

## Coronary and structural heart interventions in Switzerland 2018

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### Summary

Since the first coronary angioplasty by Andreas Grüntzig in Zurich in 1977, the number of cardiac interventional procedures has steadily increased. The aim of this report is to summarise the state of catheter-based cardiac interventions in adults in Switzerland in 2018. Since 1987, the Working Group Interventional Cardiology of the Swiss Society of Cardiology has collected annually aggregate data from all facilities with cardiac catheterisation laboratories in the country, currently 36 institutions in 17 cantons of Switzerland. Over past years, the numbers of coronary angiography procedures (CAs) and percutaneous coronary interventions (PCIs) increased steadily reaching 57,309 for CA and 27,318 for PCI in 2018. Among structural heart interventions, a broad spectrum of transcatheter procedures is currently available in Switzerland. Numbers of transcatheter aortic valve implantations similarly increased, with 1781 implantations in 2018.

**Keywords:** annual report, interventional cardiology, structural cardiology

### Introduction

Cardiovascular diseases including coronary artery disease and structural heart disease are still the main causes of hospitalisations and medical consultations worldwide. Despite improvements in the management of patients with cardiovascular diseases, they remain life-threatening disorders [1–3]. In Switzerland, the entire population (permanent residents, periodic residents, as well as tourists) have an unrestricted access to emergency care and high-quality, evidence-based medicine, and health costs are covered by compulsory insurance. Individuals who cannot afford to pay health insurance fees are subsidised by the government.

In this scenario, the Working Group Interventional Cardiology of the Swiss Society of Cardiology performs a nationwide annual survey on percutaneous cardiac procedures in adults based on aggregate data provided by each institution. Since 1987, and based on a standardised questionnaire that has evolved over the years, all cardiology centres are asked to report yearly aggregate data on the number and type of procedures performed [4]. Since 2008, data have been published on the [website](#) of the Swiss Working Group for Interventional Cardiology of the Swiss Society of Cardiology and several publications emerged from these data [5–8].

### Methods

All interventional centres in Switzerland were asked to participate and to fill in an online questionnaire or electronic data sheets containing important items that mirror current interventional activities. In our current version of the questionnaire, 71 items are covered: information on infrastructure, numbers of operators, availability of on-site cardiac surgery, numbers of coronary angiography investigations (CAs) and percutaneous coronary interventions (PCIs) (stratified for ST-segment elevation myocardial infarction [STEMI], non-ST-segment elevation acute coronary syndromes [NSTEMI-ACS], cardiogenic shock or cardiac arrest and stable coronary disease [CAD]), access site, specific revascularisation techniques (e.g., rotational atherectomy, recanalisation of chronic totally occluded vessels [CTO]), adjunctive techniques (e.g., use of intravascular imaging, distal protection devices) and use of mechanical circulatory support. Among structural heart interventions, information was available on balloon valvuloplasties, transcatheter aortic valve implantation (TAVI), percutaneous mitral-, tricuspidal- or pulmonary-valve interventions, closure of shunts, as well as of paravalvular leaks and left atrial appendage (LAA) occlusion,

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#### Author contributions

The authors designed the investigation, gathered and analysed the data, vouch for the data and analysis, wrote the paper, and decided to submit it for publication.

TN, RT and RJ had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors have read and approved the manuscript. The manuscript and its contents have not been published previously and are not being considered for publications elsewhere in whole or in part in any language, including publicly accessible web sites or e-print servers.

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**Table 1:** Characteristics of the centres included.

Centre	Clinic description	Canton	Number of catheter labs	PCI operators	Operators diagnostic only	Cardiac surgery on-site
Aarau, Hirslanden Klinik	Non-university community centre	Aargau	2	14	–	Yes
Aarau, Kantonsspital	Non-university community centre	Aargau	2	5	5	No
Baden, Kantonsspital	Non-university community centre	Aargau	1	5	–	No
Basel, St. Claraspital	Private clinic	Basel-Stadt	1	3	–	No
Basel, Universitätsspital	University centre	Basel-Stadt	2	8	1	Yes
Bern, Klinik Beau-Site	Private clinic	Bern	2	7	–	Yes
Bern, Lindenhofspital	Private clinic	Bern	2	4	3	No
Bern, Universitätsspital und Tiefenau	University centre	Bern	4	11	–	Yes
Biel, Spitalzentrum	Non-university community centre	Bern	1	5	–	No
Brig, Centre de Cardiologie du Valais	Private clinic	Wallis	1	3	–	No
Chur, Kantonsspital Graubünden	Non-university community centre	Graubünden	1	4	–	No
Frauenfeld, Kantonsspital Thurgau	Non-university community centre	Thurgau	1	6	1	No
Fribourg, Hôpital cantonal	Non-university community centre	Freiburg	1	5	–	No
Genf, Clinique des Grangettes	Private clinic	Genf	1	4	3	No
Genf, Hôpital de la Tour	Private clinic	Genf	2	8	3	Yes
Genf, Hôpitaux universitaires	University centre	Genf	2	5	–	Yes
Genolier, Clinique de Genolier	Private clinic	Waadt	1	4	–	No
Kreuzlingen, Herz-Neuro-Zentrum Bodensee	Private clinic	Thurgau	1	7	–	Yes
Lachen, Spital	Non-university community centre	Schwyz	1	6	1	No
Lausanne, Centre hospitalier universitaire vaudois	University centre	Waadt	2	6	–	Yes
Lausanne, Clinique Cecil	Private clinic	Waadt	1	17	11	Yes
Lausanne, Clinique de la Source	Private clinic	Waadt	1	4	1	No
Liestal, Kantonsspital Baselland	Non-university community centre	Basel-Landschaft	1	2	–	No
Lugano, Cardiocentro Ticino	Non-university community centre	Tessin	4	9	1	Yes
Luzern, Kantonsspital	Non-university community centre	Luzern	2	5	–	Yes
Luzern, Klinik St. Anna	Private clinic	Luzern	1	5	1	No
Morges, Hôpital	Non-university community centre	Waadt	1	4	4	No
Pfäffikon, Cardiance Clinic	Private clinic	Schwyz	1	3	1	No
Sion, Hôpital du Valais	Non-university community centre	Wallis	2	5	–	Yes
Solothurn, Bürgerspital	Non-university community centre	Solothurn	1	4	–	No
St. Gallen, Kantonsspital	Non-university community centre	St. Gallen	3	8	–	No
Winterthur, Kantonsspital	Non-university community centre	Zürich	2	5	–	No
Zürich, Hirslanden Klinik	Private clinic	Zürich	2	12	–	Yes
Zürich, Klinik im Park	Private clinic	Zürich	2	6	1	Yes
Zürich, Triemli Stadspital	Non-university community centre	Zürich	2	7	–	Yes
Zürich, Universitätsspital	University centre	Zürich	2	8	–	Yes
<b>Total</b>		<b>17</b>	<b>59</b>	<b>224</b>	<b>37</b>	<b>16</b>

