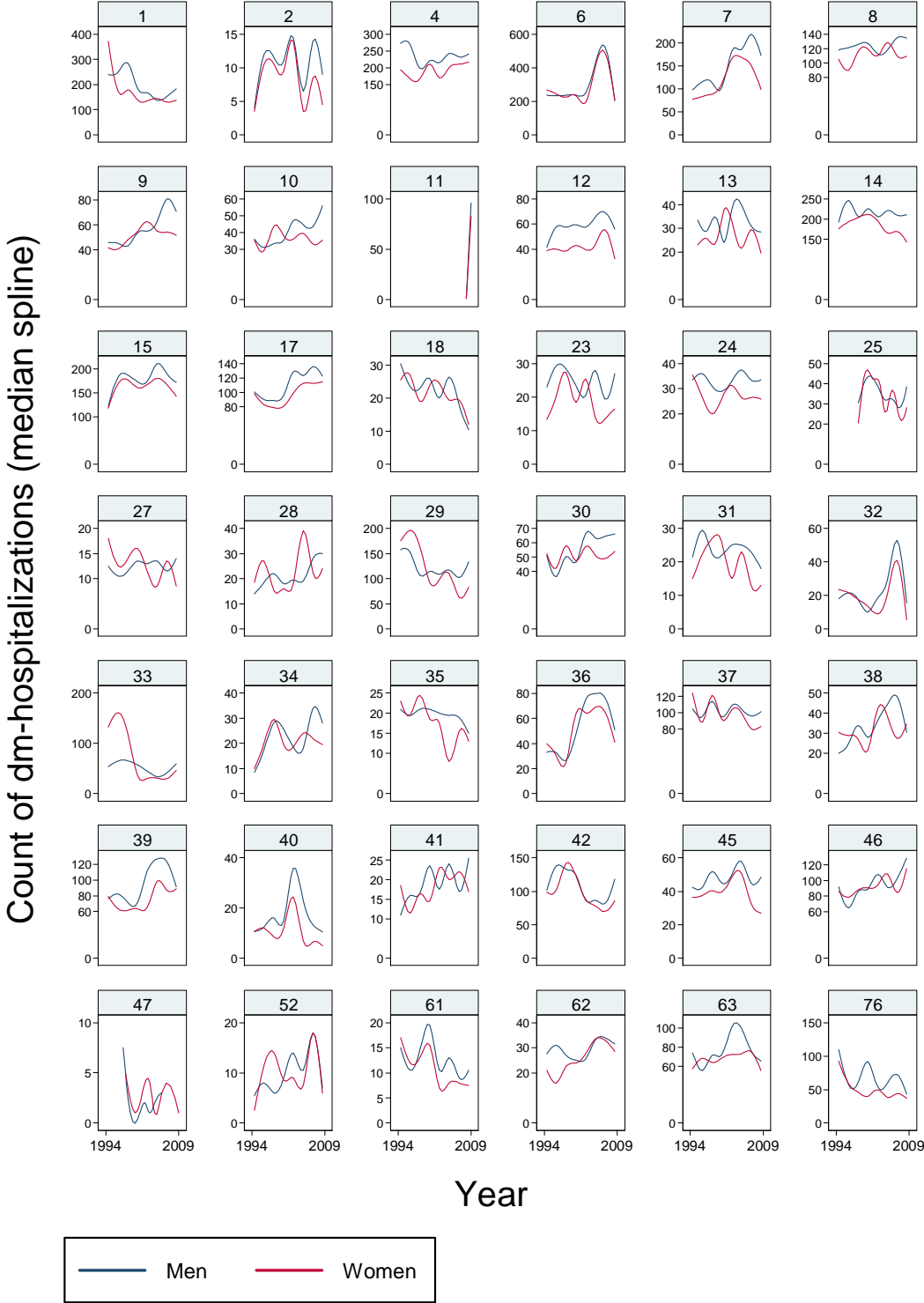


Figure 11: Count of hospitalizations with DM as main diagnosis by hospital, 1994-2009

# Hospitalizations with atrial fibrillation (AF) as main diagnosis by hospital

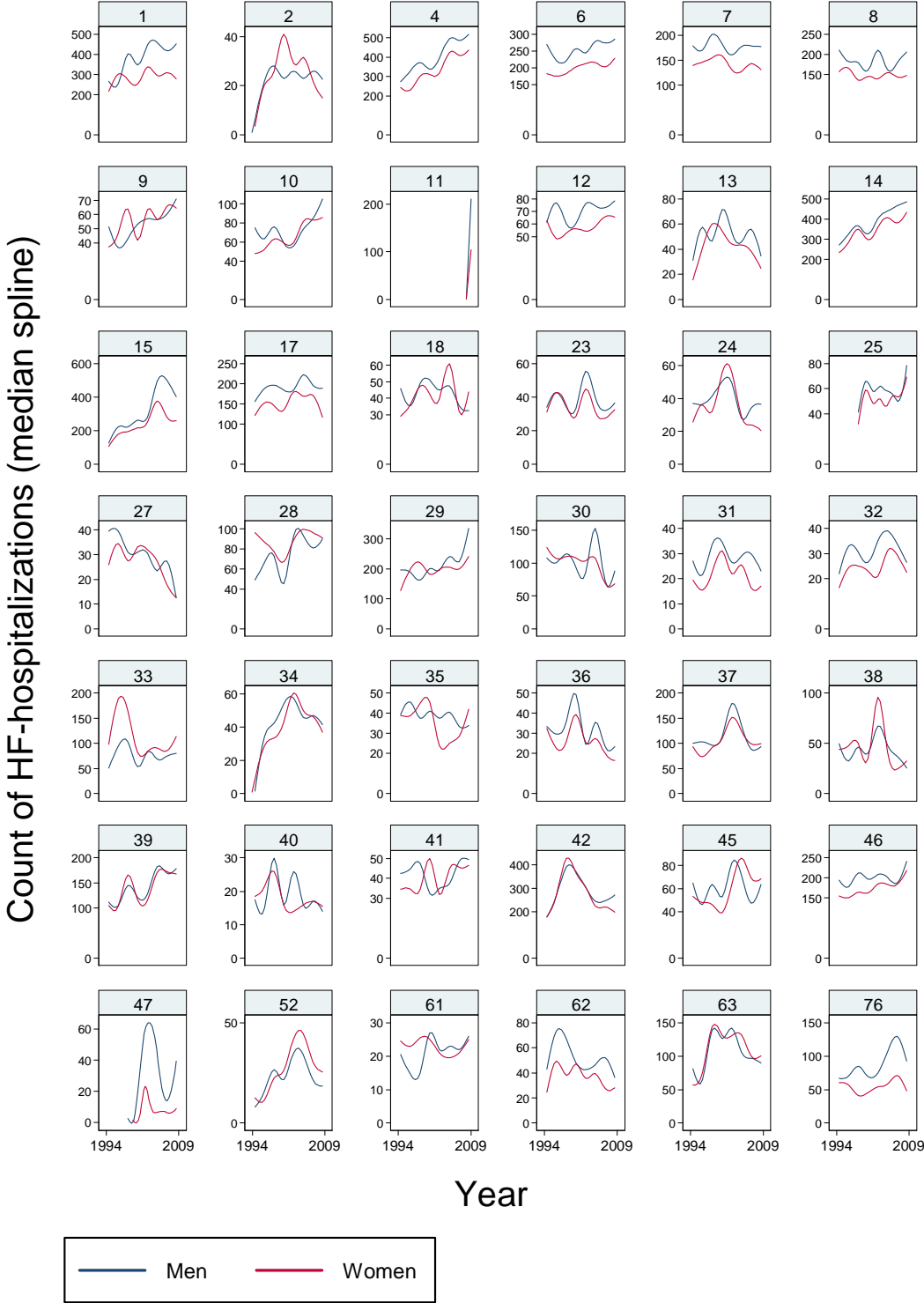


Figure 12: Count of hospitalizations with AF as main diagnosis by hospital, 1994-2009

