

## Supplemental Material

Haverkamp C, Kaier K, Shah MJ, et al.: Cerebral Aneurysms: Germany-Wide Real-World Outcome Data of Endovascular or Neurosurgical Treatment from 2007 to 2019

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**eTable 1: Billing codes used for cohort definition**

Category	System	Code	Description
AVM/AVF	ICD10	G28.0-	Arteriovenous malformation of precerebral vessels
AVM/AVF	ICD10	G28.00	Congenital arteriovenous aneurysm of precerebral vessels
AVM/AVF	ICD10	G28.01	Congenital arteriovenous fistula of precerebral vessels
AVM/AVF	ICD10	G28.08	Other congenital arteriovenous malformations of precerebral vessels
AVM/AVF	ICD10	G28.09	Congenital arteriovenous malformation of precerebral vessels, unspecified
AVM/AVF	ICD10	G28.1-	Other malformations of precerebral vessels
AVM/AVF	ICD10	G28.10	Congenital aneurysm of precerebral vessels
AVM/AVF	ICD10	G28.11	Congenital fistula of precerebral vessels
AVM/AVF	ICD10	G28.18	Other congenital malformations of precerebral vessels
AVM/AVF	ICD10	G28.19	Congenital malformation of precerebral vessels, unspecified
AVM/AVF	ICD10	G28.2-	Arteriovenous malformation of cerebral vessels
AVM/AVF	ICD10	G28.20	Congenital arteriovenous aneurysm of cerebral vessels
AVM/AVF	ICD10	G28.21	Congenital arteriovenous fistula of cerebral vessels
AVM/AVF	ICD10	G28.28	Other congenital arteriovenous malformations of cerebral vessels
AVM/AVF	ICD10	G28.29	Congenital arteriovenous malformation of cerebral vessels, unspecified
AVM/AVF	ICD10	G28.3-	Other malformations of cerebral vessels
AVM/AVF	ICD10	G28.31	Congenital fistula of cerebral vessels
AVM/AVF	ICD10	G28.38	Other congenital malformations of cerebral vessels
AVM/AVF	ICD10	G28.39	Congenital malformation of cerebral vessels, unspecified
AVM/AVF	ICD10	G28.8-	Other congenital malformation of the circulatory system, unspecified
AVM/AVF	ICD10	G28.80	Other congenital aneurysm
AVM/AVF	ICD10	G28.81	Other congenital fistula of the circulatory system
AVM/AVF	ICD10	G28.88	Other specified congenital malformations of the circulatory system
AVM/AVF	ICD10	G28.9	Congenital malformation of the circulatory system, unspecified
AVM/AVF	ICD10	I67.11	Cerebral arteriovenous fistula (acquired)
AVM/AVF	OPS	8-836.9d	Percutaneous transluminal vascular intervention: selective embolization with embolizing fluids: Vascular malformations
AVM/AVF	OPS	8-836.9f	Percutaneous transluminal vascular intervention: selective embolization with embolizing fluids: Vessels spinal
AVM/AVF	OPS	8-836.kd	Percutaneous transluminal vascular intervention: selective embolization with particles: Vascular malformations
AVM/AVF	OPS	8-836.kf	Percutaneous transluminal vascular intervention: selective embolization with particles: Vessels spinal
SAH	ICD10	I60	Subarachnoid hemorrhage
ICH	ICD10	I61	Intracerebral hemorrhage
IA	ICD10	I67.10	Cerebral aneurysm (acquired)
IA	ICD10	I72.0	Aneurysm and dissection of carotid artery
IA	ICD10	I72.5	Aneurysm and dissection of other precerebral arteries
IA	ICD10	I72.6	Aneurysm and dissection of vertebral artery
IA	ICD10	Q28.30	Congenital aneurysm of cerebral vessels
EVT	OPS	8-836.m0	Selective embolization with metal coils: Vessels intracranial