PCI = percutaneous coronary intervention

transcatheter ablation of septal hypertrophy (TASH), pericardial drainage, catheter-based therapies of pulmonary embolism, coronary sinus reduction, and interventional renal denervation. Finally, data on in-hospital mortality for PCIs were gathered and stratified according to the clinical presentation (STEMI, NSTEMI-ACS, stable CAD and cardiac arrest/cardiogenic shock).

Data were aggregated and displayed using standard software. There was no formal statistical analysis. Since data collection and analysis were for quality assurance/control purposes only for in-hospital mortality after interventional procedures, no formal approval by local institutional review boards and/or written patient consent is required.

## Results

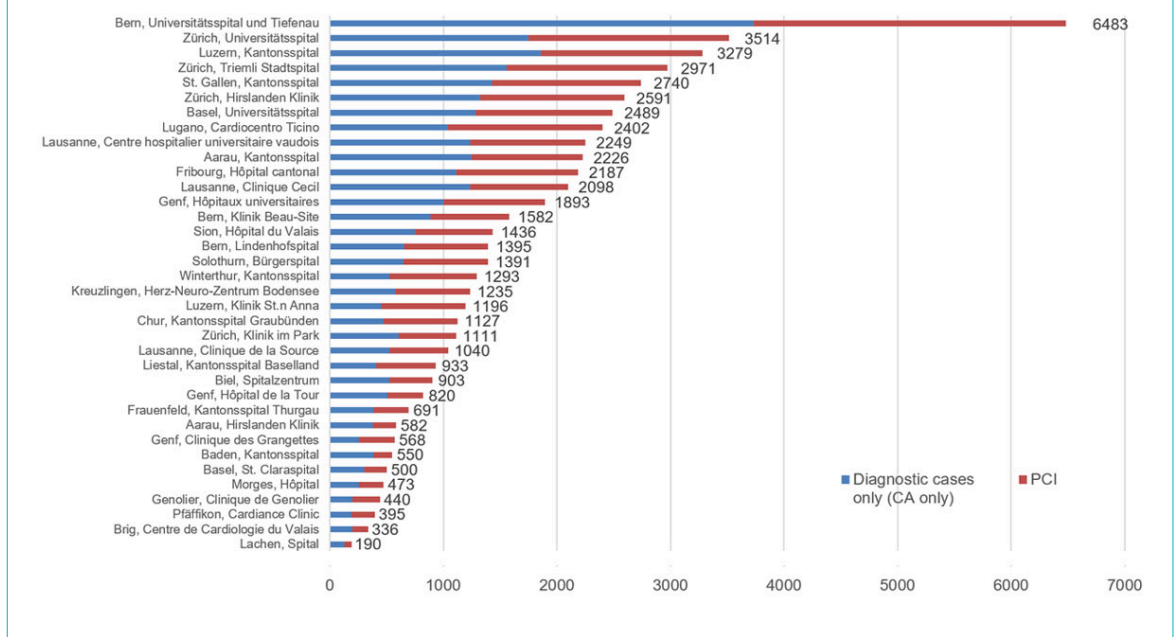
In 2018, there were 36 interventional centres located in 17 of the 26 Swiss cantons: 5 university hospitals, 15 non-university

public hospitals and 16 private institutions. All 36 centres provided local data on their performances in 2018.

### Coronary interventions

All centres performed both diagnostic and therapeutic procedures and 16 (43%) had on-site cardiac surgery (table 1). During 2018, 57,309 CAs and 27,318 PCIs were performed by 224 PCI operators and 37 operators performing diagnostic CA only (fig. 1). The median PCI/CA ratio was 47% with a range from 32 to 62% (table 2). Figure 1 displays the distribution of CA and PCIs among the different centres in 2018. The average number of CAs per operator was 220 cases/year and the average number of PCIs per operator was 122 cases/year (tables 1 and 2). With regard to access sites, the femoral and the radial artery were used almost equally often in all institutions together (53 vs 47%, respectively) with a wide range from 16 to 98% among the centres (table 3, fig. 2).

