

KAROLINSKA HOSPITAL  
DEPARTMENT OF CARDIOLOGY  
SWEDEN

# ANNUAL STATISTICAL REPORT 2022

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**SWEDISH ICD &  
PACEMAKER REGISTRY**

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## Foreword

We are proud to present the annual report for 2022 regarding CIED usage in Sweden.

We have over the last years focused on longevity of devices, leads and complications triggered by the current events. 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.

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.

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.

We have 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 62965 active pacemaker patients in Sweden at the end of 2022. As always there are regional differences with the highest implant rates in the large northern region of Västernorrland, 1069 per million and the lowest Stockholm and Uppsala 582 and 609. Stockholm has a low implant rate due to a younger population than the national average.

The overall implant rate decreased somewhat from 715 to 709 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 7460 new pacemaker implants.

The number of implanting hospitals is the same as in 2021, 41 centers.

### **Age and gender distribution of pacemaker treatment**

The average age for females receiving pacemaker treatment is 78 years and males 77 years and 13 patients over 100 years of age received primary implants. There is a male predominance with 60% of the new implants going to male patients but generator changes are more common in females due to the higher average survival of females in the country. 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 47%, and Medtronic with the brand Vitatron is in second place with 22% market share. Boston Scientific has decreased its market shares to 11% in brady segment. Biotronik are still increasing and now up to 20% and Sorin is almost out with 0,1% of the market.

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 32% 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 92% of the LV leads are now quadripolar, an increase from 65% in 2016.

16665 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, 43%, and direct subclavian puncture 25% and 28% axillary puncture which has increased as access route. Only a small subset are stated as sonar guided.

The leadless pacemaker systems are new in clinical use and Medtronic Micras were implanted in 34 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” 84% 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 2017 a total of 221 patients were upgraded from normal brady pacing to CRT compared to 260 in 2022. 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 2022 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 61% of the cases and 1% exhibit premature EOL, technical failure or changed due to recall 2,5%, 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%.

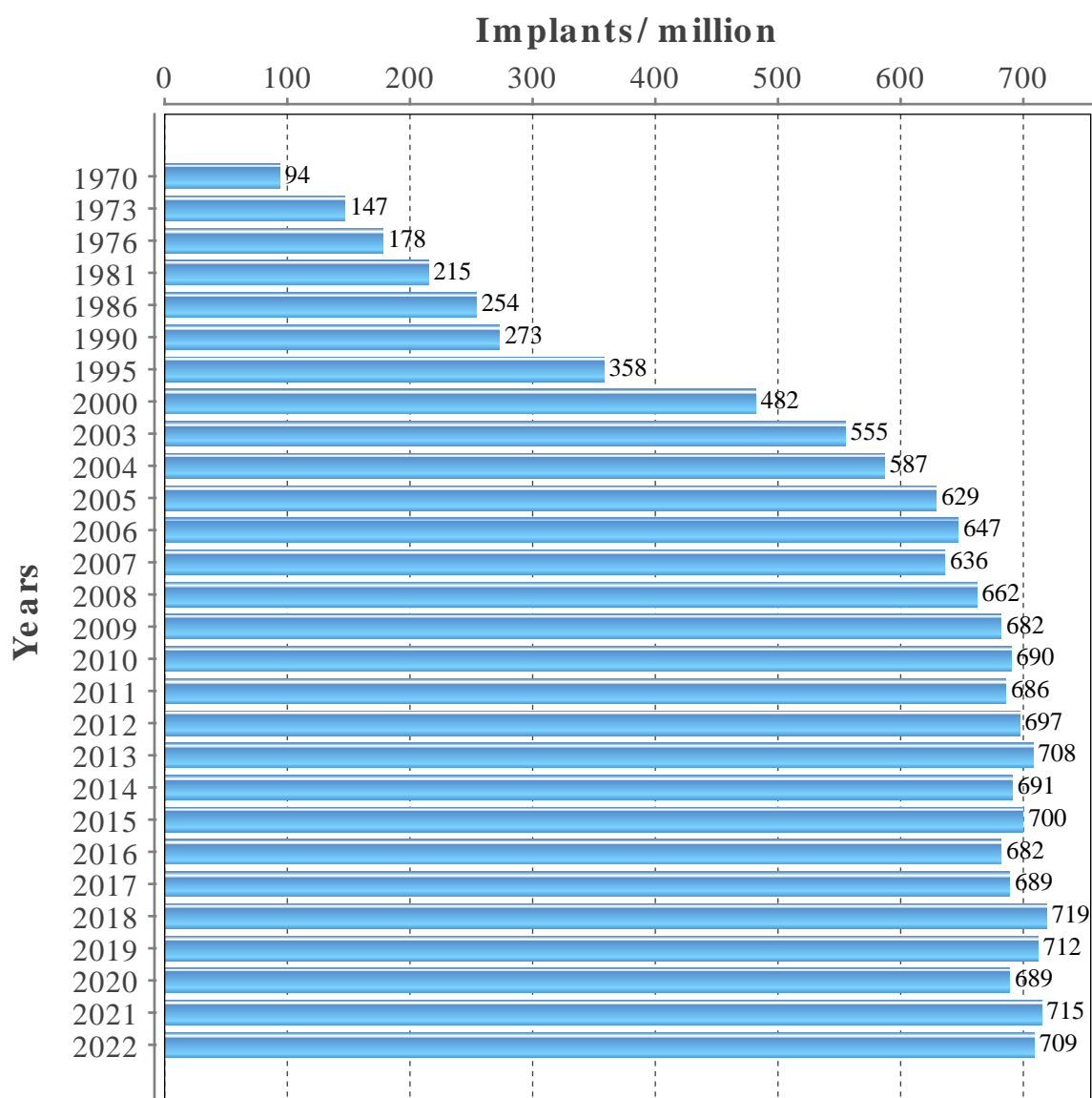
### **Implanting organization**

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 no impact on the organization in hospital with low individual implant numbers.

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## STATISTICS – PACEMAKER – HISTORICAL IMPLANTATION RATES

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STATISTICS – PACEMAKER – IMPLANTS PER COUNTY

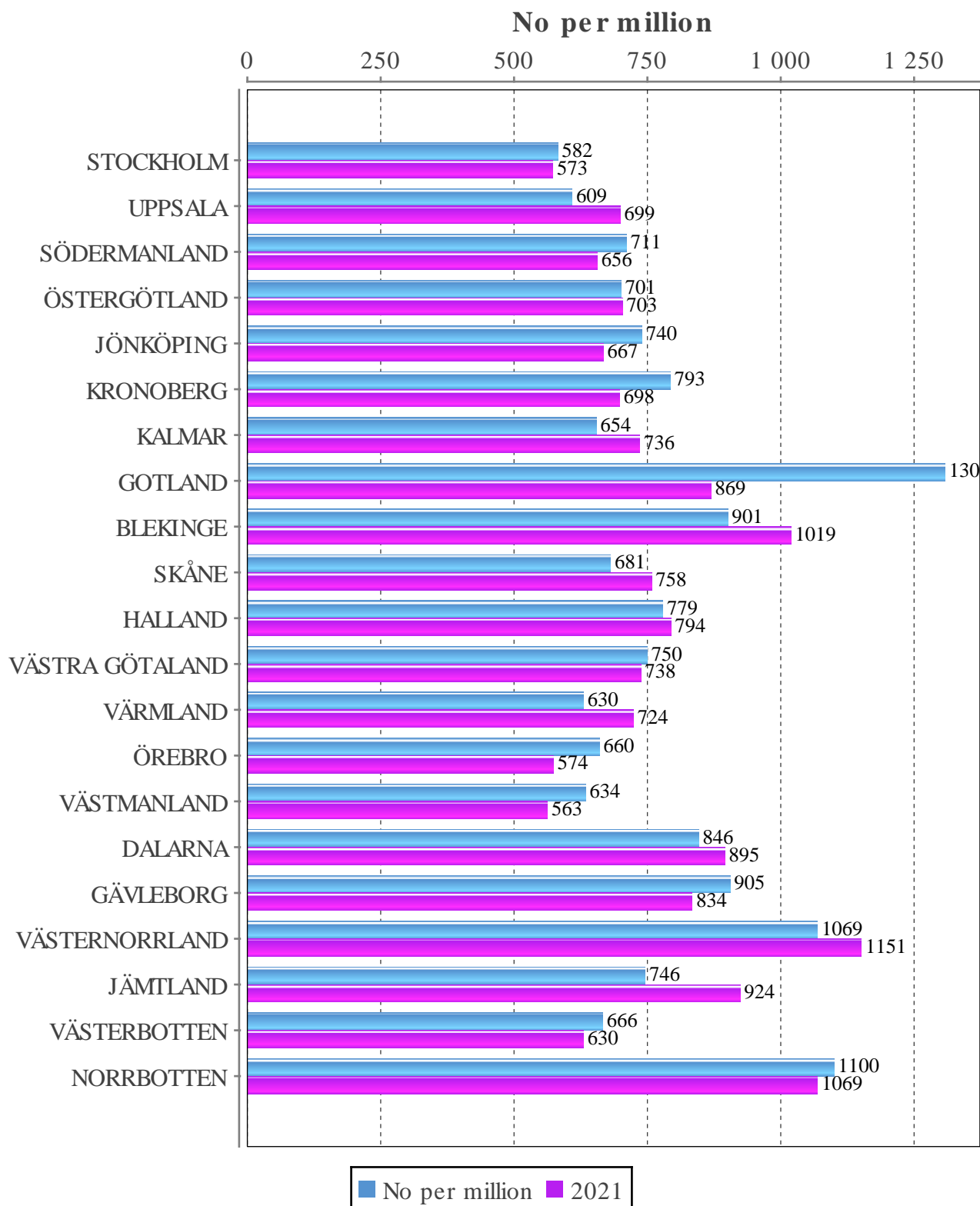
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*The regions are based on where the patients live, not where they are treated*

<b>County</b>	<b>Population</b>	<b>No of first</b>	<b>No per million</b>	<b>Active patients</b>
STOCKHOLM	2440027	1420	582	12204
UPPSALA	400682	244	609	2329
SÖDERMANLAND	302566	215	711	1863
ÖSTERGÖTLAND	471912	331	701	2904
JÖNKÖPING	369113	273	740	2051
KRONOBERG	204335	162	793	1106
KALMAR	247711	162	654	1382
GOTLAND	61173	80	1308	529
BLEKINGE	158740	143	901	1172
SKÅNE	1414324	963	681	8412
HALLAND	342805	267	779	2074
VÄSTRA GÖTALAND	1758656	1319	750	10498
VÄRMLAND	283976	179	630	1762
ÖREBRO	307772	203	660	1634
VÄSTMANLAND	280713	178	634	1509
DALARNA	288310	244	846	2077
GÄVLEBORG	287334	260	905	2469
VÄSTERNORRLAND	243265	260	1069	2185
JÄMTLAND	132670	99	746	1059
VÄSTERBOTTEN	276295	184	666	1738
NORRBOTTEN	249177	274	1100	2008
Total	10521556	7460	709	62965



STATISTICS – PACEMAKER – IMPLANTS PER COUNTY



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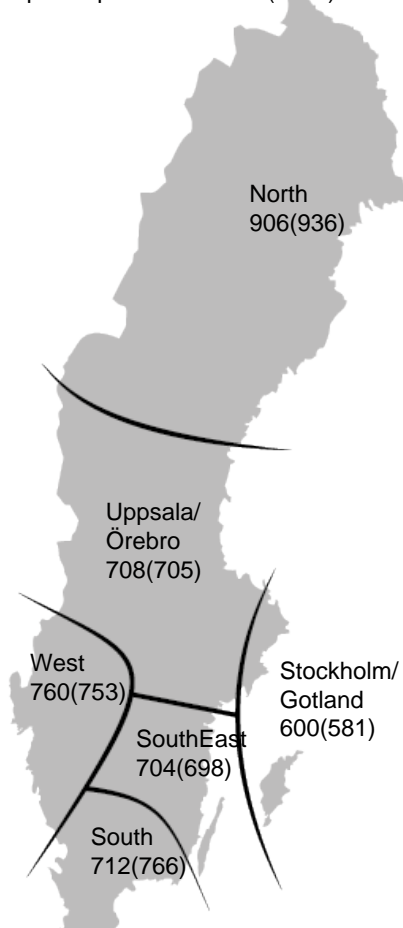
## STATISTICS – PACEMAKER – IMPLANTS PER REGION

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*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	2501200	1500	600	12733
Uppsala/Örebro	2151353	1523	708	13643
South-East Sweden	1088736	766	704	6337
Southern Sweden	1918910	1367	712	11450
Western Sweden	1957388	1488	760	11812
Northern Sweden	901407	817	906	6990
Total	10518994	7461	709	62965

Implants per million 2022(2021)



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STATISTICS – PACEMAKER – IMPLANTING HOSPITALS

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*First implants per hospital*

<b>Region</b>	<b>Hospital</b>	<b>2022</b>	<b>2021</b>
Northern Sweden	Norrlands Universitetssjukhus	177	170
	Skellefteå lasarett	34	32
	Sollefteå sjukhus	30	14
	Sunderby sjukhus	273	266
	Sundsvalls sjukhus	161	197
	Örnsköldsviks sjukhus	69	60
	Östersunds sjukhus	96	118
Southern Sweden	Blekingesjukhuset	161	169
	Centrallasarettet Växjö	161	129
	Centralsjukhuset Kristianstad	215	259
	Helsingborgs lasarett	204	221
	Länssjukhuset Halmstad	68	93
	Skånes universitetssjukhus, Lund	371	430
	Skånes universitetssjukhus, Malmö	210	182
	Varbergs sjukhus	186	164
South-East Sweden	Linköpings Universitetssjukhus	357	356
	Länssjukhuset Kalmar	113	137
	Länssjukhuset Ryhov	252	223
	Västerviks sjukhus	44	40
Stockholm/Gotland	Danderyds sjukhus	432	452
	Karolinska Universitetssjukhuset	453	393
	St Görans sjukhus	283	279
	Södersjukhuset	305	302
	Visby lasarett	39	25
Uppsala/Örebro	Akademiska sjukhuset	282	306
	Bollnäs sjukhus	1	0
	Centralsjukhuset Karlstad	145	172
	Centralsjukhuset Västerås	156	151
	Falu lasarett	239	251
	Gävle sjukhus	206	190
	Hudiksvalls sjukhus	46	45
	Mälarsjukhuset	200	190
	Torsby sjukhus	26	27
	Universitetssjukhuset Örebro	212	182
Western Sweden	Alingsås lasarett	58	74
	Drottning Silvias Bus	10	1
	Kungälv's sjukhus	132	102
	Sahlgrenska Universitetssjukhuset	395	503
	Sahlgrenska Universitetssjukhuset /Östra	57	0
	Skaraborgs sjukhus Skövde	227	193
	Södra Älvsborgs sjukhus	229	192
	Trollhättan, NÄL	257	238

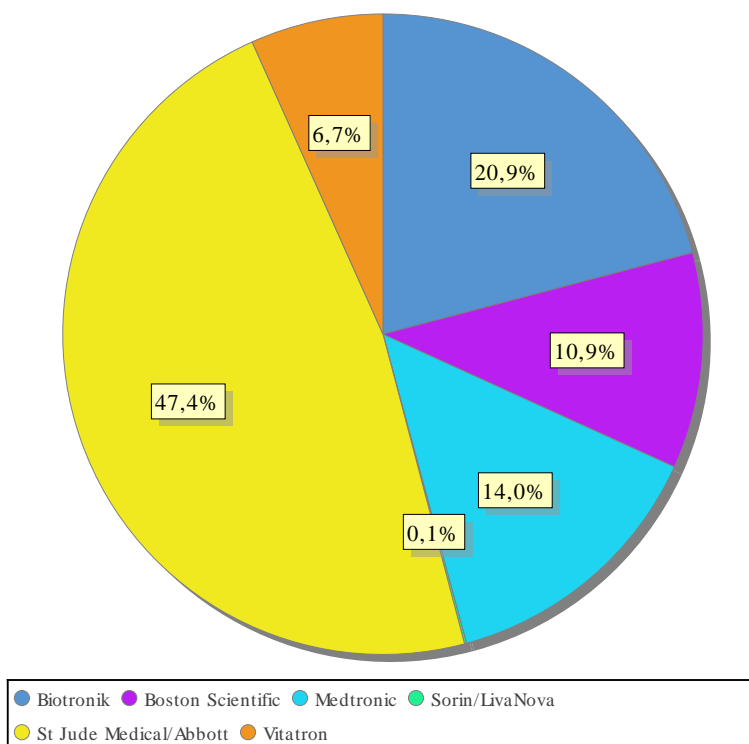
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## STATISTICS – PACEMAKER – PACEMAKERS PER MANUFACTURER

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

Manufacturer	2019 %	2020 %	2021 %	2022 %
Biotronik	18.2	19.1	18.0	20.9
Boston Scientific	11.5	11.8	10.5	10.9
Medtronic	11.3	10.4	11.1	14.0
Sorin/LivaNova	0.1	-	0.1	0.1
St. Jude Medical	48.1	48.4	50.4	47.4
Vitatron	4.9	10.3	9.9	6.7
Impulse Dynamics	-	-	-	-

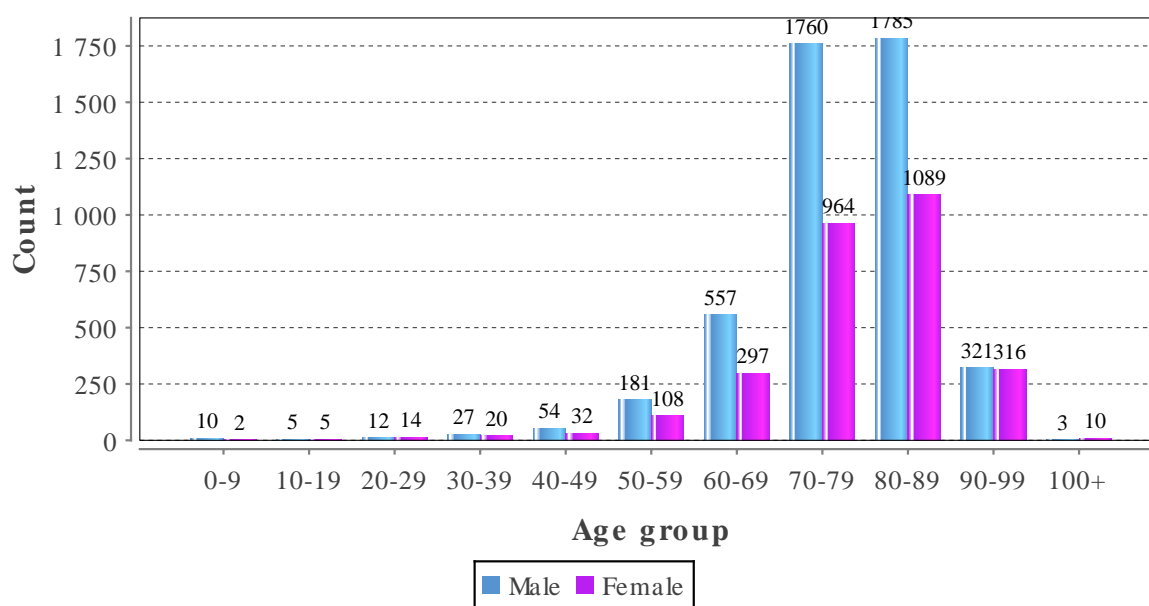


## STATISTICS – PACEMAKER – AGE DISTRIBUTION MALES/FEMALES

*Age and gender distribution for new implants, total numbers*

Age (years)	Total no	%	Male	Female
0-9	12	0.2	10	2
10-19	10	0.1	5	5
20-29	26	0.3	12	14
30-39	47	0.6	27	20
40-49	86	1.1	54	32
50-59	289	3.8	181	108
60-69	854	11.3	557	297
70-79	2724	36.0	1760	964
80-89	2874	38.0	1785	1089
90-99	637	8.4	321	316
100+	13	0.2	3	10
Average age	77	0.0	77	78

Total number of implants: 7572



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## STATISTICS – PACEMAKER – TYPE OF IMPLANTS

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*Ratio of new implants versus generator changes*

	<b>Total</b>		<b>Male</b>		<b>Female</b>	
	<b>no</b>	<b>%</b>	<b>no</b>	<b>%</b>	<b>no</b>	<b>%</b>
First implant	7572	68.3	4715	62.3	2857	37.7
Replacement	3521	31.7	2079	59.0	1442	41.0
Total	11093	100.0	6794	61.2	4299	38.8

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STATISTICS – PACEMAKER – LEAD TYPES

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

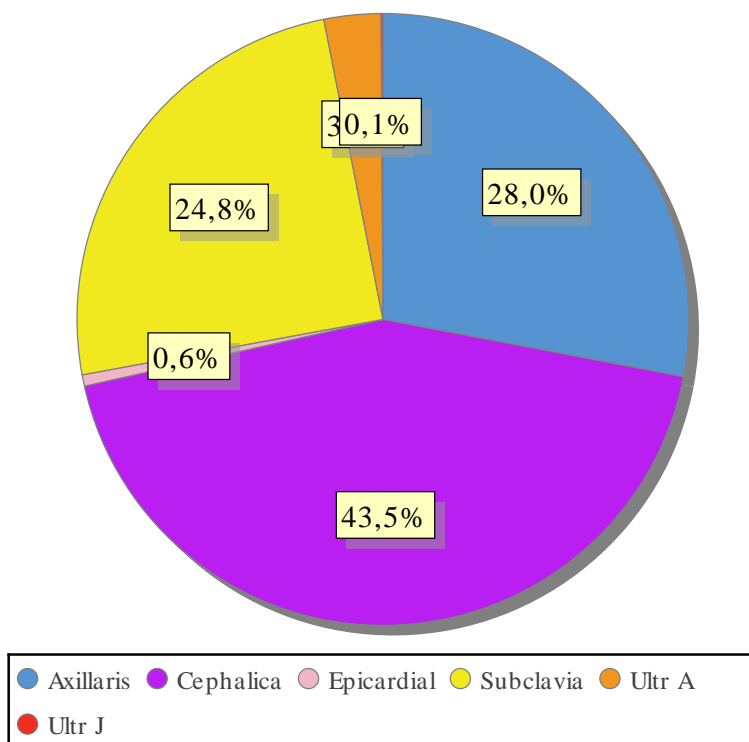
	Atrial		Ventricular		LV-lead	
	no	%	no	%	no	%
Bipolar	7416	99.5	7886	99.5	83	6.5
Epicardial	36	0.5	43	0.5	22	1.7
Unipolar	1	-	-	-	-	-
Quadripolar	-	-	-	-	1174	91.8

	Atrial		Ventricular		LV-lead	
	no	%	no	%	no	%
Active fixation	7449	99.9	7687	96.9	412	32.2
Passive fixation	5	0.1	245	3.1	867	67.8
Total number of leads: 16665						

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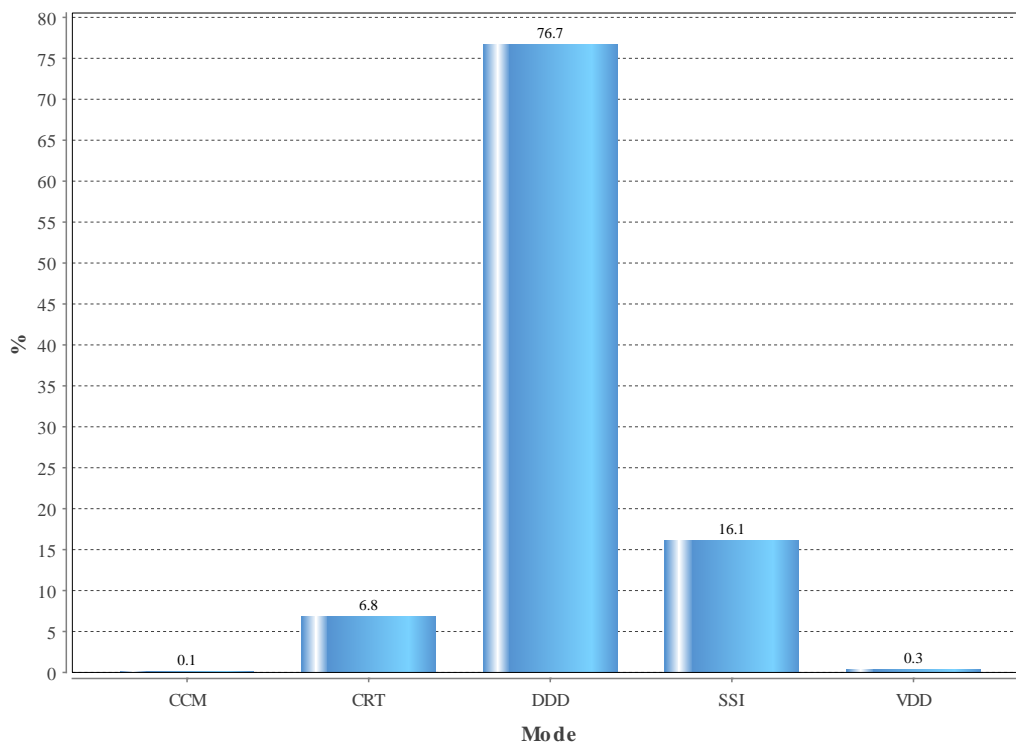
STATISTICS – PACEMAKER – LEAD ACCESS

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## STATISTICS – PACEMAKER – SUB TYPE



*Wireless implants per subtype*

Mode	No
SSIR	29
VDDR	21
Total number of first implants 7572	

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STATISTICS – PACEMAKER - AETIOLOGY FIRST IMPLANT

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*Main aetiology for implanting pacemakers*

<b>Aetiology</b>	<b>Total %</b>	<b>Male %</b>	<b>Female %</b>
Amyloidosis	0.5	0.7	0.3
Cardiomyopathy cytostatic induced	0.0	0.0	0.0
Cardiomyopathy dilated	1.5	1.7	1.3
Cardiomyopathy hypertrophic	0.4	0.4	0.4
Cardiomyopathy ischaemic	0.8	1.1	0.4
Conduction tissue fibrosis	81.3	79.7	83.8
Congenital	0.3	0.2	0.4
Drug induced	0.2	0.1	0.4
Endocarditis	0.0	0.0	0.0
Heart transplantation	0.1	0.1	0.0
High degree RV pacing	0.0	0.0	0.0
His-ablation	1.4	0.9	2.2
Ionizing radiation	0.0	0.0	0.0
Ischaemic	5.3	6.4	3.4
Long QT-syndrome	0.0	0.0	0.0
Maze procedure	0.1	0.1	0.0
Myocarditis	0.0	0.0	0.1
N/A	0.1	0.0	0.1
Neurocardiogenic syncope	0.1	0.1	0.2
Other structural heart disease	1.7	1.7	1.6
Post TAVI	1.4	1.5	1.3
Post infarction	0.4	0.3	0.4
RF-ablation, complication	0.2	0.3	0.1
Sarcoidosis	0.0	0.0	0.1
Surgical complication	2.8	3.0	2.5
Valvular heart disease	1.4	1.6	1.1

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## STATISTICS – PACEMAKER – SYSTEM UPGRADE

