



Product Performance Report 2nd Edition 2020

Cardiac Rhythm Management
Cumulative Survival Probability

**Product
Performance Report
2nd Edition 2020**

Cardiac Rhythm Management
Pacemakers
ICDs
Leads

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Quality Excellence

BIOTRONIK has a long history of high quality in product design and performance. For more than 50 years, the name BIOTRONIK has been synonymous with excellent workmanship and reliable patient safety. Our quality concept follows an integrated approach and extends from preventative risk measures during a product's development phase through all the steps of the manufacturing and design process.

BIOTRONIK's quality assurance system guarantees strict adherence to internal quality standards as well as compliance with international standards and guidelines. Regular reviews of our product performance and manufacturing evaluations contribute significantly to the achievement of extraordinary quality. Our customers, patients, and physicians can rely on the highest degree of safety built into our products. We always welcome suggestions from users about how we can improve the quality of our products.

This Product Performance Report is an integral component of BIOTRONIK's commitment to provide detailed, accurate information regarding long term reliability. The Product Performance Report exemplifies BIOTRONIK's policy of transparent and timely communication with our customers.

As a means to obtain continuous improvement of the designs, BIOTRONIK carefully analyzes returned products and incorporates all findings into our quality assurance system. This Product Performance Report was prepared in accordance with International Standard ISO 5841-2: 2014 (E) and is in compliance with the recommendations from the U.S. Heart Rhythm Society Task Force on Device Performance Policies and Guidelines. As an active member of AdvaMed and their Pacemaker/ICD Working Group, BIOTRONIK has worked extensively with the CRM industry to ensure comparable product performance data is reported by all manufacturers. The data provided in BIOTRONIK's Product Performance Report incorporates the requirements and definitions as defined in AdvaMed's Requirements for Uniform Reporting of Clinical Performance of Pulse Generators, except as noted herein.

In BIOTRONIK's continuous efforts to provide accurate and transparent information and to ensure that a conservative estimate for device performance is reported, the Survival Probability calculations presented herein also consider reported pacemaker and ICD battery depletions as well as lead complications without the device having been returned for analysis.

¹ The ISO 5841-2:2014(E) is replacing the previous version ISO 5841-2:2000. As part of the update, AdvaMed's Requirements for Uniform Reporting of Clinical Performance of Pulse Generators were incorporated in the new ISO 5841-2:2014(E).

Because a significant portion of this report is based on analyses of returned products, BIOTRONIK urges all physicians to return explanted devices and to notify us when a product is explanted or no longer in use for any reason.

BIOTRONIK aims to continually improve and enhance the scope of this report while integrating the latest information and data concerning the performance of our products. Please contact Advanced Product Support (800) 547-0394 or the PPR Support Team at ppr@biotronic.com with any comments, suggestions or questions regarding this report. Your feedback is highly appreciated and will be used to further develop this report.

BIOTRONIK, October 2020



A handwritten signature in blue ink, appearing to read 'R. Borkowski'.

Roman Borkowski
Senior Vice President
Quality Management
& Regulatory Affairs CRM
BIOTRONIK SE & Co. KG



Terms and Definitions

1. Terms and Definitions

The following terms and definitions are used for pacemakers and implantable cardioverter-defibrillators (ICDs) as well as pacing and ICD leads throughout this Product Performance Report. These definitions form the basis for this Product Performance Report by clearly articulating the status of each device return and product analysis classification.

Elective Replacement Indicator

All active implantable devices that are powered by an internal battery need to be replaced when their battery is depleted. BIOTRONIK pacemakers and ICDs have an Elective Replacement Indicator (ERI) feature aka Recommended Replacement Time (RRT) that notifies the health care provider when the device's battery is nearing the end of its useful life. Display of ERI is BIOTRONIK's recommendation to the user that the battery's present state will require device replacement in the near future. For further details please refer to the corresponding manual.

Battery Depletion

Battery depletions are classified as either normal (expected) or premature. Premature battery depletions are defined as device malfunctions, while normal battery depletions are not device malfunctions. Batteries of returned devices are considered to have depleted normally when (a) a device is returned with no associated complaint and the device has reached its elective replacement indicator(s) with implant time that meets or exceeds the nominal (50 percentile) predicted longevity at default (labeled) settings, or (b) a device is returned and the device has reached its elective replacement indicator(s) with implant time exceeding 75% of the expected longevity using the longevity calculation tool available at time of product introduction, calculated using the device's actual use conditions and settings.

For consistency with previous Product Performance Reports, for ICDs released prior to Lumax and pacemakers released prior to Philos II, batteries of returned devices are considered to have depleted normally if they have reached their elective replacement indicator and testing indicates that the battery and associated circuitry are within specifications.

Out of Specification

Any component or software related event that causes the device's characteristics to not meet pre-defined performance specifications and requirements while implanted and in service. Returned product analysis that determines a device to be out of specification is considered a device malfunction. Normal battery depletions are not considered device malfunctions. BIOTRONIK defines the requirements and performance specifications for each product.

Device Malfunctions

Any component or software related event that causes the device's characteristics to be out of specification while implanted and in service are considered as device malfunctions. Because it is impossible to verify that a device has malfunctioned without analyzing it, only returned devices can be classified as malfunctions for this report. Each returned lead, ICD and pacemaker is analyzed to determine if it has malfunctioned. If the analysis determines that a pacemaker or ICD failed to meet its specifications while implanted and in service, it is further classified as either a malfunction with compromised therapy or as a malfunction without compromised therapy. Devices damaged during implant, revision or after explant, damaged due to external causes (i.e. electrocautery) or due to failure to follow instructions, warnings or contraindications in its associated technical manual are not considered

malfunctions. Devices damaged due to interaction with other implanted devices (i.e., leads) are also not considered as malfunctions for the purposes of this Product Performance Report.

Malfunctions with Compromised Therapy

The condition when a pacemaker or ICD is found to have malfunctioned in a manner that compromised pacing or defibrillation therapy (including complete loss or partial degradation) while implanted and in service. Therapy is considered to have been compromised if critical patient-protective pacing or defibrillation therapy is not available. Examples include: sudden loss of battery voltage; accelerated current drain such that a depleted battery was not detected before loss of therapy; sudden malfunction during a tachycardia or fibrillation event resulting in aborted delivery of therapy; intermittent malfunction where therapy is sporadically unavailable.

Malfunctions without Compromised Therapy

The condition when a pacemaker or ICD is found to have malfunctioned in a manner that did not compromise pacing or defibrillation therapy while implanted and in service. Therapy is not compromised as long as critical patient-protective pacing and defibrillation therapies are available as determined through device analysis.

Lead Complications

A lead performance issue where a complaint, associated with at least one of the clinical manifestations listed below, is reported and where the non-returned lead is:

- Verified by medical records to have been implanted and in-service, and
- Reported to have been removed from service,
- Modified to remedy the malfunction, or
- Left in service based on medical judgment.

Complications for leads implanted greater than 30 days are reported as qualifying lead complications, whereas complications occurring during the first 30 days are reported as acute lead observations.

In accordance with the latest AdvaMed guidelines and ISO 5841-2:2014(E), the complications are classified in the following categories:

- Failure to Capture
- Failure to Sense
- Oversensing
- Abnormal Pacing Impedance
- Abnormal Defibrillation Impedance
- Insulation Breach
- Conductor Fracture
- Lead Dislodgement
- Extracardiac Stimulation
- Cardiac Perforation
- Other

Survival Probability Estimates

The probability that a device remains operational during a discrete time interval is defined as survival probability. Survival probability, as presented in this report, is related to device survival only and not survival of the patient. The survival probability

estimates in this report are based on BIOTRONIK's analysis of returned products as well as events that are reported to BIOTRONIK (e.g., battery depletions or lead complications).

Cumulative Survival Probability Estimates

The survival probability over a device's service time is the cumulative survival probability. It is calculated from all discrete survival probabilities of previous time intervals. This characteristic is calculated separately for malfunction-free survival and all-cause survival (including normal battery depletions). Specific populations that are subject to a safety advisory notification are excluded and shown separately.

Implanted Devices

Only devices remaining implanted for at least one calendar day after the implantation date are considered as implanted. Devices that are removed from the patient on the same calendar day as the implant procedure do not contribute to the survival statistics.

Active Implants

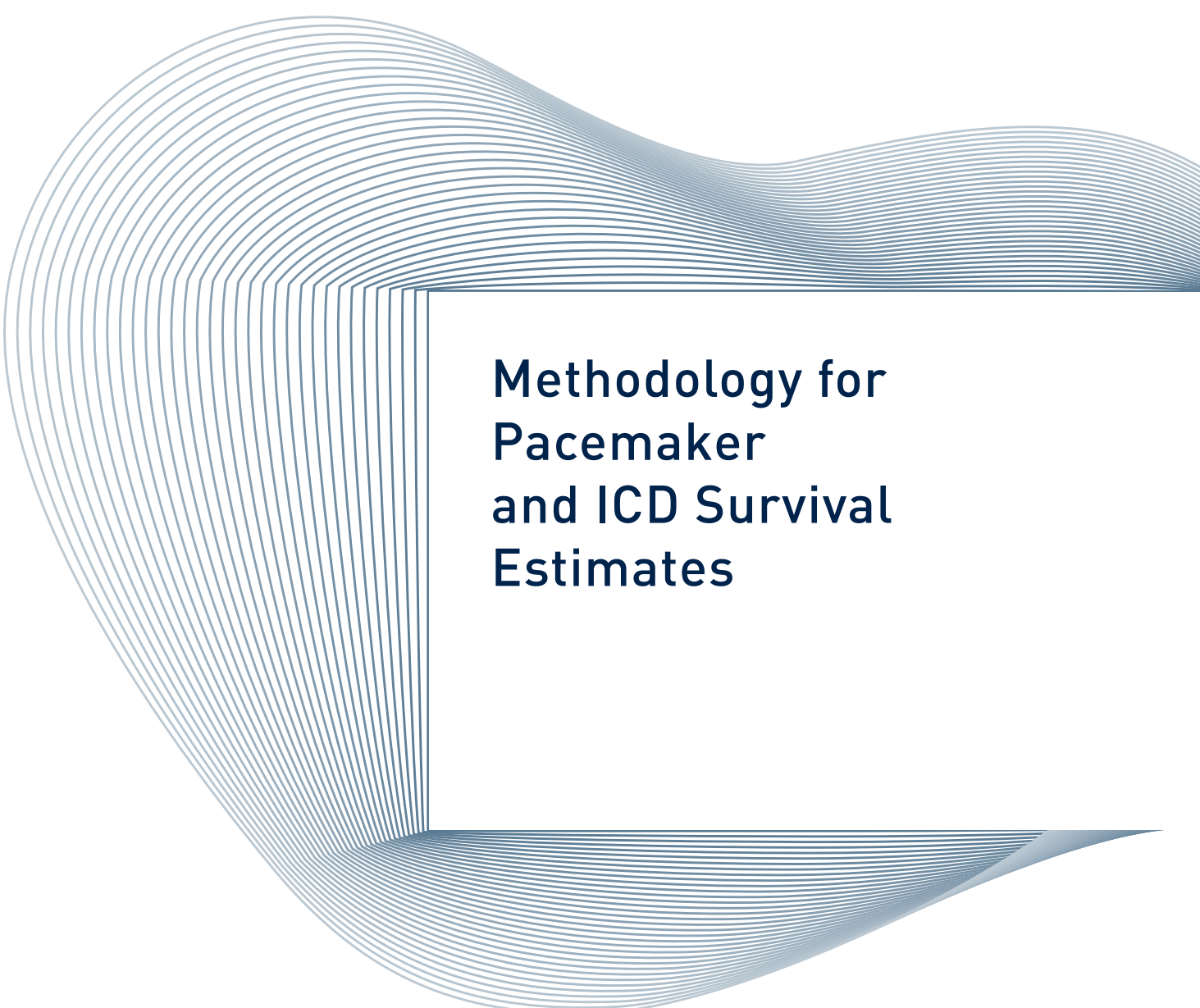
The number of devices that remain operational within a discrete observation interval are active implants. Units are removed from this cohort due to patient death or explant for any reason.

Underreporting

A device status may change without being accounted for in the Product Performance database due to a lack of information being provided to BIOTRONIK. Underreporting adjustments deemed to be necessary are detailed in this report.

Safety Advisory Notifications

Any action taken by the manufacturer to inform clinicians concerning a device performance issue that may cause the device to not meet its predefined specifications is referred to as a Safety Advisory Notification.



Methodology for Pacemaker and ICD Survival Estimates

2. Methodology for Pacemaker and ICD Survival Estimates

2.1 Cumulative Survival Probability

This report has been prepared in accordance with ISO 5841-2:2014(E) applying actuarial analysis for the calculation of survival probabilities. Survival estimates given in this report are considered to be generally representative for worldwide performance of BIOTRONIK devices.

The cumulative survival probability is an estimate based on the percentage of pacemakers and ICDs that remain implanted and operational at various points of the product's service time in absence of concurrent events such as morbidity and voluntary explants for various reasons (e.g., device upgrade). The device survival estimate over time is displayed in cumulative curves (Kaplan-Meier). The product's performance is evaluated in discrete one-month intervals. The survival probability for each month is given by the number of devices that remain implanted and operational through this month divided by the number of devices that entered the interval. The cumulative survival probability for any period is given by multiplying all survival probabilities of previous months.

At the time of implantation, the cumulative survival probability is 100 %. Even though they are analyzed as part of our quality system monitoring, devices that are found to be out of specification prior to or during the implantation procedure are removed from the statistics as they do not contribute to a patient's risk of being subject to a device malfunction or replacement during the device's service time. Because this report is provided to describe product performance based on returned product analyses, the pacemaker and ICD data does not include information

regarding medical complications such as erosion, infection or diaphragmatic stimulation.

In general, during the initial phase of the service time, devices which are out of specification are the primary contribution to reduction of survival probability. As the product lifecycle lengthens, normal battery depletion assumes a greater impact on the survival curve and becomes the dominating factor.

In order to make these two effects distinguishable, the cumulative survival probability curves are shown separately for devices that are confirmed to have malfunctioned only, and for total (all-cause) cumulative survival. In case of a device being subject to a safety advisory notification that significantly impacts the survival probability, this factor is displayed separately.

2.2 Data Acquisition

This report is based on the observation of BIOTRONIK's U.S. products through review of our device registration and tracking systems and analyses of returned products from all sources. Because the ability to perform decedent searches of patients with BIOTRONIK devices via the U.S. Social Security Administration, the use of U.S. data more accurately represents the active patient population for reporting purposes. In addition, device tracking regulations and vigilance reporting regulations vary throughout the world; therefore use of the U.S. data is most appropriate for accurate and consistent reporting of product performance.

In order to be included in the population under observation, a device must be registered and implanted for at least one calendar day. The cutoff date for the data included in this report is December 31, 2019. The

number of U.S. devices that are implanted and remain active as well as the total number of products distributed worldwide are provided for each product family in this report. Information is provided for separate product families, in that devices with nearly identical hardware and therapy functions are combined. For example, Edora 8 DR and DR-T (with Home Monitoring) IPGs are combined into a single family, Edora 8 Single Chamber IPGs.

Survival estimates are calculated for product families having accumulated at least 10,000 cumulative implant months. Because 10,000 implant months may take some time to accumulate, there may be a gap between U.S. market release and the start of graphical representation of survival probability. Products no longer being distributed with less than 500 active implants may be excluded from this report.

ISO 5841-2 describes a method for adjusting the device survival probability to compensate for underreported malfunctions and unrelated patient deaths. The factor for underreporting of malfunctions is unknown as currently no systematic data is available that reveals this factor. Consequently, this factor remains unaccounted for this report. Patient mortality is artificially elevated if the reported rate from our registration and tracking systems is below the annual mortality in clinical studies. Normal battery depletion rate is assumed if the reported rate of depletion decreases over time.

2.3 Returned Product Analysis

Information on malfunctioning for the pacemaker and ICD portions of this report is taken exclusively from the analysis of returned products. The outcome of this analysis is the basis for the final classification of the device's cause of explantation. Only analyzed products with confirmed device malfunctions are utilized in the calculation of malfunction-free survival probability.

Every pacemaker and ICD returned to BIOTRONIK is analyzed per internal procedures and classified as functioning normally, normal battery depletion, or malfunctioning (including premature battery depletion) while implanted and in service. These device classifications are the basis for BIOTRONIK's cumulative survival estimates on pacemakers and ICDs.

As a significant portion of pacemakers and ICDs with normal battery depletion are not returned for analysis, BIOTRONIK also considers unconfirmed pacemaker and ICD battery depletions (reported, but device not returned) in the total survival estimates to ensure that a conservative estimate for device performance is reported.

2.4 Product Performance Graphs and Data

The product performance information is shown in each section in alphabetical order and by product type.

For each product, the report provides:

- Product versions that contribute to the evaluation

- U.S. and CE market release dates
- Worldwide quantity of products that have been distributed
- U.S. registered implants (number of products included in this report)
- Estimated active U.S. implants
- Number of U.S. normal battery depletions
- Number of U.S. confirmed malfunctions

The survival plots provide:

1. Total Survival

The combined cumulative survival probability for all causes that result in device removal or a system out of operation, excluding removals for clinical reasons unrelated to the device's performance (i.e., infections).

2. Malfunction-Free Survival

The cumulative survival probability free of component or software malfunctions excluding normal battery depletions, but including premature battery depletions. Normal battery depletions only have an impact on the total cumulative survival.

Products or subgroups of products may become subject to safety advisory notifications that can significantly impact the overall product performance. However, as these subgroups are clearly defined they are separated from the non-advisory devices. The impact of the advisory notification is then shown in a separate graph for total cumulative survival and for malfunction-free survival of the device population affected by the advisory notification. Current advisories are listed in chapter 9 of this report.

The cumulative survival data and the 95% confidence intervals according to the Greenwood's Formula¹ are shown in numerical form for the observed population.

¹ Greenwood, M. The natural duration of cancer. Reports on Public Health and Medical Subjects 33, London: Her Majesty's Stationery Office, 1-26, 1926

Performance of BIOTRONIK Pacemakers

- 3.1 Single-Chamber Pacemakers
- 3.2 Dual-Chamber Pacemakers
- 3.3 CRT Pacemakers

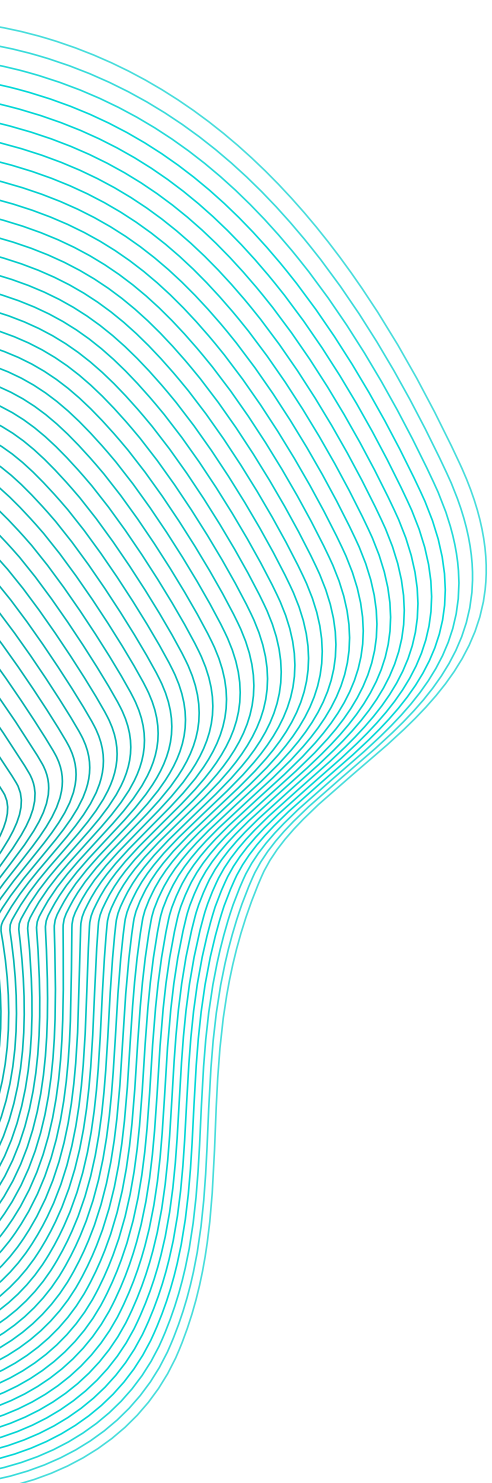


Performance of BIOTRONIK Pacemakers

3.1 Single-Chamber Pacemakers

3.2 Dual-Chamber Pacemakers

3.3 CRT Pacemakers

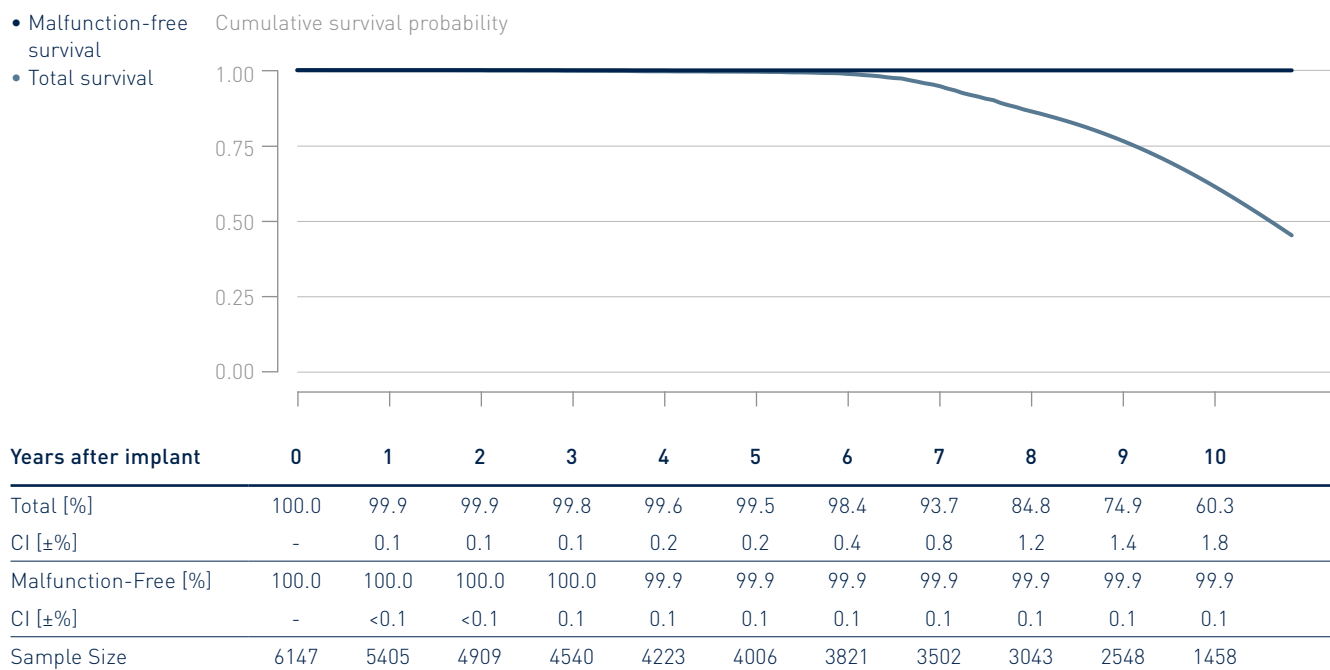


3.1 Single-Chamber Pacemakers

Cylos and Cylos 990

Product Versions _____	VR
NBG Codes _____	VVIR
US Market Release _____	Jan 2006
CE Market Release _____	Nov 2005 / Mar 2008
Worldwide Distributed Devices _____	25 900
Registered U.S. Implants _____	6 147
Estimated Active U.S. Implants _____	2 590
U.S. Normal Battery Depletions _____	830

	Quantity	Rate
U.S. Confirmed Malfunctions _____	4	0.07%
Therapy Compromised _____	1	0.02%
Therapy Available _____	3	0.05%



* While Cylos 990 VR is not distributed in the U.S., the performance is expected to be similar to the U.S. distributed products

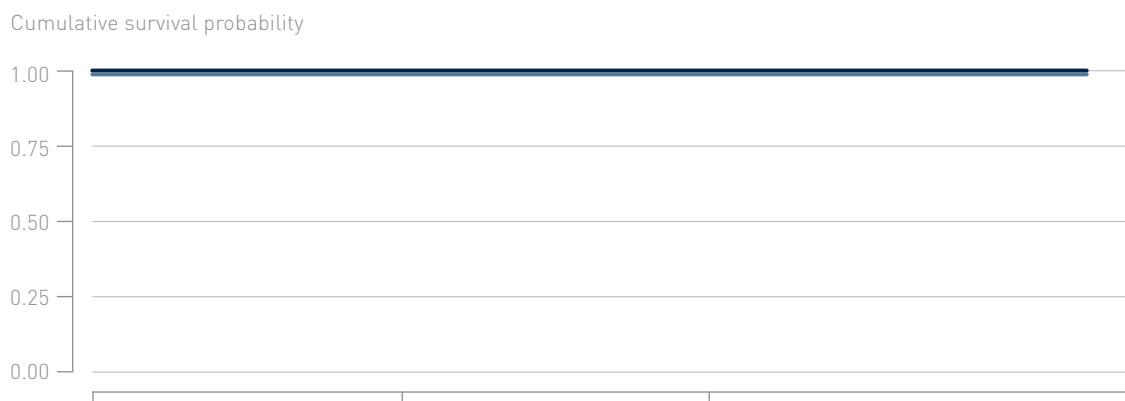
3.1 Single-Chamber Pacemakers

Edora 8

Product Versions	SR, SR-T
NBG Codes	VVIR
US Market Release	May 2017
CE Market Release	Sep 2016
Worldwide Distributed Devices	19 200
Registered U.S. Implants	3 929
Estimated Active U.S. Implants	3 670
U.S. Normal Battery Depletions	1