**Figure 1:** Percutaneous coronary interventions (PCI) during the year 2018 in Switzerland. CA = coronary angiography



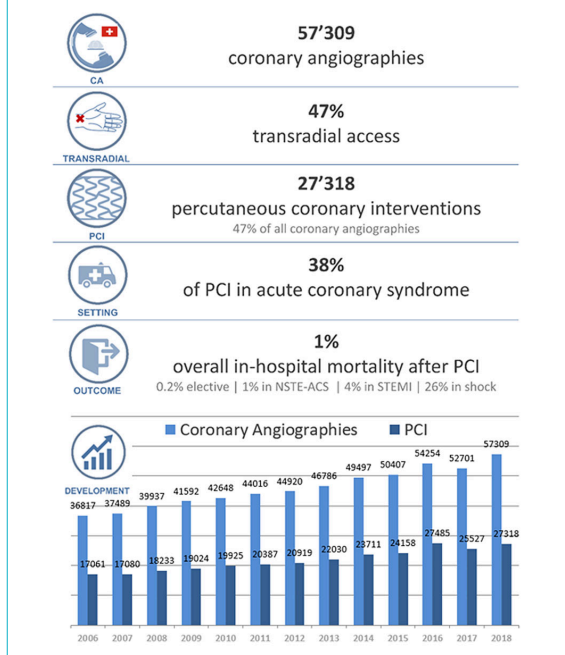
Among all stents, the drug-eluting stent (DES) was almost always the stent type applied (99%). Bare metal stents (BMSs), bioresorbable or self-expandable stents were used in a minority of patients only (0.2, 0.2 and 0.2%, respectively). PCI in chronic total occlusion (CTO) was performed in 6.4% of all PCI cases (1739 patients), whereas the majority of CTO cases the procedure was done by the antegrade route (82% of CTO cases; [table 3](#)).

Emergency interventions in patients with a STEMI accounted for 16% of PCI procedures, whereas 22% of patients presented with NSTEMI-ACS. PCI for cardiogenic shock accounted for 2.4% of all PCI cases ([table 2](#)). In

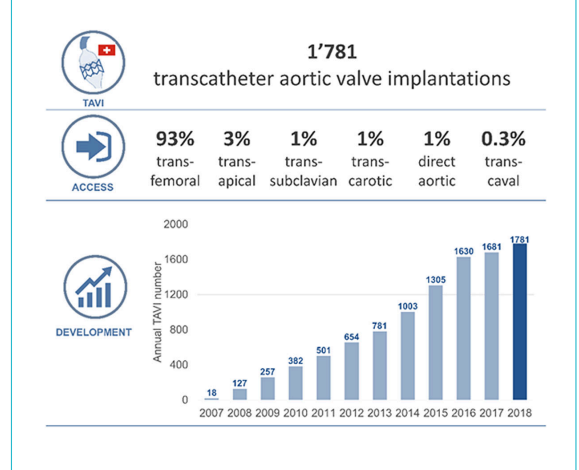
2018, mechanical support systems were used in 494 patients (1.8% of PCI cases; Impella [Abiomed Inc, Danvers MA] in 231 patients, intra-aortic balloon pumps in 176 patients and extracorporeal membrane oxygenation in 87 patients). Pericardial drainage was performed in 322 patients. A catheter-based therapy of pulmonary embolism (e.g., EKOS) was performed in 98 patients ([table 4](#)).

Intracoronary pressure measurements (fractional flow reserve [FFR] or instant wave free ratio [iFR]) were made in 2569 (9.4%) and 1573 (5.8%) patients, respectively. Intravascular ultrasound (IVUS) and intravascular optical coherence tomography (OCT) was performed in 534 (1.9%) and in 867 (3.2%) patients, respectively. Distal protection devices were used in 79 patients (0.3% of PCI cases). Revascularisation techniques other than balloon angioplasty included rotablation (403 patients, 1.5% of PCI cases) and thrombus aspiration (1282 patients, 4.7%; [table 4](#)).

**Figure 2:** Coronary interventions in Switzerland: summary 2018 and development 2006–2018. CA = coronary angiography; PCI = percutaneous coronary intervention



