

ONLINE SUPPLEMENTAL MATERIALS

Admission Rates, Time-Trends, Risk Factors and Outcomes of Ischaemic and Haemorrhagic Stroke from German Nationwide Data

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eTable 1: Diagnoses and Procedure Codes

Diagnosis	ICD 10 – GM – 2020
Cerebrovascular disease	I60 – I64
Intracerebral haemorrhage	I61.-
Other, non-traumatic intracerebral haemorrhage	I62.-
Stroke	I63.-
Stroke, not referred to as bleeding or infarction	I64.-
Secondary Diagnosis	
Chronic Kidney Disease*	N18
Diabetes Mellitus	E10-E11
Obesity	E66.-
Dyslipidaemia	E78.-
Current Smoking Use	F17
Hypertensive Disease	I10-I15
Atrial Fibrillation	I48.-
Acute Myocardial Infarction	I21.-, I22.-
Coronary Heart Disease	I25.1
Congestive Heart Failure	I50.-
Left Ventricular Failure	I50.1 et seqq.
Right Ventricular Failure	I50.0
Peripheral Artery Disease	I70.20 - I70.25
Dementia	F00.-, F01.--
Cancer	C
* GFR <60ml/min/1.73m ² BSA	

Acute stroke as principal diagnosis and co-morbidities as secondary diagnoses were coded according to the German Modification of the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10-GM). Procedures were coded according to the German Procedure Classification (OPS).

eTable 2. Definitions of complications and procedures according to ICD-10-GM and OPS codes

Complication	Parameter / ICD-10-GM code / OPS code
In-Hospital Death	7
Sepsis, unspecified	A41
Transfusion	8-800.c
Bleeding event	H44.8, K92, T81.0-3, K81.7
Haemorrhagic transformation	I60 – I62
Acute kidney injury	N17.-
Renal replacement therapy	8-853, 8-854, 8-855
Cardiac arrest	8-771
Coronary artery bypass graft	5-36 et seqq.
Percutaneous coronary intervention	8-837 et seqq.
Valve surgery	Z95.2
Systemic thrombolysis	8-020.8
Intra-arterial thrombolysis	8-020.d
Carotid endarterectomy	5-380.0, 5-380.1
Carotid stenting	8-840.0h, 8-840.0j, 8-840.0k, 8-840.0m, 8-840.1h, 8-840.1j, 8-840.1k, 8-840.1m, 8-840.2h, 8-840.2j, 8-840.2k, 8-840.2m, 8-840.3h, 8-840.3j, 8-840.3k, 8-840.3m
Carotid interposition graft	5-383.0
Craniectomy	5-010-10, 5-010-11, 5-010-12, 5-010-13, 5-010-14
ICH evacuation	5-014.1
Evacuation of extracranial haemorrhage	5-013.1
Extracranial thrombectomy	8-836.81

Intracranial thrombectomy 8-8368.0

A code marked by a dash (-) indicates that all subheadings of this code are included.

eTable III. Baseline characteristics of patients hospitalized with acute ischaemic stroke in Germany according to year.