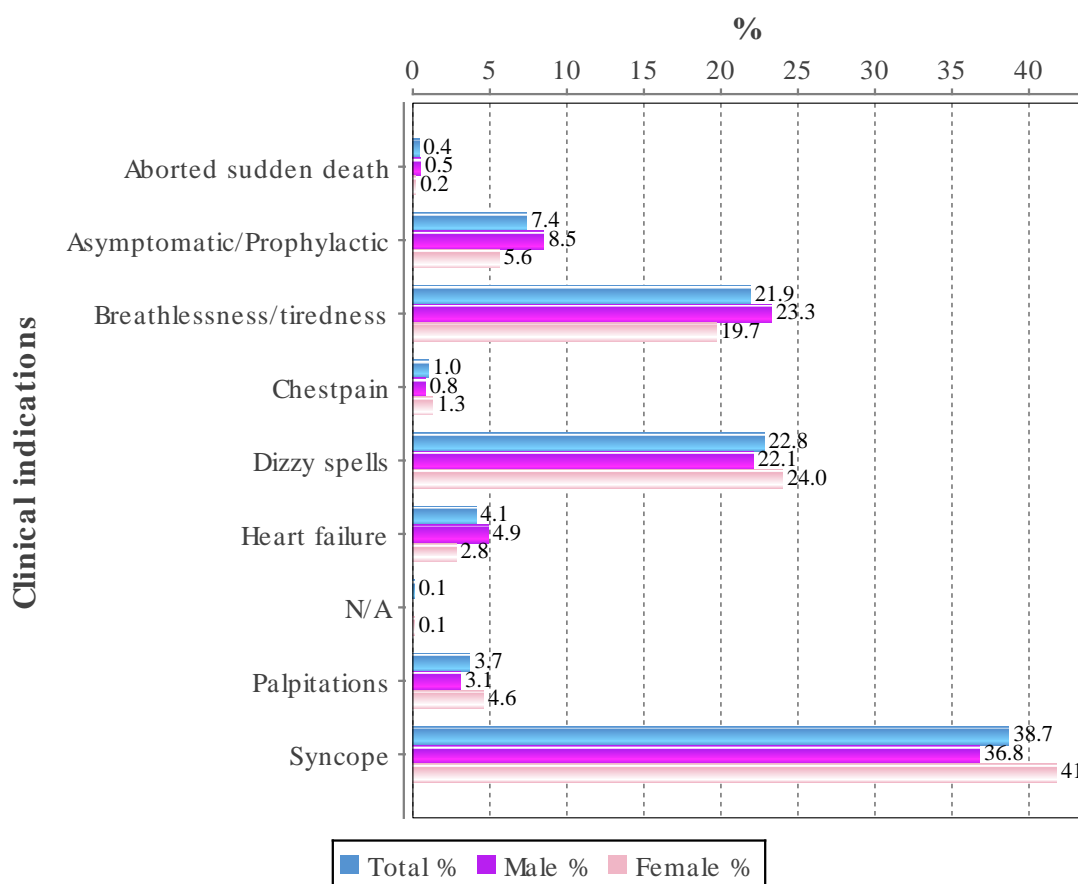
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	<b>2022</b>	<b>2021</b>	<b>2020</b>	<b>2019</b>	<b>2018</b>	<b>2017</b>
VVI to VVIR	1	4	3	3	4	3
AAI/AAIR to DDD/DDDR	11	17	21	21	21	21
VVI/VVIR to DDD/DDDR	34	13	28	35	23	24
VVI/VVIR/DDD/DDDR to CRT	260	267	255	260	274	221

## STATISTICS – PACEMAKER – CLINICAL INDICATIONS FIRST IMPLANT

*Main symptom for implanting pacemakers*

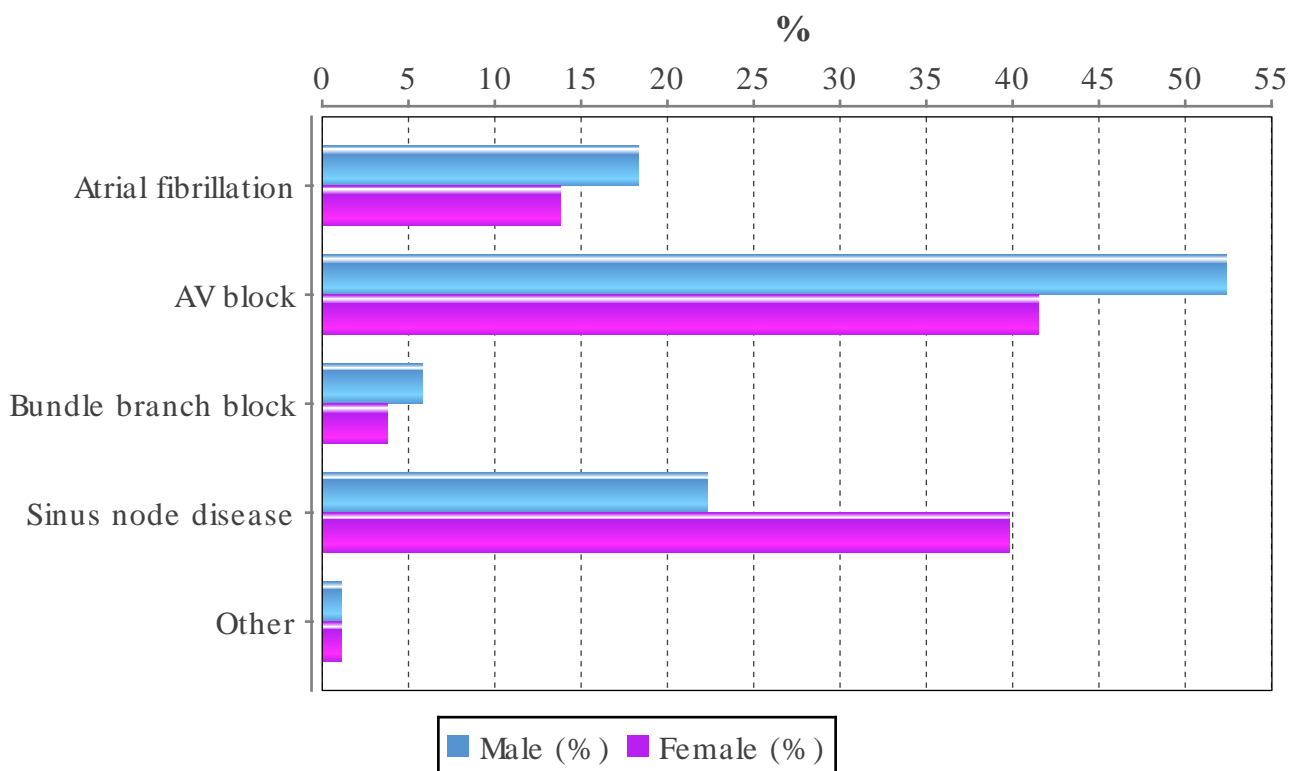
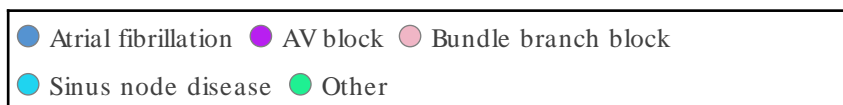
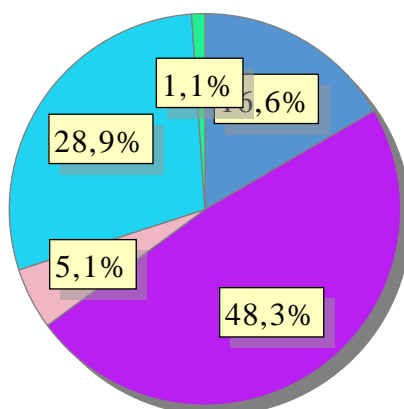
Indication	Total %	Male %	Female %
Aborted sudden death	0.4	0.5	0.2
Asymptomatic/Prophylactic	7.4	8.5	5.6
Breathlessness/tiredness	21.9	23.3	19.7
Chestpain	1.0	0.8	1.3
Dizzy spells	22.8	22.1	24.0
Heart failure	4.1	4.9	2.8
N/A	0.1	0.0	0.1
Palpitations	3.7	3.1	4.6
Syncope	38.7	36.8	41.8



## STATISTICS – PACEMAKER - PREPACING ECG FIRST IMPLANT

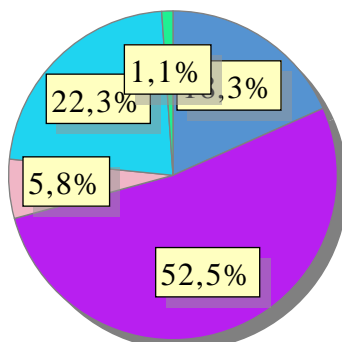
*Main ECG indication by gender and for patients < 18 years of age*

Indication	No	%	Male (%)	Female (%)	Younger than 18 (%)
Atrial fibrillation	1257	16.6	18.3	13.8	0.0
AV block	3655	48.3	52.4	41.5	72.2
Bundle branch block	383	5.1	5.8	3.8	0.0
Sinus node disease	2190	28.9	22.3	39.8	22.2
Other	84	1.1	1.1	1.1	5.6
Total number of implants 7569					

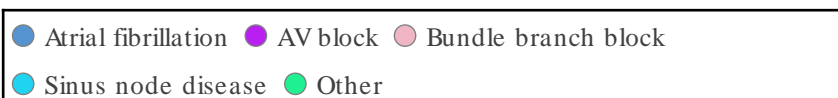
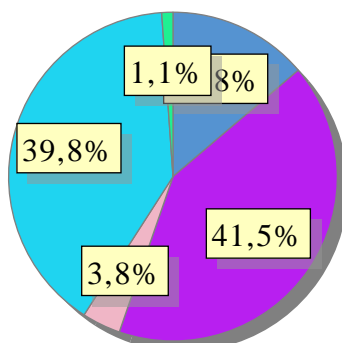


STATISTICS – PACEMAKER - PREPACING ECG FIRST IMPLANT

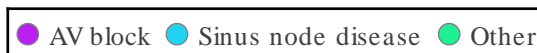
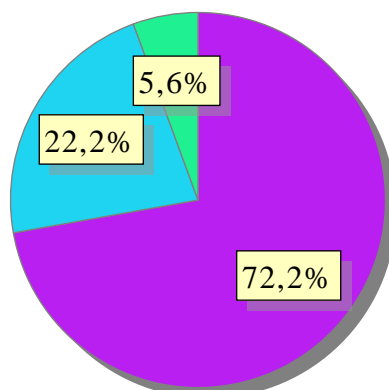
Male



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)*

<b>Hospital</b>	<b>Number</b>	<b>DDD %</b>	<b>VVI %</b>	<b>AAI %</b>	<b>CRT %</b>
Akademiska sjukhuset	282	81.6	12.4	0.4	5.7
Alingsås lasarett	58	79.3	19.0	1.7	0.0
Blekingesjukhuset	161	82.6	7.5	0.6	9.3
Bollnäs sjukhus	1	0.0	100.0	0.0	0.0
Centrallasarettet Växjö	161	85.1	13.7	0.0	1.2
Centralsjukhuset Karlstad	145	81.4	7.6	0.0	11.0
Centralsjukhuset Kristianstad	215	84.2	15.8	0.0	0.0
Centralsjukhuset Västerås	156	66.0	28.8	0.0	5.1
Danderyds sjukhus	432	84.0	11.1	0.2	4.6
Drottning Silvias Bus	9	77.8	0.0	22.2	0.0
Falu lasarett	239	72.8	15.1	0.0	12.1
Gävle sjukhus	206	77.7	17.5	0.5	4.4
Helsingborgs lasarett	203	79.8	18.2	0.0	2.0
Hudiksvalls sjukhus	46	93.5	6.5	0.0	0.0
Karolinska Universitetssjukhuset	449	78.4	12.2	0.0	9.4
Kungälv's sjukhus	132	84.1	15.2	0.8	0.0
Linköpings Universitetssjukhus	356	74.7	13.8	0.3	11.2
Länssjukhuset Halmstad	68	82.4	17.6	0.0	0.0
Länssjukhuset Kalmar	112	55.4	40.2	0.9	3.6
Länssjukhuset Ryhov	252	74.2	25.8	0.0	0.0
Mälarsjukhuset	200	81.5	11.5	0.0	7.0
Norrlands Universitetssjukhus	177	78.5	13.6	3.4	4.5
Sahlgrenska Universitetssjukhuset	381	72.4	13.9	0.5	13.1
Sahlgrenska Universitetssjukhuset /Östra	57	59.6	40.4	0.0	0.0
Skaraborgs sjukhus Skövde	227	72.7	10.6	0.0	16.7
Skellefteå lasarett	34	76.5	23.5	0.0	0.0
Skånes universitetssjukhus, Lund	368	71.5	12.5	0.3	15.8
Skånes universitetssjukhus, Malmö	210	85.2	14.3	0.5	0.0
Sollefteå sjukhus	30	93.3	6.7	0.0	0.0
St Görans sjukhus	282	81.6	17.0	0.0	1.4
Sunderby sjukhus	273	71.4	20.5	0.0	8.1
Sundsvalls sjukhus	161	80.7	16.8	0.6	1.9
Södersjukhuset	305	77.4	17.4	0.3	4.9
Södra Älvsborgs sjukhus	229	80.3	14.0	0.0	5.7
Torsby sjukhus	26	84.6	15.4	0.0	0.0
Trollhättan, NÄL	257	70.0	22.6	0.0	7.4
Universitetssjukhuset Örebro	211	81.0	17.1	0.0	1.9
Varbergs sjukhus	185	81.6	13.5	0.0	4.9
Visby lasarett	39	71.8	28.2	0.0	0.0
Västerviks sjukhus	44	79.5	20.5	0.0	0.0
Örnsköldsviks sjukhus	69	85.5	14.5	0.0	0.0
Östersunds sjukhus	96	78.1	18.8	0.0	3.1

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STATISTICS – PACEMAKER – REASON FOR GENERATOR CHANGE HISTORICAL

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*Historical explant indications*

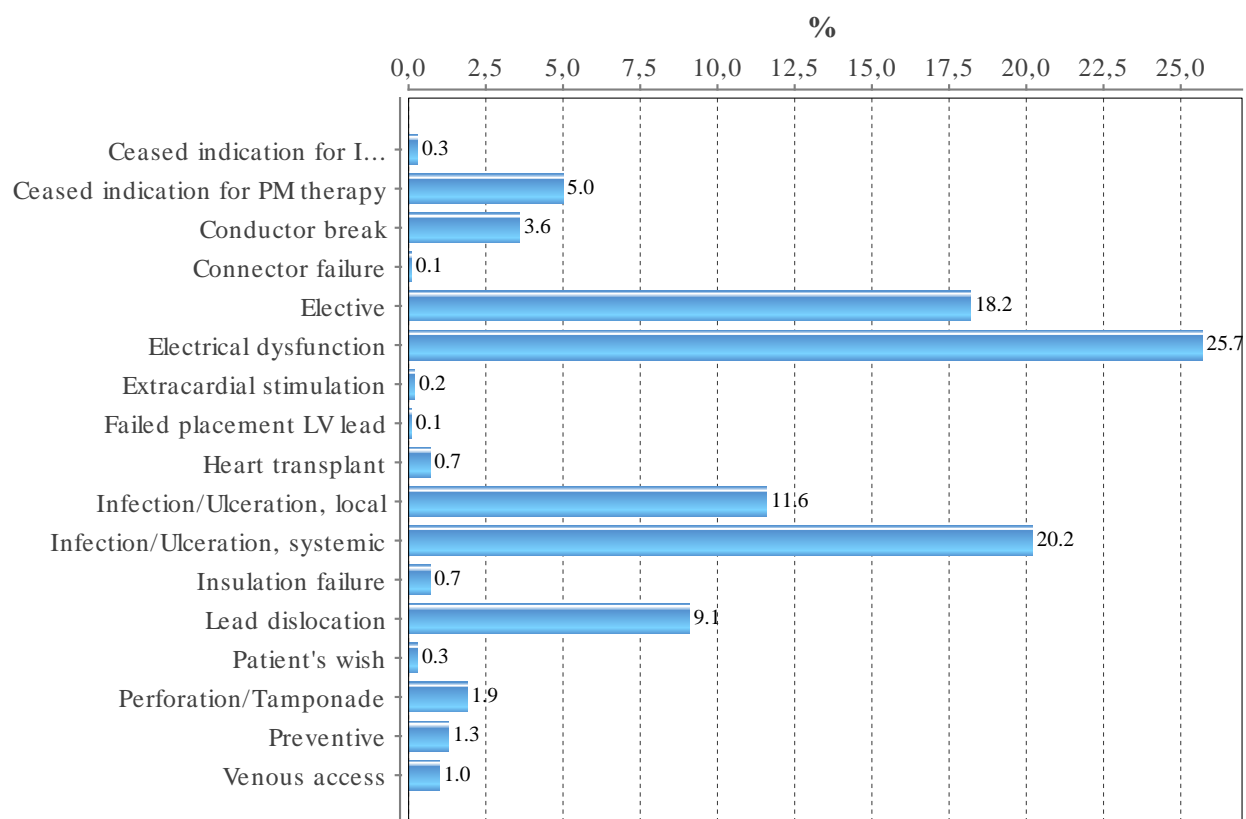
<b>Reason</b>	<b>2018 %</b>	<b>2019 %</b>	<b>2020 %</b>	<b>2021 %</b>	<b>2022 %</b>
Preventive	2.1	2.7	1.7	1.3	2.1
Elective	13.7	15.9	18.1	17.0	20.7
System change hemodynamic	0.9	0.2	0.0	0.0	0.0
Recall/Alert	0.1	0.2	0.2	0.3	1.9
Erosion/Infection, local	2.7	2.0	2.1	2.3	1.6
Erosion/Infection, systemic	3.8	3.3	3.0	3.1	2.9
Patient's wish	0.1	0.1	0.1	0.2	0.3
CRT-P to PM because of discontinued CRT-indication	0.1	0.0	0.1	0.1	0.0
CRT-P to CRT-D	0.5	0.8	0.3	0.4	0.4
ERI	66.2	65.9	64.5	65.4	61.1
Premature EOL	0.6	0.7	1.6	1.4	0.9
Heart transplant	0.1	0.1	0.1	0.1	0.1
Ceased indication for PM therapy	0.5	0.2	0.3	0.6	0.5
PM to CRT-P	5.6	5.1	4.5	5.0	4.7
PM to CRT-D	2.0	1.5	1.9	1.3	1.3
PM to ICD because of arrhythmia	0.9	0.9	1.1	1.2	0.8
Technical failure	0.2	0.4	0.4	0.5	0.5



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## STATISTICS – PACEMAKER – REASON FOR LEAD EXPLANT

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### Implant rates

There are 14636 active ICD patients in Sweden 2022, the number slowly increasing over years and could be an effect of better heart failure management, 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 lower in 2022 than 2021 136 vs 145 per million. Of this 81 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 southeast, 220 in Blekinge and the lowest in the Örebro region with 94 per million.

About 38% 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 49% market share, Medtronic second with 33%. Boston Scientific with 13% and Biotronik is smallest with 5% market share.

### Patients

The average age for ICD implant is stable at 65 years in males and 61 years in females for all types of implants, unchanged from previous years. In the older category 92 patients in the age group 80-89 received a first ICD implants as secondary prevention and 29 were primary prevention.

Clinical indication for all ICD implants was secondary prevention in 38% and primary in 62%. Aethiology was ischemic heart disease in 45% of all patients but more common in males, 49% vs 31% in females. Medication at the start of therapy is displayed in tables.

### Subtypes and leads

98% 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 42%, CRT with 31% , VR with 25%. A small number of S-ICD devices were also used; 17.

Only 60% of the ICD's are used until normal EOL/ERI, 10% are changed due to system upgrade to a CRT system. Technical recalls stand for 0.1% of all box changes and premature EOL is 1.8%.

ICD leads display larger failure rates compared to pacemaker leads but overall longevity is still good.

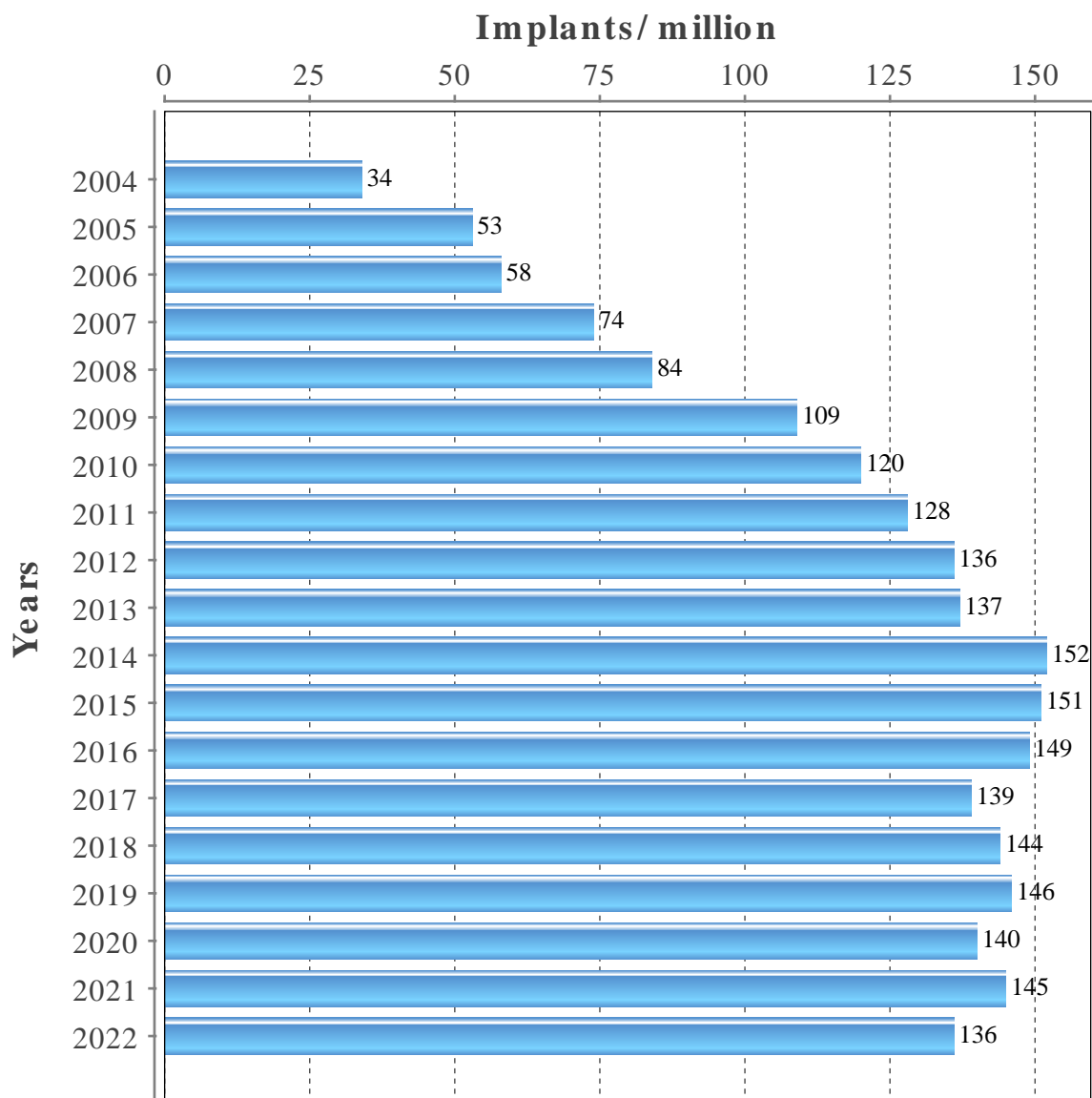
Specific statistics for Sprint Fidelis and Durata leads are displayed in the quality section.