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

- Malfunction-free survival
- Total survival



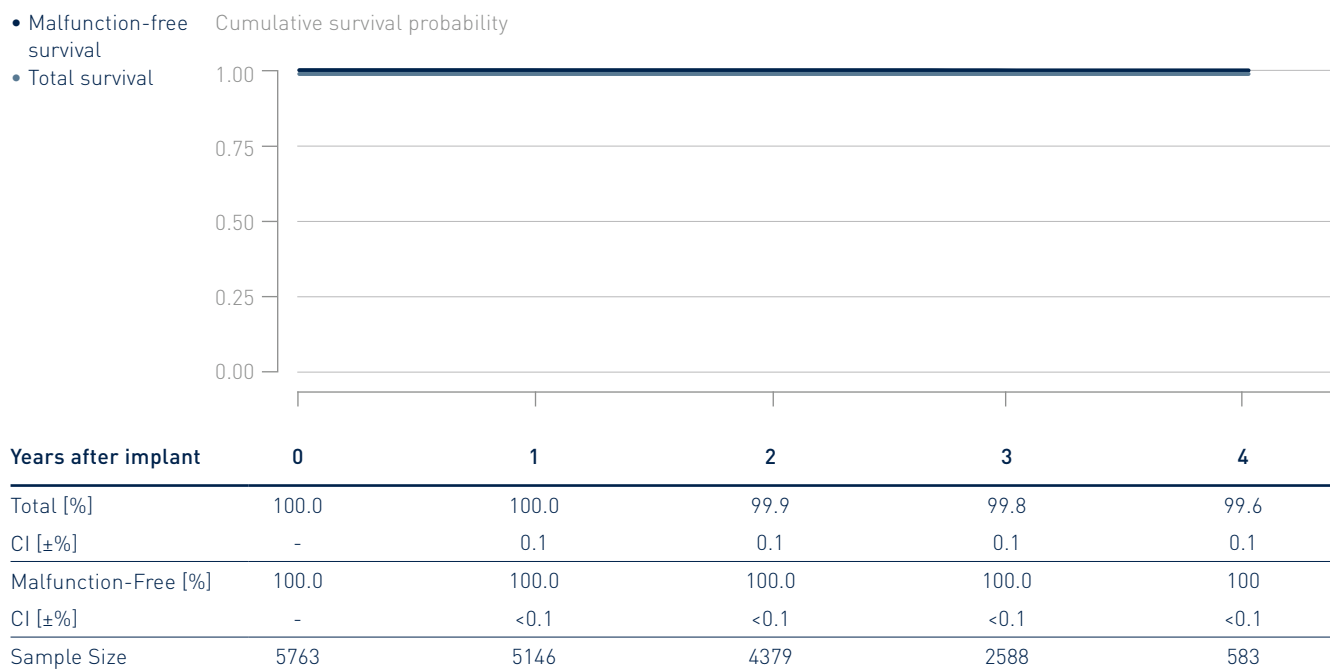
Years after implant	0	1	2
Total [%]	100.0	100.0	100.0
CI [±%]		0.1	0.1
Malfunction-Free [%]	100.0	100.0	100
CI [±%]	-	<0.1	<0.1
Sample Size	3929	2049	459

3.1 Single-Chamber Pacemakers

Eluna 8

Product Versions	SR, SR-T
NBG Codes	AAIR, VVIR
US Market Release	Dec 2014
CE Market Release	Aug 2014
Worldwide Distributed Devices	19 600
Registered U.S. Implants	5 763
Estimated Active U.S. Implants	4 760
U.S. Normal Battery Depletions	11

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

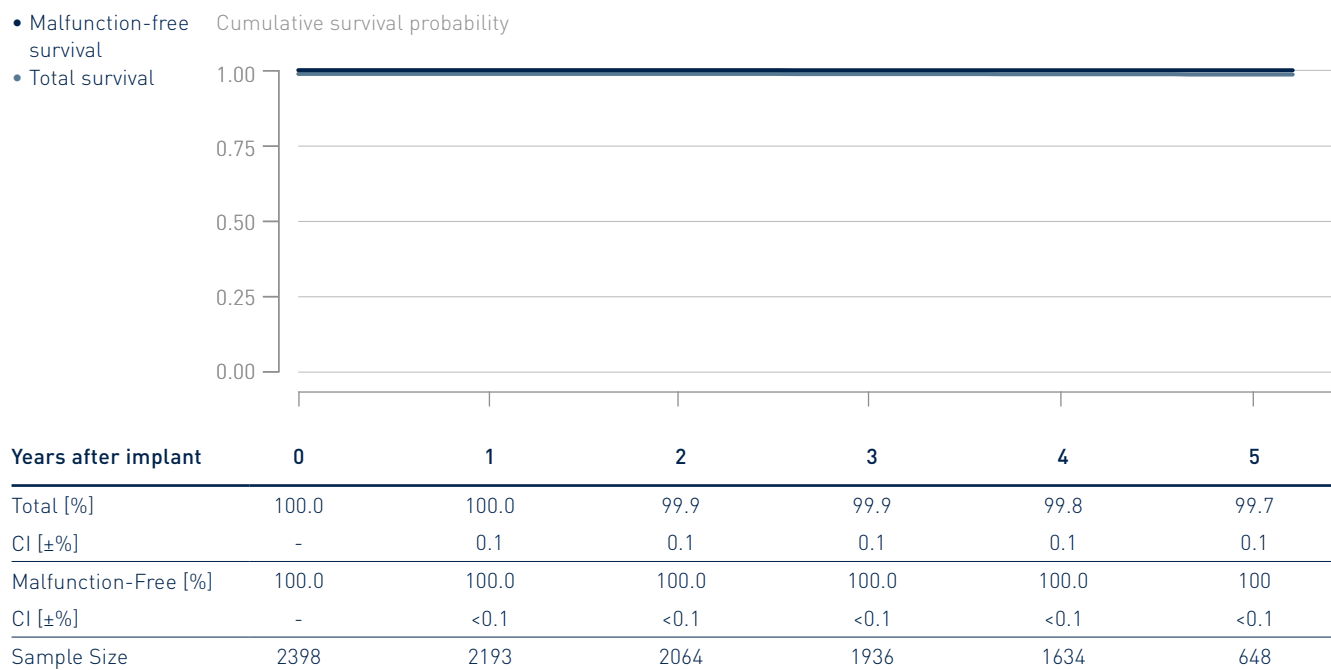


3.1 Single-Chamber Pacemakers

Entovis

Product Versions	SR, SR-T
NBG Codes	AAIR, VVIR
US Market Release	Jun 2010
CE Market Release	Nov 2009
Worldwide Distributed Devices	28 000
Registered U.S. Implants	2398
Estimated Active U.S. Implants	1780
U.S. Normal Battery Depletions	6

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.04%
Therapy Compromised	1	0.04%
Therapy Available	0	0.00%

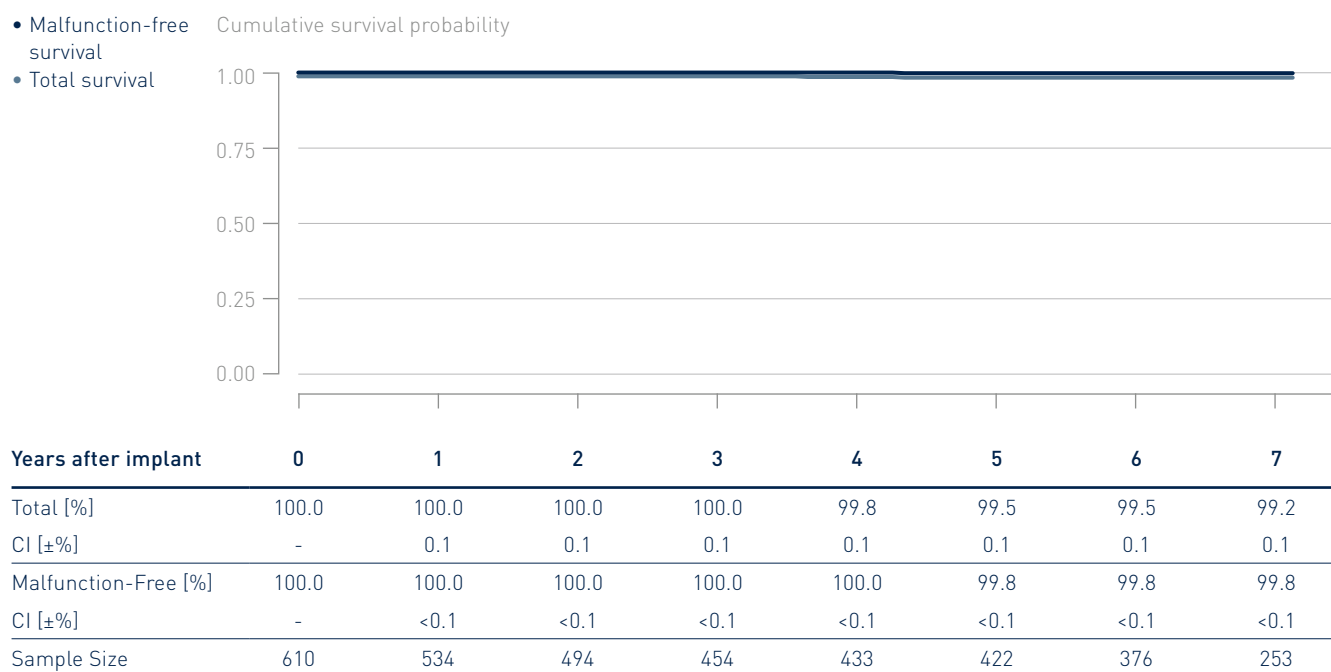


3.1 Single-Chamber Pacemakers

Estella

Product Versions	SR, SR-T
NBG Codes	AAIR, WVIR
US Market Release	Feb 2011
CE Market Release	Feb 2011
Worldwide Distributed Devices	36 500
Registered U.S. Implants	610
Estimated Active U.S. Implants	415
U.S. Normal Battery Depletions	2

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.16%
Therapy Compromised	0	0.00%
Therapy Available	1	0.16%

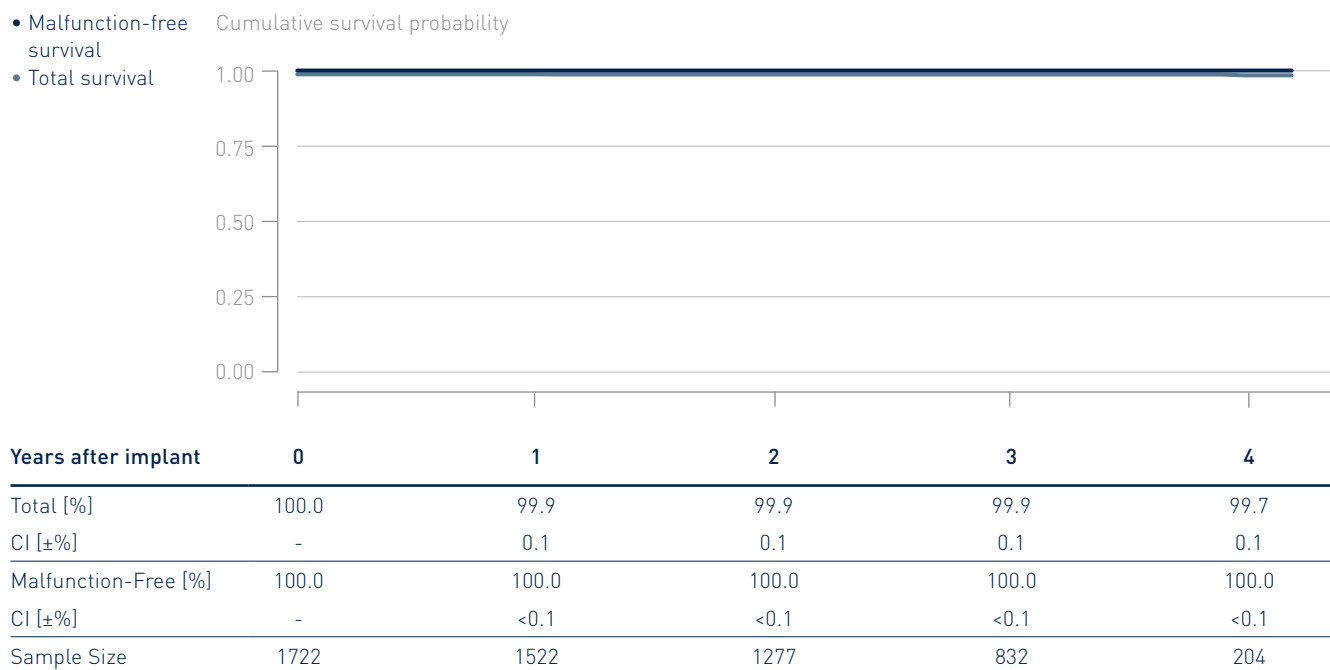


3.1 Single-Chamber Pacemakers

Etrinsa 8

Product Versions	SR-T
NBG Codes	AAIR, WIR
US Market Release	Dec 2014
CE Market Release	Aug 2014
Worldwide Distributed Devices	18 500
Registered U.S. Implants	1 722
Estimated Active U.S. Implants	1 400
U.S. Normal Battery Depletions	3

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

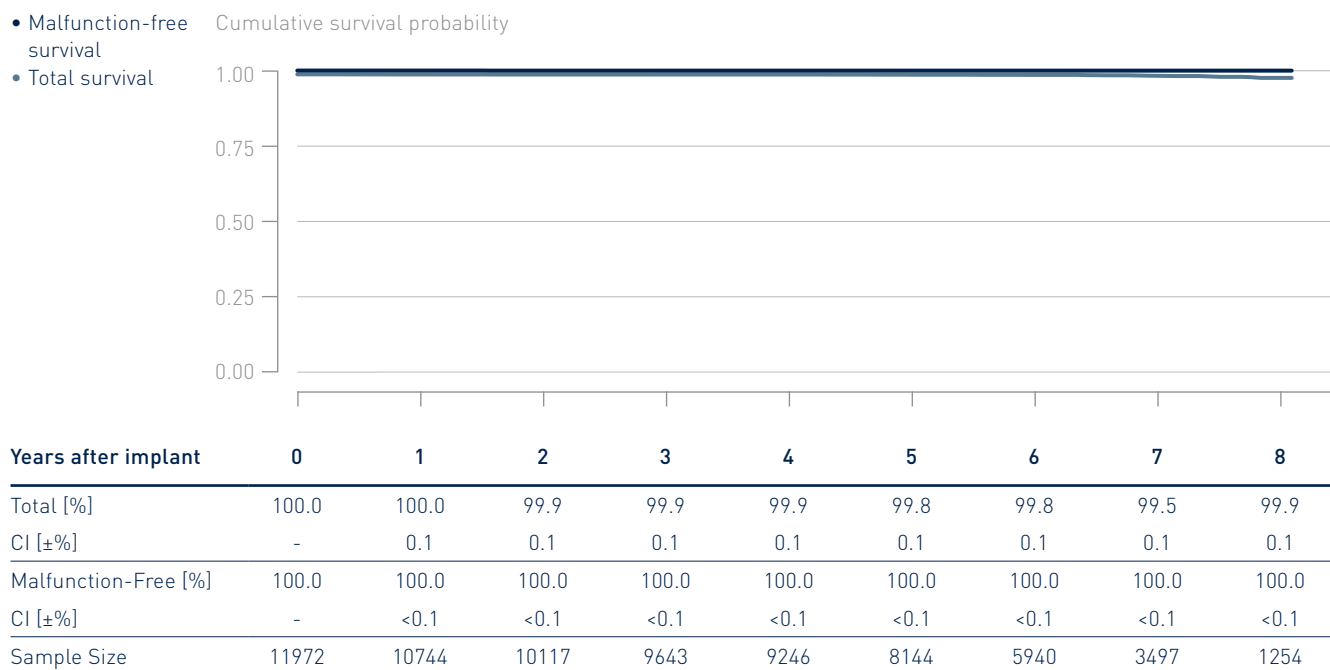


3.1 Single-Chamber Pacemakers

Evia

Product Versions	SR, SR-T
NBG Codes	AAIR, WVIR
US Market Release	May 2010
CE Market Release	Oct 2009
Worldwide Distributed Devices	60800
Registered U.S. Implants	11972
Estimated Active U.S. Implants	8000
U.S. Normal Battery Depletions	46

	Quantity	Rate
U.S. Confirmed Malfunctions	2	0.02%
Therapy Compromised	1	0.01%
Therapy Available	1	0.01%

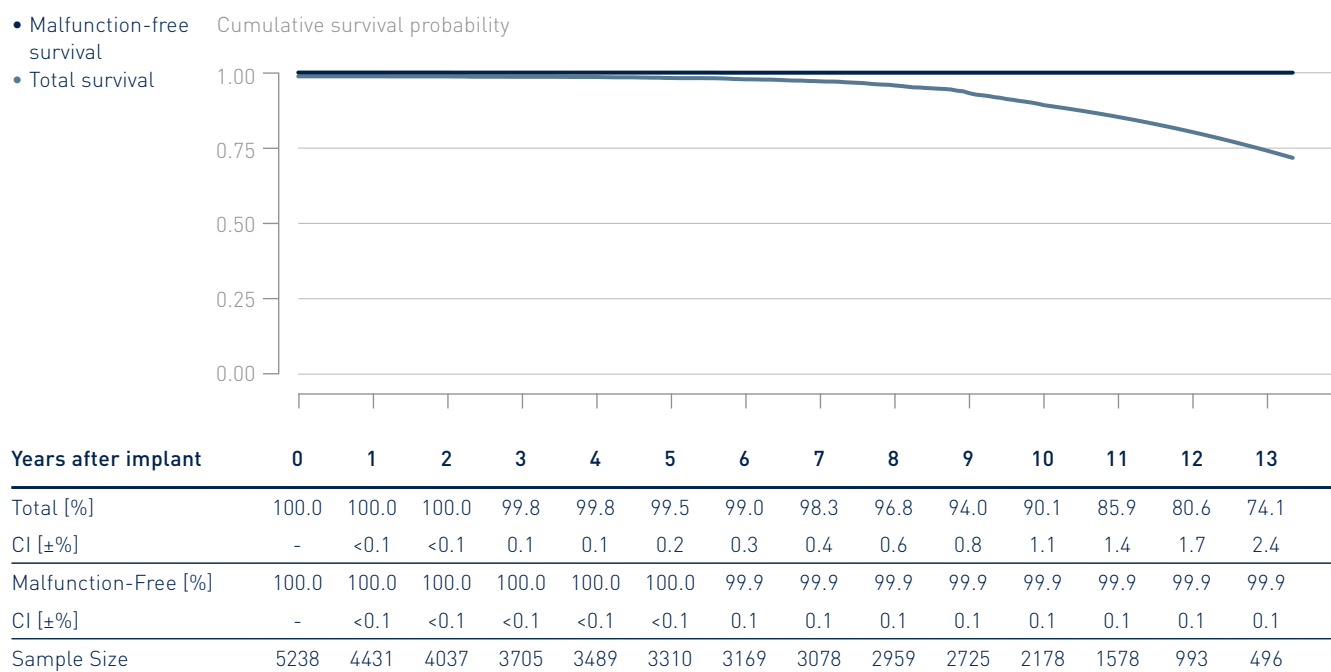


3.1 Single-Chamber Pacemakers

Philos II and Talos

Product Versions	S, SR
NBG Codes	SSI, SSIR
US Market Release	Sep 2004
CE Market Release	Feb 2004 / May 2006
Worldwide Distributed Devices	215 000
Registered U.S. Implants	5 238
Estimated Active U.S. Implants	2 540
U.S. Normal Battery Depletions	362

	Quantity	Rate
U.S. Confirmed Malfunctions	2	0.04%
Therapy Compromised	1	0.02%
Therapy Available	1	0.02%



* While Talos SR and Talos S are not distributed in the U.S., their performance is expected to be similar to the U.S. distributed products



Performance of BIOTRONIK Pacemakers

3.1 Single-Chamber Pacemakers

3.2 Dual-Chamber Pacemakers

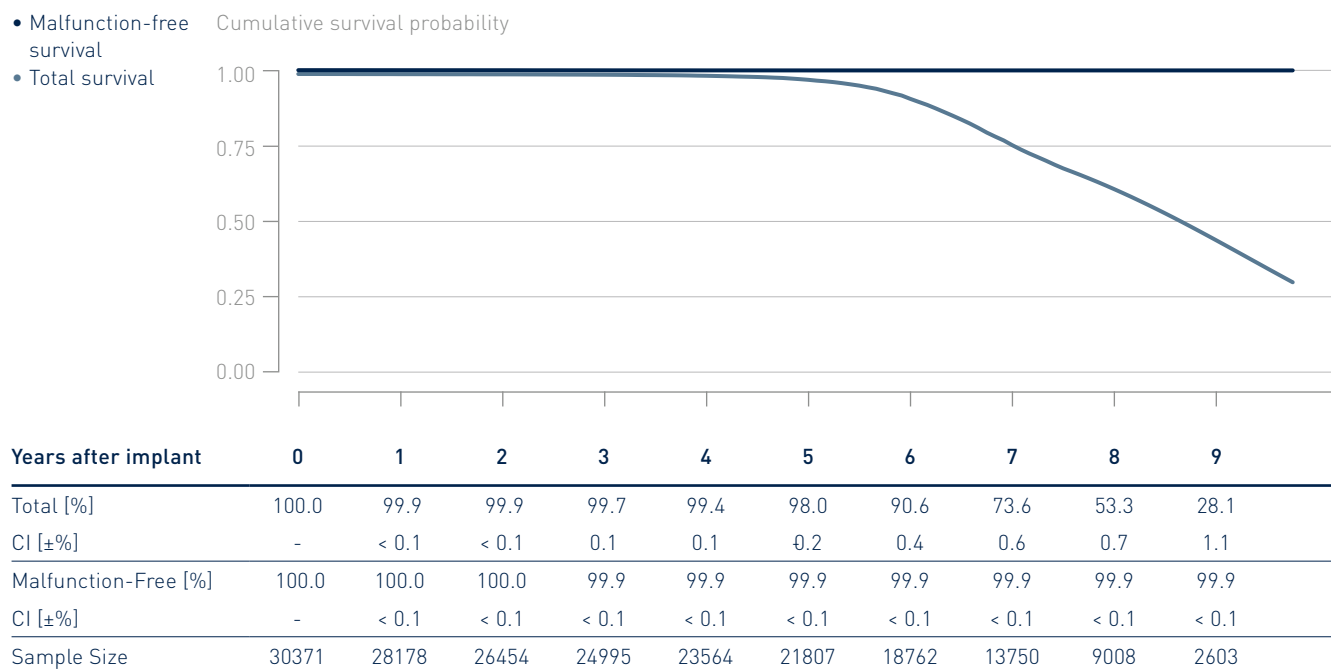
3.3 CRT Pacemakers

3.2 Dual-Chamber Pacemakers

Cylos and Cylos 990

Product Versions	DR, DR-T
NBG Codes	DDDR
US Market Release	Jan 2006
CE Market Release	Nov 2005 / Mar 2008
Worldwide Distributed Devices	81 300
Registered U.S. Implants	30 371
Estimated Active U.S. Implants	7 930
U.S. Normal Battery Depletions	8 389

	Quantity	Rate
U.S. Confirmed Malfunctions	27	0.09%
Therapy Compromised	7	0.02%
Therapy Available	20	0.07%



*While Cylos 990 DR and Cylos 990 DR-T are not distributed in the U.S., the performance is expected to be similar to the U.S. distributed products

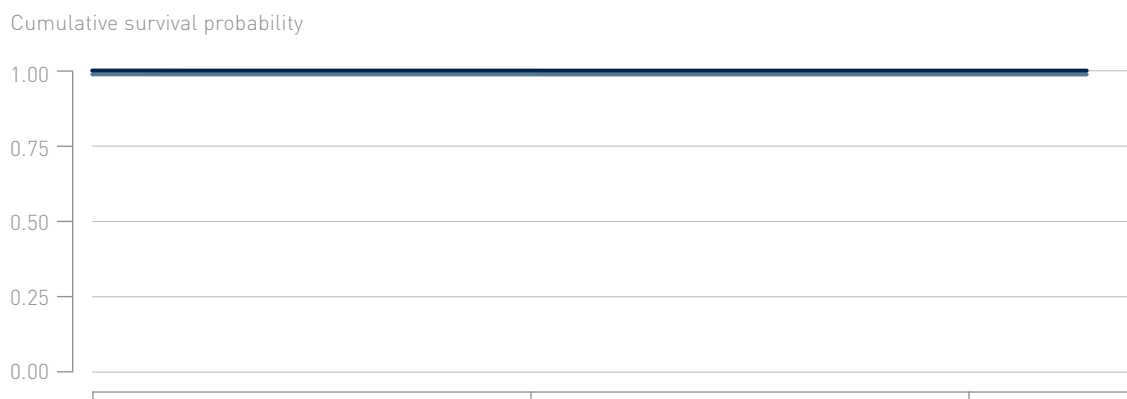
3.2 Dual-Chamber Pacemakers

Edora 8

Product Versions	DR, DR-T
NBG Codes	DDDR
US Market Release	May 2017
CE Market Release	Jul 2016
Worldwide Distributed Devices	103 000
Registered U.S. Implants	36 066
Estimated Active U.S. Implants	33 900
U.S. Normal Battery Depletions	14

	Quantity	Rate
U.S. Confirmed Malfunctions	2	0.01%
Therapy Compromised	1	0.00%
Therapy Available	1	0.00%

- Malfunction-free survival
- Total survival



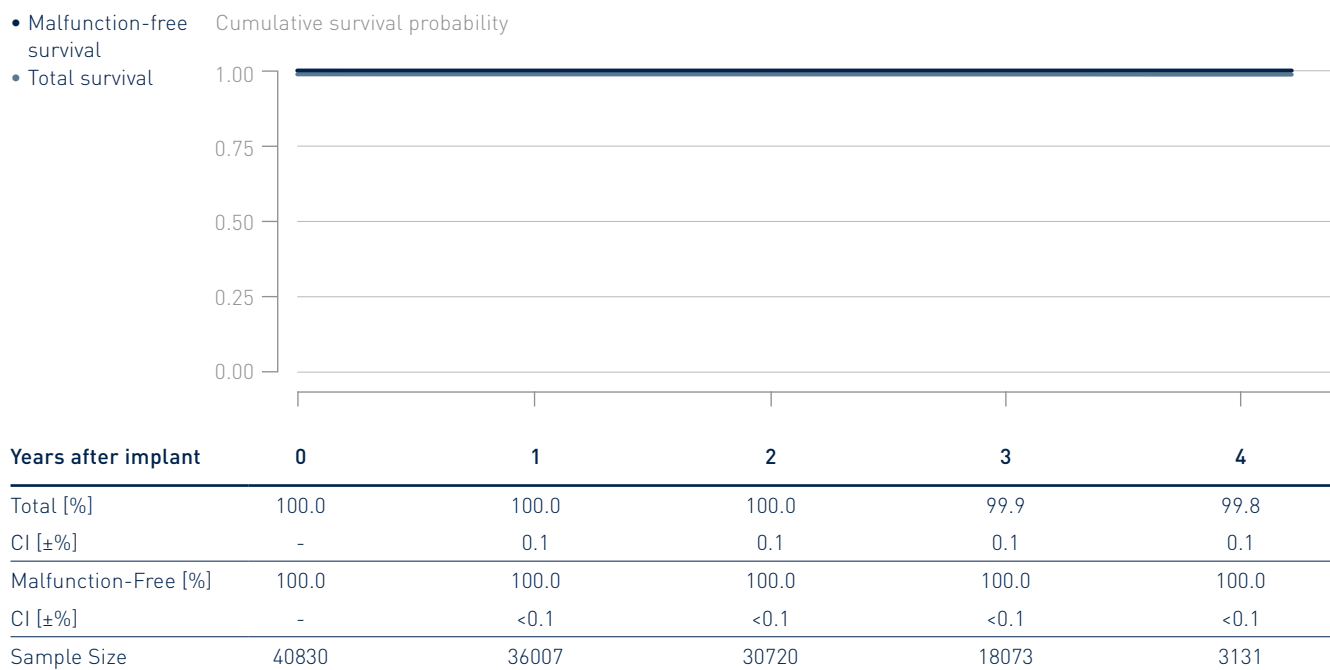
Years after implant	0	1	2
Total [%]	100.0	100.0	99.9
CI [±%]	-	0.1	0.1
Malfunction-Free [%]	100.0	100.0	100
CI [±%]	-	<0.1	<0.1
Sample Size	36066	19218	3822