Year	2014	2015	2016	2017	2018	2019	Total	P for trend
Number of cases – N (%)	255,276 (83.3%)	259,706 (83.2%)	266,778 (83.8%)	267,375 (83.9%)	264,485 (84.1%)	264,264 (84.5%)	1,577,884 (83.8%)	n.a.
Median age - Yr (Q1,Q3)	76 (66, 83)	76 (66, 83)	76 (66, 83)	76 (66, 83)	77 (66, 83)	77 (66, 83)	76 (66, 83)	<0.001
Female sex – n (%)	126,070 (49.4%)	126,195 (48.6%)	129,021 (48.4%)	128,488 (48.1%)	125,776 (47.6%)	125,987 (47.7%)	761,537 (48.3%)	<0.001
Co-Diagnoses								
LEAD Stages – n (%)								<0.001
LEAD RF 1-3	6,614 (2.6%)	5,330 (2.1%)	5,195 (2.0%)	4,965 (1.9%)	4,899 (1.9%)	4,617 (1.8%)	31,620 (2.0%)	
LEAD RF 4-6	2,510 (1.0%)	2,181 (0.8%)	2,397 (0.9%)	2,386 (0.9%)	2,488 (0.9%)	2,270 (0.9%)	14,232 (0.9%)	
Hypertension — n (%)	193,070 (75.6%)	196,915 (75.8%)	202,445 (75.9%)	202,565 (75.8%)	200,899 (76.0%)	200,826 (76.0%)	1,196,720 (75.8%)	0.003
Atrial fibrillation — n (%)	75,130 (29.4%)	76,590 (29.5%)	77,854 (29.2%)	78,412 (29.3%)	77,115 (29.2%)	77,498 (29.3%)	462,599 (29.3%)	0.065
Acute myocard. infarction — n (%)	3,352 (1.3%)	3,446 (1.3%)	3,461 (1.3%)	3,350 (1.3%)	3,166 (1.2%)	3,110 (1.2%)	19,885 (1.3%)	<0.001
Cancer — n (%)	6,891 (2.7%)	7,158 (2.8%)	7,657 (2.9%)	7,726 (2.9%)	7,653 (2.9%)	7,899 (3.0%)	44,984 (2.9%)	<0.001
Cerebrovascular disease — n (%)	31,295 (12.3%)	33,240 (12.8%)	36,518 (13.7%)	37,888 (14.2%)	38,215 (14.5%)	35,654 (13.5%)	212,810 (13.5%)	<0.001
CHD — n (%)	38,589 (15.1%)	39,859 (15.4%)	41,248 (15.5%)	40,809 (15.3%)	41,092 (15.5%)	40,884 (15.5%)	242,481 (15.4%)	<0.001
Chronic heart failure — n (%)	28,185 (11.0%)	27,889 (10.7%)	28,919 (10.8%)	29,297 (11.0%)	28,959 (11.0%)	29,276 (11.1%)	172,525 (10.9%)	0.061
RV-CHF — n (%)	6,012 (2.4%)	6,035 (2.3%)	6,335 (2.4%)	6,597 (2.5%)	6,375 (2.4%)	6,228 (2.4%)	37,582 (2.4%)	0.151
LV-CHF — n (%)								0.001
NYHA I	2,313 (0.9%)	2,181 (0.8%)	2,511 (0.9%)	2,421 (0.9%)	2,617 (1.0%)	2,810 (1.1%)	14,853 (0.9%)	
NYHA II	6,724 (2.6%)	6,424 (2.5%)	6,735 (2.5%)	7,270 (2.7%)	6,960 (2.6%)	7,214 (2.7%)	41,327 (2.2%)	
NYHA III	6,578 (2.6%)	6,618 (2.6%)	7,121 (2.7%)	7,164 (2.7%)	7,059 (2.7%)	7,010 (2.7%)	41,550 (2.6%)	
NYHA IV	4,826 (1.9%)	4,924 (1.9%)	4,980 (1.9%)	5,196 (1.9%)	5,168 (2.0%)	5,159 (2.0%)	30,253 (1.9%)	
CKD — n (%)	33,995 (13.3%)	35,088 (13.5%)	37,380 (14.0%)	38,688 (14.5%)	39,011 (14.8%)	39,336 (14.9%)	223,498 (14.2%)	<0.001
Diabetes mellitus — n (%)	72,547 (28.4%)	73,394 (28.3%)	74,756 (28.0%)	74,537 (27.9%)	73,194 (27.7%)	73,794 (27.9%)	442,222 (28.0%)	<0.001
Dyslipidemia — n (%)	98,959 (38.8%)	101,784 (39.2%)	107,185 (40.2%)	107,404 (40.2%)	108,418 (41.0%)	109,808 (41.6%)	633,558 (40.2%)	<0.001
Obesity — n (%)	12,749 (5.0%)	12,612 (4.9%)	13,168 (4.9%)	12,965 (4.9%)	12,860 (4.9%)	12,377 (4.7%)	76,731 (4.9%)	<0.001
Current smoking — n (%)	11,453 (4.5%)	11,565 (4.5%)	12,321 (4.6%)	12,033 (4.5%)	11,853 (4.5%)	11,332 (4.3%)	70,557 (4.5%)	0.002
Prev. Ischaemic stroke – n (%)	18,371 (7.2%)	18,549 (7.1%)	18,640 (7.0%)	19,256 (7.2%)	18,302 (6.9%)	17,760 (6.7%)	110,878 (7.0%)	<0.001
Prev. Intracranial bleeding – n (%)	1,292 (0.5%)	1,296 (0.5%)	1,350 (0.5%)	1,373 (0.5%)	1,330 (0.5%)	1,369 (0.5%)	8,010 (0.5%)	0.497
Ischaemic heart disease – n (%)	40,169 (15.7%)	41,543 (16.0%)	42,783 (16.0%)	42,273 (15.8%)	42,437 (16.1%)	42,202 (16.0%)	251,407 (15.9%)	0.074
Dementia – n (%)	14,845 (5.8%)	14,502 (5.6%)	14,264 (5.4%)	13,922 (5.2%)	13,183 (5.0%)	12,450 (4.7%)	83,166 (5.3%)	<0.001
Prev. CABG – n (%)	5,609 (2.2%)	5,939 (2.3%)	5,905 (2.2%)	5,888 (2.2%)	5,857 (2.2%)	5,395 (2.0%)	34,593 (2.2%)	<0.001
Prev. Valve – n (%)	1,751 (0.7%)	1,849 (0.7%)	1,906 (0.7%)	1,876 (0.7%)	1,871 (0.7%)	1,848 (0.7%)	11,101 (0.7%)	0.780