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

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STATISTICS – ICD – HISTORICAL IMPLANTATION RATES

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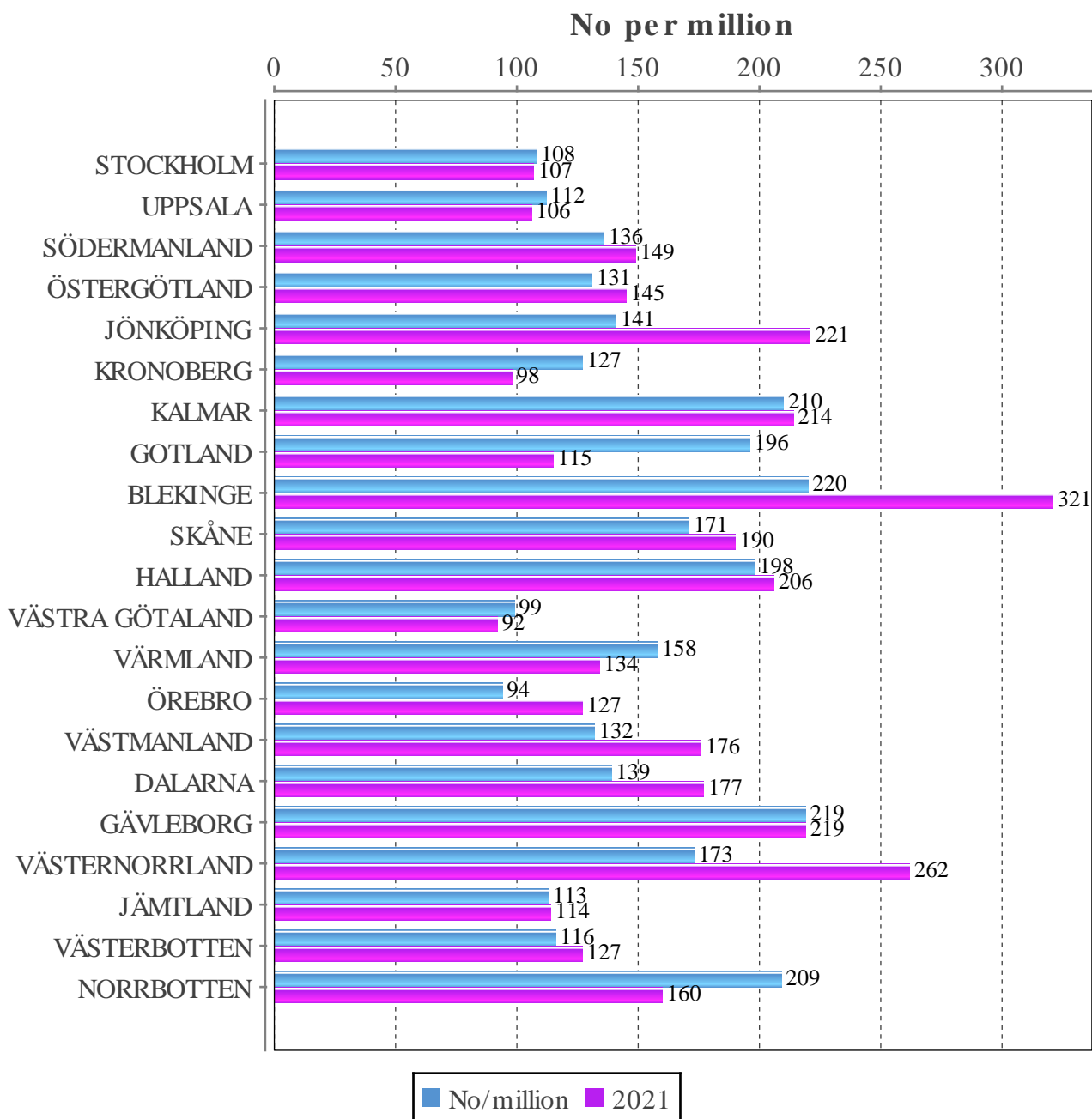
STATISTICS – ICD – IMPLANTS PER COUNTY

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

<b>County</b>	<b>Population</b>	<b>No of first</b>	<b>No/million</b>	<b>Active patients</b>
STOCKHOLM	2440027	263	108	2913
UPPSALA	400682	45	112	576
SÖDERMANLAND	302566	41	136	408
ÖSTERGÖTLAND	471912	62	131	663
JÖNKÖPING	369113	52	141	540
KRONOBERG	204335	26	127	303
KALMAR	247711	52	210	447
GOTLAND	61173	12	196	121
BLEKINGE	158740	35	220	324
SKÅNE	1414324	242	171	2091
HALLAND	342805	68	198	542
VÄSTRA GÖTALAND	1758656	174	99	1730
VÄRMLAND	283976	45	158	400
ÖREBRO	307772	29	94	435
VÄSTMANLAND	280713	37	132	399
DALARNA	288310	40	139	502
GÄVLEBORG	287334	63	219	624
VÄSTERNORRLAND	243265	42	173	457
JÄMTLAND	132670	15	113	222
VÄSTERBOTTEN	276295	32	116	429
NORRBOTTEN	249177	52	209	510
Total	10521556	1427	136	14636

STATISTICS – ICD – IMPLANTS PER COUNTY



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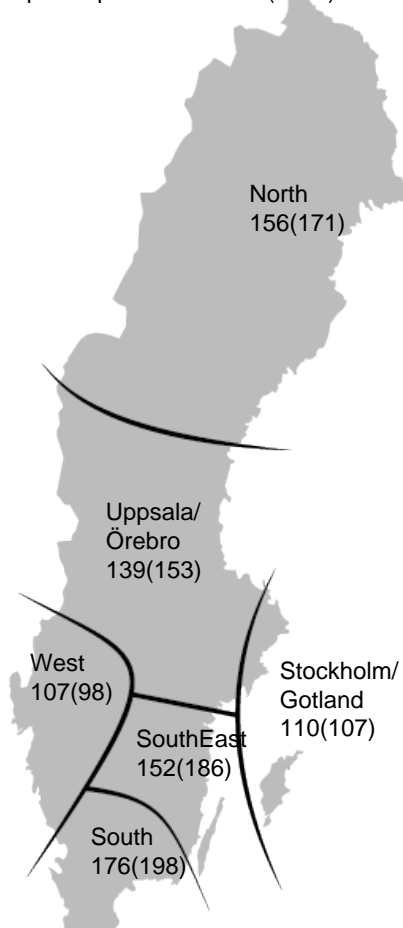
## STATISTICS – ICD – IMPLANTS PER REGION

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*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	2501200	275	110	3034
Uppsala/Örebro	2151353	300	139	3344
South-East Sweden	1088736	166	152	1650
Southern Sweden	1918910	337	176	2978
Western Sweden	1957388	209	107	2012
Northern Sweden	901407	141	156	1618
Total	10518994	1428	136	14636

Implants per million 2022(2021)



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STATISTICS – ICD – IMPLANTING HOSPITALS

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*First implants per hospital (inclusive CRT)*

<b>Region</b>	<b>Hospital</b>	<b>2022</b>	<b>2021</b>
Northern Sweden	Norrlands Universitetssjukhus	35	33
	Skellefteå lasarett	1	2
	Sunderby sjukhus	48	42
	Sundsvalls sjukhus	33	46
	Örnsköldsviks sjukhus	11	17
	Östersunds sjukhus	12	17
Southern Sweden	Blekingesjukhuset	42	50
	Centrallasarettet Växjö	24	17
	Centralsjukhuset Kristianstad	44	31
	Helsingborgs lasarett	18	27
	Skånes universitetssjukhus, Lund	152	181
	Skånes universitetssjukhus, Malmö	29	36
	Varbergs sjukhus	70	69
South-East Sweden	Linköpings Universitetssjukhus	78	109
	Länssjukhuset Kalmar	50	48
	Länssjukhuset Ryhov	37	46
Stockholm/Gotland	Danderyds sjukhus	51	70
	Karolinska Universitetssjukhuset	128	122
	St Görans sjukhus	45	34
	Södersjukhuset	59	45
	Visby lasarett	1	0
Uppsala/Örebro	Akademiska sjukhuset	49	54
	Centralsjukhuset Karlstad	44	37
	Centralsjukhuset Västerås	34	43
	Falu lasarett	40	52
	Gävle sjukhus	54	50
	Hudiksvalls sjukhus	9	8
	Mälarsjukhuset	37	42
	Universitetssjukhuset Örebro	31	40
Western Sweden	Drottning Silvias Bus	2	0
	Sahlgrenska Universitetssjukhuset	84	67
	Skaraborgs sjukhus Skövde	29	30
	Södra Älvsborgs sjukhus	32	28
	Trollhättan, NÄL	34	39

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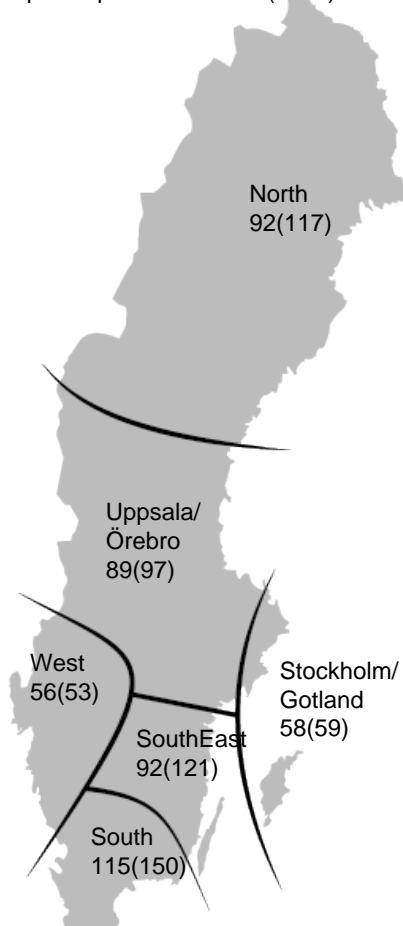
## STATISTICS – ICD – PRIMARY PREVENTION PER REGION

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*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	2501200	145	58	1729
Uppsala/Örebro	2151353	192	89	2000
South-East Sweden	1088736	100	92	1014
Southern Sweden	1918910	221	115	1809
Western Sweden	1957388	109	56	997
Northern Sweden	901407	83	92	936
Total	10518994	850	81	8485

Implants per million 2022(2021)

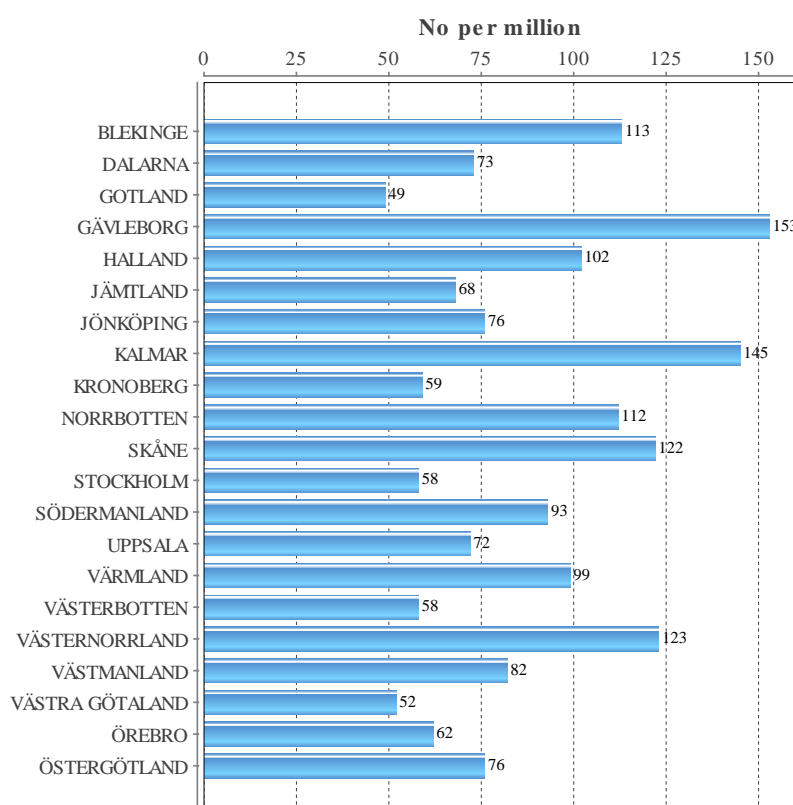




## STATISTICS – ICD – PRIMARY PREVENTION PER COUNTY

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

County	Population	No of first	No/million
BLEKINGE	158740	18	113
DALARNA	288310	21	73
GOTLAND	61173	3	49
GÄVLEBORG	287334	44	153
HALLAND	342805	35	102
JÄMTLAND	132670	9	68
JÖNKÖPING	369113	28	76
KALMAR	247711	36	145
KRONOBERG	204335	12	59
NORRBOTTEN	249177	28	112
SKÅNE	1414324	172	122
STOCKHOLM	2440027	142	58
SÖDERMANLAND	302566	28	93
UPPSALA	400682	29	72
VÄRMLAND	283976	28	99
VÄSTERBOTTEN	276295	16	58
VÄSTERNORRLAND	243265	30	123
VÄSTMANLAND	280713	23	82
VÄSTRA GÖTALAND	1758656	92	52
ÖREBRO	307772	19	62
ÖSTERGÖTLAND	471912	36	76
Total	10521556	849	81



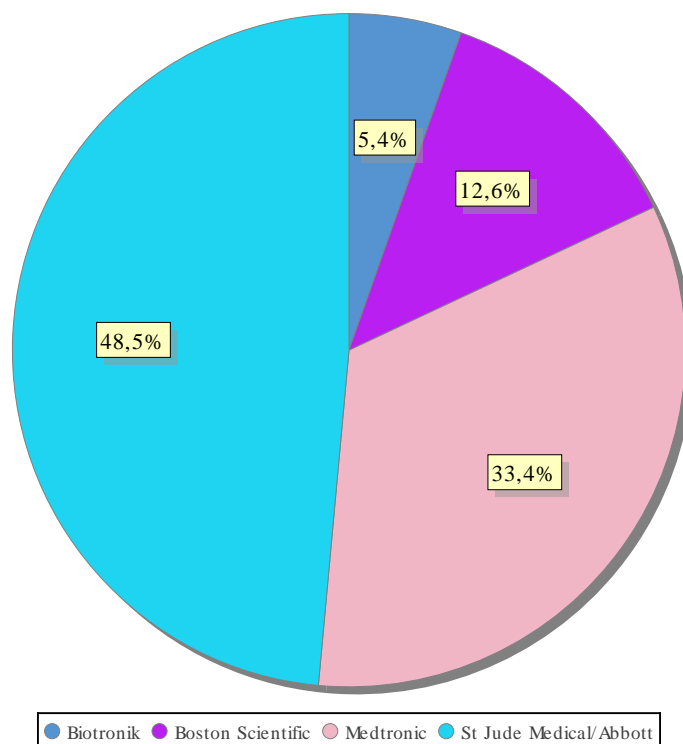
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## STATISTICS – ICD – ICDS PER MANUFACTURER

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*Market share per manufacturer in Sweden*

Manufacturer	2019 %	2020 %	2021 %	2022 %
Biotronik	5.3	5.5	4.7	5.4
Boston Scientific	14.4	14.9	10.2	12.6
Medtronic	41.0	36.0	32.9	33.4
St. Jude Medical	39.2	43.5	52.2	48.5

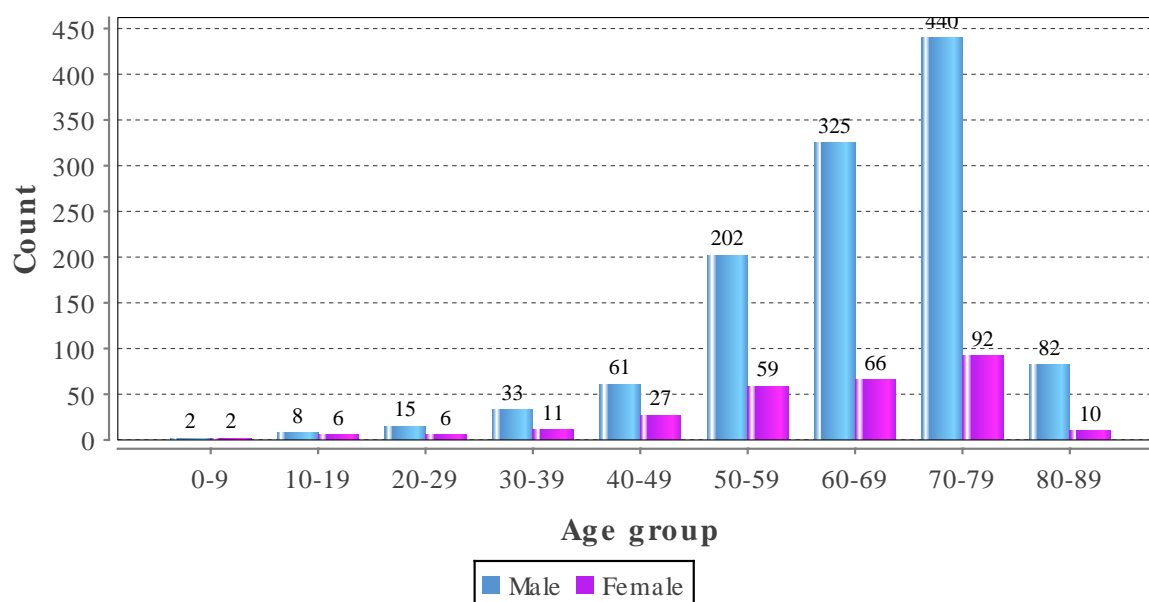


## STATISTICS – ICD – AGE DISTRIBUTION MALES/FEMALES

*Age and gender distribution for new implants, total numbers*

Age (years)	Total no	%	Male	Female
0-9	4	0.3	2	2
10-19	14	1.0	8	6
20-29	21	1.5	15	6
30-39	44	3.0	33	11
40-49	88	6.1	61	27
50-59	261	18.0	202	59
60-69	391	27.0	325	66
70-79	532	36.8	440	92
80-89	92	6.4	82	10
Average age	64	-	65	61

Total number of implants: 1447

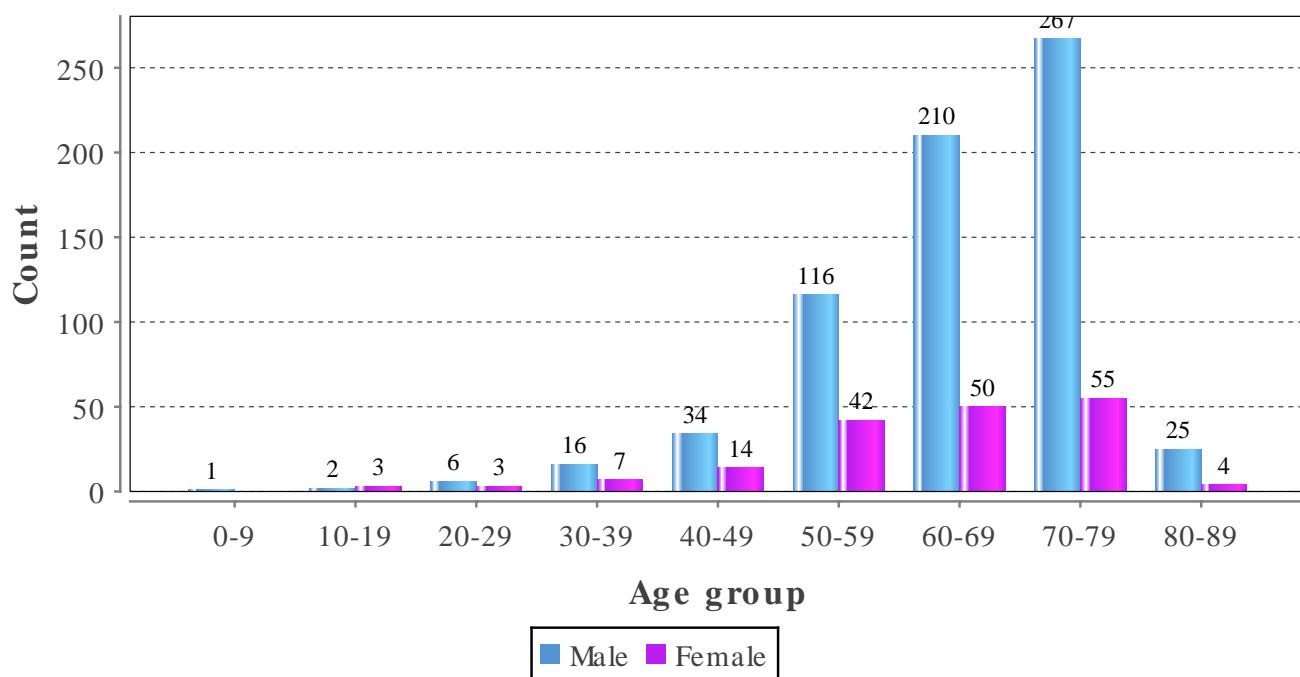


## STATISTICS – ICD – AGE DISTRIBUTION PRIMARY PREVENTION

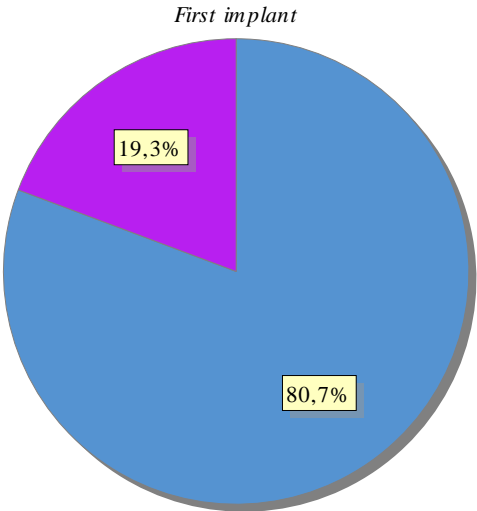
*Primary prevention divided by gender and age.*

Age (years)	Total no	%	Male	Female
0-9	1	0.1	1	0
10-19	5	0.6	2	3
20-29	9	1.1	6	3
30-39	23	2.7	16	7
40-49	48	5.6	34	14
50-59	158	18.5	116	42
60-69	260	30.4	210	50
70-79	322	37.7	267	55
80-89	29	3.4	25	4
Average age	64	-	65	61

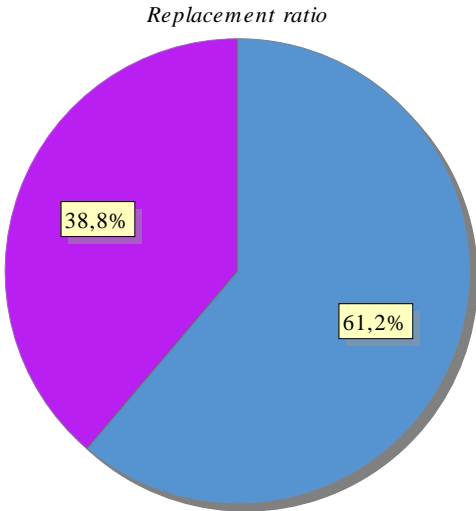
Total number of implants: 855



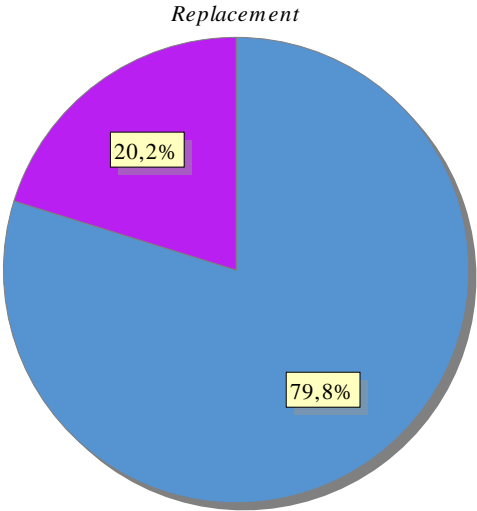
STATISTICS – ICD – TYPE OF IMPLANTS



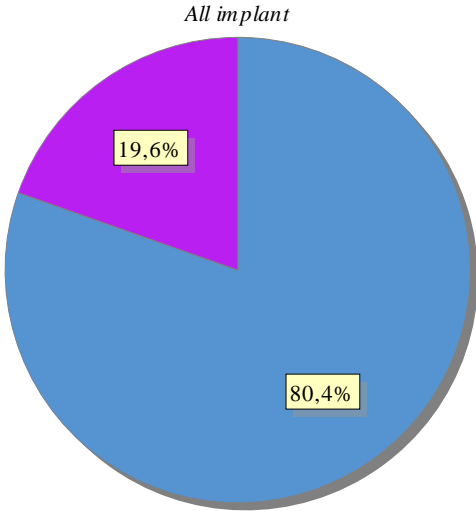
● male ● female



● First implant ● Replacement



● male ● female



● male ● female

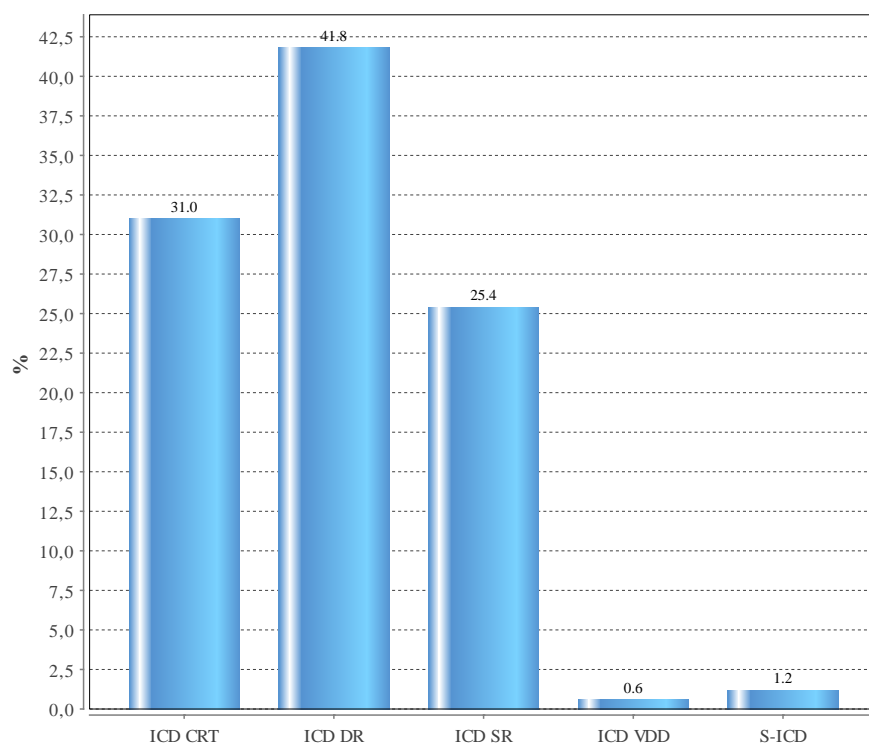
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## STATISTICS – ICD – SUB TYPE

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*ICD subtype for new implants*

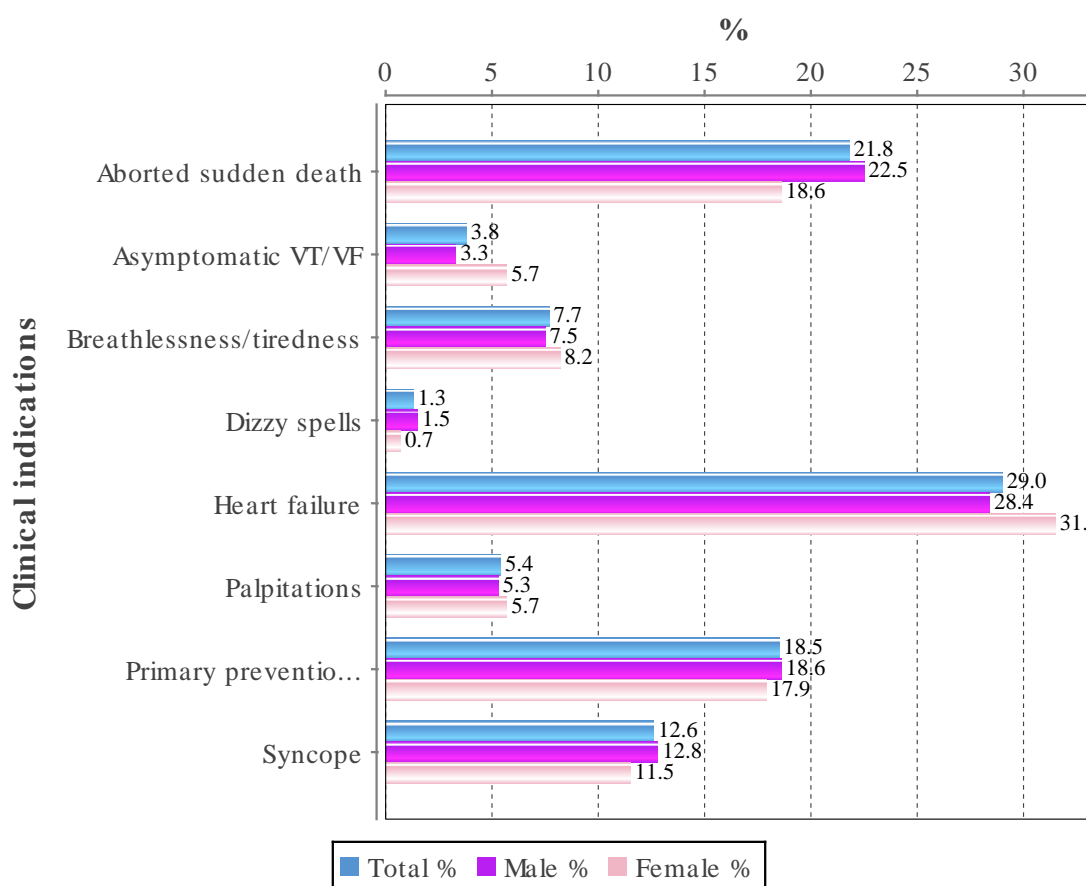
Mode	%	No
ICD CRT	31.0	449
ICD DR	41.8	605
ICD SR	25.4	368
ICD VDD	0.6	8
S-ICD	1.2	17