**Figure 4:** Transcatheter aortic valve implantations in Switzerland: summary 2018 and development 2007–2018.



**Table 2:** Characteristics of the coronary interventions: number of cases and indications.

Centre	Total number of cases (CA + PCI)	Diagnostic cases only (CA only)	PCI	% PCI per CA	PCI for NST-ACS	PCI for STEMI	PCI for cardiogenic shock / cardiac arrest	PCI for CTO	Antegrade CTO	Retrograde CTO
Aarau, Hirslanden Klinik	582	377	205	35%	32	17	3	15	15	–
Aarau, Kantonsspital	2226	1249	977	44%	311	238	23	129	117	12
Baden, Kantonsspital	550	384	166	30%	82	–	–	21	21	–
Basel, St. Claraspital	500	301	199	40%	25	8	1	6	6	–
Basel, Universitätsspital	2489	1281	1208	49%	296	272	90	64	56	8
Bern, Klinik Beau-Site	1582	884	698	44%	92	46	–	n.a.	n.a.	n.a.
Bern, Lindenhofspital	1395	655	740	53%	92	64	87	10	10	–
Bern, Universitätsspital und Tiefenau	6483	3732	2751	42%	815	526	88	157	–	–
Biel, Spitalzentrum	903	524	379	42%	153	90	6	19	15	4
Brig, Centre de Cardiologie du Valais	336	196	140	42%	1	–	–	20	20	–
Chur, Kantonsspital Graubünden	1127	474	653	58%	178	154	5	51	44	7
Frauenfeld, Kantonsspital Thurgau	691	386	305	44%	63	4	–	11	11	1
Fribourg, Hôpital cantonal	2187	1111	1076	49%	198	141	17	178	178	2
Genf, Clinique des Granges	568	255	313	55%	13	2	–	23	18	5
Genf, Hôpital de la Tour	820	508	312	38%	41	20	–	16	12	4
Genf, Hôpitaux universitaires	1893	1001	892	47%	123	229	20	52	n.a.	n.a.
Genolier, Clinique de Genolier	440	199	241	55%	–	2	–	5	4	1
Kreuzlingen, Herz-Neuro-Zentrum Bodensee	1235	578	657	53%	87	42	18	21	21	–
Lachen, Spital	190	130	60	32%	7	–	–	4	4	–
Lausanne, Centre hospitalier universitaire vaudois	2249	1233	1016	45%	381	298	18	54	40	14
Lausanne, Clinique Cecil	2098	1234	864	41%	38	1	–	47	n.a.	n.a.
Lausanne, Clinique de la Source	1040	522	518	50%	49	–	–	52	52	–
Liestal, Kantonsspital Baselland	933	406	527	56%	174	54	8	81	56	25
Lugano, Cardiocentro Ticino	2402	1037	1365	57%	293	227	30	31	28	3
Luzern, Kantonsspital	3279	1858	1421	43%	273	388	99	177	135	42
Luzern, Klinik St. Anna	1196	453	743	62%	62	38	19	40	32	8
Morges, Hôpital	473	255	218	46%	67	1	–	14	12	2
Pfäffikon, Cardiance Clinic	395	193	202	51%	34	1	–	12	12	–
Sion, Hôpital du Valais	1436	749	687	48%	225	165	15	25	20	5
Solothurn, Bürgerspital	1391	648	743	53%	305	134	–	–	–	–
St. Gallen, Kantonsspital	2740	1426	1314	48%	267	222	28	259	162	96
Winterthur, Kantonsspital	1293	523	770	60%	157	173	22	33	28	5
Zürich, Hirslanden Klinik	2591	1320	1271	49%	107	95	9	21	19	2
Zürich, Klinik im Park	1111	606	505	45%	39	33	9	26	16	11
Zürich, Triemli Stadtsptal	2971	1557	1414	48%	418	400	52	65	n.a.	n.a.
Zürich, Universitätsspital	3514	1746	1768	50%	425	341	n.a.	n.a.	n.a.	n.a.
<b>Total</b>	<b>57309</b>	<b>29991</b>	<b>27318</b>	<b>47%</b>	<b>5923</b>	<b>4426</b>	<b>667</b>	<b>1739</b>	<b>1164</b>	<b>257</b>

CA = coronary angiography; CTO = chronic total occlusion; n.a. = not available; NST-ACS = non-ST-segment elevation acute coronary syndromes; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction

### Outcome in coronary interventions

The mean overall in-hospital mortality rate after PCI was 1.0%. The mortality rate after PCI for stable CAD was 0.2%, after PCI for NSTEMI-ACS 1.2%, after PCI for STEMI 4.3% and after PCI for cardiogenic shock or cardiac arrest 26.2% (fig. 2).

### Development over recent years

Since 2006, almost all Swiss interventional centres report their data to the Swiss Working Group Interventional Cardiology of the Swiss Society of Cardiology. Since 2010, the number of facilities with a cardiac catheterisation laboratory increased from 33 to 36, corresponding to a total increase in cardiac catheterisation rooms from 50 in 2011 to 60 in 2018. The number of facilities with on-site cardiac

surgery remained stable at 16 centres. Accordingly, the number of operators performing PCI rose from 144 in 2011 to 224 in 2018. The evolution of cases of CA and PCI is shown in figure 2. The ratio of PCI to CA remained virtually the same over the years (47% in 2010 and 47% in 2018) [8]. The percentage of radial access increased steadily from 15% in 2010 to 35% in 2014, and reached now 47% in 2018, reflecting the adoption of new recommendations. The number of PCIs per 100,000 inhabitants increased steadily from 254/100,000 in 2010 to 320/100,000 in 2018. Mortality rates were comparable to reports from previous years [8].