# Hospitalizations with hypertension (HT) as main diagnosis by hospital

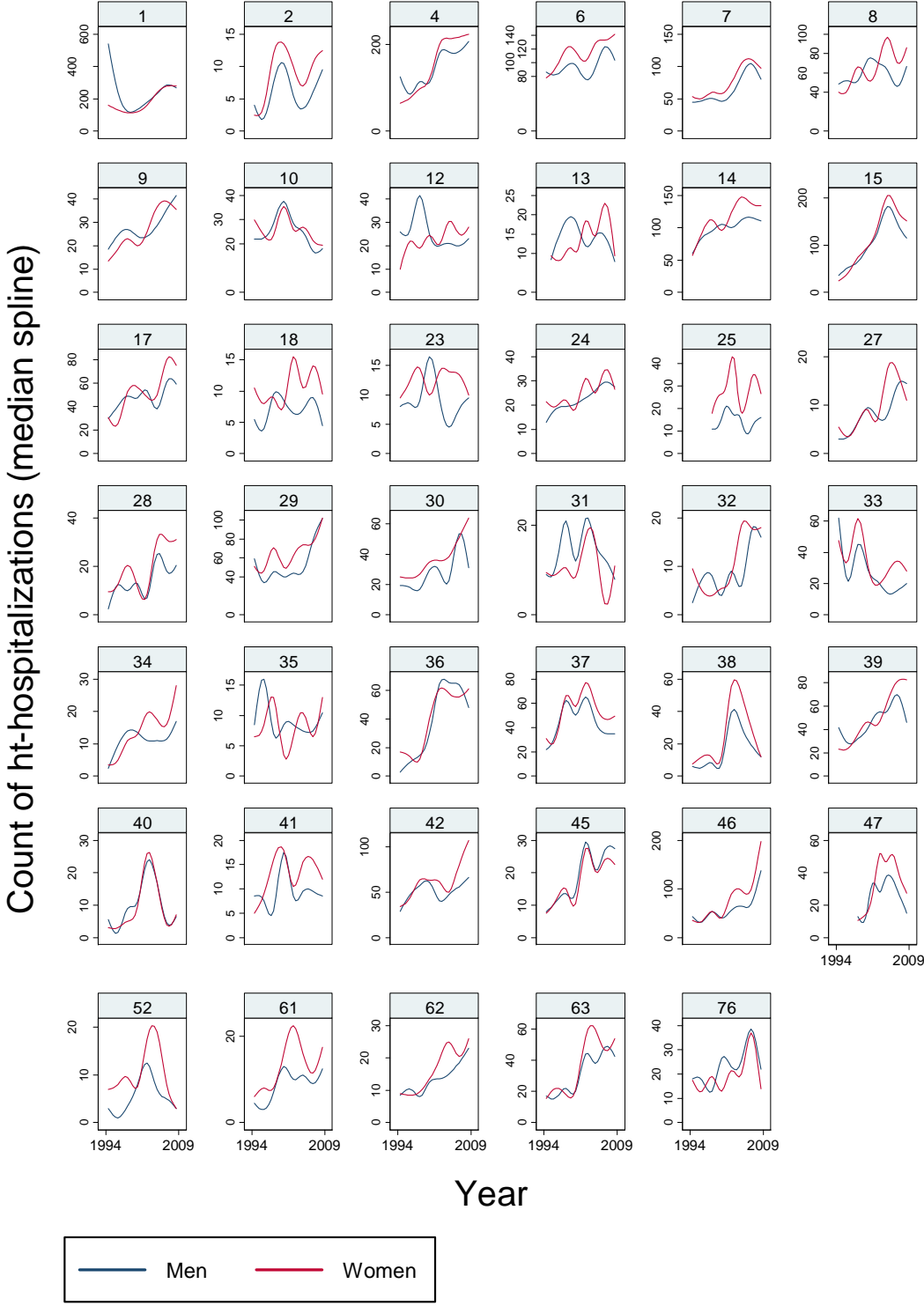


Figure 13: Count of hospitalizations with HT as main diagnosis by hospital, 1994-2009



# Hospitalizations with heart failure (HF) as main diagnosis by hospital

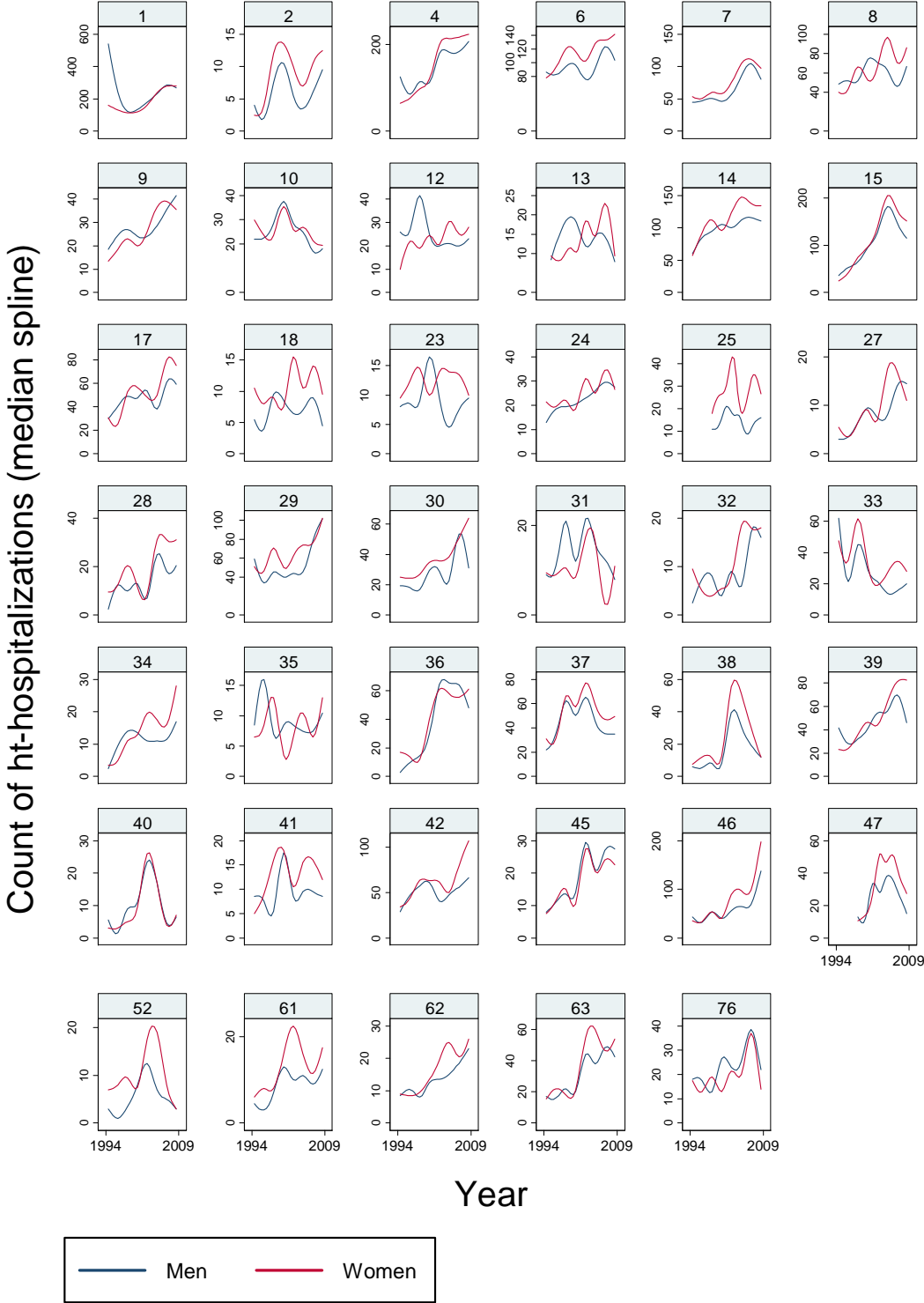


Figure 14: Count of hospitalizations with HF as main diagnosis by hospital, 1994-2009

# Hospitalizations with pre-eclampsia or eclampsia (PRECL) as main diagnosis by hospital

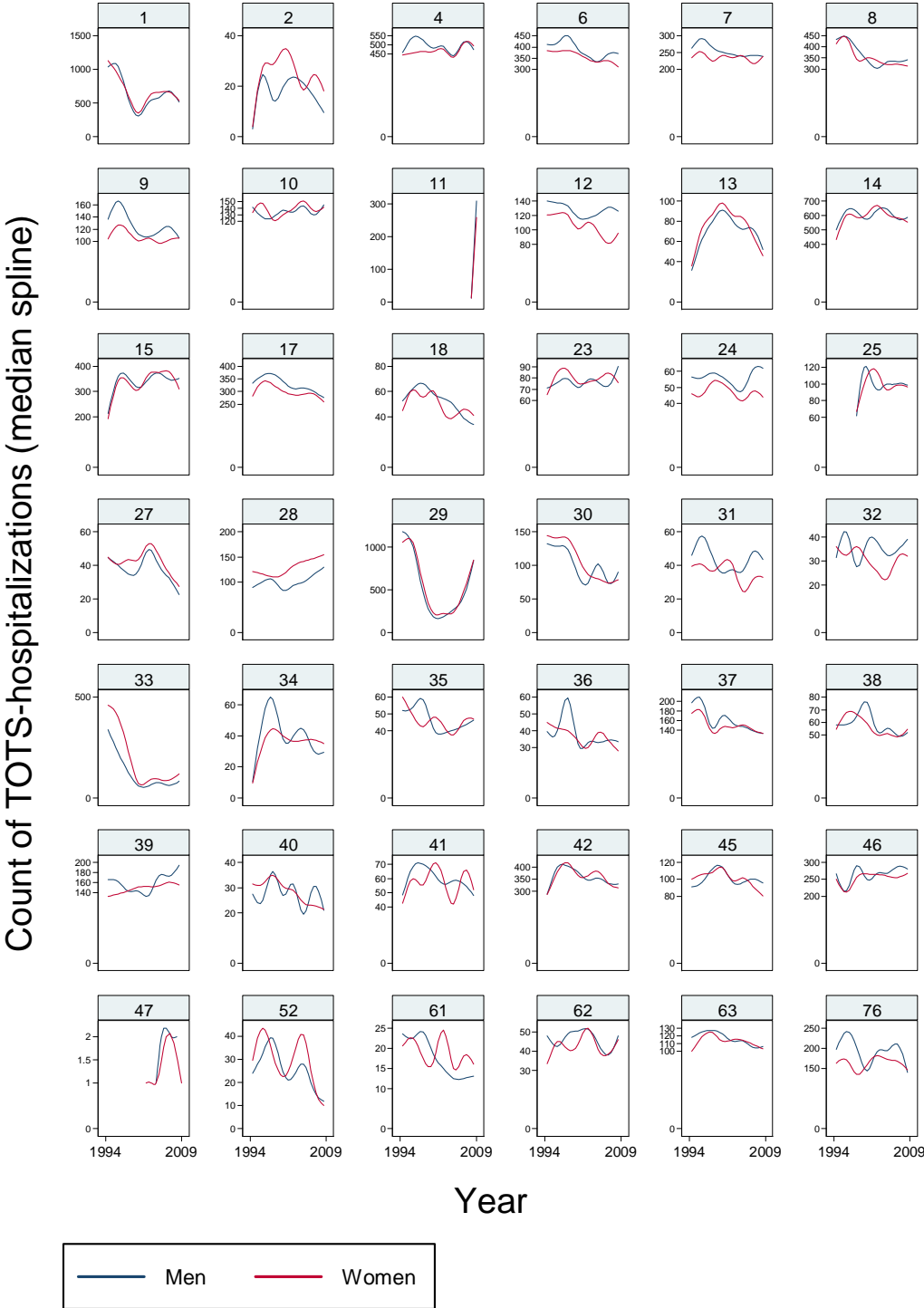


Figure 15: Count of hospitalizations with PRECL as main diagnosis by hospital, 1994-2009

