

KAROLINSKA HOSPITAL
DEPARTMENT OF CARDIOLOGY
SWEDEN

ANNUAL STATISTICAL REPORT 2023



**SWEDISH ICD &
PACEMAKER REGISTRY**

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Foreword

We are proud to present the annual report for 2023 regarding CIED usage in Sweden.

We have over the last years focused on longevity of devices, leads and complications as well as the general usage of CIED in Sweden. We have also increased the data collected regarding lead extractions which is rapidly increasing in Sweden.

Complications are shown for each type of implantation for the country, for the region and hospital. There is also an ongoing discussion regarding concentration of therapy to fewer centers to improve outcomes by increasing the numbers of procedures per operator. To aid in this transformation we publish data on number of interventions for all individual implanters. We have seen some changes this year in the concentration of CRT procedures to fewer implanters.

Lead extractions are reported per hospital using the definition by ACC, the removal of a lead with an implant duration of > one year regardless of the method and leads of < than one year if tools are used. All hospitals performing lead extractions are now sending complete data. Lead extractions are in 2024 concentrated by a decision by the National Board of Welfare to four hospitals, Akademiska Sjukhuset Uppsala, Karolinska Sjukhuset in Stockholm, Skånes universitetssjukhus in Lund and Sahlgrenska Universitetssjukhuset in Göteborg.

The report contains data from all implanting hospitals and > 95-98% of all procedures are reported when validated against the Patient care registry from The National Board of Welfare, Socialstyrelsen, in an annual validation process. There is also started an ongoing process of annual auditing at all implanting hospitals.

Fredrik Gadler
Manager Swedish National ICD and Pacemaker Registry

Implant rates

There are 66764 active pacemaker patients in Sweden at the end of 2023. As always there are regional differences with the highest implant rates in the large northern region of Västernorrland, 1222 per million and the lowest in the regions of Värmland and Västmanland; 592 and 595 per million.

The overall implant rate increased somewhat from 709 to 731 new implants per million. The Swedish population has also increased to 10,5 million and the total number of first implants increased in total to 7718 new pacemaker implants.

The number of implanting hospitals is the same as in the previous five years, 41 centers

Age and gender distribution of pacemaker treatment

The average age for females receiving pacemaker treatment is 77 years and the same for males, 77 years and 12 patients over 100 years of age received primary implants. There is a male predominance with 60% of the new implants going to male patients. Generator changes are also more common in males. There is no change in this distribution compared to previous years.

Pacemakers and leads

The manufacturer's shares of the market show only slight redistribution and all regions are bound by tenders for 1-3 years. St Jude Medical is now Abbott and again largest with 42%, and Medtronic with the brand Vitatron is in second place with 24% market share. Boston Scientific has increased its market shares to 13% in brady segment. Biotronik are still increasing and now up to 20% of the market share. Right side pacemaker leads are now solely bipolar. Active fixation is used to 99% in the atrium and 99% in the ventricle. We now have active fixation LV leads and 37% of the LV leads were active fixation and all are quadripolar. Medtronic is the sole manufacturer with active fixation LV-leads. Quadripolar lead technology for CRT has rapidly increased and 94% of the LV leads are now quadripolar, an increase from 65% in 2016.

17068 new leads were implanted all together.

Only a small number of epicardial systems are implanted in small children and patients without venous access and in some CRT patients. Venous access is almost equal between cephalic cut-down technique, 41%, and direct subclavian puncture 22% and 30% axillary puncture which has increased as access route. Only a small subset, 5% are stated as sonar guided.

The leadless pacemaker systems are new in clinical use and Medtronic Micras were implanted in 62 patients in 2022.

Pacemakers

All pacemakers implanted have RR capability and DDD-R is the most common subtype, 77%. CRT-P are used in small numbers, 7%, unchanged from previous years.

The rate of MRI safe systems increases rapidly, approximately 98% of the new systems implanted are MRI safe. The trend from the manufacturers to label older leads together with new pulse generators as MRI safe have made it difficult to keep correct track of the actual percentage.

The most common aetiology for pacemaker treatment is still the “conductive tissue fibrosis” 80% and ischaemic disease is more common in males than females, 6% vs 3%. The usage of the term “conductive tissue fibrosis” is most probably too high and only represents a lack of proper diagnosis when entering registry data.

System upgrade is at a steady state, especially used in brady-paced patients with heart failure and 2018 a total of 274 patients were upgraded from normal brady pacing to CRT compared to 285 in 2023. Since the EHRA recommendation for upgrade has been strengthened and there is now major increase maybe this is an indication that CRT system are more widely used from the beginning in patients prone to develop heart failure from RV pacing.

The most common symptom is syncope followed closely by dizziness and dyspnea. ECG indications are 2023 mainly related to AV conduction disorders and sinus node disease second. Sinus node disease is slightly more common as an indication in women than in men.

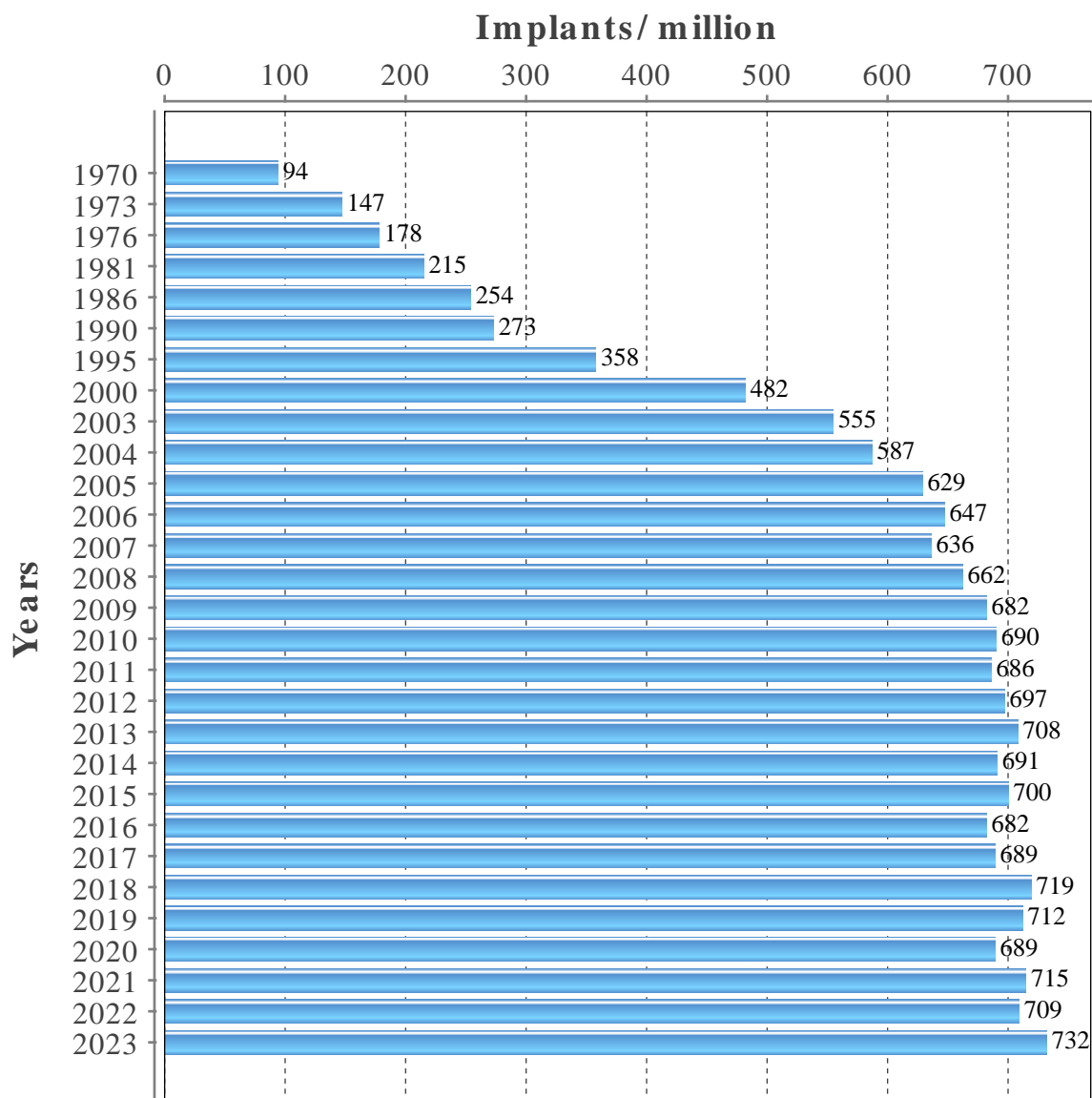
Smaller hospitals tend to use VVI-R pacing more often than larger hospitals for AV-block and SSS.

Generators are used to ERI criteria are fulfilled in 60% of the cases and 1% exhibit premature EOL, technical failure or changed due to recall 2%, Boston Proponent and Abbot Assurity generators being the most common. The Abbott Assurity generators show an increasing rate of premature depletion. Lead failures are uncommon and survival rates are very good with a 10-year survival of 98%.

Implanting organization

The number of procedures for each implanter vary to a large extent between hospitals. Recommendations as to minimum number of procedures from EHRA is not routinely followed especially regarding CRT implantation. A recommendation to implant volumes were made by the Swedish Cardiology Societies Arrhythmia Group in 2016 and has so far had little impact on the organization in hospital with low individual implant numbers although some hospitals have concentrated CRT to fewer implanters.

STATISTICS – PACEMAKER – HISTORICAL IMPLANTATION RATES

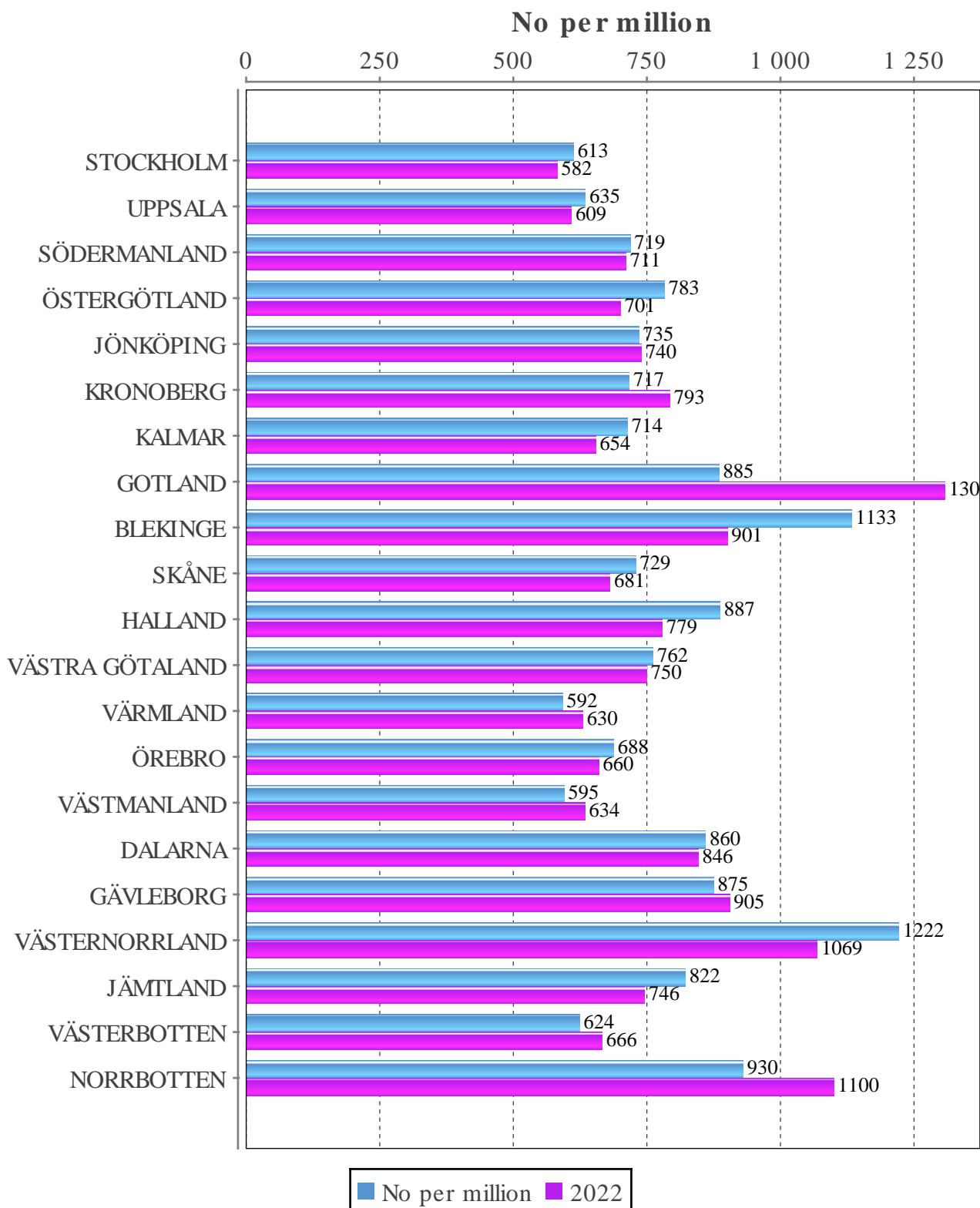


STATISTICS – PACEMAKER – IMPLANTS PER COUNTY

The regions are based on where the patients live, not where they are treated

County	Population	No of first	No per million	Active patients
STOCKHOLM	2454821	1506	613	12873
UPPSALA	404589	257	635	2507
SÖDERMANLAND	301944	217	719	1953
ÖSTERGÖTLAND	472298	370	783	3096
JÖNKÖPING	368856	271	735	2147
KRONOBERG	203686	146	717	1181
KALMAR	246667	176	714	1458
GOTLAND	61029	54	885	550
BLEKINGE	157973	179	1133	1350
SKÅNE	1421781	1037	729	9002
HALLAND	343746	305	887	2204
VÄSTRA GÖTALAND	1767016	1346	762	11237
VÄRMLAND	283548	168	592	1813
ÖREBRO	308116	212	688	1733
VÄSTMANLAND	280813	167	595	1559
DALARNA	287253	247	860	2206
GÄVLEBORG	285642	250	875	2507
VÄSTERNORRLAND	242148	296	1222	2346
JÄMTLAND	132572	109	822	1112
VÄSTERBOTTEN	278729	174	624	1806
NORRBOTTEN	248480	231	930	2124
Total	10551707	7718	731	66764

STATISTICS – PACEMAKER – IMPLANTS PER COUNTY

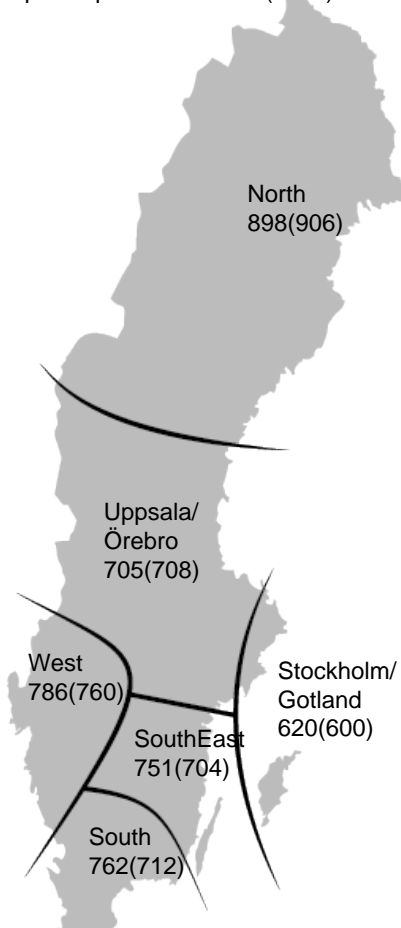


STATISTICS – PACEMAKER – IMPLANTS PER REGION

The regions are based on where the patients live, not where they are treated

Region	Population	No of first impl	No per million	Active patients
Stockholm/Gotland	2515850	1560	620	13423
Uppsala/Örebro	2151905	1518	705	14278
South-East Sweden	1087821	817	751	6701
Southern Sweden	1926100	1468	762	12324
Western Sweden	1968102	1546	786	12651
Northern Sweden	901929	810	898	7388
Total	10551707	7719	732	66765

Implants per million 2023(2022)



STATISTICS – PACEMAKER – IMPLANTING HOSPITALS

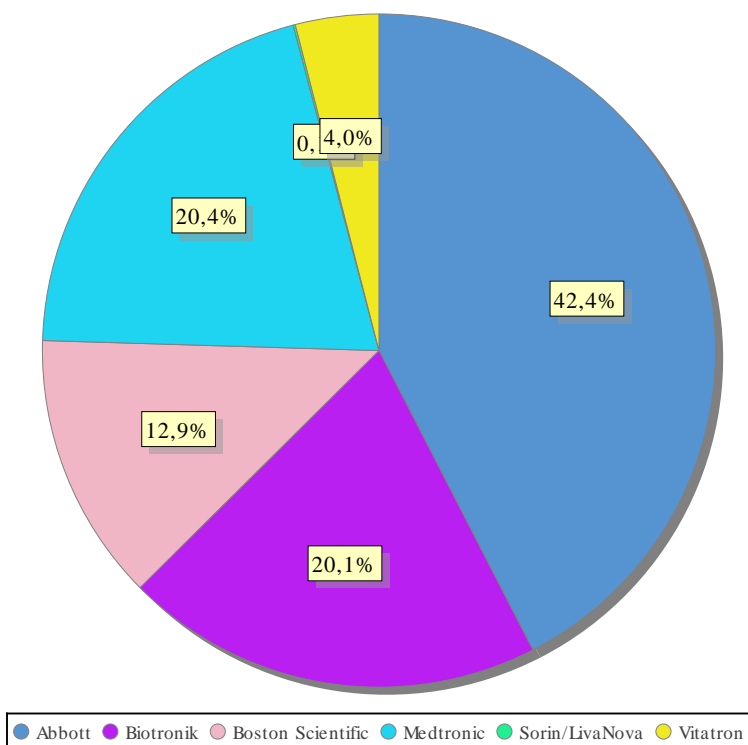
First implants per hospital

Region	Hospital	2023	2022
Northern Sweden	Norrlands Universitetssjukhus	168	177
	Skellefteå lasarett	33	34
	Sollefteå sjukhus	16	30
	Sunderby sjukhus	221	273
	Sundsvalls sjukhus	179	161
	Örnsköldsviks sjukhus	89	69
	Östersunds sjukhus	107	96
Southern Sweden	Blekingesjukhuset	189	161
	Centrallasarettet Växjö	139	161
	Centralsjukhuset Kristianstad	213	215
	Helsingborgs lasarett	180	204
	Länssjukhuset Halmstad	70	68
	Skånes universitetssjukhus, Lund	384	371
	Skånes universitetssjukhus, Malmö	289	210
	Varbergs sjukhus	222	186
South-East Sweden	Linköpings Universitetssjukhus	384	357
	Länssjukhuset Kalmar	121	113
	Länssjukhuset Ryhov	258	252
	Västerviks sjukhus	47	44
Stockholm/Gotland	Danderyds sjukhus	442	432
	Karolinska Universitetssjukhuset	459	453
	St Görans sjukhus	320	283
	Södersjukhuset	325	305
	Visby lasarett	21	39
Uppsala/Örebro	Akademiska sjukhuset	296	282
	Centralsjukhuset Karlstad	134	145
	Centralsjukhuset Västerås	149	156
	Falu lasarett	240	239
	Gävle sjukhus	197	206
	Hudiksvalls sjukhus	50	46
	Mälarsjukhuset	202	200
	Torsby sjukhus	19	26
	Universitetssjukhuset Örebro	234	212
Western Sweden	Alingsås lasarett	73	58
	Drottning Silvias Bus	6	10
	Kungälv sjukhus	123	132
	Sahlgrenska Universitetssjukhuset	387	395
	Sahlgrenska Universitetssjukhuset /Östra	62	57
	Skaraborgs sjukhus Skövde	223	227
	Södra Älvsborgs sjukhus	190	229
	Trollhättan, NÄL	303	257

STATISTICS – PACEMAKER – PACEMAKERS PER MANUFACTURER

Market share per manufacturer in Sweden. Medtronic and Vitatron regarded as separat companies

Manufacturer	2020 %	2021 %	2022 %	2023 %
Biotronik	19.1	18.0	20.9	20.1
Boston Scientific	11.8	10.5	10.9	12.9
Medtronic	10.4	11.1	14.0	20.4
Sorin/LivaNova	-	0.1	0.1	0.1
Abbott	48.4	50.4	47.4	42.4
Vitatron	10.3	9.9	6.7	4.0

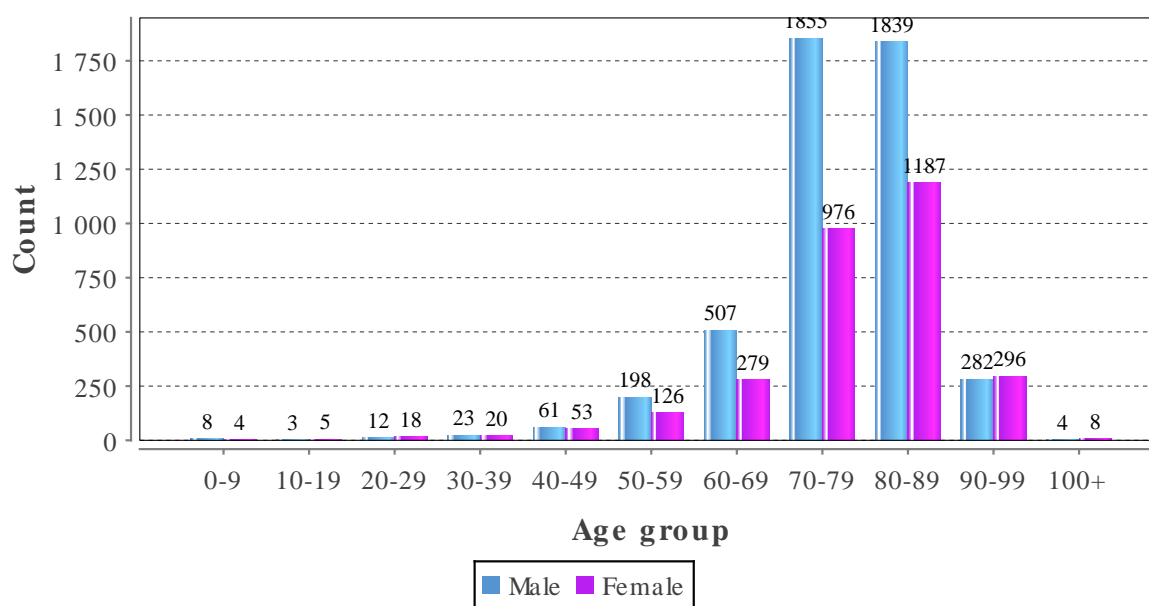


STATISTICS – PACEMAKER – AGE DISTRIBUTION MALES/FEMALES

Age and gender distribution for new implants, total numbers

Age (years)	Total no	%	Male	Female
0-9	12	0.2	8	4
10-19	8	0.1	3	5
20-29	30	0.4	12	18
30-39	43	0.6	23	20
40-49	114	1.5	61	53
50-59	324	4.2	198	126
60-69	786	10.1	507	279
70-79	2831	36.5	1855	976
80-89	3026	39.0	1839	1187
90-99	578	7.4	282	296
100+	12	0.2	4	8
Average age	77	0.0	77	77

Total number of implants: 7764



STATISTICS – PACEMAKER – TYPE OF IMPLANTS

Ratio of new implants versus generator changes

	Total		Male		Female	
	no	%	no	%	no	%
First implant	7764	69.0	4792	61.7	2972	38.3
Replacement	3489	31.0	2002	57.4	1487	42.6
Total	11253	100.0	6794	60.4	4459	39.6

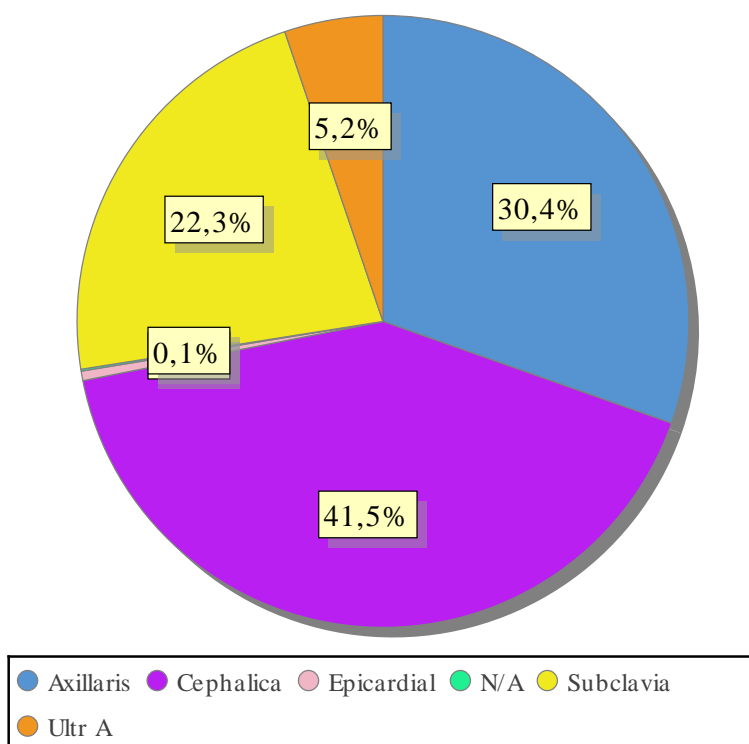
STATISTICS – PACEMAKER – LEAD TYPES

Lead type distribution for atrial and ventricular use for first implants and replacements including all pace leads, pace and ICD systems

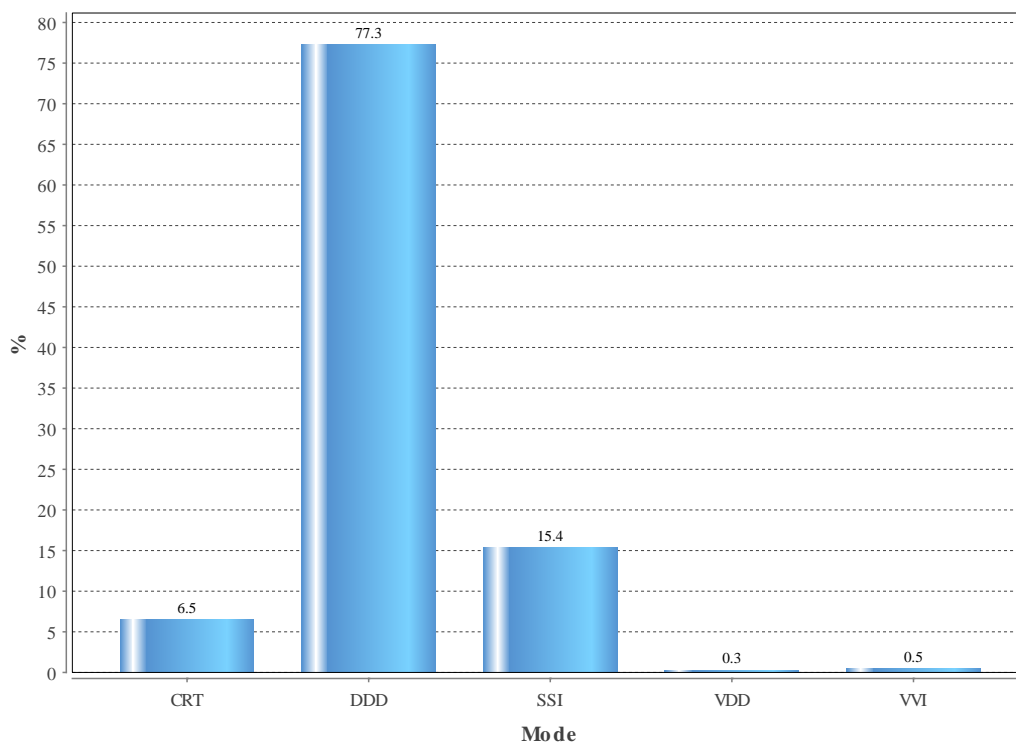
	Atrial		Ventricular		LV-lead	
	no	%	no	%	no	%
Bipolar	7621	99.7	8100	99.5	52	4.0
Epicardial	26	0.3	42	0.5	20	1.6
Unipolar	-	-	1	-	-	-
Quadripolar	-	-	-	-	1212	94.4

	Atrial		Ventricular		LV-lead	
	no	%	no	%	no	%
Active fixation	7641	99.9	7960	97.7	482	37.5
Passive fixation	7	0.1	185	2.3	802	62.5
Total number of leads: 17077						