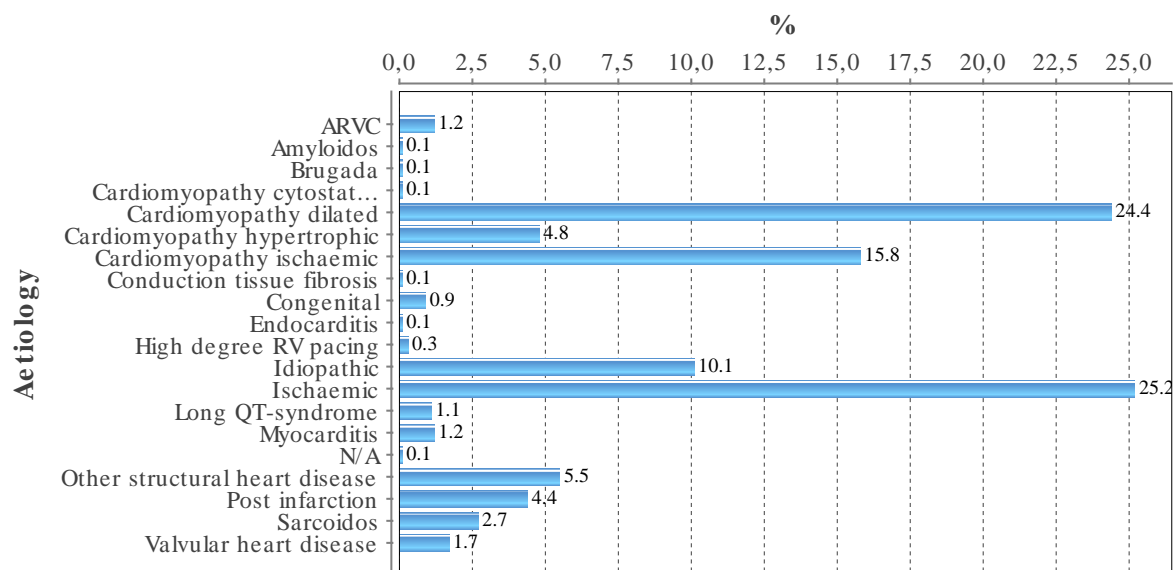
## STATISTICS – ICD – CLINICAL INDICATIONS FIRST IMPLANT

*Main symptom for implanting ICDs*

Indication	Total %	Male %	Female %
Aborted sudden death	21.8	22.5	18.6
Asymptomatic VT/VF	3.8	3.3	5.7
Breathlessness/tiredness	7.7	7.5	8.2
Dizzy spells	1.3	1.5	0.7
Heart failure	29.0	28.4	31.5
Palpitations	5.4	5.3	5.7
Primary prevention, asymptomatic	18.5	18.6	17.9
Syncope	12.6	12.8	11.5

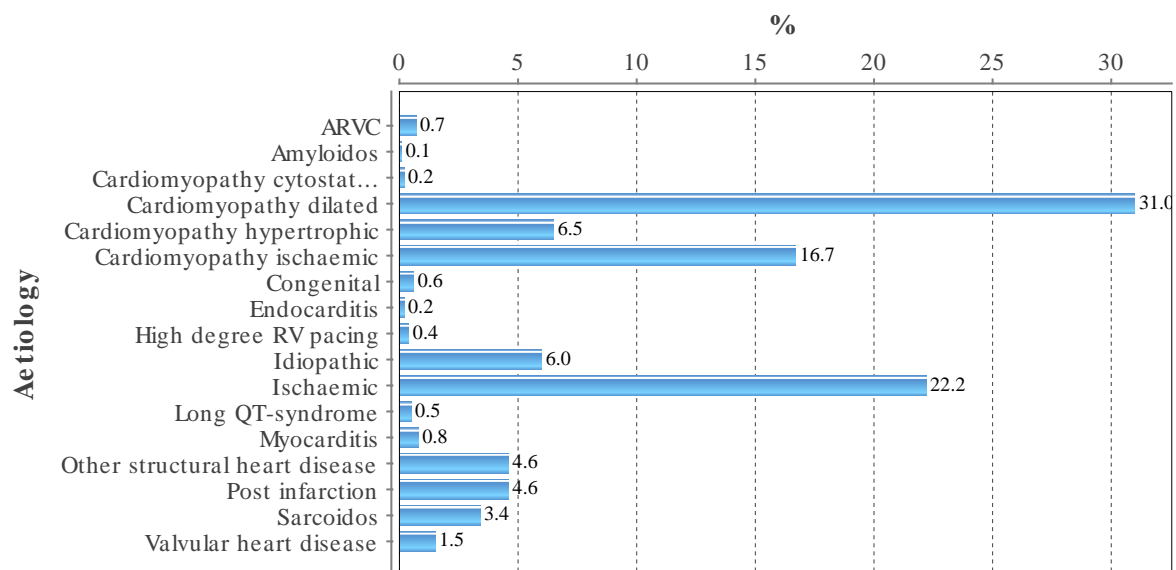


## STATISTICS – ICD - AETIOLOGY FIRST IMPLANT





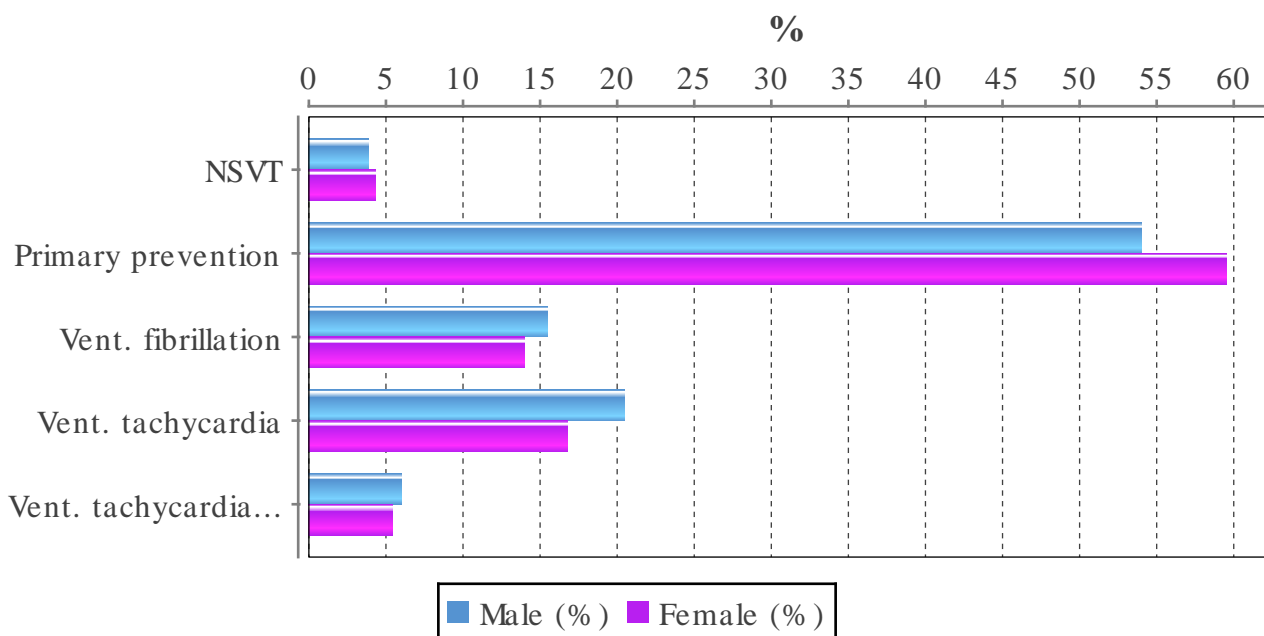
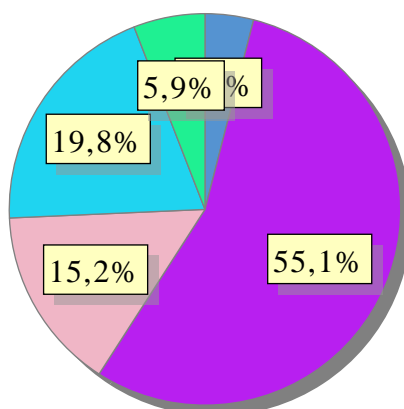
## STATISTICS – ICD - AETIOLOGY PRIMARY PREVENTION



## STATISTICS – ICD – PREPACING ECG (TACHY)

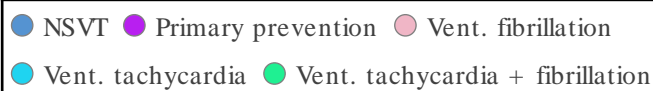
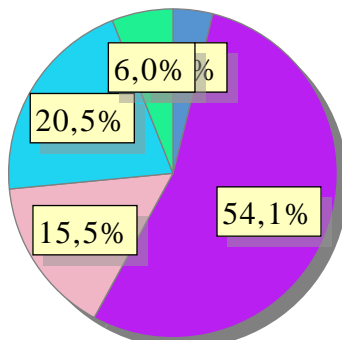
Documented ECG leading to ICD implant. (NSVT = non sustained VT) by gender and patients < 18 years

Indication	No	Total %	Male (%)	Female (%)	It 18 (%)
NSVT	58	4.0	3.9	4.3	9.1
Primary prevention	797	55.1	54.0	59.5	18.2
Vent. fibrillation	220	15.2	15.5	14.0	36.4
Vent. tachycardia	287	19.8	20.5	16.8	9.1
Vent. tachycardia + fibrillation	85	5.9	6.0	5.4	27.3
Total number of implants 1447					

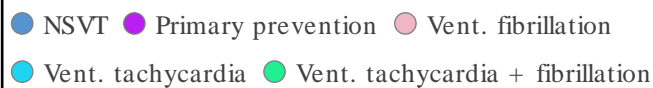
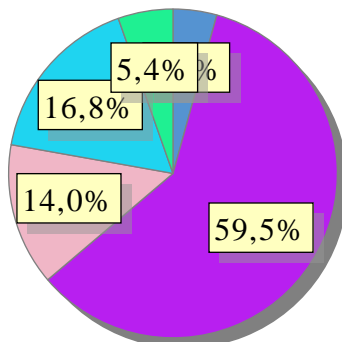


STATISTICS – ICD – PREPACING ECG (TACHY)

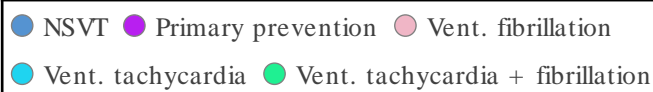
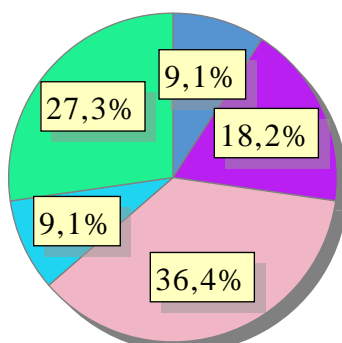
Male



Female



< 18



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STATISTICS – ICD – REASON FOR GENERATOR EXPLANT

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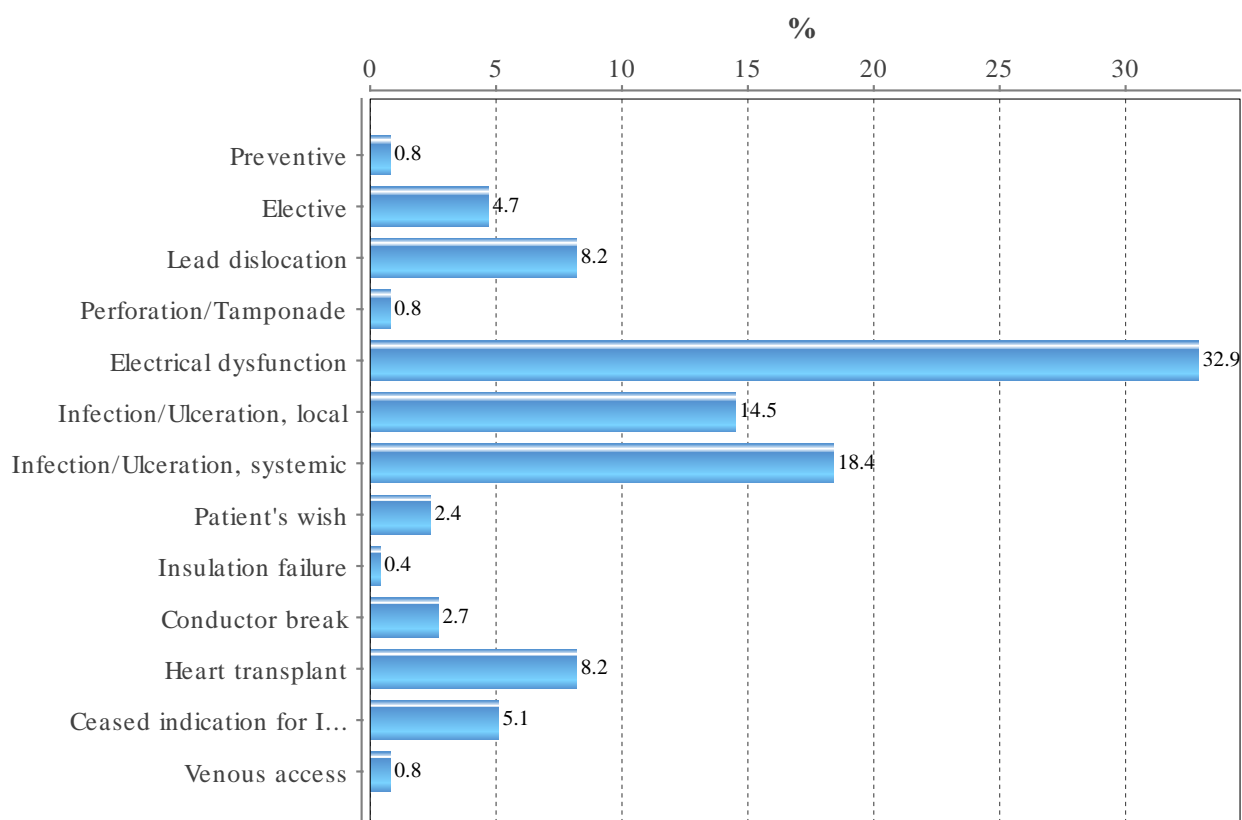
*Historical explants indications*

<b>Reason</b>	<b>2020 %</b>	<b>2021 %</b>	<b>2022 %</b>
Preventive	1.6	1.1	1.3
Elective	14.8	16.2	14.1
Recall/Alert	0.8	0.2	0.1
Erosion/Infection, local	4.8	4.1	3.6
Erosion/Infection, systemic	2.9	3.2	4.5
Patient's wish	0.5	0.9	0.6
CRT-D to CRT-P	1.0	0.5	0.5
CRT-D to ICD because of ceased CRT-indication	0.2	0.2	0.0
ERI	57.2	58.2	59.0
Premature EOL	1.6	1.2	1.8
Heart transplant	0.3	0.4	2.0
Ceased indication for ICD therapy	1.0	1.6	1.4
ICD to CRT-D	11.4	10.5	9.5
ICD to PM because of ceased indication	0.8	0.4	0.7
Technical failure	0.8	1.2	0.9
ICD to CRT-P because of heart failure	0.0	0.2	0.0

## STATISTICS – ICD – REASON FOR LEAD EXPLANT

*Historical lead explants indications*

Reason	2020 %	2021 %	2022 %
Preventive	0.5	0.4	0.8
Elective	5.2	4.7	4.7
Lead dislocation	8.5	8.6	8.2
Extracardial stimulation	0.9	0.4	0.0
Perforation/Tamponade	0.5	1.7	0.8
Electrical dysfunction	32.1	31.3	32.9
Infection/Ulceration, local	19.8	16.7	14.5
Infection/Ulceration, systemic	18.9	16.3	18.4
Insulation failure	0.5	1.3	0.4
Conductor break	4.7	3.9	2.7
Heart transplant	1.4	1.7	8.2
Ceased indication for ICD therapy	7.1	9.9	5.1
Patient's wish	0.0	3.0	2.4
Venous access	0.0	0.0	0.8



### **Implant rates**

Implant rates of CRT system in 2022 were 62 per million CRT-P's and 54 per million CRT-D's. The highest implant rate of CRT in total is found in Norrbotten with 224 per million and the lowest in Örebro with 39. 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 67 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 3 implanters performed >50 implants and 15 implanters out of 72 perform > 20 implants per year which is the recommended minimum. The failure rate at implant is according to the registry 5% but this is most likely an underestimation when compared to the literature.

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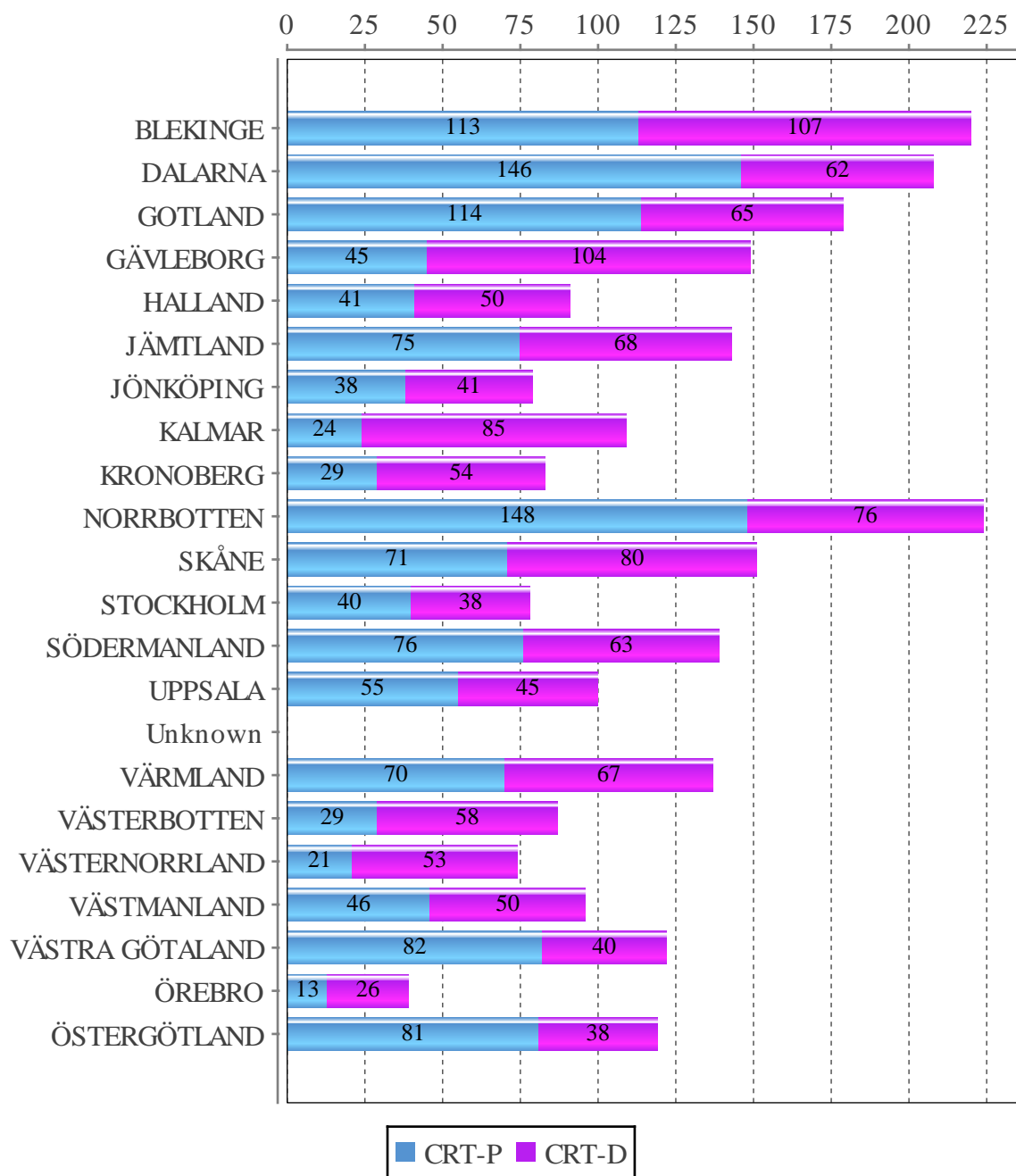
## STATISTICS – CRT – HISTORICAL IMPLANT RATES

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*CRT Historical implant rates per hundred thousand residents*

Year	Population	No First Impl	CRT-P		CRT-D	
			No	Rate	No	Rate
2018	10230185	1209	611	6.0	598	5.8
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

## STATISTICS – CRT – IMPLANTS PER COUNTY





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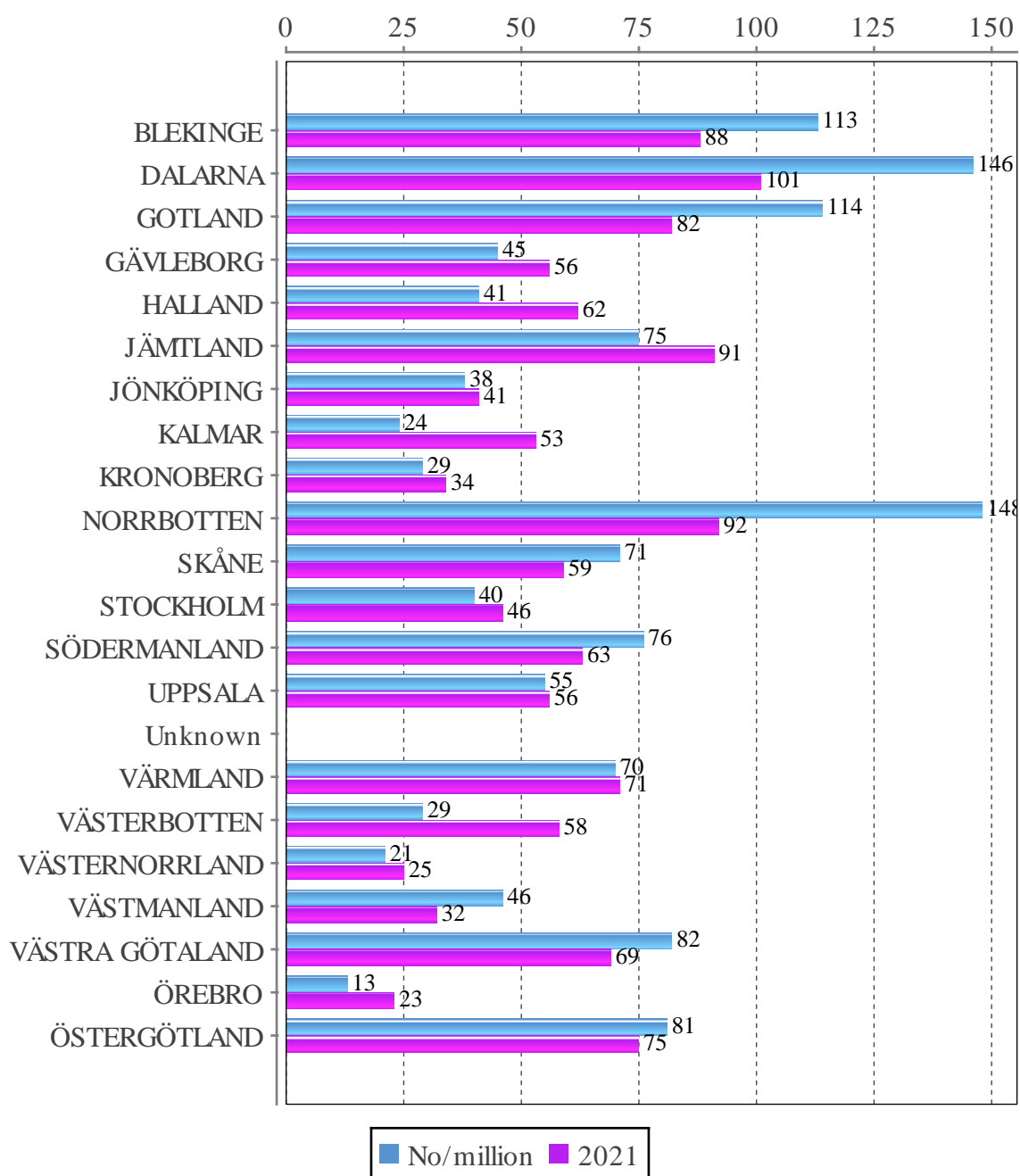
STATISTICS – CRT-P – IMPLANTS PER COUNTY

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

	<b>Population</b>	<b>No first impl</b>	<b>No/million</b>
BLEKINGE	158740	18	113
DALARNA	288310	42	146
GOTLAND	61173	7	114
GÄVLEBORG	287334	13	45
HALLAND	342805	14	41
JÄMTLAND	132670	10	75
JÖNKÖPING	369113	14	38
KALMAR	247711	6	24
KRONOBERG	204335	6	29
NORRBOTTEN	249177	37	148
SKÅNE	1414324	101	71
STOCKHOLM	2440027	98	40
SÖDERMANLAND	302566	23	76
UPPSALA	400682	22	55
Unknown	0	10	0
VÄRMLAND	283976	20	70
VÄSTERBOTTEN	276295	8	29
VÄSTERNORRLAND	243265	5	21
VÄSTMANLAND	280713	13	46
VÄSTRA GÖTALAND	1758656	144	82
ÖREBRO	307772	4	13
ÖSTERGÖTLAND	471912	38	81
Total	10521556	653	62

STATISTICS – CRT-P – IMPLANTS PER COUNTY



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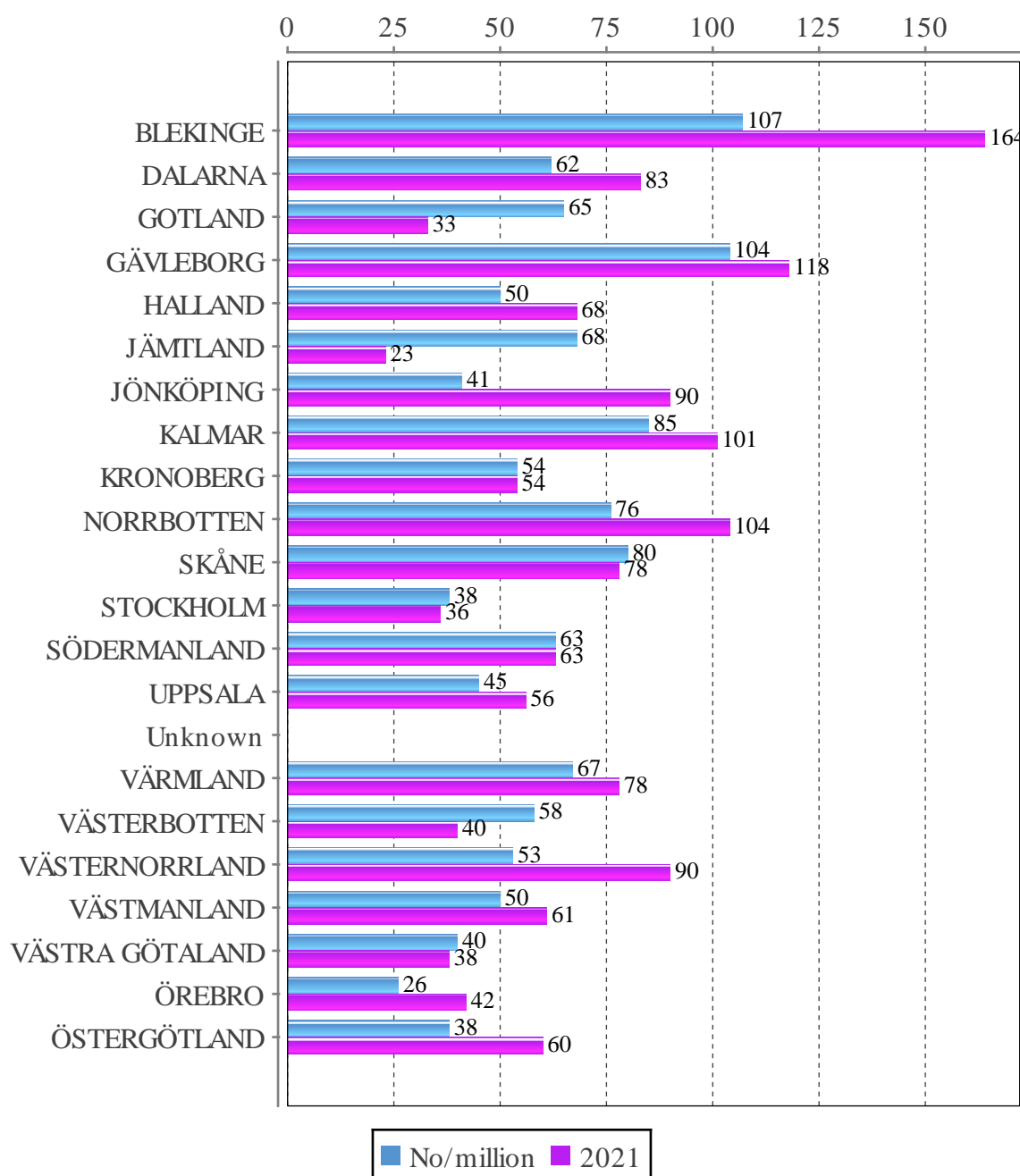
STATISTICS – CRT-D – IMPLANTS PER COUNTY