3.2 Dual-Chamber Pacemakers

Eluna 8

Product Versions	DR, DR-T
NBG Codes	DDDR
US Market Release	Dec 2014
CE Market Release	Aug 2014
Worldwide Distributed Devices	94 700
Registered U.S. Implants	40 830
Estimated Active U.S. Implants	34 200
U.S. Normal Battery Depletions	29

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.00%
Therapy Compromised	0	0.00%
Therapy Available	1	0.00%

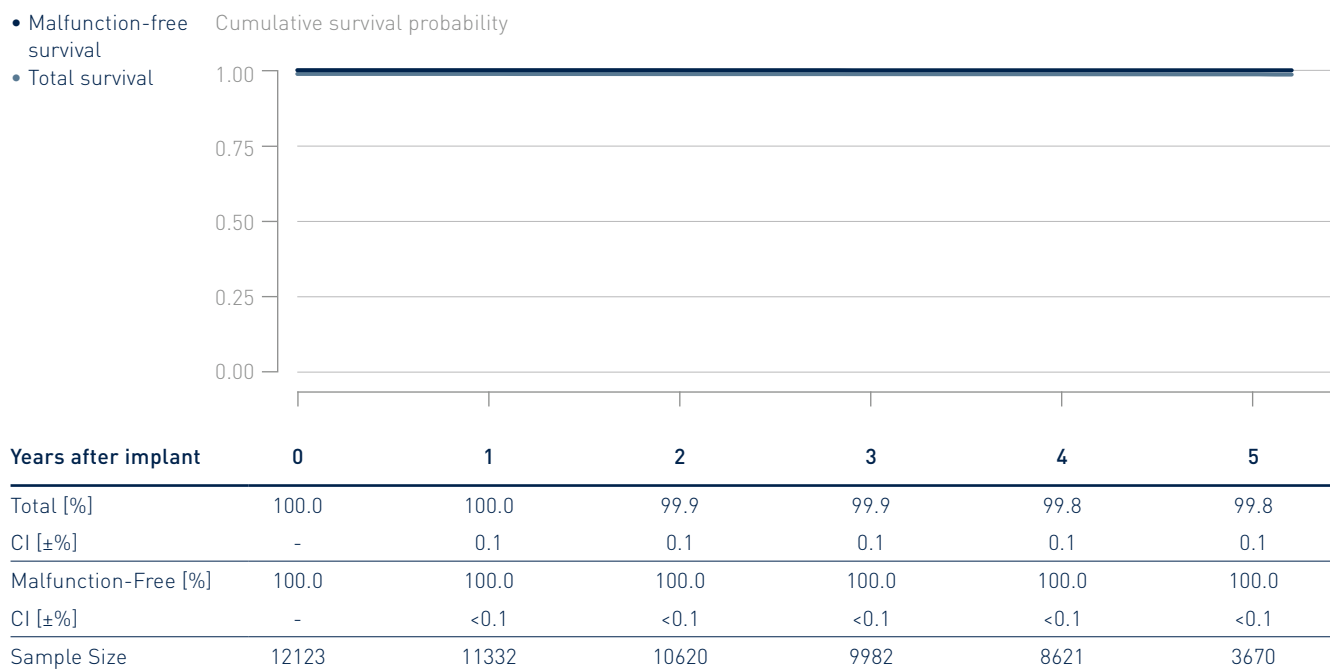


3.2 Dual-Chamber Pacemakers

Entovis

Product Versions _____	DR, DR-T
NBG Codes _____	DDDR
US Market Release _____	Feb 2010
CE Market Release _____	Nov 2009
Worldwide Distributed Devices _____	105 000
Registered U.S. Implants _____	12 123
Estimated Active U.S. Implants _____	8 890
U.S. Normal Battery Depletions _____	19

	Quantity	Rate
U.S. Confirmed Malfunctions _____	4	0.03%
Therapy Compromised _____	2	0.02%
Therapy Available _____	2	0.02%

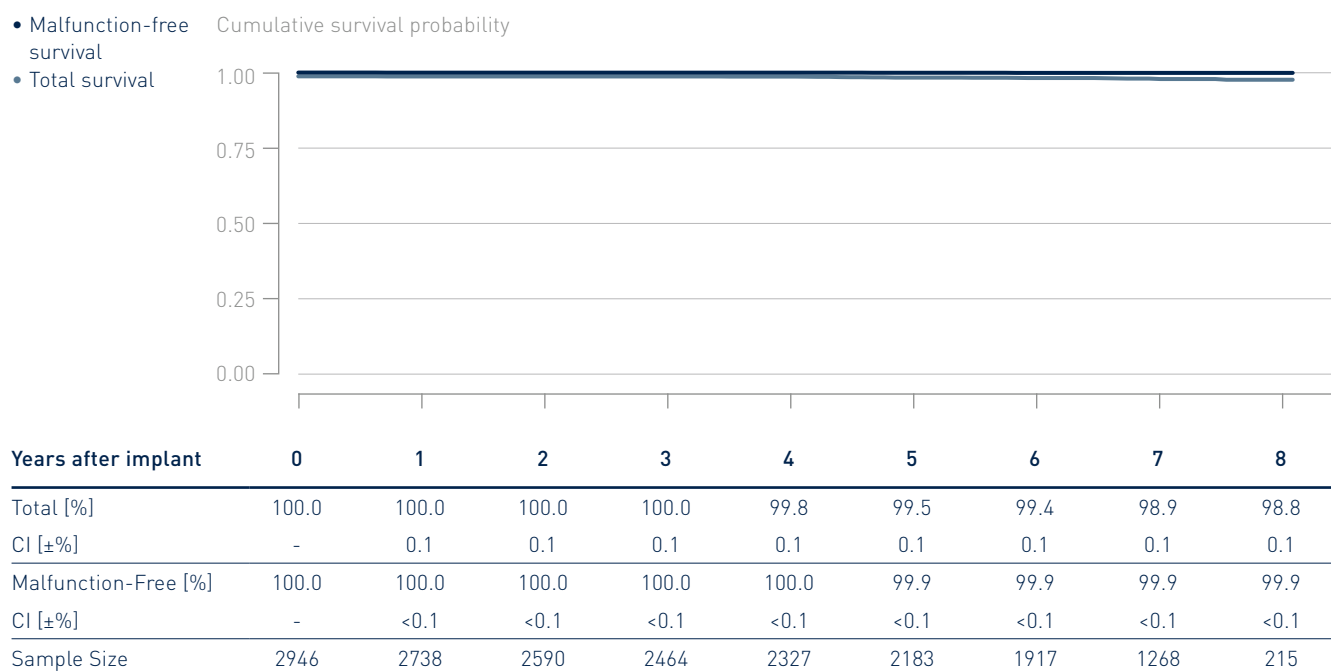


3.2 Dual-Chamber Pacemakers

Estella

Product Versions _____	DR, DR-T
NBG Codes _____	DDDR
US Market Release _____	Feb 2011
CE Market Release _____	Feb 2011
Worldwide Distributed Devices _____	39800
Registered U.S. Implants _____	2946
Estimated Active U.S. Implants _____	1940
U.S. Normal Battery Depletions _____	20

	Quantity	Rate
U.S. Confirmed Malfunctions _____	3	0.10%
Therapy Compromised _____	0	0.00%
Therapy Available _____	3	0.10%

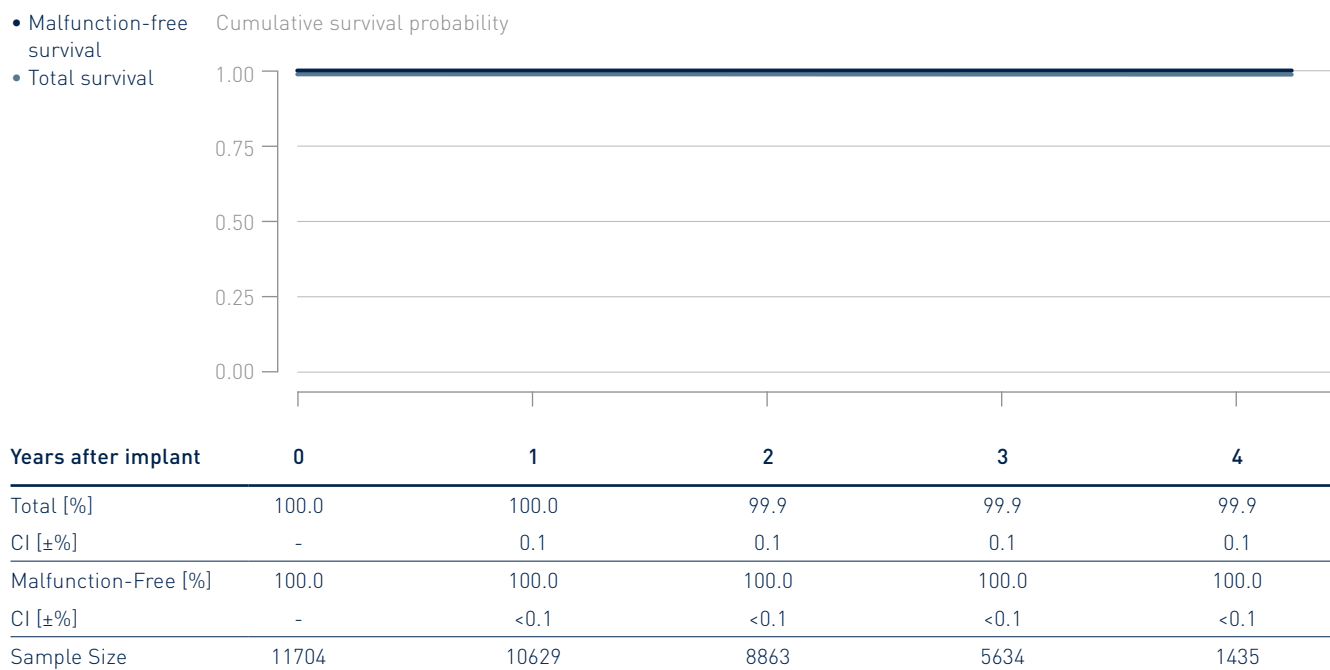


3.2 Dual-Chamber Pacemakers

Etrinsa 8

Product Versions	DR-T
NBG Codes	DDDR
US Market Release	Dec 2014
CE Market Release	Aug 2014
Worldwide Distributed Devices	76300
Registered U.S. Implants	11704
Estimated Active U.S. Implants	9690
U.S. Normal Battery Depletions	8

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

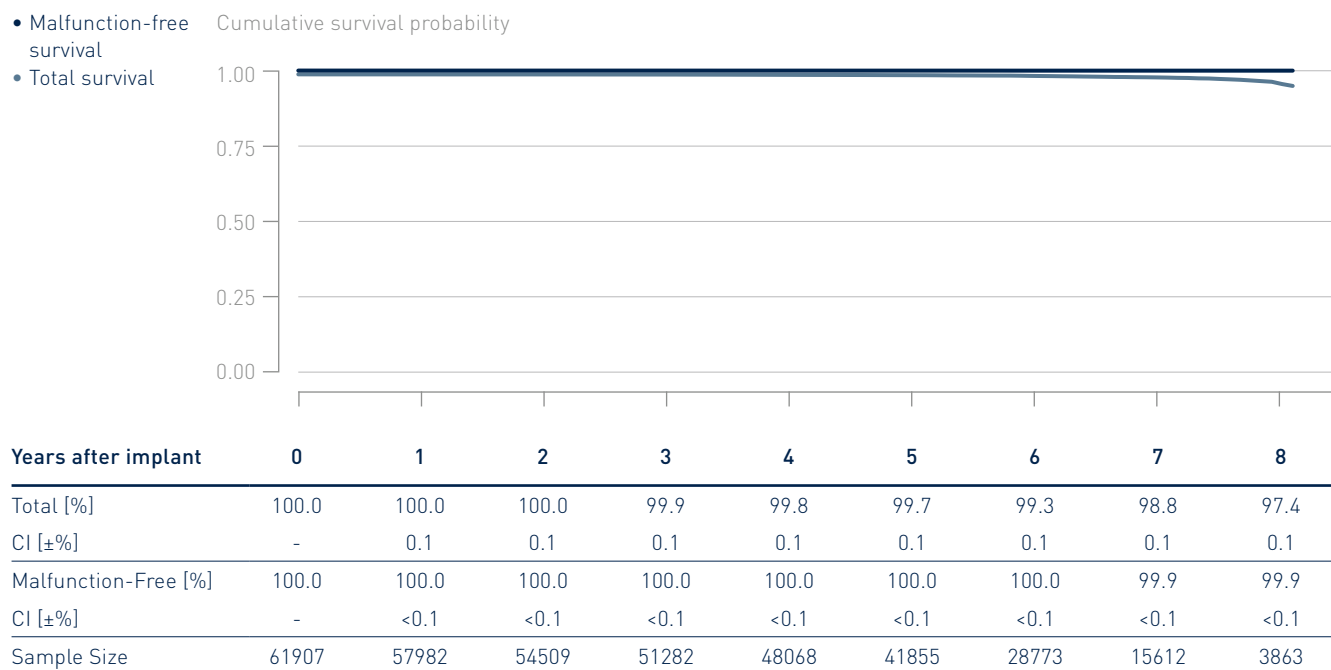


3.2 Dual-Chamber Pacemakers

Evia

Product Versions	DR, DR-T
NBG Codes	DDDR
US Market Release	May 2010
CE Market Release	Oct 2009
Worldwide Distributed Devices	211 000
Registered U.S. Implants	61907
Estimated Active U.S. Implants	41200
U.S. Normal Battery Depletions	539

	Quantity	Rate
U.S. Confirmed Malfunctions	27	0.04%
Therapy Compromised	11	0.02%
Therapy Available	16	0.03%

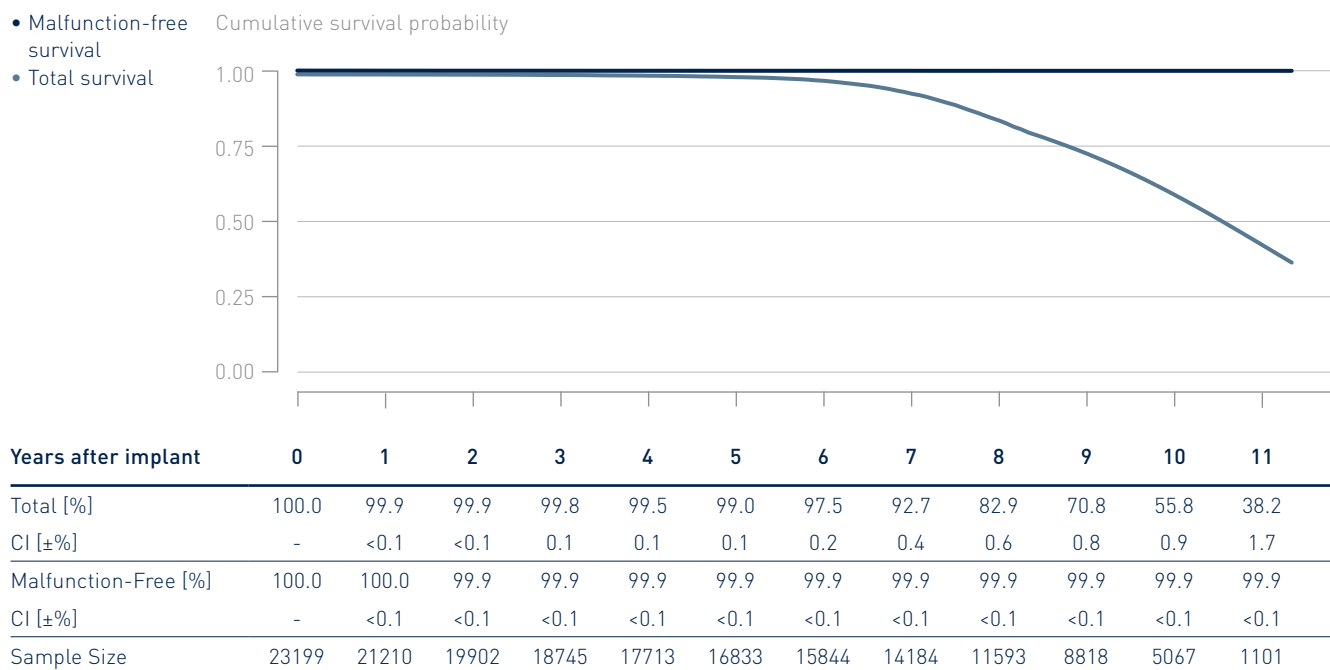


3.2 Dual-Chamber Pacemakers

Philos II and Talos

Product Versions	D, DR, DR-T (Philos II only), SLR
NBG Codes	DDD, DDDR, VDDR
US Market Release	Sep 2004
CE Market Release	Feb 2004 / May 2006
Worldwide Distributed Devices	372 000
Registered U.S. Implants	23 199
Estimated Active U.S. Implants	7 380
U.S. Normal Battery Depletions	4 694

	Quantity	Rate
U.S. Confirmed Malfunctions	21	0.09%
Therapy Compromised	0	0.00%
Therapy Available	21	0.09%



* While Philos II SLR, Talos D, Talos DR and Talos SLR are not distributed in the U.S., their performance is expected to be similar to the U.S. distributed products



Performance of BIOTRONIK Pacemakers

3.1 Single-Chamber Pacemakers

3.2 Dual-Chamber Pacemakers

3.3 CRT Pacemakers

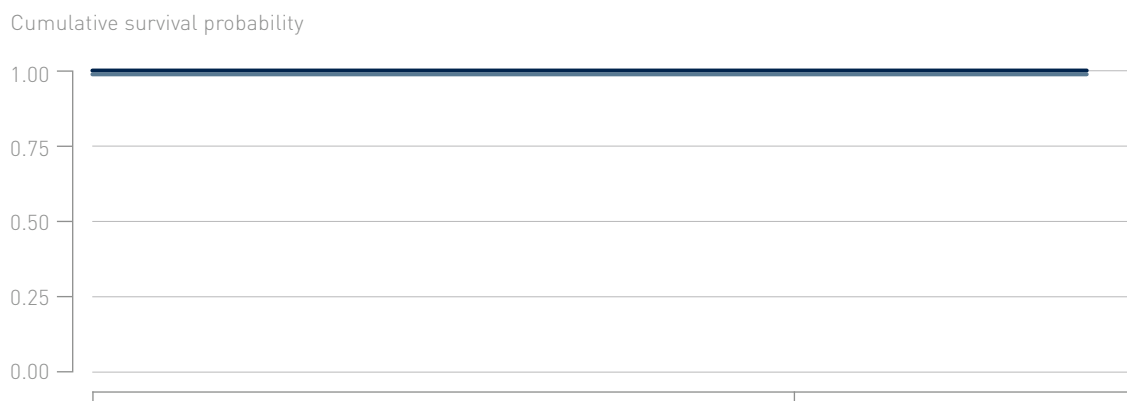
3.3 CRT Pacemakers

Edora 8

Product Versions _____	HF-T, HF-T QP
NBG Codes _____	DDDRV
US Market Release _____	Jun 2017
CE Market Release _____	Mar 2017
Worldwide Distributed Devices _____	7 240
Registered U.S. Implants _____	2 805
Estimated Active U.S. Implants _____	2 470
U.S. Normal Battery Depletions _____	0

	Quantity	Rate
U.S. Confirmed Malfunctions _____	0	0.00%
Therapy Compromised _____	0	0.00%
Therapy Available _____	0	0.00%

- Malfunction-free survival
- Total survival



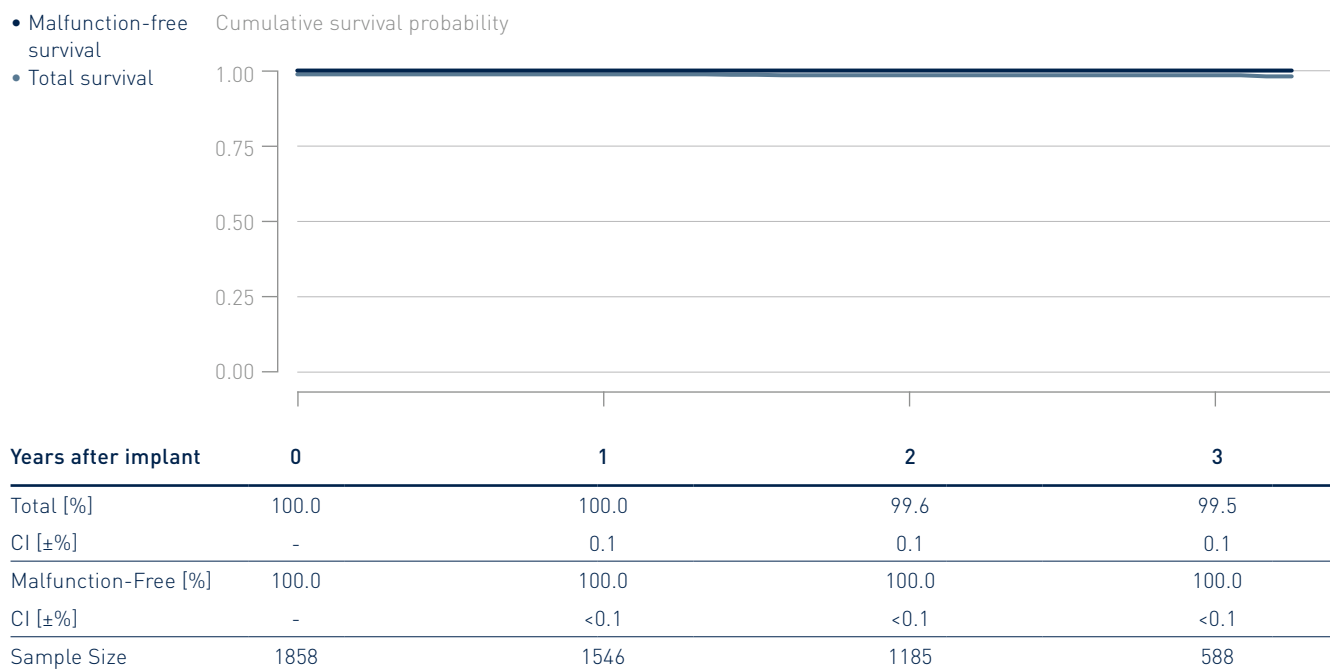
Years after implant	0	1
Total [%]	100.0	100.0
CI [±%]	-	0.1
Malfunction-Free [%]	100.0	100.0
CI [±%]	-	<0.1
Sample Size	2805	1266

3.3 CRT Pacemakers

Etrinsa 8

Product Versions	HF-T
NBG Codes	DDDRV
US Market Release	Dec 2014
CE Market Release	Aug 2014
Worldwide Distributed Devices	8 630
Registered U.S. Implants	1 858
Estimated Active U.S. Implants	1 330
U.S. Normal Battery Depletions	9

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

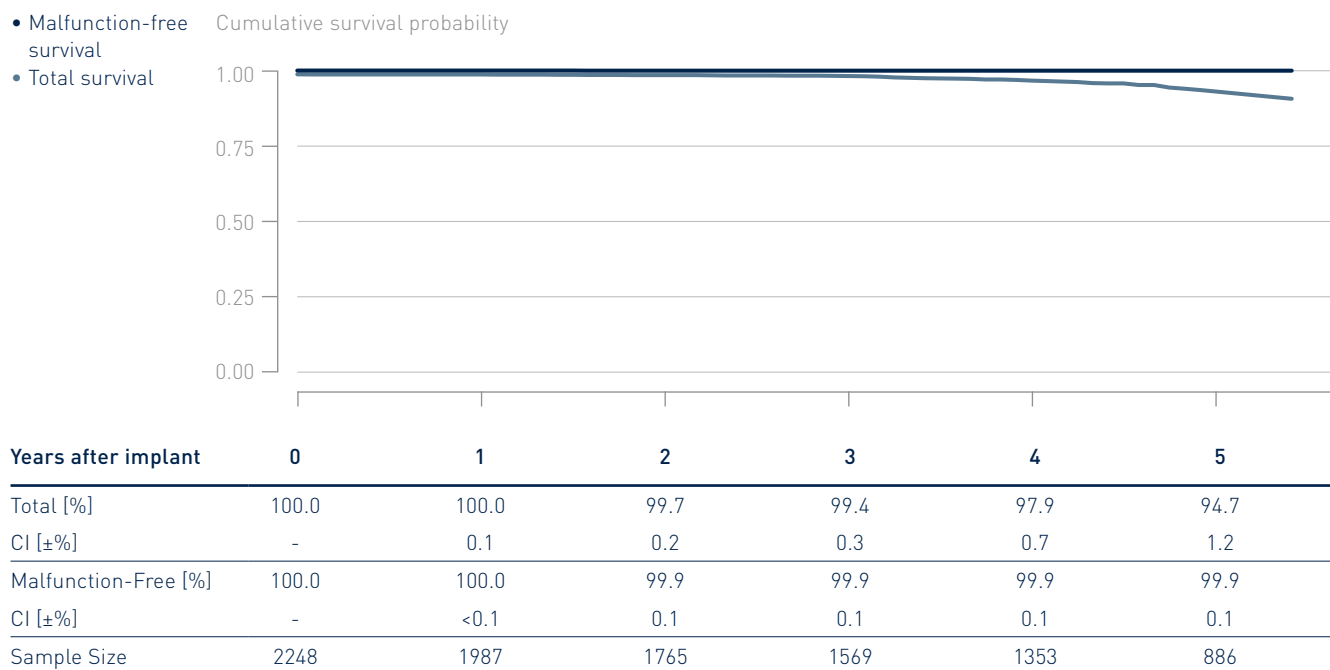


3.3 CRT Pacemakers

Evia

Product Versions _____	HF, HF-T
NBG Codes _____	DDDRV
US Market Release _____	May 2010
CE Market Release _____	Oct 2009
Worldwide Distributed Devices _____	8890
Registered U.S. Implants _____	2248
Estimated Active U.S. Implants _____	1110
U.S. Normal Battery Depletions _____	87

	Quantity	Rate
U.S. Confirmed Malfunctions _____	1	0.04%
Therapy Compromised _____	0	0.00%
Therapy Available _____	1	0.04%