**Table 3:** Characteristics of the coronary interventions: access and stenting.

Centre	Radial access for CA	Radial access for PCI	Radial access for CA (rate)	Radial access for PCI (rate)	BMS	DES	Self-expandable stents (DES or BMS)	Bioabsorbable scaffolds (Absorb, Magmaris, etc.)	Bifurcation dedicated stents
Aarau, Hirslanden Klinik	272	125	47%	61%	1	195	–	–	–
Aarau, Kantonsspital	946	546	42%	56%	–	934	–	–	–
Baden, Kantonsspital	171	137	31%	83%	–	161	–	5	–
Basel, St. Claraspital	79	30	16%	15%	–	191	–	–	–
Basel, Universitätsspital	1701	750	68%	62%	–	1128	23	–	–
Bern, Klinik Beau-Site	n.a.	248	n.a.	36%	–	857	–	–	–
Bern, Lindenhofspital	1161	648	83%	88%	–	718	–	–	243
Bern, Universitätsspital und Tiefenau	3985	1895	61%	69%	1	2499	–	1	–
Biel, Spitalzentrum	473	243	52%	64%	–	371	–	–	–
Brig, Centre de Cardiologie du Valais	330	139	98%	99%	–	135	–	–	–
Chur, Kantonsspital Graubünden	776	410	69%	63%	–	1004	–	–	–
Frauenfeld, Kantonsspital Thurgau	476	221	69%	72%	–	295	1	–	–
Fribourg, Hôpital cantonal	349	162	16%	15%	2	1074	–	–	–
Genf, Clinique des Grangettes	539	289	95%	92%	–	545	–	–	–
Genf, Hôpital de la Tour	651	253	79%	81%	–	293	–	–	–
Genf, Hôpitaux universitaires	1670	821	88%	92%	2	794	–	n.a.	n.a.
Genolier, Clinique de Genolier	165	148	38%	61%	–	221	–	–	–
Kreuzlingen, Herz-Neuro-Zentrum Bodensee	838	671	68%	102%	–	649	–	–	–
Lachen, Spital	163	52	86%	87%	–	60	–	–	–
Lausanne, Centre hospitalier universitaire vaudois	1573	785	70%	77%	6	956	–	6	–
Lausanne, Clinique Cecil	844	537	40%	62%	7	804	–	–	–
Lausanne, Clinique de la Source	716	351	69%	68%	34	484	–	–	–
Liestal, Kantonsspital Baselland	833	460	89%	87%	–	487	–	23	–
Lugano, Cardiocentro Ticino	913	932	38%	68%	–	1338	10	17	–
Luzern, Kantonsspital	1542	1179	47%	83%	–	1421	8	–	–
Luzern, Klinik St. Anna	390	331	33%	45%	–	590	–	4	–
Morges, Hôpital	176	161	37%	74%	1	209	–	–	–
Pfäffikon, Cardiance Clinic	74	43	19%	21%	–	201	–	–	–
Sion, Hôpital du Valais	1120	542	78%	79%	–	680	–	–	–
Solothurn, Bürgerspital	371	176	27%	24%	–	697	–	–	–
St. Gallen, Kantonsspital	2201	1198	80%	91%	–	1314	11	3	–
Winterthur, Kantonsspital	752	412	58%	54%	–	724	7	–	–
Zürich, Hirslanden Klinik	657	695	25%	55%	1	1192	2	–	–
Zürich, Klinik im Park	521	274	47%	54%	–	437	–	–	–
Zürich, Triemli Stadtsptal	1200	1000	40%	71%	–	1412	2	–	–
Zürich, Universitätsspital	n.a.	n.a.	n.a.	n.a.	–	3512	–	2	n.a.
<b>Total</b>	<b>28628</b>	<b>16864</b>	<b>56%</b>	<b>66%</b>	<b>55</b>	<b>28582</b>	<b>64</b>	<b>61</b>	<b>243</b>

BMS = bare metal stents; CA = coronary angiography; DES = drug-eluting stent; n.a. = not available; PCI = percutaneous coronary intervention

### Structural interventions

Eleven years after its first introduction in Switzerland in 2007, TAVI continued to increase over the years with a slight flattening since 2016 (from 382 procedures performed in 11 centres in 2010 to 1781 cases in 15 centres in 2018) (figs 3 and 4). Most cases currently are performed by the transfemoral route (1663 patients, 93% of all cases). Access via the transapical (52 patients, 1.9%), trans-subclavian (19 patients, 1.1%) trans-carotid (23 patients, 1.3%), direct aortic (20 patients, 1.1%) and transcaval (5 patients, 0.3%) routes are less often used (figs 3 and 4, table 5).

Nine years after its introduction in 2009, transcatheter mitral edge-to-edge repair procedures using the Mitraclip device (Abbott Structural Heart, Santa Clara CA) showed a pronounced increase from 67 cases in 4 centres in 2010 to 382 cases in 14 centres in 2018 (table 6a). Additionally, transcatheter direct mitral annuloplasty using the Cardioband device (Edwards Lifesciences, Irvine CA) was performed in nine patients and indirect mitral annuloplasty

using the Carillon device (Cardiac Dimensions, Kirkland, WA) in six patients in two centres in Switzerland. Transcatheter tricuspid interventions (32 patients), pulmonary valvuloplasty (33 patients), and transcatheter pulmonary valve implantations (6 patients) were performed in 8 centres in Switzerland. Detailed information on TAVI and mitral transcatheter edge-to-edge repair procedures performed in Switzerland can be found in the SwissTAVI [9] and MitraSwiss [10] registries.

We noted an increase in left atrial appendage (LAA) closure from 117 in 2011 to 406 in 2018 and an increase of paravalvular leak closure from 10 in 2011 to 39 in 2018. The number of persistent foramen ovale (PFO) and atrial septal defect (ASD) closures remained roughly stable over the years, with 733 PFO closures in 2010 and 833 in 2018; the corresponding numbers for ASD closures were 142 and 154. Interventional ventricular septal defect (VSD) closures were performed in 11 patients in 2018. TASH, renal denervation and coronary sinus reduction were performed in 34, 11 and 19 cases, respectively, in 2018 (table 6b).

## Limitations

Limitations of this report include the fact that the survey was based on aggregate data submitted by the centres on a voluntary basis and not subjected to monitoring. While all centres provided data for this survey, not all information was available for all items in every centre.

## Conclusions

The data collected in 2018 show a high and adequate number of diagnostic and therapeutic coronary procedures in comparison with other countries [11, 12], as well as a significant qualitative leap in advanced intracoronary diagnostic techniques as compared to with from previous years [5–8]. The increasing dominance of the radial approach and the high rate of PCI as treatment for acute myocardial infarction and ischaemic coronary artery disease are clear indicators of the quality of the Swiss interventional activity. Furthermore, there has been a marked increase in the number of procedures for structural heart disease over the last 10 years, for both TAVI and percutaneous mitral valve repair, which incorporates and reflects current guidelines and European standards.