CABG indicates coronary artery bypass graft; CHD, coronary heart disease; CHF, congestive heart failure; LV, left ventricular; NYHA, New York Heart Association; RV, right ventricular.

eTable IV. Baseline characteristics of patients hospitalized with acute haemorrhagic stroke in Germany according to year

Year	2014	2015	2016	2017	2018	2019	Total	P for trend
Number of cases – N (%)	51,149 (16.7%)	52,346 (16.8%)	51,569 (16.2%)	51,474 (16.1%)	50,080 (15.9%)	48,428 (15.5%)	305,046 (16.2%)	n.a.
Median age - Yr (Q1,Q3)	74 (61, 81)	74 (61, 81)	74 (61, 81)	74 (61, 81)	75 (61, 82)	75 (61, 82)	74 (61, 83)	<0.001
Female sex – n (%)	24,442 (47.8%)	25,025 (47.8%)	24,326 (47.2%)	24,043 (46.7%)	23,515 (47.0%)	22,779 (47.0%)	144,130 (47.3%)	<0.001
Co-Diagnosis								
LEAD Stages – n (%)								0.004
LEAD RF 1-3	590 (1.2%)	453 (0.9%)	416 (0.8%)	429 (0.8%)	399 (0.8%)	376 (0.8%)	2,663 (0.9%)	
LEAD RF 4-6	229 (0.5%)	225 (0.4%)	223 (0.4%)	218 (0.4%)	222 (0.4%)	230 (0.5%)	1,347 (0.4%)	
Hypertension — n (%)	33,136 (64.8%)	34,520 (66.0%)	34,402 (66.7%)	34,571 (67.2%)	33,952 (67.8%)	32,892 (67.9%)	203,473 (66.7%)	<0.001
Atrial fibrillation — n (%)	10,148 (19.8%)	10,541 (20.1%)	10,680 (20.7%)	10,606 (20.6%)	10,301 (20.6%)	9,978 (20.6%)	62,254 (20.4%)	<0.001
Acute myocard. infarction — n (%)	412 (0.8%)	439 (0.8%)	377 (0.7%)	419 (0.8%)	353 (0.7%)	327 (0.7%)	2,327 (0.8%)	0.003
Cancer — n (%)	1,768 (3.5%)	1,792 (3.4%)	1,783 (3.5%)	1,765 (3.4%)	1,712 (3.4%)	1,691 (3.5%)	10,511 (3.5%)	0.893
Cerebrovascular disease — n (%)	1,138 (2.2%)	1,233 (2.4%)	1,280 (2.5%)	1,241 (2.4%)	1,395 (2.8%)	1,452 (3.0%)	7,739 (2.5%)	<0.001
CHD — n (%)	5,021 (9.8%)	5,295 (10.1%)	5,409 (10.5%)	5,204 (10.1%)	5,210 (10.4%)	4,919 (10.2%)	31,058 (10.2%)	0.049
Chronic heart failure — n (%)	3,513 (6.9%)	3,651 (7.0%)	3,620 (7.0%)	3,538 (6.9%)	3,446 (6.9%)	3,245 (6.7%)	21,013 (6.9%)	0.188
RV-CHF — n (%)	784 (1.5%)	722 (1.4%)	850 (1.7%)	814 (1.6%)	839 (1.7%)	766 (1.6%)	4,775 (1.6%)	0.019