STATISTICS – PACEMAKER – LEAD ACCESS



STATISTICS – PACEMAKER – SUB TYPE



Wireless implants per subtype

Mode	No
VDDR	21
VVIR	41
Total number of first implants 7764	

STATISTICS – PACEMAKER - AETIOLOGY FIRST IMPLANT

Main aetiology for implanting pacemakers

Aetiology	Total %	Male %	Female %
Amyloidosis	0.5	0.6	0.3
Borreliosis	0.0	0.1	0.0
Cardiomyopathy cytostatic induced	0.0	0.0	0.0
Cardiomyopathy dilated	2.2	2.5	1.7
Cardiomyopathy hypertrophic	0.5	0.3	0.6
Cardiomyopathy ischaemic	0.9	1.2	0.4
Conduction tissue fibrosis	79.7	78.1	82.3
Congenital	0.3	0.2	0.4
Drug induced	0.1	0.1	0.1
Endocarditis	0.0	0.0	0.0
Heart transplantation	0.1	0.1	0.0
High degree RV pacing	0.0	0.0	0.1
His-ablation	1.3	0.7	2.3
Ionizing radiation	0.0	0.0	0.0
Ischaemic	5.0	6.2	3.2
Long QT-syndrome	0.0	0.0	0.1
Maze procedure	0.0	0.0	0.0
Myocarditis	0.1	0.1	0.1
N/A	0.0	0.1	0.0
Neurocardiogenic syncope	0.4	0.4	0.4
Other structural heart disease	1.8	1.6	2.0
Post TAVI	2.0	2.3	1.6
Post infarction	0.4	0.3	0.4
RF-ablation, complication	0.5	0.4	0.6
Sarcoidosis	0.0	0.0	0.0
Surgical complication	2.8	2.9	2.6
Valvular heart disease	1.4	1.8	0.8

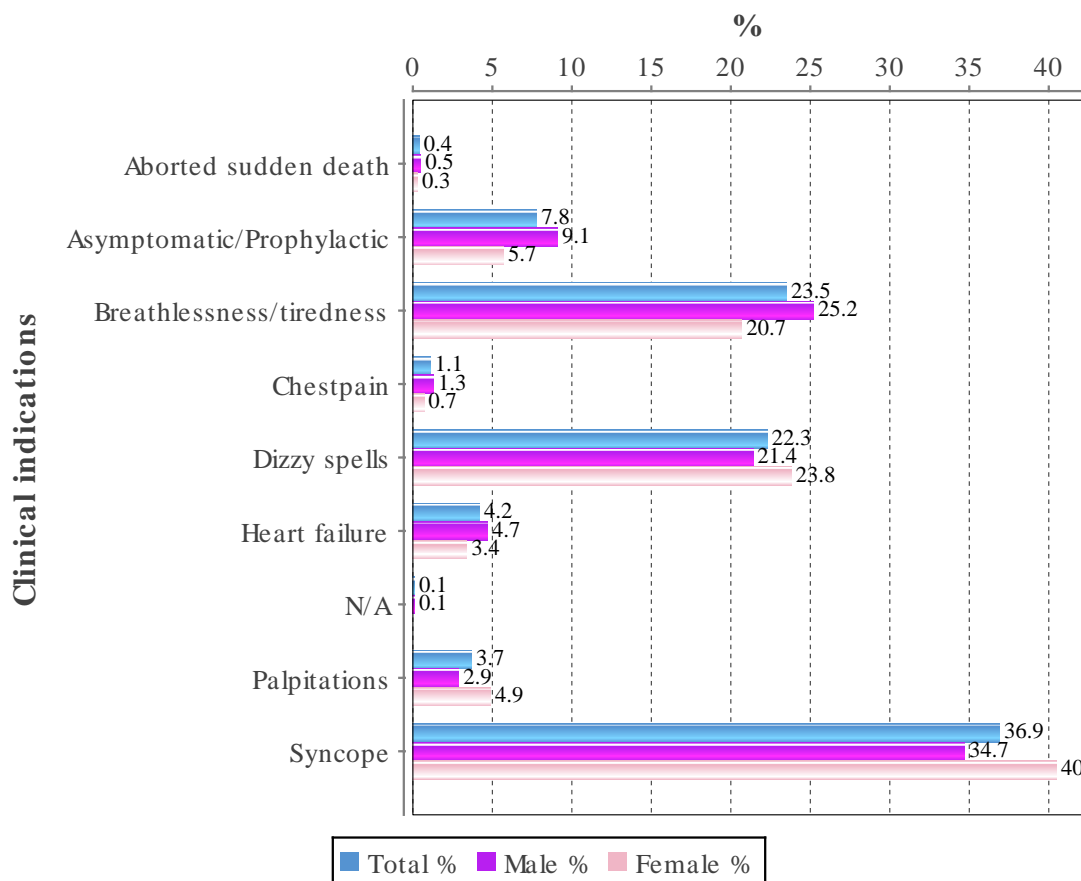
STATISTICS – PACEMAKER – SYSTEM UPGRADE

	2023	2022	2021	2020	2019	2018
VVI to VVIR	1	1	4	3	3	4
AAI/AAIR to DDD/DDDR	15	11	17	21	21	21
VVI/VVIR to DDD/DDDR	33	34	13	28	35	23
VVI/VVIR/DDD/DDDR to CRT	285	260	267	255	260	274

STATISTICS – PACEMAKER – CLINICAL INDICATIONS FIRST IMPLANT

Main symptom for implanting pacemakers

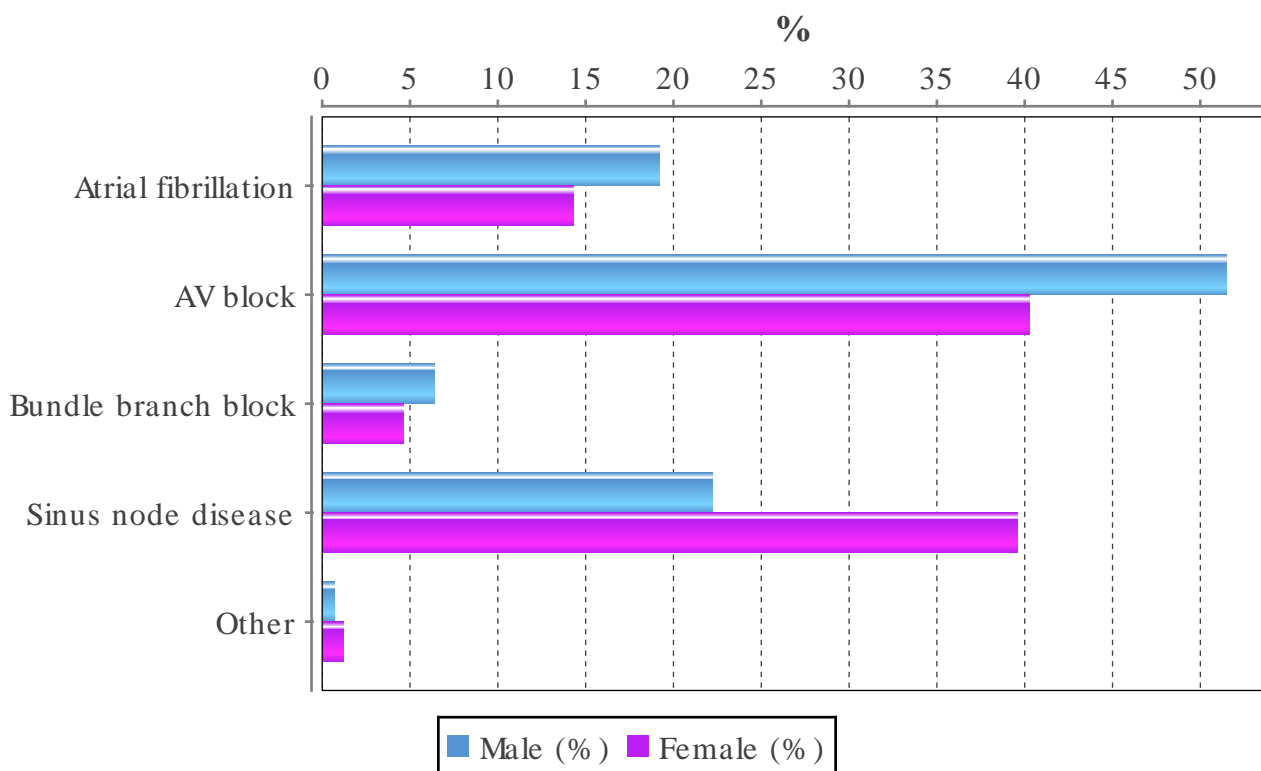
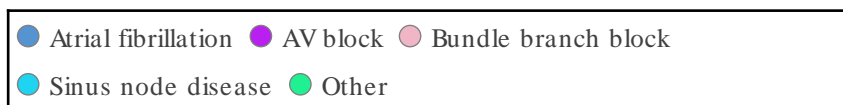
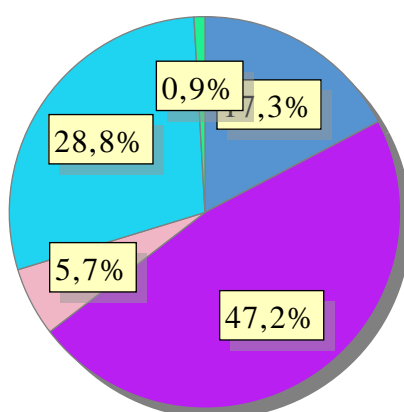
Indication	Total %	Male %	Female %
Aborted sudden death	0.4	0.5	0.3
Asymptomatic/Prophylactic	7.8	9.1	5.7
Breathlessness/tiredness	23.5	25.2	20.7
Chestpain	1.1	1.3	0.7
Dizzy spells	22.3	21.4	23.8
Heart failure	4.2	4.7	3.4
N/A	0.1	0.1	0.0
Palpitations	3.7	2.9	4.9
Syncope	36.9	34.7	40.5



STATISTICS – PACEMAKER - PREPACING ECG FIRST IMPLANT

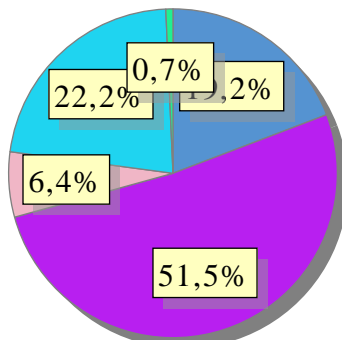
Main ECG indication by gender and for patients < 18 years of age

Indication	No	%	Male (%)	Female (%)	Younger than 18 (%)
Atrial fibrillation	1342	17.3	19.2	14.3	0.0
AV block	3667	47.2	51.5	40.3	82.4
Bundle branch block	446	5.7	6.4	4.6	0.0
Sinus node disease	2238	28.8	22.2	39.6	17.6
Other	71	0.9	0.7	1.2	0.0
Total number of implants 7764					

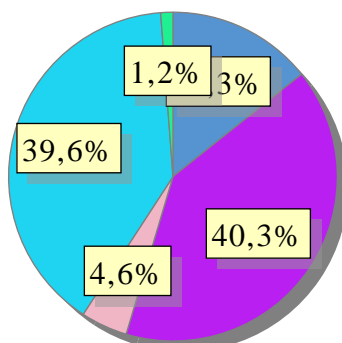


STATISTICS – PACEMAKER - PREPACING ECG FIRST IMPLANT

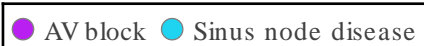
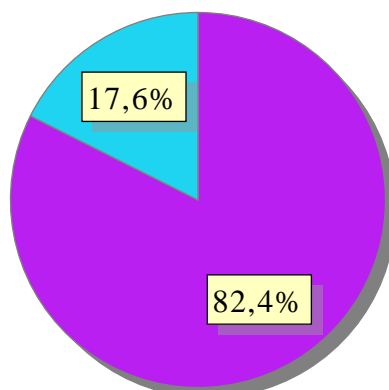
Male



Female



< 18



**STATISTICS – PACEMAKER – USE OF PACING
MODES FIRST IMPLANT PER HOSPITAL**

Use of pacemaker sub type for all indications per hospital (number of new implants / year and hospital)

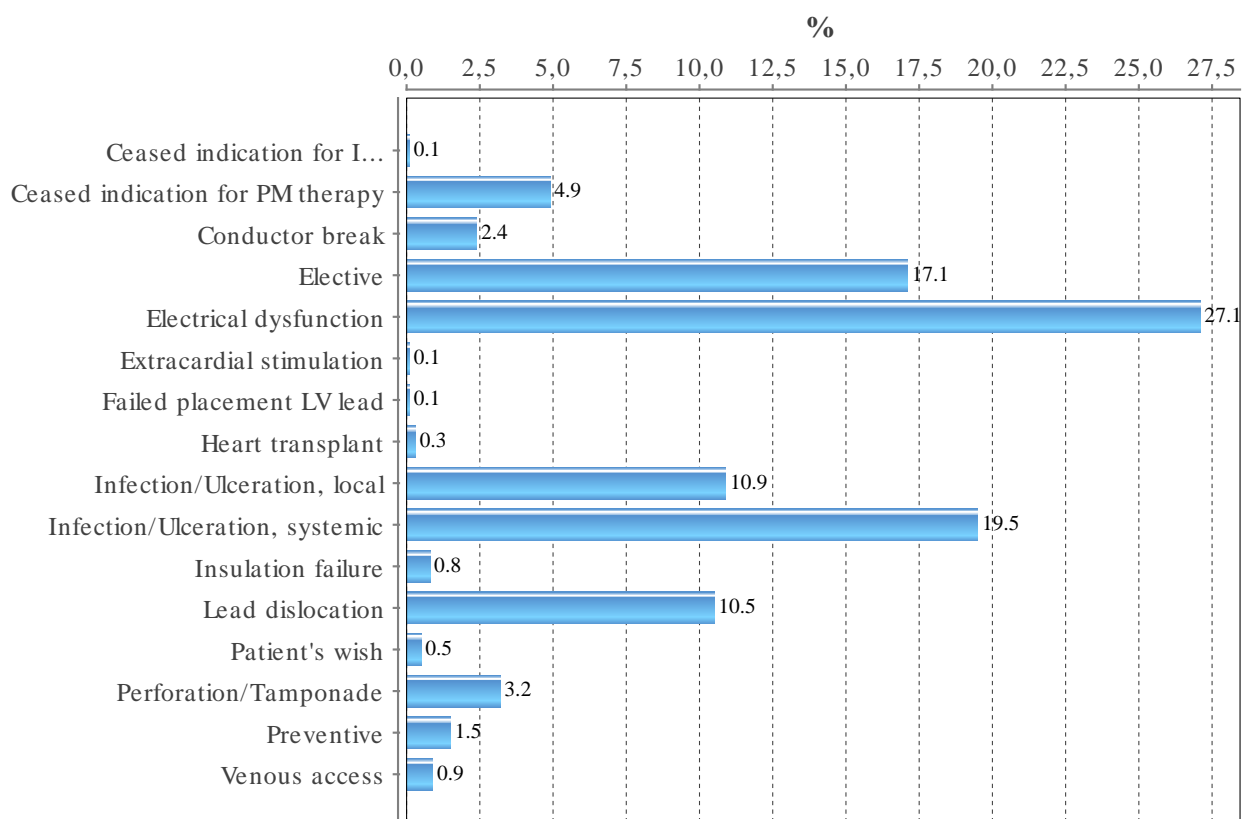
Hospital	Number	DDD %	VVI %	AAI %	CRT %
Akademiska sjukhuset	295	79.7	13.9	0.0	6.4
Alingsås lasarett	73	72.6	27.4	0.0	0.0
Blekingesjukhuset	189	83.1	11.6	1.1	4.2
Centrallasarettet Växjö	139	84.9	10.1	0.0	5.0
Centralsjukhuset Karlstad	134	82.1	7.5	0.0	10.4
Centralsjukhuset Kristianstad	213	80.8	19.2	0.0	0.0
Centralsjukhuset Västerås	149	74.5	24.2	0.7	0.7
Danderyds sjukhus	442	77.4	15.4	0.0	7.2
Drottning Silvias Bus	6	100.0	0.0	0.0	0.0
Falu lasarett	240	78.3	10.0	0.4	11.3
Gävle sjukhus	197	81.7	14.7	0.0	3.6
Helsingborgs lasarett	180	78.3	18.9	0.6	2.2
Hudiksvalls sjukhus	50	84.0	16.0	0.0	0.0
Karolinska Universitetssjukhuset	457	78.1	13.1	0.0	8.8
Kungälv's sjukhus	123	87.8	11.4	0.8	0.0
Linköpings Universitetssjukhus	381	80.1	13.1	0.5	6.3
Länssjukhuset Halmstad	70	82.9	17.1	0.0	0.0
Länssjukhuset Kalmar	116	60.3	31.9	0.0	7.8
Länssjukhuset Ryhov	258	75.2	24.4	0.4	0.0
Mälarsjukhuset	202	81.2	14.4	0.0	4.5
Norrlands Universitetssjukhus	168	74.4	13.7	0.0	11.9
Sahlgrenska Universitetssjukhuset	366	78.1	13.9	0.0	7.9
Sahlgrenska Universitetssjukhuset /Östra	62	82.3	17.7	0.0	0.0
Skaraborgs sjukhus Skövde	223	69.1	12.6	0.0	18.4
Skellefteå lasarett	33	84.8	15.2	0.0	0.0
Skånes universitetssjukhus, Lund	371	76.5	8.6	1.1	13.7
Skånes universitetssjukhus, Malmö	289	84.4	15.6	0.0	0.0
Sollefteå sjukhus	16	43.8	50.0	6.3	0.0
St Görans sjukhus	320	81.3	18.1	0.0	0.6
Sunderby sjukhus	221	74.7	16.7	0.0	8.6
Sundsvalls sjukhus	179	80.4	11.2	1.1	7.3
Södersjukhuset	325	74.2	19.7	0.0	6.2
Södra Älvsborgs sjukhus	190	70.0	15.8	1.1	13.2
Torsby sjukhus	19	73.7	21.1	5.3	0.0
Trollhättan, NÄL	303	77.6	17.5	0.0	5.0
Universitetssjukhuset Örebro	216	77.8	18.1	0.0	4.2
Varbergs sjukhus	222	82.0	11.7	0.0	6.3
Visby lasarett	21	95.2	4.8	0.0	0.0
Västerviks sjukhus	47	91.5	8.5	0.0	0.0
Örnsköldsviks sjukhus	89	91.0	6.7	0.0	2.2
Östersunds sjukhus	107	73.8	18.7	0.0	7.5

STATISTICS – PACEMAKER – REASON FOR GENERATOR CHANGE HISTORICAL

Historical explant indications

Reason	2019 %	2020 %	2021 %	2022 %	2023 %
Preventive	2.7	1.7	1.3	2.1	1.8
Elective	15.9	18.1	17.0	20.7	21.3
System change hemodynamic	0.2	0.0	0.0	0.0	0.0
Recall/Alert	0.2	0.2	0.3	1.9	1.3
Erosion/Infection, local	2.0	2.1	2.3	1.6	1.6
Erosion/Infection, systemic	3.3	3.0	3.1	2.9	2.8
Patient's wish	0.1	0.1	0.2	0.3	0.3
CRT-P to CRT-D	0.8	0.3	0.4	0.4	0.3
ERI	65.9	64.5	65.4	61.1	60.8
Premature EOL	0.7	1.6	1.4	0.9	0.9
Heart transplant	0.1	0.1	0.1	0.1	0.1
Ceased indication for PM therapy	0.2	0.3	0.6	0.5	0.4
PM to CRT-P	5.1	4.5	5.0	4.7	5.3
PM to CRT-D	1.5	1.9	1.3	1.3	1.2
PM to ICD because of arrhythmia	0.9	1.1	1.2	0.8	1.0
Technical failure	0.4	0.4	0.5	0.5	0.8
CRT-P to PM because of discontinued CRT-indication	0.0	0.1	0.1	0.0	0.1

STATISTICS – PACEMAKER – REASON FOR LEAD EXPLANT



Implant rates

There are 15666 active ICD patients in Sweden 2023, the number slowly increasing over years and could be an effect of better heart failure management with primary prevention increasing most. The number centers implanting ICD's is 31 and represents roughly 2/3 of the PM implanting centers although 4 centers do <20 implants per year, well below recommendations by ESC and the Swedish national society. The national implant rate is the higher in 2023 than 2022 145 vs 136 per million. Of this 90 per million is primary prevention.

The southeast and southern regions are the only regions that have increased their implant rates, all others show stable implant rates. Otherwise implant rates show the same regional differences as in pacemakers with the highest rates in the Southern region 199 and the lowest in the Western region with 99 per million. About 37% of the ICD procedures are replacements but could be expected to go further down with generators now showing increased longevity.

As with PM the regions are bound by ICD purchasing tenders and manufacturers share show only slight variations over previous year. Abbott is the largest with 43% market share, Medtronic second with 35%. Boston Scientific with 15% and Biotronik is smallest with 6% market share.

Patients

The average age for ICD implant is stable at 65 years in males and 59 years in females for all types of implants, unchanged from previous years. In the older category 107 patients in the age group 80-89 received a first ICD implants as secondary prevention and of these 47 were primary prevention.

Clinical indication for all ICD implants was secondary prevention in 38% and primary in 62%. Aethiology was ischemic heart disease in 43% of all patients but more common in males, 49% vs 31% in females.

Subtypes and leads

97% of the leads are now single coil and 99% were active fixation. An increase in single coil use from 65% in 2015. Venous access is comparable to PM implants with an equal distribution between cephalic cut-down and direct subclavian puncture.

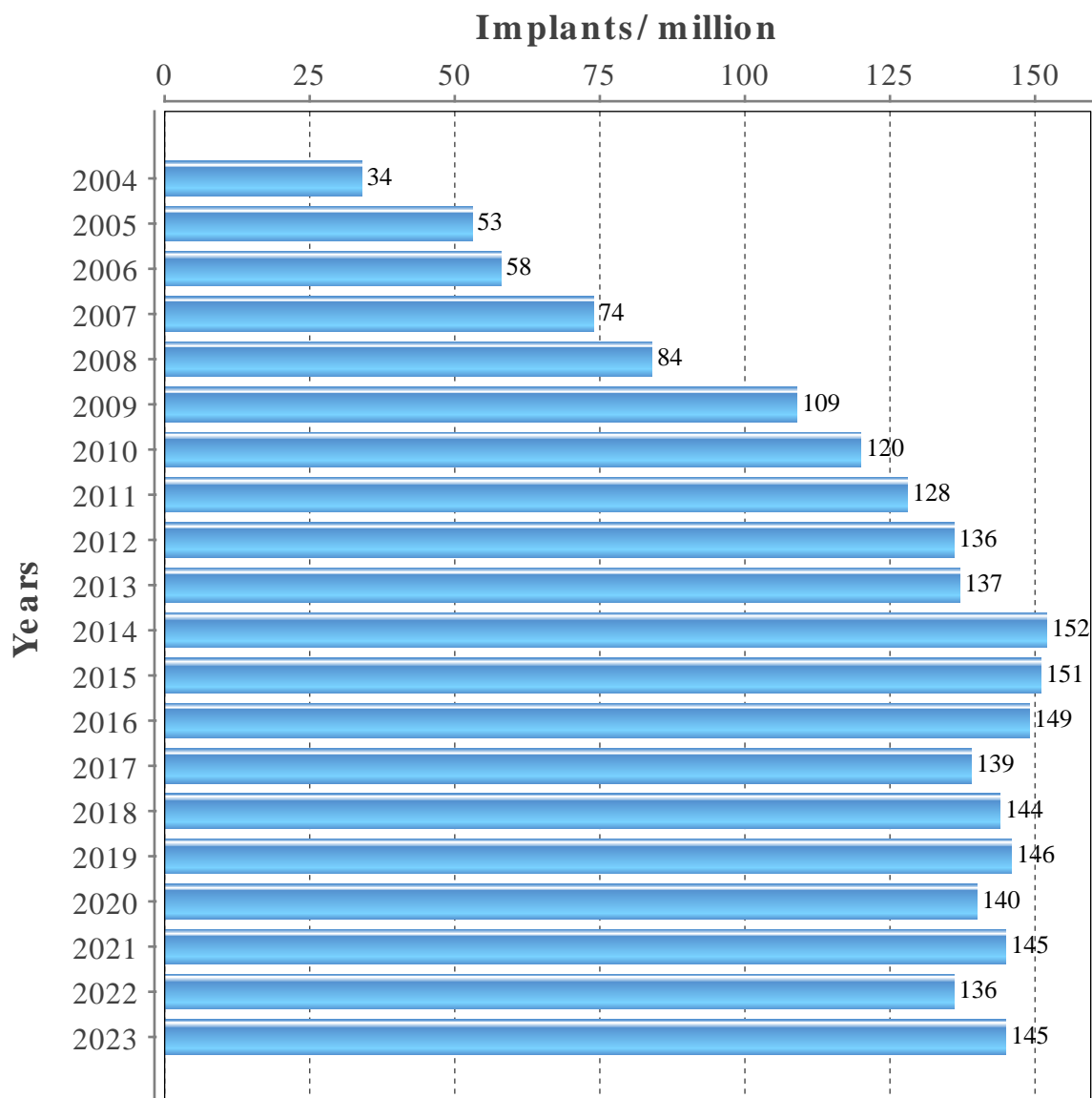
The most common type of ICD was DDDR with 43%, CRT with 29%, VR with 26%. A small number of S-ICD devices were also used; 24.

Only 56% of the ICD's are used until normal EOL/ERI, 9% are changed due to system upgrade to a CRT system. Technical recalls stand for 0.1% of all box changes and premature EOL is 1.1%.

ICD leads display larger failure rates compared to pacemaker leads but overall longevity is still good. Specific statistics for Sprint Fidelis and Durata leads are displayed in the quality section.

The number of procedures display the same large variation I (in) volumes as with pacemaker procedures at different hospitals and some are clearly below recommended volumes.