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## Potential competing interests

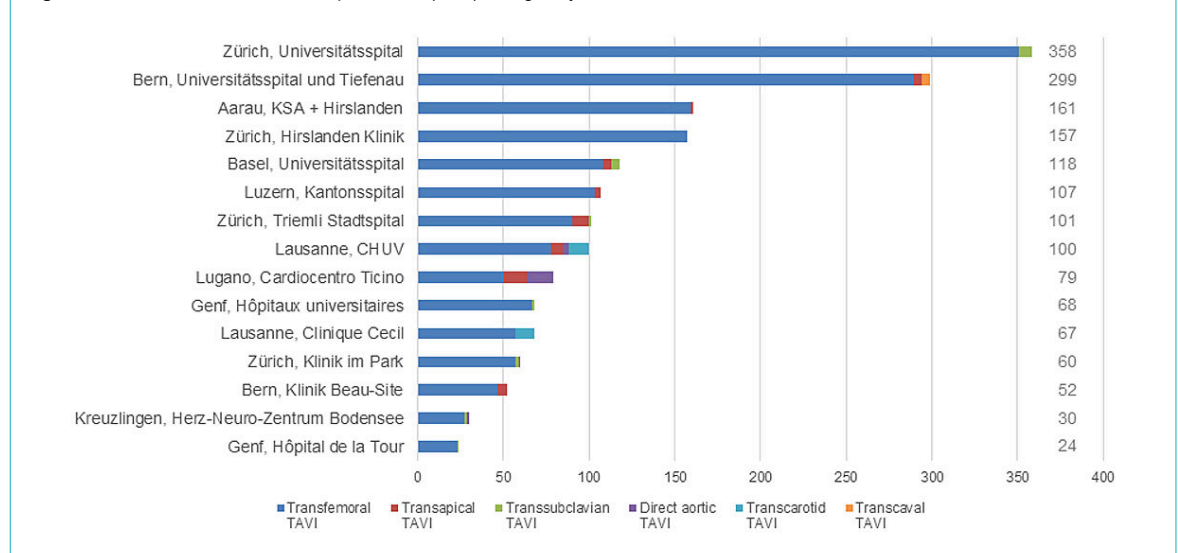
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sciences. OM Has received honoraria from Abbott and Edwards Life-science. Other authors declare that they have no conflict of interest related to this study.

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**Figure 3:** Transcatheter aortic valve implantations (TAVI) during the year 2018 in Switzerland.



**Table 4:** Characteristics of the coronary interventions: revascularisation techniques (other than balloon angioplasty), pressure measurements and mechanical support systems.

Centre	Rotablator (number of cases)	Thrombus aspiration	Distal protection device	FFR	iFR	IVUS	OCT	IABP	Impella	ECMO
Aarau, Hirslanden Klinik	–	–	–	–	20	–	–	1	–	–
Aarau, Kantonsspital	18	–	8	46	70	9	47	1	14	–
Baden, Kantonsspital	–	4	5	22	–	–	–	–	–	–
Basel, St. Claraspital	5	99	–	44	20	40	40	6	–	–
Basel, Universitätsspital	24	57	2	120	–	19	28	–	41	2
Bern, Klinik Beau–Site	8	8	–	94	–	–	–	1	–	–
Bern, Lindenhofspital	4	–	–	–	–	–	–	–	–	–
Bern, Universitätsspital und Tiefenau	40	201	4	222	9	22	217	9	45	25
Biel, Spitalzentrum	4	14	–	22	–	–	–	–	2	–
Brig, Centre de Cardiologie du Valais	–	–	–	57	–	–	10	–	–	–
Chur, Kantonsspital Graubünden	7	55	–	11	62	4	11	5	–	–
Frauenfeld, Kantonsspital Thurgau	–	–	–	21	34	–	6	–	–	–
Fribourg, Hôpital cantonal	11	29	–	77	–	13	58	9	–	3
Genf, Clinique des Granges	5	–	3	74	–	–	11	–	–	–
Genf, Hôpital de la Tour	11	14	6	71	2	11	–	6	–	–
Genf, Hôpitaux universitaires	16	40	2	2	239	40	35	5	–	5
Genolier, Clinique de Genolier	5	–	1	108	–	–	17	–	–	–
Kreuzlingen, Herz–Neuro–Zentrum Bodensee	–	–	–	15	145	3	–	–	–	–
Lachen, Spital	–	–	–	15	–	3	–	–	–	–
Lausanne, Centre hospitalier universitaire vaudois	28	149	6	195	–	32	68	10	–	13
Lausanne, Clinique Cecil	1	2	–	115	–	–	–	1	–	1
Lausanne, Clinique de la Source	–	11	–	149	–	–	–	–	–	–
Liestal, Kantonsspital Baselland	11	4	3	47	–	–	32	–	4	–
Lugano, Cardiocentro Ticino	3	87	15	105	248	49	81	16	3	11
Luzern, Kantonsspital	2	284	1	197	–	10	90	32	47	4
Luzern, Klinik St. Anna	8	–	–	112	2	23	–	2	4	–
Morges, Hôpital	5	1	2	29	–	–	9	–	–	–
Pfäffikon, Cardiance Clinic	–	1	–	1	22	1	–	–	–	–
Sion, Hôpital du Valais	–	22	–	121	–	–	12	10	–	3
Solothurn, Bürgerspital	6	9	1	135	–	–	–	–	–	–
St. Gallen, Kantonsspital	114	145	3	141	122	56	16	22	11	10
Winterthur, Kantonsspital	10	20	–	25	129	27	–	–	9	3
Zürich, Hirslanden Klinik	5	–	5	–	282	53	4	13	5	4
Zürich, Klinik im Park	2	1	–	8	167	–	–	10	–	3
Zürich, Triemli Stadtspital	5	25	12	93	–	–	20	17	16	–
Zürich, Universitätsspital	45	n.a.	n.a.	75	n.a.	119	55	n.a.	30	n.a.
<b>Total</b>	<b>403</b>	<b>1282</b>	<b>79</b>	<b>2569</b>	<b>1573</b>	<b>534</b>	<b>867</b>	<b>176</b>	<b>231</b>	<b>87</b>

ECMO = extracorporeal membrane oxygenation; FFR = fractional flow reserve; IABP = intra–aortic balloon counterpulsation; iFR = instant wave free ratio; IVUS = intravascular ultrasound; n.a. = not available; OCT = intravascular optical coherence tomography

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**Table 5:** Structural interventions: aortic valve.