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

	<b>Population</b>	<b>No first impl</b>	<b>No/million</b>
BLEKINGE	158740	17	107
DALARNA	288310	18	62
GOTLAND	61173	4	65
GÄVLEBORG	287334	30	104
HALLAND	342805	17	50
JÄMTLAND	132670	9	68
JÖNKÖPING	369113	15	41
KALMAR	247711	21	85
KRONOBERG	204335	11	54
NORRBOTTEN	249177	19	76
SKÅNE	1414324	113	80
STOCKHOLM	2440027	93	38
SÖDERMANLAND	302566	19	63
UPPSALA	400682	18	45
Unknown	0	8	0
VÄRMLAND	283976	19	67
VÄSTERBOTTEN	276295	16	58
VÄSTERNORRLAND	243265	13	53
VÄSTMANLAND	280713	14	50
VÄSTRA GÖTALAND	1758656	71	40
ÖREBRO	307772	8	26
ÖSTERGÖTLAND	471912	18	38
Total	10521556	571	54

STATISTICS – CRT-D – IMPLANTS PER COUNTY



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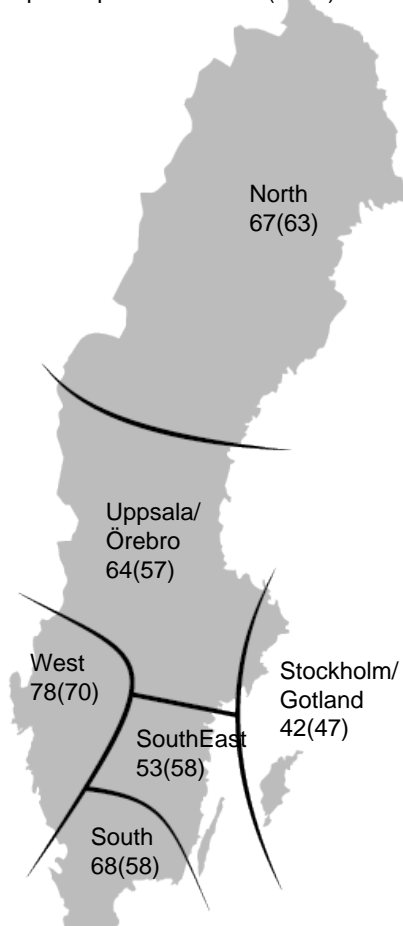
## STATISTICS – CRT-P – IMPLANTS PER REGION

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*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	2501200	105	42
Uppsala/Örebro	2151353	137	64
South-East Sweden	1088736	58	53
Southern Sweden	1918910	131	68
Western Sweden	1957388	152	78
Northern Sweden	901407	60	67
Total	10518994	643	61

Implants per million 2022(2021)



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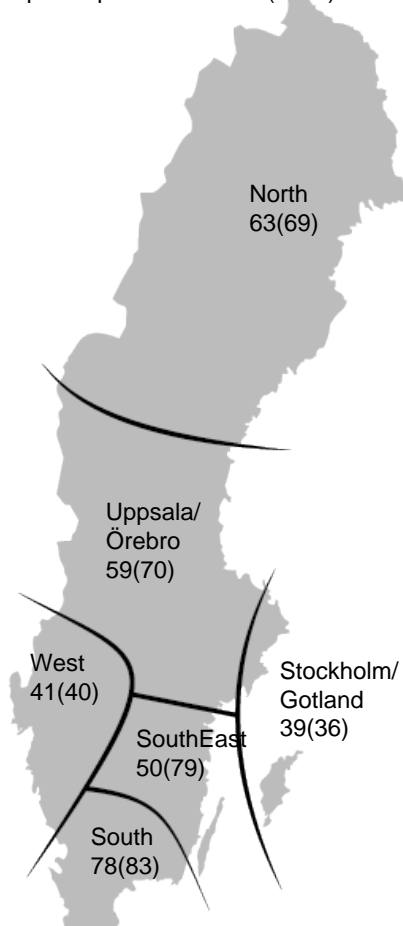
## STATISTICS – CRT-D – IMPLANTS PER REGION

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*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	2501200	97	39
Uppsala/Örebro	2151353	126	59
South-East Sweden	1088736	54	50
Southern Sweden	1918910	149	78
Western Sweden	1957388	81	41
Northern Sweden	901407	57	63
Total	10518994	564	54

Implants per million 2022(2021)

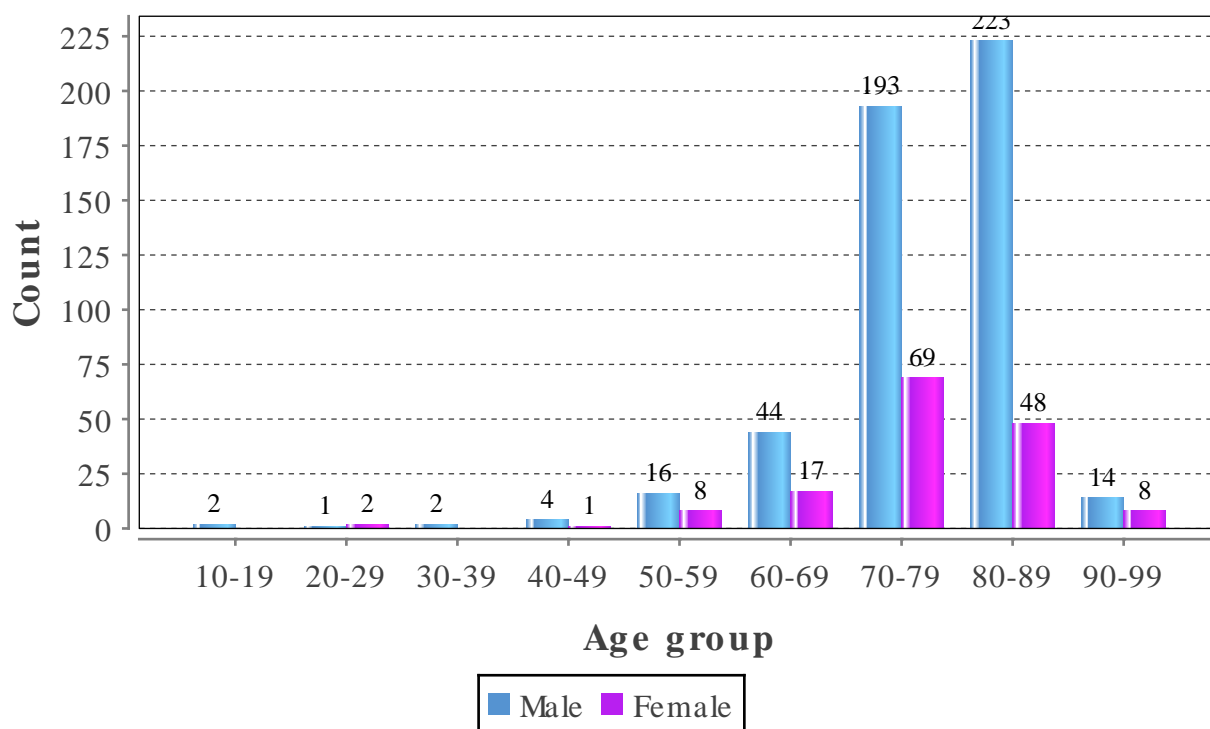


STATISTICS – CRT-P – AGE DISTRIBUTION MALES/FEMALES

Age and gender distribution for new implants, total numbers

Age (years)	Total no	%	Male	Female
10-19	2	0.3	2	0
20-29	3	0.5	1	2
30-39	2	0.3	2	0
40-49	5	0.8	4	1
50-59	24	3.7	16	8
60-69	61	9.4	44	17
70-79	262	40.2	193	69
80-89	271	41.6	223	48
90-99	22	3.4	14	8
Average age	77	0.0	77	76

Total number of implants: 652



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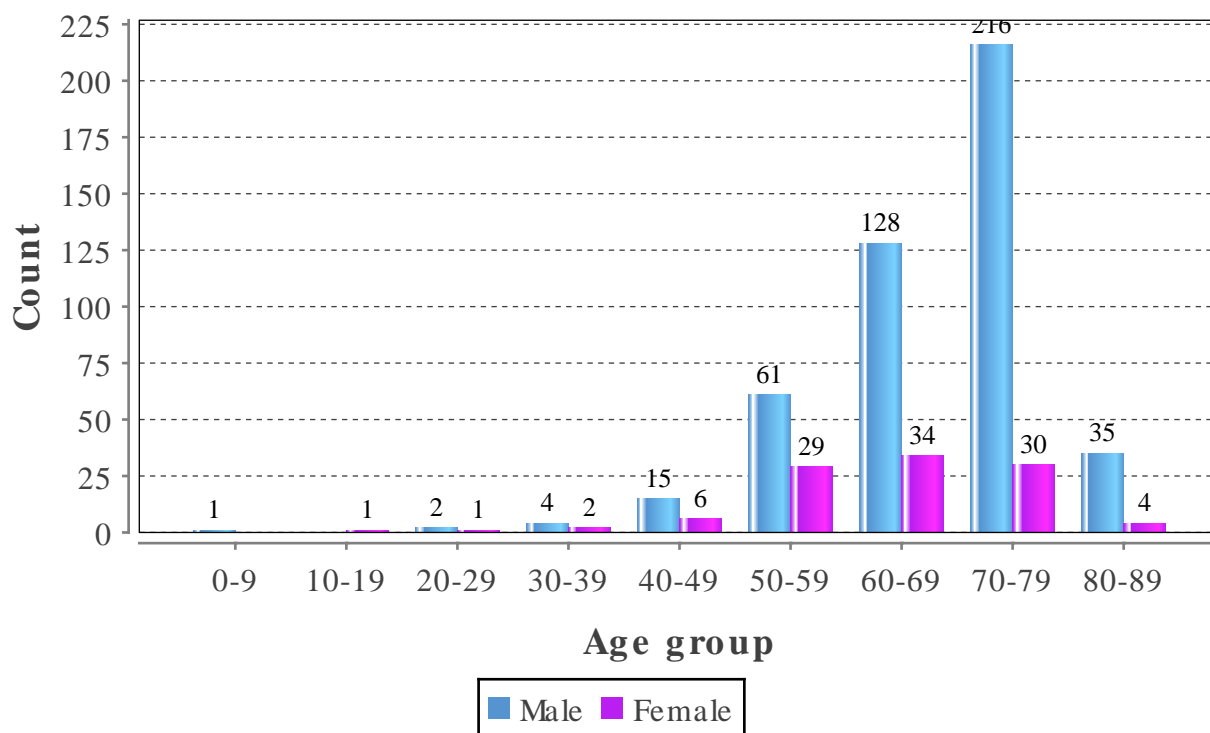
STATISTICS – CRT-D – AGE DISTRIBUTION MALES/FEMALES

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*Age and gender distribution for new implants, total numbers*

Age (years)	Total no	%	Male	Female
0-9	1	0.2	1	0
10-19	1	0.2	0	1
20-29	3	0.5	2	1
30-39	6	1.1	4	2
40-49	21	3.7	15	6
50-59	90	15.8	61	29
60-69	162	28.5	128	34
70-79	246	43.2	216	30
80-89	39	6.9	35	4
Average age	67	0.0	68	63

Total number of implants: 569





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## STATISTICS – CRT – TYPE OF IMPLANTS

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*Based on both CRT-P and CRT-D*

	<b>Total</b>		<b>Male</b>		<b>Female</b>	
	<b>no</b>	<b>%</b>	<b>no</b>	<b>%</b>	<b>no</b>	<b>%</b>
First implant	1219	57.9	960	78.8	259	21.2
Replacement	887	42.1	677	76.3	210	23.7
Total	2106	100.0	1637	77.7	469	22.3

### **ILR**

1140 ILR's were implanted in Sweden 2022 which is slightly down from 1222 in 2021 with the main indication being dizzy spells 5%, palpitations, 7% and syncope 80%.

At the end of the ILR investigation period 68% of the patients were found to have an PM indication and 8% an ICD indication, the rest showed no pathological rhythm during the FU.

In 6% a new ILR was implanted to extend the monitoring period.

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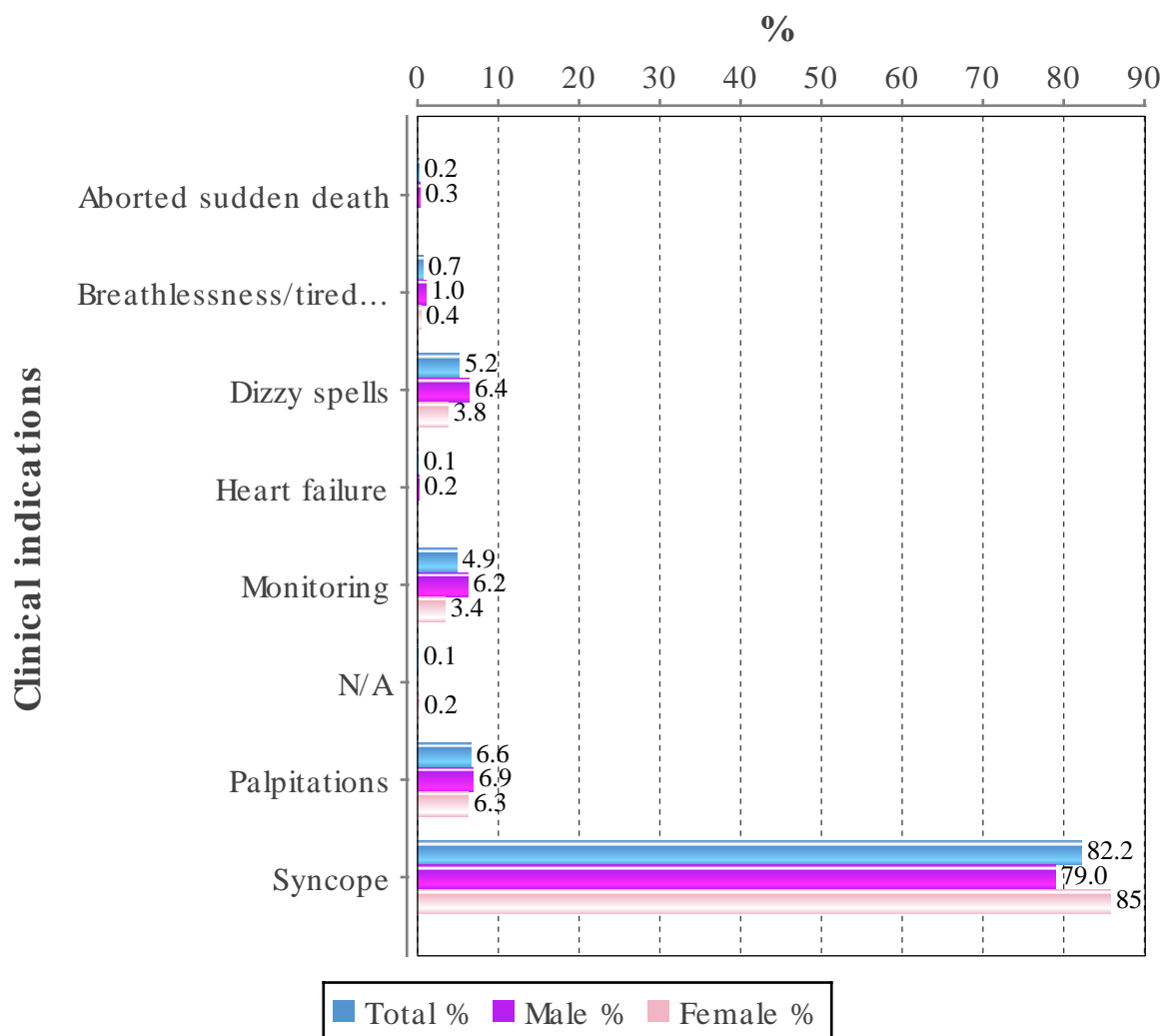
## STATISTICS – ILR – TYPE OF IMPLANTS

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*Ratio of new implants versus generator changes*

	<b>Total</b>		<b>Male</b>		<b>Female</b>	
	<b>no</b>	<b>%</b>	<b>no</b>	<b>%</b>	<b>no</b>	<b>%</b>
First implant	1117	97.9	595	53.3	522	46.7
Replacement	24	2.1	15	62.5	9	37.5
Total	1141	100.0	610	53.5	531	46.5

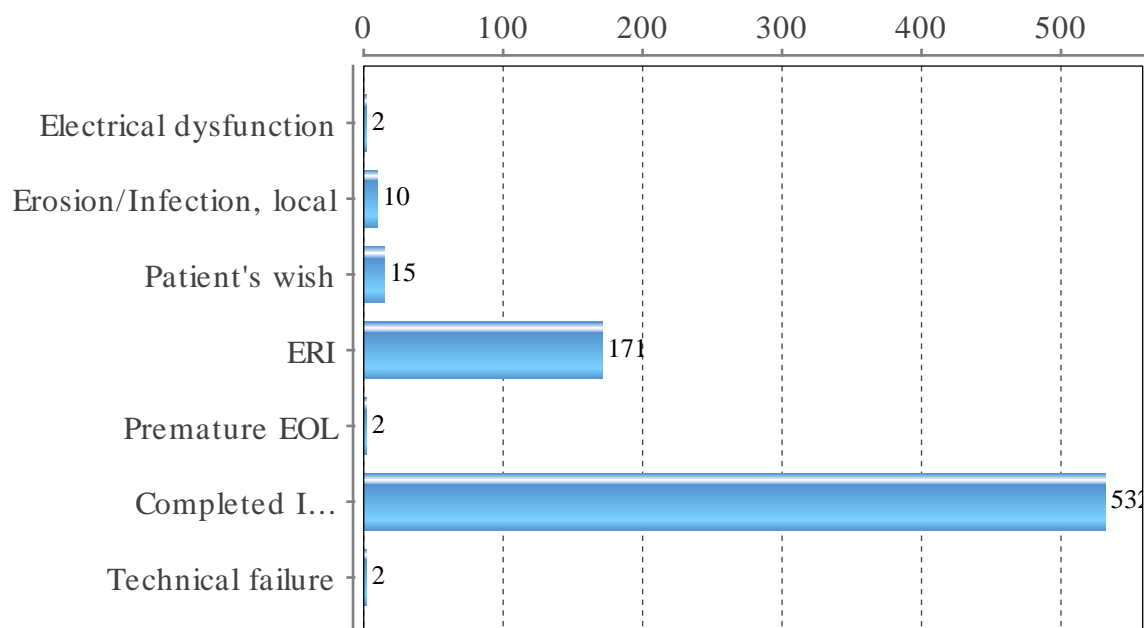
STATISTICS – ILR – CLINICAL INDICATIONS



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STATISTICS – ILR – REASON FOR REMOVAL

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## STATISTICS – ILR – ACTION AFTER ILR

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*Investigation after first ILR implant in % of completed ILR investigation*

<b>Action</b>	<b>No</b>	<b>%</b>
Pacemaker implant	363	68.2
ICD implant	43	8.1
New ILR implant	30	5.6

### Pacing modes

In high degree AV block only 5% of the patients receive VVI-R systems on average but to a higher degree, 7%, in small hospitals.

The use of VVIR pacing mode in sinus node disease vary from 5-11% when comparing small and large hospitals.

### Lead extraction

The numbers of lead extractions are increasing and there are now 4 centers performing regular assisted lead extraction. Karolinska: 193 leads, Sahlgrenska: 103 leads, Uppsala: 65 leads, Lund: 154. The numbers are expected further increase in 2023.

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 2022 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 3,9% vs 5.4% in 2016 with lead dislodgement being the most common. Passive atrial leads show the highest dislodgement rate with 3% vs 1.6% for active fix atrial leads. LV leads show the same tendency with 2% 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, 1,0%, than new implants, 0,7% and most common in CRT system changes, 1.9%.

In PMR female sex is associated with less complications of all types except perforation, pneumothorax and infections after upgrade to CRT. This is different 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 4,4% and is down slightly from 6.8% in 2019. The most common complication is lead dislodgement 1.2% followed by infection with 0,6%.

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 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 1,0% vs 1,9% 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 as a mean takes 38-45 minutes to implant VVI-AAI, and a dual chamber device 48 min and a CRT system 86 min on average.

### Device longevity ICD and PM

Generators generally have very good longevity with an average for Pacemakers of 99% after 5 years and 55% 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 24% 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 77% 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 31% 10-year survival. CRT-D patients 31% 5-year survival and 28% 10 year survival.

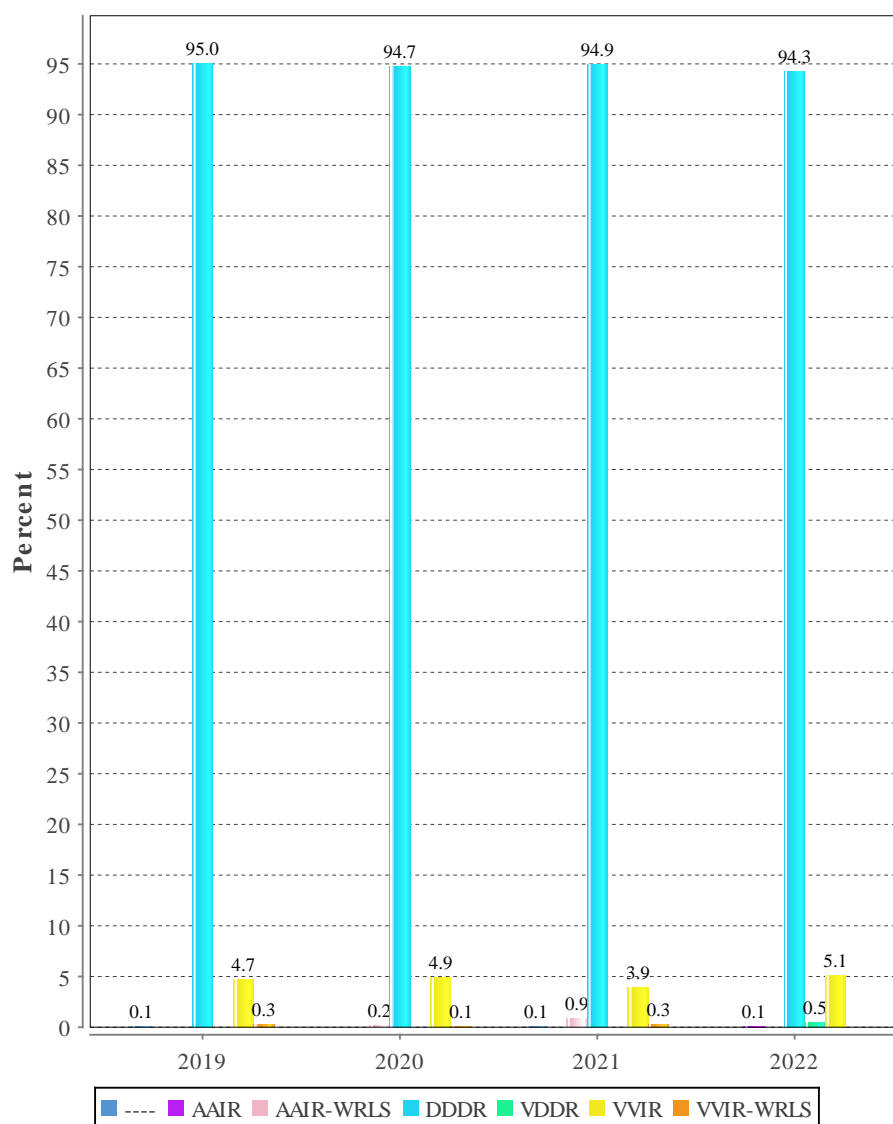
One-year mortality is 9% in PM patients, 4% in ICD patients 9% in CRT-P patients and 4% in CRT-D patients.