LV-CHF — n (%)								0.104
NYHA I	197 (0.4%)	227 (0.4%)	202 (0.4%)	224 (0.4%)	185 (0.4%)	221 (0.5%)	1,256 (0.4%)	
NYHA II	669 (1.3%)	793 (1.5%)	788 (1.5%)	756 (1.5%)	755 (1.5%)	688 (1.4%)	4,449 (1.5%)	
NYHA III	795 (1.6%)	852 (1.6%)	859 (1.7%)	888 (1.7%)	861 (1.7%)	825 (1.7%)	5,080 (1.7%)	
NYHA IV	726 (1.4%)	731 (1.4%)	711 (1.4%)	689 (1.3%)	714 (1.4%)	670 (1.4%)	4,241 (1.4%)	
CKD — n (%)	4,482 (8.8%)	4,786 (9.1%)	4,864 (9.4%)	4,888 (9.5%)	4,741 (9.5%)	4,732 (9.8%)	28,493 (9.3%)	<0.001
Diabetes mellitus — n (%)	8,864 (17.3%)	9,169 (17.5%)	8,731 (16.9%)	8,742 (17.0%)	8,380 (16.7%)	8,120 (16.8%)	52,006 (17.1%)	<0.001
Dyslipidemia — n (%)	6,283 (12.2%)	6,598 (12.6%)	6,522 (12.7%)	6,521 (12.7%)	6,731 (13.4%)	6,489 (13.4%)	39,144 (12.8%)	<0.001
Obesity — n (%)	1,776 (3.5%)	1,886 (3.6%)	1,976 (3.8%)	1,792 (3.5%)	1,768 (3.5%)	1,707 (3.5%)	10,905 (3.6%)	0.666
Current smoking — n (%)	991 (1.9%)	1,024 (2.0%)	1,043 (2.0%)	989 (1.9%)	1,025 (2.1%)	965 (2.0%)	6,037 (2.0%)	0.389
Prev. Ischaemic stroke – n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	n.a.
Prev. Intracranial bleeding – n (%)	1,000 (2.0%)	1,024 (2.0%)	1,065 (2.1%)	1,034 (2.0%)	984 (2.0%)	945 (2.0%)	6,052 (2.0%)	0.941
Ischaemic heart disease – n (%)	5,264 (10.3%)	5,546 (10.6%)	5,623 (10.9%)	5,429 (10.6%)	5,419 (10.8%)	5,095 (10.5%)	32,376 (10.6%)	0.191
Dementia – n (%)	1,802 (3.5%)	1,871 (3.6%)	1,907 (3.7%)	1,935 (3.8%)	1,818 (3.6%)	1,642 (3.4%)	10,975 (3.6%)	0.579
Prev. CABG – n (%)	731 (1.4%)	832 (1.6%)	794 (1.5%)	789 (1.5%)	785 (1.6%)	701 (1.5%)	4,632 (1.5%)	0.947
Prev. Valve – n (%)	391 (0.8%)	381 (0.7%)	404 (0.8%)	357 (0.7%)	350 (0.7%)	315 (0.7%)	2,234 (0.7%)	0.235

CABG indicates coronary artery bypass graft; CHD, coronary heart disease; CHF, congestive heart failure; LV, left ventricular; NYHA, New York Heart Association; RV, right ventricular.

eTable 5. Acute therapies received by all patients hospitalized in Germany with acute stroke from 2014-2019.