# Hospitalizations with congenital heart defect (CongHeart) as main diagnosis by hospital

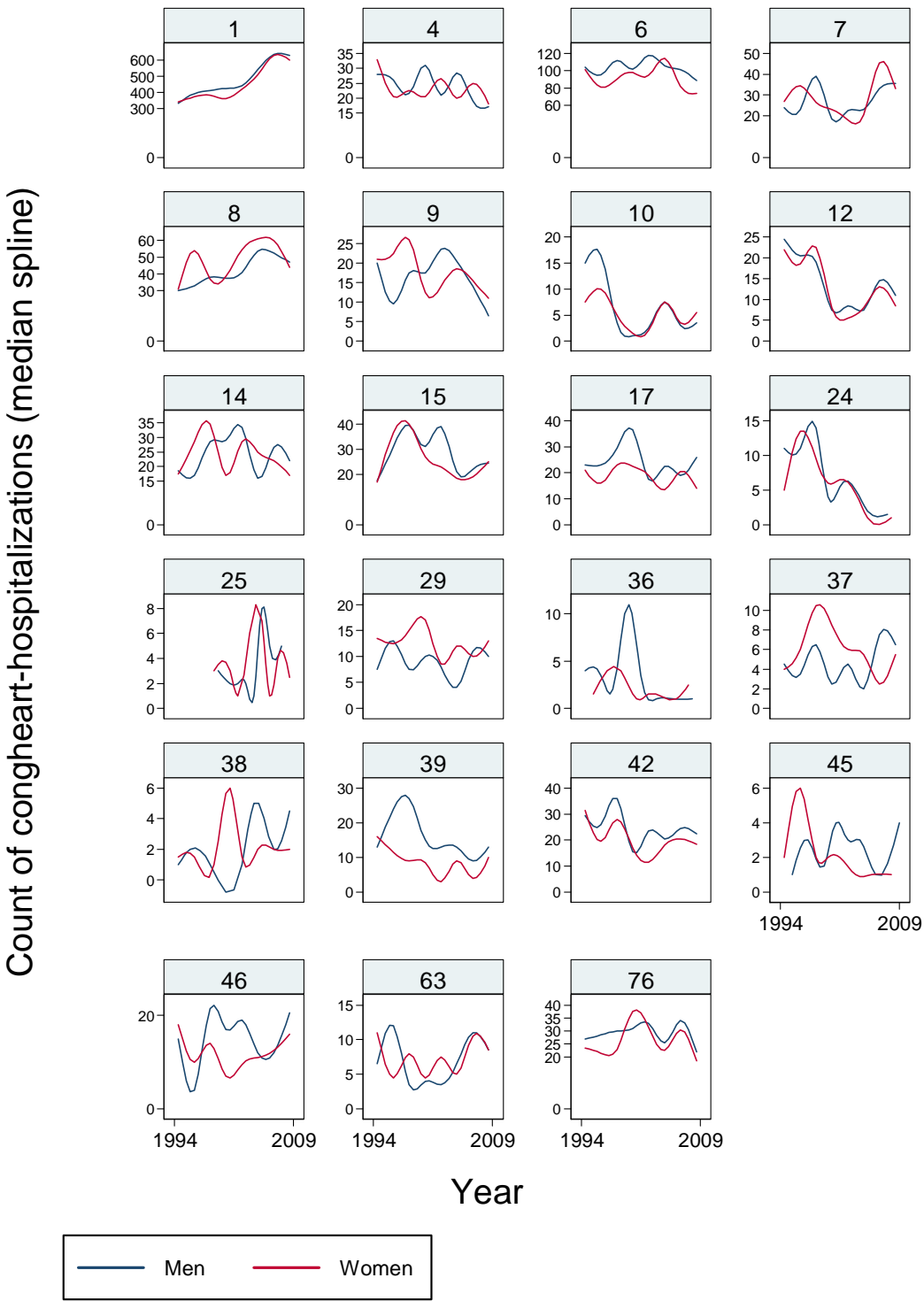


Figure 16: Count of hospitalizations with CongHeart as main diagnosis by hospital, 1994-2009

**Count of hospitalizations by procedure groups**

**Count of total number of hospitalizations in Norway by procedure groups**

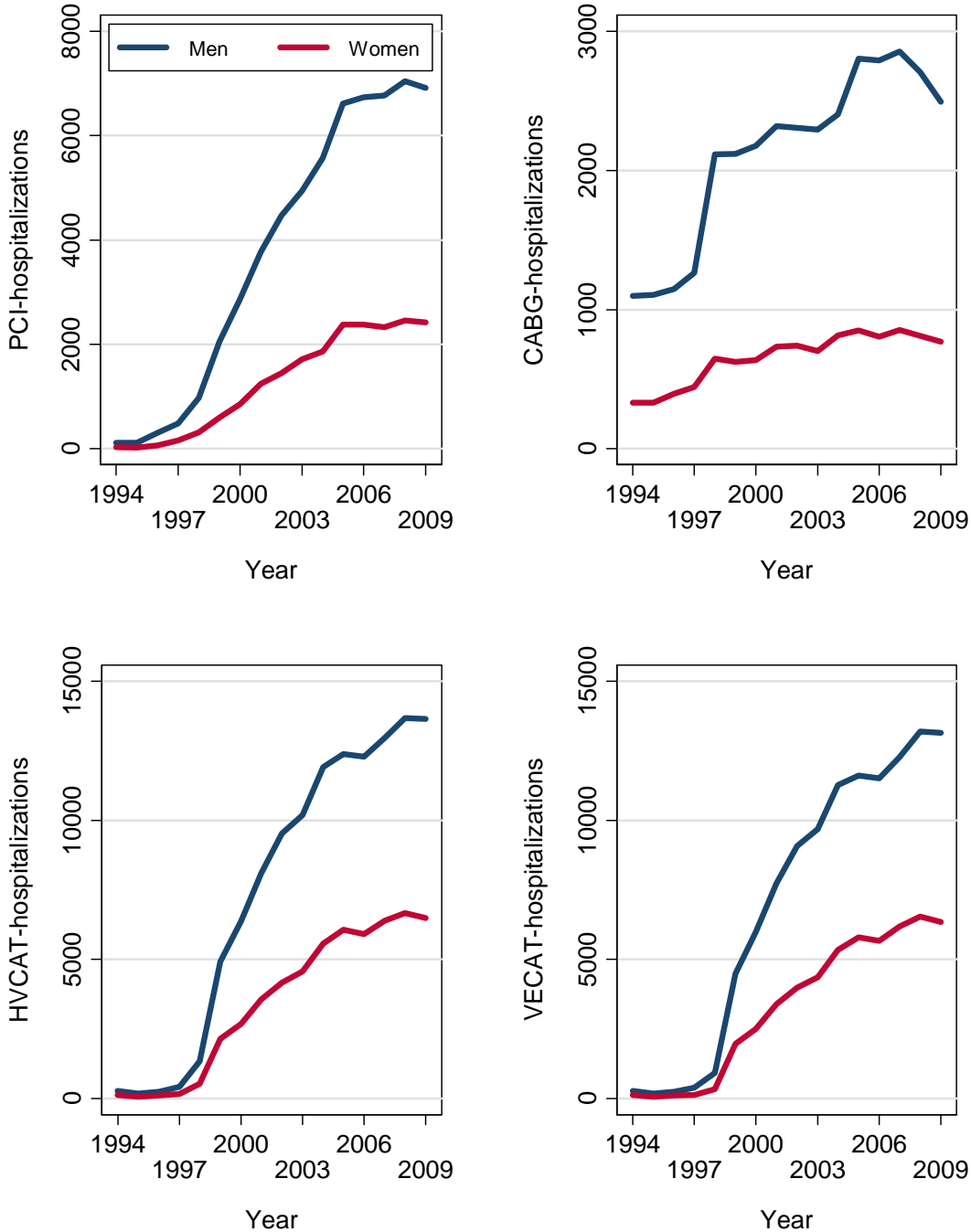


Figure 17: Count of hospitalizations by procedure group, total numbers for Norway