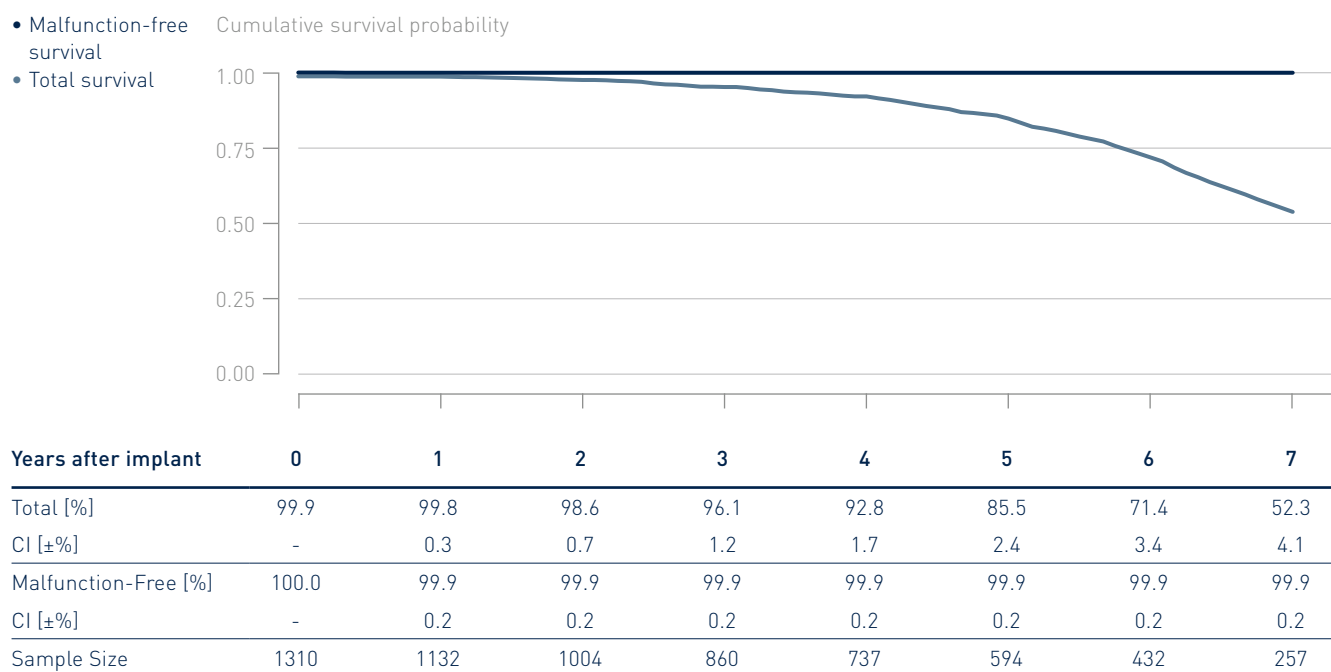


3.3 CRT Pacemakers

Stratos

Product Versions	LV, LV-T
NBG Codes	DDDRV
US Market Release	May 2008
CE Market Release	Nov 2002
Worldwide Distributed Devices	3780
Registered U.S. Implants	1310
Estimated Active U.S. Implants	217
U.S. Normal Battery Depletions	322

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.08%
Therapy Compromised	0	0.00%
Therapy Available	1	0.08%

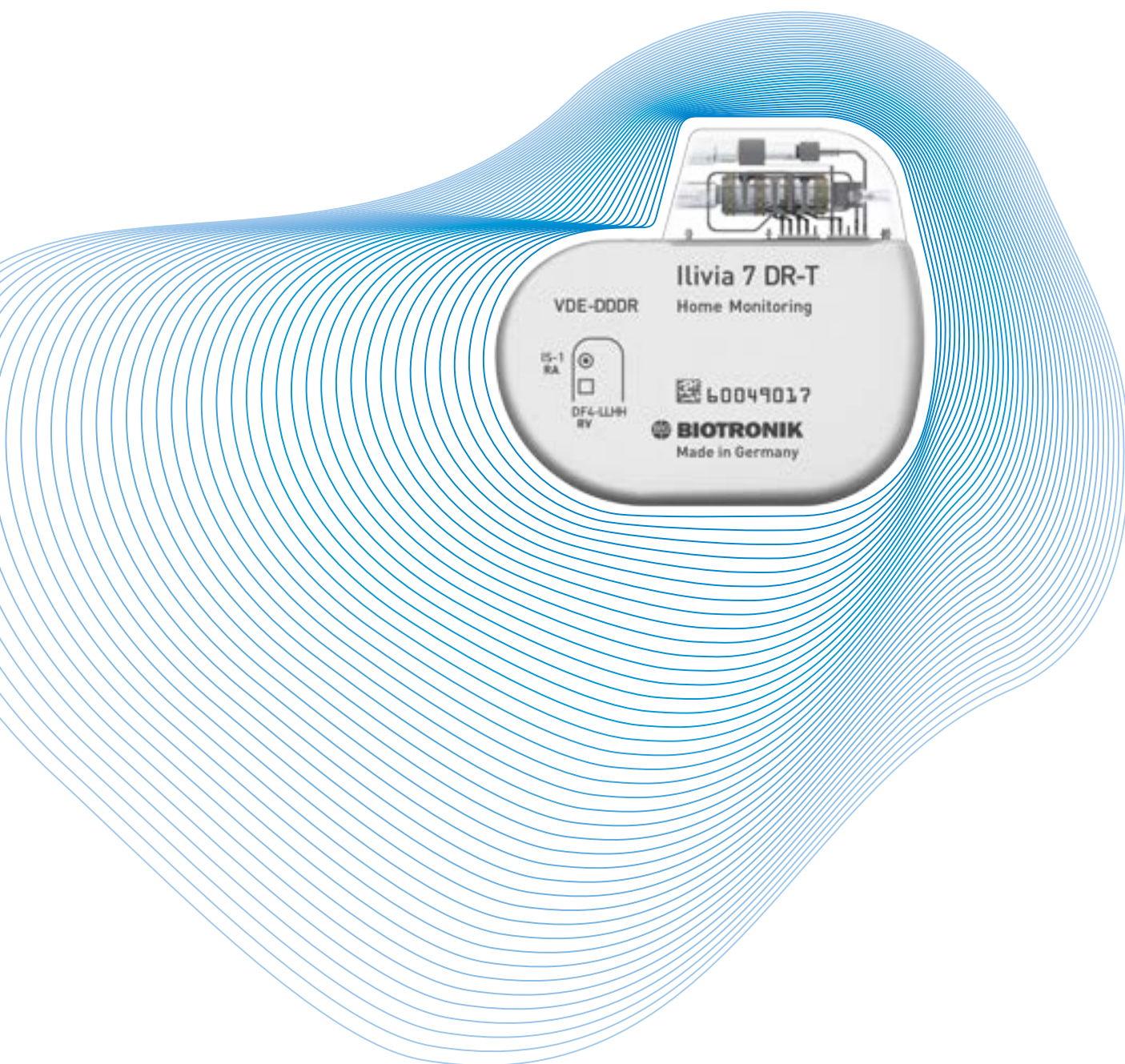


Performance of BIOTRONIK ICDs

4.1 Single-Chamber ICDs

4.2 Dual-Chamber ICDs

4.3 CRT ICDs

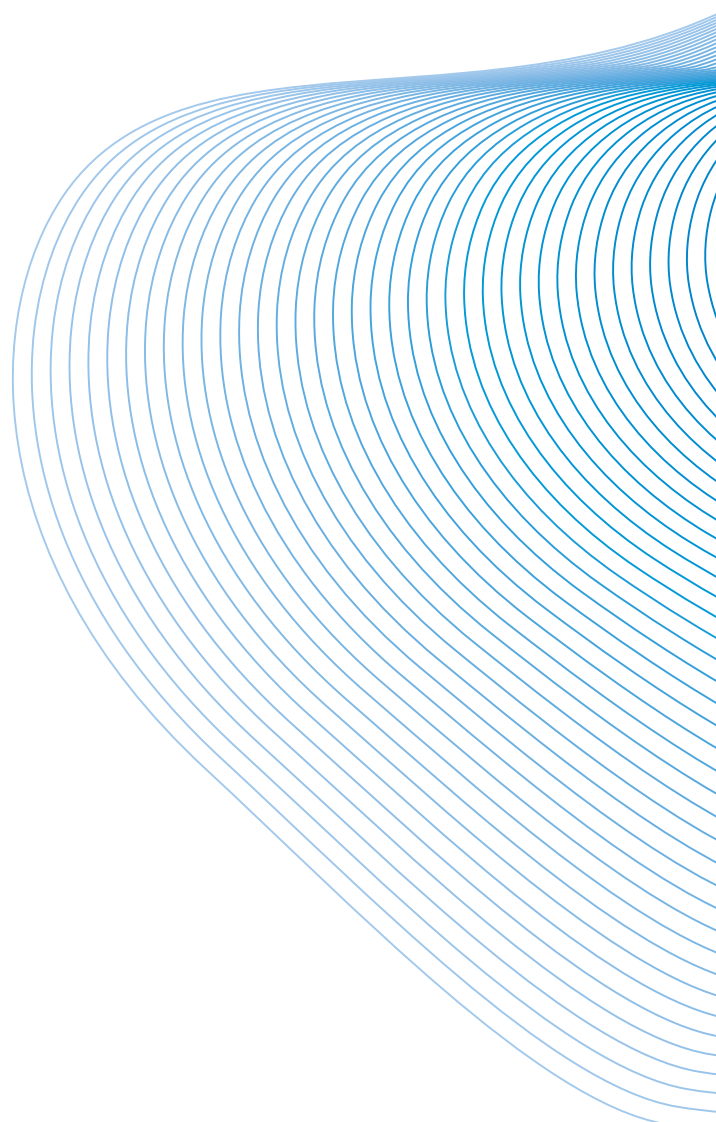


Performance of BIOTRONIK ICDs

4.1 Single-Chamber ICDs

4.2 Dual-Chamber ICDs

4.3 CRT ICDs

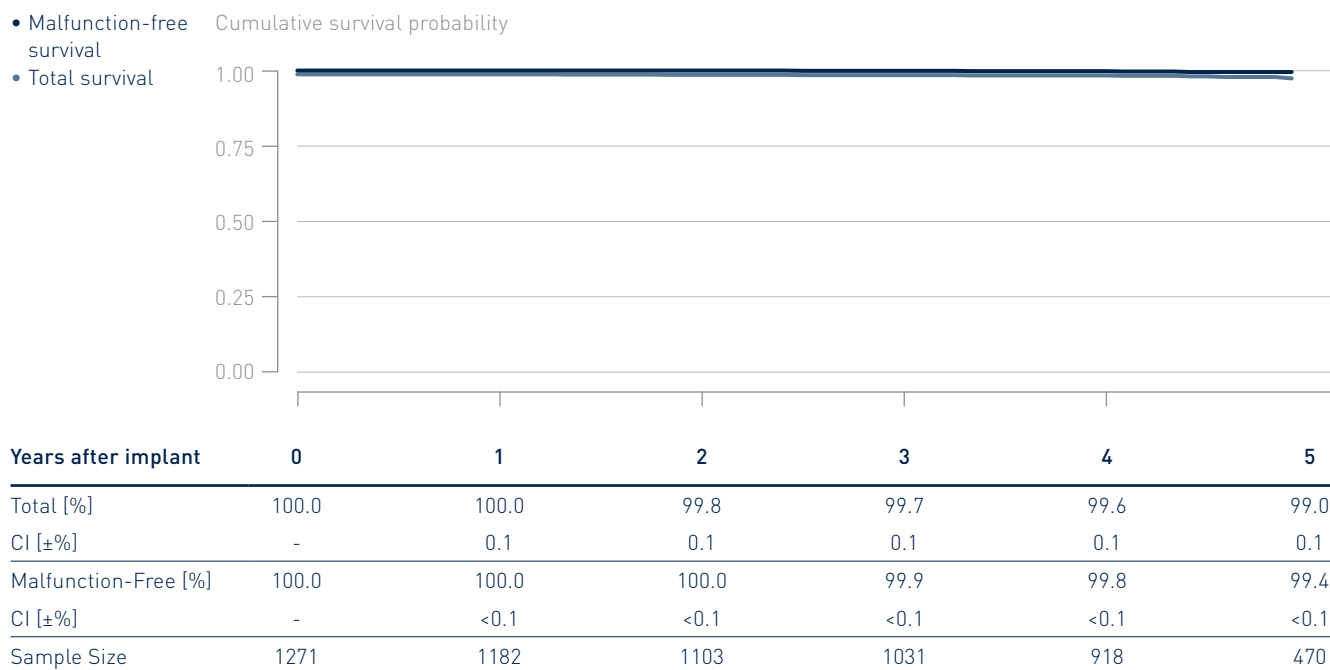


4.1 Single-Chamber ICDs

Ilesto 7

Product Versions	VR-T
NBG Codes	VVE-VVIR
Maximum Energy J	40
US Market Release	Sep 2013
CE Market Release	Jun 2013
Worldwide Distributed Devices	2470
Registered U.S. Implants	1271
Estimated Active U.S. Implants	926
U.S. Normal Battery Depletions	5

	Quantity	Rate
U.S. Confirmed Malfunctions	5	0.39%
Therapy Compromised	3	0.24%
Therapy Available	2	0.16%

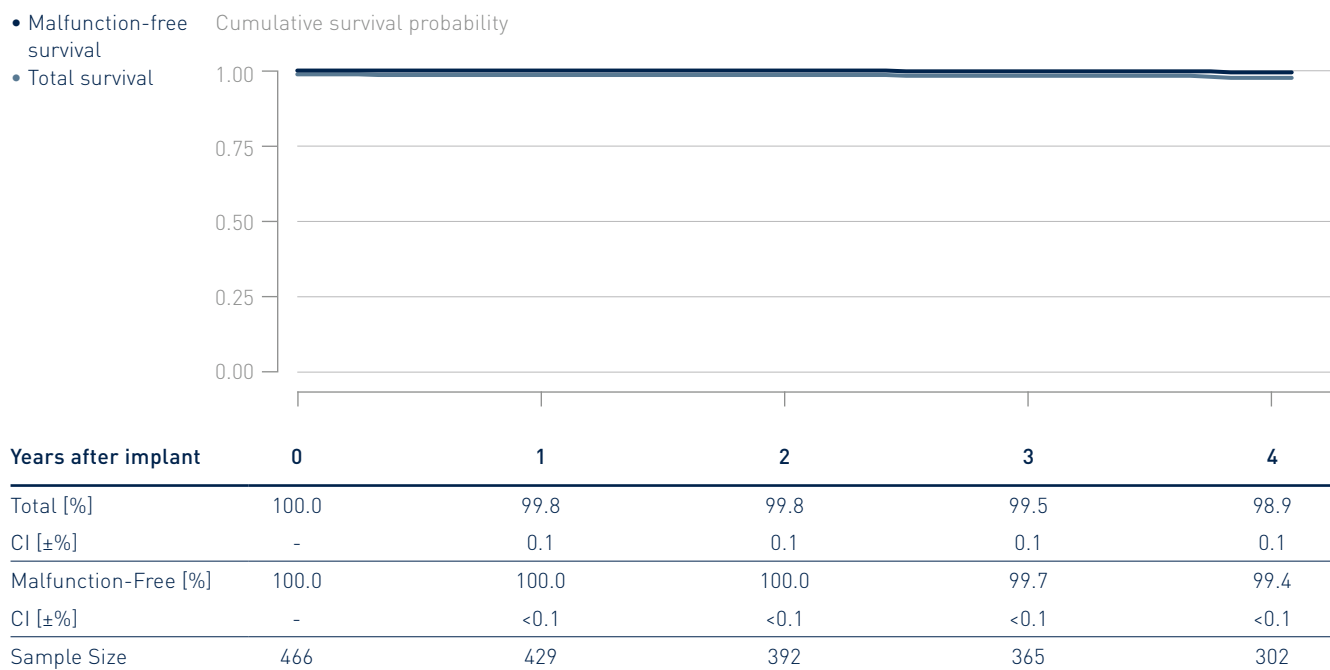


4.1 Single-Chamber ICDs

Ilesto 7 DF4

Product Versions _____	VR-T
NBG Codes _____	VVE-VVIR
Maximum Energy J _____	40
US Market Release _____	Sep 2013
CE Market Release _____	Jun 2013
Worldwide Distributed Devices _____	2400
Registered U.S. Implants _____	466
Estimated Active U.S. Implants _____	329
U.S. Normal Battery Depletions _____	2

	Quantity	Rate
U.S. Confirmed Malfunctions _____	2	0.43%
Therapy Compromised _____	2	0.43%
Therapy Available _____	0	0.00%

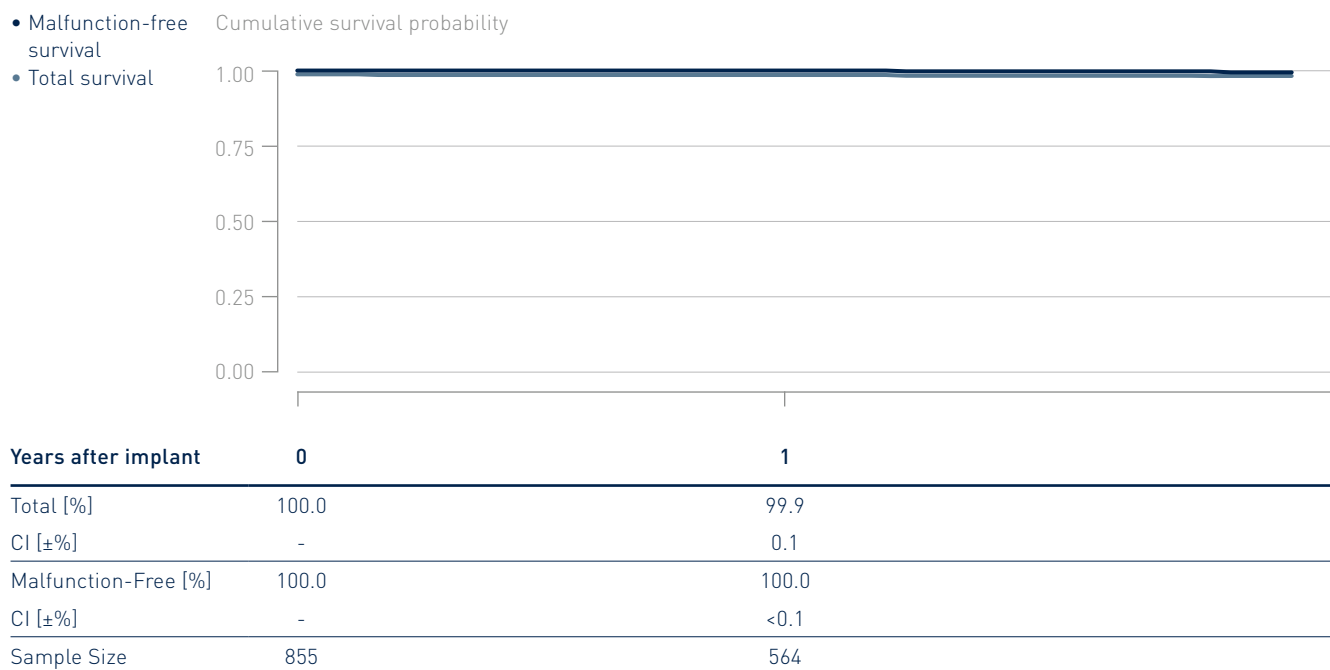


4.1 Single-Chamber ICDs

Ilivia 7 DF4

Product Versions	VR-T
NBG Codes	VVE-VVIR
Maximum Energy J	40
US Market Release	Aug 2017
CE Market Release	Mar 2017
Worldwide Distributed Devices	3 780
Registered U.S. Implants	855
Estimated Active U.S. Implants	779
U.S. Normal Battery Depletions	1

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

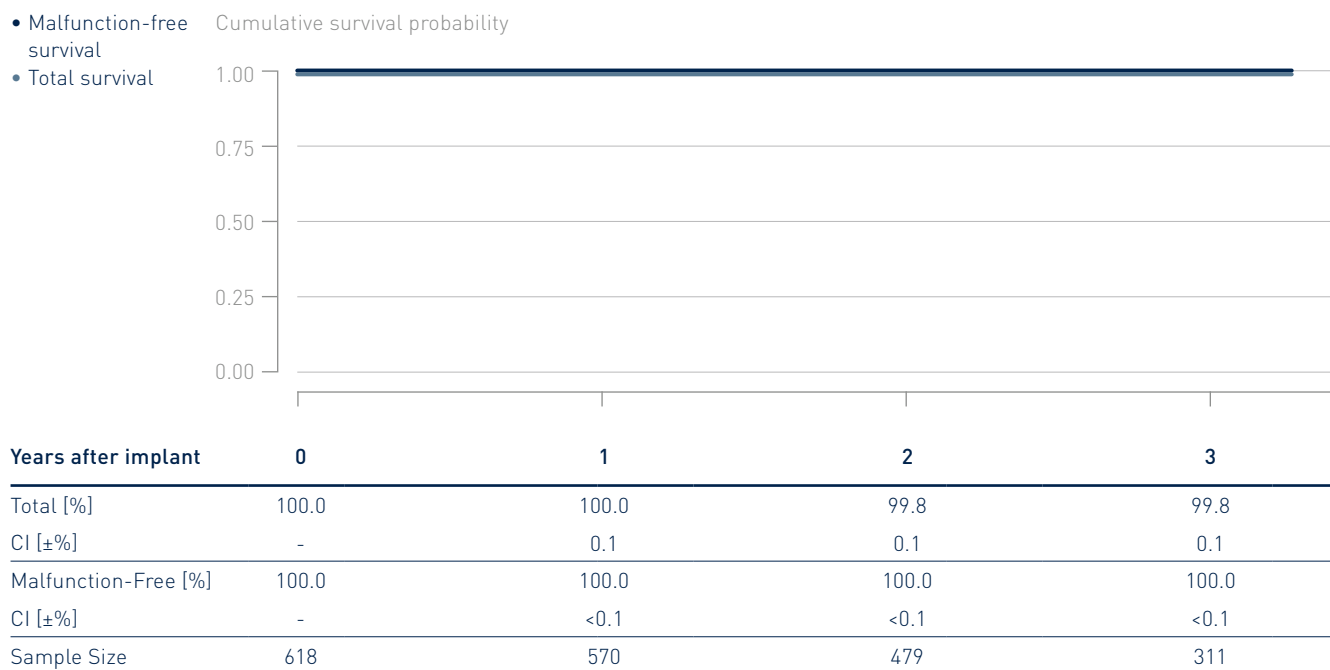


4.1 Single-Chamber ICDs

Itrevia 7

Product Versions	VR-T
NBG Codes	VVE-VVIR
Maximum Energy J	40
US Market Release	Mar 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	1280
Registered U.S. Implants	618
Estimated Active U.S. Implants	503
U.S. Normal Battery Depletions	2

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

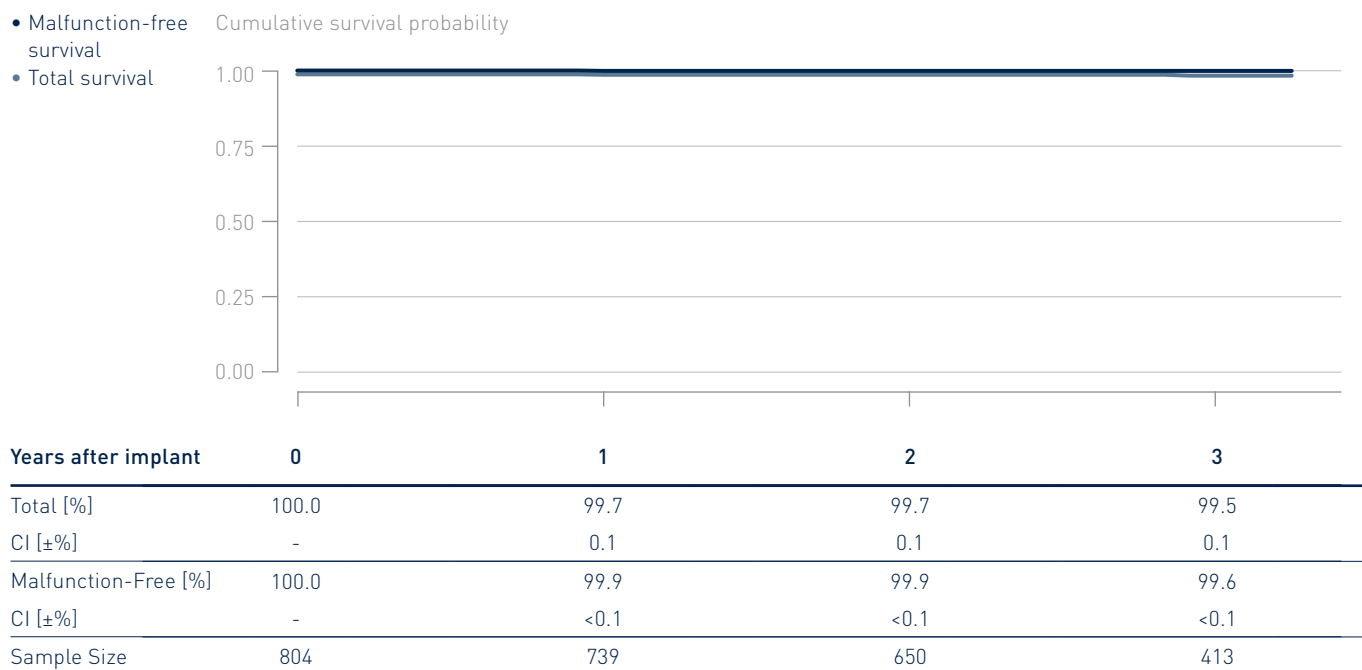


4.1 Single-Chamber ICDs

Itrevia 7 DF4

Product Versions	VR-T
NBG Codes	VVE-VVIR
Maximum Energy J	40
US Market Release	Mar 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	1 420
Registered U.S. Implants	804
Estimated Active U.S. Implants	641
U.S. Normal Battery Depletions	1

	Quantity	Rate
U.S. Confirmed Malfunctions	3	0.37%
Therapy Compromised	2	0.25%
Therapy Available	1	0.12%



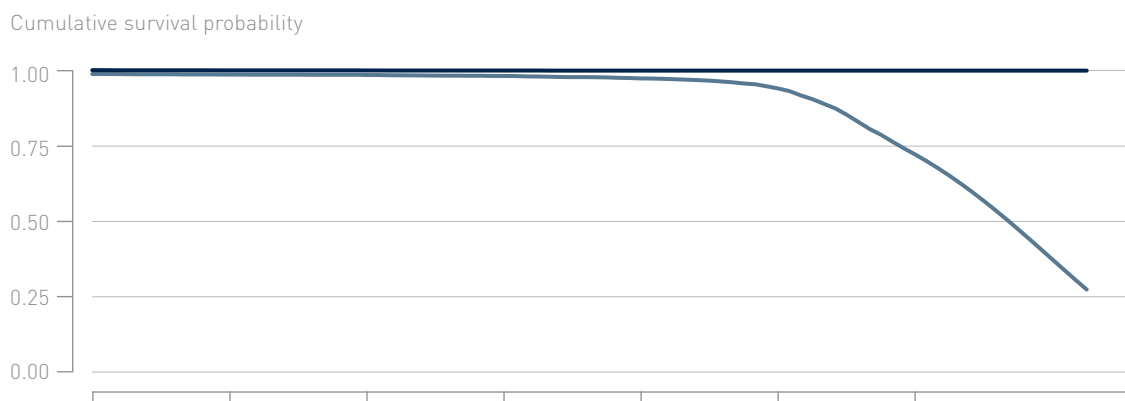
4.1 Single-Chamber ICDs

Lumax 340

Product Versions	VR, VR-T
NBG Codes	VVE-VVIR
Maximum Energy J	40
US Market Release	Feb 2007
CE Market Release	Feb 2007
Worldwide Distributed Devices	27 100
Registered U.S. Implants	3 985
Estimated Active U.S. Implants	977
U.S. Normal Battery Depletions	924