STATISTICS – ICD – HISTORICAL IMPLANTATION RATES

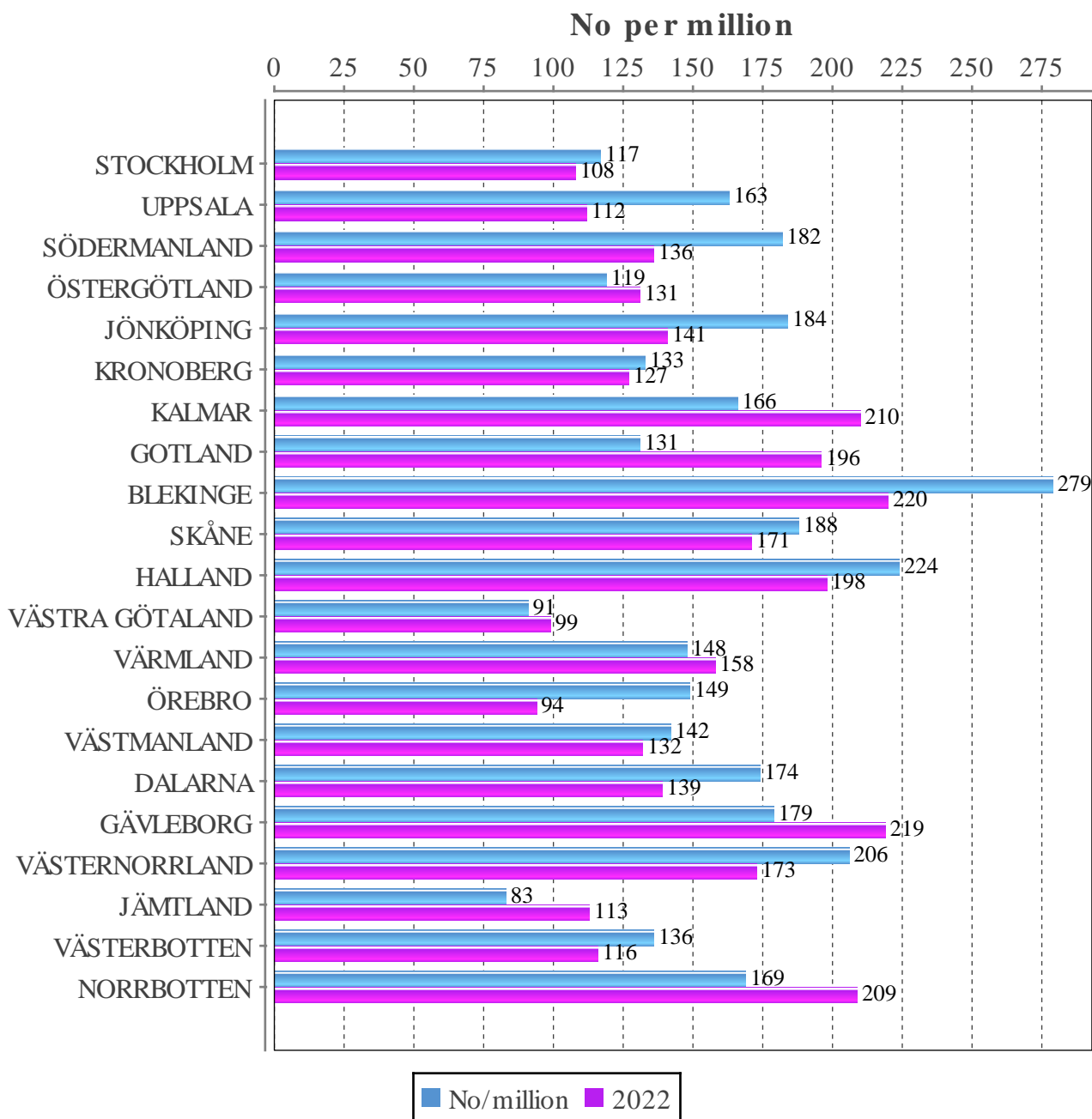


STATISTICS – ICD – IMPLANTS PER COUNTY

The regions are based on where the patients live, not where they are treated

County	Population	No of first	No/million	Active patients
STOCKHOLM	2454821	287	117	3083
UPPSALA	404589	66	163	647
SÖDERMANLAND	301944	55	182	449
ÖSTERGÖTLAND	472298	56	119	692
JÖNKÖPING	368856	68	184	584
KRONOBERG	203686	27	133	308
KALMAR	246667	41	166	473
GOTLAND	61029	8	131	125
BLEKINGE	157973	44	279	376
SKÅNE	1421781	268	188	2296
HALLAND	343746	77	224	594
VÄSTRA GÖTALAND	1767016	160	91	1850
VÄRMLAND	283548	42	148	418
ÖREBRO	308116	46	149	466
VÄSTMANLAND	280813	40	142	419
DALARNA	287253	50	174	534
GÄVLEBORG	285642	51	179	634
VÄSTERNORRLAND	242148	50	206	499
JÄMTLAND	132572	11	83	228
VÄSTERBOTTEN	278729	38	136	453
NORRBOTTEN	248480	42	169	538
Total	10551707	1527	145	15666

STATISTICS – ICD – IMPLANTS PER COUNTY

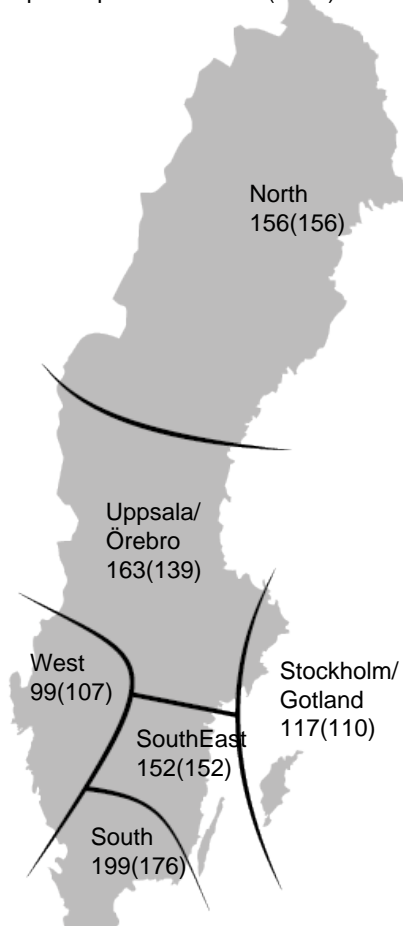


STATISTICS – ICD – IMPLANTS PER REGION

The regions are based on where the patients live, not where they are treated

Region	Population	No of first impl	No per million	Active patients
Stockholm/Gotland	2515850	295	117	3208
Uppsala/Örebro	2151905	350	163	3567
South-East Sweden	1087821	165	152	1749
Southern Sweden	1926100	383	199	3267
Western Sweden	1968102	195	99	2157
Northern Sweden	901929	141	156	1718
Total	10551707	1529	145	15666

Implants per million 2023(2022)



STATISTICS – ICD – IMPLANTING HOSPITALS

First implants per hospital (inclusive CRT)

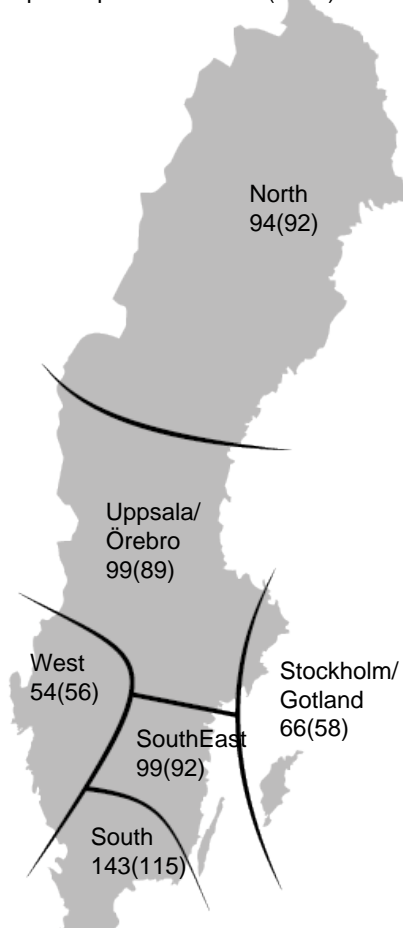
Region	Hospital	2023	2022
Northern Sweden	Norrlands Universitetssjukhus	41	35
	Skellefteå lasarett	2	1
	Sunderby sjukhus	41	48
	Sundsvalls sjukhus	34	33
	Örnsköldsviks sjukhus	14	11
	Östersunds sjukhus	10	12
Southern Sweden	Blekingesjukhuset	43	42
	Centrallasarettet Växjö	22	24
	Centralsjukhuset Kristianstad	38	44
	Helsingborgs lasarett	21	18
	Länssjukhuset Halmstad	1	0
	Skånes universitetssjukhus, Lund	180	152
	Skånes universitetssjukhus, Malmö	38	29
	Varbergs sjukhus	79	70
South-East Sweden	Linköpings Universitetssjukhus	72	78
	Länssjukhuset Kalmar	41	50
	Länssjukhuset Ryhov	48	37
Stockholm/Gotland	Danderyds sjukhus	62	51
	Karolinska Universitetssjukhuset	134	128
	St Görans sjukhus	40	45
	Södersjukhuset	69	59
	Visby lasarett	4	1
Uppsala/Örebro	Akademiska sjukhuset	63	49
	Centralsjukhuset Karlstad	39	44
	Centralsjukhuset Västerås	35	34
	Falu lasarett	50	40
	Gävle sjukhus	40	54
	Hudiksvalls sjukhus	11	9
	Mälarsjukhuset	52	37
	Universitetssjukhuset Örebro	51	31
Western Sweden	Drottning Silvias Bus	1	2
	Sahlgrenska Universitetssjukhuset	62	84
	Skaraborgs sjukhus Skövde	23	29
	Södra Älvsborgs sjukhus	40	32
	Trollhättan, NÄL	37	34

STATISTICS – ICD – PRIMARY PREVENTION PER REGION

The regions are based on where the patients live, not where they are treated

Region	Population	No of first impl	No per million	Active patients
Stockholm/Gotland	2515850	166	66	1814
Uppsala/Örebro	2151905	212	99	2133
South-East Sweden	1087821	108	99	1084
Southern Sweden	1926100	276	143	2021
Western Sweden	1968102	107	54	1087
Northern Sweden	901929	85	94	998
Total	10551707	954	90	9137

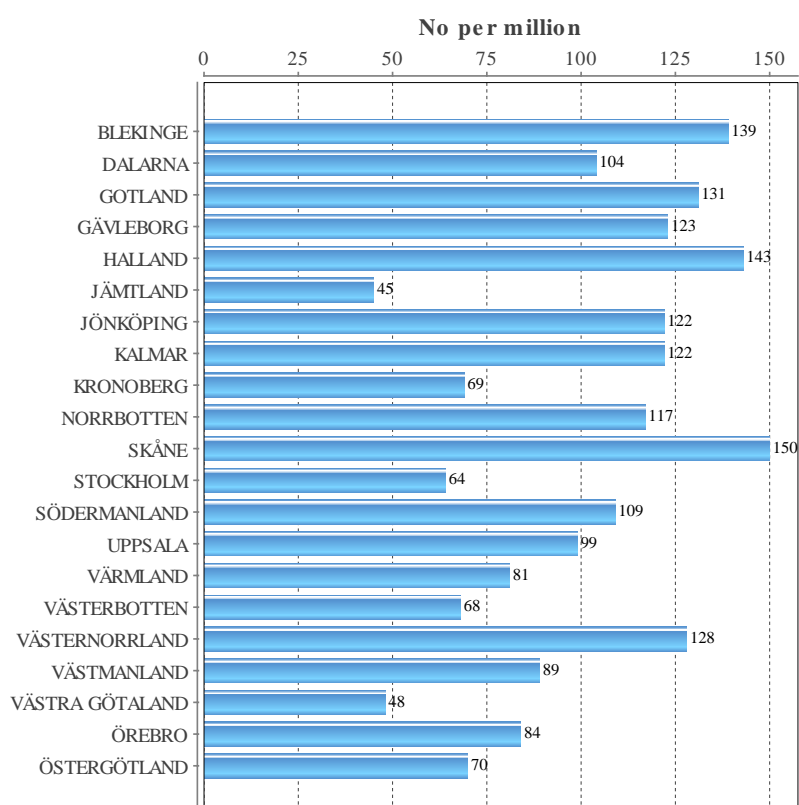
Implants per million 2023(2022)



STATISTICS – ICD – PRIMARY PREVENTION PER COUNTY

The regions are based on where the patients live, not where they are treated

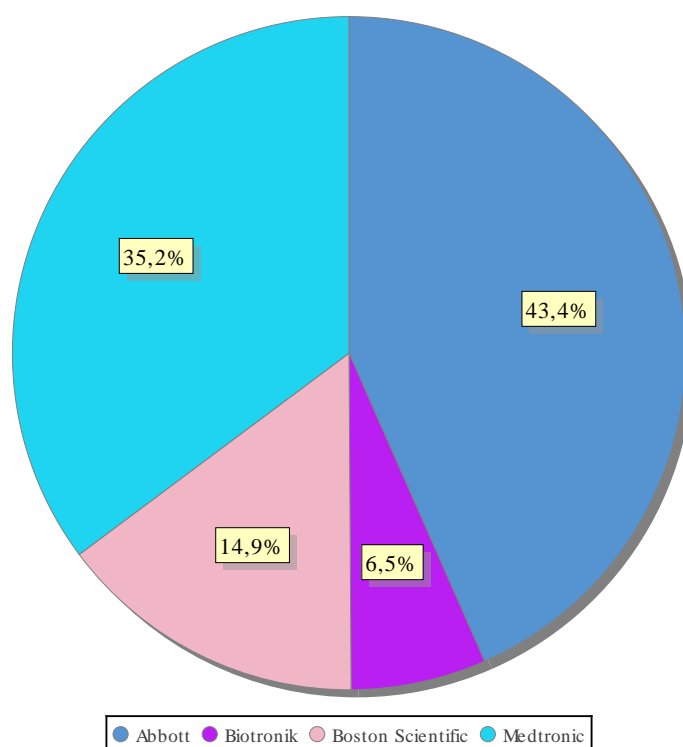
County	Population	No of first	No/million
BLEKINGE	157973	22	139
DALARNA	287253	30	104
GOTLAND	61029	8	131
GÄVLEBORG	285642	35	123
HALLAND	343746	49	143
JÄMTLAND	132572	6	45
JÖNKÖPING	368856	45	122
KALMAR	246667	30	122
KRONOBERG	203686	14	69
NORRBOTTEN	248480	29	117
SKÅNE	1421781	213	150
STOCKHOLM	2454821	158	64
SÖDERMANLAND	301944	33	109
UPPSALA	404589	40	99
VÄRMLAND	283548	23	81
VÄSTERBOTTEN	278729	19	68
VÄSTERNORRLAND	242148	31	128
VÄSTMANLAND	280813	25	89
VÄSTRA GÖTALAND	1767016	84	48
ÖREBRO	308116	26	84
ÖSTERGÖTLAND	472298	33	70
Total	10551707	953	90



STATISTICS – ICD – ICDS PER MANUFACTURER

Market share per manufacturer in Sweden

Manufacturer	2020 %	2021 %	2022 %	2023 %
Biotronik	5.5	4.7	5.4	6.5
Boston Scientific	14.9	10.2	12.6	14.9
Medtronic	36.0	32.9	33.4	35.2
Abbott	43.5	52.2	48.5	43.4

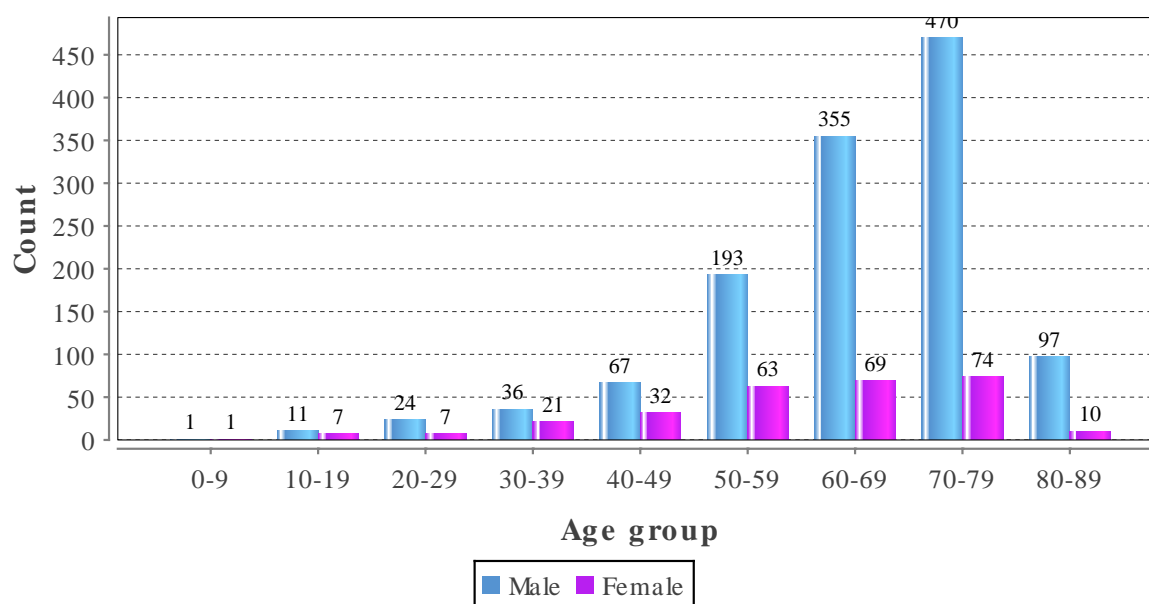


STATISTICS – ICD – AGE DISTRIBUTION MALES/FEMALES

Age and gender distribution for new implants, total numbers

Age (years)	Total no	%	Male	Female
0-9	2	0.1	1	1
10-19	18	1.2	11	7
20-29	31	2.0	24	7
30-39	57	3.7	36	21
40-49	99	6.4	67	32
50-59	256	16.6	193	63
60-69	424	27.6	355	69
70-79	544	35.4	470	74
80-89	107	7.0	97	10
Average age	64	-	65	59

Total number of implants: 1538

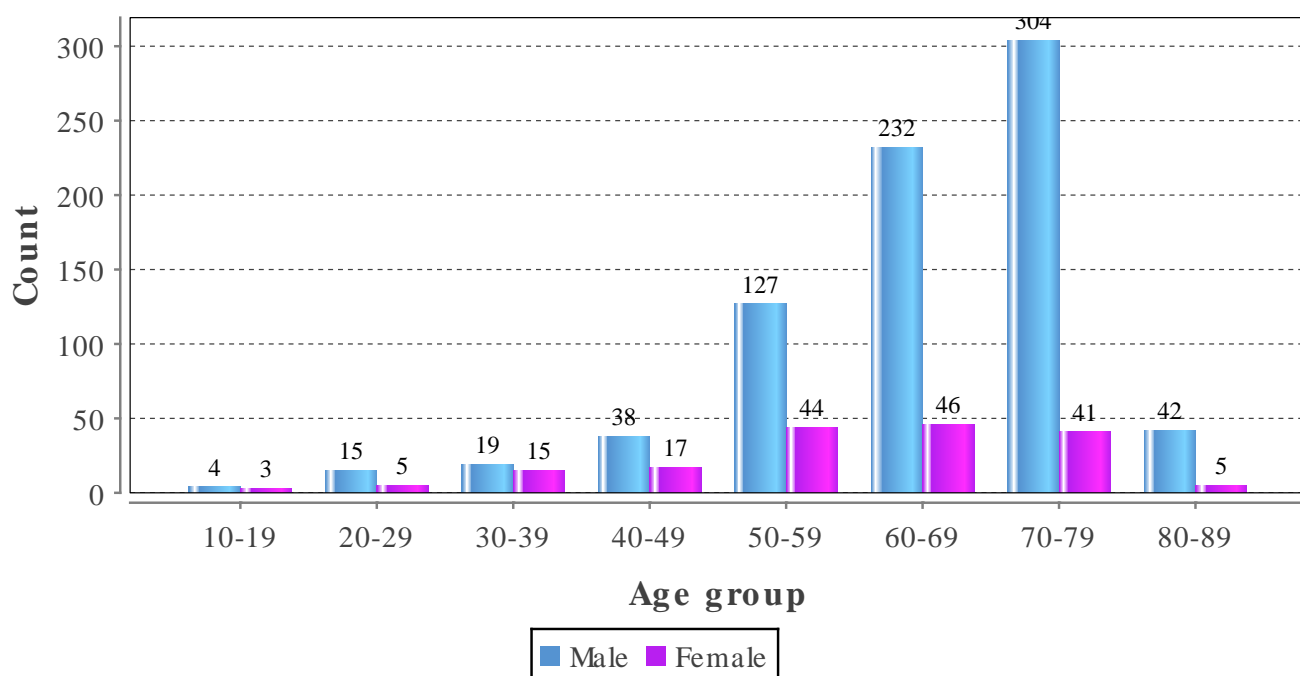


STATISTICS – ICD – AGE DISTRIBUTION PRIMARY PREVENTION

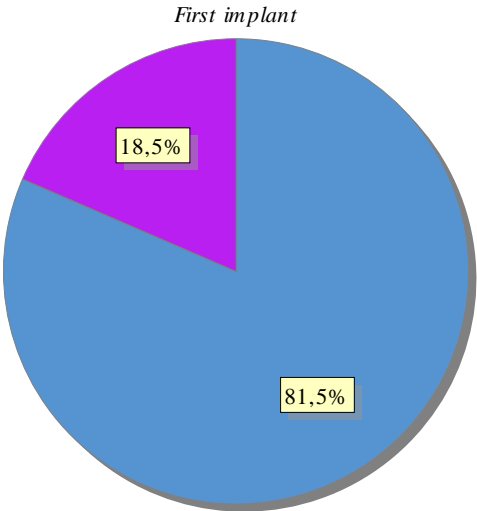
Primary prevention divided by gender and age.

Age (years)	Total no	%	Male	Female
10-19	7	0.7	4	3
20-29	20	2.1	15	5
30-39	34	3.6	19	15
40-49	55	5.7	38	17
50-59	171	17.9	127	44
60-69	278	29.0	232	46
70-79	345	36.1	304	41
80-89	47	4.9	42	5
Average age	64	-	65	58

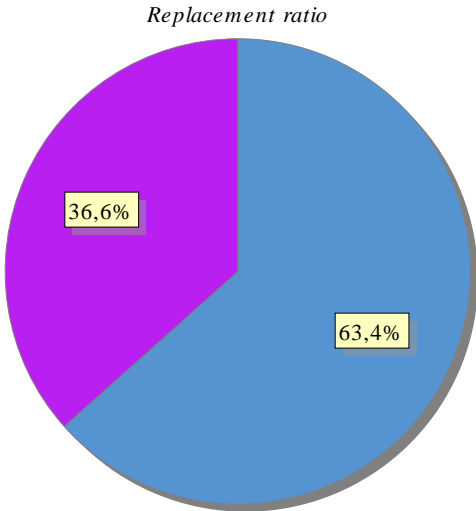
Total number of implants: 957



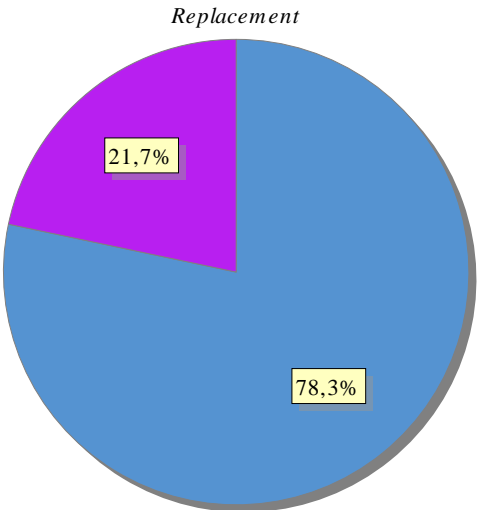
STATISTICS – ICD – TYPE OF IMPLANTS



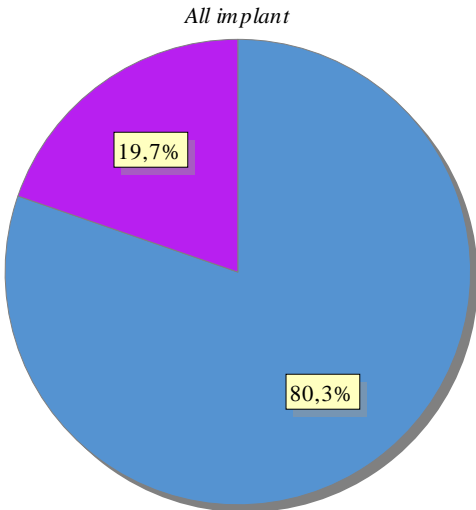
● male ● female



● First implant ● Replacement



● male ● female

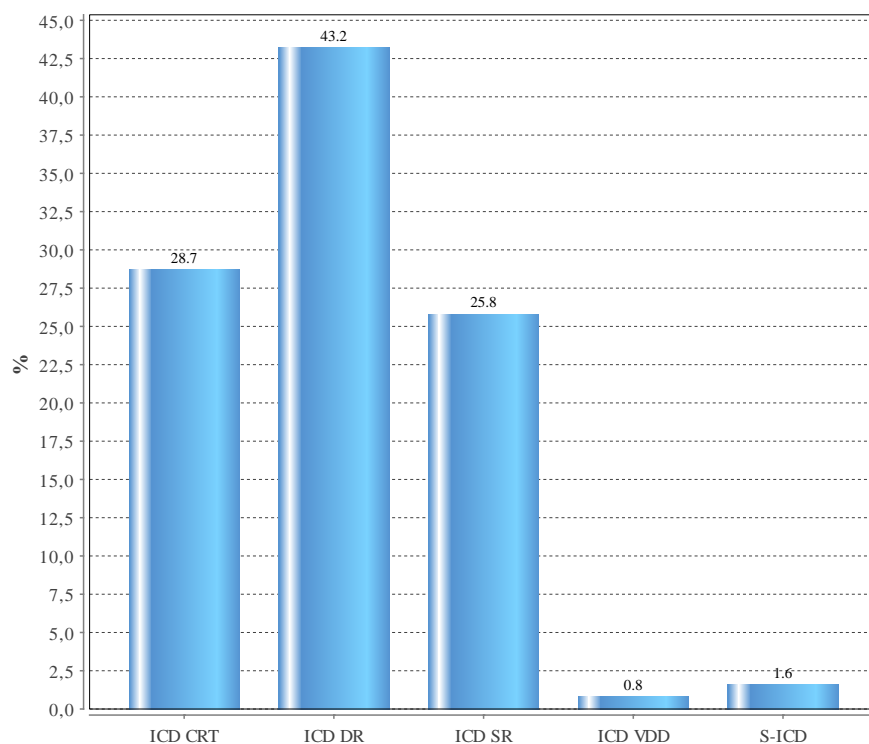


● male ● female

STATISTICS – ICD – SUB TYPE

ICD subtype for new implants

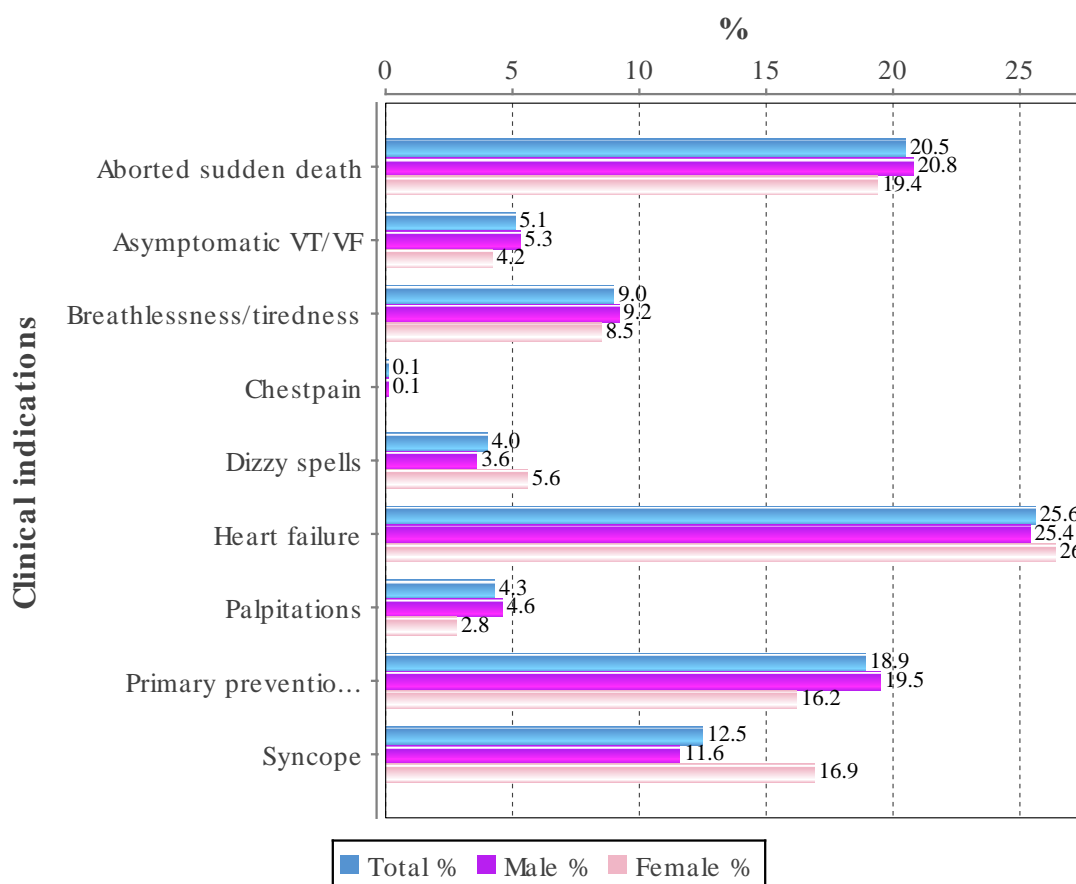
Mode	%	No
ICD CRT	28.7	441
ICD DR	43.2	664
ICD SR	25.8	397
ICD VDD	0.8	12
S-ICD	1.6	24