### Hospitalizations with PCI by hospital

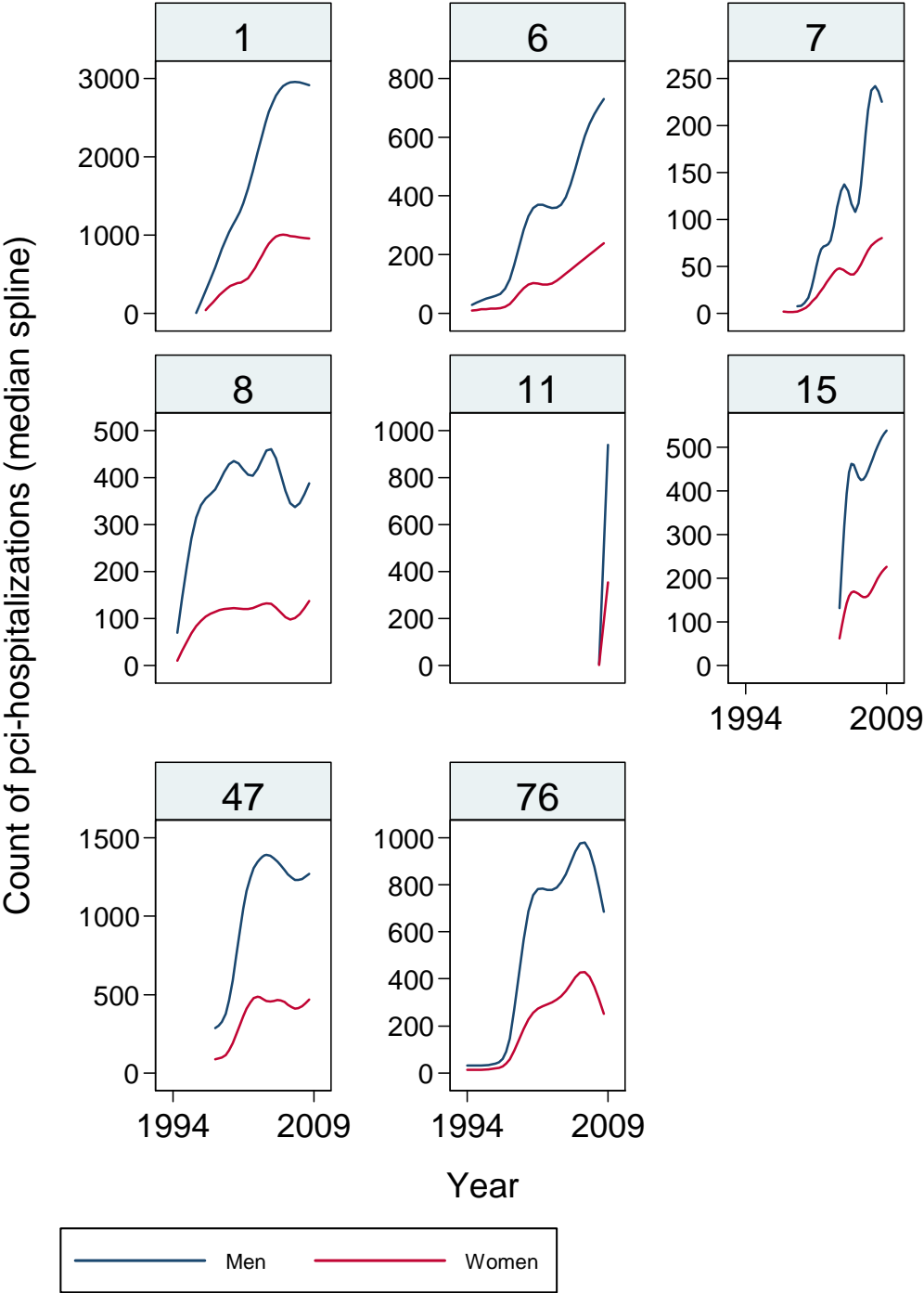


Figure 18: Count of hospitalizations with PCI (percutaneous coronary intervention) as main diagnosis by hospital, 1994-2009

### Hospitalizations with CABG by hospital

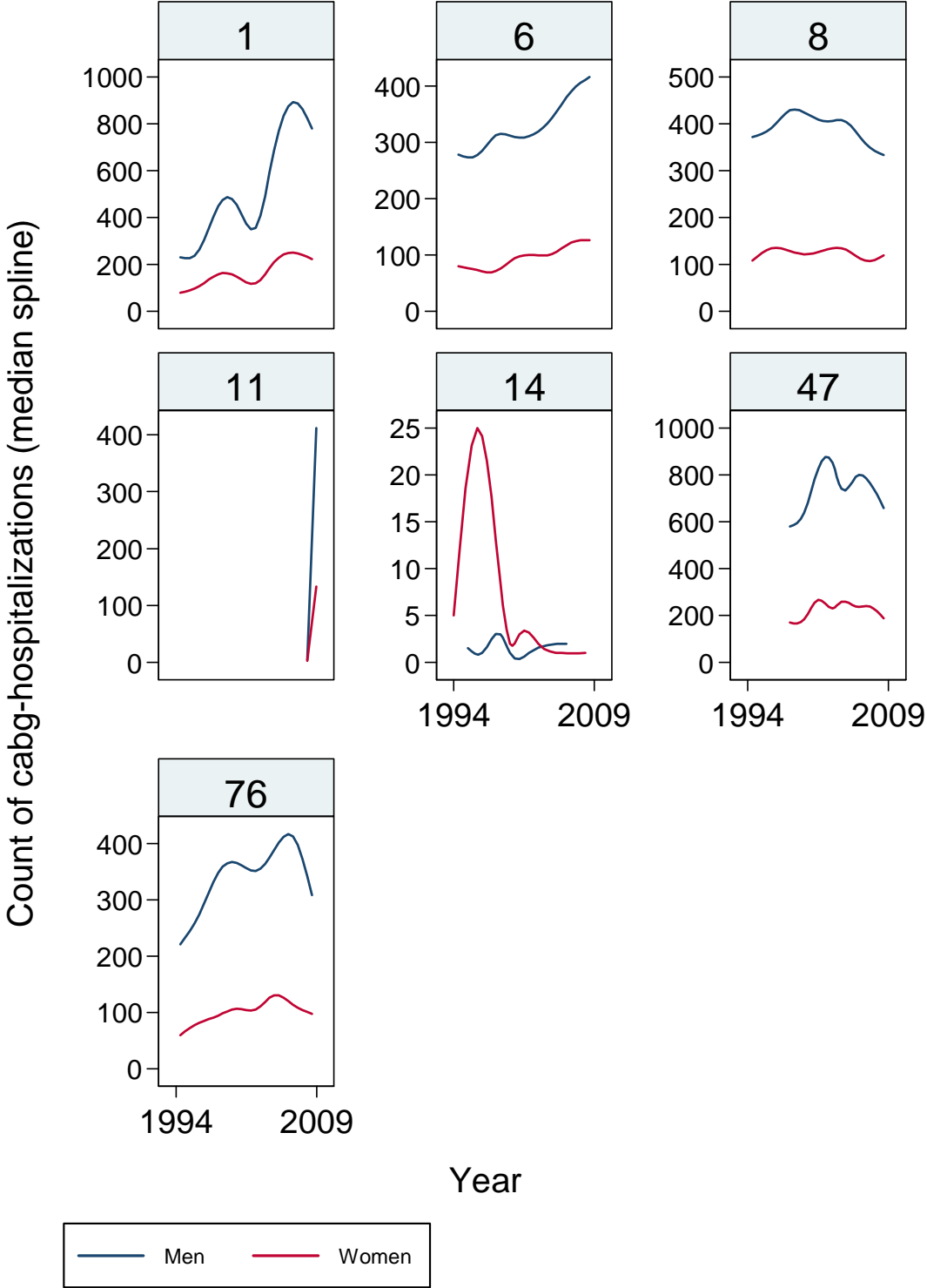


Figure 19: Count of hospitalizations with CABG (coronary artery bypass graft) as main diagnosis by hospital, 1994-2009

### Hospitalizations with VECAT by hospital

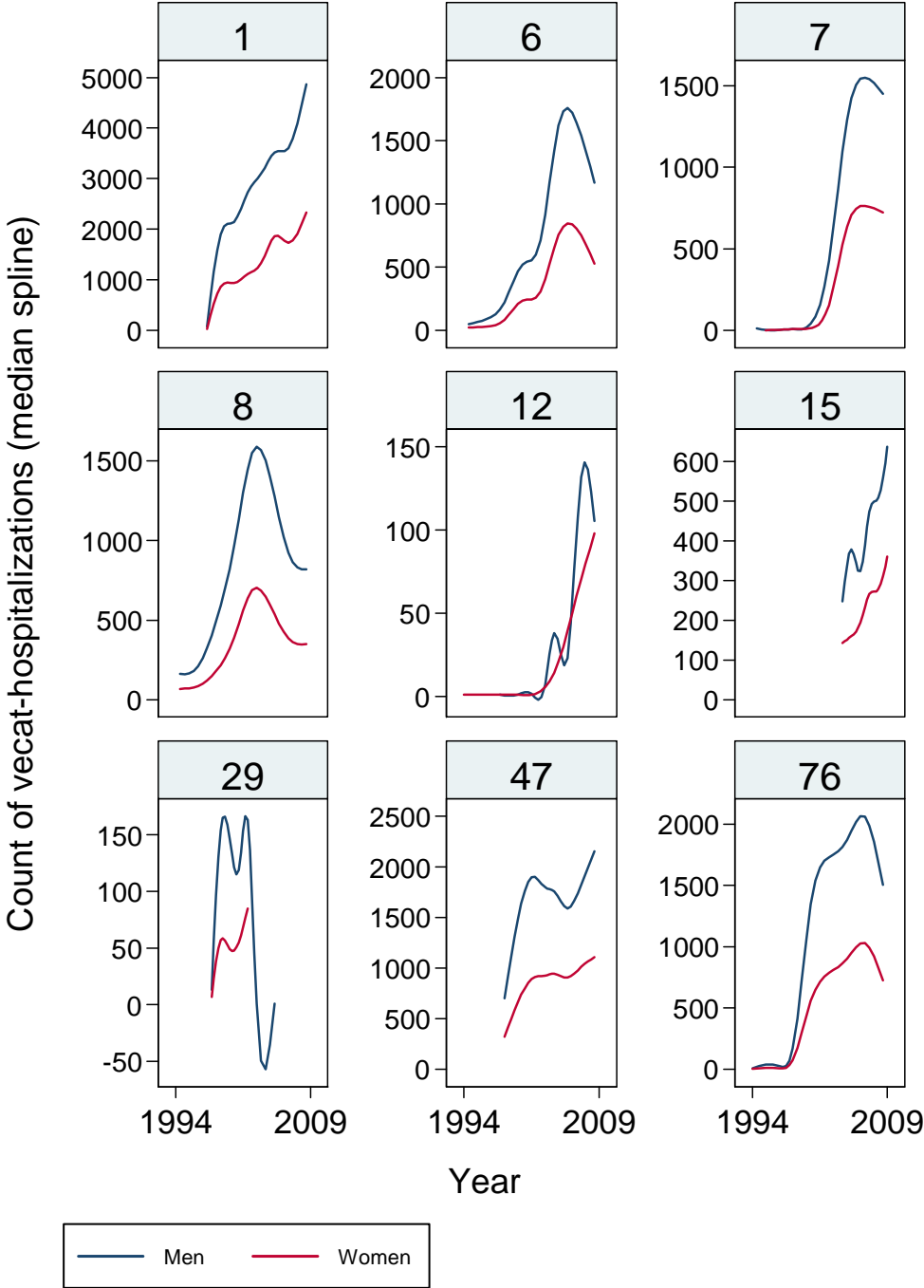


Figure 20: Count of hospitalizations with VECAT (left-sided heart catheterization) as main diagnosis by hospital, 1994-2009