	Ischaemic	Haemorrhagic	Total	p value
Carotid EA – n (%)	27,097 (1.7%)	26 (0.0%)	27,123 (1.4%)	<0.001
Carotid stent – n (%)	16,479 (1.0%)	74 (0.0%)	16,553 (0.9%)	<0.001
Carotid interposition graph– n (%)	***	***	222 (0.0%)	<0.001
Craniectomy – n (%)	5,684 (0.4%)	5,663 (1.9%)	11,347 (0.6%)	<0.001
Evacuation of extracranial haemorrhage – n (%)	2,419 (0.2%)	30,391 (10.0%)	32,810 (1.7%)	<0.001
Evacuation of ICH – n (%)	32 (0.0%)	211 (0.1%)	243 (0.0%)	<0.001
Thrombectomy, extra cranial – n (%)	2,041 (0.1%)	5 (0.0%)	2,046 (0.1%)	<0.001
Thrombectomy, intra cranial – n (%)	65,187 (4.1%)	356 (0.1%)	65,543 (3.5%)	<0.001
PCI – n (%)	5,085 (0.3%)	258 (0.1%)	5,343 (0.3%)	<0.001
DES – n (%)	3,566 (0.2%)	146 (0.1%)	3,712 (0.2%)	<0.001
BMS, only – n (%)	319 (0.0%)	25 (0.0%)	344 (0.0%)	<0.001
CABG OP – n (%)	113 (0.0%)	8 (0.0%)	121 (0.0%)	0.004
Renal replacement therapy – n (%)	8,063 (0.5%)	2,714 (0.9%)	10,777 (0.6%)	<0.001
Systemic Thrombolysis – n (%)	204,155 (12.9%)	663 (0.2%)	204,818 (10.9%)	<0.001
Selective Thrombolysis – n (%)	5,425 (0.3%)	538 (0.2%)	5,963 (0.3%)	<0.001
Intracerebral Thrombolysis – n (%)	332 (0.0%)	1,534 (0.5%)	1,866 (0.1%)	<0.001
GpIIb/IIIa inhibitor – n (%)	2,175 (0.1%)	574 (0.2%)	2,749 (0.2%)	<0.001
Bleeding – n (%)	23,457 (1.5%)	6,327 (2.1%)	29,784 (1.6%)	<0.001
Haemorrhagic transformation – n (%)	54,692 (3.5%)	305,046 (100.0%)	359,738 (19.1%)	***
Blood transfusion– n (%)	32,710 (2.1%)	15,652 (5.1%)	48,362 (2.6%)	<0.001
Blood transfusion or bleeding event – n (%)	50,500 (3.2%)	19,999 (6.6%)	70,499 (3.7%)	<0.001
AKI – n (%)	34,241 (2.2%)	8,710 (2.9%)	42,951 (2.3%)	<0.001
Sepsis – n (%)	21,178 (1.3%)	8,446 (2.8%)	29,624 (1.6%)	<0.001
AKI or replacement therapy – n (%)	39,780 (2.5%)	10,061 (3.3%)	49,841 (2.7%)	<0.001
Cardiac arrest – n (%)	8,096 (0.5%)	3,311 (1.1%)	11,407 (0.6%)	<0.001
Mechanical ventilation – n (%)	79,381 (5.0%)	67,161 (22.0%)	146,542 (7.8%)	<0.001
Median duration of ventilation – h (Q1,Q3)	93 (22,302)	82 (17, 318)	89 (20, 308)	<0.001
In-hospital Death – n (%)	106,007 (6.7%)	54,469 (17.9%)	160,476 (8.5%)	<0.001
Mean length of hospital stay – days (SD)	12.0 (13.5)	15.4 (20.7)	12.6 (15.0)	<0.001
Mean charges per case – EUR (SD)	6,946.17 (9,921.42)	11,397.59 (19,637.89)	7,651.02 (12,105.92)	<0.001

AKI indicates acute kidney injury; BMS, bare metal stent; CABG OP, coronary artery bypass graft off pump; DES, drug-eluting stent; EA, endarterectomy; ICH, intracerebral haemorrhage; IQR, interquartile range; PCI, percutaneous coronary intervention; SD, standard deviation.