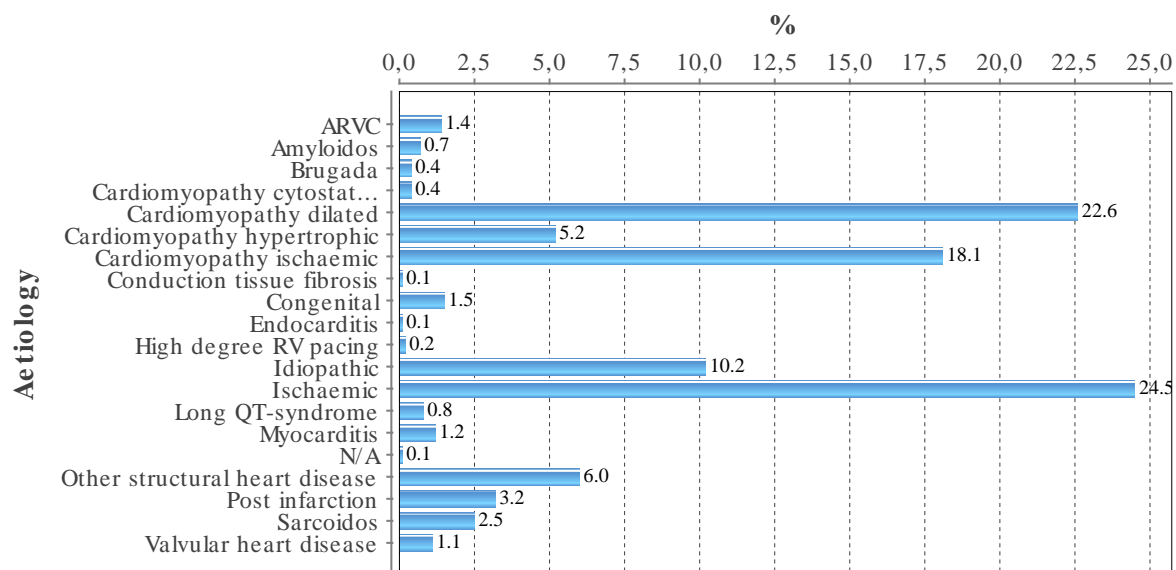
STATISTICS – ICD – CLINICAL INDICATIONS FIRST IMPLANT

Main symptom for implanting ICDs

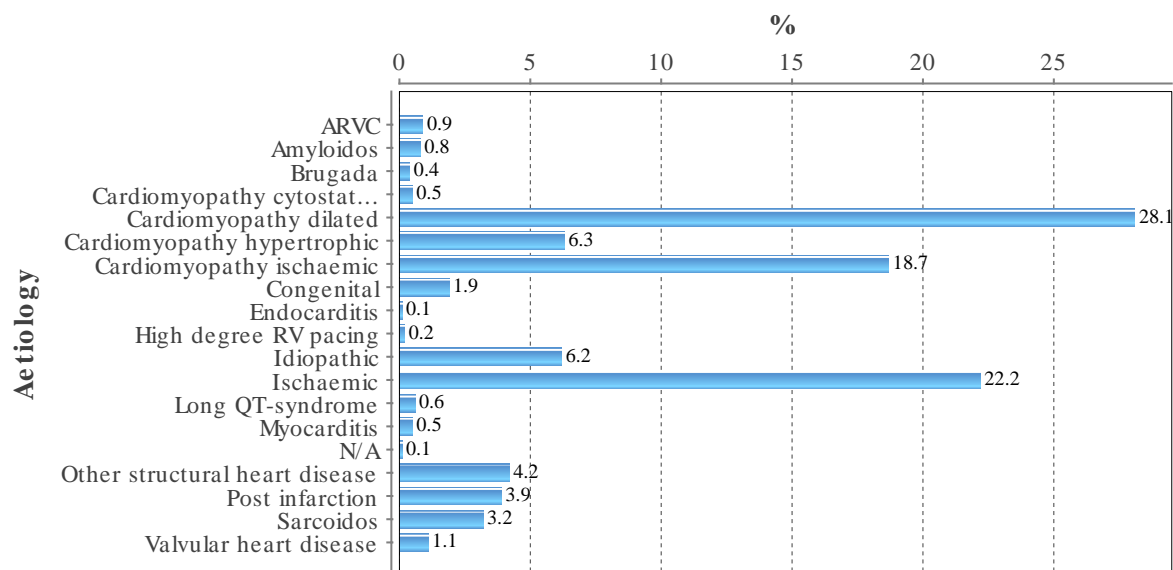
Indication	Total %	Male %	Female %
Aborted sudden death	20.5	20.8	19.4
Asymptomatic VT/VF	5.1	5.3	4.2
Breathlessness/tiredness	9.0	9.2	8.5
Chestpain	0.1	0.1	0.0
Dizzy spells	4.0	3.6	5.6
Heart failure	25.6	25.4	26.4
Palpitations	4.3	4.6	2.8
Primary prevention, asymptomatic	18.9	19.5	16.2
Syncope	12.5	11.6	16.9



STATISTICS – ICD - AETIOLOGY FIRST IMPLANT



STATISTICS – ICD - AETIOLOGY PRIMARY PREVENTION

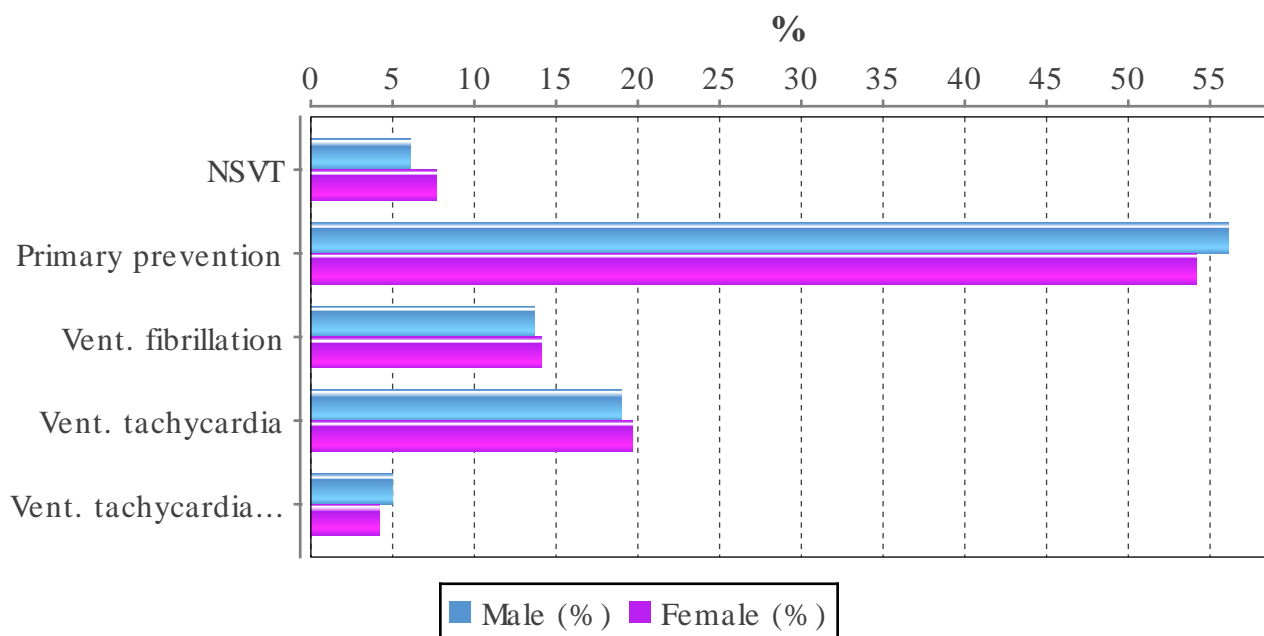
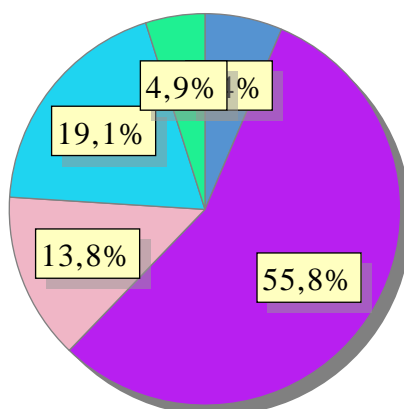


STATISTICS – ICD – PREPACING ECG (TACHY)

Documented ECG leading to ICD implant.(NSVT = non sustained VT) by gender and patients < 18 years

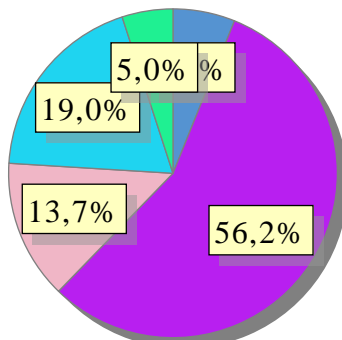
Indication	No	Total %	Male (%)	Female (%)	It 18 (%)
NSVT	99	6.4	6.1	7.7	0.0
Primary prevention	858	55.8	56.1	54.2	15.4
Vent. fibrillation	212	13.8	13.7	14.1	69.2
Vent. tachycardia	294	19.1	19.0	19.7	0.0
Vent. tachycardia + fibrillation	75	4.9	5.0	4.2	15.4

Total number of implants 1538



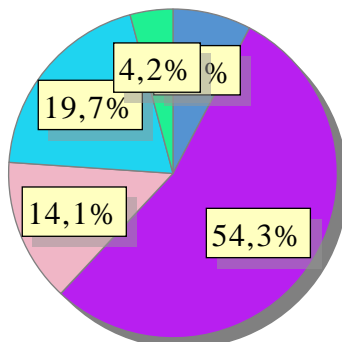
STATISTICS – ICD – PREPACING ECG (TACHY)

Male



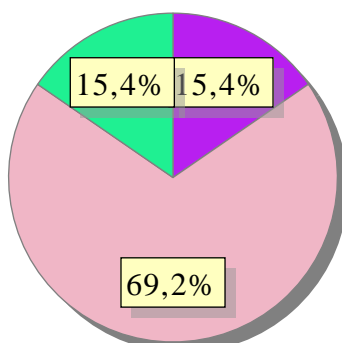
- NSVT ● Primary prevention ● Vent. fibrillation
- Vent. tachycardia ● Vent. tachycardia + fibrillation

Female



- NSVT ● Primary prevention ● Vent. fibrillation
- Vent. tachycardia ● Vent. tachycardia + fibrillation

< 18



- Primary prevention ● Vent. fibrillation
- Vent. tachycardia + fibrillation

STATISTICS – ICD – REASON FOR GENERATOR EXPLANT

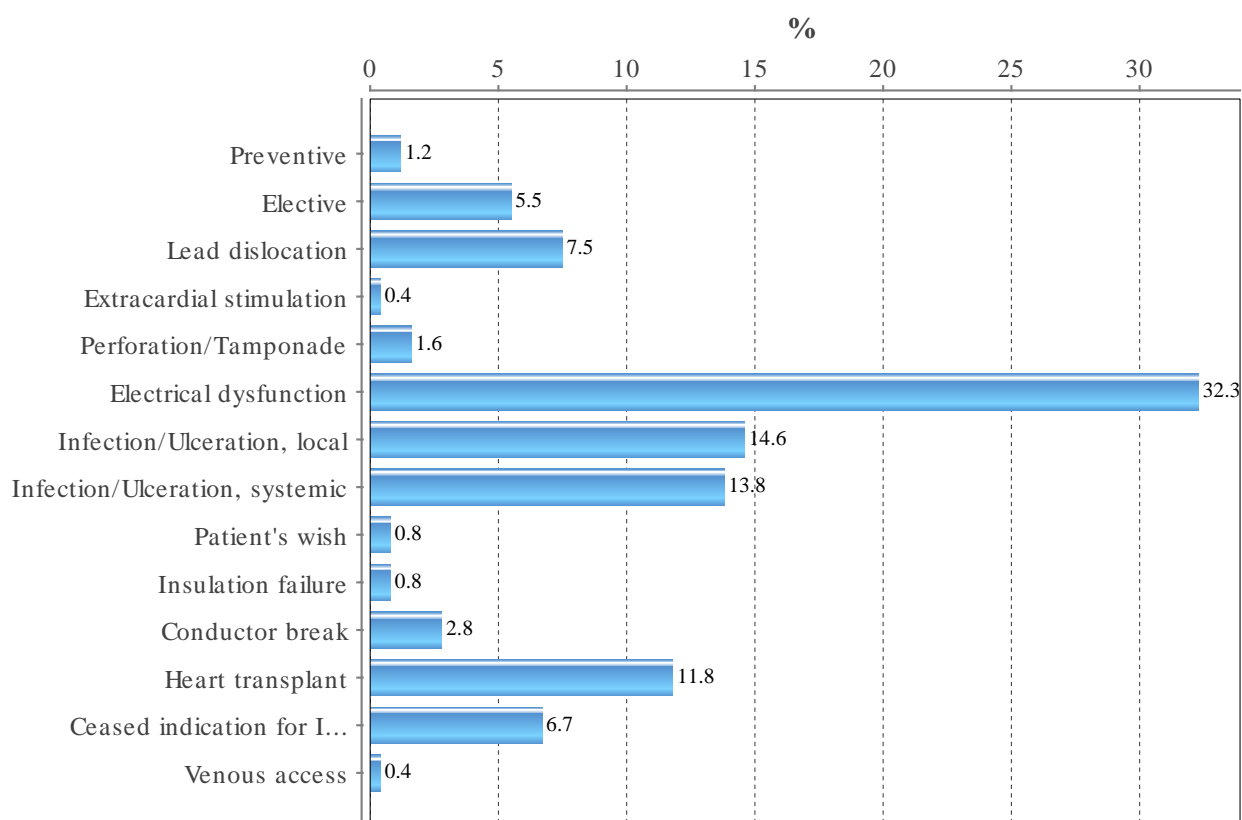
Historical explants indications

Reason	2021 %	2022 %	2023 %
Preventive	1.1	1.3	1.4
Elective	16.2	14.1	18.1
Recall/Alert	0.2	0.1	0.1
Erosion/Infection, local	4.1	3.6	3.9
Erosion/Infection, systemic	3.2	4.5	3.2
Patient's wish	0.9	0.6	0.8
CRT-D to CRT-P	0.5	0.5	0.8
CRT-D to ICD because of ceased CRT-indication	0.2	0.0	0.2
ERI	58.2	59.0	55.8
Premature EOL	1.2	1.8	1.1
Heart transplant	0.4	2.0	2.8
Ceased indication for ICD therapy	1.6	1.4	1.9
ICD to CRT-D	10.5	9.5	8.7
ICD to PM because of ceased indication	0.4	0.7	0.3
ICD to CRT-P because of heart failure	0.2	0.0	0.0
Technical failure	1.2	0.9	0.8

STATISTICS – ICD – REASON FOR LEAD EXPLANT

Historical lead explants indications

Reason	2021 %	2022 %	2023 %
Preventive	0.4	0.8	1.2
Elective	4.7	4.7	5.5
Lead dislocation	8.6	8.2	7.5
Extracardial stimulation	0.4	0.0	0.4
Perforation/Tamponade	1.7	0.8	1.6
Electrical dysfunction	31.3	32.9	32.3
Infection/Ulceration, local	16.7	14.5	14.6
Infection/Ulceration, systemic	16.3	18.4	13.8
Patient's wish	3.0	2.4	0.8
Insulation failure	1.3	0.4	0.8
Conductor break	3.9	2.7	2.8
Heart transplant	1.7	8.2	11.8
Ceased indication for ICD therapy	9.9	5.1	6.7
Venous access	0.0	0.8	0.4



Implant rates

Implant rates of CRT system in 2023 were 69 per million CRT-P's and 55 per million CRT-D's. The highest implant rate of CRT in total is found in Gotland with 279 per million and the lowest in Örebro with 71. The distribution between CRT-D and CRT-P systems show only small regional differences.

Patients

The average age of CRT-P patients at first implant is 77 y and CRT-D patients 68 years with a large male predominance, the same as last year. Medication for patients receiving CRT for the first time is given in tables.

Implanting organisations

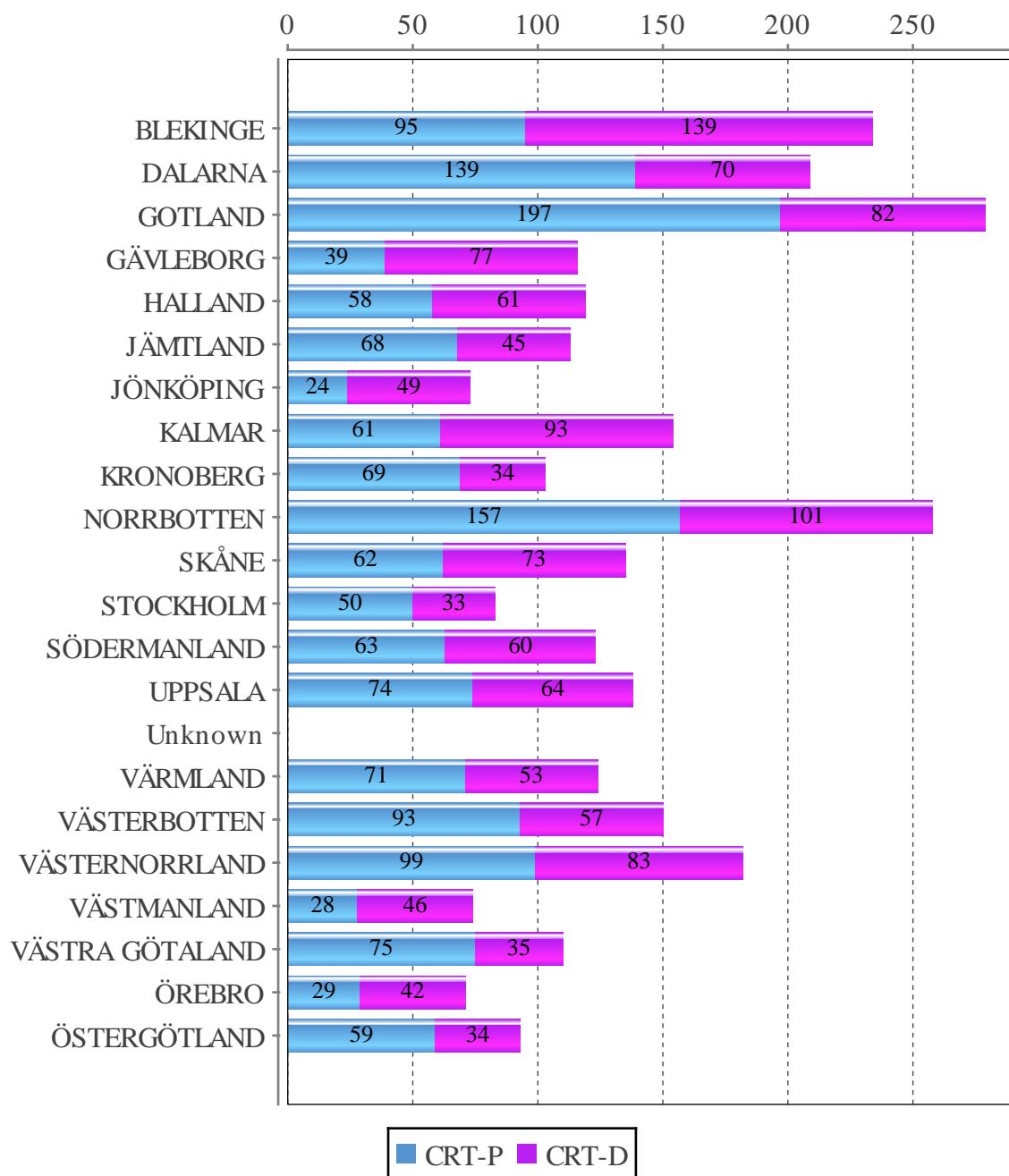
The number of centers performing CRT implantations are less than the number doing ICD's 22 vs 32. The number of CRT procedures per implanter range from 1-98 and only a few implanters performing >50 implants. The failure rate at implant is according to the registry 5% but this is most likely an underestimation when compared to the literature. Medication at the start of therapy is displayed in tables.

STATISTICS – CRT – HISTORICAL IMPLANT RATES

CRT Historical implant rates per hundred thousand residents

Year	Population	No First Impl	CRT-P		CRT-D	
			No	Rate	No	Rate
2019	10327589	1312	650	6.3	662	6.4
2020	10379295	1162	563	5.4	599	5.8
2021	10457147	1236	606	5.8	630	6.0
2022	10520558	1221	652	6.2	569	5.4
2023	10551707	1246	694	6.6	552	5.2

STATISTICS – CRT – IMPLANTS PER COUNTY

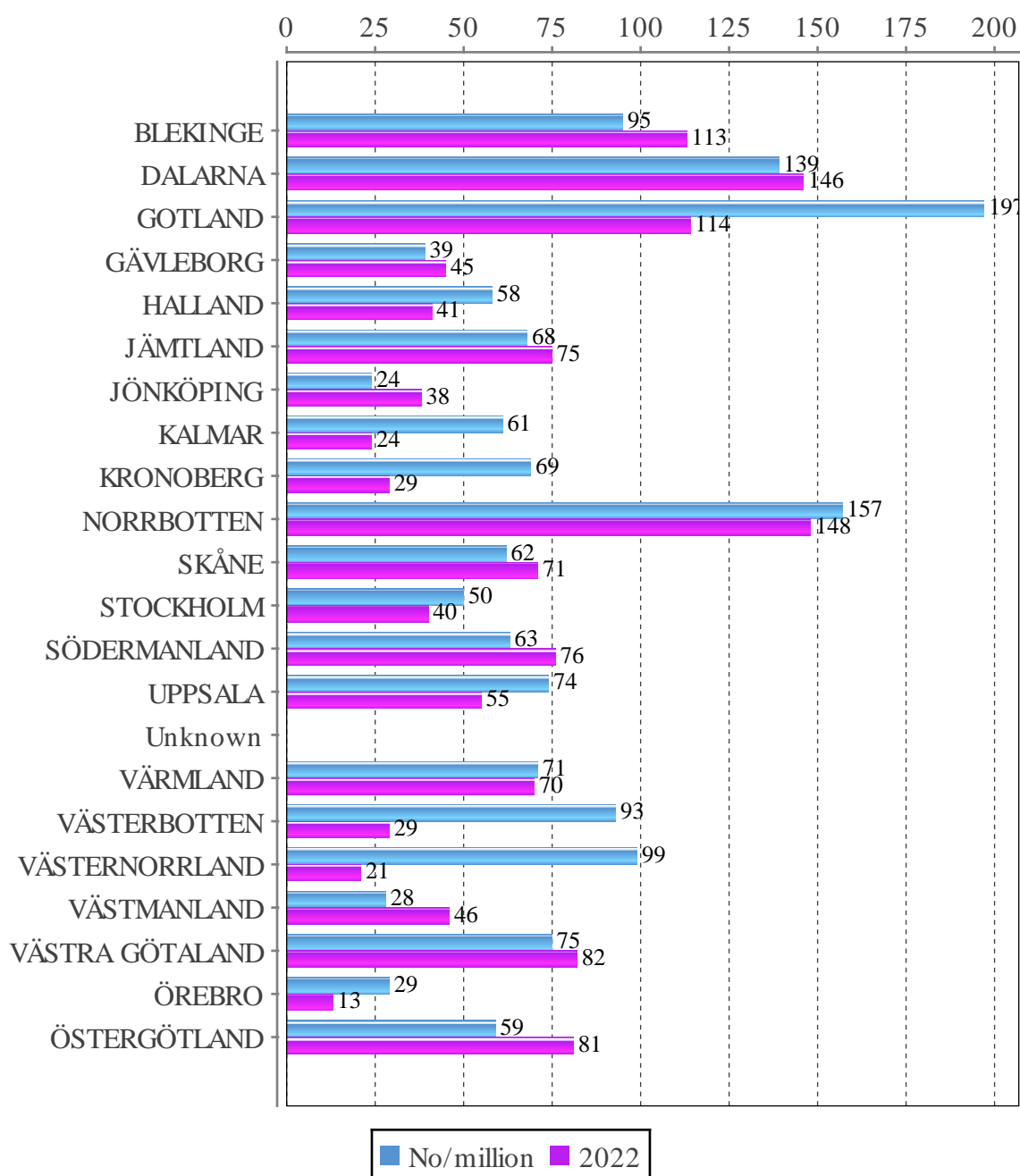


STATISTICS – CRT-P – IMPLANTS PER COUNTY

The regions are based on where the patients live, not where they are treated

	Population	No first impl	No/million
BLEKINGE	157973	15	95
DALARNA	287253	40	139
GOTLAND	61029	12	197
GÄVLEBORG	285642	11	39
HALLAND	343746	20	58
JÄMTLAND	132572	9	68
JÖNKÖPING	368856	9	24
KALMAR	246667	15	61
KRONOBERG	203686	14	69
NORRBOTTEN	248480	39	157
SKÅNE	1421781	88	62
STOCKHOLM	2454821	123	50
SÖDERMANLAND	301944	19	63
UPPSALA	404589	30	74
Unknown	0	3	0
VÄRMLAND	283548	20	71
VÄSTERBOTTEN	278729	26	93
VÄSTERNORRLAND	242148	24	99
VÄSTMANLAND	280813	8	28
VÄSTRA GÖTALAND	1767016	133	75
ÖREBRO	308116	9	29
ÖSTERGÖTLAND	472298	28	59
Total	10551707	695	66

STATISTICS – CRT-P – IMPLANTS PER COUNTY

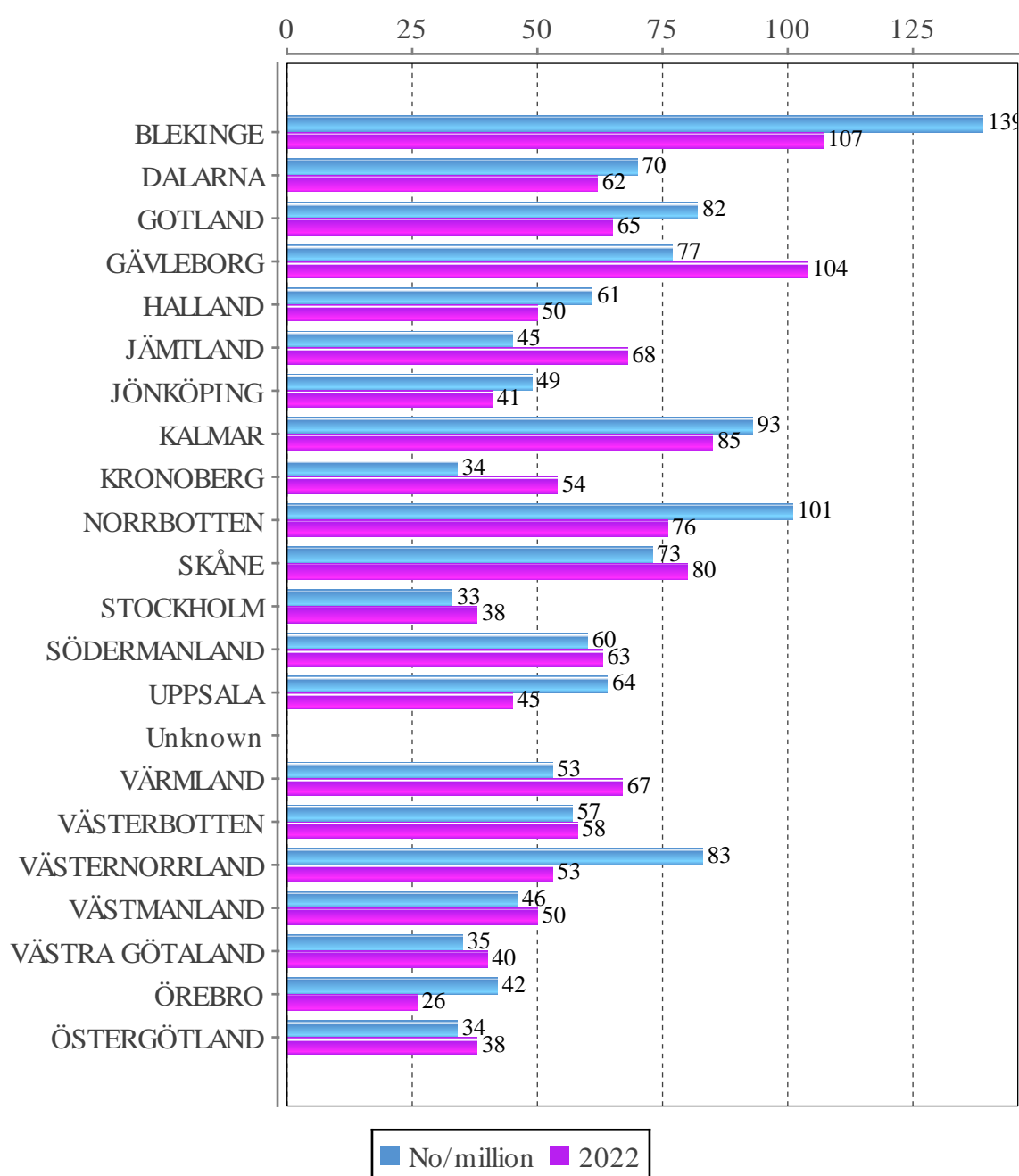


STATISTICS – CRT-D – IMPLANTS PER COUNTY

The regions are based on where the patients live, not where they are treated

	Population	No first impl	No/million
BLEKINGE	157973	22	139
DALARNA	287253	20	70
GOTLAND	61029	5	82
GÄVLEBORG	285642	22	77
HALLAND	343746	21	61
JÄMTLAND	132572	6	45
JÖNKÖPING	368856	18	49
KALMAR	246667	23	93
KRONOBERG	203686	7	34
NORRBOTTEN	248480	25	101
SKÅNE	1421781	104	73
STOCKHOLM	2454821	80	33
SÖDERMANLAND	301944	18	60
UPPSALA	404589	26	64
Unknown	0	4	0
VÄRMLAND	283548	15	53
VÄSTERBOTTEN	278729	16	57
VÄSTERNORRLAND	242148	20	83
VÄSTMANLAND	280813	13	46
VÄSTRA GÖTALAND	1767016	61	35
ÖREBRO	308116	13	42
ÖSTERGÖTLAND	472298	16	34
Total	10551707	555	53

STATISTICS – CRT-D – IMPLANTS PER COUNTY

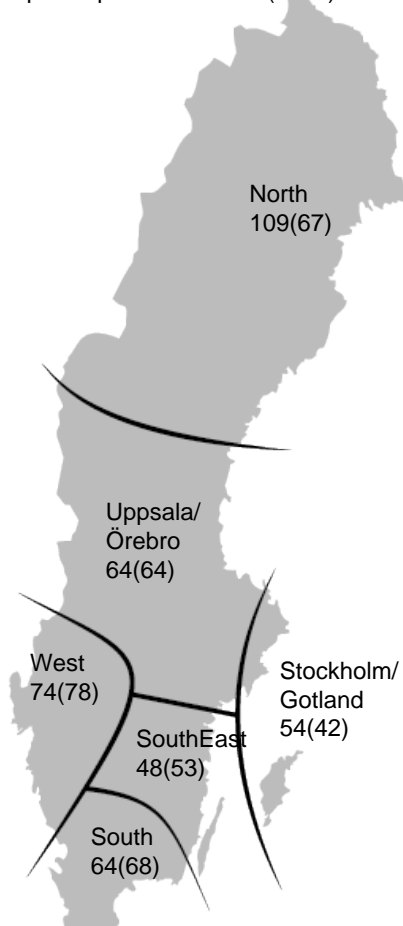


STATISTICS – CRT-P – IMPLANTS PER REGION

The regions are based on where the patients live, not where they are treated

Region	Population	No of first impl	No per million
Stockholm/Gotland	2515850	135	54
Uppsala/Örebro	2151905	137	64
South-East Sweden	1087821	52	48
Southern Sweden	1926100	124	64
Western Sweden	1968102	146	74
Northern Sweden	901929	98	109
Total	10551707	692	66