	Quantity	Rate
U.S. Confirmed Malfunctions	6	0.15%
Therapy Compromised	4	0.10%
Therapy Available	2	0.05%

- Malfunction-free survival
- Total survival



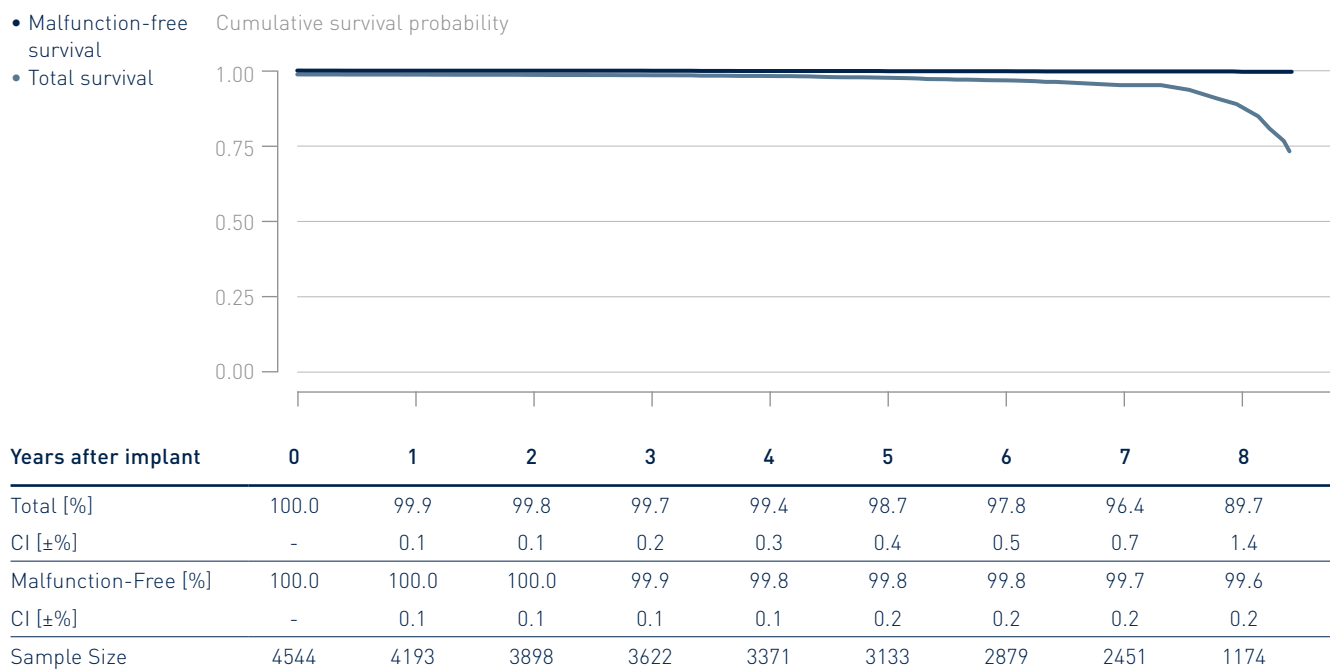
Years after implant	0	1	2	3	4	5	6	7
Total [%]	100.0	99.8	99.7	99.3	98.3	94.7	68.3	28.3
CI [±%]	-	0.1	0.2	0.3	0.4	0.8	1.9	3.3
Malfunction-Free [%]	100.0	99.9	99.9	99.9	99.8	99.8	99.8	99.8
CI [±%]	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sample Size	3985	3616	3393	3155	2908	2550	1512	368

4.1 Single-Chamber ICDs

Lumax 540

Product Versions	VR-T
NBG Codes	VVE-VVIR
Maximum Energy J	40
US Market Release	May 2009
CE Market Release	Jun 2008
Worldwide Distributed Devices	20 000
Registered U.S. Implants	4 544
Estimated Active U.S. Implants	2 100
U.S. Normal Battery Depletions	435

	Quantity	Rate
U.S. Confirmed Malfunctions	11	0.24%
Therapy Compromised	7	0.15%
Therapy Available	4	0.09%



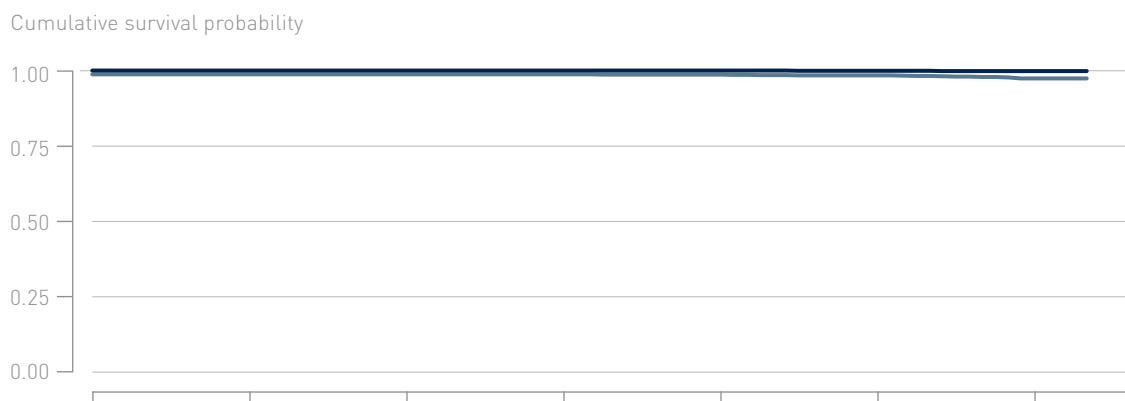
4.1 Single-Chamber ICDs

Lumax 740

Product Versions	VR-T
NBG Codes	VVE-VVIR
Maximum Energy J	40
US Market Release	Sep 2012
CE Market Release	Apr 2012
Worldwide Distributed Devices	4810
Registered U.S. Implants	1574
Estimated Active U.S. Implants	987
U.S. Normal Battery Depletions	20

	Quantity	Rate
U.S. Confirmed Malfunctions	2	0.13%
Therapy Compromised	2	0.13%
Therapy Available	0	0.00%

- Malfunction-free survival
- Total survival



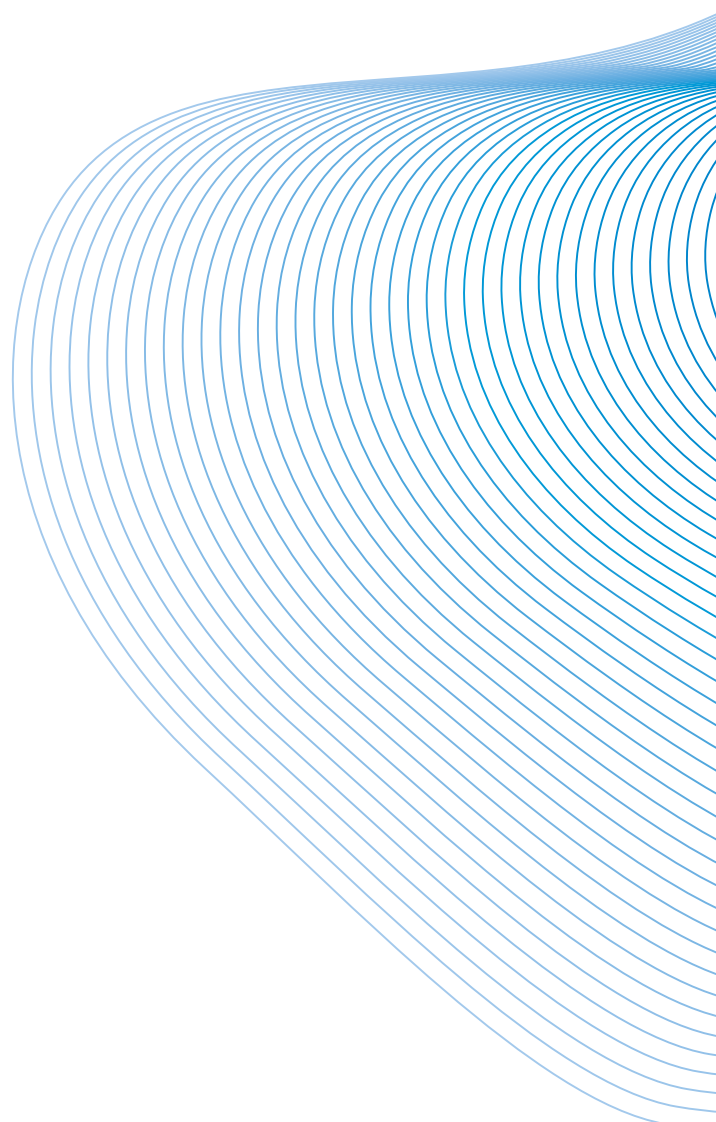
Years after implant	0	1	2	3	4	5	6
Total [%]	100.0	100.0	100.0	99.9	99.8	99.6	98.4
CI [±%]	-	<0.1	<0.1	0.2	0.2	0.4	0.8
Malfunction-Free [%]	100.0	100.0	100.0	100.0	100.0	99.9	99.8
CI [±%]	-	<0.1	<0.1	<0.1	<0.1	0.2	0.3
Sample Size	1574	1447	1348	1255	1161	1079	849

Performance of BIOTRONIK ICDs

4.1 Single-Chamber ICDs

4.2 Dual-Chamber ICDs

4.3 CRT ICDs

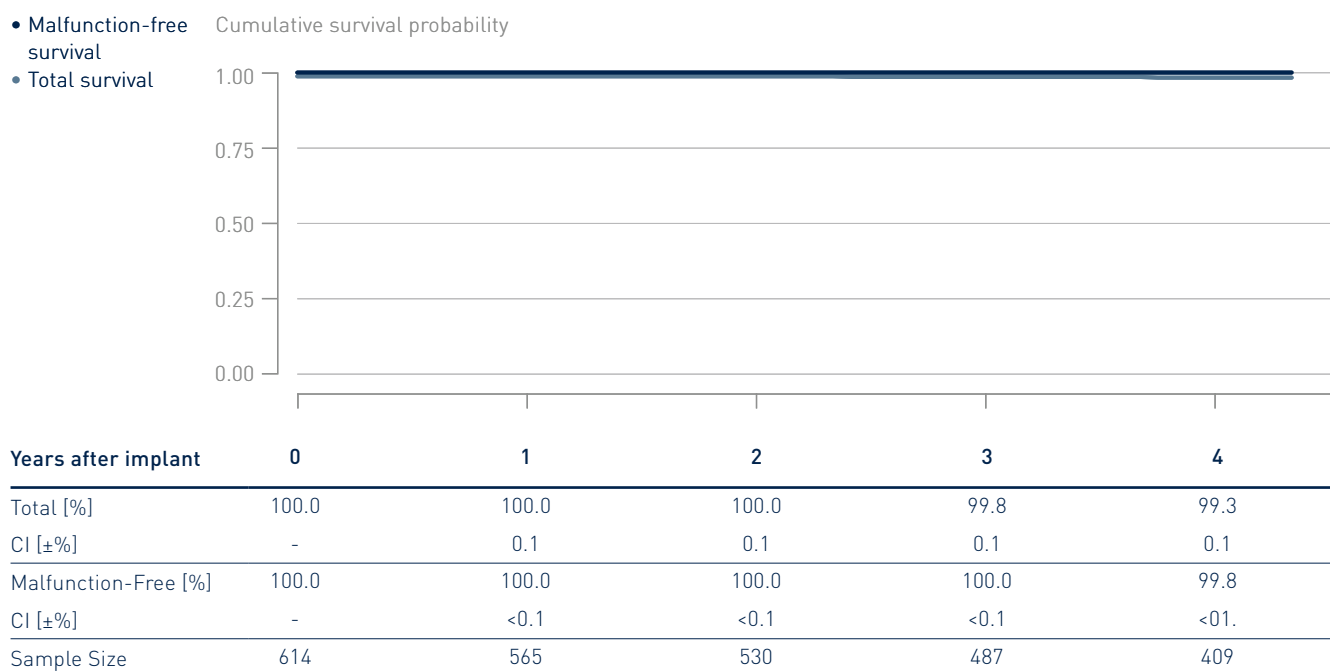


4.2 Dual-Chamber ICDs

Iforia 7

Product Versions	DR-T
NBG Codes	WE-VDDR
Maximum Energy J	40
US Market Release	Sep 2013
CE Market Release	Jun 2013
Worldwide Distributed Devices	1370
Registered U.S. Implants	614
Estimated Active U.S. Implants	446
U.S. Normal Battery Depletions	3

	Quantity	Rate
U.S. Confirmed Malfunctions	2	0.33%
Therapy Compromised	2	0.33%
Therapy Available	0	0.00%

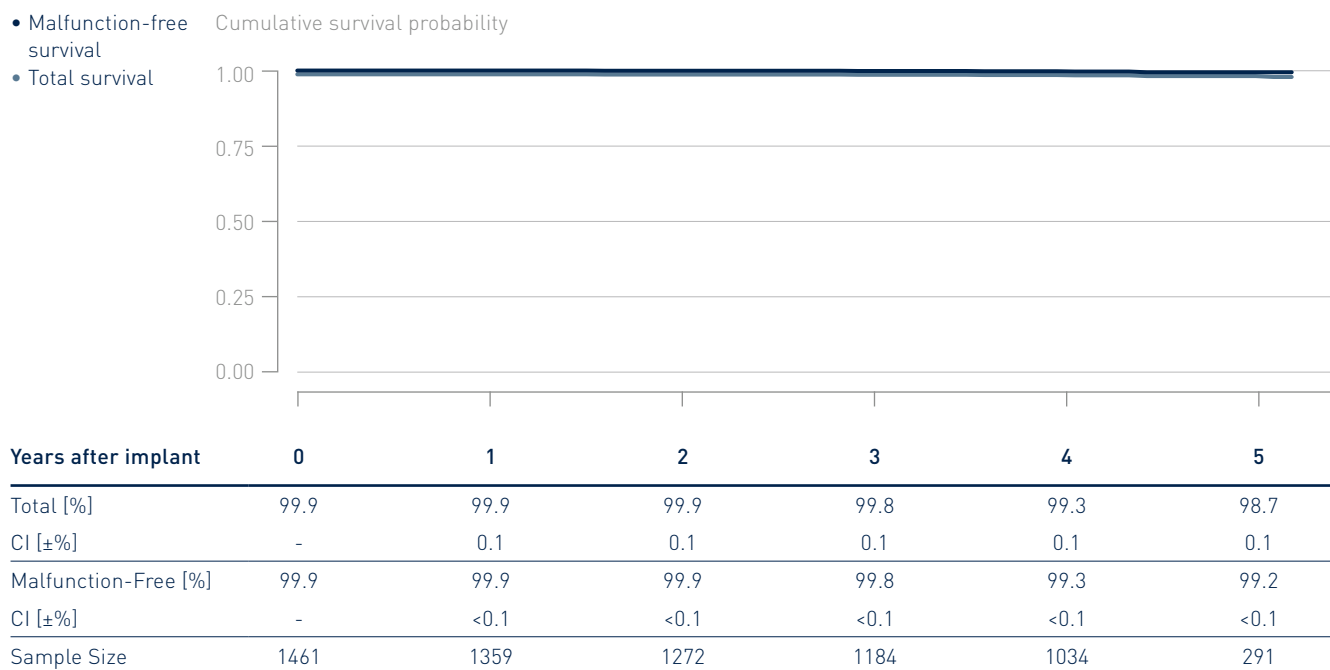


4.2 Dual-Chamber ICDs

Iforia 7 DX

Product Versions	VR-T
NBG Codes	WE-VDDR
Maximum Energy J	40
US Market Release	Sep 2013
CE Market Release	Jun 2013
Worldwide Distributed Devices	3370
Registered U.S. Implants	1461
Estimated Active U.S. Implants	1050
U.S. Normal Battery Depletions	2

	Quantity	Rate
U.S. Confirmed Malfunctions	9	0.62%
Therapy Compromised	6	0.41%
Therapy Available	3	0.21%



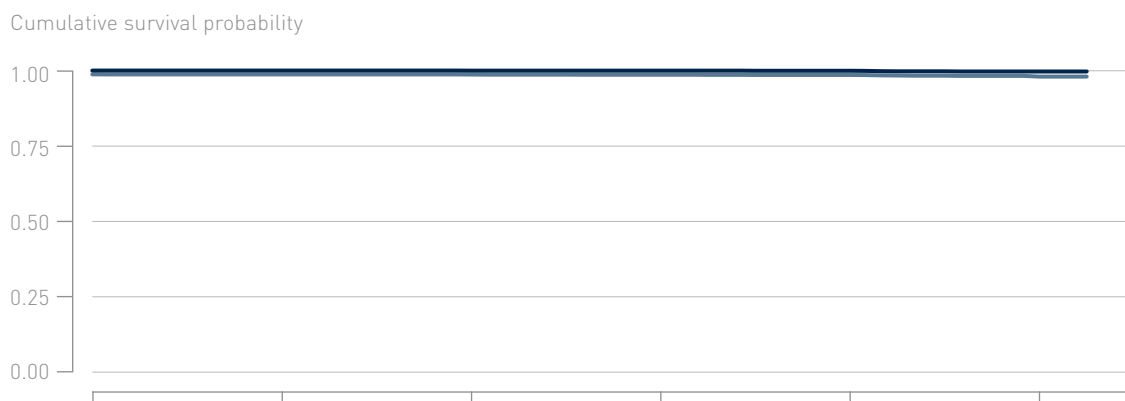
4.2 Dual-Chamber ICDs

Ilesto 7

Product Versions _____	DR-T
NBG Codes _____	WE-DDDR
Maximum Energy J _____	40
US Market Release _____	Sep 2013
CE Market Release _____	Jun 2013
Worldwide Distributed Devices _____	5 110
Registered U.S. Implants _____	3486
Estimated Active U.S. Implants _____	2430
U.S. Normal Battery Depletions _____	26

	Quantity	Rate
U.S. Confirmed Malfunctions _____	11	0.32%
Therapy Compromised _____	6	0.17%
Therapy Available _____	5	0.14%

- Malfunction-free survival
- Total survival



Years after implant	0	1	2	3	4	5
Total [%]	100.0	99.9	99.9	99.8	99.6	99.1
CI [±%]	-	0.1	0.1	0.1	0.1	0.1
Malfunction-Free [%]	100.0	100.0	100.0	100.0	99.9	99.5
CI [±%]	-	<0.1	<0.1	<0.1	<0.1	<0.1
Sample Size	3486	3219	2997	2787	2461	1521

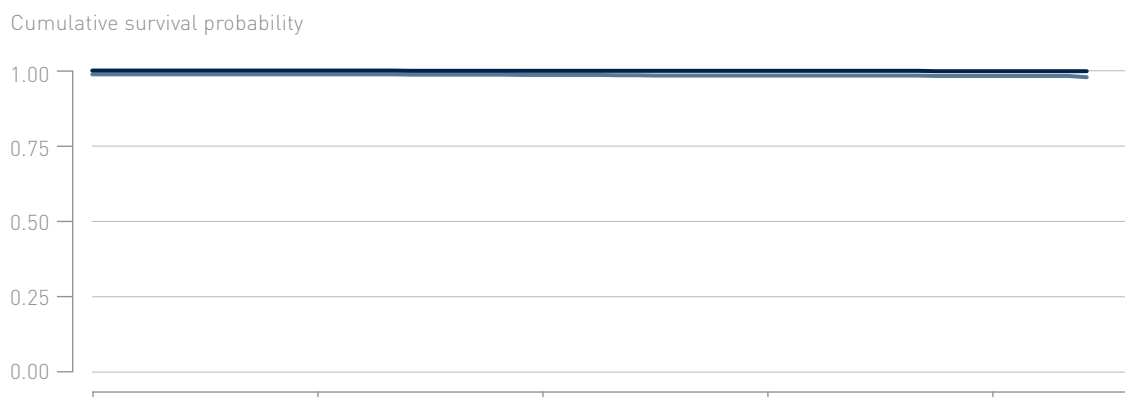
4.2 Dual-Chamber ICDs

Ilesto 7 DF4

Product Versions	DR-T
NBG Codes	WE-DDDR
Maximum Energy J	40
US Market Release	Jul 2014
CE Market Release	Jul 2013
Worldwide Distributed Devices	3730
Registered U.S. Implants	1147
Estimated Active U.S. Implants	840
U.S. Normal Battery Depletions	6

	Quantity	Rate
U.S. Confirmed Malfunctions	2	0.17%
Therapy Compromised	0	0.00%
Therapy Available	2	0.17%

- Malfunction-free survival
- Total survival



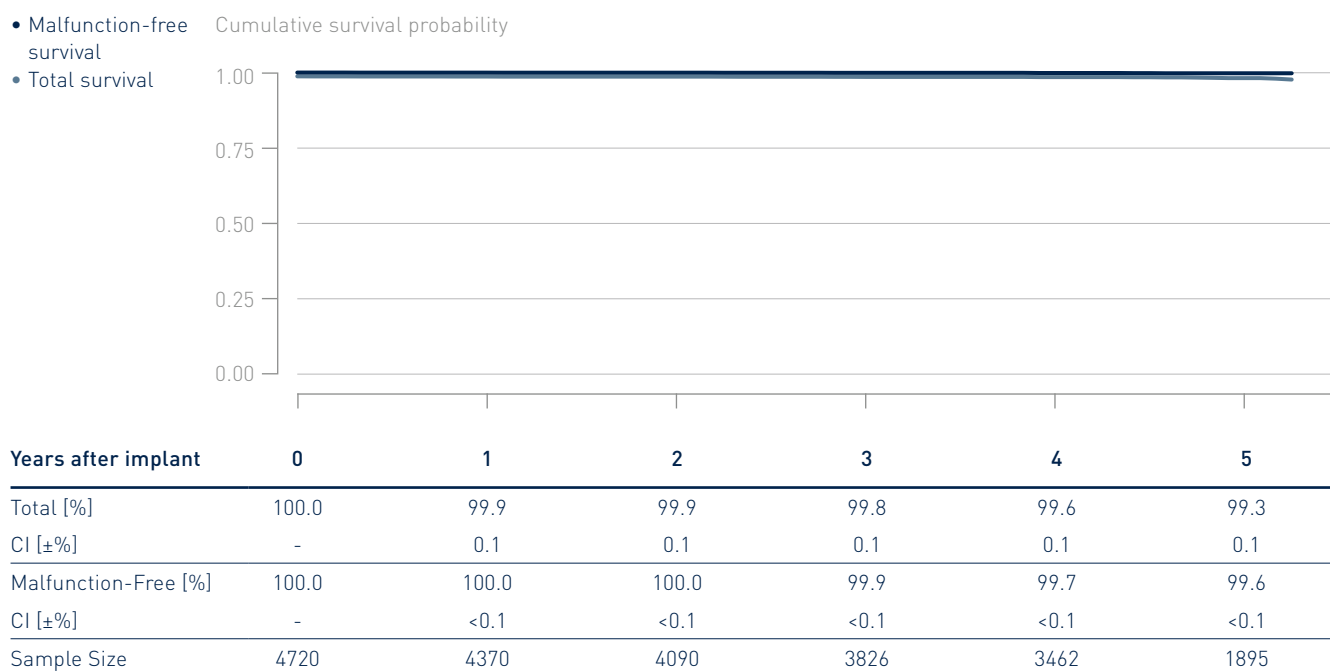
Years after implant	0	1	2	3	4
Total [%]	100.0	100.0	99.8	99.6	99.5
CI [±%]	-	0.1	0.1	0.1	0.1
Malfunction-Free [%]	100.0	100.0	99.9	99.9	99.8
CI [±%]	-	<0.1	<0.1	<0.1	<0.1
Sample Size	1147	1060	984	913	803

4.2 Dual-Chamber ICDs

Ilesto 7 DX

Product Versions	VR-T
NBG Codes	WE-VDDR
Maximum Energy J	40
US Market Release	Sep 2013
CE Market Release	Jun 2013
Worldwide Distributed Devices	6 600
Registered U.S. Implants	4 720
Estimated Active U.S. Implants	3 340
U.S. Normal Battery Depletions	21

	Quantity	Rate
U.S. Confirmed Malfunctions	17	0.36%
Therapy Compromised	10	0.21%
Therapy Available	7	0.15%

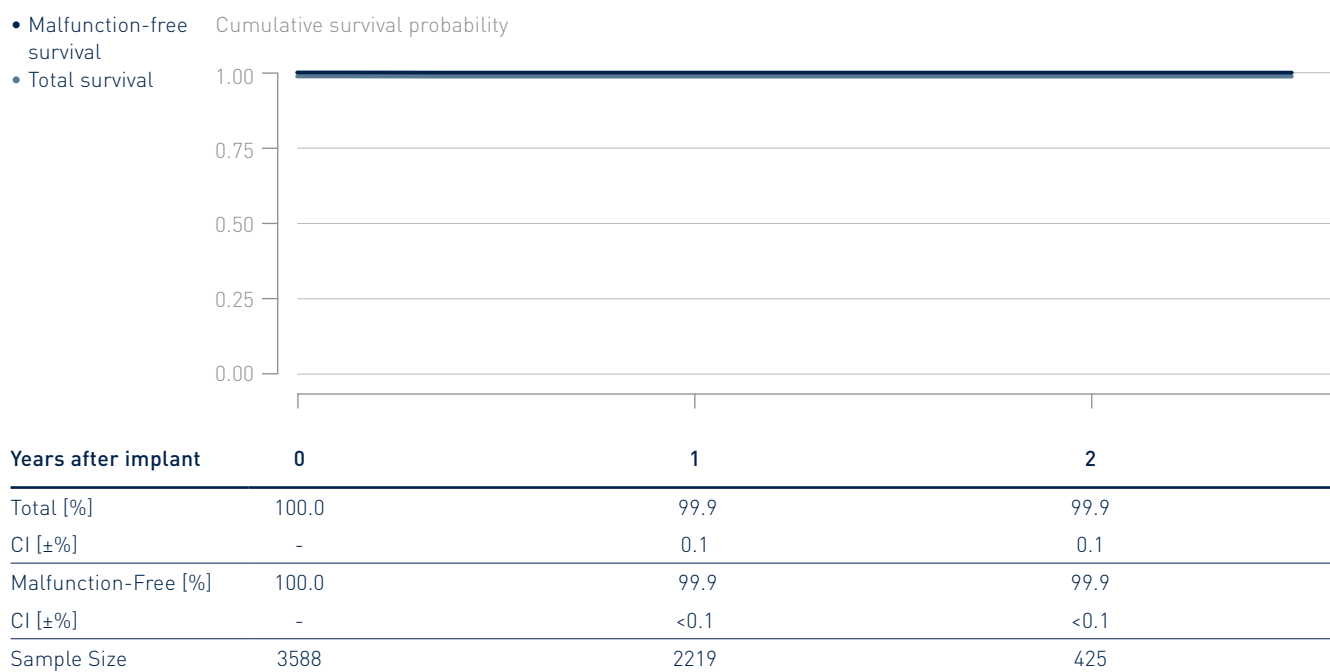


4.2 Dual-Chamber ICDs

Ilivia 7 DF4

Product Versions	DR-T
NBG Codes	WE-DDDR
Maximum Energy J	40
US Market Release	May 2017
CE Market Release	Aug 2016
Worldwide Distributed Devices	7710
Registered U.S. Implants	3588
Estimated Active U.S. Implants	3290
U.S. Normal Battery Depletions	0