### Hospitalizations with HVCAT by hospital

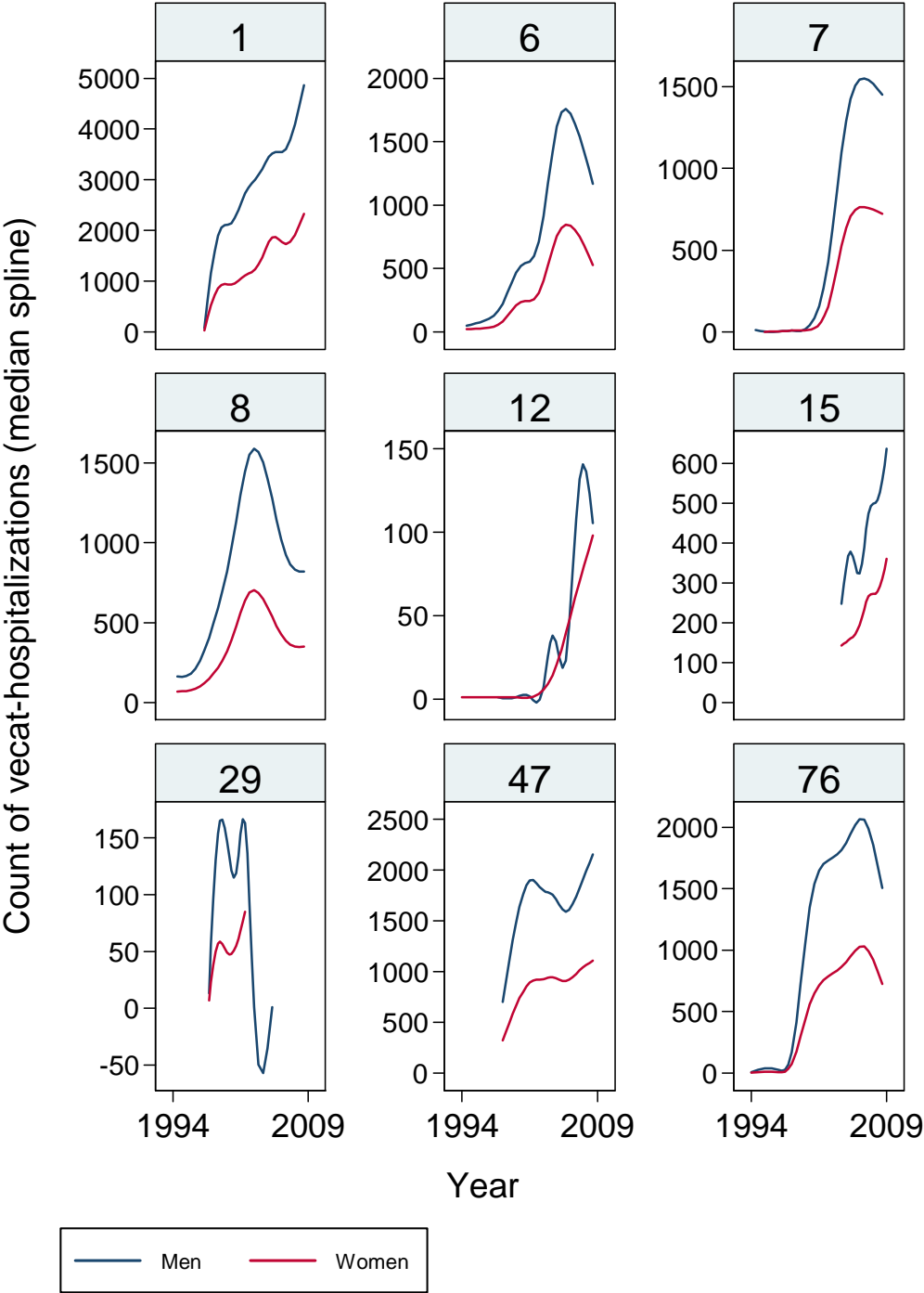


Figure 21: Count of hospitalizations with HVECAT (right or left-sided heart catheterization) as main diagnosis by hospital, 1994-2009



## CONOR Endpoints

### Definition of endpoint-groups for CONOR participants

Table 12: Definition of diagnosis groups for hospitalizations and deaths

Short name	Name	ICD9-codes	ICD10-codes
<b>CVD</b>	Cardiovascular disease	390-459	I00-I99
<b>CHD</b>	Coronary heart disease	410-414	I20-I25
<b>CHD2</b>	Coronary heart disease 2	410-414, 798.1, 798.2, 798.9	I20-I25, I46.1, R96, R98
<b>CHD3</b>	Coronary heart disease 3	410-414, 798.1, 798.2	I20-I25, I46.1, R96
<b>SD</b>	Sudden death 1	427.5, 798.1, 798.2, 798.9	I46.1, R96, R98
<b>SD2</b>	Sudden death 2	427.5, 798.1, 798.2	I46.1, R96
<b>AMI</b>	Acute myocardial infarction	410	I21, I22
<b>AMI2</b>	Acute myocardial infarction 2	410, 427.5, 798.1, 798.2, 798.9	I21, I22, I46.1, R96, R98
<b>AMI3</b>	Acute myocardial infarction 3	410, 427.5, 798.1, 798.2	I21, I22, I46.1, R96
<b>AMI4</b>	Acute myocardial infarction 4	410, 798.1, 798.2	I21, I22, R96
<b>AMI5</b>	Acute myocardial infarction 5	410, 427.5	I21, I22, I46.1
<b>MCE</b>	Major Coronary Event	410, 427.5, 798.1, 798.2, 798.9	I21, I22, I46.1, R96, R98
<b>MCE2</b>	Major Coronary Event 2	410, 427.5, 798.1, 798.2	I21, I22, I46.1, R96
<b>ACS</b>	Acute coronary syndrome	410, 411	I20.0, I21, I22
<b>ACS2</b>	Acute coronary syndrome 2	410, 411, 427.5, 798.1, 798.2, 798.9	I20.0, I21, I22, I46.1, R96, R98
<b>ACS3</b>	Acute coronary syndrome 3	410, 411, 427.5, 798.1, 798.2	I20.0, I21, I22, I46.1, R96
<b>CEREBRO</b>	Cerebrovascular disease	430-438	I60-I69
<b>TOTS</b>	Total stroke	430-434, 436	I60-I61, I63-I64 except I63.6
<b>ISCHS</b>	Ischemic stroke	433, 434	I63 except I63.6
<b>ISCHUC</b>	Ischemic/unspecified cerebrovascular disease	433, 434, 436, 437.0, 437.1	I63 except I63.6, I64, I65, I66, I67.0, I67.2
<b>TIA</b>	Transient Ischemic attack	435	G45
<b>AA</b>	Aorta aneurism	441	I71
<b>PAD</b>	Peripheral artery disease	440, 441 except 441.7, 442, 443.9, 444	I70-I79
<b>ASVD</b>	Atherosclerotic disease	410-414, 433, 434, 436, 437.0, 437.1, 440, 441 except 441.7, 442, 443.9, 444	I20-I25, I63 except I63.6, I64, I65, I66, I67.0, I67.2, I70-I79
<b>HT</b>	Hypertension	401-405	I10-I15
<b>AS</b>	Aorta stenosis	424.1	I35.0, I35.2
<b>AF</b>	Atrial fibrillation/ flutter	427.3	I48

Short name	Name	ICD9-codes	ICD10-codes
HF	Heart Failure	428	I50
DM	Diabetes Mellitus	250	E10-E14
CongHeart	Congenital Heart Defects	745-747	Q20-Q28

Table 13: Definition of main groups for underlying causes of death

Short name	Name	ICD9-codes	ICD10-codes
CVD	Cardiovascular disease	390-459	I00-I99
CANCER	Cancer	140-208	C00-C97
LUNGCANCER	Lung Cancer	162	C33-C34
OTHER	Other diseases	001-139, 210-389, 460-738, 740-759, 760-779	A, B, D, E, F, G, H, J, K, L, M, N, O, Q
VIOLENT	Violent deaths and accidents	E800-E999	V,W,X,Y
ILLDEFINED	Ill-defined causes of death	780-799	R00-R99

Table 14: Definition of treatment groups

Short name	Name	SIF	NCSP/NCMP
PCI	Percutaneous coronary intervention	3294,3236,3239	FNG
CABG	Coronary artery bypass grafting	3112-3129	FNA, FNB, FNC, FND, FNE, FNF
CR	Coronary revascularization	3112-3129, 3294,3236,3239	FNA, FNB, FNC, FND, FNE, FNF, FNG

## Endpoint variables

For each group in Table 12 and Table 14 a set of endpoint variables has been generated.