Implants per million 2023(2022)

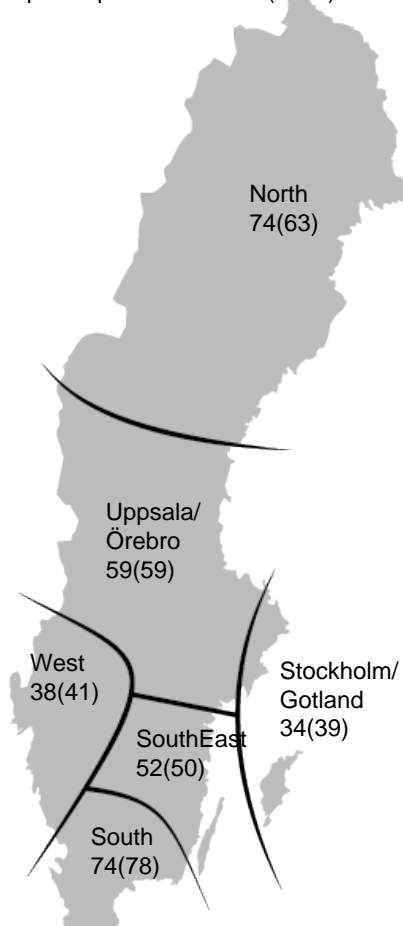


STATISTICS – CRT-D – IMPLANTS PER REGION

The regions are based on where the patients live, not where they are treated

Region	Population	No of first impl	No per million
Stockholm/Gotland	2515850	85	34
Uppsala/Örebro	2151905	127	59
South-East Sweden	1087821	57	52
Southern Sweden	1926100	142	74
Western Sweden	1968102	74	38
Northern Sweden	901929	67	74
Total	10551707	552	52

Implants per million 2023(2022)

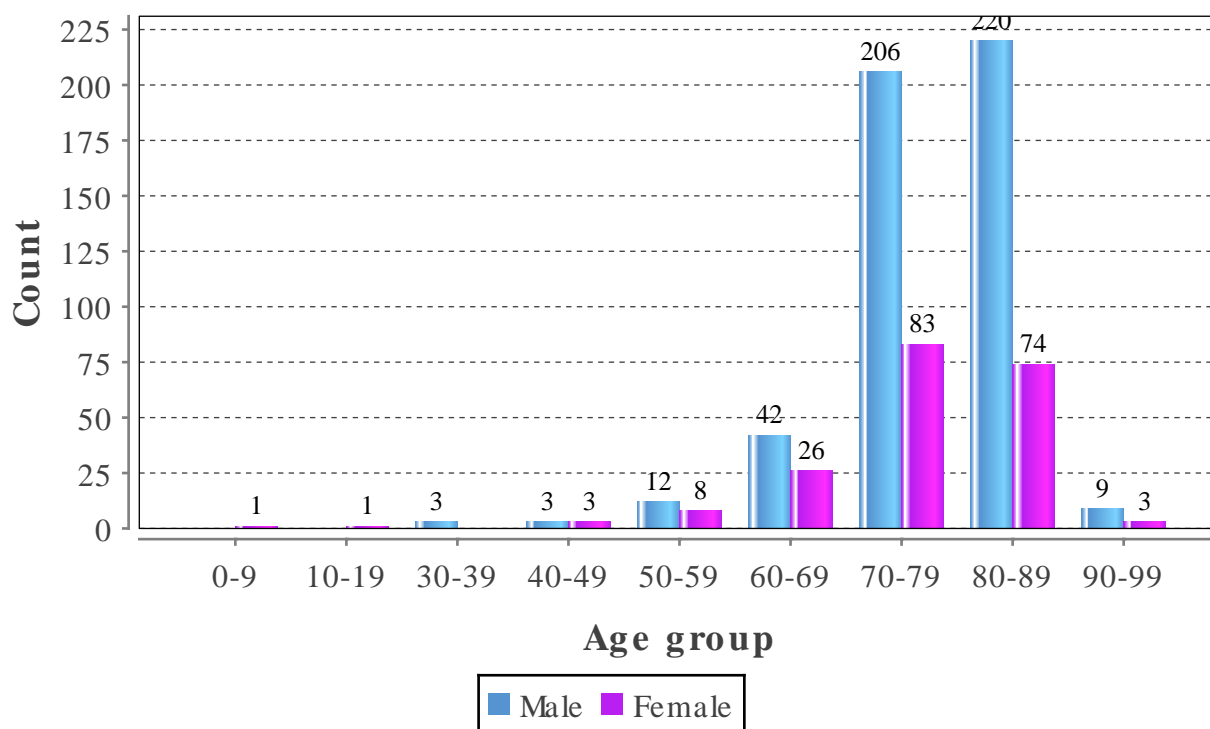


STATISTICS – CRT-P – AGE DISTRIBUTION MALES/FEMALES

Age and gender distribution for new implants, total numbers

Age (years)	Total no	%	Male	Female
0-9	1	0.1	0	1
10-19	1	0.1	0	1
30-39	3	0.4	3	0
40-49	6	0.9	3	3
50-59	20	2.9	12	8
60-69	68	9.8	42	26
70-79	289	41.6	206	83
80-89	294	42.4	220	74
90-99	12	1.7	9	3
Average age	77	0.0	78	75

Total number of implants: 694

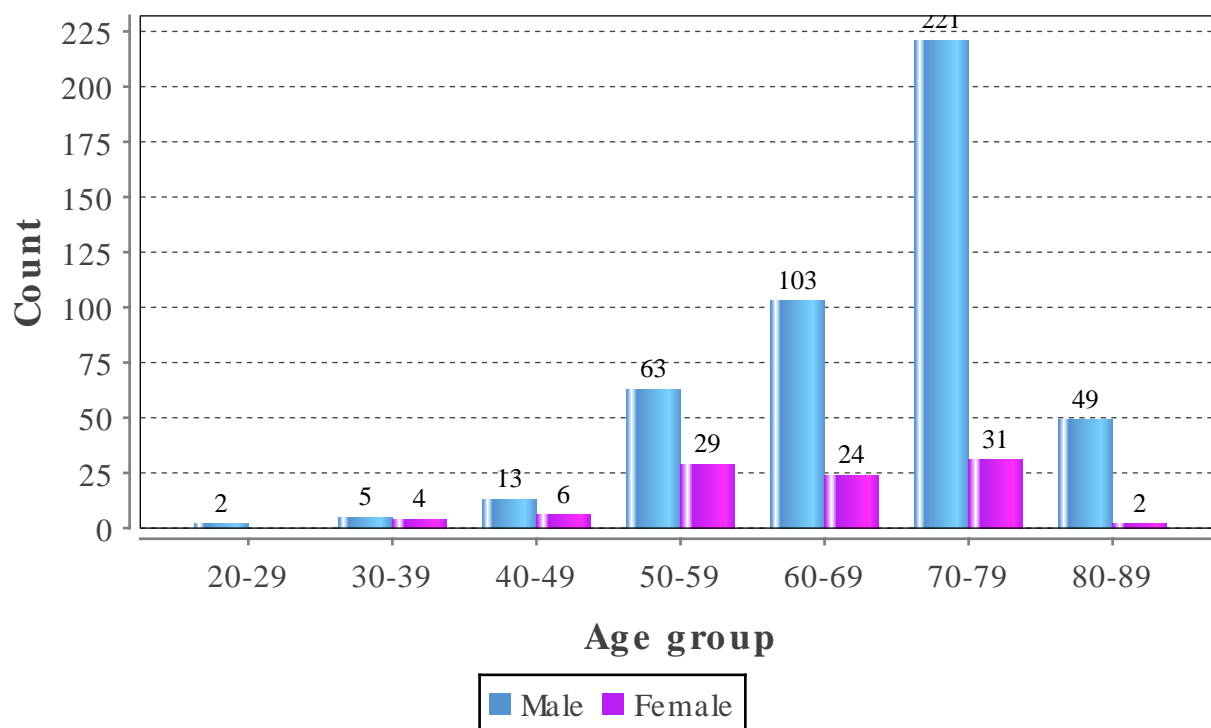


STATISTICS – CRT-D – AGE DISTRIBUTION MALES/FEMALES

Age and gender distribution for new implants, total numbers

Age (years)	Total no	%	Male	Female
20-29	2	0.4	2	0
30-39	9	1.6	5	4
40-49	19	3.4	13	6
50-59	92	16.7	63	29
60-69	127	23.0	103	24
70-79	252	45.7	221	31
80-89	51	9.2	49	2
Average age	68	0.0	69	63

Total number of implants: 552



STATISTICS – CRT – TYPE OF IMPLANTS

Based on both CRT-P and CRT-D

	Total		Male		Female	
	no	%	no	%	no	%
First implant	1245	56.5	950	76.3	295	23.7
Replacement	960	43.5	713	74.3	247	25.7
Total	2205	100.0	1663	75.4	542	24.6

ILR

1236 ILR's were implanted in Sweden 2023 which is slightly up from 1142 in 2022 with the main indication being dizzy spells 4%, palpitations, 7% and syncope 84%.

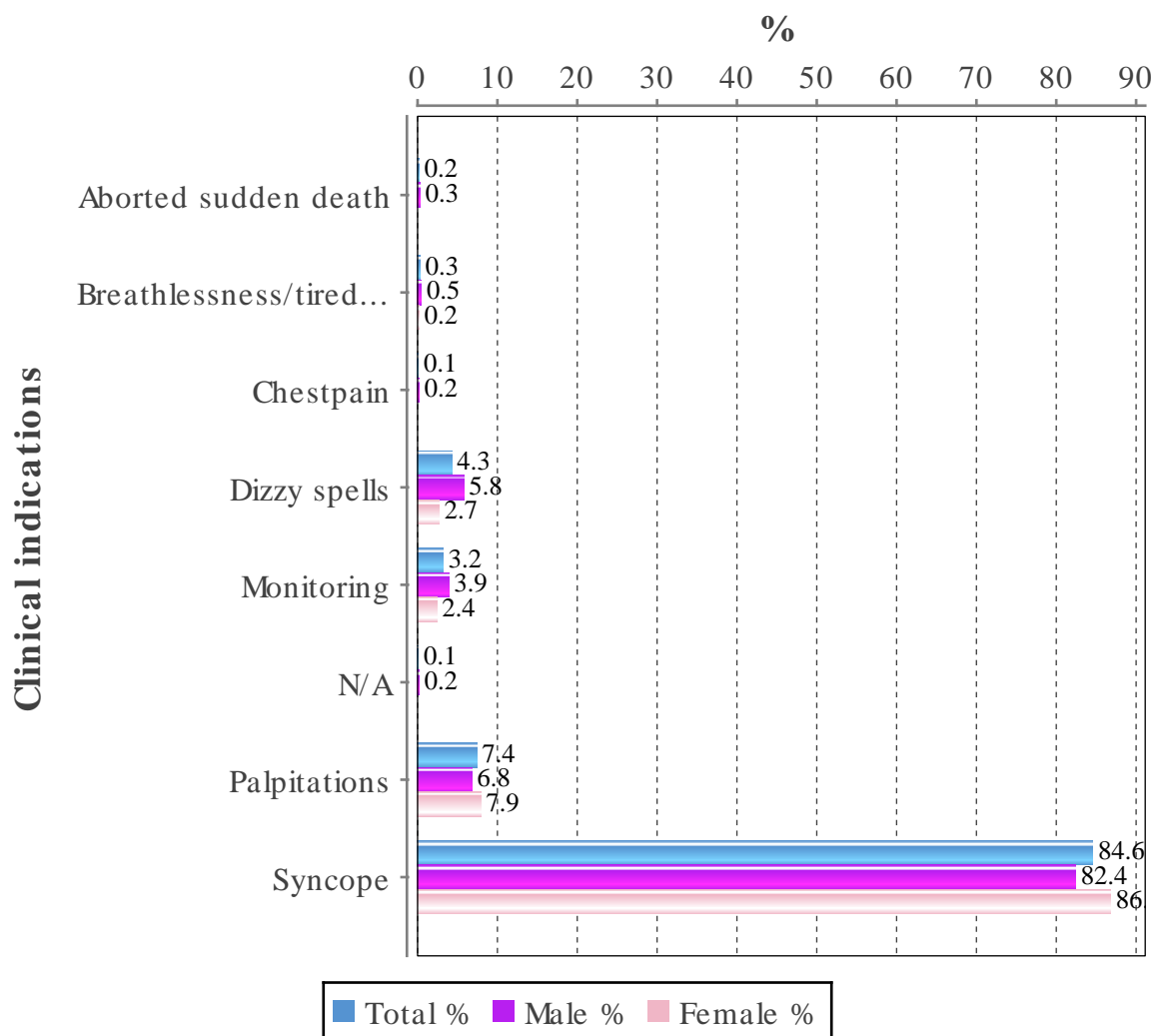
At the end of the ILR investigation period 70% of the patients were found to have an PM indication and 9% an ICD indication, the rest showed no pathological rhythm during the FU. In 10% a new ILR was implanted to extend the monitoring period.

STATISTICS – ILR – TYPE OF IMPLANTS

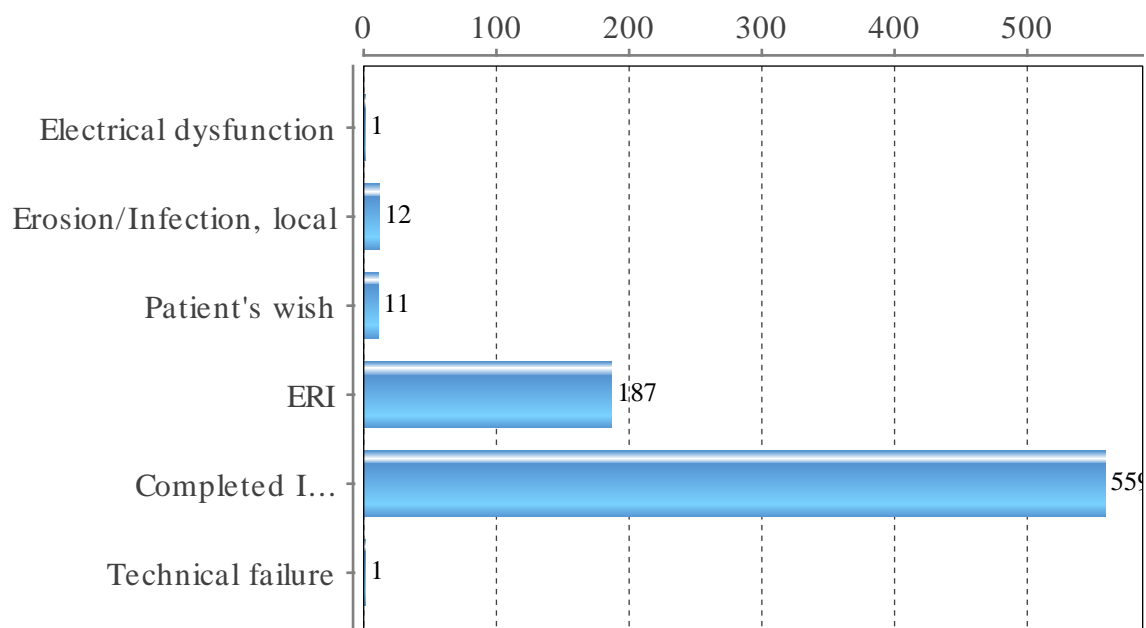
Ratio of new implants versus generator changes

	Total		Male		Female	
	no	%	no	%	no	%
First implant	1237	96.0	618	50.0	619	50.0
Replacement	51	4.0	16	31.4	35	68.6
Total	1288	100.0	634	49.2	654	50.8

STATISTICS – ILR – CLINICAL INDICATIONS



STATISTICS – ILR – REASON FOR REMOVAL



STATISTICS – ILR – ACTION AFTER ILR

Investigation after first ILR implant in % of completed ILR investigation

Action	No	%
Pacemaker implant	389	69.6
ICD implant	52	9.3
New ILR implant	58	10.4

Pacing modes

In high degree AV block only 5% of the patients receive VVI-R systems on average but to a higher degree, 9%, in small and medium sized hospitals.

The use of VVIR pacing mode in sinus node disease vary from 2-50% when comparing different hospitals.

Lead extraction

The numbers of lead extractions are increasing and there are now 5 centers performing regular assisted lead extraction. Numbers are given as patients/leads: Karolinska 104/195 leads, Lund 94/184, Sahlgrenska 33/59, Uppsala 41/88. The numbers are expected further increase in 2024. The lead dwell time is in the vast majority of cases 1-2 years but 71 leads had >20 years dwell time.

The most common reason is infection. Preventive extraction of leads with problems such as Medtronic Sprint Fidelis and SJM Riata is also performed in a lower number of cases 2023 than before due to decreasing numbers of leads still in use.

Methods and success rate are displayed for those hospitals that have complete reporting.

Complications pacemaker

The total complication rate for pacemaker procedures is 3,4% vs 5.4% in 2016 with lead dislodgement being the most common. Passive atrial leads show the highest dislodgement rate with 3,3% vs 1.6% for active fix atrial leads. LV leads show the same tendency with 1,9% dislodgement for all passive types and 0,8% for the Medtronic screw-in type CS lead.

There is a variation among the operating hospitals with possible underreporting in many cases. Hospitals that have registered <3% in total complication can be regarded as not having complete registration. This is based on literature regarding pacemaker procedure complications with a common rate of 5-10%.

Complications and gender

Infections are more common during generator changes 1%, than new implants 0,6% and most common in CRT system upgrades 0,7%.

In PMR female sex is associated with less complications of all types except perforation, pneumothorax and infections after upgrade to CRT. This is difference from the literature that usually have an overrepresentation of females in all types of complications.

Complications ICD

The overall complication rate to ICD treatment is 4,6% and is down slightly from 6.8% in 2019. The most common complication is lead dislodgement 1.5% followed by infection with 0,5%.

The rate between hospitals is also given in tables and as with pacemaker treatment <3% overall complication rate is considered incomplete registration.

Complications CRT

This is presented as a both CRT-D and CRT-P complications. Both are 3-4% and are very low and does not compare well with literature findings of up to 15% complications.

Most common are as with ICD's and PM's lead dislodgement 0,9% vs 1,1% for CRT-P and CRT-D. Most commonly it is the sc lead that dislodges.

Procedures

Duration of fluoroscopy and procedure times are given for all types and hospitals in tables. The procedures that have been performed in less than 10 procedures at different sites are marked as not reliable for comparison.

A single chamber device takes 50+-27 minutes to implant, and a dual chamber device 50+-25 min and a CRT system 92+-40 minutes to implant.

Device longevity ICD and PM

Generators generally have very good longevity with an average for Pacemakers of 99% after 5 years and 56% after 10 years but there are large differences between models and manufacturers. Each model is given in the tables.

Pacemaker lead survival is very good with a survival rate of 98% after 10 years with very little difference between models.

ICD generator survival is more heterogenous than PM generator survival with larger differences between manufacturers and models and an average of 97% after 5 years and 27% after 10 years.

Abbott Fortify and Unify were identified as problem generators in 2014 in our registry long before the Abbott alert and survival curves are given for each model.

ICD lead survival is also shorter than pacemaker lead survival, 97% after 5 years and 95% after 10 years.

The Medtronic Sprint Fidelis models were implanted in 903 cases in Sweden and the survival rate is 68% after 10 years and decreased rapidly as expected from previous years but now seems to be steady.

In the Abbott Riata model's failures are increasing and 10-year survival is now down to 73%, down from 77% in 2016.

The Biotronik Linux leads also have a decreased longevity compared to the average ICD lead and have an 72% 10-year survival.

Patients

The pacemaker patients have a 5-year survival of 69% and a 10-year survival of 42%.

The ICD patient survival is 67% after 5 years and 47% after 10 years.

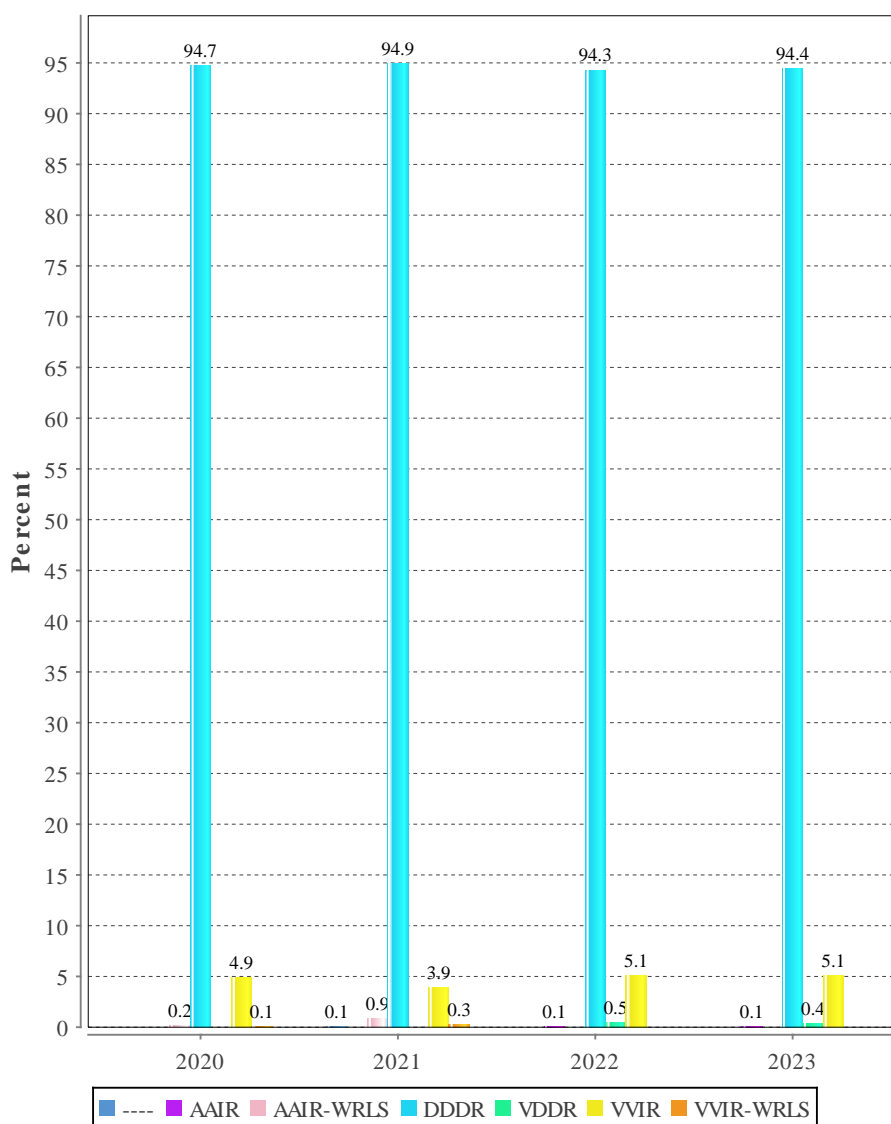
The heart failure patients treated with CRT also have the shortest expected survival rate among the PM and ICD patients. CRT-P patients have a 63% 5-year survival and 32% 10-year survival. CRT-D patients 31% 5-year survival and 28% 10 year survival.

One-year mortality is 9% in PM patients, 5% in ICD patients 7% in CRT-P patients and 4% in CRT-D patients.

QUALITY – PACEMAKER – FIRST IMPLANT HIGH DEGREE AV-BLOCK

Use of pacing mode for total AV block indication, historical data

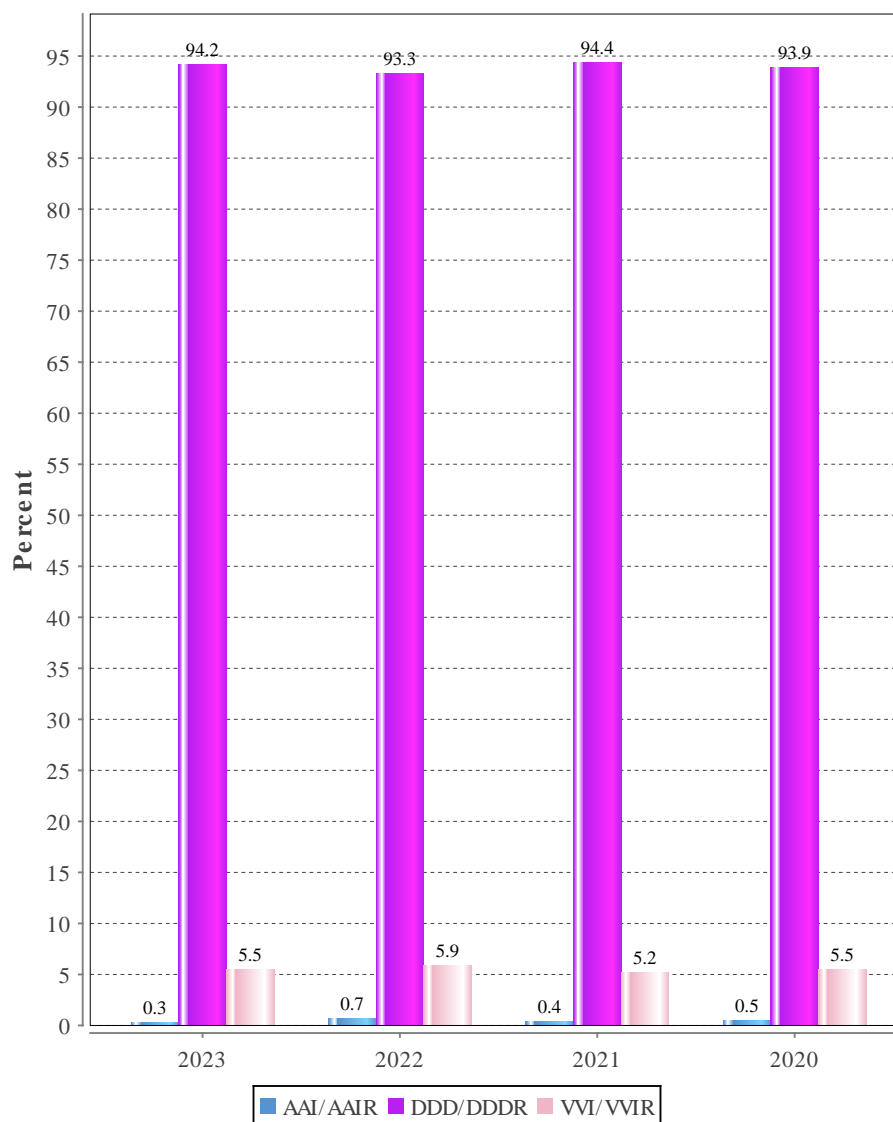
Mode %	2020	2021	2022	2023
----	0.0	0.1	0.0	0.0
AAIR	0.0	0.0	0.1	0.1
AAIR-WRLS	0.2	0.9	0.0	0.0
DDDR	94.7	94.9	94.3	94.4
VDDR	0.0	0.0	0.5	0.4
VVIR	4.9	3.9	5.1	5.1
VVIR-WRLS	0.1	0.3	0.0	0.0



QUALITY – PACEMAKER – FIRST IMPLANT SINUS NODE DYSFUNCTION

Use of pacing mode for Sinus Node Disease, historical data

Mode (%)	2023	2022	2021	2020
AAI/AAIR	0.3	0.7	0.4	0.5
DDD/DDDR	94.2	93.3	94.4	93.9
VVI/VVIR	5.5	5.9	5.2	5.5



QUALITY – PACEMAKER – LEAD DISLOCATION

Dislocation rate for different lead types in atrial or ventricular placement. Based on all implants implanted 2007 and later and explanted/corrected 2023 or earlier

Type	Right atrium %	Right ventricle %	Left ventricle %	Total %
Fixed screw	1.6	0.9	0.8	1.2
Retractable screw	1.6	0.9	0.8	1.2
Passive	3.3	1.6	1.9	1.3
All	1.6	1.0	1.6	1.3

QUALITY – LEAD EXTRACTIONS

Extractions per hospital

Hospital	No of patients	No of leads
Akademiska sjukhuset	41	88
Falu lasarett	6	11
Karolinska Solna	104	195
Linköpings universitetssjukhus	5	10
Sahlgrenska universitetssjukhuset	33	59
Skånes universitetssjukhus, Lund	94	184
Sunderby sjukhus	5	7
Universitetssjukhuset Örebro	4	7

Extractions per type

Type	Extractions
ICD lead	112
Pacemaker lead	487

Extractions per model (more than 5 extractions)