	Quantity	Rate
U.S. Confirmed Malfunctions	3	0.08%
Therapy Compromised	3	0.08%
Therapy Available	0	0.00%

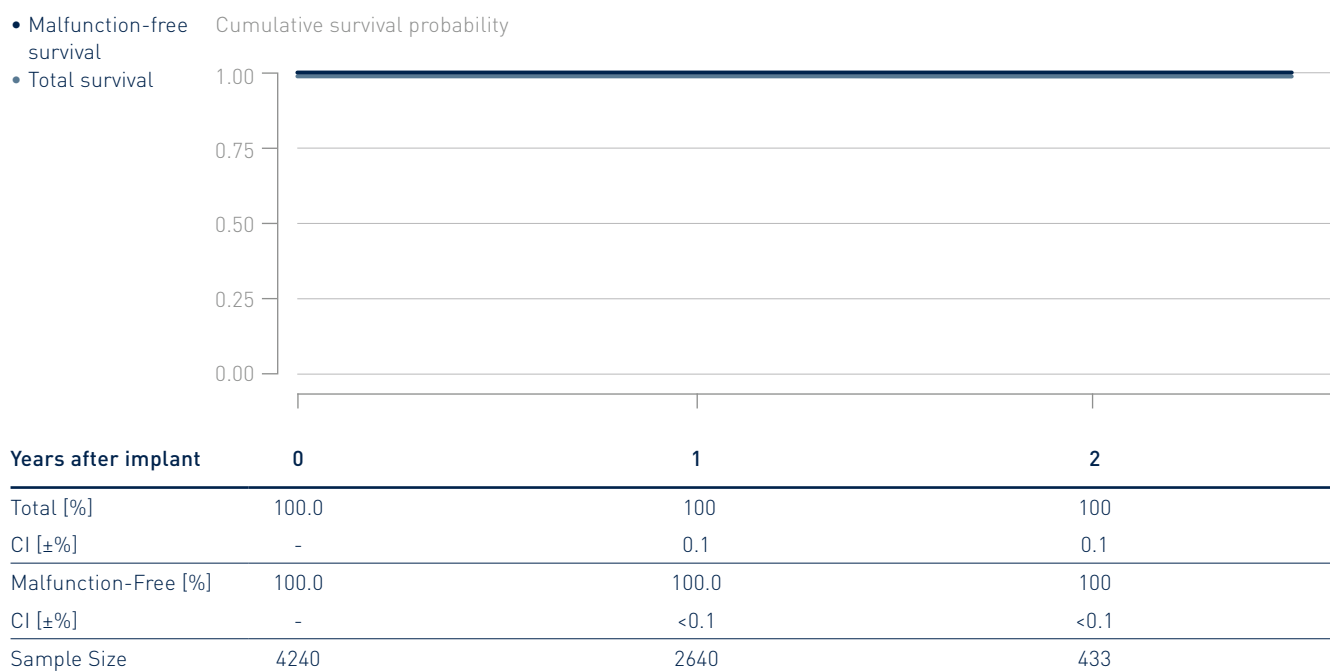


4.2 Dual-Chamber ICDs

Intica 7 DX

Product Versions	VR-T
NBG Codes	WE-DDDR
Maximum Energy J	40
US Market Release	May 2017
CE Market Release	Sep 2016
Worldwide Distributed Devices	6 180
Registered U.S. Implants	4 240
Estimated Active U.S. Implants	3 860
U.S. Normal Battery Depletions	1

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

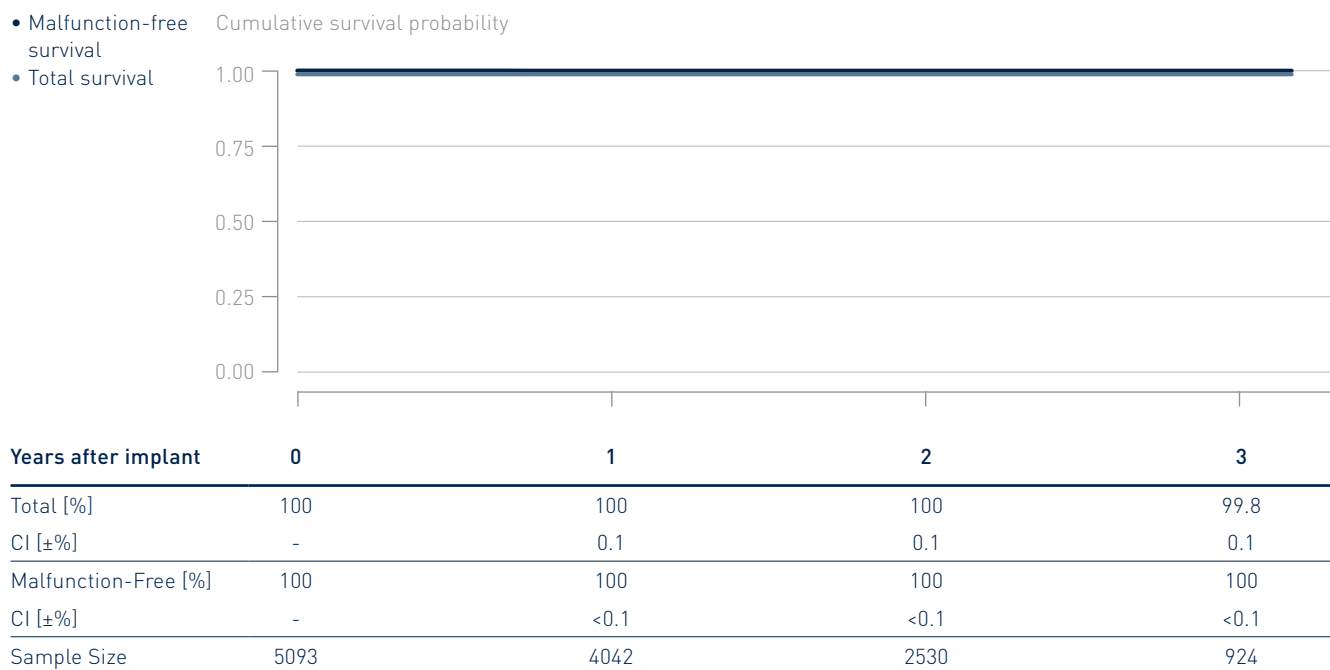


4.2 Dual-Chamber ICDs

Inventra 7 DX

Product Versions	VR-T
NBG Codes	VVE-VDDR
Maximum Energy J	45
US Market Release	Mar 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	5550
Registered U.S. Implants	5093
Estimated Active U.S. Implants	4280
U.S. Normal Battery Depletions	3

	Quantity	Rate
U.S. Confirmed Malfunctions	2	0.04%
Therapy Compromised	2	0.04%
Therapy Available	0	0.00%



4.2 Dual-Chamber ICDs

Iperia 7

Product Versions	DR-T
NBG Codes	VDE-DDDR
Maximum Energy J	40
US Market Release	Dec 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	2700
Registered U.S. Implants	1955
Estimated Active U.S. Implants	1720
U.S. Normal Battery Depletions	1

	Quantity	Rate
U.S. Confirmed Malfunctions	2	0.10%
Therapy Compromised	2	0.10%
Therapy Available	0	0.00%

- Malfunction-free survival
- Total survival



Years after implant	0	1	2
Total [%]	100	99.9	99.9
CI [±%]	-	0.1	0.1
Malfunction-Free [%]	100	99.9	99.9
CI [±%]	-	<0.1	<0.1
Sample Size	1955	1568	600

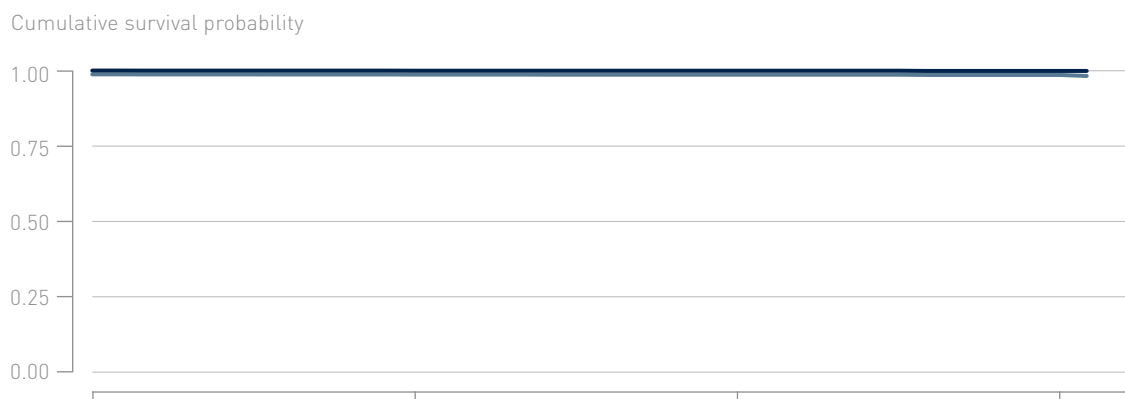
4.2 Dual-Chamber ICDs

Iperia 7 DF4

Product Versions	DR-T
NBG Codes	WE-DDDR
Maximum Energy J	40
US Market Release	Dec 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	7480
Registered U.S. Implants	4091
Estimated Active U.S. Implants	3370
U.S. Normal Battery Depletions	4

	Quantity	Rate
U.S. Confirmed Malfunctions	3	0.07%
Therapy Compromised	1	0.02%
Therapy Available	2	0.05%

- Malfunction-free survival
- Total survival



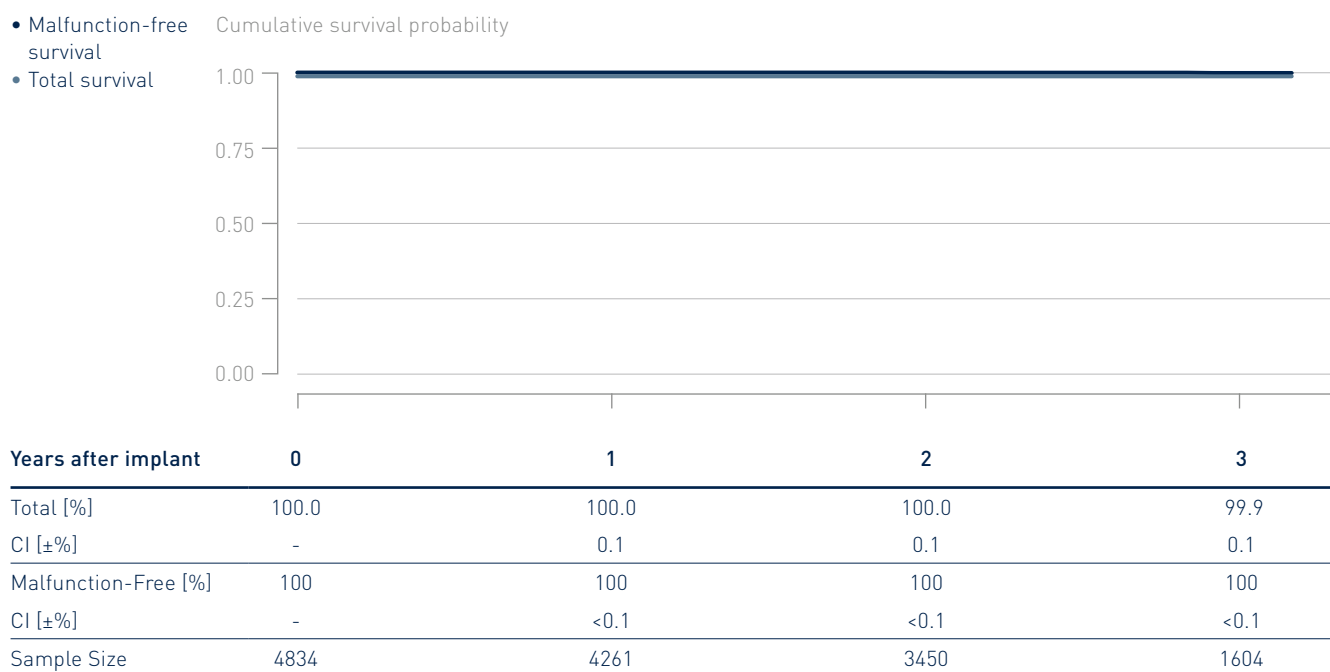
Years after implant	0	1	2	3
Total [%]	100.0	99.9	99.9	99.8
CI [±%]	-	0.1	0.1	0.1
Malfunction-Free [%]	100.0	99.9	99.9	99.9
CI [±%]	-	<0.1	<0.1	<0.1
Sample Size	4091	3530	2764	1196

4.2 Dual-Chamber ICDs

Iperia 7 DX

Product Versions	VR-T
NBG Codes	VVE-VDDR
Maximum Energy J	40
US Market Release	Dec 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	6 540
Registered U.S. Implants	4 834
Estimated Active U.S. Implants	3 990
U.S. Normal Battery Depletions	3

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%



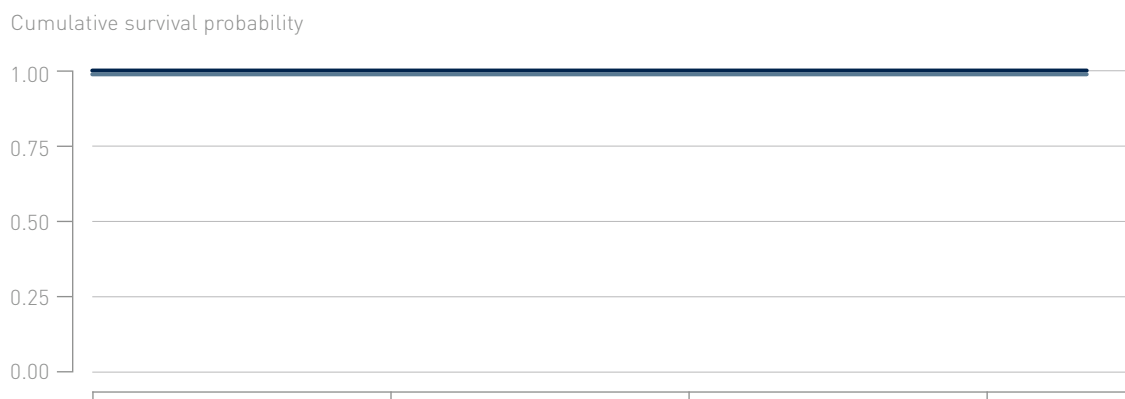
4.2 Dual-Chamber ICDs

Itrevia 7

Product Versions	DR-T
NBG Codes	WE-DDDR
Maximum Energy J	40
US Market Release	Mar 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	2 170
Registered U.S. Implants	1 416
Estimated Active U.S. Implants	1 160
U.S. Normal Battery Depletions	0

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.07%
Therapy Compromised	1	0.07%
Therapy Available	0	0.00%

- Malfunction-free survival
- Total survival



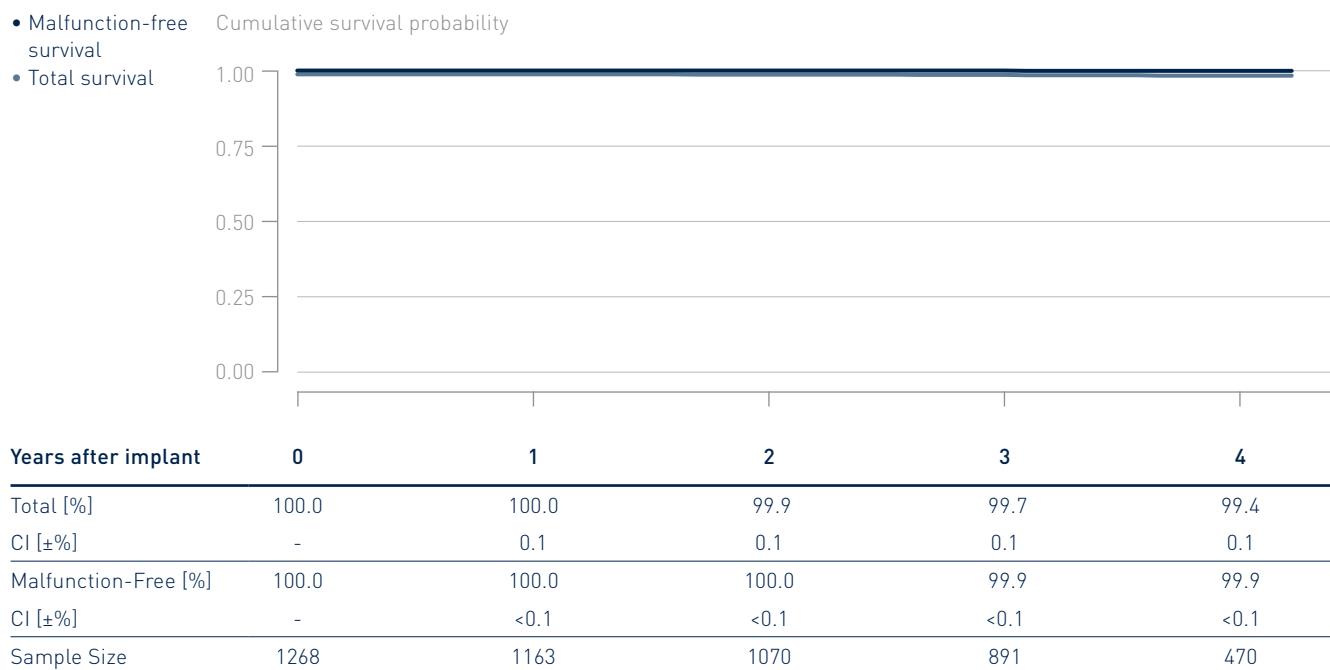
Years after implant	0	1	2	3
Total [%]	100	100	100	100
CI [±%]	-	0.1	0.1	0.1
Malfunction-Free [%]	100	100	100	100
CI [±%]	-	<0.1	<0.1	<0.1
Sample Size	1416	1297	982	549

4.2 Dual-Chamber ICDs

Itrevia 7 DF4

Product Versions	DR-T
NBG Codes	WE-DDDR
Maximum Energy J	40
US Market Release	Mar 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	2330
Registered U.S. Implants	1268
Estimated Active U.S. Implants	954
U.S. Normal Battery Depletions	5

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.08%
Therapy Compromised	1	0.08%
Therapy Available	0	0.00%

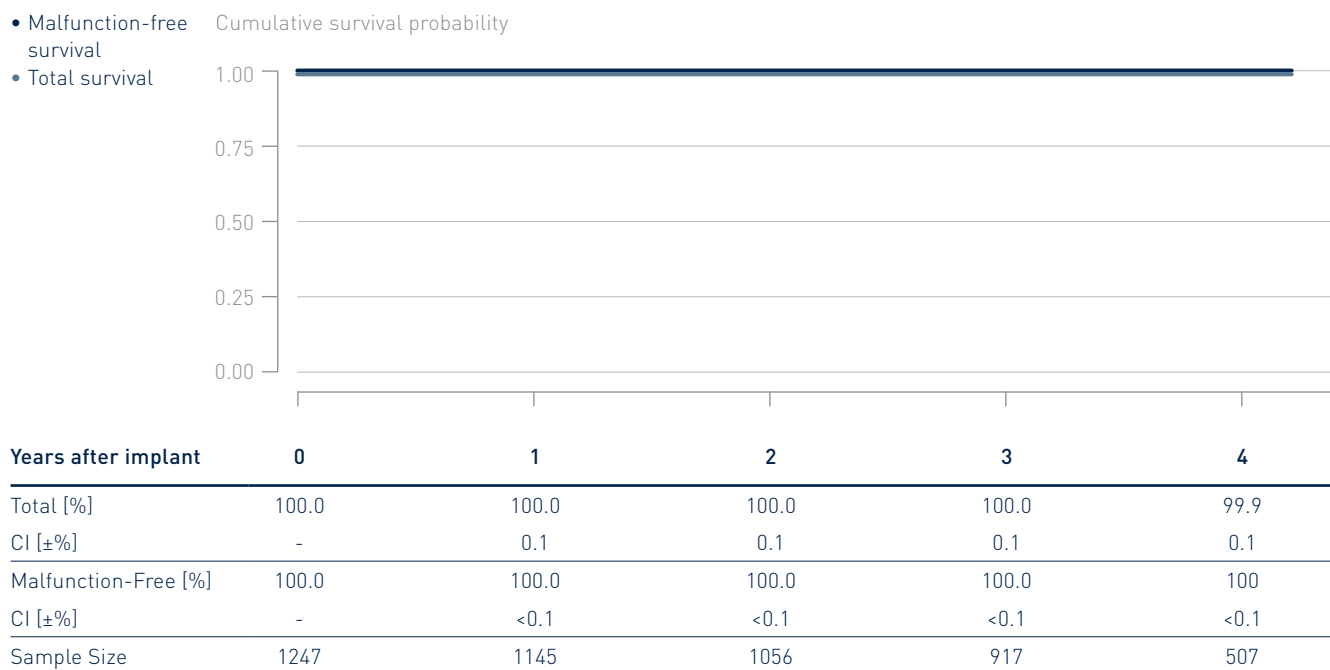


4.2 Dual-Chamber ICDs

Itrevia 7 DX

Product Versions	VR-T
NBG Codes	WE-VDDR
Maximum Energy J	40
US Market Release	Mar 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	2750
Registered U.S. Implants	1247
Estimated Active U.S. Implants	981
U.S. Normal Battery Depletions	1

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

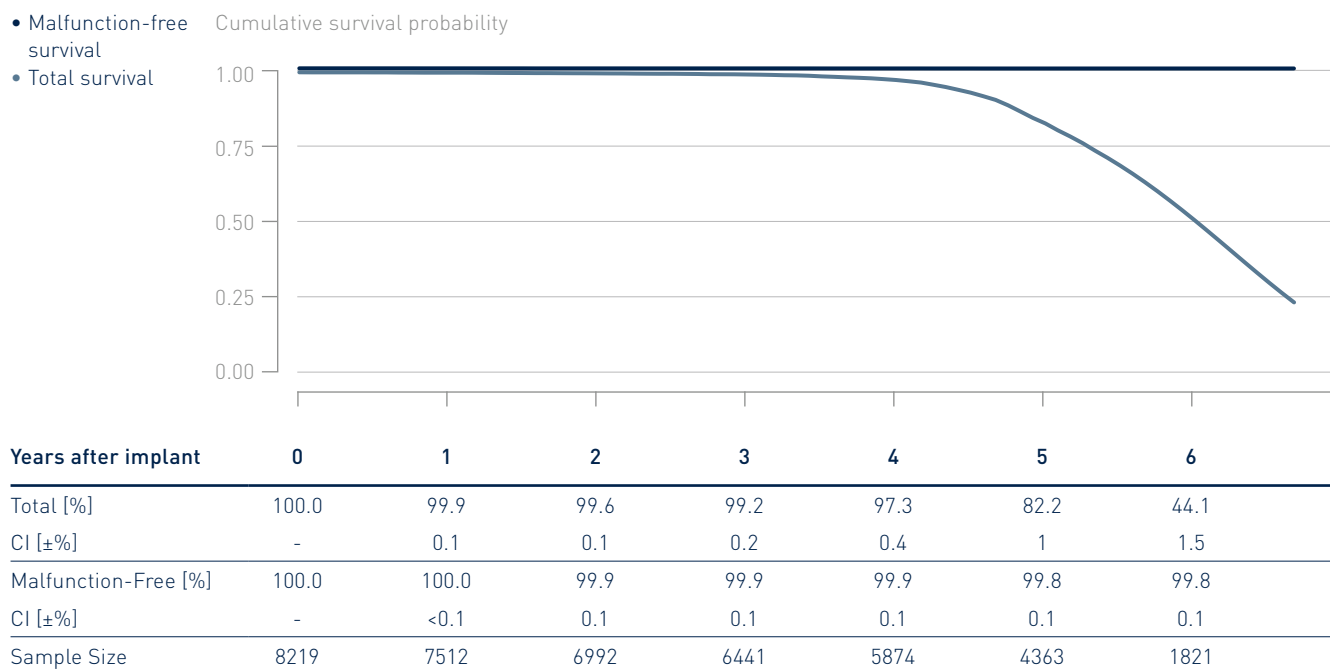


4.2 Dual-Chamber ICDs

Lumax 340

Product Versions	DR, DR-T
NBG Codes	VVE-DDDR
Maximum Energy J	40
US Market Release	Feb 2007
CE Market Release	Feb 2007
Worldwide Distributed Devices	26 400
Registered U.S. Implants	8 219
Estimated Active U.S. Implants	1 790
U.S. Normal Battery Depletions	2 148

	Quantity	Rate
U.S. Confirmed Malfunctions	10	0.12%
Therapy Compromised	8	0.10%
Therapy Available	2	0.02%

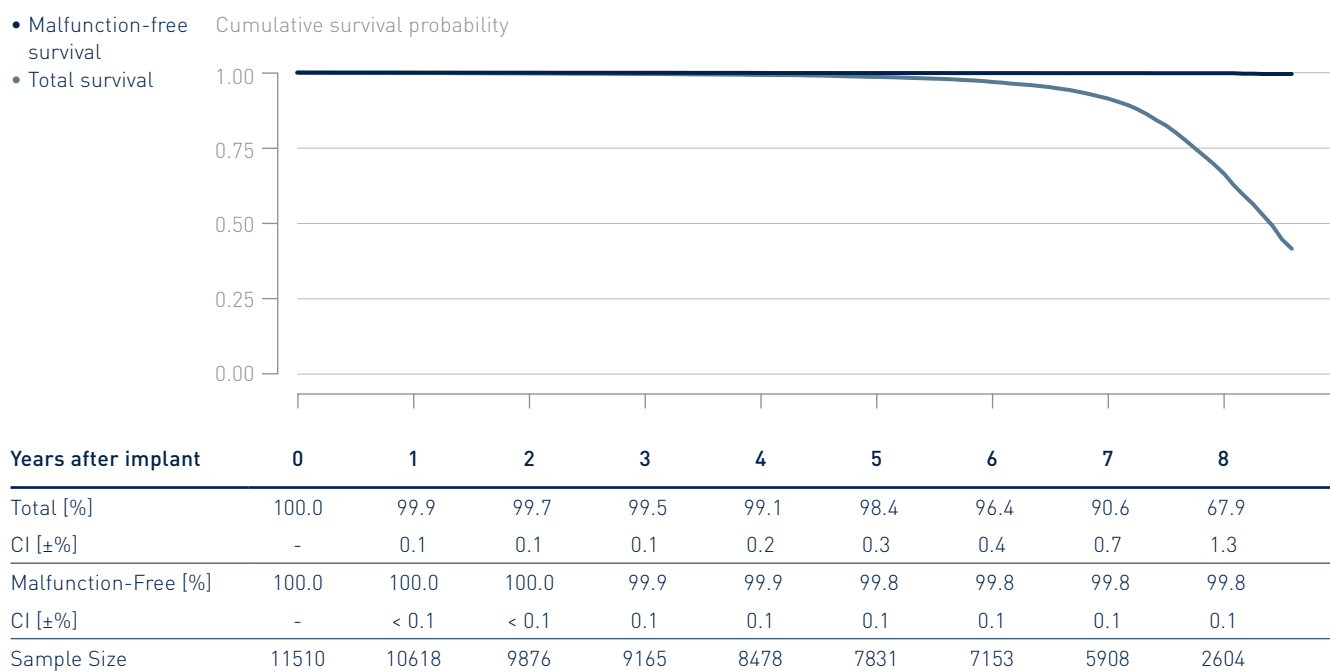


4.2 Dual-Chamber ICDs

Lumax 540

Product Versions	DR-T
NBG Codes	WE-DDDR
Maximum Energy J	40
US Market Release	May 2009
CE Market Release	Jun 2008
Worldwide Distributed Devices	26 000
Registered U.S. Implants	11 510
Estimated Active U.S. Implants	3 980
U.S. Normal Battery Depletions	2 306