**Table 15: Variable Explanation for disease endpoints with the AMI –group as example**

<b>Variable</b>	<b>Explanation</b>
<b>exdate</b>	Examination date in CONOR
<b>age_ex_days</b>	Age at examination generated by assuming that all participants are born on the 15 <sup>th</sup> of month_born_co
<b>age_ex_years</b>	age_ex_days/365.25
<b>ami_death</b>	1: Death with AMI as underlying cause of death. 0: Death from other causes or alive at 31DEC2010
<b>death_date</b>	Date of death
<b>days_death</b>	Days from exdate until death or 31DEC2010 if still alive.
<b>age_death_exit_days</b>	Age in days at death or 31DEC2010 if still alive
<b>age_death_exit_years</b>	age_death_exit_days/365.25
<b>ami_hosp</b>	1: Hospitalization with AMI as main or secondary diagnosis after exdate 0: No AMI-hospitalization between exdate and 31DEC2009.
<b>ami_hosp_date</b>	Date of first AMI-hospitalization after exdate
<b>prev_ami_hosp</b>	1: Hospitalization with AMI as main or secondary diagnosis before exdate. 0: No AMI-hospitalization in CVDNOR before exdate (NB! CVDNOR does not have data before 1994. Should combine information with data from CONOR-questionnaire)
<b>prev_ami_hosp_date</b>	Date of first AMI-hospitalization before exdate
<b>ami_hospdeath</b>	1: AMI-hospitalization or AMI-death between exdate and 31DEC2009 0: No AMI-hospitalization or AMI-death between exdate and 31DEC2009
<b>ami_hospdeath_date</b>	Date of first AMI(hospitalization or death) between exdate and 31DEC2009
<b>days_ami_hospdeath</b>	Days from exdate until first AMI or until death if death from other causes or until 31DEC2009 if still alive and ami_hospdeath=0.
<b>age_ami_hospdeath_days</b>	Age in days at first AMI between exdate and 31DEC2009
<b>age_ami_hospdeath_years</b>	age_ami_hospdeath_days/365.25

**Table 16: Variable Explanation for treatment endpoints with PCI as example**

<b>Variable</b>	<b>Explanation</b>
<b>pci_hosp</b>	1: Hospitalization with PCI between exdate and 31DEC2009 2: No PCI-hospitalization between exdate and 31DEC2009
<b>pci_hosp_date</b>	Date of first PCI-hospitalization between exdate and 31DEC2009
<b>prev_pci_hosp</b>	1: Hospitalization with PCI before exdate. 0: No PCI-hospitalization before exdate.
<b>prev_pci_hosp_date</b>	Date of first PCI-hospitalization before exdate.
<b>days_pci_hosp</b>	Days from exdate until first PCI-hospitalization or until death if pci_hosp=0 or until 31DEC2009 if still alive and pci_hosp=0.
<b>age_pci_hosp_days</b>	Age in days at first PCI-hospitalization
<b>age_pci_hosp_years</b>	$\text{age\_pci\_hosp\_days}/365.25$

## Count of fatal endpoints

Table 17: Count of deaths by underlying cause. Participants are followed for fatal endpoints until 31DEC2010.

	Men, n (%) <sup>1</sup>	Women, n (%) <sup>2</sup>	Total, n (%) <sup>3</sup>	Percent of total deaths
<b>CONOR Participants</b>	87358	93195	180553 <sup>4</sup>	
<b>Main groups of deaths</b>				
Total deaths	13729(15.7)	10442(11.2)	24171(13.4)	100.0
Cardiovascular disease	5139(5.9)	3918(4.2)	9057(5.0)	37.5
Cancer	4385(5.0)	3125(3.4)	7510(4.2)	31.1
Other diseases	3002(3.4)	2580(2.8)	5582(3.1)	23.1
Accidents/ violent deaths	662(0.8)	413(0.4)	1075(0.6)	4.4
Ill-defined deaths	541(0.6)	406(0.4)	947(0.5)	3.9
<b>Sub-groups of deaths</b>				
Coronary Heart Disease	2625(3.0)	1440(1.6)	4065(2.3)	16.8
Acute Myocardial Infarction	1798(2.1)	952(1.0)	2750(1.5)	11.4
Acute Myocardial Infarction 2	2061(2.4)	1114(1.2)	3175(1.8)	13.1
Acute Myocardial Infarction 3	2031(2.3)	1095(1.2)	3126(1.7)	12.9
Acute Myocardial Infarction 4	2021(2.3)	1088(1.2)	3109(1.7)	12.9
Acute Myocardial infarction 5	1808(2.1)	959(1.0)	2767(1.5)	11.4
Sudden Death	263(0.3)	162(0.2)	425(0.2)	1.8
Sudden Death 2	233(0.3)	143(0.2)	376(0.2)	1.6
Cerebrovascular disease	1069(1.2)	1148(1.2)	2217(1.2)	9.2
Total Stroke	852(1.0)	947(1.0)	1799(1.0)	7.4
Ischemic stroke	202(0.2)	184(0.2)	386(0.2)	1.6
Ischemic and unspecified stroke	613(0.7)	703(0.8)	1316(0.7)	5.4
Transient Ischemic attack	12(0.01)	12(0.01)	24(0.01)	0.1
Aorta aneurism	274(0.3)	137(0.2)	411(0.2)	1.7
Peripheral Artery Disease	394(0.5)	242(0.3)	636(0.4)	2.6
Atherosclerotic disease	3643(4.2)	2394(2.6)	6037(3.3)	25.0
Hypertension	110(0.1)	125(0.1)	235(0.1)	1.0
Aorta stenosis	89(0.1)	126(0.1)	215(0.1)	0.9
Atrial fibrillation/flutter	159(0.2)	214(0.2)	373(0.2)	1.5
Heart Failure	295(0.3)	312(0.3)	607(0.3)	2.5
Diabetes Mellitus	203(0.2)	163(0.2)	366(0.2)	1.5
Congenital Heart Defects	3(0.003)	4(0.004)	7(0.004)	0.03
Lung Cancer	956(1.1)	512(0.6)	1468(0.01)	6.1

<sup>1</sup> Percentage of male participants

<sup>2</sup> Percentage of female participants

<sup>3</sup> Percentage of total number of participants

<sup>4</sup> 173243 unique persons since 7309 have participated more than once

## Count of combined endpoints, hospitalization or death

Table 18: Count of combined endpoints, hospitalization or death. Participants are followed for combined endpoints until 31DEC2009.

	Men, n (%)	Women, n (%)	Total, n (%)
<b>CONOR Participants</b>	87358	93195	180553 <sup>5</sup>
<b>Disease endpoints</b>			
Cardiovascular disease	27060(31.0)	21377(22.9)	48437(26.8)
Coronary heart disease	13577(15.5)	7375(7.9)	20952(11.6)
Coronary heart disease 2	13783(15.8)	7486(8.0)	21269(11.8)
Coronary heart disease 3	13760(15.8)	7472(8.0)	21232(11.8)
Acute myocardial infarction	6561(7.5)	3174(3.4)	9735(5.4)
Major Coronary Event	6791(7.8)	3296(3.5)	10087(5.6)
Major Coronary Event 2	6764(7.7)	3281(3.5)	10045(5.6)
Acute coronary syndrome	7915(9.1)	3978(4.3)	11893(6.6)
Acute coronary syndrome 2	8143(9.3)	4099(4.4)	12242(6.8)
Acute coronary syndrome 3	8117(9.3)	4084(4.4)	12201(6.8)
Cerebrovascular disease	6214(7.1)	4937(5.3)	11151(6.2)
Total stroke	4935(5.7)	3991(4.3)	8926(4.9)
Ischemic stroke	3858(4.4)	2949(3.2)	6807(3.8)
Ischemic/unspecified cerebrovascular disease	4618(5.3)	3673(3.9)	8291(4.6)
Transient Ischemic attack	1562(1.8)	1315(1.4)	2877(1.6)
Aorta aneurism	1521(1.7)	489(0.5)	2010(1.1)
Peripheral artery disease	3484(4.0)	1868(2.0)	5352(3.0)
Atherosclerotic disease	17517(20.1)	10784(11.6)	28301(15.7)
Hypertension	11536(13.2)	10810(11.6)	22346(12.4)
Aorta stenosis	1177(1.4)	1084(1.2)	2261(1.3)
Atrial fibrillation/flutter	6911(7.9)	4283(4.6)	11194(6.2)
Heart Failure	4411(5.1)	3157(3.4)	7568(4.2)
Diabetes Mellitus	4549(5.2)	3479(3.7)	8028(4.4)
Congenital Heart Defects	156(0.2)	185(0.2)	341(0.2)
<b>Treatment endpoints</b>			
Percutaneous coronary intervention	3310(3.8)	1228(1.3)	4538(2.5)
Coronary artery bypass graft	2272(2.6)	695(0.8)	2967(1.7)
Coronary revascularization	5255(6.0)	1795(1.9)	7050(3.9)

<sup>5</sup> 173243 unique persons since 7309 have participated more than once

## Appendix A: Requirement Specification for retrieval of hospital data

### ICD-9 diagnosis codes

Beskrivelse	ICD9
Ondartet svulst i hjerte/mediastinum	164.1
Godartet svulst i hjertet	212.7
Diabetes mellitus	250
Flebitt, tromboflebitt og trombose i hjernens venøse sinus	325
Diabetes retinopati	<b>362</b>
Sykdommer i sirkulasjonssystemet	390- 459
Ødem, proteinuri og komplikasjoner som følge av hypertensive lidelser under svangerskap, fødsel og barseltid (puerperium)	642
DM under svangerskap	648
Venøse komplikasjoner under svangerskap	668.1
Dyp tromboflebitt før fødselen	671.3
Dyp tromboflebitt etter fødselen	671.4
Annen flebitt og trombose Cerebral venetrombose	671.5
Flebitt i.n.a., Trombose i.n.a.	671.9
Obstetrisk blodpropp, puerperal lungeemboli i.n.a	673.2
I.n.a. Plutselig død av ukjent årsak i barselseng	674.9
Medfødte misdannelser i sirkulasjonssystemet	745- 747
Koma og sopor	780.0
Synkope og kollaps	780.2
Forbigående lammelse av ekstremitet	781.4
Ødem	782.3
Cyanose	782.5
Symptomer fra det kardiovaskulære system Ekskl.: Hjertesvikt i.n.a. (428.9)	785
Dyspné	786.0
Brystsmerter	786.5
Uspesifikke og unormale funn ved radiologisk og annen undersøkelse av kroppsstrukturer Andre intratorakale organer	793.2