Manufacturer	Model	Extractions
Abbott	1258T QuickFlex	9
Abbott	1458Q Quartet MRI	18
Abbott	1948 Isoflex MRI	6
Abbott	1999 Optisense	23
Abbott	2088TC Tendril STS MRI 46/52/58 cm	171
Abbott	7122Q Durata	23
Abbott	LDA210Q Optisure DF4	21
Biotronik	Linax Smart S75	6
Biotronik	Solia S53 MRI	15
Biotronik	Solia S60 MRI	13
Boston Scientific	4470 Fineline II Sterox EZ MRI	11
Boston Scientific	7741 Ingevity MRI	12
Boston Scientific	7742 Ingevity MRI	13
Medtronic	3830 SelectSecure MRI	8
Medtronic	4076 CapSureFix Novus MRI	70
Medtronic	4796 Attain Stability MRI	6
Medtronic	5076 CapSureFix MRI	11
Medtronic	6935M Sprint Quattro S MRI DF4	14
Vitatron	ICQ09B Crystalline	7

QUALITY – LEAD EXTRACTIONS

Extractions per reason

Reason	Extractions
Ceased indication for PM therapy	18
Conductor break	9
Elective	51
Electrical dysfunction	76
Heart transplant	56
Infection/Ulceration, local	128
Infection/Ulceration, systemic	208
Lead dislocation	23
Preventive	9
Venous access	10

*Extraction positions**

Hospital	Femoral	Left superior	N/A	Right superior
Akademiska sjukhuset	0	78	1	9
Falu lasarett	0	11	0	0
Karolinska Solna	0	188	3	4
Linköpings universitetssjukhus	0	10	0	0
Skånes universitetssjukhus, Lund	0	183	0	1
Universitetssjukhuset Örebro	0	7	0	0

*Hospital Sahlgrenska and Sunderby excluded

QUALITY – LEAD EXTRACTIONS

*Extraction problems**

Hospital	I	E	O	P	X	D
Akademiska sjukhuset	0	1	0	0	0	0
Falu lasarett	0	0	0	0	0	0
Karolinska Solna	0	0	0	0	0	0
Linköpings universitetssjukhus	0	0	0	0	0	0
Skånes universitetssjukhus, Lund	0	0	0	0	0	0
Universitetssjukhuset Örebro	0	0	0	0	0	0

(*Hospital Sahlgrenska and Sunderby excluded), I: Insulation break, E: Conductor break, O: Unintentional extraction of another lead, P: Perforation/Tamponade, X: Pneumothorax, D: Death

*Extraction results**

Hospital	Failed	Partially successful	Successful
Akademiska sjukhuset	0	0	88
Falu lasarett	0	0	11
Karolinska Solna	0	4	191
Linköpings universitetssjukhus	0	0	10
Skånes universitetssjukhus, Lund	0	6	178
Universitetssjukhuset Örebro	0	0	7

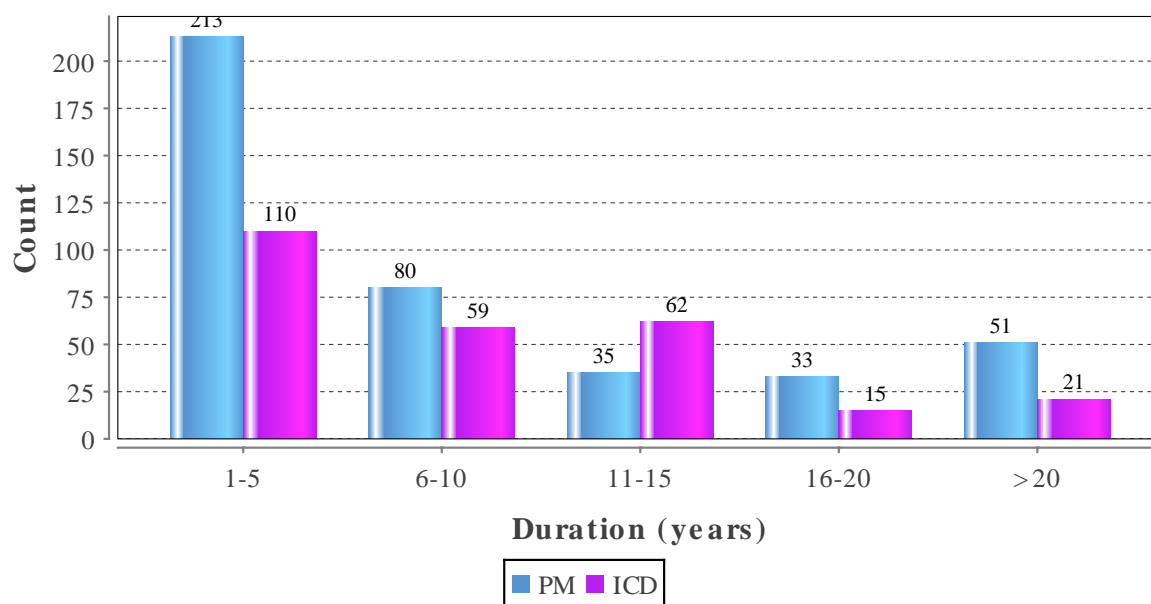
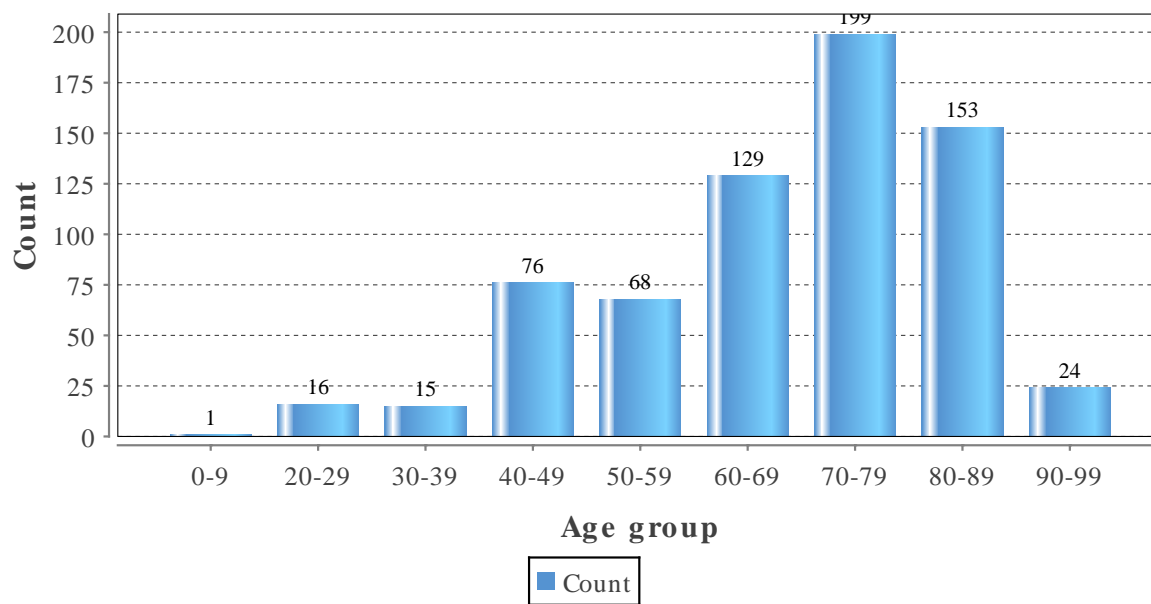
*Hospital Sahlgrenska and Sunderby excluded

*Extraction tools**

Hospital	SS	LS	PS	AM	L	S	PK	EK	AL
Akademiska sjukhuset	42	50	10	41	0	0	0	0	2
Falu lasarett	0	0	0	0	0	0	0	0	0
Karolinska Solna	0	38	16	90	0	0	0	0	1
Linköpings universitetssjukhus	8	0	0	0	0	0	0	0	0
Skånes universitetssjukhus, Lund	39	7	17	55	0	5	0	0	0
Universitetssjukhuset Örebro	5	0	0	0	0	0	0	0	0

(*Hospital Sahlgrenska and Sunderby excluded), SS: Standard stylet, LS: Locking stylet, PS: Passive sheath, AM: Active mechanical sheath, L: Lasso, S: Snare, PK: Pigtail catheter, EP: EP catheter, AL: Active laser sheath

QUALITY – LEAD EXTRACTIONS

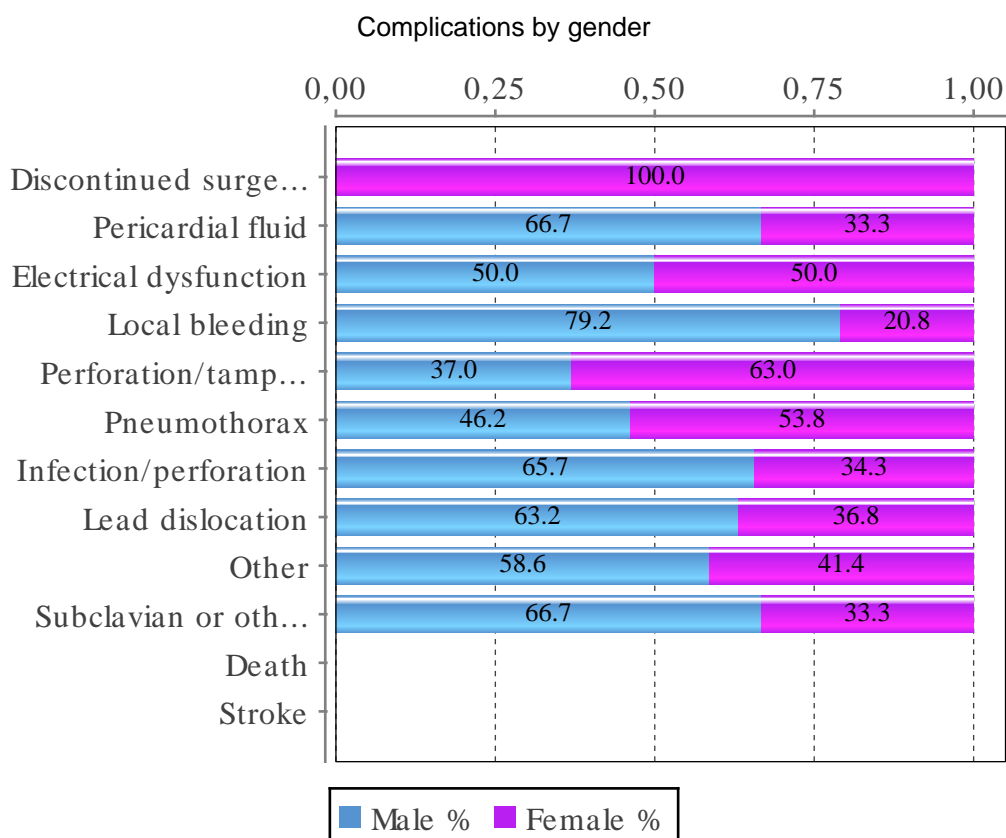


QUALITY – PACEMAKER – COMPLICATIONS

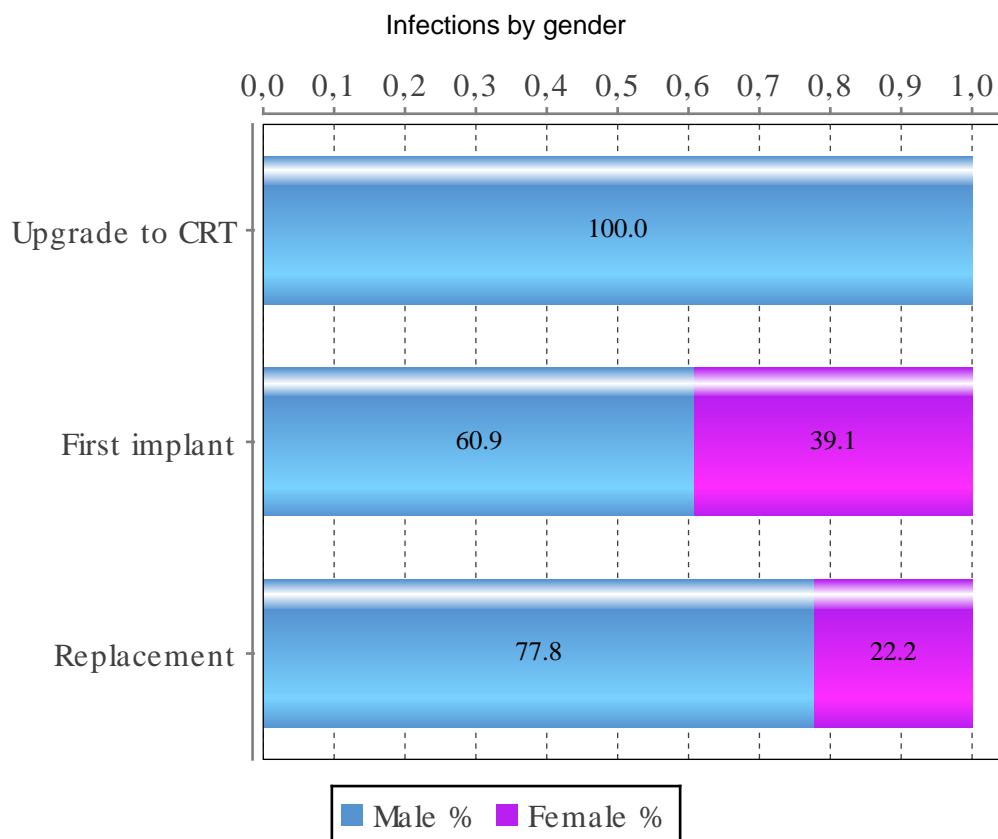
Registered complications for new implants and for bleeding, infection and other also including replacements

Complication	2022 %	2023 %	Based on
Discontinued surgery due to hemodynamic reasons	0.0	0.0	A
Pericardial fluid	0.0	0.1	A
Electrical dysfunction	0.3	0.3	B
Local bleeding	0.3	0.2	A
Perforation/tamponade	0.4	0.3	B
Pneumothorax	0.4	0.5	B
Infection/perforation	0.4	0.3	A
Lead dislocation	1.5	1.4	B
Other	0.3	0.3	A
Subclavian or other related thrombosis	0.1	0.0	B
Death	0.0	0.0	A
Stroke	0.0	0.0	A
Discontinued surgery due to lack of venous access	0.0	0.0	A
Discontinued surgery due to LV-lead impl. failure	0.2	0.1	A
Total	3.9	3.5	

Based on A=11253 (all implants) alternatively B=8264 (first implants + lead replacement) validated events



QUALITY – PACEMAKER INFECTIONS



Infections related to all interventions by gender

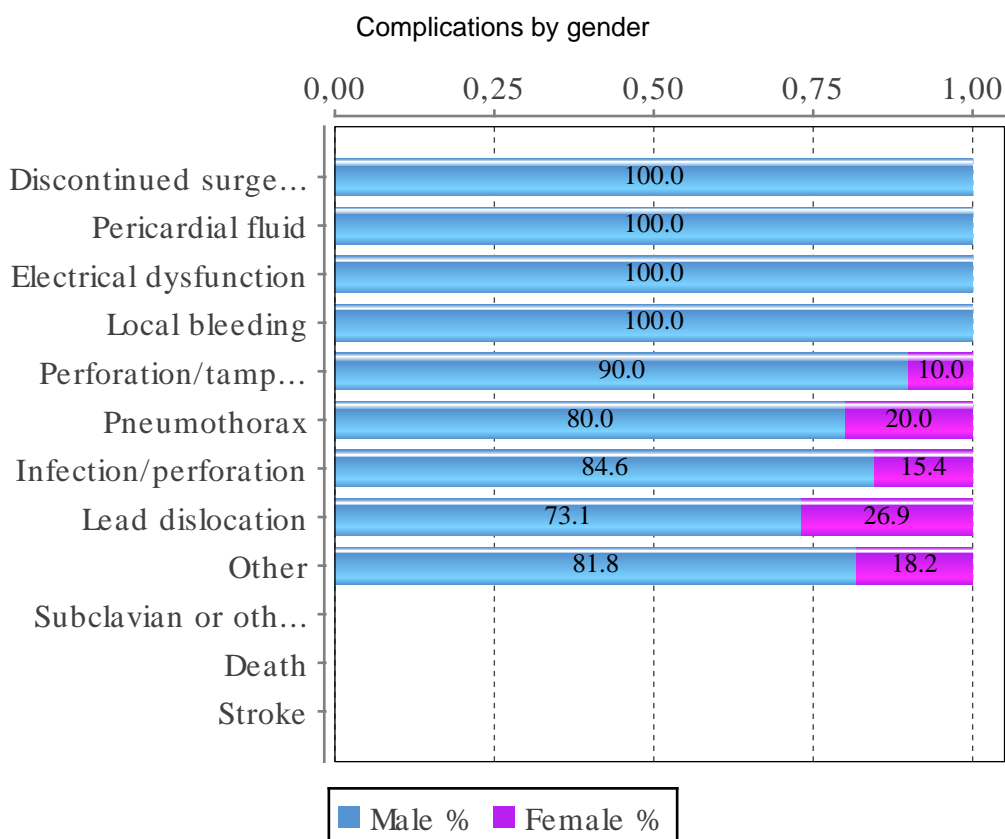
Reason	Male %	Female %
<i>First implant</i>	<i>0.3</i>	<i>0.3</i>
<i>Replacement</i>	<i>0.7</i>	<i>0.3</i>
<i>Upgrade to CRT</i>	<i>0.7</i>	<i>0.0</i>

QUALITY – ICD – COMPLICATIONS

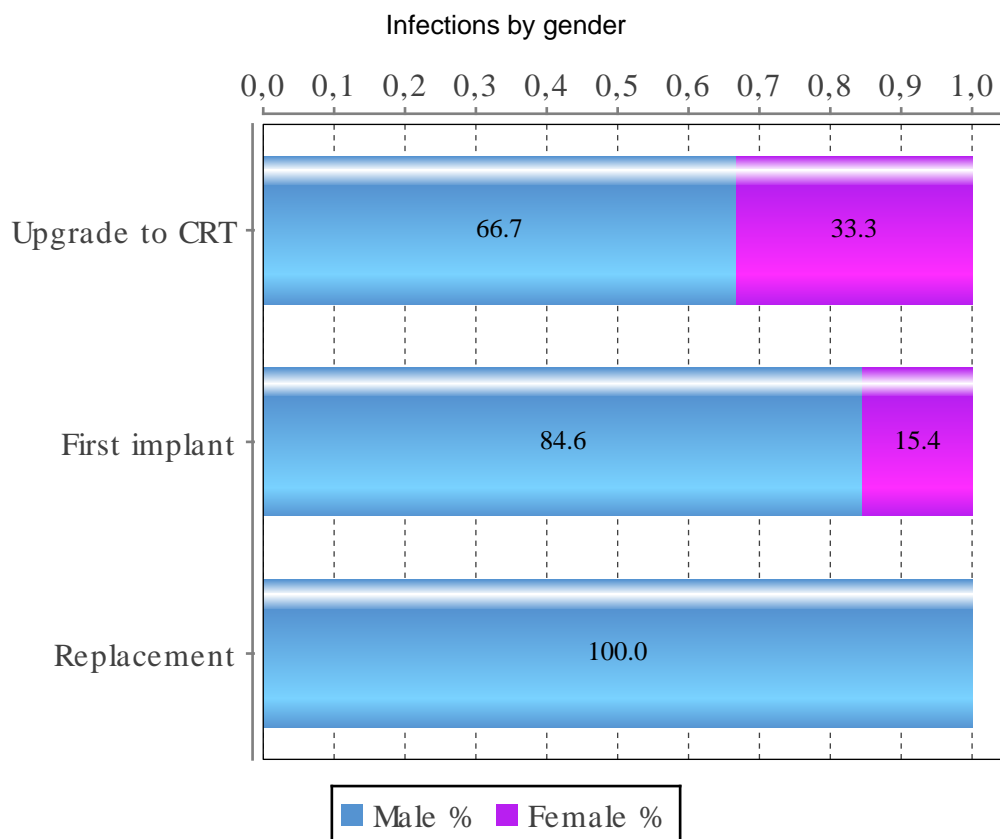
Registered complications for new implants and for bleeding, infection and other also including replacements

Complication	2022 %	2023 %
Discontinued surgery due to hemodynamic reasons	0.0	0.0
Electrical dysfunction	0.6	0.6
Local bleeding	0.6	0.5
Perforation/tamponade	0.4	0.6
Pneumothorax	0.4	0.3
Infection/perforation	0.6	0.5
Lead dislocation	1.2	1.6
Other	0.2	0.5
Subclavian or other related thrombosis	0.0	0.0
Death	0.0	0.0
Pericardial fluid	0.0	0.0
Stroke	0.0	0.0
Discontinued surgery due to lack of venous access	0.0	0.0
Discontinued surgery due to LV-lead impl. failure	0.4	0.2
Total	4.4	4.8

Based on 2427 (all implants) alternatively 1668 (first implants + lead replacements) validated events



QUALITY – ICD INFECTIONS



Infections related to all interventions by gender

Reason	Male %	Female %
<i>First implant</i>	<i>0.9</i>	<i>0.7</i>
<i>Replacement</i>	<i>0.6</i>	<i>0.0</i>
<i>Upgrade to CRT</i>	<i>0.8</i>	<i>1.9</i>

QUALITY – CRT – COMPLICATIONS

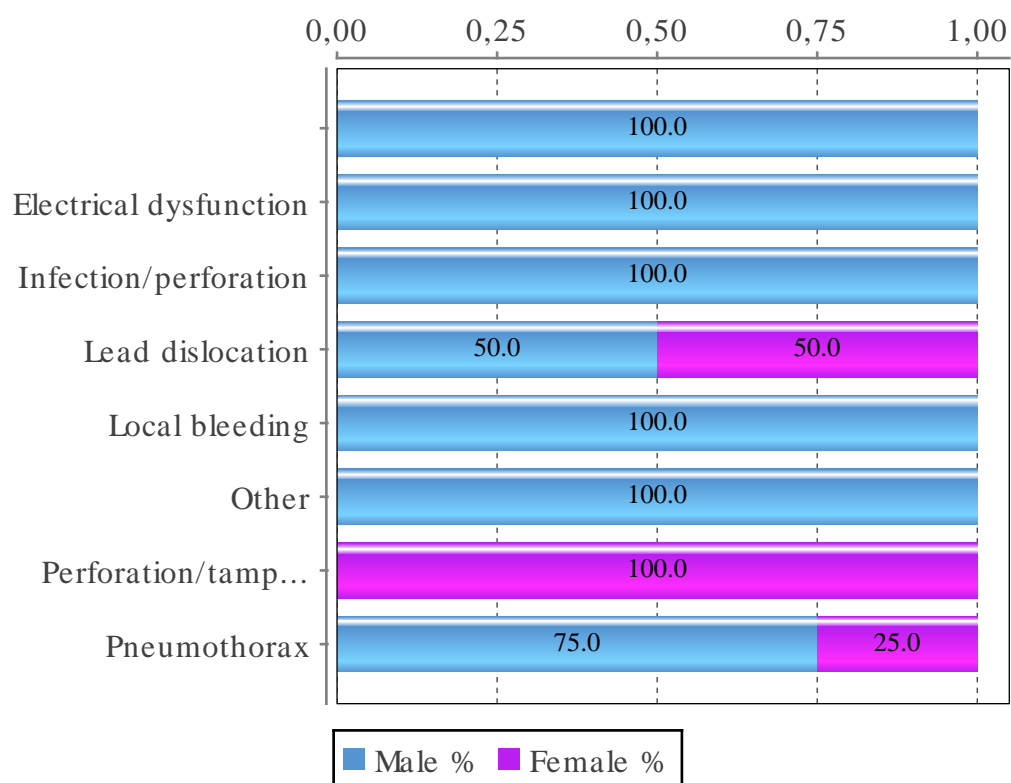
Registered complications for new implants and for bleeding, infection and other also including replacements.

CRT-P Complication	%
Death	-
Discontinued surgery due to LV-lead impl. failure	-
Discontinued surgery due to hemodynamic reasons	-
Discontinued surgery due to lack of venous access	-
Electrical dysfunction	0.6
Infection/perforation	0.3
Lead dislocation	0.9
Local bleeding	0.3
Other	0.4
Perforation/tamponade	0.1
Pericardial fluid	-
Peroperative arrhythmia requiring acute medication	-
Pneumothorax	0.6
Stroke	-
Subclavian or other related thrombosis	-
Total	3.2
Total no of implants 690	

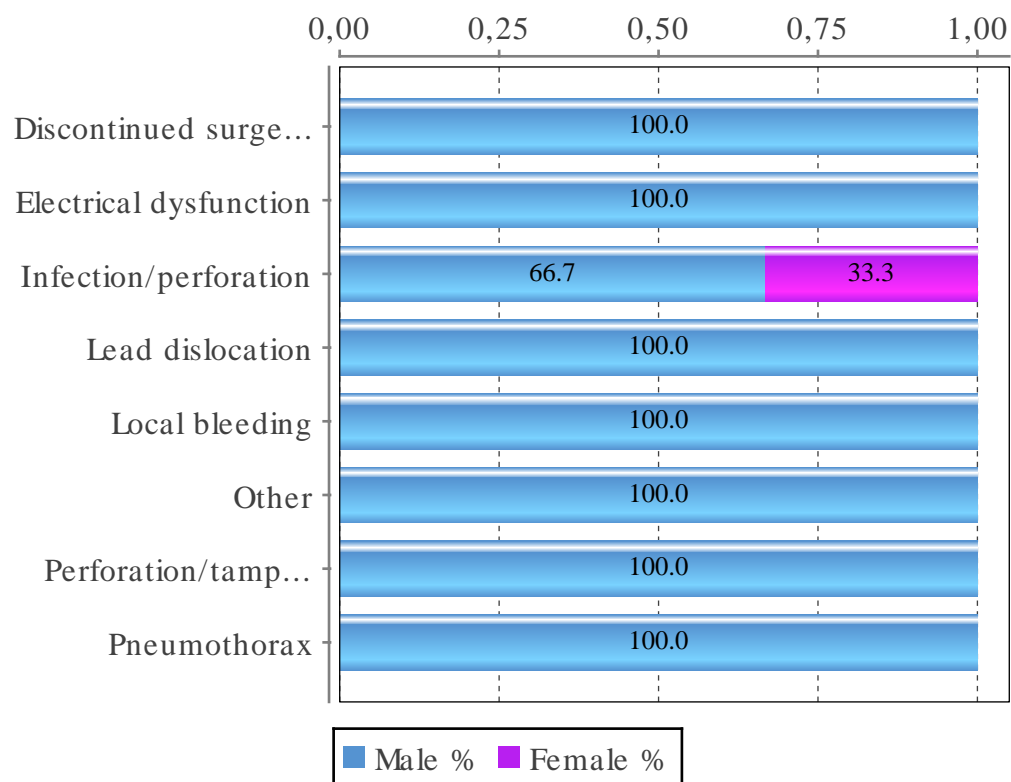
CRT-D Complication	%
Death	-
Discontinued surgery due to LV-lead impl. failure	-
Discontinued surgery due to hemodynamic reasons	0.2
Discontinued surgery due to lack of venous access	-
Electrical dysfunction	0.6
Infection/perforation	0.6
Lead dislocation	1.1
Local bleeding	0.6
Other	0.2
Perforation/tamponade	0.2
Pericardial fluid	-
Peroperative arrhythmia requiring acute medication	-
Pneumothorax	0.4
Stroke	-
Subclavian or other related thrombosis	-
Total	3.7
Total no of implants 543	