Centre	Aortic valvuloplasty without percutaneous valve replacement	TAVI	Trans-femoral TAVI	Trans-apical TAVI	Trans-subclavian TAVI	Direct aortic TAVI	Trans-carotid TAVI	Trans-caval TAVI	Use of embolic protection device during TAVI
Aarau, Hirslanden Klinik	–	161	159	2	–	–	–	–	–
Aarau, Kantonsspital	–	–	–	–	–	–	–	–	–
Baden, Kantonsspital	–	–	–	–	–	–	–	–	–
Basel, St. Claraspital	1	–	–	–	–	–	–	–	–
Basel, Universitätsspital	2	118	108	5	5	–	–	–	2
Bern, Klinik Beau-Site	–	52	47	5	–	–	–	–	–
Bern, Lindenhofspital	–	–	–	–	–	–	–	–	–
Bern, Universitätsspital und Tiefenau	–	299	289	5	–	–	–	5	2
Biel, Spitalzentrum	–	–	–	–	–	–	–	–	–
Brig, Centre de Cardiologie du Valais	–	–	–	–	–	–	–	–	–
Chur, Kantonsspital Graubünden	–	–	–	–	–	–	–	–	–
Frauenfeld, Kantonsspital Thurgau	–	–	–	–	–	–	–	–	–
Fribourg, Hôpital cantonal	–	–	–	–	–	–	–	–	–
Genf, Clinique des Granges	–	–	–	–	–	–	–	–	–
Genf, Hôpital de la Tour	1	24	23	–	1	–	–	–	–
Genf, Hôpitaux universitaires	–	68	67	–	1	–	–	–	5
Genolier, Clinique de Genolier	–	–	–	–	–	–	–	–	–
Kreuzlingen, Herz-Neuro-Zentrum Bodensee	–	30	27	–	2	1	–	–	–
Lachen, Spital	–	–	–	–	–	–	–	–	–
Lausanne, Centre hospitalier universitaire vaudois	–	100	78	7	–	3	12	–	–
Lausanne, Clinique Cecil	1	67	57	–	–	–	11	–	–
Lausanne, Clinique de la Source	–	–	–	–	–	–	–	–	–
Liestal, Kantonsspital Baselland	–	–	–	–	–	–	–	–	–
Lugano, Cardiocentro Ticino	4	79	50	14	–	15	–	–	12
Luzern, Kantonsspital	5	107	103	4	–	–	–	–	–
Luzern, Klinik St. Anna	–	–	–	–	–	–	–	–	–
Morges, Hôpital	–	–	–	–	–	–	–	–	–
Pfäffikon, Cardiance Clinic	–	–	–	–	–	–	–	–	–
Sion, Hôpital du Valais	–	–	–	–	–	–	–	–	–
Solothurn, Bürgerspital	–	–	–	–	–	–	–	–	–
St. Gallen, Kantonsspital	–	–	–	–	–	–	–	–	n.a.
Winterthur, Kantonsspital	–	–	–	–	–	–	–	–	–
Zürich, Hirslanden Klinik	–	157	157	–	–	–	–	–	–
Zürich, Klinik im Park	3	60	57	–	2	1	–	–	–
Zürich, Triemli Stadtspital	–	101	90	10	1	–	–	–	–
Zürich, Universitätsspital	–	358	351	–	7	–	–	–	n.a.
<b>Total</b>	<b>17</b>	<b>1781</b>	<b>1663</b>	<b>52</b>	<b>19</b>	<b>20</b>	<b>23</b>	<b>5</b>	<b>21</b>

n.a. = not available; TAVI = transcatheter aortic valve implantation



Table 6: a: Structural interventions: other.

Centre	Occlusion of para-valvular leakage	Percutaneous transvenous mitral valvuloplasty	Mitral edge-to-edge repair devices (e.g. Mitraclip, Pascal)	Transcatheter direct mitral annuloplasty (e.g. Cardioband, Accucinch)	Transcatheter indirect mitral annuloplasty (e.g. Carillon)	Transcatheter tricuspid valve intervention	PTA / stenting pulmonary artery	Transcatheter pulmonary valvuloplasty	TPVI (e.g. Melody)
Aarau, Hirslanden Klinik	–	–	11	–	–	–	–	–	–
Aarau, Kantonsspital	–	–	51	–	–	–	–	–	–
Baden, Kantonsspital	–	–	–	–	–	–	–	–	–
Basel, St. Claraspital	–	–	–	–	–	–	–	–	–
Basel, Universitätsspital	2	2	16	3	–	1	–	–	–
Bern, Klinik Beau–Site	–	–	–	–	–	–	–	–	–
Bern, Lindenhofspital	–	–	–	–	–	–	–	–	–
Bern, Universitätsspital und Tiefenau	13	2	70	–	–	10	32	5	1
Biel, Spitalzentrum	–	–	–	–	–	–	–	–	–
Brig, Centre de Cardiologie du Valais	–	–	–	–	–	–	–	–	–
Chur, Kantonsspital Graubünden	–	–	–	–	–	–	–	–	–
Frauenfeld, Kantonsspital Thurgau	–	–	–	–	–	–	–	–	–
Fribourg, Hôpital cantonal	–	–	9	–	–	–	–	–	–
Genf, Clinique des Granges	–	–	–	–	–	–	–	–	–
Genf, Hôpital de la Tour	–	–	–	–	–	–	–	–	–
Genf, Hôpitaux universitaires	1	–	20	–	–	–	–	–	–
Genolier, Clinique de Genolier	–	–	–	–	–	–	–	–	–
Kreuzlingen, Herz–Neuro–Zentrum Bodensee	–	–	1	–	–	–	–	–	–
Lachen, Spital	–	–	–	–	–	–	–	–	–
Lausanne, Centre hospitalier universitaire vaudois	6	5	21	–	–	1	1	4	3
Lausanne, Clinique Cecil	–	–	–	–	–	–	–	–	–
Lausanne, Clinique de la Source	–	–	–	–	–	–	–	–	–
Liestal, Kantonsspital Baselland	–	–	–	–	–	–	–	–	–
Lugano, Cardiocentro Ticino	–	–	11	–	–	6	–	–	1
Luzern, Kantonsspital	3	3	36	–	–	2	–	–	–
Luzern, Klinik St. Anna	–	–	6	–	–	–	–	–	–
Morges, Hôpital	–	–	–	–	–	–	–	–	–
Pfäffikon, Cardiance Clinic	–	–	–	–	–	–	–	–	–
Sion, Hôpital du Valais	–	–	–	–	–	–	–	–	–
Solothurn, Bürgerspital	–	–	–	–	–	–	–	–	–
St. Gallen, Kantonsspital	2	–	–	–	–	–	–	–	–
Winterthur, Kantonsspital	–	–	–	–	–	–	–	–	–
Zürich, Hirslanden Klinik	3	–	37	–	–	5	–	–	–
Zürich, Klinik im Park	–	1	25	–	–	–	–	–	–
Zürich, Triemli Stadtsptal	1	1	3	–	–	1	–	–	–
Zürich, Universitätsspital	8	6	65	6	6	6	–	–	1
<b>Total</b>	<b>39</b>	<b>20</b>	<b>382</b>	<b>9</b>	<b>6</b>	<b>32</b>	<b>33</b>	<b>9</b>	<b>6</b>