<b>Uspesifikke og unormale resultater av funksjonsundersøkelser Hjerte og kar</b>	794.3
<b>Unormal blodtrykksmåling, uten diagnose; hypertensjon</b>	796.2
<b>Unormal blodtrykksmåling, uten diagnose; hypotensjon</b>	796.3
<b>Ubestemte og ukjente årsaker til sykdom og død Plutselig død</b>	798.1
<b>Ubestemte og ukjente årsaker til sykdom og død Død av ukjent årsak mindre enn 24 timer etter symptomenes begynnelse</b>	798.2
<b>Ubestemte og ukjente årsaker til sykdom og død Funnnet død</b>	798.9
<b>Andre ubestemte og ukjente årsaker til død Respirasjonssvikt</b>	799.1
<b>Andre ubestemte og ukjente årsaker til død Andre ubestemte tilstander</b>	799.8
<b>Andre ubestemte og ukjente årsaker til død Annen ukjent og uspesifisert årsak</b>	799.9
<b>Mekaniske komplikasjoner i forbindelse med kardial protese, implantat eller graft</b>	996.0
<b>Mekaniske komplikasjoner i forbindelse med annen vaskulær protese, implantat eller graft</b>	996.1
<b>Andre komplikasjoner i forbindelse med innvortes protese, implantat eller graft</b>	996.7
<b>Komplikasjoner som påvirker spesifiserte organsystemer, ikke klassifisert andre steder Sentralnevøse komplikasjoner</b>	997.0
<b>Komplikasjoner som påvirker spesifiserte organsystemer, ikke klassifisert andre steder Hjertekomplikasjoner</b>	997.1
<b>Komplikasjoner som påvirker spesifiserte organsystemer, ikke klassifisert andre steder Perifere vaskulære komplikasjoner</b>	997.2
<b>Personer med potensiell helserisiko i forbindelse med personlig eller familiens sykehistorie Personlig sykehistorie om bestemte andre sykdommer Sykdommer i hjertekarsystemet</b>	V12.5
<b>Personer med potensiell helserisiko i forbindelse med personlig eller familiens sykehistorie Annen personlig sykehistorie om helserisiko Kirurgiske inngrep på hjertet og de store kar</b>	V15.1
<b>Personer med tilstand som påvirker deres helse Organer eller vev erstattet med transplantat Hjerte</b>	V42.1
<b>Personer med tilstand som påvirker deres helse Organer eller vev erstattet med transplantat Hjerteklaffer</b>	V42.2
<b>Personer med tilstand som påvirker deres helse Organer eller vev erstattet på annen måte</b>	V43.2



<b>Hjerte</b>	
<b>Personer med tilstand som påvirker deres helse</b> <b>Organer eller vev erstattet på annen måte</b> <b>Hjerteklaffer</b>	V43.3
<b>Personer med tilstand som påvirker deres helse</b> <b>Organer eller vev erstattet på annen måte</b> <b>Blodårer</b>	V43.4
<b>Personer med tilstand som påvirker deres helse</b> <b>Tilstand med kunstig åpning</b> <b>Trakeostomi</b>	V44.0
<b>Personer med tilstand som påvirker deres helse</b> <b>Andre postoperative tilstander</b> <b>Kardial pacemaker in situ</b>	V45.0
<b>Personer med tilstand som påvirker deres helse</b> <b>Andre problemer med indre organer</b> <b>Andre kardio-respiratoriske problemer</b>	V47.2
<b>Personer som kontakter helsetjenesten for spesielle behandlingsopplegg og etterbehandling</b> <b>Tilpasning eller korreksjon av andre hjelpemidler</b> <b>Pacemaker</b>	V53.3
<b>Kontakt med personer uten kjent diagnose i forbindelse med enkelt- eller masseundersøkelse</b> <b>Observasjon og evaluering av suspekke tilstander</b> <b>Observasjon for suspekt kardiovaskulær sykdom</b>	V71.7

## ICD-10 diagnosis codes

Beskrivelse	ICD10
Hjertesykdom forårsaket av meningokokksykdom	A39.5
Ondartet svulst i hjerte	C38.0
Overlappende svulst i hjerte, mediastinum og brysthinne	C38.8
Godartet svulst i hjertet	D15.1
Diabetes mellitus	E10-E14
Intrakraniell og intraspinal flebitt og tromboflebitt	G08
Idiopatisk perifer autonom nevropati	G90.0
Andre ryggmargssykdommer; Vaskulære myelopatier	G95.1
Karokklusjoner i netthinne (retina)	H34
Sykdommer i sirkulasjonssystemet	I00-I99
Ødem, proteinuri og komplikasjoner som følge av hypertensive lidelser under svangerskap, fødsel og barseltid (puerperium)	O10-16
Venøse komplikasjoner under svangerskap Dyp flebotrombose under svangerskap	O22.3
Venøse komplikasjoner under svangerskap Cerebral venøs trombose under svangerskap	O22.5
Venøse komplikasjoner under svangerskap Andre spesifiserte venøse komplikasjoner under svangerskapet	O22.8
Venøse komplikasjoner under svangerskap Uspesifisert venøs komplikasjon under svangerskap	O22.9
Diabetes mellitus under svangerskap	O24
Hjertekomplikasjoner som følge av anestesi under svangerskap	O29.1
Hjertekomplikasjoner som følge av anestesi under fødsel og forløsning	O74.2
Andre komplikasjoner ved fødsel og forløsning, ikke klassifisert annet sted Andre komplikasjoner til obstetrisk kirurgi og inngrep (cerebral anoksi / hjertekomplik.)	O75.4
Venøse komplikasjoner i barseltid	O87
Obstetrisk blodproppemboli	O88.2
Hjertekomplikasjoner i forbindelse med anestesi i barseltid	O89.1
Komplikasjoner i barseltid , ikke klassifisert annet sted Kardiomyopati i barseltid	O90.3
Obstetrisk død av uspesifisert årsak	O95
Sykdommer i sirkulasjonssystemet som kompliserer svangerskap, fødsel og barseltid	O99.4

<b>(tilstander i I00-I99).</b>	
<b>Medfødte misdannelser i sirkulasjonssystemet</b>	Q20-Q28
<b>Symptomer, tegn og unormale kliniske funn</b> <b>Unormale hjerteslag</b>	R00-R03
<b>Åndedrettsabnormiteter</b> <b>Dyspné</b>	R06.0
<b>Smerte i hals og bryst</b>	R07
<b>Andre symptomer og tegn med tilknytning til sirkulasjons- og åndedrettssystemet</b> <b>Respirasjonsstans</b>	R09.2
<b>Andre symptomer og tegn med tilknytning til sirkulasjons- og åndedrettssystemet</b> <b>Andre spesifiserte symptomer og tegn med tilknytning til sirkulasjons- og åndedrettssystemet</b>	R09.8
<b>Cyanose</b>	R23.0
<b>Symptomer og tegn med tilknytning til kognisjon, persepsjon, emosjonell tilstand og adferd:</b>  <b>Somnolens, stupor og koma</b>	R40
<b>Synkope og kollaps</b>	R55
<b>Sjokk, ikke klassifisert annet sted (ICD-8/9 inkludere septisk / hypovolemisk sjokk)</b>	R57
<b>Ødem, ikke klassifisert annet sted</b>	R60
<b>Unormale funn ved diagnostisk avbildning av andre kroppsstrukturer</b> <b>Hjerte og karsirkulasjon</b>	R93.1
<b>Unormale resultater av funksjonsstudier</b> <b>Hjerte og kar</b>	R94.3
<b>Dårlig definerte og ukjente dødsårsaker</b> <b>Annen plutselig død av ukjent årsak</b>	R96
<b>Dårlig definerte og ukjente dødsårsaker</b> <b>Funnet død</b>	R98
<b>Dårlig definerte og ukjente dødsårsaker</b> <b>Andre dårlig definerte og uspesifiserte dødsårsaker</b>	R99
<b>Komplikasjoner til inngrep, ikke klassifisert annet sted (blødning, sjokk, infeksjon osv)</b>	T81
<b>Komplikasjoner ved proteser, implantater og transplantater i hjerte og blodkar</b>	T82
<b>Funksjonssvikt og avstøtning av transplanterte organer og vev</b> <b>Funksjonssvikt og avstøtning av hjertetransplantat</b>	T86.2
<b>Funksjonssvikt og avstøtning av transplanterte organer og vev</b> <b>Funksjonssvikt og avstøtning av hjerte- lungetransplantat</b>	T86.3
<b>Skade på pasient som følge av svikt ved medisinsk utstyr i diagnostisk eller terapeutisk bruk</b> <b>Svikt ved kardiovaskulært utstyr</b>	Y71
<b>Pasientreaksjon som følge av medisinsk eller kirurgisk prosedyre, og senere komplikasjon til</b>	Y83.2

slik prosedyre, hvis selve prosedyren forløp uten anmerkning om skade Kirurgisk prosedyre med anastomose, "bypass" eller kartransplantasjon	
Pasientreaksjon som følge av medisinsk eller kirurgisk prosedyre, og senere komplikasjon til slik prosedyre, hvis selve prosedyren forløp uten anmerkning om skade Hjertekateterisering	Y84.0
Medisinsk observasjon og vurdering ved mistanke om sykdommer og tilstander Observasjon ved mistanke om hjerteinfarkt	Z03.4
Medisinsk observasjon og vurdering ved mistanke om sykdommer og tilstander; Observasjon ved mistanke om hjertekarsykdommer	Z03.5
Kontakt med helsetjenesten for justering og kontroll av implantert hjelpemiddel; Justering og kontroll av hjertepacemaker	Z45.0
Kontakt med helsetjenesten ved status etter transplantert organ og vev Status etter transplantert hjerte	Z94.1
Kontakt med helsetjenesten ved status etter transplantert organ og vev Status etter transplantert hjerte og lunger	Z94.3
Kontakt med helsetjenesten ved status med implantater og transplantater i hjerte og blodkar	Z95