QUALITY – CRT – COMPLICATIONS

CRT-P complications by gender



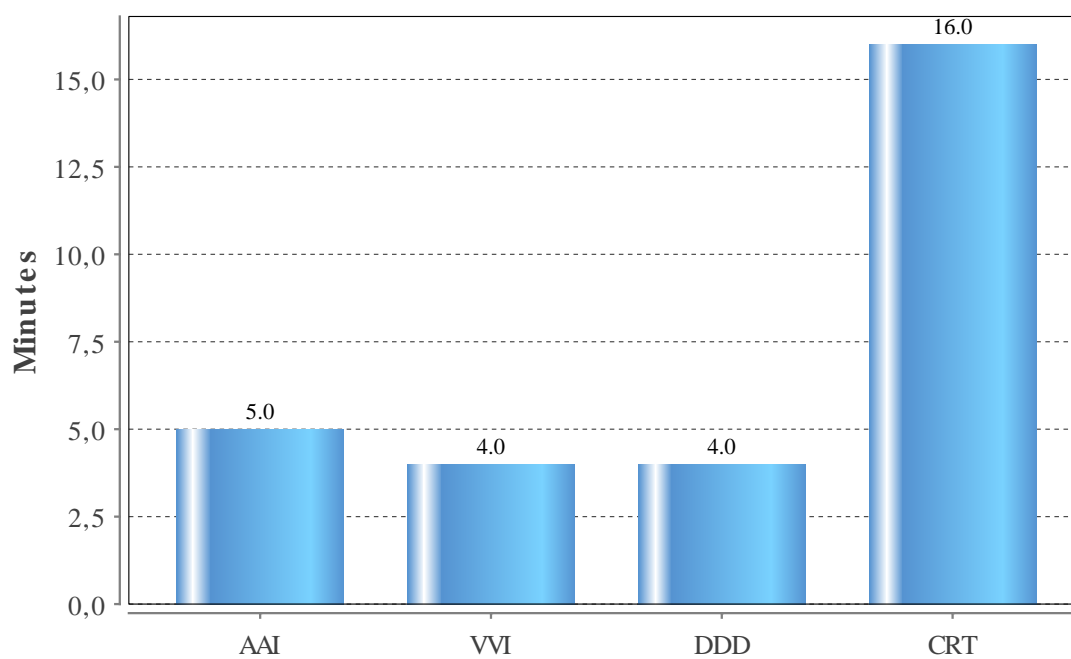
CRT-D complications by gender



QUALITY – PACEMAKER – FLUOROSCOPY PER SUBTYPE

National mean fluoroscopy duration for a new implant of different subtypes

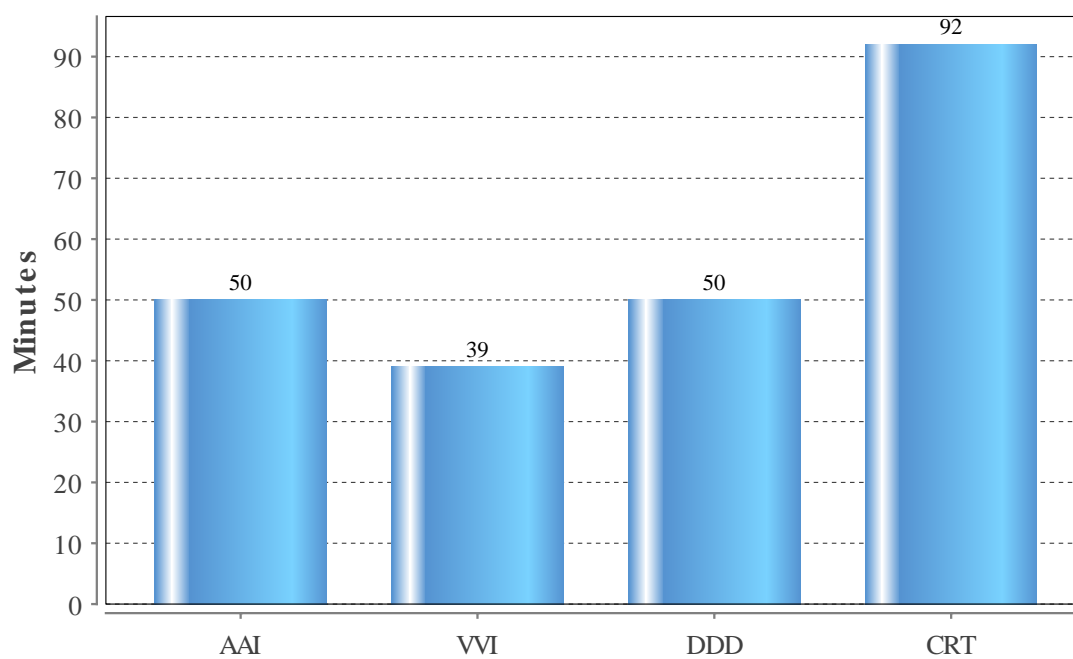
Fluoroscopy time	Average	Standard deviation
AAI	5.0	5.6
VVI	4.0	7.2
DDD	4.0	5.7
CRT	16.0	13.6



QUALITY – PACEMAKER – KNIFE TIME PER SUBTYPE

National mean skin to skin duration for a new implant of different subtypes

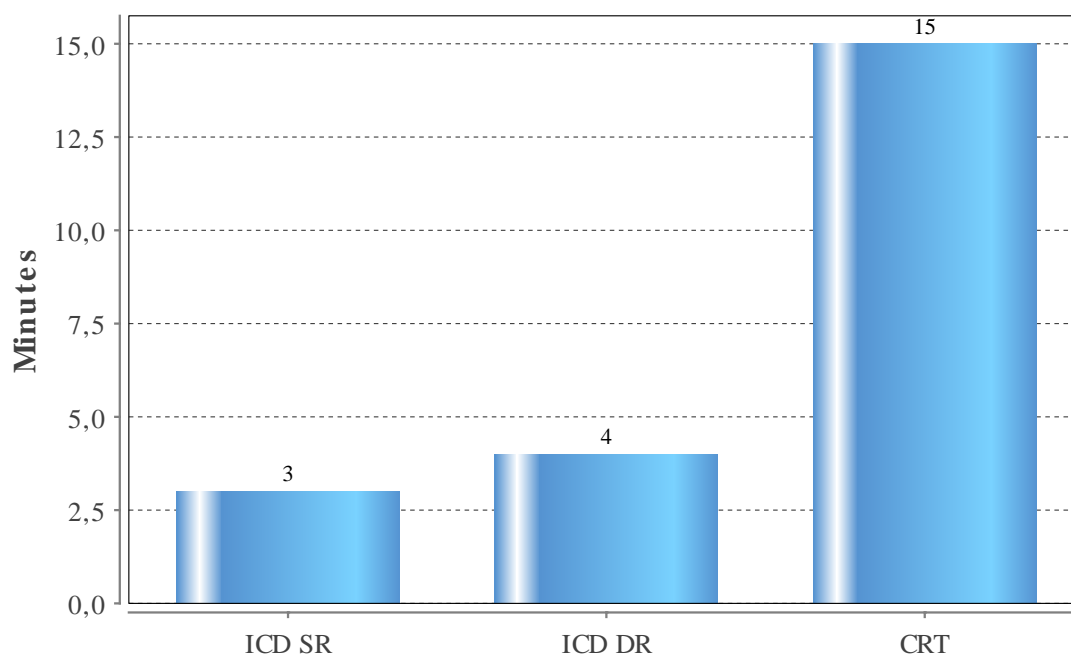
Knife time	Average	Standard deviation
AAI	50	27.1
VVI	39	22.4
DDD	50	25.2
CRT	92	40.6



QUALITY – ICD – FLUOROSCOPY PER SUBTYPE

National mean fluoroscopy duration for a new implant of different subtypes

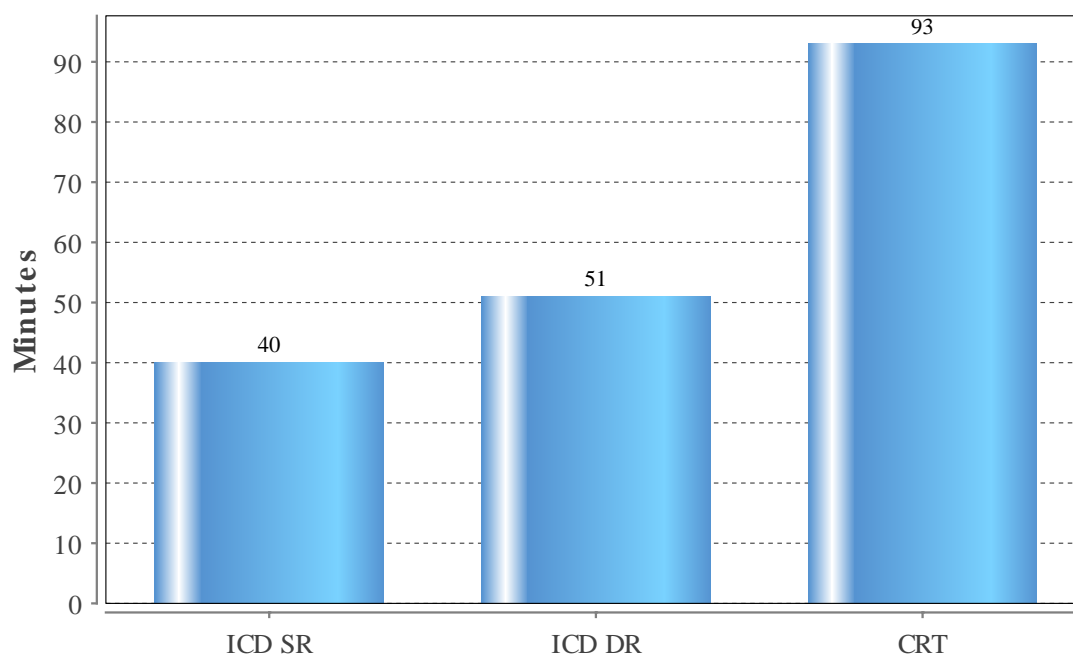
Fluoroscopy time	Average	Standard deviation
ICD SR	3	4.1
ICD DR	4	5.9
CRT	15	13.6



QUALITY – ICD – KNIFE TIME PER SUBTYPE

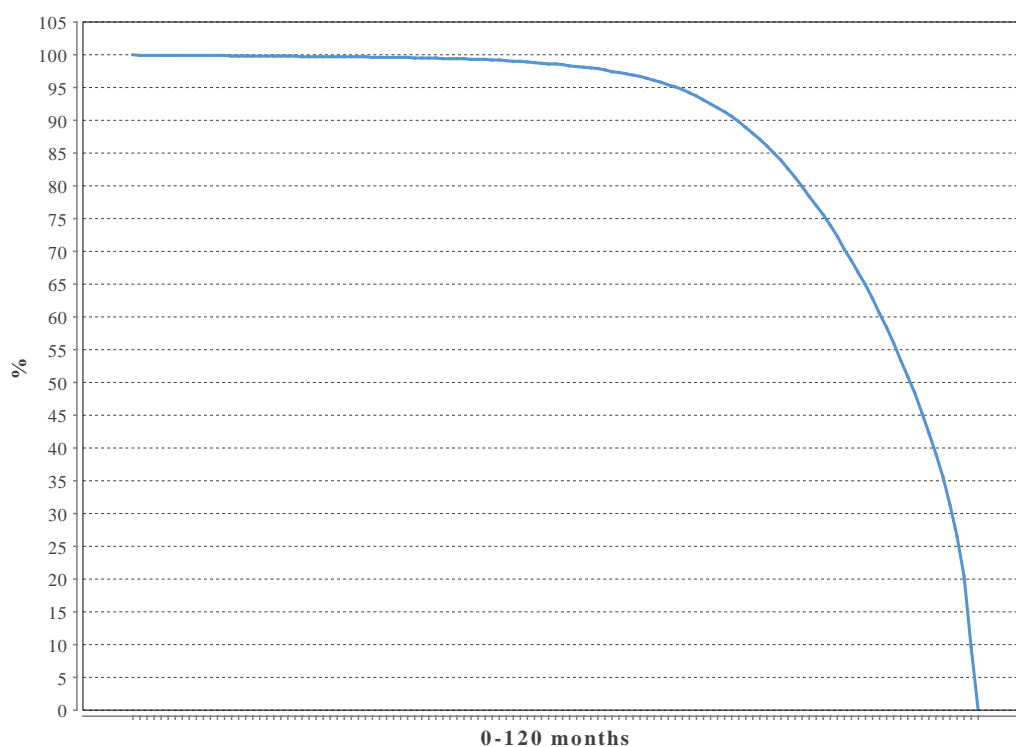
National mean skin to skin duration for a new implant of different subtypes

Knife time	Average	Standard deviation
ICD SR	40	16.5
ICD DR	51	24.1
CRT	93	40.4



QUALITY – PACEMAKER – GENERATOR SURVIVAL

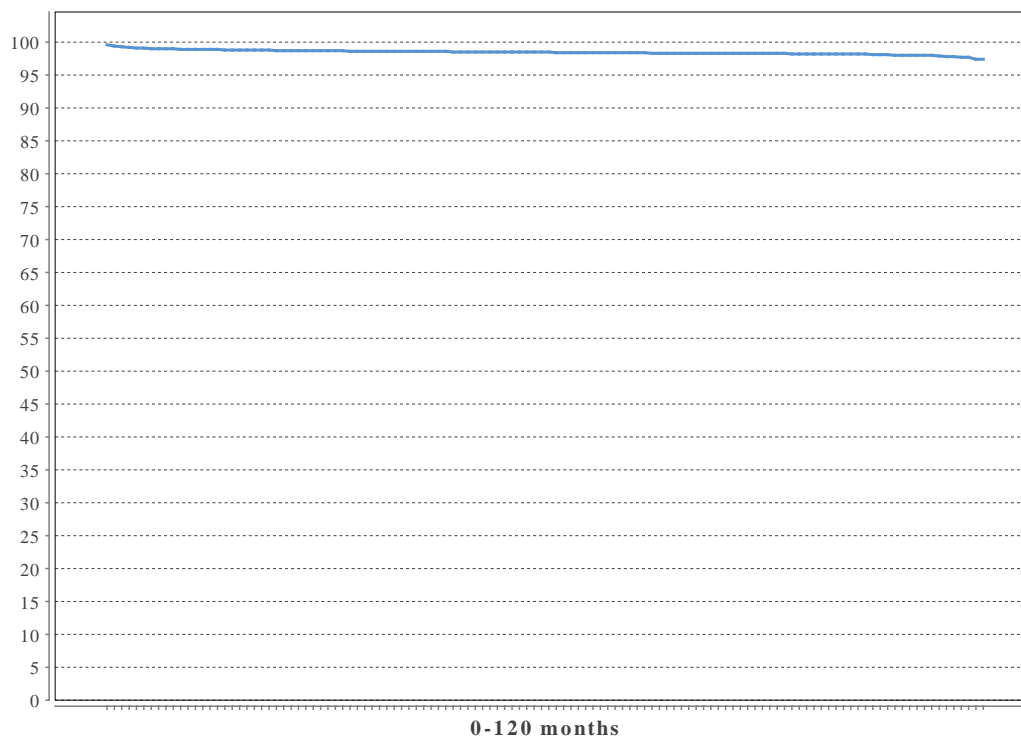
Year	At risk	Survival probability %
1	155636	100.0
2	134209	99.9
3	111908	99.7
4	92366	99.6
5	74889	99.3
6	59305	98.6
7	45448	96.7
8	32447	91.3
9	19628	78.4
10	8491	56.0



QUALITY – PM – LEAD SURVIVAL

Based on all implants after 1990

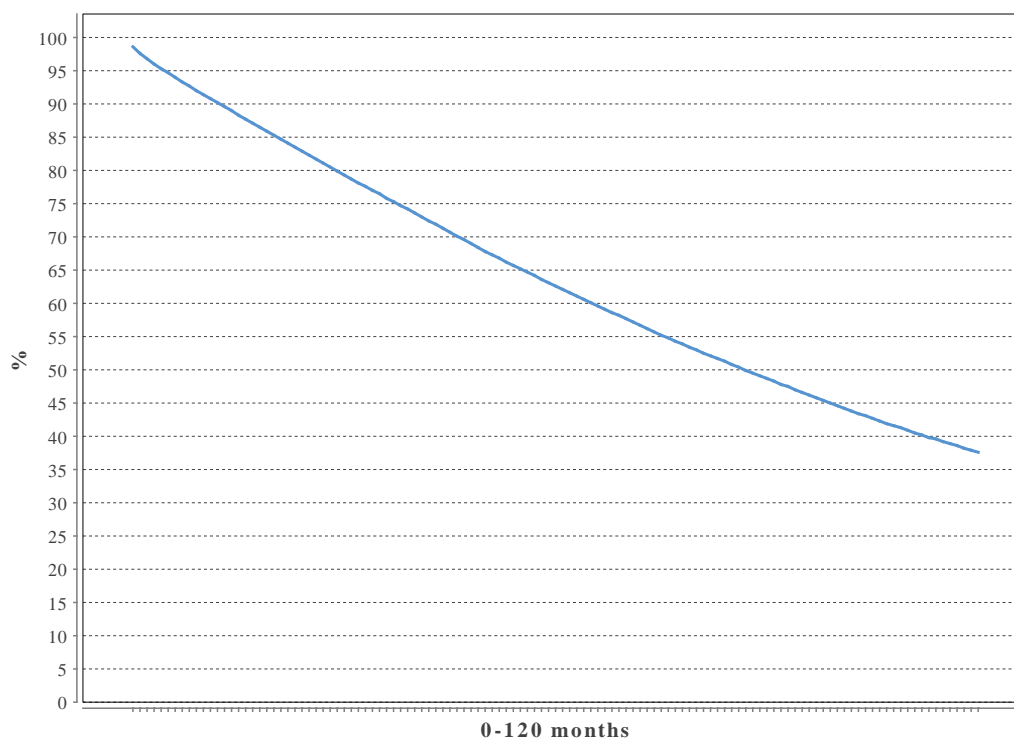
Year	At risk	Survival probability %
1	217541	99.6
2	183206	98.9
3	152880	98.7
4	125099	98.6
5	100354	98.5
6	77221	98.5
7	56867	98.4
8	39443	98.3
9	24365	98.2
10	11192	98.0



QUALITY – PACEMAKER – PATIENT SURVIVAL

Based on all implants after 1990

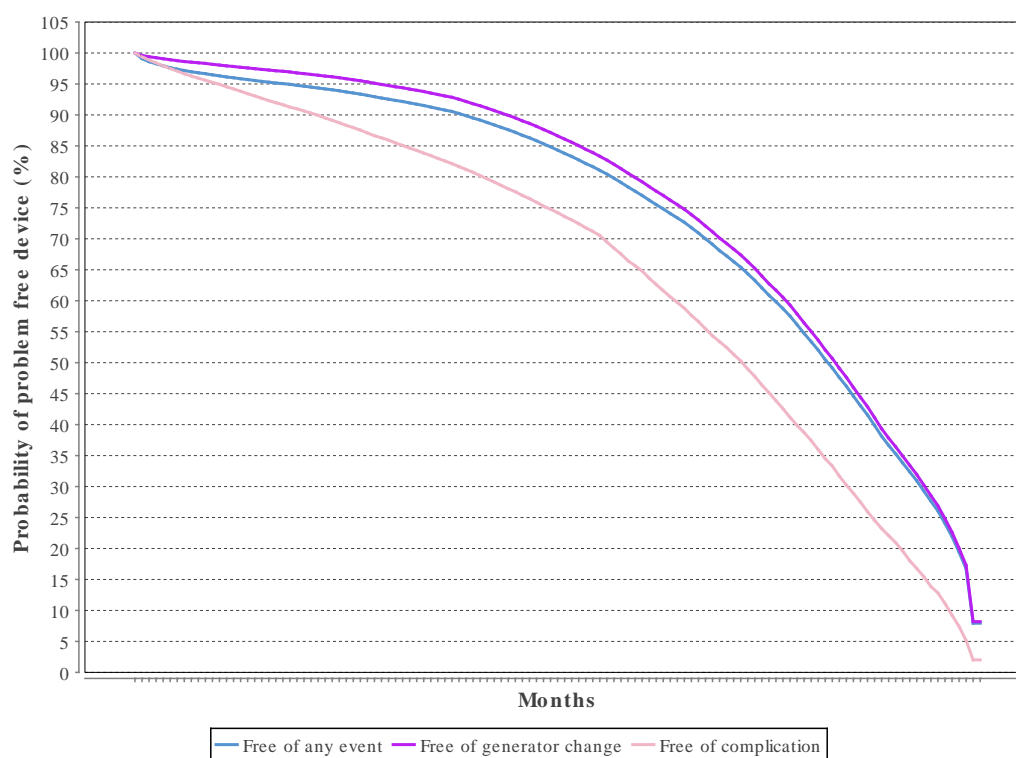
Year	At risk	Survival probability %
1	169991	98.6
2	144442	90.2
3	122348	82.9
4	102997	75.8
5	85978	69.0
6	70418	62.6
7	56836	56.7
8	44012	51.3
9	31395	46.2
10	20448	41.6



QUALITY – ICD – FREE OF EVENT

Probability of event free ICD-device

Year	At risk	Free of any event %	Free of generator change %	Free of complication %
1	37376	96.3	98.1	95.0
2	34500	94.6	96.7	90.6
3	31464	92.5	94.7	85.9
4	28141	89.5	91.8	80.7
5	23848	84.3	86.6	74.2
6	18432	77.0	79.2	64.8
7	12376	67.2	69.3	52.5
8	6650	53.4	55.1	37.4
9	2239	35.3	36.4	21.0
10	97	7.9	8.2	2.0



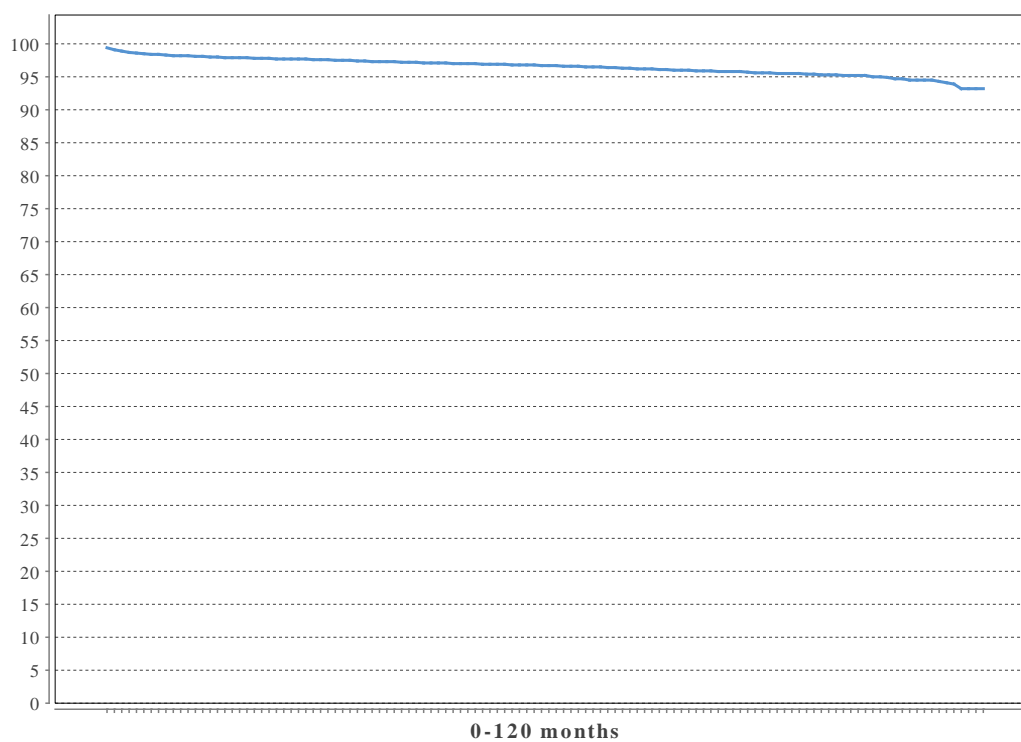
QUALITY – ICD – GENERATOR SURVIVAL

Year	At risk	Survival probability %
1	32796	99.9
2	28639	99.8
3	24639	99.5
4	20728	98.9
5	17126	97.2
6	13286	92.4
7	9486	83.5
8	6015	70.1
9	2946	50.0
10	868	26.7

QUALITY – ICD – LEAD SURVIVAL

Overall survival probability for all ICD leads as a mean. Elective replacements and replacements due to infections and system changes have been considered as censored events. Based on all implants after 1990

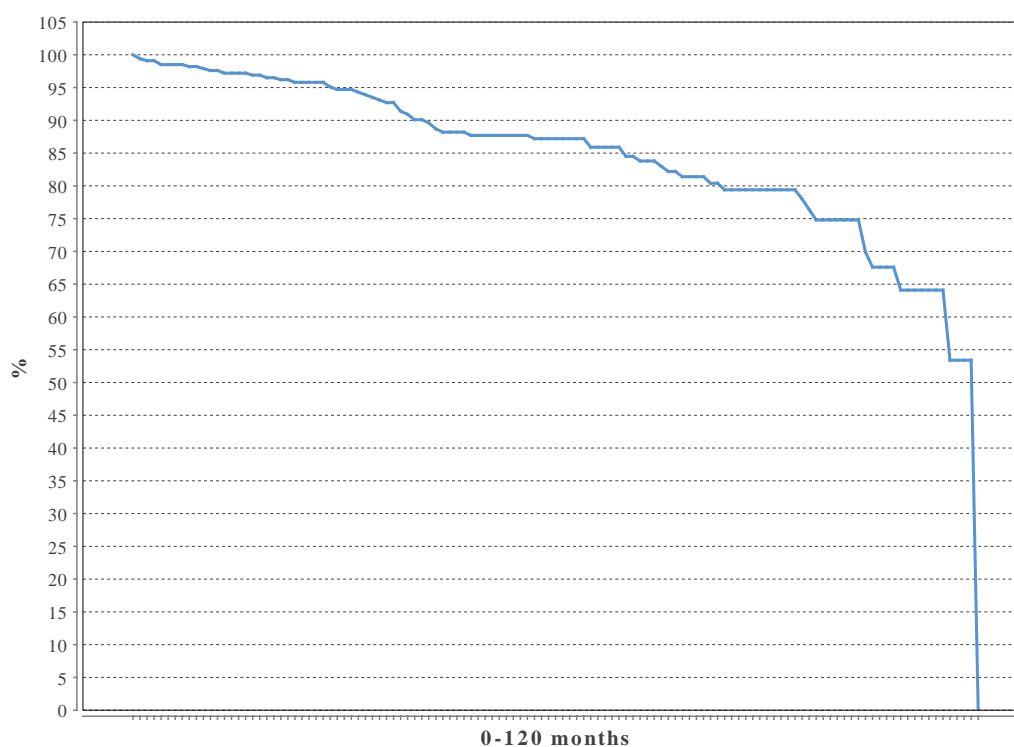
Year	At risk	Survival probability %
1	20436	99.4
2	17503	98.1
3	14988	97.7
4	12512	97.3
5	10303	97.0
6	8106	96.7
7	6110	96.2
8	4332	95.8
9	2751	95.4
10	1264	94.7



QUALITY – ICD – SURVIVAL MEDTRONIC SPRINT FIDELIS

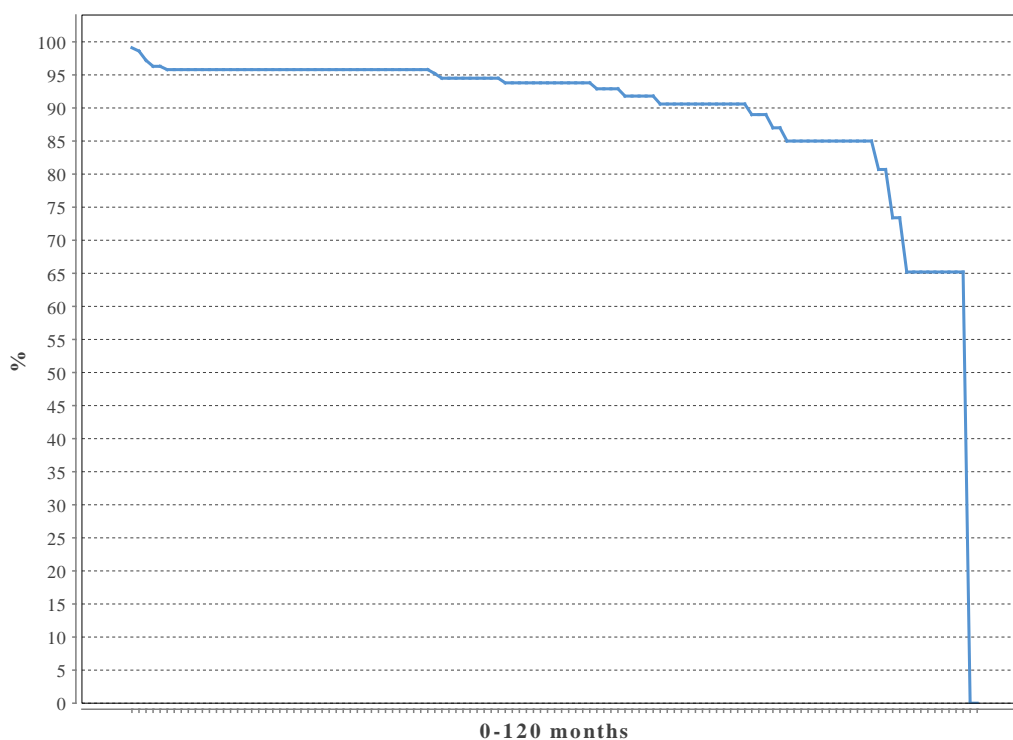
Survival probability for ICD lead Medtronic Sprint Fidelis. Elective replacement and replacements due to infections and system changes have been considered as censored events.

Year	At risk	Survival probability %
1	345	100.0
2	301	97.6
3	269	95.8
4	221	92.7
5	181	87.7
6	152	87.2
7	116	83.8
8	80	79.4
9	49	76.4
10	23	67.6



Survival probability for SJM lead type 1561,1570,1571,1572,1580,1581,1582,1591. Elective replacement and replacements due to infections and system changes have been considered as censored events.