PTA = percutaneous transluminal angioplasty; TPVI = transcatheter pulmonary valve implantation

Table 6b: Structural interventions: other.

Centre	Alcohol ablation for septal hypertrophy	Pericardial drainage (ad hoc or scheduled)	Catheter-based therapy of pulmonary embolism	Catheter-based renal sympathetic denervation for treatment of hypertension	Coronary sinus reduction	PFO closure	ASD closure	VSD closure	LAA closure
Aarau, Hirslanden Klinik	–	–	–	–	–	3	–	–	1
Aarau, Kantonsspital	2	–	–	–	–	58	7	–	47
Baden, Kantonsspital	–	–	–	–	–	–	–	–	–
Basel, St. Claraspital	–	6	–	–	–	–	–	–	–
Basel, Universitätsspital	1	25	2	–	2	32	5	–	20
Bern, Klinik Beau–Site	–	–	–	–	–	3	7	–	1
Bern, Lindenhofspital	–	9	1	–	–	10	20	–	–
Bern, Universitätsspital und Tiefenau	4	43	57	1	–	176	28	1	84
Biel, Spitalzentrum	–	3	–	–	–	6	–	–	–
Brig, Centre de Cardiologie du Valais	–	–	–	–	–	0	–	–	–
Chur, Kantonsspital Graubünden	–	0	–	–	–	4	–	1	–
Frauenfeld, Kantonsspital Thurgau	–	0	–	–	–	12	–	–	–
Fribourg, Hôpital cantonal	3	19	3	–	1	30	10	–	10
Genf, Clinique des Granges	–	–	–	–	–	3	–	–	–
Genf, Hôpital de la Tour	–	7	–	–	–	10	3	–	3
Genf, Hôpitaux universitaires	3	26	32	–	–	40	1	–	17
Genolier, Clinique de Genolier	–	1	–	1	–	3	–	–	–
Kreuzlingen, Herz–Neuro–Zentrum Bodensee	–	2	–	–	–	7	–	–	–
Lachen, Spital	–	5	–	–	–	6	–	–	–
Lausanne, Centre hospitalier universitaire vaudois	1	20	–	2	–	26	18	3	2
Lausanne, Clinique Cecil	–	10	–	–	–	10	–	–	2
Lausanne, Clinique de la Source	2	12	–	–	1	6	–	–	–
Liestal, Kantonsspital Baselland	2	10	2	–	–	13	–	–	–
Lugano, Cardiocentro Ticino	–	23	–	–	7	15	5	–	12
Luzern, Kantonsspital	3	36	1	–	4	34	2	1	13
Luzern, Klinik St. Anna	–	2	–	1	–	4	–	1	7
Morges, Hôpital	–	1	–	–	–	2	–	–	–
Pfäffikon, Cardiance Clinic	1	1	–	–	–	7	2	–	1
Sion, Hôpital du Valais	–	15	–	1	–	11	2	–	2
Solothurn, Bürgerspital	–	3	–	1	–	17	–	–	10
St. Gallen, Kantonsspital	2	15	–	–	–	27	3	–	7
Winterthur, Kantonsspital	–	4	–	–	–	21	–	–	–
Zürich, Hirslanden Klinik	–	7	–	–	–	35	10	–	24
Zürich, Klinik im Park	5	8	–	4	–	39	4	–	28
Zürich, Triemli Stadtspital	5	9	–	–	2	56	8	–	29
Zürich, Universitätsspital	n.a.	n.a.	n.a.	n.a.	2	107	19	4	86
<b>Total</b>	<b>34</b>	<b>322</b>	<b>98</b>	<b>11</b>	<b>19</b>	<b>833</b>	<b>154</b>	<b>11</b>	<b>406</b>

ASD = atrial septal defect; LAA = left atrial appendage; n.a. = not available; PFO = patent foramen ovale; VSD = ventricular septal defect