## Procedure codes

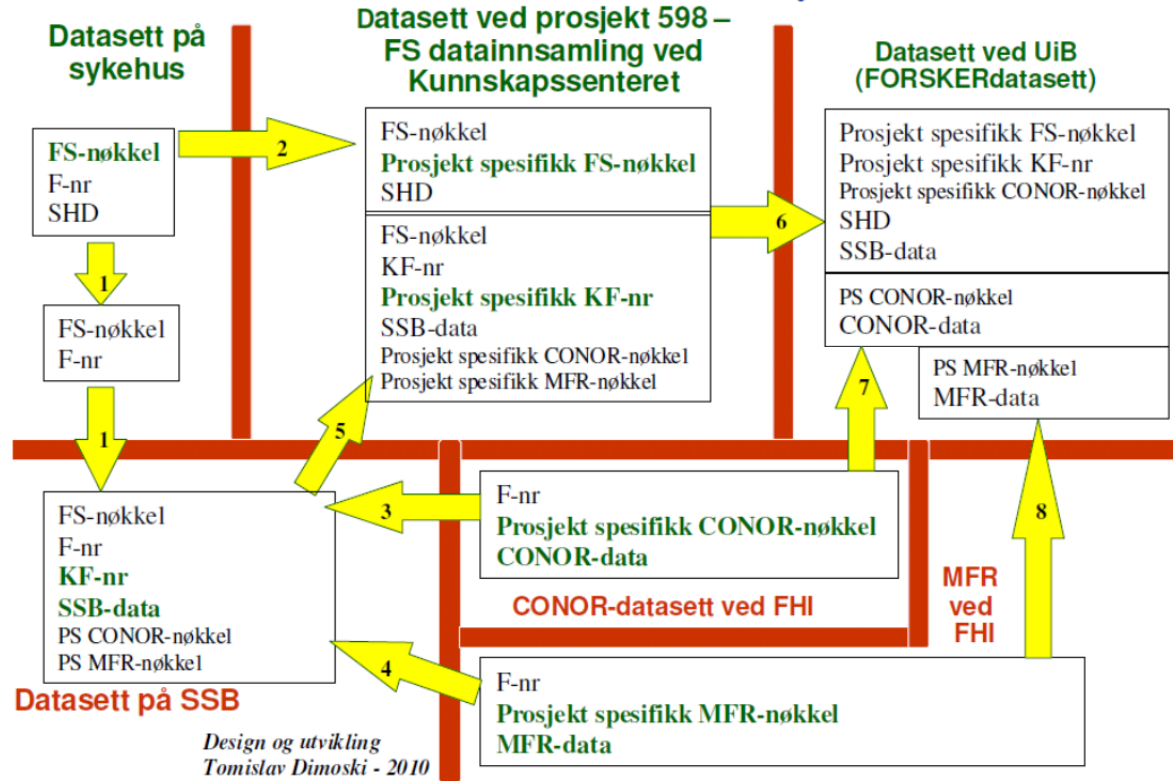
Beskrivelse	Klassifikasjon av operasjoner, 3. Versjon, 1995 Kodeverk: SIF95	Klassifikasjon av medisinske prosedyrer og kirurgiske inngrep 2006 <sup>6</sup> Kodeverk: NCMP og NCSP 2006
Operasjoner på hjertet og de store kar	3000-3299	F
Operasjoner på perifere blodkar og lymfesystemet	8800-8899	P
Operasjoner på halskar, kode benyttet før 1995	0220	
Operasjoner på halskar, kode benyttet før 1995	0230	
Operasjoner på halskar, kode benyttet før 1995	0231	
Operasjoner på halskar, kode benyttet før 1995	0249	
Mindre kardiologiske inngrep		TF, WDAB80
Mindre karkirurgiske inngrep		TP, KAGD46, KAGD47, KAGD48,

<sup>6</sup> Gjeldende fra 01.01.1999, består koden av 5 tegn; to første tegn er alltid bokstaver, to siste er alltid tall.

	RXGG61
<b>Hjerteundersøkelser</b>	XF
<b>Peroperativ transøsofagela ultralysundersøkelse</b>	XGX 02
<b>Undersøkelser ved perifer karkirurgi</b>	XP
<b>Tilleggskoder til kapittel F</b>	ZF
<b>Ballongdillatasjon (Denne tilleggskoden benyttes trolig ikke)</b>	ZFX 00
<b>Bruk av rotablator</b>	ZFX 01
<b>Bruk av angiojet</b>	ZFX 02
<b>Bruk av atrektomi-instrument</b>	ZFX 03
<b>Inngrep knyttet til tidligere inngrep til kapittel F</b>	ZSF 00
<b>Inngrep knyttet til tidligere inngrep til kapittel P</b>	ZSP 00
<b>Behandling av peroperativt hjerteblem</b>	ZXG
<b>Midlertidige nasjonale særkoder: Åpen hjertekompresjon (ved hjertestans under kirurgiske inngrep; se ZXG 10-20)</b>	FX2 81

**Appendix B: Overview of the linkage process**

**FS-systemet: CVDNOR - datainnsamling for UiBs prosjekt:  
Cardiovascular Disease in Norway 1994-2009**



### ***Appendix C: List of hospitals included in the CVDNOR project***

<b>Institution number</b>	<b>Hospital Name</b>	<b>Health Region</b>
29	Aker universitetssykehus (inkl. Ski)	Helse Sør-Øst
17	Akershus universitetssykehus	Helse Sør-Øst
28	Diakonhjemmets sykehus	Helse Sør-Øst
47	Feiringklinikken	Helse Sør-Øst
33	Lovisenberg Diakonale sykehus	Helse Sør-Øst
1	Oslo universitetssykehus HF	Helse Sør-Øst
14	Sykehuset Innlandet HF	Helse Sør-Øst
42	Sykehuset Østfold HF	Helse Sør-Øst
34	Klinikk Notodden	Helse Sør-Øst
2	Klinikk Rjukan	Helse Sør-Øst
46	Sykehuset i Vestfold HF	Helse Sør-Øst
52	Sykehuset Telemark - Kragerø	Helse Sør-Øst
39	Sykehuset Telemark - Skien/Porsgrunn	Helse Sør-Øst
15	Sørlandet sykehus HF	Helse Sør-Øst
4	Vestre Viken HF	Helse Sør-Øst
30	Haraldsplass Diakonale sjukehus	Helse Vest
63	Haugesund sjukehus	Helse Vest
6	Helse Bergen HF	Helse Vest
37	Helse Førde HF	Helse Vest
61	Odda sjukehus	Helse Vest
7	Stavanger Universitetssykehus	Helse Vest
62	Stord sjukehus	Helse Vest
38	Kristiansund sjukehus	Helse Midt-Norge
45	Molde sjukehus	Helse Midt-Norge
25	Orkdal Sjukehus	Helse Midt-Norge
8	St. Olavs Hospital	Helse Midt-Norge
10	Sykehuset Levanger	Helse Midt-Norge
23	Sykehuset Namsos	Helse Midt-Norge
41	Volda sjukehus	Helse Midt-Norge
9	Ålesund sjukehus	Helse Midt-Norge
24	Klinikk Hammerfest	Helse Nord
31	Klinikk Kirkenes	Helse Nord
35	Mo i Rana	Helse Nord
40	Mosjøen	Helse Nord
12	Nordlandssykehuset, Bodø	Helse Nord
32	Nordlandssykehuset, Lofoten	Helse Nord

Institution number	Hospital Name	Health Region
36	Sandnessjøen	Helse Nord
13	UNN - Harstad	Helse Nord
27	UNN - Narvik	Helse Nord
76*	UNN – Tromsø	Helse Nord
11**	UNN – Tromsø*	Helse Nord
18	Vesterålen	Helse Nord

\* Code used between 1994 and 2007

\*\* Code used in 2008 and 2009



## References

1. Clench-Aas J, Hofoss D, Rønning O, Helgeland J, Dimoski T, Gulbrandsen P, et al. Methodological development and evaluation of 30-day mortality as quality indicator for Norwegian hospitals. The Norwegian Knowledge Centre for the Health Services, 2005, p. 179.
2. Naess O, Sogaard AJ, Arnesen E, Beckstrom AC, Bjertness E, Engeland A, et al. Cohort profile: cohort of Norway (CONOR). *International journal of epidemiology*. 2008; 37: 481-5.
3. Pajunen P, Paakkonen R, Juolevi A, Hamalainen H, Keskimaki I, Laatikainen T, et al. Trends in fatal and non-fatal coronary heart disease events in Finland during 1991-2001. *Scandinavian cardiovascular journal : SCJ*. 2004; 38: 340-4.
4. Yeh RW, Sidney S, Chandra M, Sorel M, Selby JV and Go AS. Population trends in the incidence and outcomes of acute myocardial infarction. *The New England journal of medicine*. 2010; 362: 2155-65.
5. Osler M, Rostgaard K, Sorensen TI and Madsen M. The effect of recurrent events on register-based estimates of level and trends in incidence of acute myocardial infarction. *Journal of clinical epidemiology*. 1999; 52: 595-600.
6. Tell GS, Nygaard OK, Seifert R, Igland J, Klakegg Y, Juul K, et al. Hjerter-, kar- og slagregisteret Helseregion Vest 1972–2006. *Uni Health*, 2008.
7. Oyen N, Nygard O, Igland J, Tell GS, Nordrehaug JE, Irgens LM, et al. [Hospital admission rates for cardiovascular diseases in Western Norway, 1992-2001]. *Tidsskrift for den Norske lægeforening : tidsskrift for praktisk medicin, ny række*. 2008; 128: 17-23.
8. Langorgen J, Igland J, Vollset SE, Averina M, Nordrehaug JE, Tell GS, et al. Short-term and long-term case fatality in 11 878 patients hospitalized with a first acute myocardial infarction, 1979-2001: the Western Norway cardiovascular registry. *European journal of cardiovascular prevention and rehabilitation : official journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology*. 2009; 16: 621-7.