## QUALITY – PACEMAKER – FIRST IMPLANT HIGH DEGREE AV-BLOCK

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

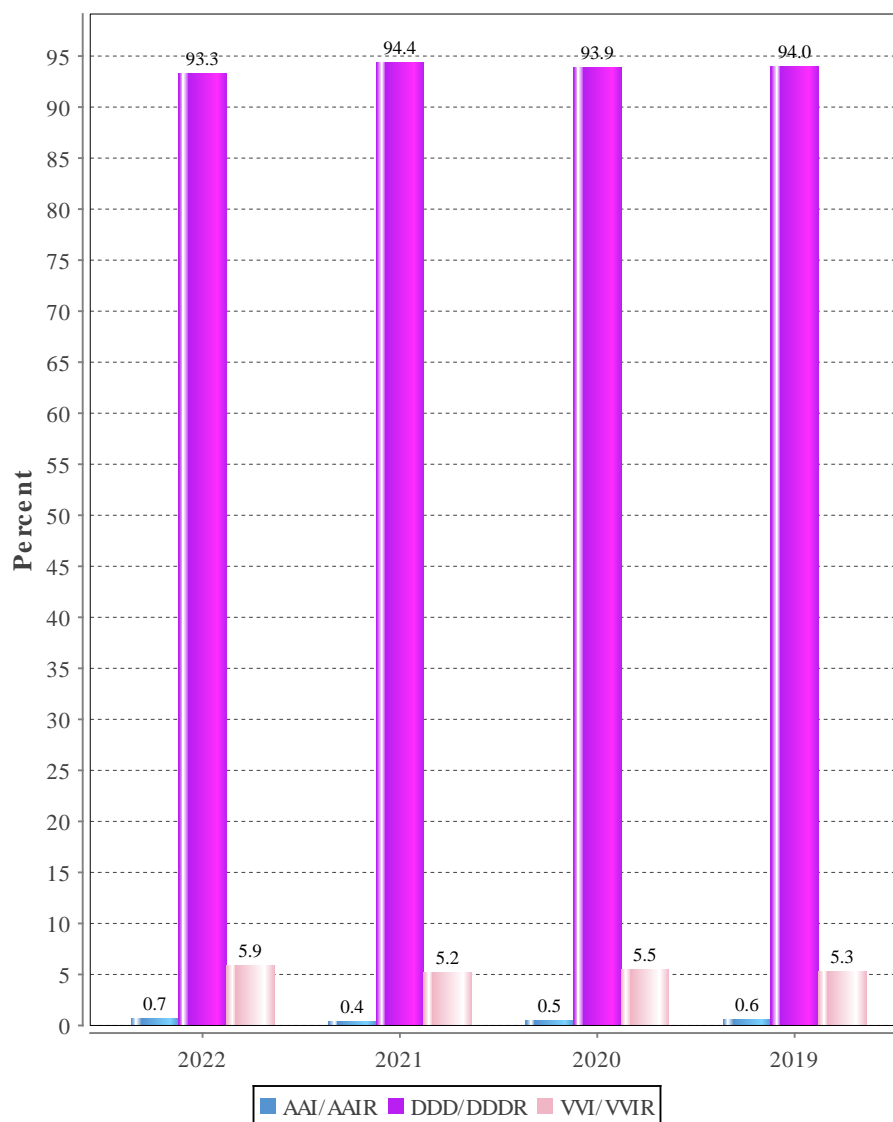
Mode %	2019	2020	2021	2022
----	0.1	0.0	0.1	0.0
AAIR	0.0	0.0	0.0	0.1
AAIR-WRLS	0.0	0.2	0.9	0.0
DDDR	95.0	94.7	94.9	94.3
VDDR	0.0	0.0	0.0	0.5
VVIR	4.7	4.9	3.9	5.1
VVIR-WRLS	0.3	0.1	0.3	0.0



## QUALITY – PACEMAKER – FIRST IMPLANT SINUS NODE DYSFUNCTION

*Use of pacing mode for Sinus Node Disease, historical data*

Mode (%)	2022	2021	2020	2019
AAI/AAIR	0.7	0.4	0.5	0.6
DDD/DDDR	93.3	94.4	93.9	94.0
VVI/VVIR	5.9	5.2	5.5	5.3



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## QUALITY – PACEMAKER – LEAD DISLOCATION

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*Dislocation rate for different lead types in atrial or ventricular placement. Based on all implants implanted 2007 and later and explanted/corrected 2022 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

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## QUALITY – LEAD EXTRACTIONS

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### *Extractions per hospital*

<b>Hospital</b>	<b>No of patients</b>	<b>No of leads</b>
Akademiska sjukhuset	33	65
Falu lasarett	5	9
Gävle sjukhus	5	6
Karolinska Solna	102	193
Linköpings universitetssjukhus	11	17
Sahlgrenska universitetssjukhuset	46	103
Skånes universitetssjukhus, Lund	88	154

### *Extractions per type*

<b>Type</b>	<b>Extractions</b>
ICD lead	112
Pacemaker lead	466

### *Extractions per model (more than 5 extractions)*

<b>Manufacturer</b>	<b>Model</b>	<b>Extractions</b>
Biotronik	Solia S53 MRI	17
Biotronik	Solia S60 MRI	15
Boston Scientific	4470 Fineline II Sterox EZ MRI	17
Boston Scientific	7741 Ingevity MRI	19
Boston Scientific	7742 Ingevity MRI	10
Medtronic	4076 CapSureFix Novus MRI	56
Medtronic	4798 Attain Stability Quad MRI	7
Medtronic	4968 CapSure Epi	6
Medtronic	5076 CapSureFix MRI	18
Medtronic	6935M Sprint Quattro S MRI DF4	25
St Jude Medical/ Abbott	1258T QuickFlex	8
St Jude Medical/ Abbott	1458Q Quartet MRI	21
St Jude Medical/ Abbott	1948 Isoflex MRI	7
St Jude Medical/ Abbott	1999 Optisense	28
St Jude Medical/ Abbott	2088TC Tendril STS MRI 46/52/58 cm	141
St Jude Medical/ Abbott	7120 Durata	6
St Jude Medical/ Abbott	7122 Durata	7
St Jude Medical/ Abbott	7122Q Durata	20
St Jude Medical/ Abbott	LDA210Q Optisure DF4	19

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QUALITY – LEAD EXTRACTIONS

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*Extractions per reason*

<b>Reason</b>	<b>Extractions</b>
Ceased indication for ICD therapy	10
Ceased indication for PM therapy	23
Conductor break	16
Elective	41
Electrical dysfunction	46
Heart transplant	42
Infection/Ulceration, local	140
Infection/Ulceration, systemic	215
Lead dislocation	16
Preventive	9
Venous access	16

*Extraction positions\**

<b>Hospital</b>	<b>Femoral</b>	<b>Left superior</b>	<b>N/A</b>	<b>Right superior</b>
Akademiska sjukhuset	0	65	0	0
Falu lasarett	0	7	0	2
Gävle sjukhus	0	6	0	0
Karolinska Solna	2	182	3	6
Linköpings universitetssjukhus	0	17	0	0
Skånes universitetssjukhus, Lund	1	149	0	4

\*Hospital Sahlgrenska and Sunderby excluded

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QUALITY – LEAD EXTRACTIONS

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*Extraction problems\**

<b>Hospital</b>	<b>I</b>	<b>E</b>	<b>O</b>	<b>P</b>	<b>X</b>	<b>D</b>
Akademiska sjukhuset	0	0	0	0	0	0
Falu lasarett	0	0	0	0	0	0
Gävle sjukhus	0	0	0	0	0	0
Karolinska Solna	0	0	1	0	0	0
Linköpings universitetssjukhus	0	0	0	0	0	0
Skånes universitetssjukhus, Lund	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

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## QUALITY – LEAD EXTRACTIONS

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*Extraction results\**

<b>Hospital</b>	<b>Failed</b>	<b>Partially successfull</b>	<b>Successfull</b>
Akademiska sjukhuset	0	0	65
Falu lasarett	0	0	9
Gävle sjukhus	0	0	6
Karolinska Solna	0	9	184
Linköpings universitetssjukhus	0	0	17
Skånes universitetssjukhus, Lund	0	2	152

\*Hospital Sahlgrenska and Sunderby excluded

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QUALITY – LEAD EXTRACTIONS

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*Extraction tools\**

<b>Hospital</b>	<b>SS</b>	<b>LS</b>	<b>PS</b>	<b>AM</b>	<b>L</b>	<b>S</b>	<b>PK</b>	<b>EK</b>	<b>AL</b>
Akademiska sjukhuset	19	38	11	37	0	0	0	0	0
Falu lasarett	0	0	0	0	0	0	0	0	0
Gävle sjukhus	0	0	0	0	0	0	0	0	0
Karolinska Solna	16	17	28	95	3	0	0	0	0
Linköpings universitetssjukhus	12	2	1	0	0	0	0	0	0
Skånes universitetssjukhus, Lund	22	4	6	56	0	5	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

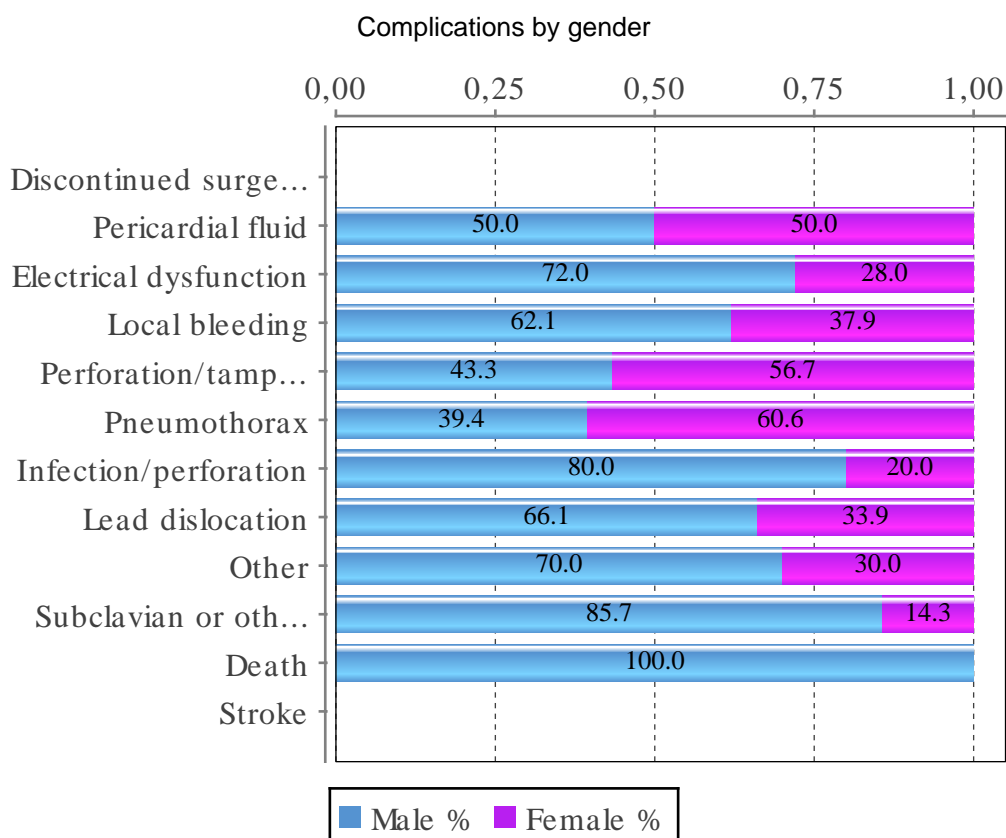


## QUALITY – PACEMAKER – COMPLICATIONS

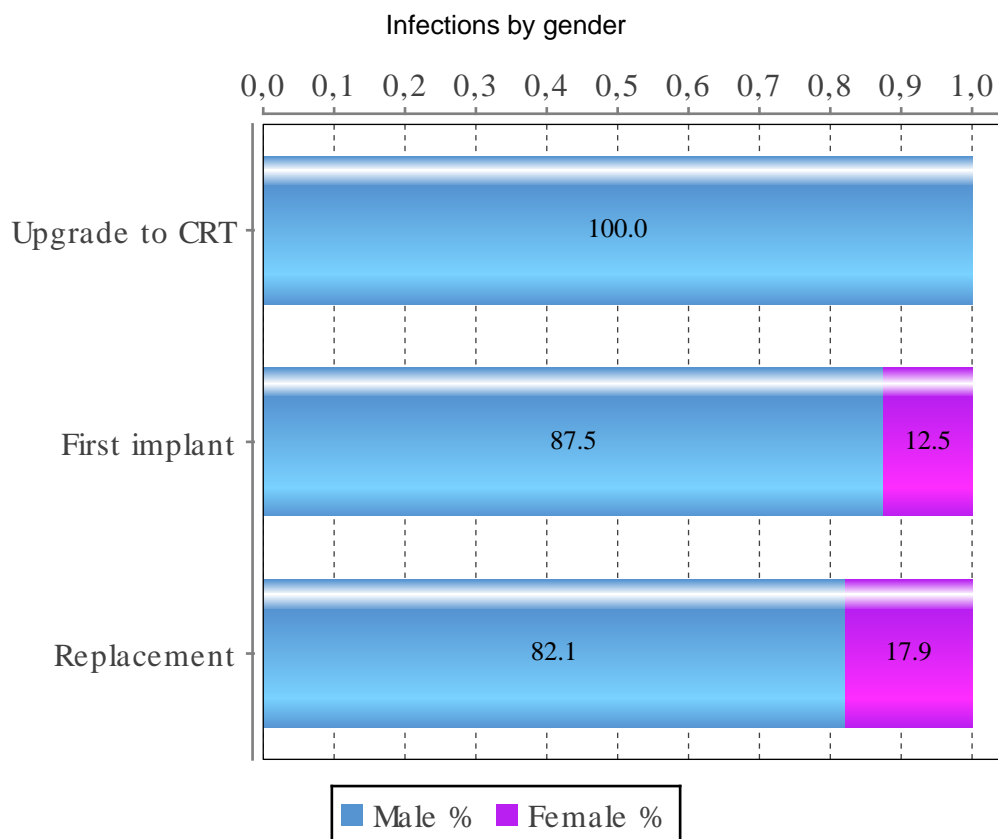
Registered complications for new implants and for bleeding, infection and other also including replacements

Complication	2021 %	2022 %	Based on
Discontinued surgery due to hemodynamic reasons	0.0	0.0	A
Pericardial fluid	0.0	0.0	A
Electrical dysfunction	0.3	0.3	B
Local bleeding	0.2	0.3	A
Perforation/tamponade	0.2	0.4	B
Pneumothorax	0.3	0.4	B
Infection/perforation	0.5	0.4	A
Lead dislocation	1.5	1.5	B
Other	0.2	0.3	A
Subclavian or other related thrombosis	0.1	0.1	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	0.1	0.2	A
<b>Total</b>	<b>3.4</b>	<b>3.9</b>	

Based on A=11093 (all implants) alternatively B=8099 (first implants + lead replacement) validated events



## QUALITY – PACEMAKER INFECTIONS



*Infections related to all interventions by gender*

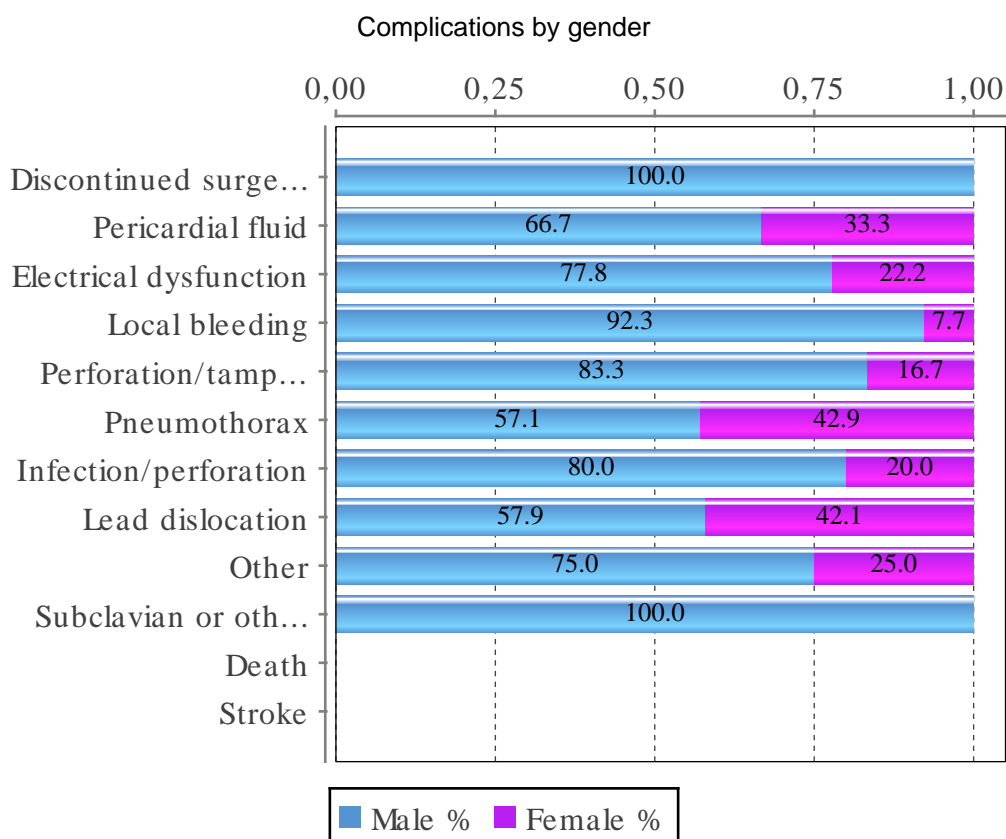
<b>Reason</b>	<b>Male %</b>	<b>Female %</b>
<i>First implant</i>	0.6	0.1
<i>Replacement</i>	1.1	0.3
<i>Upgrade to CRT</i>	0.5	0.0

## QUALITY – ICD – COMPLICATIONS

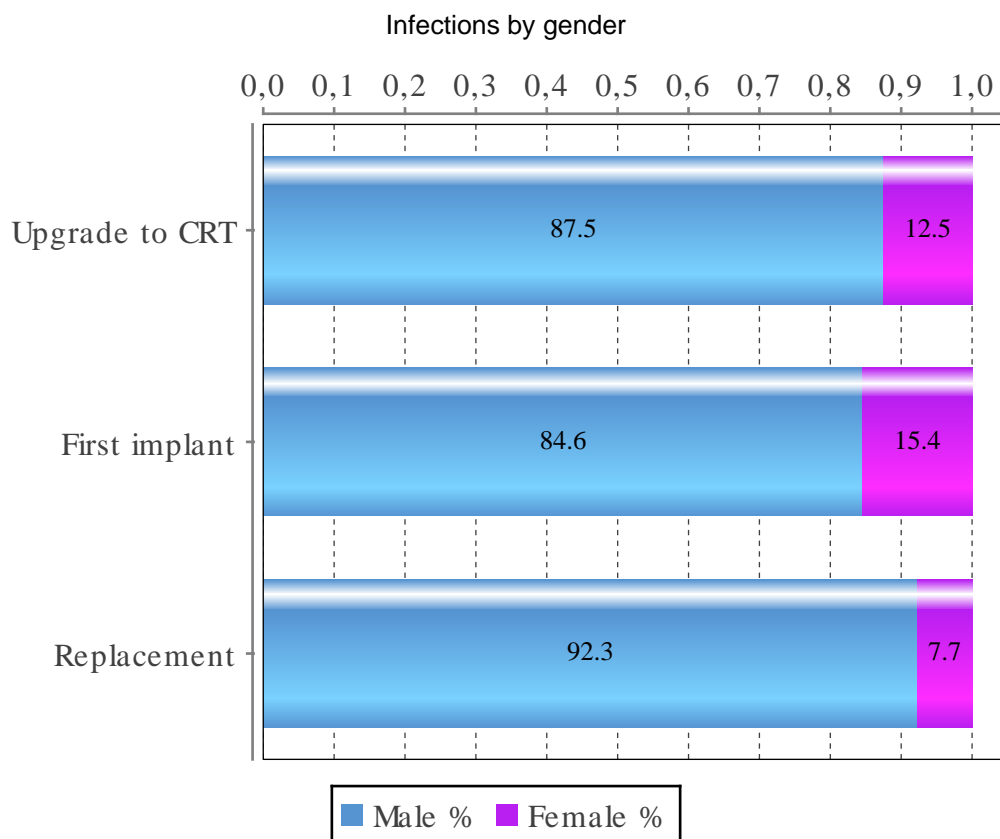
Registered complications for new implants and for bleeding, infection and other also including replacements

Complication	2021 %	2022 %
Discontinued surgery due to hemodynamic reasons	0.0	0.0
Electrical dysfunction	0.6	0.6
Local bleeding	0.2	0.6
Perforation/tamponade	0.2	0.4
Pneumothorax	0.1	0.4
Infection/perforation	0.8	0.6
Lead dislocation	1.9	1.2
Other	0.5	0.2
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	0.4
<b>Total</b>	<b>4.7</b>	<b>4.4</b>

Based on 2363 (all implants) alternatively 1599 (first implants + lead replacements) validated events



## QUALITY – ICD INFECTIONS



*Infections related to all interventions by gender*

<b>Reason</b>	<b>Male %</b>	<b>Female %</b>
<i>First implant</i>	0.9	0.7
<i>Replacement</i>	1.6	0.5
<i>Upgrade to CRT</i>	1.3	0.8

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## QUALITY – CRT – COMPLICATIONS

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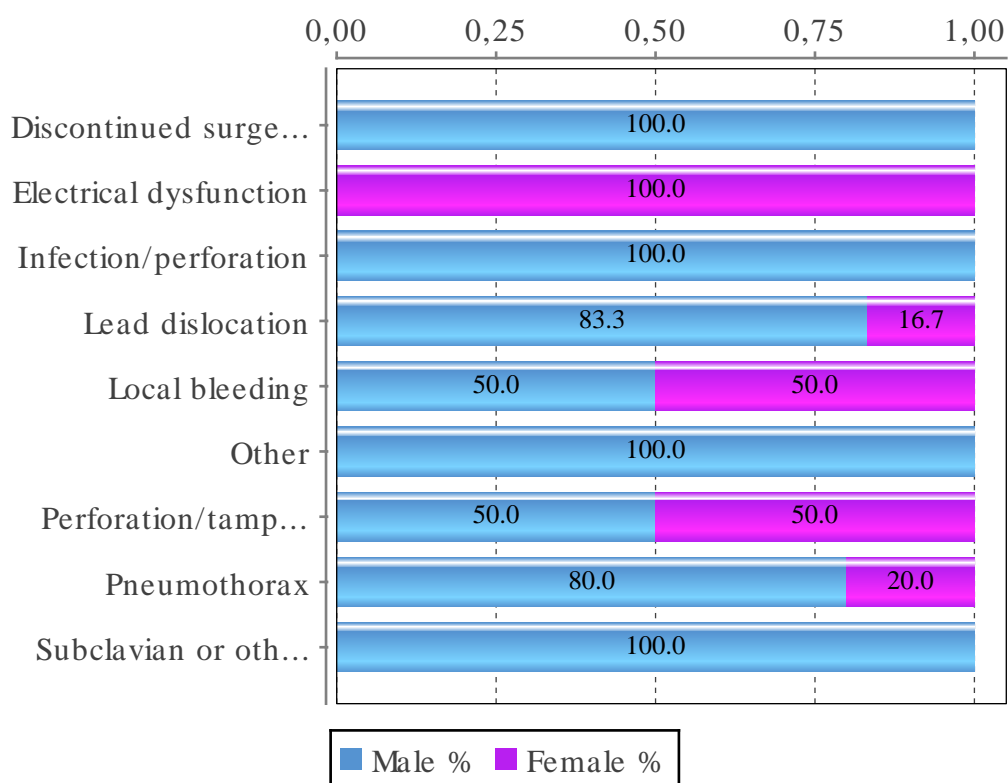
*Registered complications for new implants and for bleeding, infection and other also including replacements.*

<b>CRT-P Complication</b>	<b>%</b>
Death	-
Discontinued surgery due to LV-lead impl. failure	0.2
Discontinued surgery due to hemodynamic reasons	-
Discontinued surgery due to lack of venous access	-
Electrical dysfunction	0.2
Infection/perforation	0.3
Lead dislocation	1.8
Local bleeding	0.3
Other	0.2
Perforation/tamponade	0.3
Pericardial fluid	-
Peroperative arrhythmia requiring acute medication	-
Pneumothorax	0.8
Stroke	-
Subclavian or other related thrombosis	0.2
Total	4.1
Total no of implants 661	

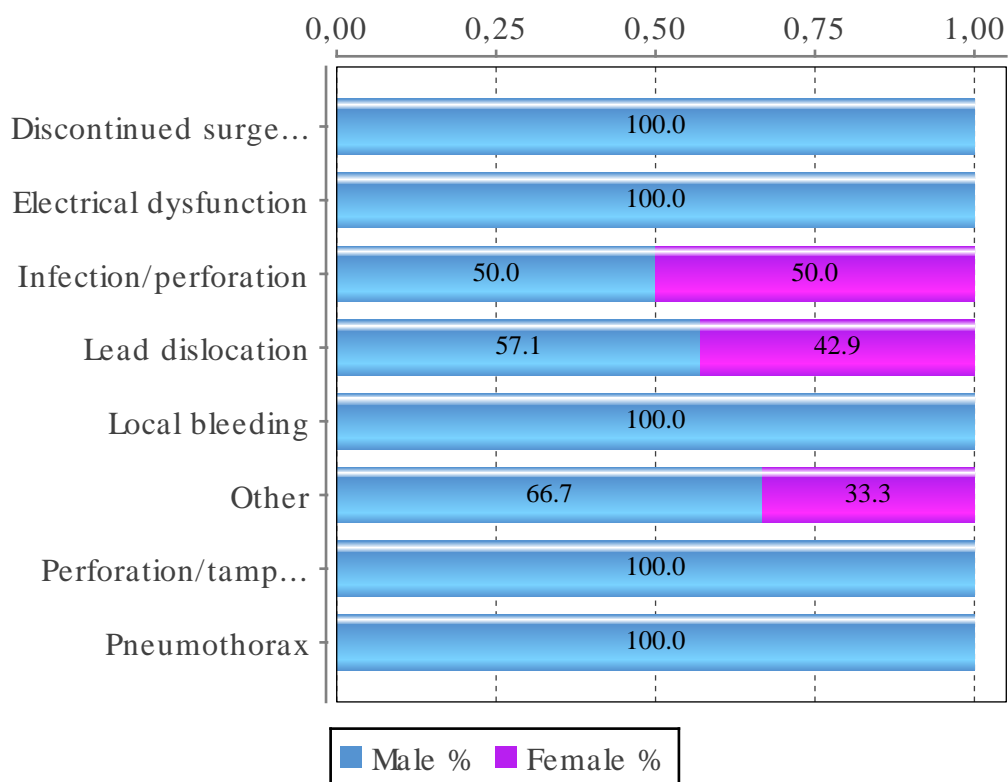
<b>CRT-D Complication</b>	<b>%</b>
Death	-
Discontinued surgery due to LV-lead impl. failure	-
Discontinued surgery due to hemodynamic reasons	-
Discontinued surgery due to lack of venous access	0.2
Electrical dysfunction	0.2
Infection/perforation	0.7
Lead dislocation	1.2
Local bleeding	0.4
Other	0.5
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 565	

## QUALITY – CRT – COMPLICATIONS

CRT-P complications by gender



CRT-D complications by gender



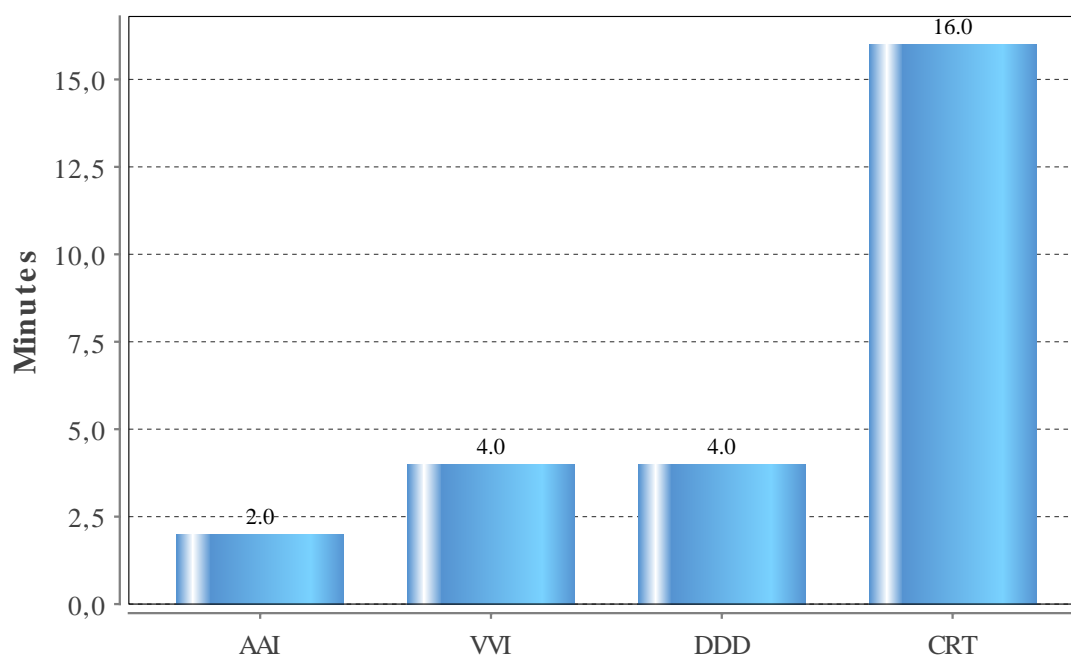
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## QUALITY – PACEMAKER – FLUOROSCOPY PER SUBTYPE

---

*National mean fluoroscopy duration for a new implant of different subtypes*

Fluoroscopy time	Average	Standard deviation
AAI	2.0	1.6
VVI	4.0	6.4
DDD	4.0	4.9
CRT	16.0	15.0