EVT	OPS	8-84b.00	Percutaneous transluminal implantation of stents for flow lamination in aneurysms: one stent, vessels intracranial
EVT	OPS	8-84b.10	Percutaneous transluminal implantation of stents for flow lamination in aneurysms: two and more stents, vessels intracranial
EVT	OPS	8-84b.20	Percutaneous transluminal implantation of stents for flow lamination in aneurysms: 2 stents, vessels intracranial
EVT	OPS	8-84b.30	Percutaneous transluminal implantation of stents for flow lamination in aneurysms: 3 Stents, vessels intracranial
EVT	OPS	8-84b.40	Percutaneous transluminal implantation of stents for flow lamination in aneurysms: 4 Stents, vessels intracranial
EVT	OPS	8-84b.50	Percutaneous transluminal implantation of stents for flow lamination in aneurysms: 5 Stents, vessels intracranial
EVT	OPS	8-84b.60	Percutaneous transluminal implantation of stents for flow lamination in aneurysms: 6 or more stents, vessels intracranial
EVT	OPS	8-83b.37	Intraaneurysmal closure device for intracranial aneurysms
NSC	OPS	5-025.3	Incision, excision, destruction, and closure of intracranial blood vessels: Dissection and clipping, intracerebral
NSC	OPS	5-025.5	Incision, excision, destruction, and closure of intracranial blood vessels: Dissection and destruction, intracerebral
NSC	OPS	5-025.7	Incision, excision, destruction, and closure of intracranial blood vessels: Clipping
NSC	OPS	5-025.9	Incision, excision, destruction, and closure of intracranial blood vessels: other combined procedures
NSC	OPS	5-026.3	Reconstruction of intracranial blood vessels: Combined procedures
NSC	OPS	5-026.4*	Reconstruction of intracranial blood vessels: Number of clips on intracranial blood vessels

AVF: arteriovenous fistula, AVM: arteriovenous malformation, EVT: endovascular treatment, IA: intracranial aneurysm, ICD10: International Statistical Classification of Diseases and Related Health Problems 10, ICH: intracranial hemorrhage, NSC: neurosurgical clipping, OPS: "Operationen- und Prozedurenschlüssel" = key of operations and procedures, SAH: subarachnoid hemorrhage

**eTable 2: Ordinal functional outcome according to type of hospital discharge**

Ordinal outcome at discharge	Type of discharge	Discharge codes according to §301german social code V*
1: Good outcome = discharge to home	Discharge to home	01, 02, 03, 04
2: Intermediate Outcome = Further hospital care, rehabilitation, or nursing required	Discharge to other hospital	06, 08
	Discharge to rehabilitation	09
	Discharge to nursing facility	10
	Discharge to hospice	11
3: Poor outcome = Intrahospital death	Intrahospital death	7

\* Source: <http://fhir.de/CodeSystem/dkgev/EntlassungsgrundErsteUndZweiteStelle>

**eTable 3: Definition of National Inpatient Sample-Subarachnoid hemorrhage Outcome Measure (NIS-SOM)\***

<b>Good outcome:</b>	discharge to home or a rehabilitation facility and/or other hospital.
<b>Poor outcome:</b>	in-hospital mortality; discharge to a nursing facility, extended care facility, or hospice (as defined above); placement of a tracheostomy tube (OPS codes: 5-311, 5-312), and/or placement of a gastrostomy tube (OPS codes: 5-431.2)

OPS: “Operationen- und Prozedurenschlüssel” = key of operations and procedures

\* Washington CW, Derdeyn CP, Dacey RG, Dhar R, Zipfel GJ. Analysis of subarachnoid hemorrhage using the Nationwide Inpatient Sample: the NIS-SAH Severity Score and Outcome Measure: Clinical article. *Journal of Neurosurgery*. 2014;121:482–489

**eTable 4: Definition of National Inpatient Sample-Subarachnoid hemorrhage Severity Score (NIS-SSS)\***

Item	ICD-10	OPS	multivariate logistic regression coefficient (B) as described by Washington et al.*
mechanical ventilation	directly contained in the DRG dataset		2,023
hydrocephalus	G91.[0-1]		-0,073
treatment of hydrocephalus		5-022.00, 5-023	0,223
coma	R40.1		1,793
cranial nerve palsy	H49, H57.1		-1,139
paralysis/paraparesis	G8.[1-3]		0,507
aphasia	R47		0,445
Score	$\text{NIS-SSS} = e^{(\sum_{i=1}^7 B_i \cdot x_i)}$ <p>where <math>x_i = 1</math> when the item is present and 0 if absent</p>		

ICD-10: International Statistical Classification of Diseases and Related Health Problems 10, OPS: “Operationen- und Prozedurenschlüssel” = key of operations and procedures, DRG: diagnosis related groups

\* Washington CW, Derdeyn CP, Dacey RG, Dhar R, Zipfel GJ. Analysis of subarachnoid hemorrhage using the Nationwide Inpatient Sample: the NIS-SAH Severity Score and Outcome Measure: Clinical article. *Journal of Neurosurgery*. 2014;121:482–489

**eFigure 1: Time course of in-hospital mortality in treatment of intracranial aneurysms (years 2007-2019)**