	Quantity	Rate
U.S. Confirmed Malfunctions	22	0.19%
Therapy Compromised	12	0.10%
Therapy Available	10	0.09%

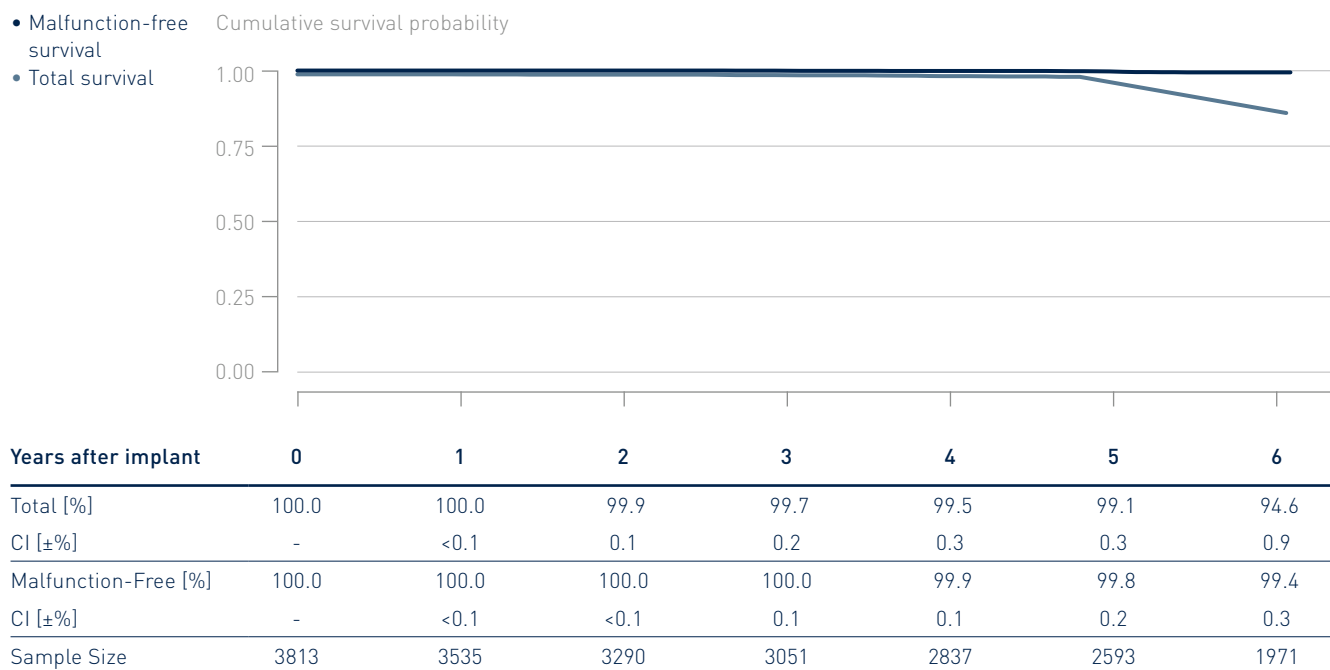


4.2 Dual-Chamber ICDs

Lumax 740

Product Versions	DR-T
NBG Codes	WE-DDDR
Maximum Energy J	40
US Market Release	Sep 2012
CE Market Release	Apr 2012
Worldwide Distributed Devices	7 990
Registered U.S. Implants	3813
Estimated Active U.S. Implants	2460
U.S. Normal Battery Depletions	46

	Quantity	Rate
U.S. Confirmed Malfunctions	16	0.42%
Therapy Compromised	7	0.18%
Therapy Available	9	0.24%

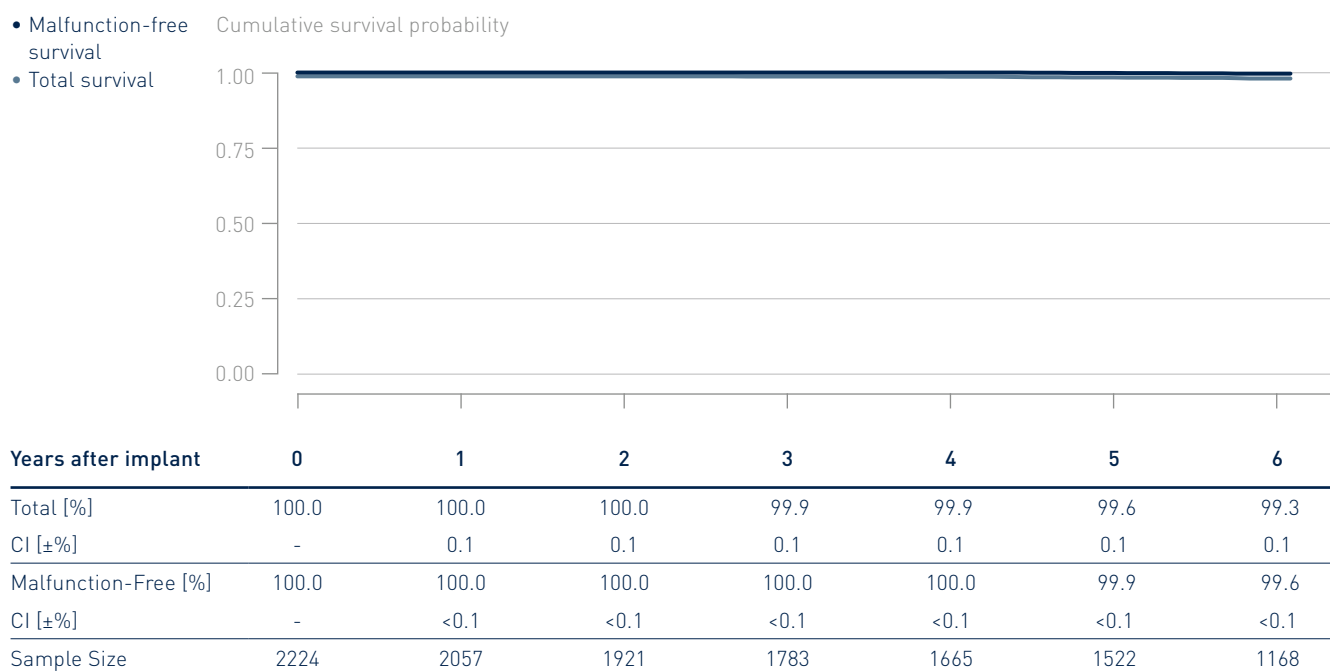


4.2 Dual-Chamber ICDs

Lumax 740 DX

Product Versions	VR-T
NBG Codes	VVE-VDDR
Maximum Energy J	40
US Market Release	May 2012
CE Market Release	Nov 2011
Worldwide Distributed Devices	4 560
Registered U.S. Implants	2 224
Estimated Active U.S. Implants	1 560
U.S. Normal Battery Depletions	8

	Quantity	Rate
U.S. Confirmed Malfunctions	6	0.27%
Therapy Compromised	3	0.13%
Therapy Available	3	0.13%

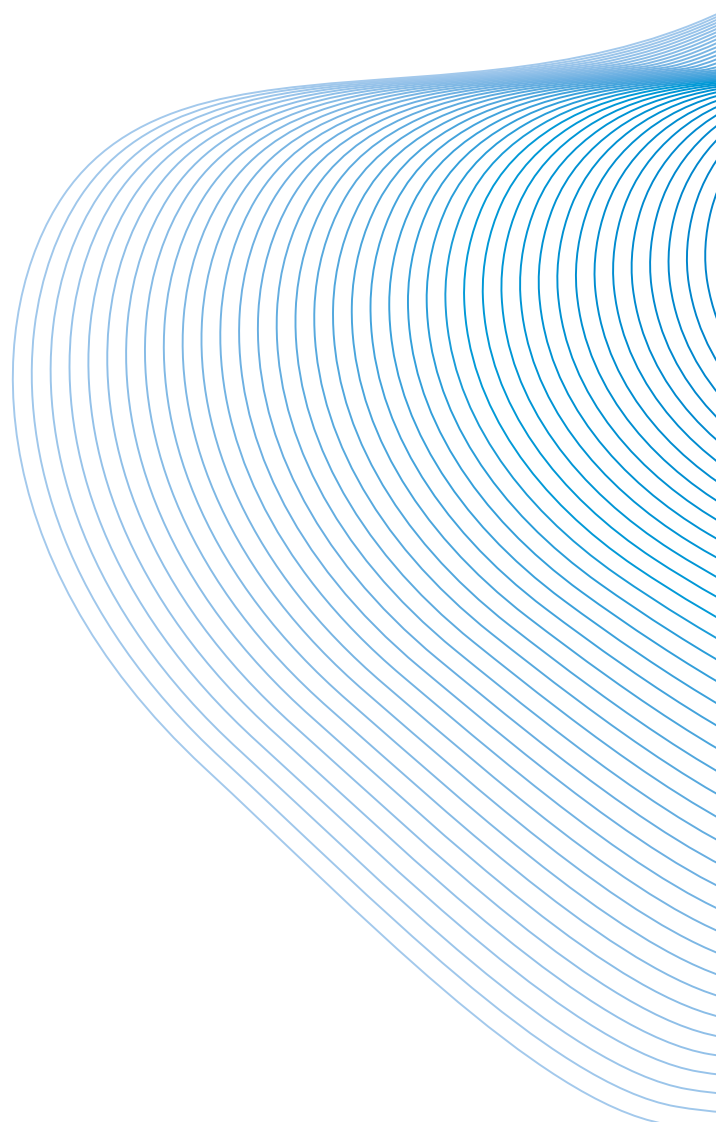


Performance of BIOTRONIK ICDs

4.1 Single-Chamber ICDs

4.2 Dual-Chamber ICDs

4.3 CRT ICDs

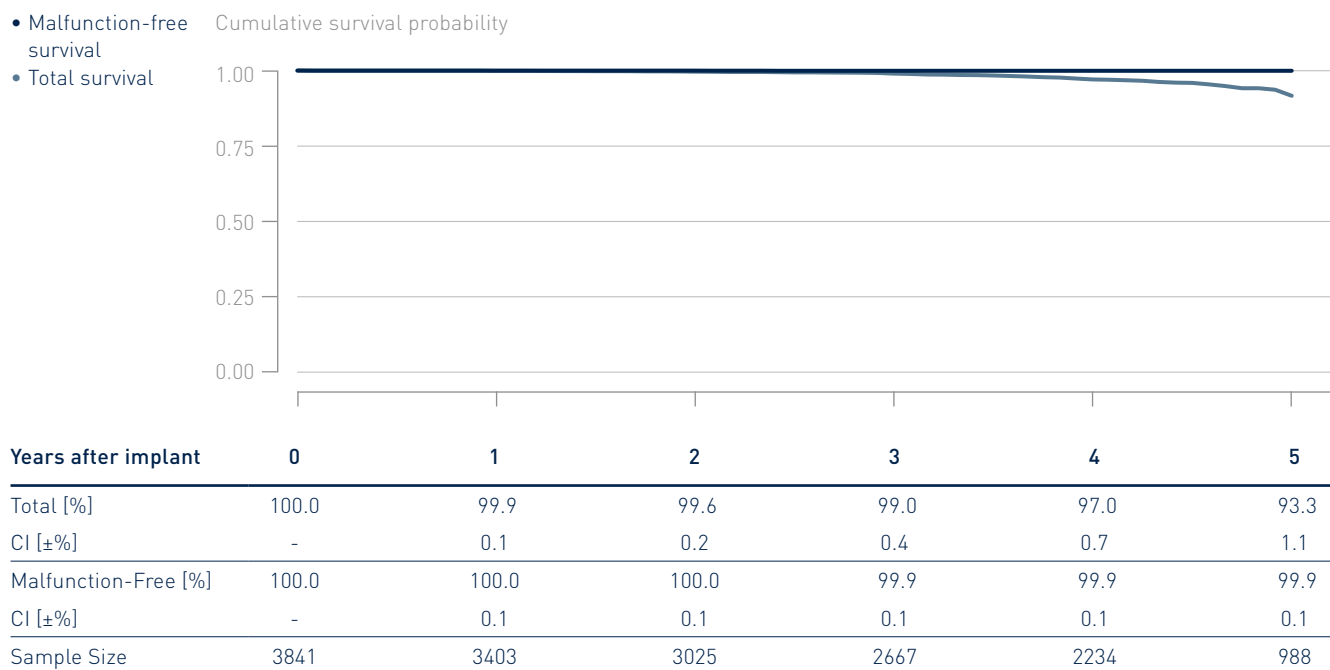


4.3 CRT ICDs

Ilesto 7

Product Versions _____	HF-T
NBG Codes _____	WE-DDDRV
Maximum Energy J _____	40
US Market Release _____	Sep 2013
CE Market Release _____	Jun 2013
Worldwide Distributed Devices _____	5290
Registered U.S. Implants _____	3841
Estimated Active U.S. Implants _____	1990
U.S. Normal Battery Depletions _____	163

	Quantity	Rate
U.S. Confirmed Malfunctions _____	3	0.08%
Therapy Compromised _____	2	0.05%
Therapy Available _____	1	0.03%

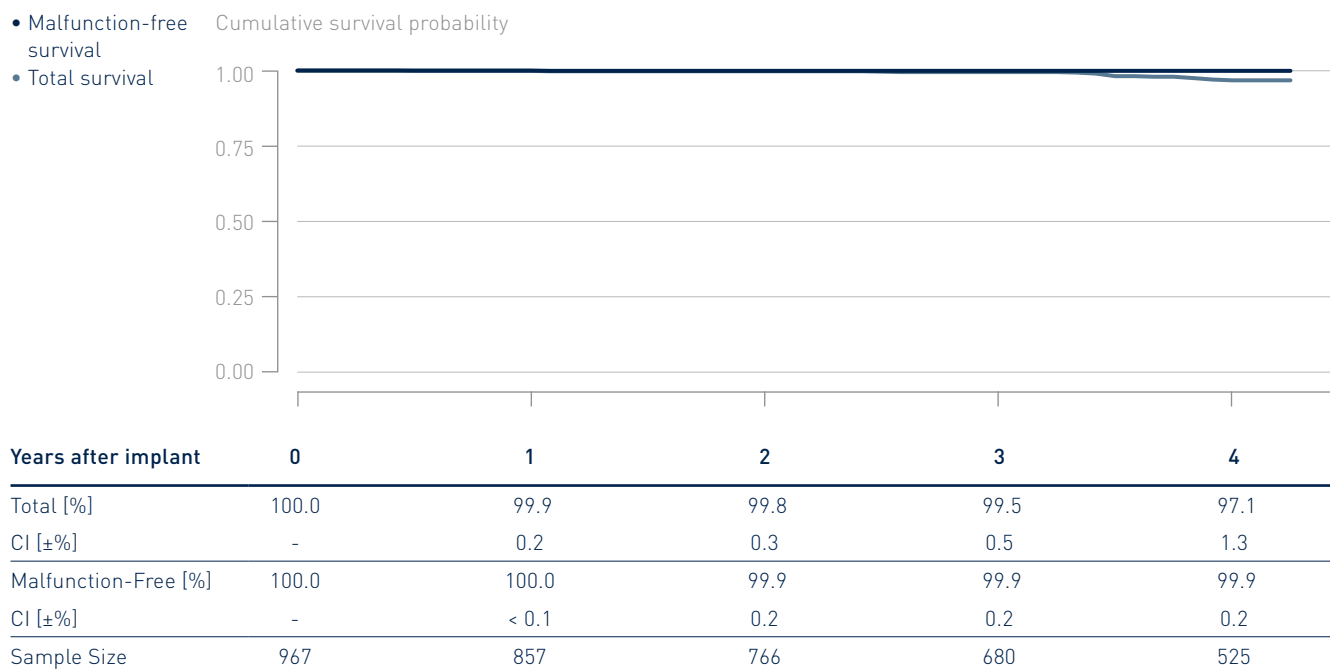


4.3 CRT ICDs

Ilesto 7 DF4

Product Versions	HF-T
NBG Codes	WE-DDDRV
Maximum Energy J	40
US Market Release	Jul 2014
CE Market Release	Jun 2013
Worldwide Distributed Devices	2360
Registered U.S. Implants	967
Estimated Active U.S. Implants	565
U.S. Normal Battery Depletions	25

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.10%
Therapy Compromised	1	0.10%
Therapy Available	0	0.00%



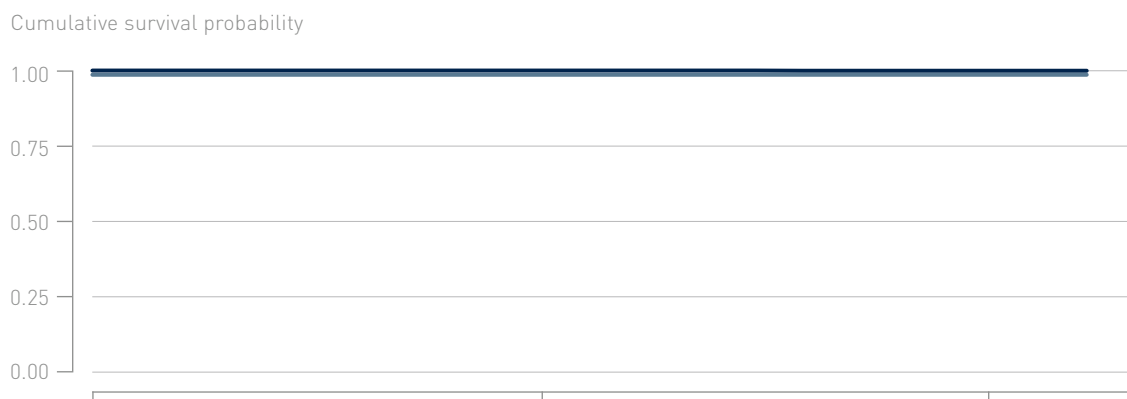
4.3 CRT ICDs

Ilivia 7 DF4

Product Versions	HF-T, HF-T QP
NBG Codes	VDE-DDDRV
Maximum Energy J	40
US Market Release	May 2017
CE Market Release	Feb 2017
Worldwide Distributed Devices	8 190
Registered U.S. Implants	4 413
Estimated Active U.S. Implants	3 750
U.S. Normal Battery Depletions	3

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

- Malfunction-free survival
- Total survival



Years after implant	0	1	2
Total [%]	100.0	99.9	99.9
CI [±%]	-	0.1	0.1
Malfunction-Free [%]	100.0	100.0	100.0
CI [±%]	-	<0.1	<0.1
Sample Size	4 413	2 717	544

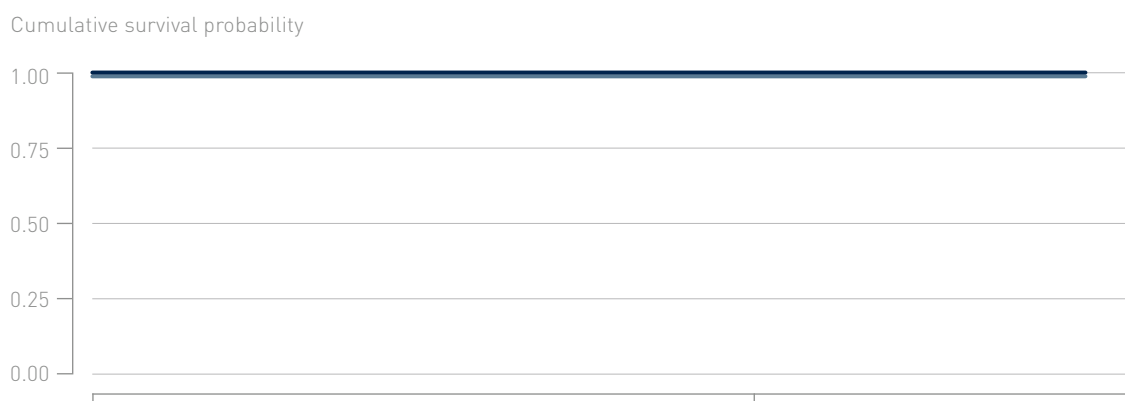
4.3 CRT ICDs

Intica 7 DF1

Product Versions	HF-T, HF-T QP
NBG Codes	VDE-DDDRV
Maximum Energy J	40
US Market Release	May 2017
CE Market Release	Sep 2016
Worldwide Distributed Devices	4 240
Registered U.S. Implants	2019
Estimated Active U.S. Implants	1 760
U.S. Normal Battery Depletions	2

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

- Malfunction-free survival
- Total survival



Years after implant	0	1
Total [%]	100.0	100.0
CI [±%]	-	0.1
Malfunction-Free [%]	100.0	100.0
CI [±%]	-	<0.1
Sample Size	2019	920

4.3 CRT ICDs

Inventra 7 DF4

Product Versions	HF-T, HF-T QP
NBG Codes	VDE-DDDRV
Maximum Energy J	45
US Market Release	Aug 2014
CE Market Release	Jul 2014
Worldwide Distributed Devices	2080
Registered U.S. Implants	856
Estimated Active U.S. Implants	670
U.S. Normal Battery Depletions	1

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

- Malfunction-free survival
- Total survival



Years after implant	0	1	2
Total [%]	100.0	100.0	100.0
CI [±%]	-	0.1	0.1
Malfunction-Free [%]	100.0	100.0	100.0
CI [±%]	-	<0.1	<0.1
Sample Size	856	640	339

4.3 CRT ICDs

Iperia 7

Product Versions _____	HF-T
NBG Codes _____	VDE-DDDRV
Maximum Energy J _____	40
US Market Release _____	Apr 2016
CE Market Release _____	Dec 2014
Worldwide Distributed Devices _____	3 000
Registered U.S. Implants _____	1 443
Estimated Active U.S. Implants _____	1 160
U.S. Normal Battery Depletions _____	4

	Quantity	Rate
U.S. Confirmed Malfunctions _____	0	0.00%
Therapy Compromised _____	0	0.00%
Therapy Available _____	0	0.00%

- Malfunction-free survival
- Total survival



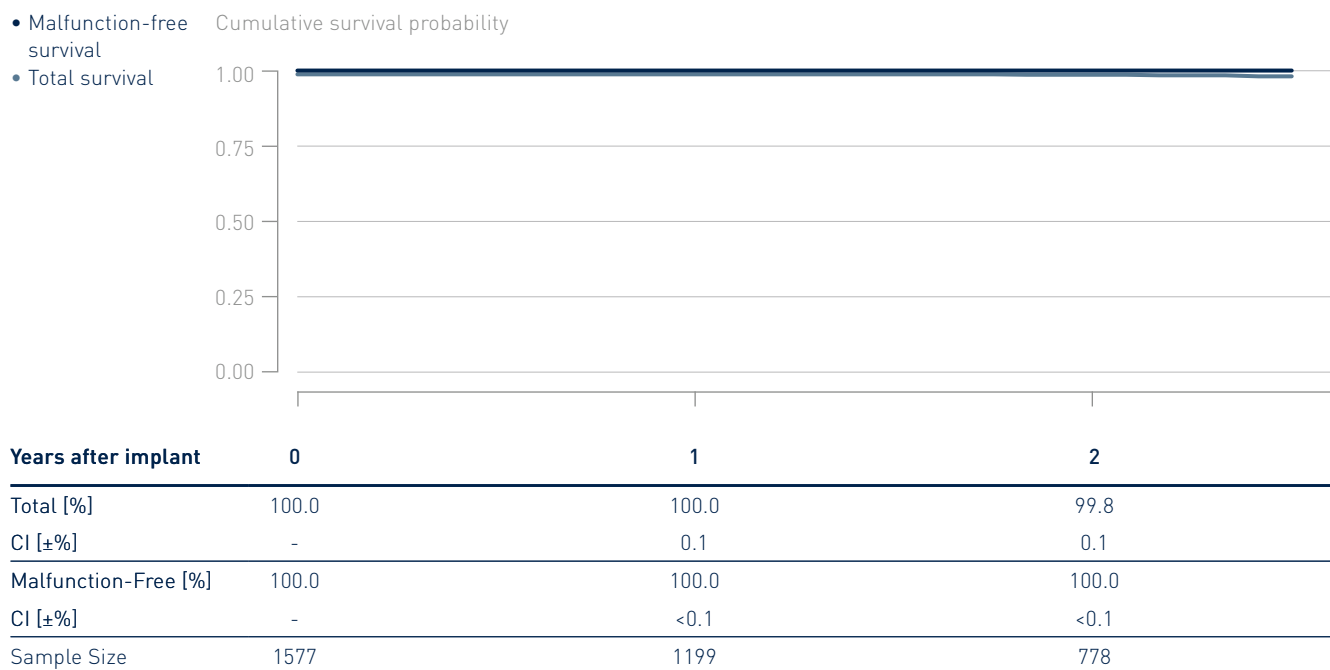
Years after implant	0	1	2
Total [%]	100.0	100.0	100.0
CI [±%]	-	0.1	0.1
Malfunction-Free [%]	100.0	100.0	100.0
CI [±%]	-	<0.1	<0.1
Sample Size	1443	1005	443

4.3 CRT ICDs

Iperia 7 DF4

Product Versions	HF-T
NBG Codes	VDE-DDDRV
Maximum Energy J	40
US Market Release	Apr 2016
CE Market Release	Dec 2014
Worldwide Distributed Devices	5790
Registered U.S. Implants	1577
Estimated Active U.S. Implants	1250
U.S. Normal Battery Depletions	5

	Quantity	Rate
U.S. Confirmed Malfunctions	0	0.00%
Therapy Compromised	0	0.00%
Therapy Available	0	0.00%