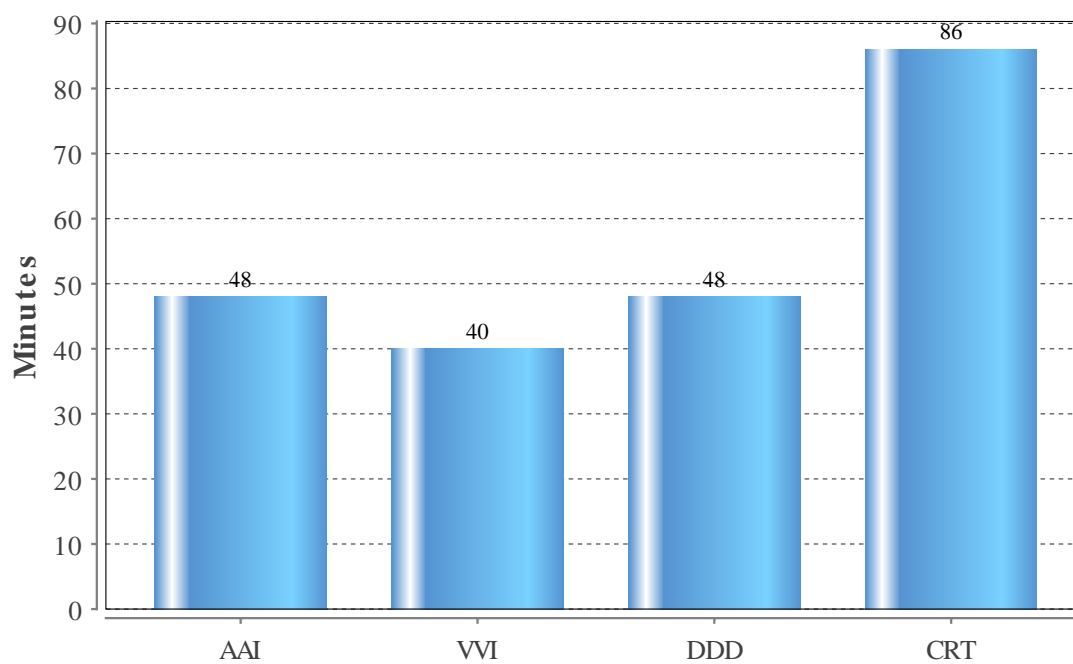
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## QUALITY – PACEMAKER – KNIFE TIME PER SUBTYPE

---

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

Knife time	Average	Standard deviation
AAI	48	28.1
VVI	40	24.5
DDD	48	23.1
CRT	86	38.7





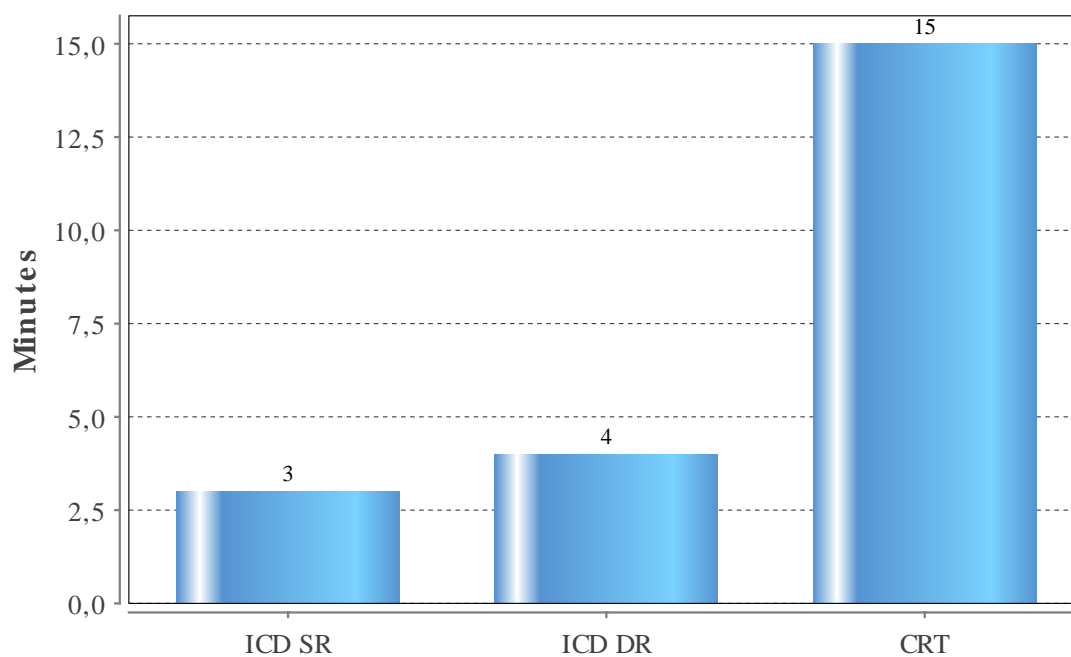
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## QUALITY – ICD – FLUOROSCOPY PER SUBTYPE

---

*National mean fluoroscopy duration for a new implant of different subtypes*

Fluoroscopy time	Average	Standard deviation
ICD SR	3	4.4
ICD DR	4	6.3
CRT	15	13.7



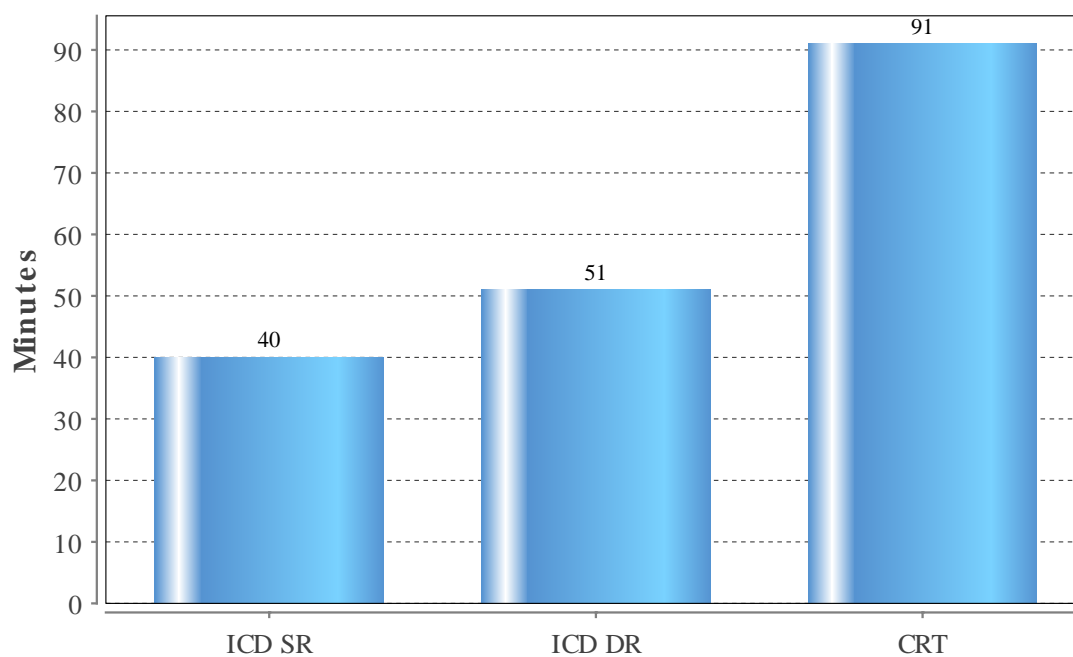
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## QUALITY – ICD – KNIFE TIME PER SUBTYPE

---

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

Knife time	Average	Standard deviation
ICD SR	40	17.1
ICD DR	51	26.5
CRT	91	38.9

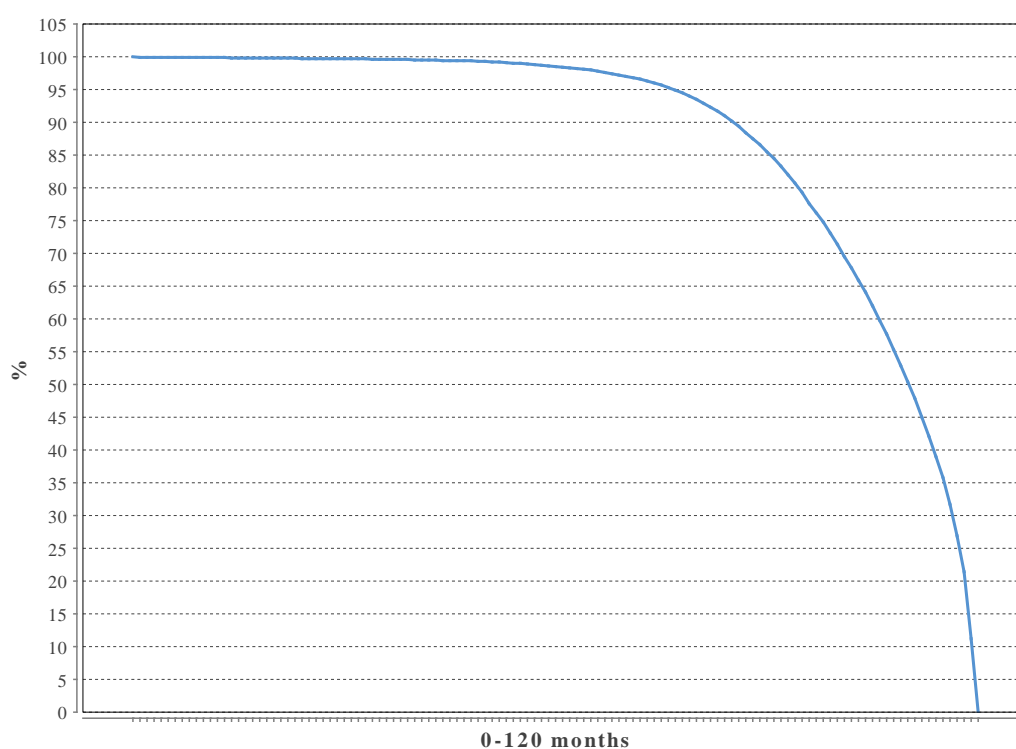


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## QUALITY – PACEMAKER – GENERATOR SURVIVAL

---

Year	At risk	Survival probability %
1	145697	100.0
2	124093	99.9
3	103301	99.7
4	85147	99.6
5	68625	99.4
6	54134	98.5
7	41481	96.6
8	29467	91.0
9	17712	77.6
10	7638	55.3



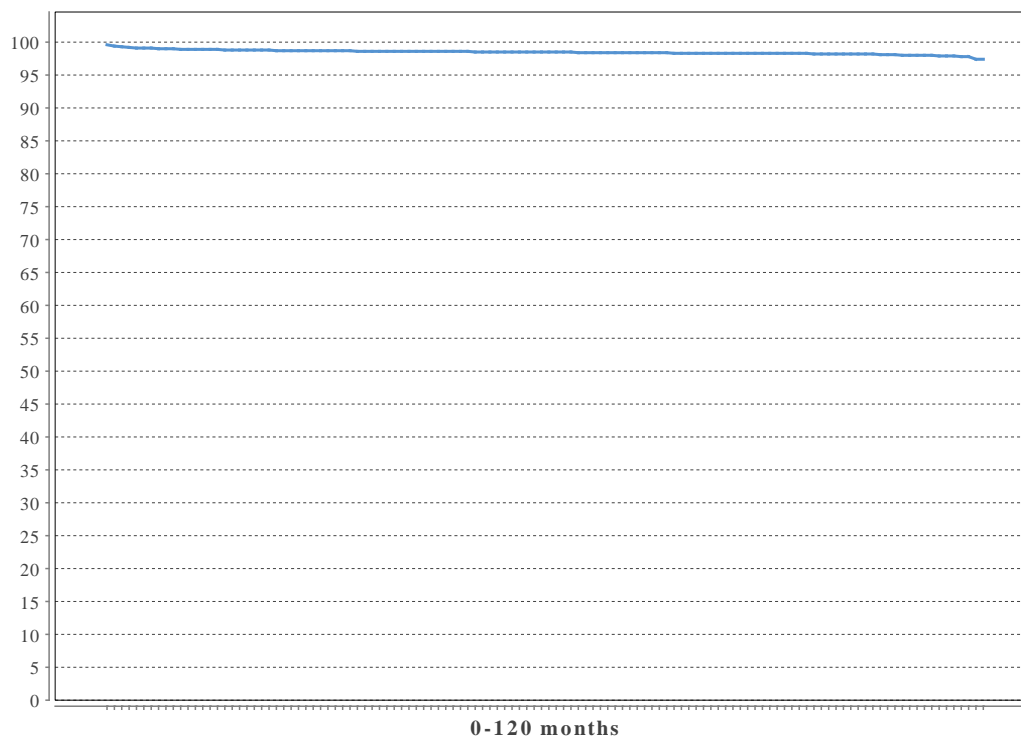
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## QUALITY – PM – LEAD SURVIVAL

---

*Based on all implants after 1990*

Year	At risk	Survival probability %
1	203771	99.6
2	173800	98.9
3	144778	98.7
4	118579	98.6
5	94234	98.6
6	72409	98.5
7	53505	98.4
8	37078	98.3
9	22906	98.2
10	10568	98.0



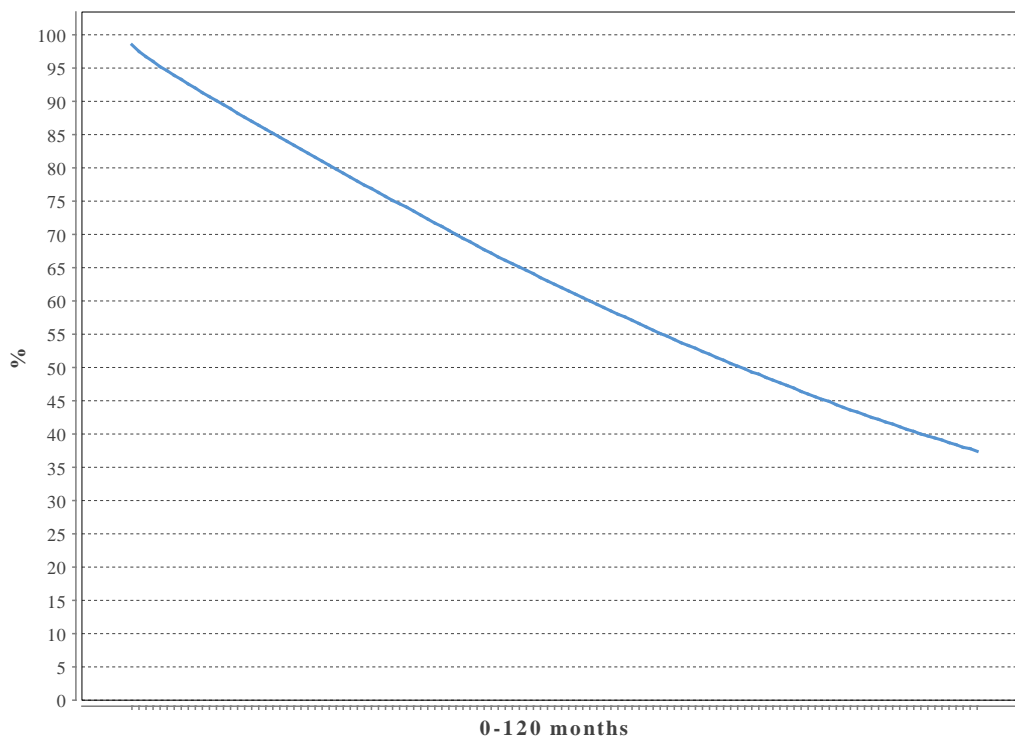
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## QUALITY – PACEMAKER – PATIENT SURVIVAL

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*Based on all implants after 1990*

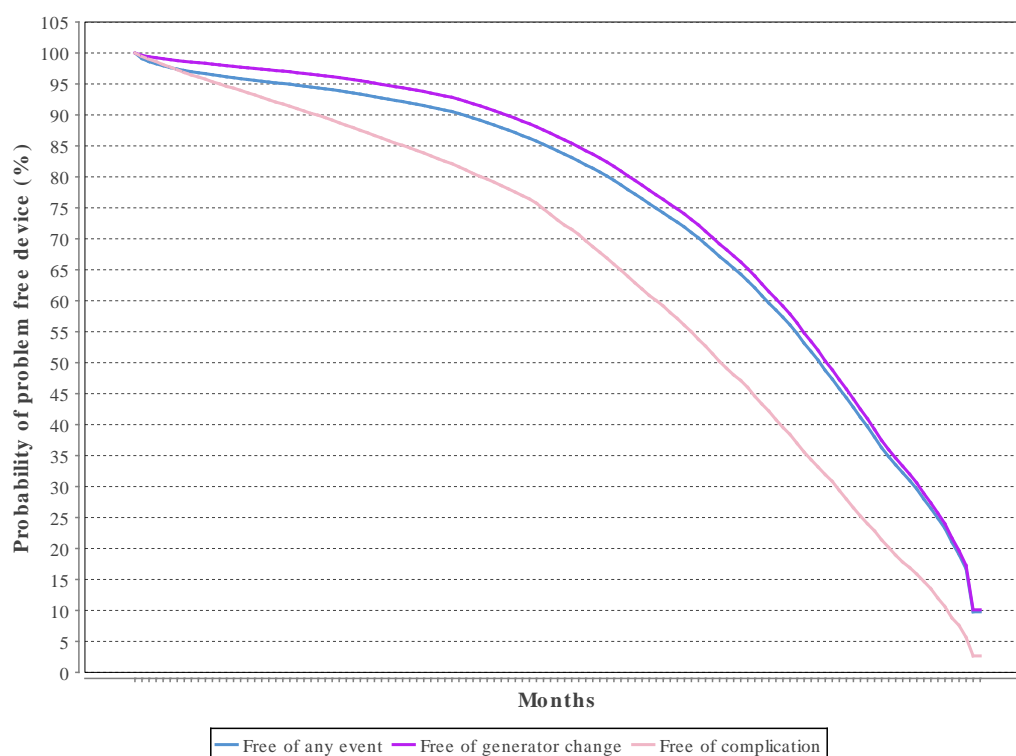
Year	At risk	Survival probability %
1	156848	98.5
2	134363	90.1
3	113422	82.8
4	95407	75.7
5	78832	68.9
6	64270	62.5
7	51692	56.6
8	39695	51.1
9	27898	46.0
10	17883	41.5



## 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	36544	96.3	98.1	95.0
2	33681	94.7	96.7	90.6
3	30650	92.5	94.8	85.9
4	27345	89.5	91.8	80.6
5	22789	84.2	86.5	73.0
6	16801	76.5	78.7	61.9
7	10940	66.2	68.2	49.1
8	5657	51.8	53.4	34.3
9	1866	33.5	34.6	18.9
10	99	9.8	10.1	2.7



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QUALITY – ICD – GENERATOR SURVIVAL

---

<b>Year</b>	<b>At risk</b>	<b>Survival probability %</b>
1	29539	99.9
2	27365	99.8
3	23530	99.5
4	19692	98.9
5	16185	97.1
6	12452	92.1
7	8822	82.9
8	5503	69.3
9	2614	49.3
10	764	27.0

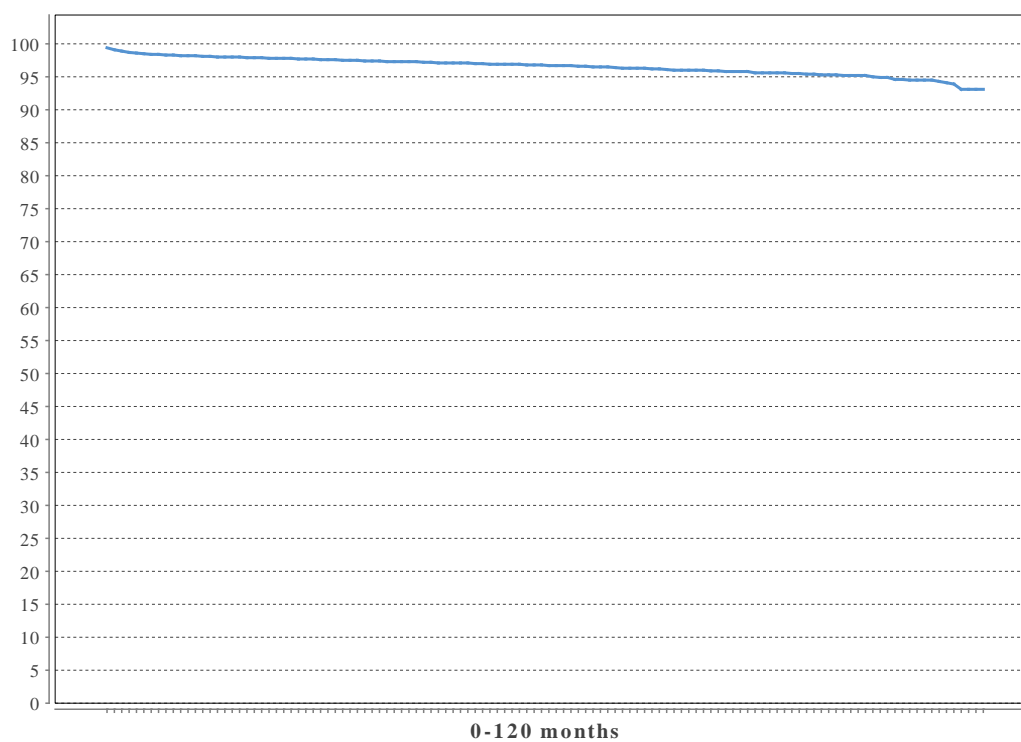
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## QUALITY – ICD – LEAD SURVIVAL

---

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	19253	99.4
2	16763	98.2
3	14319	97.8
4	11948	97.4
5	9766	97.1
6	7664	96.7
7	5808	96.3
8	4100	95.8
9	2557	95.4
10	1161	94.6

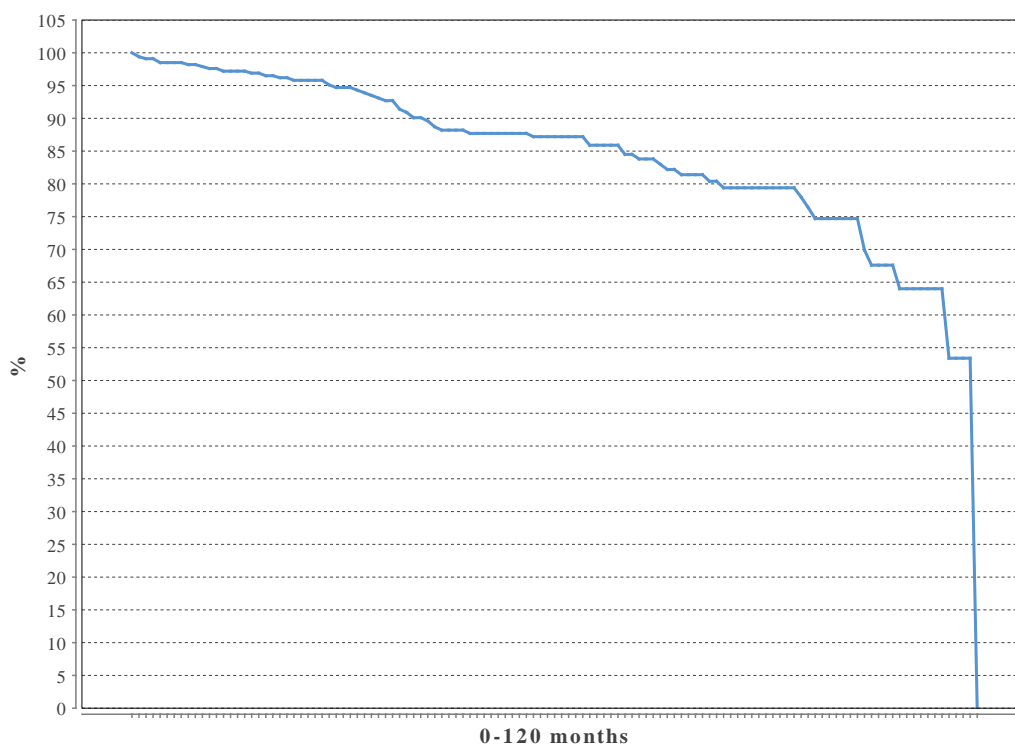




QUALITY – ICD – SURVIVAL MEDTRONIC SPRINT FIDELIS

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	115	83.8
8	80	79.4
9	49	76.4
10	23	67.6



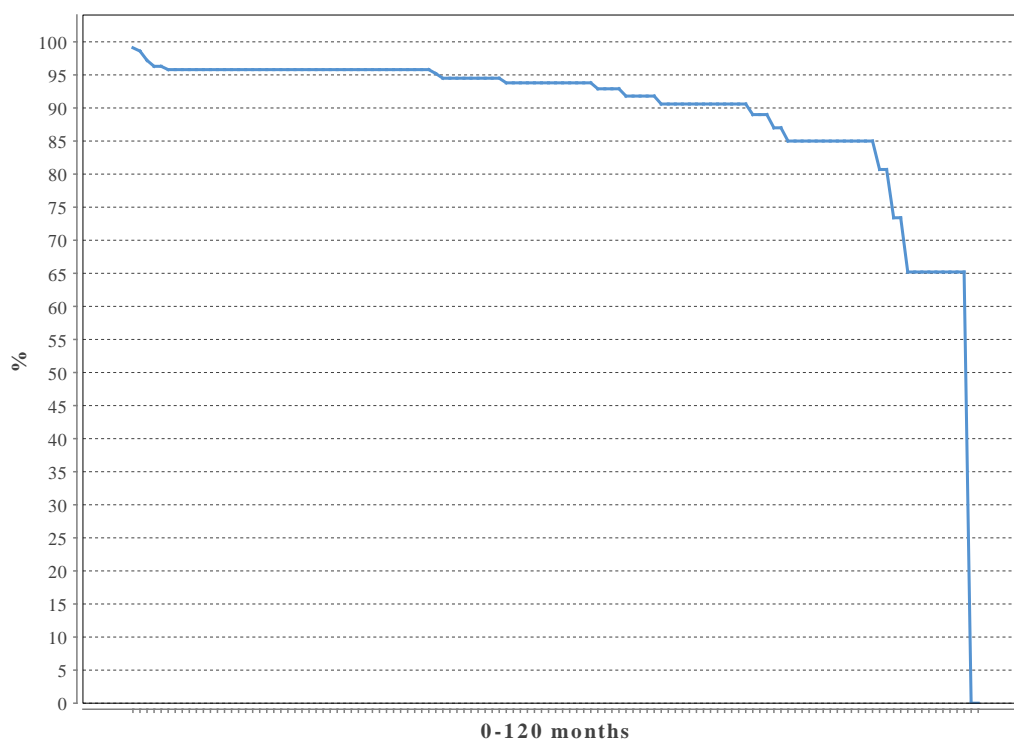
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QUALITY – ICD – SURVIVAL SJM 1561,1570,1571,1572,1580,1581,1582,1591

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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.