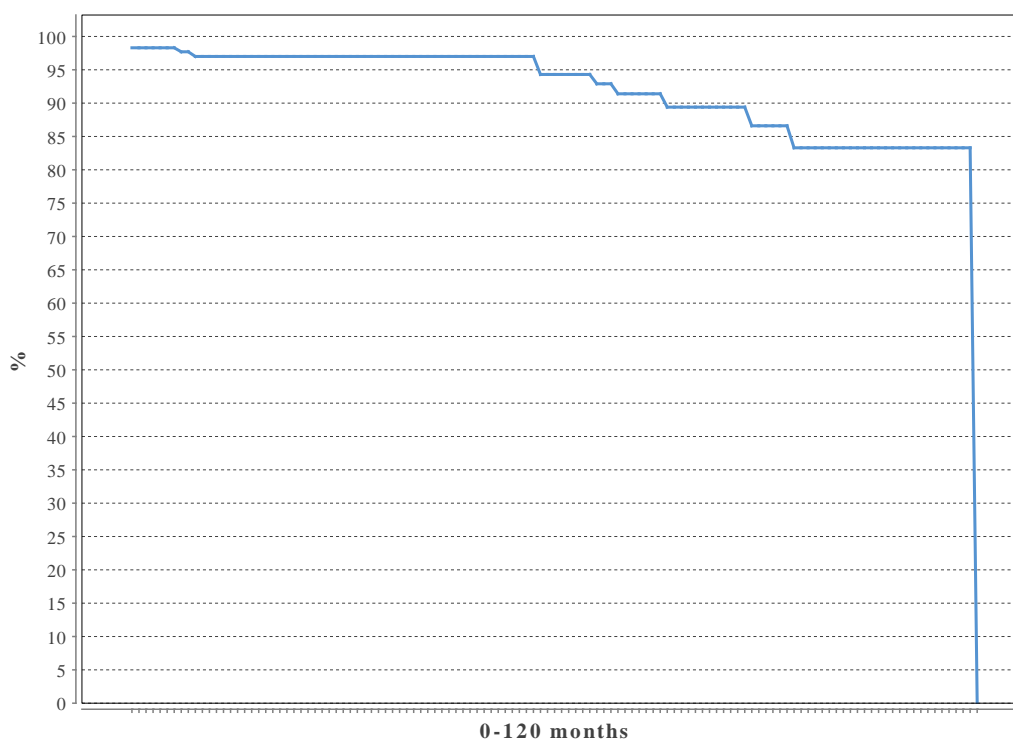
Year	At risk	Survival probability %
1	219	99.1
2	193	95.8
3	176	95.8
4	158	95.8
5	138	94.5
6	114	93.8
7	80	91.8
8	60	90.6
9	39	85.0
10	11	73.4



QUALITY – ICD – SURVIVAL SJM 7000,7001,7002,7040,7041,7042

Survival probability for SJM lead type 7000,7001,7002,7040,7041,7042. Elective replacement and replacements due to infections and system changes have been considered as censored events.

Year	At risk	Survival probability %
1	177	98.3
2	141	97.0
3	129	97.0
4	115	97.0
5	93	97.0
6	71	94.3
7	55	91.4
8	39	89.4
9	23	83.3
10	13	83.3



QUALITY – ICD – SURVIVAL SJM Fortify

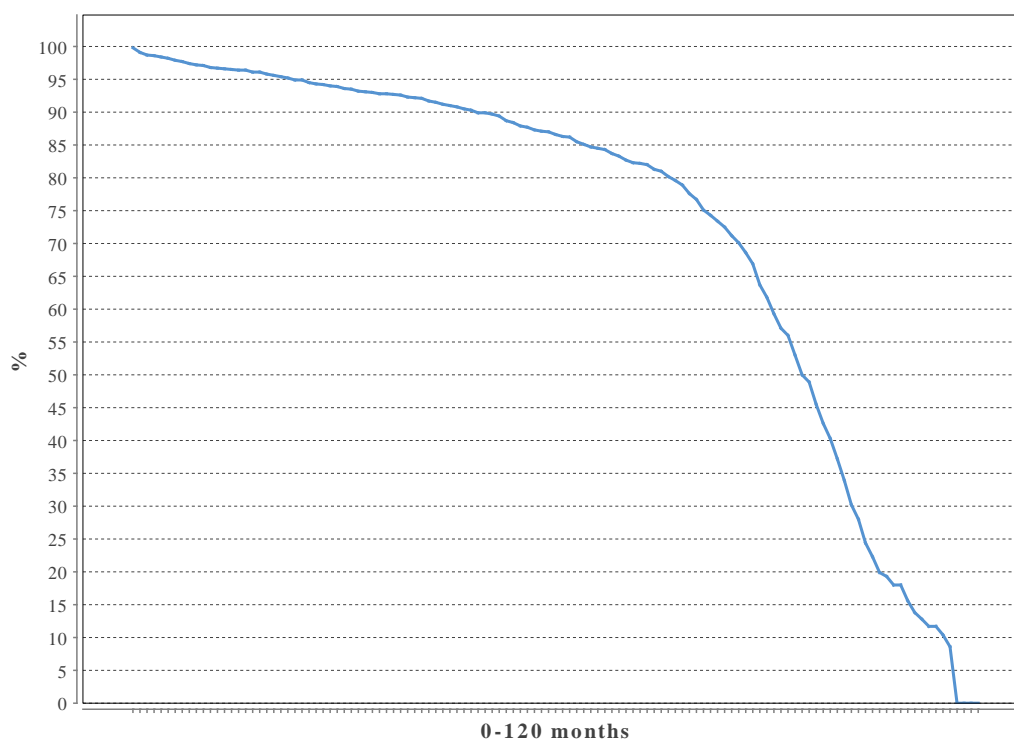
Survival probability for SJM ICD Fortify. Elective replacement and replacements due to infections and system changes have been considered as censored events.

Year	At risk	Survival probability %
1	2115	99.7
2	1932	97.3
3	1744	95.1
4	1557	92.4
5	1327	88.6
6	1118	84.8
7	905	80.8
8	657	76.3
9	436	71.1
10	209	60.1

QUALITY – ICD – SURVIVAL SJM Unify

Survival probability for SJM ICD Unify. Elective replacement and replacements due to infections and system changes have been considered as censored events.

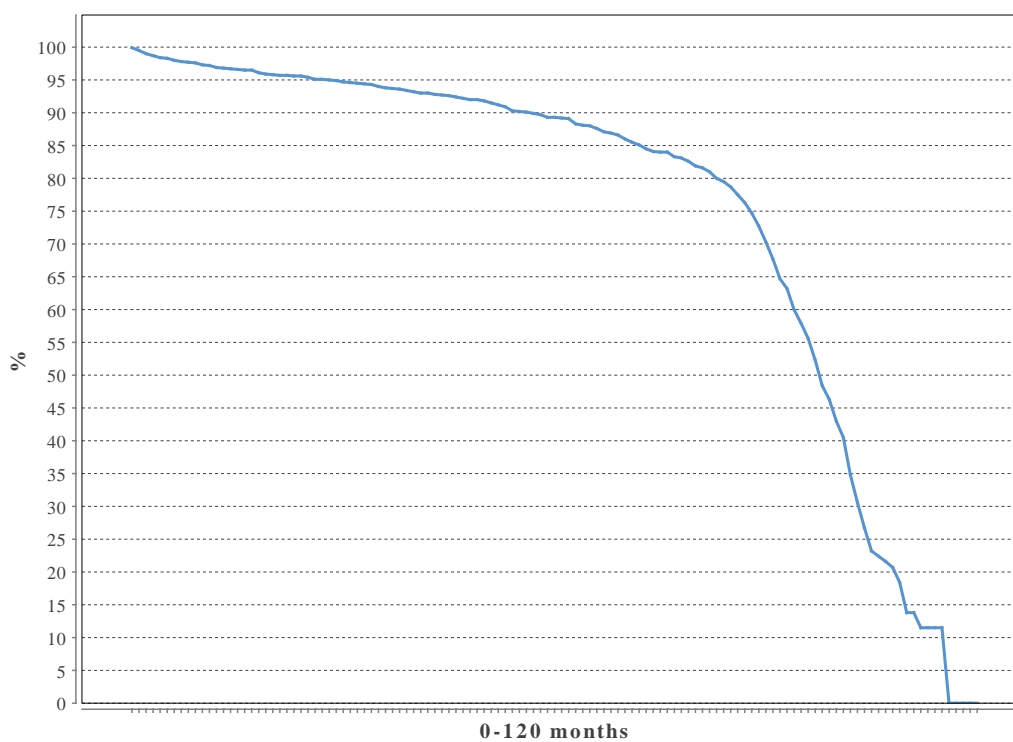
Year	At risk	Survival probability %
1	2245	99.8
2	1959	96.7
3	1761	94.9
4	1534	92.8
5	1324	90.3
6	1095	86.6
7	883	82.2
8	613	72.5
9	233	48.9
10	30	18.0



QUALITY – ICD – SURVIVAL SJM Quadra

Survival probability for SJM ICD Quadra. Elective replacement and replacements due to infections and system changes have been considered as censored events.

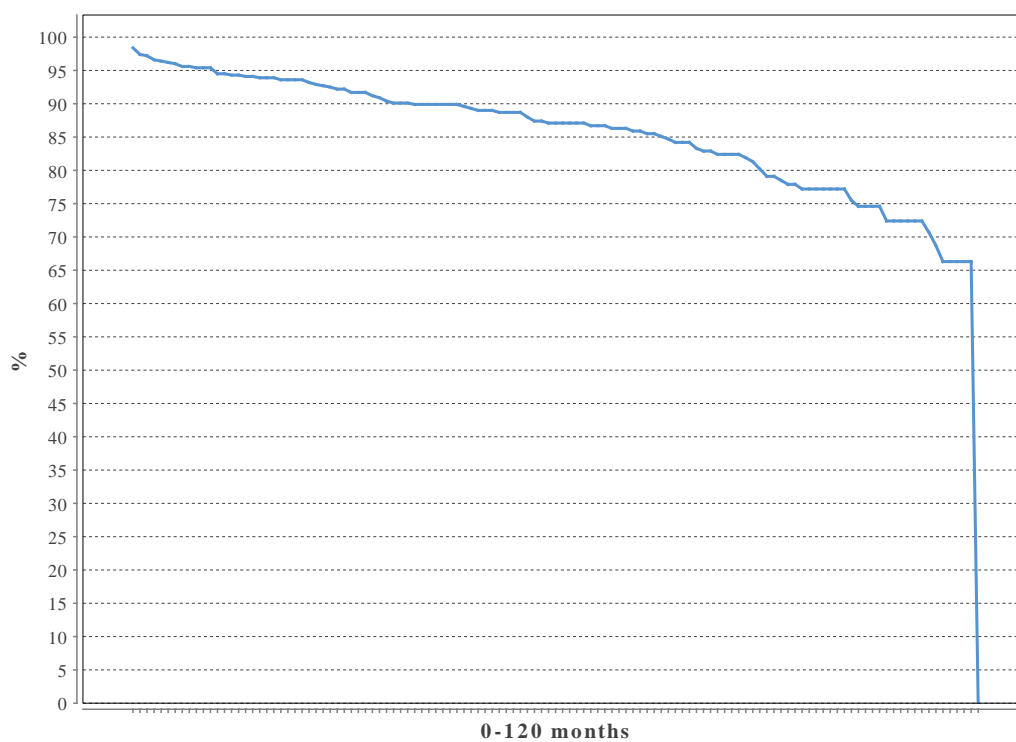
Year	At risk	Survival probability %
1	2950	99.9
2	2598	96.9
3	2247	95.6
4	1871	93.8
5	1477	92.0
6	1119	89.3
7	794	85.1
8	512	79.5
9	176	55.6
10	24	20.7



QUALITY – ICD – LEAD SURVIVAL Biotronik Linx

Survival probability for Biotronik ICD Linx. Elective replacement and replacements due to infections and system changes have been considered as censored events.

Year	At risk	Survival probability %
1	510	98.4
2	440	94.5
3	403	93.6
4	342	90.4
5	305	89.3
6	258	87.1
7	219	85.9
8	172	82.4
9	119	77.2
10	66	72.4



QUALITY – ICDLEAD – SURVIVAL SJM Durata

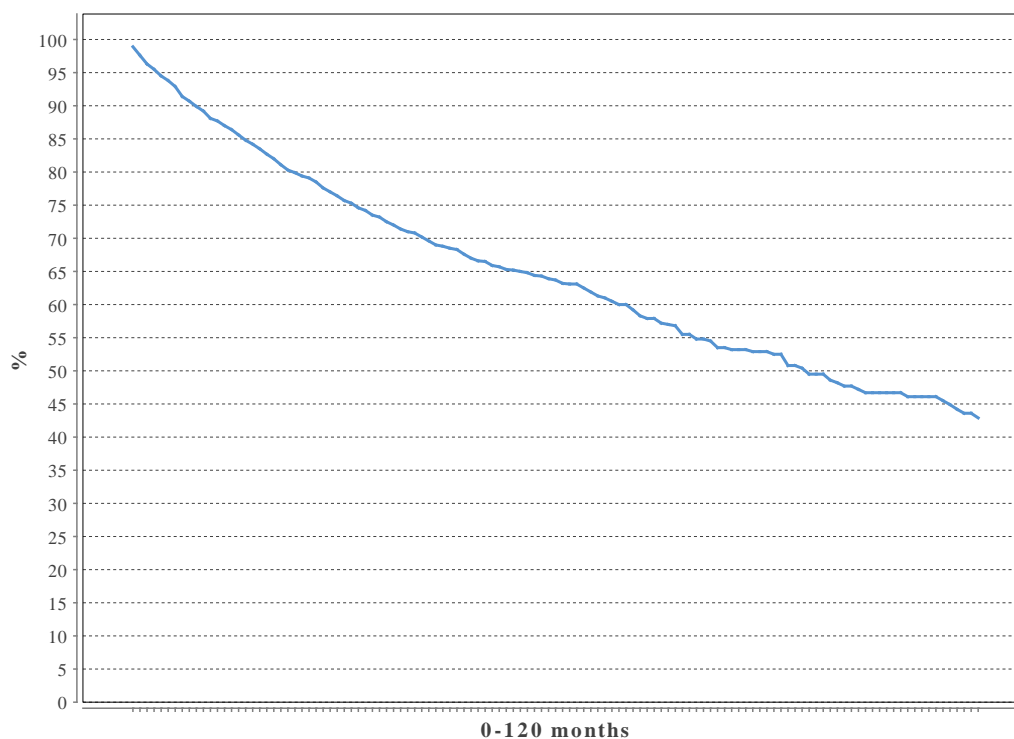
Survival probability for SJM ICDLEAD Durata. Elective replacement and replacements due to infections and system changes have been considered as censored events.

Year	At risk	Survival probability %
1	5714	98.9
2	4833	95.3
3	4221	93.9
4	3653	93.0
5	3151	92.4
6	2660	91.6
7	2131	90.4
8	1580	89.2
9	1092	88.2
10	500	86.2

QUALITY – ICD – PATIENT SURVIVAL

Based on all implants after 1990

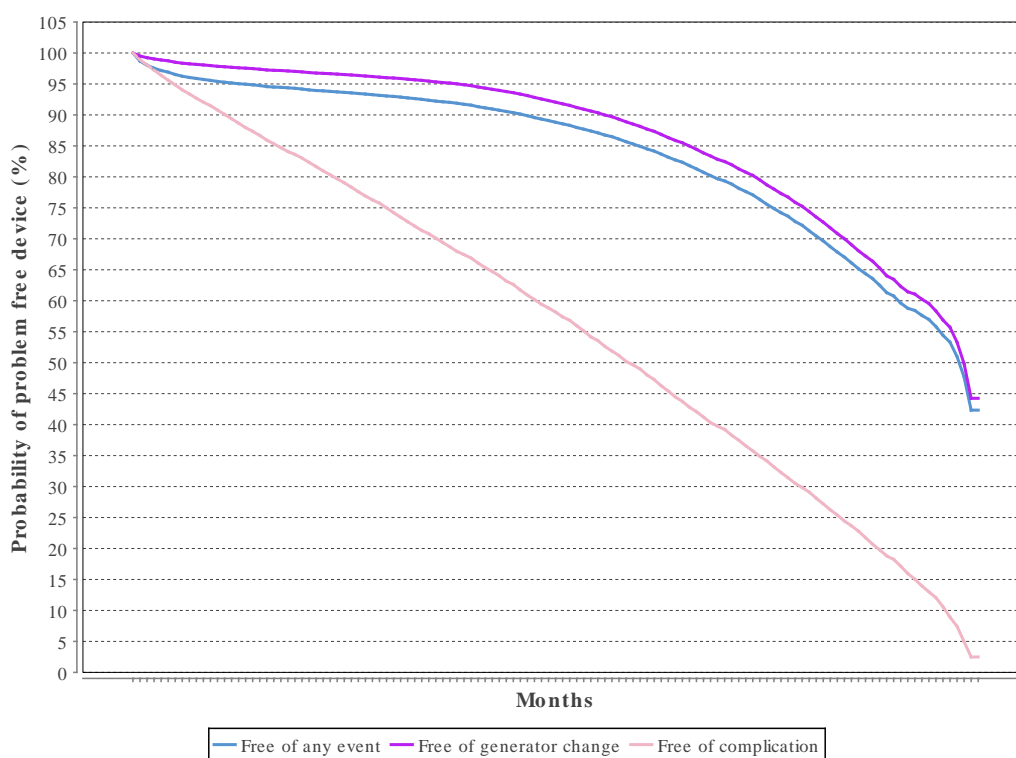
Year	At risk	Survival probability %
1	1924	98.9
2	1621	87.7
3	1404	79.4
4	1119	72.5
5	805	67.0
6	515	63.7
7	307	58.3
8	174	53.5
9	116	49.5
10	87	46.7



QUALITY – CRT – FREE OF EVENT

Probability of event free CRT-device

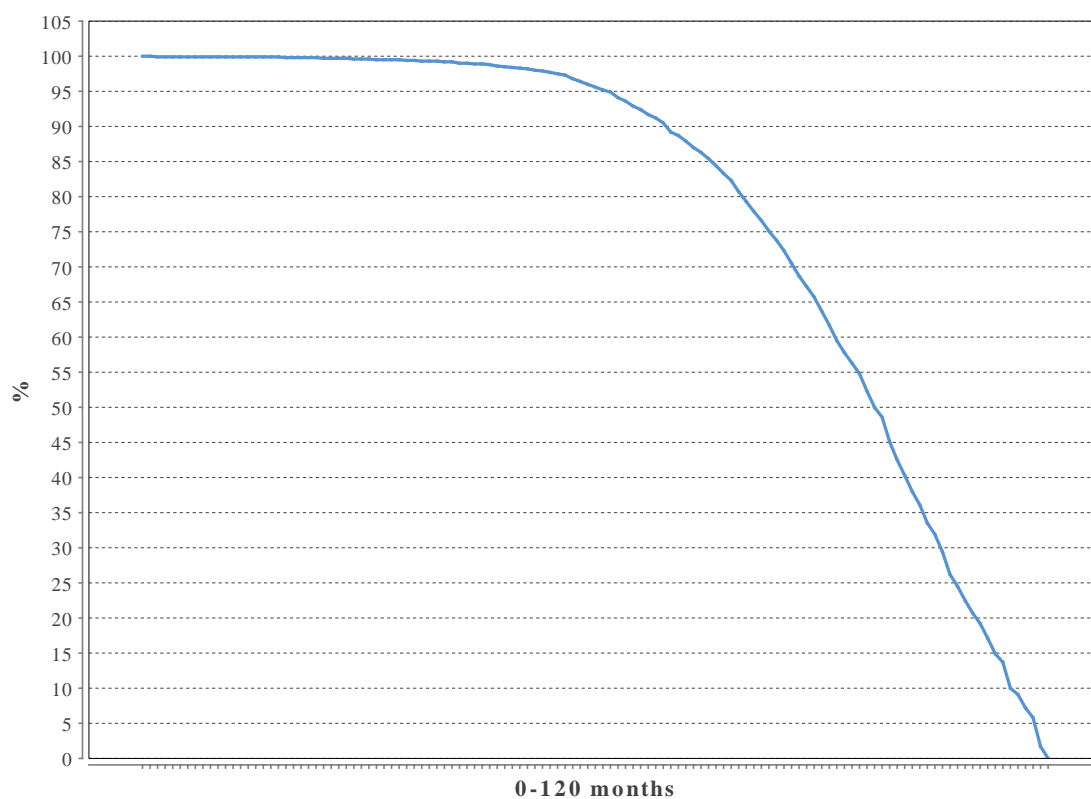
Year	At risk	Free of any event %	Free of generator change %	Free of complication %
1	59802	95.4	97.9	90.8
2	50173	94.2	97.0	83.0
3	41601	93.1	96.0	75.0
4	33509	91.6	94.7	66.9
5	25829	88.8	92.1	58.2
6	18641	84.9	88.2	49.0
7	12118	79.3	82.5	39.2
8	6900	71.3	74.4	29.1
9	2750	60.8	63.5	18.2
10	152	42.3	44.3	2.5



QUALITY – CRT-P – GENERATOR SURVIVAL

Overall CRT-P generator survival as a mean. Elective replacements and replacements due to infections and system changes have been considered as censored events. Based on all implants after 2006

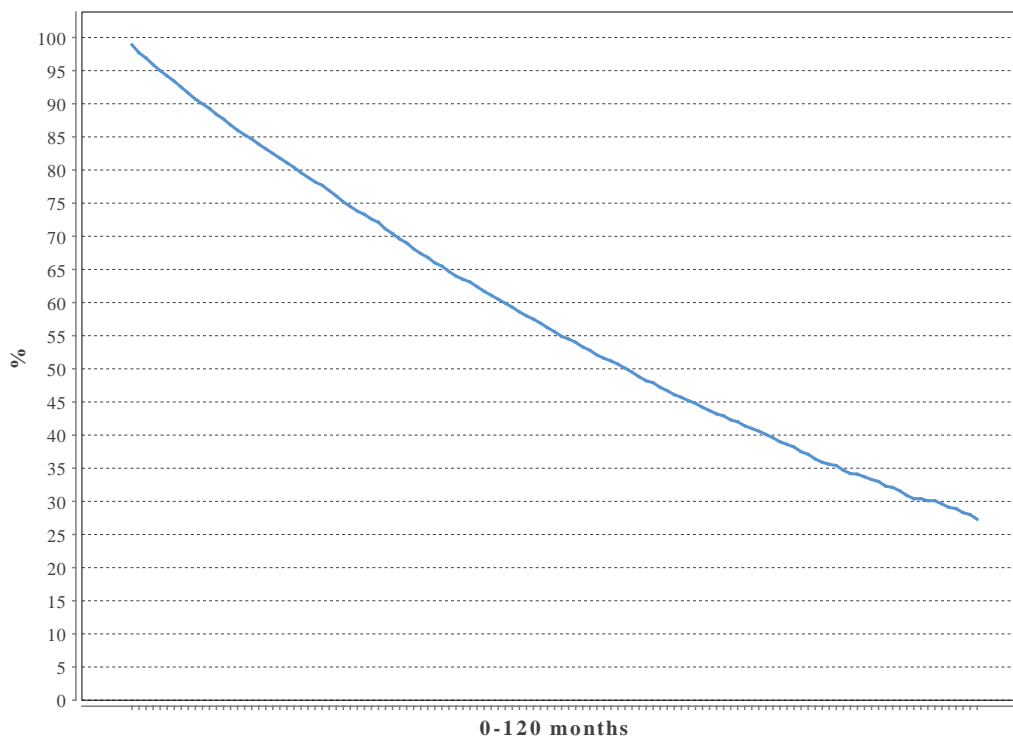
Year	At risk	Survival probability %
1	10393	100.0
2	8485	99.9
3	6853	99.7
4	5467	99.4
5	4344	98.5
6	3250	95.6
7	2250	87.9
8	1381	73.8
9	680	52.3
10	188	24.5



QUALITY – CRT-P – PATIENT SURVIVAL

Overall patient survival probability for patients receiving CRT-P therapy. Based on all implants after 2006

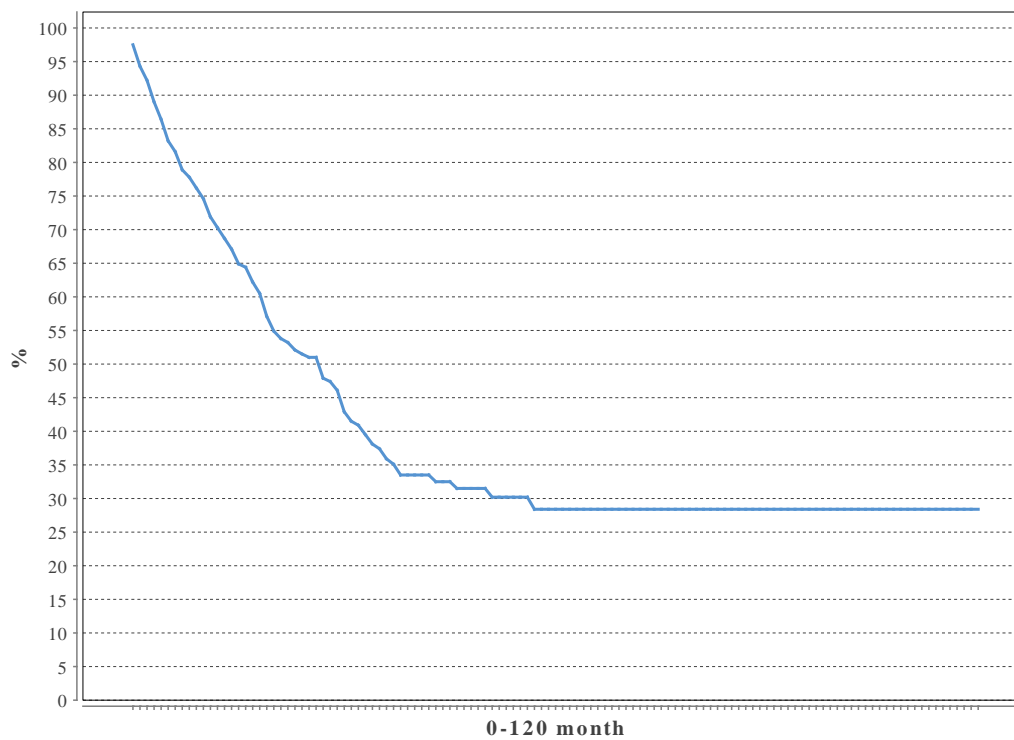
Year	At risk	Survival probability %
1	10590	98.9
2	8586	88.4
3	6937	79.6
4	5564	71.1
5	4421	63.1
6	3329	55.6
7	2324	48.8
8	1461	42.9
9	757	37.1
10	264	32.1



QUALITY – CRT-D – PATIENT SURVIVAL

Overall patient survival probability for patients receiving CRT-D therapy. Based on all implants after 1990

Year	At risk	Survival probability %
1	197	97.5
2	135	70.3
3	94	51.5
4	51	35.9
5	29	31.5
6	15	28.4
7	12	28.4
8	11	28.4
9	10	28.4
10	10	28.4



QUALITY – DEAD WITHIN ONE YEAR FROM IMPLANT

Ratio of patients being dead one year after implantation

Type	Implants in 2023	Death within year	%
PM	11157	960	8.6
ICD	2375	111	4.7
CRT-P	702	51	7.3
CRT-D	554	20	3.6

QUALITY – INTERVENTION RATIO

Intervention ratio (primary/correction)

Region	Hospital	PM	ICD
Norra Sverige	Norrlands Universitetssjukhus	246	69
	Örnsköldsviks sjukhus	119	19
	Östersunds sjukhus	159	21
	Skellefteå lasarett	67	9
	Sollefteå sjukhus	29	0
	Sunderby sjukhus	341	75
	Sundsvalls sjukhus	247	57
Södra Sverige	Blekingesjukhuset	262	70
	Centrallasarettet Växjö	203	29
	Centralsjukhuset Kristianstad	275	42
	Helsingborgs lasarett	253	28
	Länssjukhuset Halmstad	109	1
	Skånes universitetssjukhus, Lund	562	289
	Skånes universitetssjukhus, Malmö	375	39
	Varbergs sjukhus	273	108
Stockholm/Gotland	Danderyds sjukhus	669	110
	Karolinska Huddinge	266	89
	Karolinska Solna	360	152
	Södersjukhuset	469	99
	St Görans sjukhus	467	70
	Visby lasarett	40	10
Sydöstra Sverige	Länssjukhuset Kalmar	176	56
	Länssjukhuset Ryhov	377	62
	Linköpings universitetssjukhus	525	117
	Västerviks sjukhus	64	0
Uppsala/Örebro	Akademiska sjukhuset	416	106
	Centralsjukhuset Karlstad	256	63
	Centralsjukhuset Västerås	241	50
	Falu lasarett	382	86
	Gävle sjukhus	302	66
	Hudiksvalls sjukhus	83	18
	Mälarsjukhuset	318	70
	Torsby sjukhus	37	0
	Universitetssjukhuset Örebro	353	83
Utland	Ålands centralsjukhus	38	6
	Utland	15	6
Västra Sverige	Alingsås lasarett	101	0
	Drottning Silvias Bus	19	1
	Kungälv sjukhus	175	0
	Sahlgrenska universitetssjukhuset	532	107
	Sahlgrenska universitetssjukhuset /Östra	119	0
	Skaraborgs sjukhus Skövde	338	42
	Södra Älvsborgs sjukhus	235	57
	Trollhättan, NÄL	413	57