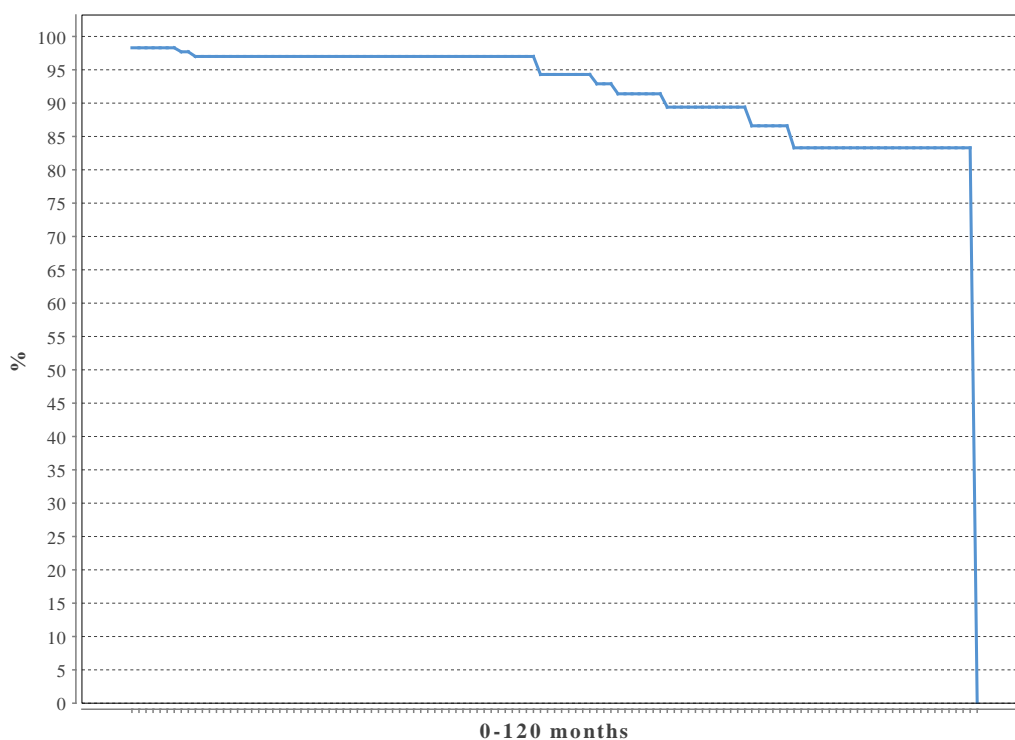
Year	At risk	Survival probability %
1	219	99.1
2	193	95.8
3	176	95.8
4	158	95.8
5	138	94.5
6	114	93.8
7	80	91.8
8	60	90.6
9	39	85.0
10	11	73.4



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



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## QUALITY – ICD – SURVIVAL SJM Fortify

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

<b>Year</b>	<b>At risk</b>	<b>Survival probability %</b>
1	2000	99.7
2	1837	97.1
3	1653	94.9
4	1466	92.1
5	1246	88.2
6	1031	84.2
7	831	80.1
8	583	75.6
9	375	70.2
10	172	60.3

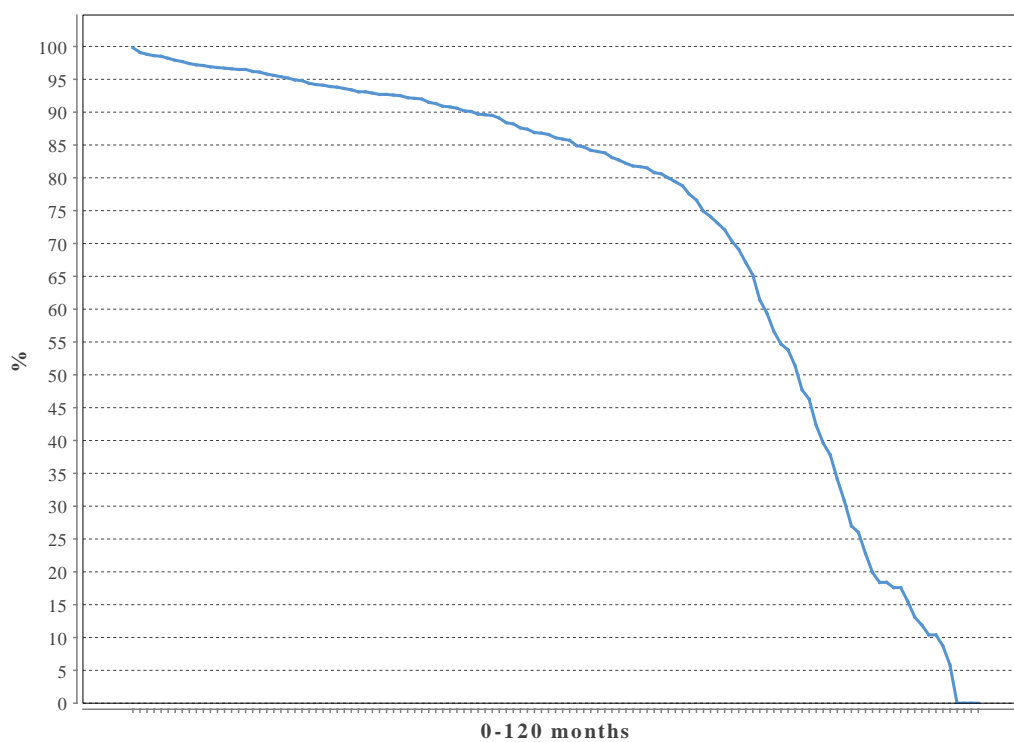
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## QUALITY – ICD – SURVIVAL SJM Unify

---

*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	2106	99.8
2	1840	96.8
3	1646	94.8
4	1429	92.7
5	1210	90.1
6	980	86.1
7	776	81.7
8	501	72.1
9	168	46.3
10	22	17.6



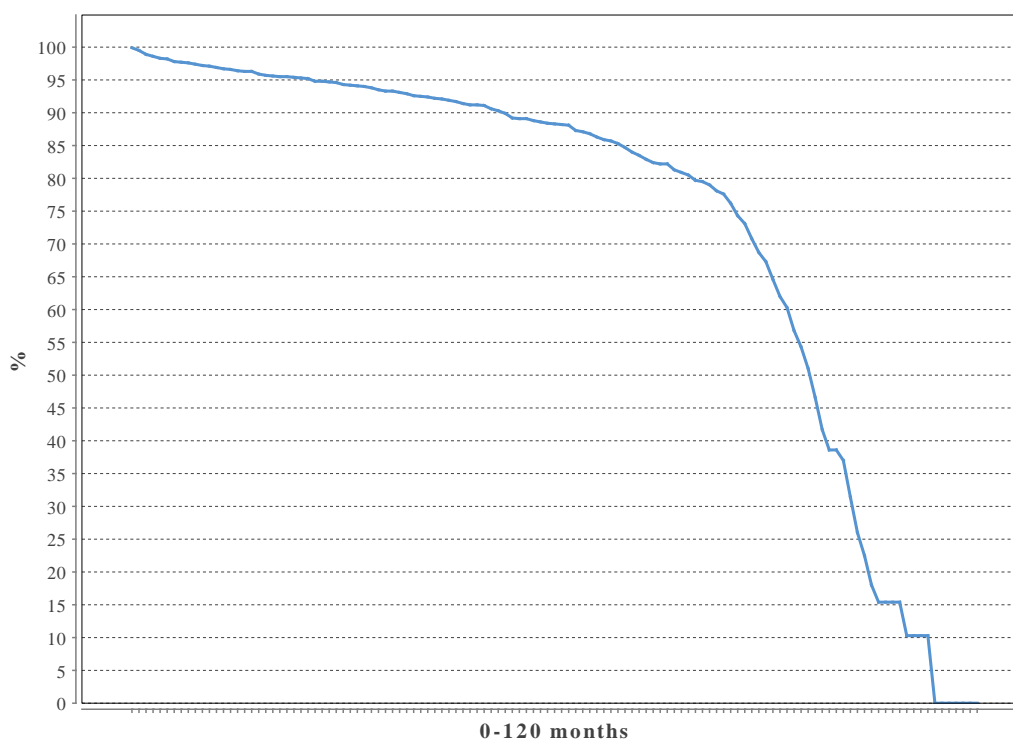
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## QUALITY – ICD – SURVIVAL SJM Quadra

---

*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	2710	99.9
2	2327	96.9
3	1948	95.3
4	1509	93.3
5	1159	91.2
6	848	88.3
7	555	83.5
8	313	77.6
9	98	51.0
10	5	15.4



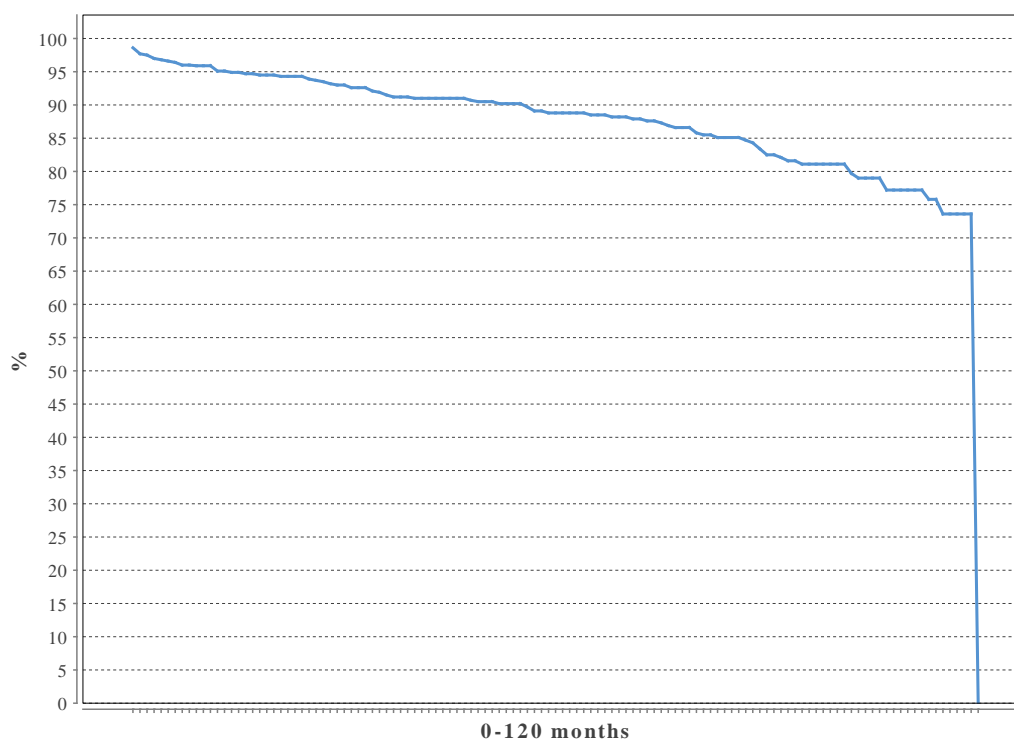
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## QUALITY – ICD – LEAD SURVIVAL Biotronik Linx

---

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

Year	At risk	Survival probability %
1	565	98.6
2	495	95.1
3	458	94.3
4	397	91.5
5	362	90.7
6	315	88.8
7	275	87.9
8	224	85.1
9	157	81.1
10	85	77.2



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## 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.*

<b>Year</b>	<b>At risk</b>	<b>Survival probability %</b>
1	5378	98.9
2	4748	95.2
3	4151	93.8
4	3592	93.0
5	3095	92.4
6	2614	91.7
7	2103	90.6
8	1570	89.5
9	1059	88.7
10	504	86.8



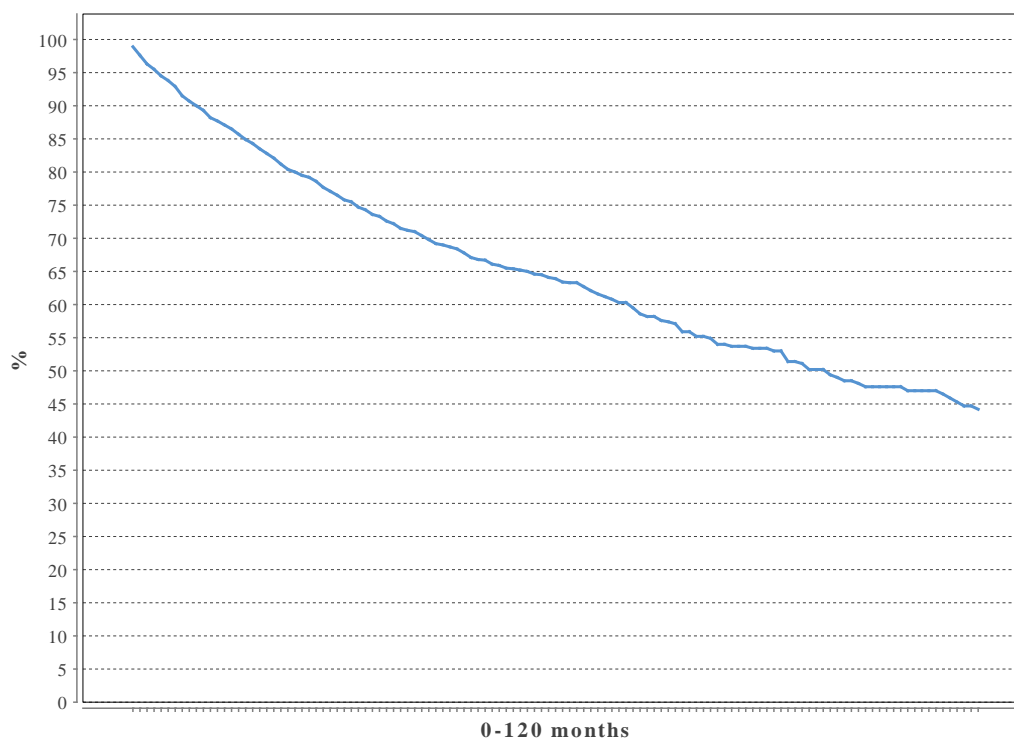
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## QUALITY – ICD – PATIENT SURVIVAL

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*Based on all implants after 1990*

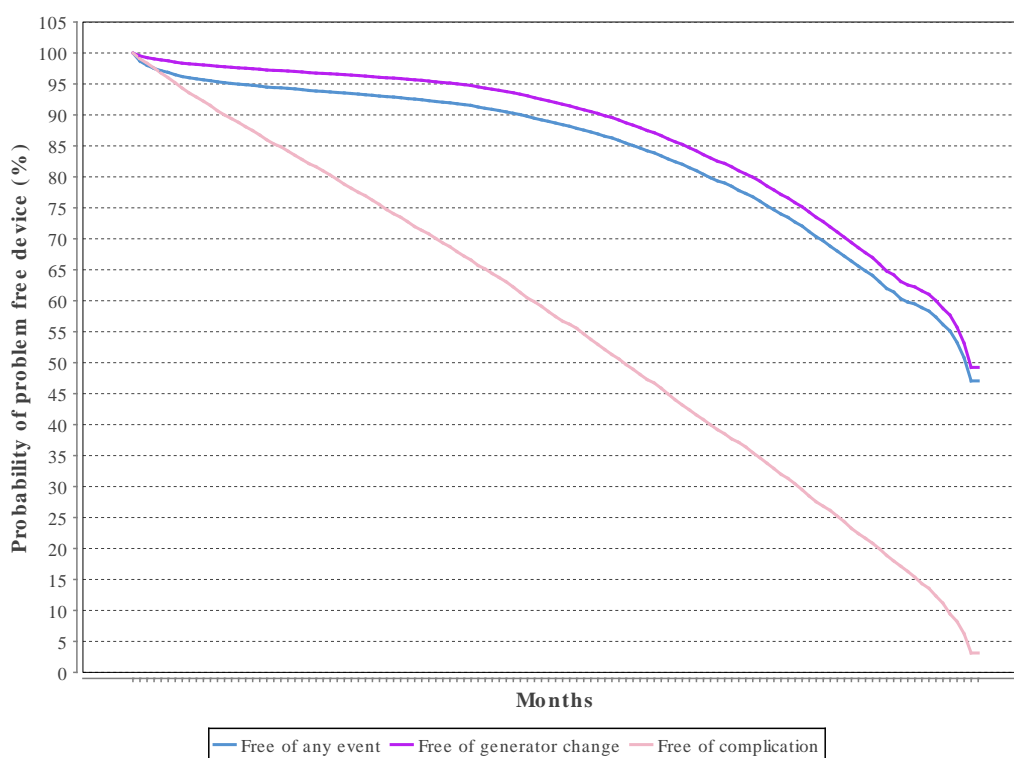
Year	At risk	Survival probability %
1	1933	98.9
2	1630	87.7
3	1413	79.5
4	1128	72.6
5	814	67.1
6	524	63.9
7	316	58.6
8	183	54.0
9	125	50.2
10	96	47.6



## 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	56973	95.4	97.9	90.7
2	47526	94.1	96.9	82.8
3	39314	93.0	96.0	74.7
4	31610	91.5	94.8	66.6
5	24023	88.7	92.0	57.5
6	17198	84.7	87.9	48.1
7	11118	79.0	82.2	38.5
8	6328	71.2	74.3	28.5
9	2603	61.4	64.2	18.0
10	177	47.1	49.2	3.1



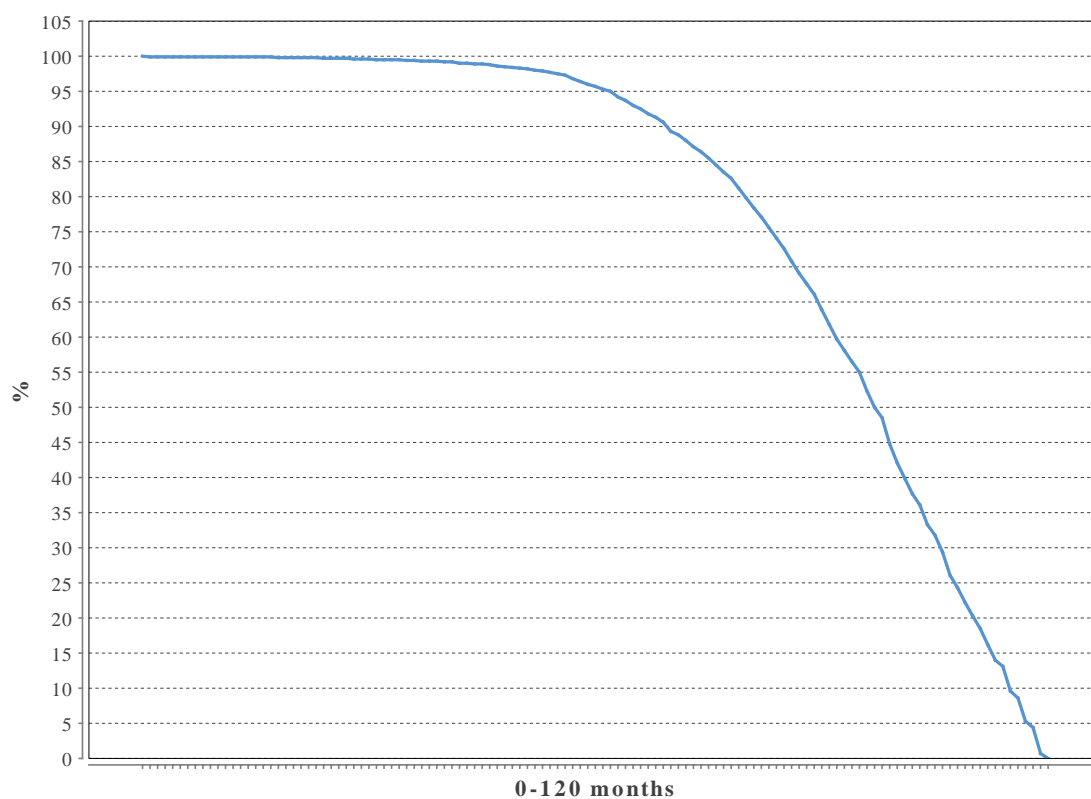
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## QUALITY – CRT-P – GENERATOR SURVIVAL

---

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	9219	100.0
2	8065	99.9
3	6489	99.7
4	5145	99.4
5	4032	98.5
6	2992	95.7
7	2045	88.0
8	1255	74.1
9	600	52.3
10	162	24.3



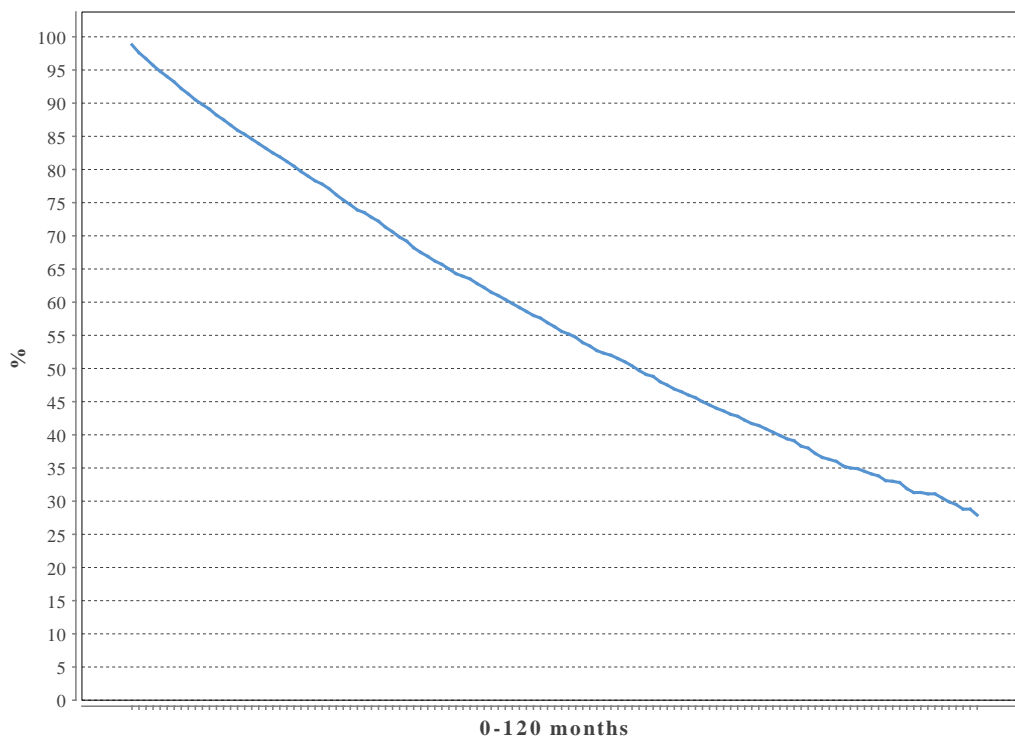
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## QUALITY – CRT-P – PATIENT SURVIVAL

---

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

Year	At risk	Survival probability %
1	9396	98.8
2	8120	88.2
3	6560	79.7
4	5220	71.3
5	4099	63.5
6	3051	56.3
7	2098	49.7
8	1320	43.6
9	656	38.0
10	224	33.0



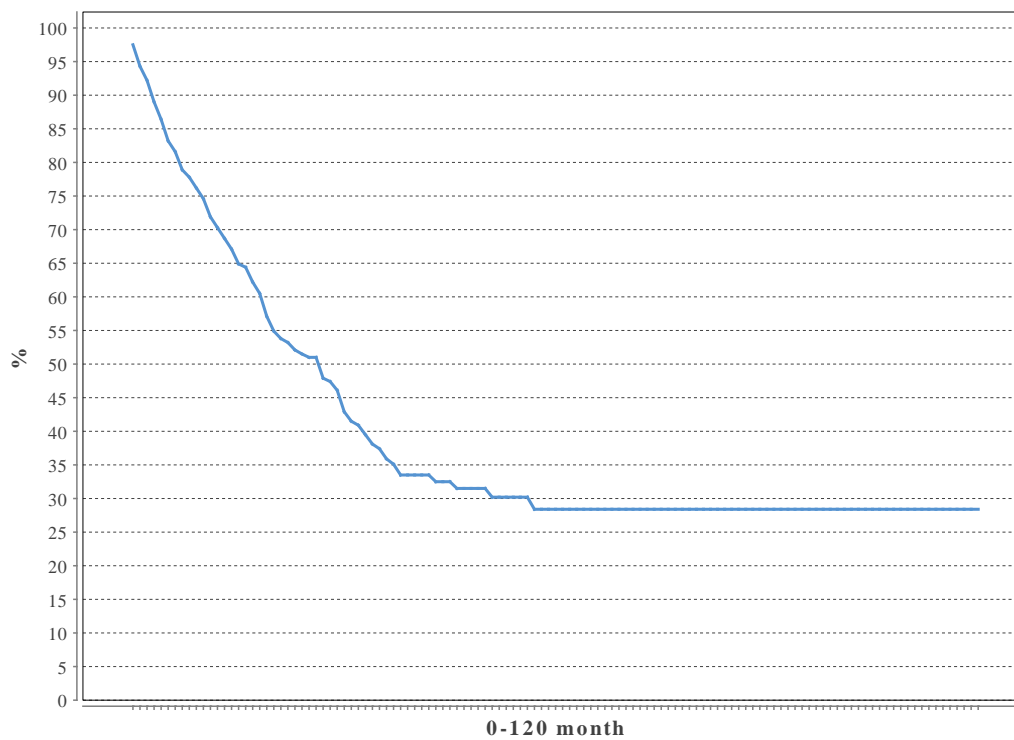
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## QUALITY – CRT-D – PATIENT SURVIVAL

---

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



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## QUALITY – DEAD WITHIN ONE YEAR FROM IMPLANT

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*Ratio of patients being dead one year after implantation*

<b>Type</b>	<b>Implants in 2022</b>	<b>Death within year</b>	<b>%</b>
PM	11009	994	9.0
ICD	2494	103	4.1
CRT-P	638	59	9.2
CRT-D	629	23	3.7

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QUALITY – INTERVENTION RATIO

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*Intervention ratio (primary/correction)*

Region	Hospital	PM	ICD
Norra Sverige	Norrlands Universitetssjukhus	251	51
	Örnsköldsviks sjukhus	89	17
	Östersunds sjukhus	157	22
	Skellefteå lasarett	60	5
	Sollefteå sjukhus	44	0
	Sunderby sjukhus	400	85
	Sundsvalls sjukhus	211	47
Södra Sverige	Blekingesjukhuset	223	58
	Centrallasarettet Växjö	216	37
	Centralsjukhuset Kristianstad	281	47
	Helsingborgs lasarett	290	35
	Länssjukhuset Halmstad	107	0
	Skånes universitetssjukhus, Lund	545	271
	Skånes universitetssjukhus, Malmö	260	30
	Varbergs sjukhus	251	96
Stockholm/Gotland	Danderyds sjukhus	629	87
	Karolinska Huddinge	280	78
	Karolinska Solna	353	150
	Södersjukhuset	495	86
	St Görans sjukhus	449	62
	Visby lasarett	56	5
Sydöstra Sverige	Länssjukhuset Kalmar	164	75
	Länssjukhuset Ryhov	367	71
	Linköpings universitetssjukhus	515	124
	Västerviks sjukhus	62	0
Uppsala/Örebro	Akademiska sjukhuset	411	95
	Bollnäs sjukhus	1	0
	Centralsjukhuset Karlstad	265	66
	Centralsjukhuset Västerås	236	56
	Falu lasarett	405	86
	Gävle sjukhus	319	80
	Hudiksvalls sjukhus	71	18
	Mälarsjukhuset	306	74
	Torsby sjukhus	42	0
	Universitetssjukhuset Örebro	335	73
Utland	Ålands centralsjukhus	42	6
	N/A	0	1
	Utland	17	4
Västra Sverige	Alingsås lasarett	99	0
	Drottning Silvias Bus	16	2
	Kungälv sjukhus	181	0
	Sahlgrenska universitetssjukhuset	545	125
	Sahlgrenska universitetssjukhuset /Östra	94	0
	Skaraborgs sjukhus Skövde	354	48
	Södra Älvsborgs sjukhus	271	46
Trollhättan, NÄL	389	55	