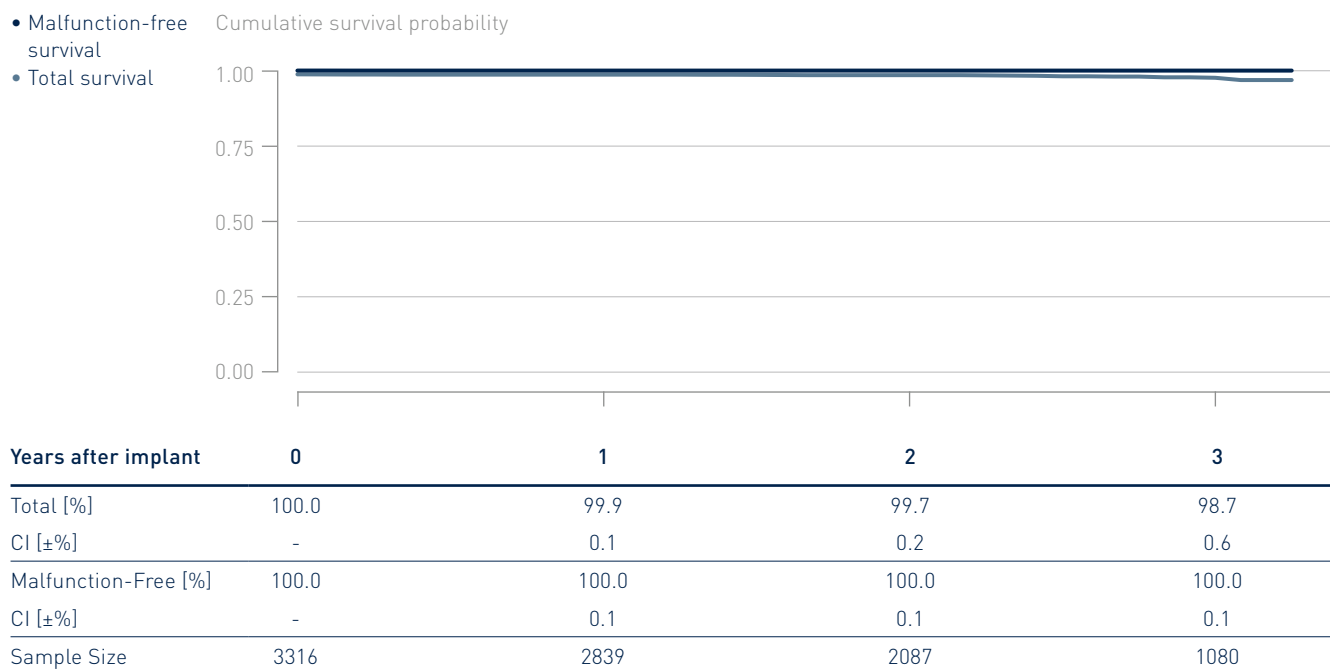


4.3 CRT ICDs

Itrevia 7

Product Versions	HF-T
NBG Codes	VDE-DDDRV
Maximum Energy J	40
US Market Release	Mar 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	4 600
Registered U.S. Implants	3 316
Estimated Active U.S. Implants	2 320
U.S. Normal Battery Depletions	38

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.03%
Therapy Compromised	0	0.00%
Therapy Available	1	0.03%

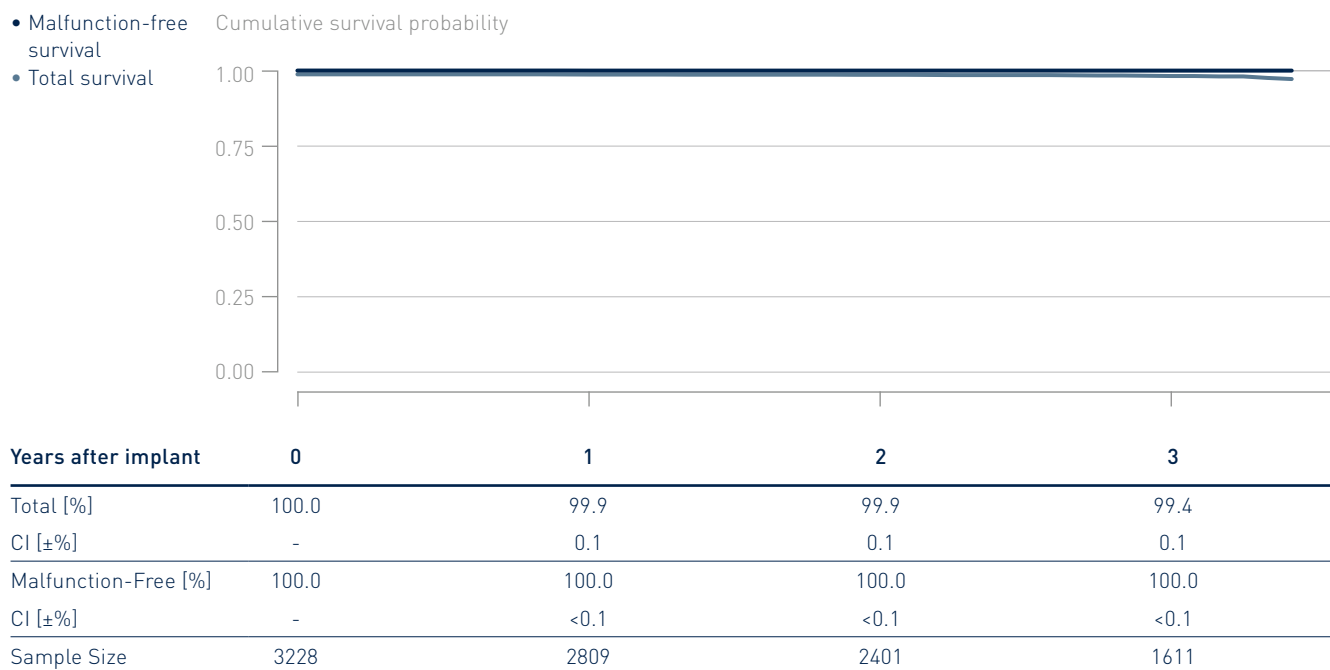


4.3 CRT ICDs

Itrevia 7 DF4

Product Versions	HF-T, HF-T QP
NBG Codes	VDE-DDDRV
Maximum Energy J	40
US Market Release	Mar 2015
CE Market Release	Dec 2014
Worldwide Distributed Devices	5 680
Registered U.S. Implants	3 228
Estimated Active U.S. Implants	2 210
U.S. Normal Battery Depletions	30

	Quantity	Rate
U.S. Confirmed Malfunctions	1	0.03%
Therapy Compromised	0	0.00%
Therapy Available	1	0.03%

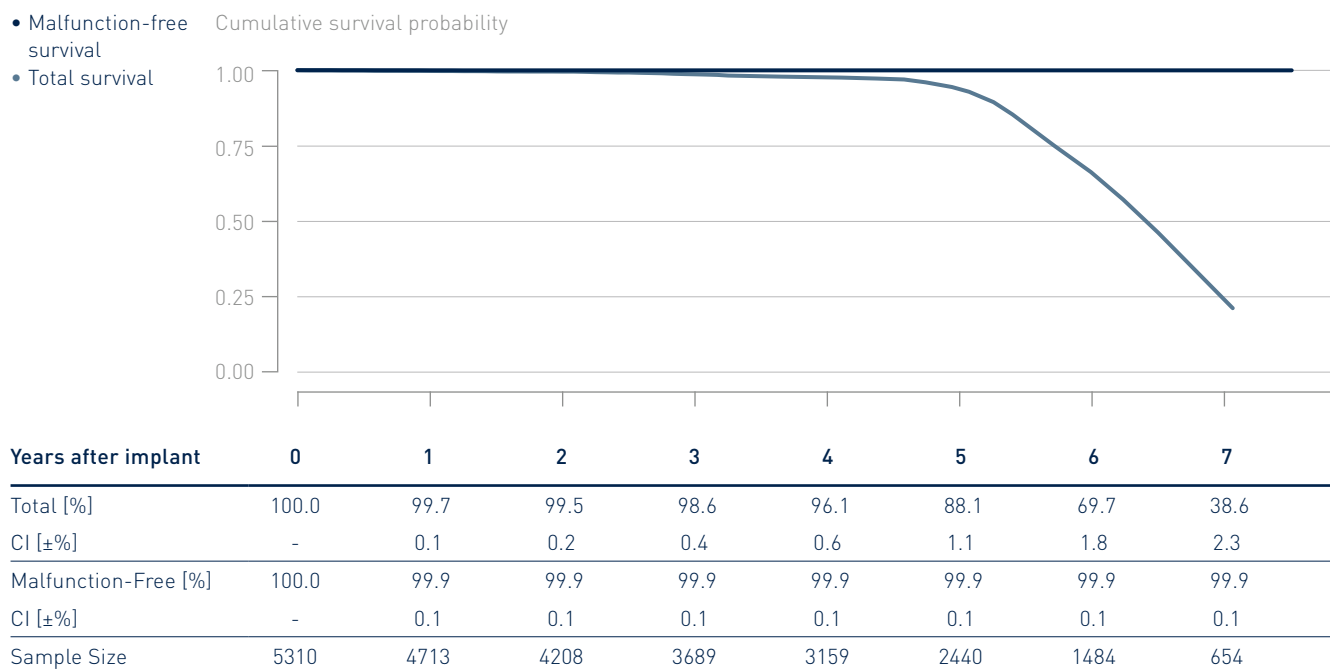


4.3 CRT ICDs

Lumax 340

Product Versions	HF, HF-T
NBG Codes	VVE-DDDRV
Maximum Energy J	40
US Market Release	Feb 2007
CE Market Release	Dec 2006
Worldwide Distributed Devices	20 700
Registered U.S. Implants	5310
Estimated Active U.S. Implants	626
U.S. Normal Battery Depletions	1 264

	Quantity	Rate
U.S. Confirmed Malfunctions	4	0.08%
Therapy Compromised	2	0.04%
Therapy Available	2	0.04%

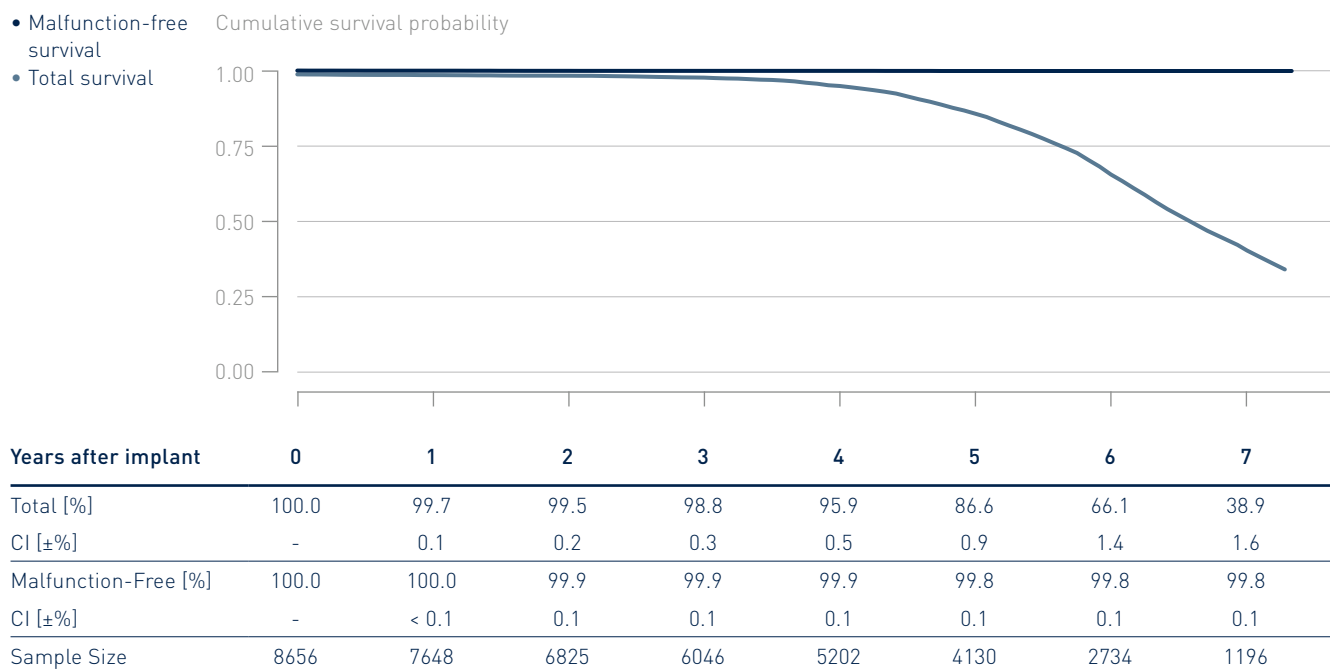


4.3 CRT ICDs

Lumax 540

Product Versions _____	HF-T
NBG Codes _____	VVE-DDDRV
Maximum Energy J _____	40
US Market Release _____	May 2009
CE Market Release _____	Jun 2008
Worldwide Distributed Devices _____	24 800
Registered U.S. Implants _____	8 656
Estimated Active U.S. Implants _____	1 180
U.S. Normal Battery Depletions _____	2 543

	Quantity	Rate
U.S. Confirmed Malfunctions _____	11	0.13%
Therapy Compromised _____	5	0.06%
Therapy Available _____	6	0.07%

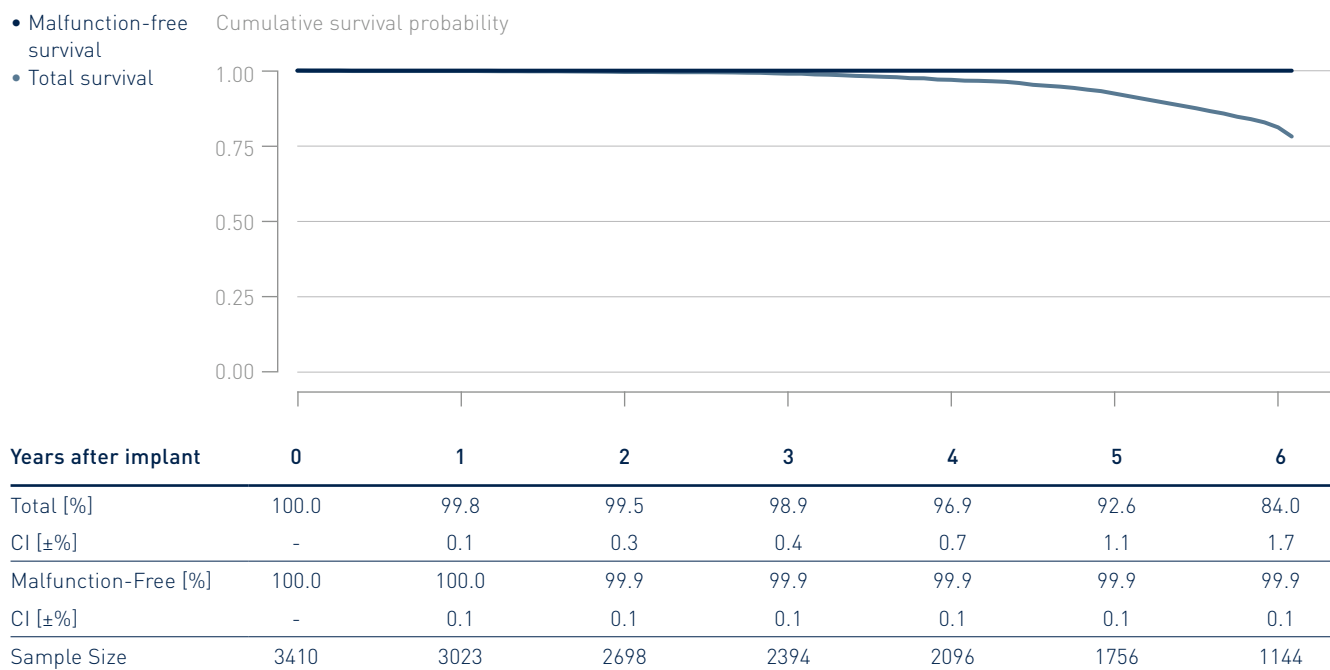


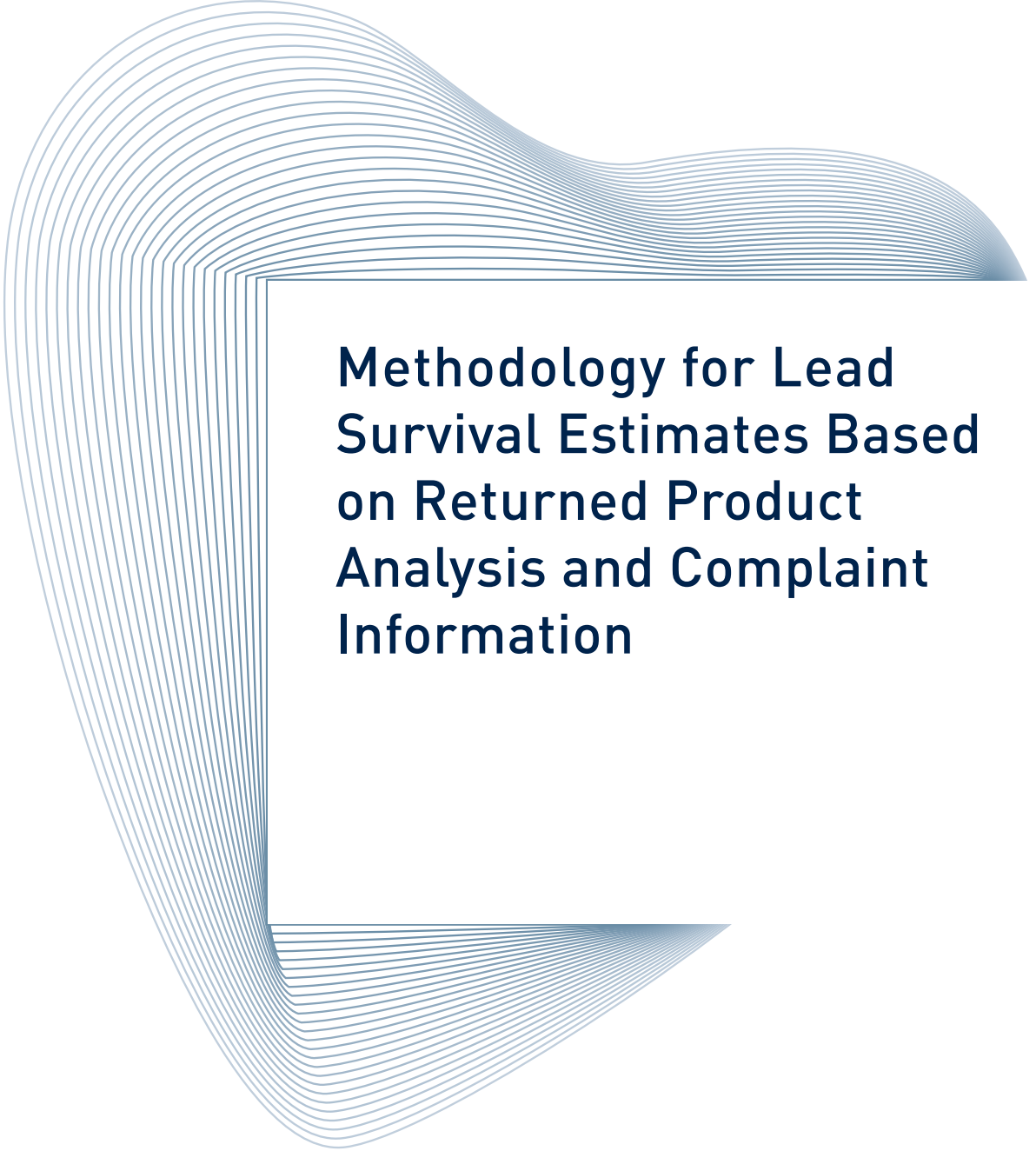
4.3 CRT ICDs

Lumax 740

Product Versions	HF-T
NBG Codes	VVE-DDDRV
Maximum Energy J	40
US Market Release	Sep 2012
CE Market Release	Apr 2012
Worldwide Distributed Devices	7050
Registered U.S. Implants	3410
Estimated Active U.S. Implants	1300
U.S. Normal Battery Depletions	372

	Quantity	Rate
U.S. Confirmed Malfunctions	3	0.09%
Therapy Compromised	1	0.03%
Therapy Available	2	0.06%





Methodology for Lead Survival Estimates Based on Returned Product Analysis and Complaint Information

5. Methodology for Lead Survival Estimates Based on Returned Product Analysis and Complaint Information

5.1 Cumulative Lead Survival Probability

This report has been prepared in accordance with ISO 5841-2:2014(E) applying actuarial analysis for the calculation of lead survival probabilities based on returned product analysis. Lead survival estimates given in this report are considered to be generally representative for worldwide performance of BIOTRONIK's pacing and ICD leads.

The cumulative survival probability for leads is an estimate based on the percentage of devices that remain implanted and in service at various points of the product's service time in the absence of concurrent events such as morbidity. The lead survival estimate over time is displayed in cumulative survival curves (Kaplan-Meier). The product's performance is evaluated in discrete one-month intervals. The survival probability for each month is given by the number of leads that remain implanted and active through this month divided by the number of leads that were actively implanted at the start of the interval. The cumulative survival probability for any period is given by multiplying all survival probabilities of previous months.

At the time of implantation, the cumulative lead survival probability is 100 %. Even though they are analyzed as part of our quality system monitoring, leads that are found to be out of specification prior to or during the implantation procedure are removed from the statistics as they do not contribute to a patient's risk of being subject to a device malfunction or replacement during the device's service time.

Because this report is provided to communicate information regarding product performance, it does not include data regarding medical complications such as erosion, infection or diaphragmatic stimulation.

Compared to pacemakers and ICDs, a considerable portion of leads with observed or suspected failures are not explanted and returned for laboratory analysis. This is primarily because it is much more difficult and risky to the patient to remove chronically implanted leads. In order to report a conservative measure of lead performance, unconfirmed reports of lead complications are therefore also included in the calculation of a lead's survival probability.

In order to be classified as a qualifying lead complication and thus contributing to the survival probability calculation the same way as a confirmed malfunction, the reported anomaly must have occurred at least 30 days post-implant. Otherwise, factors not related to the lead would likely be the root cause of the observed anomaly, (i.e., patientspecific conditions or implant techniques).

In order to minimize the effect of underreporting of lead malfunctions, BIOTRONIK additionally includes the long term performance post market study data if available.

5.2 Lead Data Acquisition

The following sections of this report provide performance data on BIOTRONIK's pacing and ICD leads and are based on the observation of BIOTRONIK's U.S. products through review of our device registration and tracking systems, and through the analyses of both, returned leads as well as reports of lead complications of non-returned leads. The prospective data from BIOTRONIK's post-approval studies is presented separately in chapters 8 and 9.

In order to be included in the population under observation a lead must be registered and implanted for at least one calendar day. The cut-off date for the data included in this report is December 31, 2019. The sample sizes of U.S. leads that are implanted and remain active as well as the total number of products distributed worldwide are provided for each lead family in this report.

Survival estimates are calculated for lead families having accumulated at least 10,000 cumulative implant months. Products no longer being distributed with less than 500 active implants may be excluded from this report.

ISO 5841-2:2014(E) describes a method for adjusting the device survival probability for underreported malfunctions and unrelated patient deaths that result in an overestimation of the device's survival probability. The factor for U.S. underreporting of malfunctions of pacing and ICD leads is unknown as currently no systematic data is available that reveals this factor. Consequently, this factor remains unaccounted for in this report. Patient mortality is artificially elevated if the reported rate from our registration and tracking systems is below the annual mortality in clinical studies.

5.3 Returned Product Analysis

Information for the lead sections of this report is taken from the analysis of returned products. The outcome of this analysis is the basis for the final classification of the cause for explantation of the lead. Additionally, reports of lead complications not confirmed by laboratory analysis are taken into consideration. Both, leads with confirmed malfunctions as well as unconfirmed lead complications decrease a lead's total survival probability.

Every lead and lead segment returned to BIOTRONIK is analyzed per our internal procedures and classified as within specification, damaged by external causes, or out of specification (malfunction) while implanted and in service.

Those leads found to be out of specification, are divided into the following categories as proposed by AdvaMed and ISO 5841-2:2014(E):

Conductor Fracture

Conductor break with complete or intermittent loss of continuity that could interrupt current flow (e.g. fractured conductors)

Crimps, Welds and Bonds

Any interruption in the conductor or lead body associated with a point of connection

Insulation Breach

Any lead insulation breach

Other

Includes specific proprietary lead mechanical attributes.

5.4 Lead Complications

A considerable portion of leads with observed or suspected failures are not explanted and returned for laboratory analysis. A clinical observation is considered a lead complication if a complaint, associated with at least one of the clinical manifestations listed below, is reported and where the non-returned lead is:

- Verified by medical records to have been implanted and in-service, and
- Reported to have been removed from service,
- Modified surgically or electrically to remedy the malfunction, or
- Left in service based on medical judgment.

Complications for leads implanted greater than 30 days are reported as Qualifying lead complications, whereas complications occurring during the first 30 days are reported as Acute Lead Observations.

In accordance with the latest AdvaMed guidelines and ISO 5841-2:2014(E) such clinical observations are classified in the following categories:

Failure to Capture

Intermittent or complete failure to achieve cardiac stimulation at programmed output delivered outside of the cardiac refractory period. Sudden and significant increase in the pacing threshold value at which 2:1 safety margin can no longer be achieved.

Failure to Sense

Intermittent or complete loss of sensing or failure to detect intended intrinsic cardiac signals during non-refractory periods at programmed sensitivity settings

Oversensing

Misinterpretation of cardiac or non-cardiac events as cardiac depolarization

Abnormal Pacing Impedance

Pacing impedance is typically considered abnormal if a measurement is < 200 ohms or > 3000 ohms

Abnormal Defibrillation Impedance

Defibrillation impedance is typically considered abnormal if a measurement is < 20 ohms or > 200 ohms. Including high or low shock impedance when attempting to deliver a shock

Insulation Breach

A disruption or break in lead insulation observed visually, electrically, or radiographically

Conductor Fracture

A mechanical break within the lead conductor observed visually, electrically, or radiographically

Lead Dislodgement

Radiographic, electrical or electrocardiographic evidence of electrode displacement from the original implant site or electrode displacement that adversely affects pacing and/or lead performance

Extracardiac Stimulation

Clinical observation of inadvertent nerve/muscle stimulation other than cardiac muscle

Cardiac Perforation

Penetration of the lead tip through the myocardium, clinically suspected and confirmed by chest x-ray, fluoroscopy, echocardiogram, or visual observation, which results in clinical symptoms, typically degradation of pacing/ICD lead electrical performance, chest pain, and tamponade

Other

Specific proprietary attributes of a lead such as sensors which affect a lead's ability to perform as designed or remain in service

In order to report a conservative measure of lead performance, qualifying lead complications are also included in the calculation of a lead's survival probability.

Acute Lead Observations may be subject to a number of factors, including patient-specific anatomy, clinical conditions and/or varying implant conditions/techniques. Therefore, acute lead observations are not included in lead survival probability.

5.5 Lead Product Performance Graphs and Data

The lead performance information is shown in each section in alphabetical order and by product name. For each lead, the report provides:

- Product versions that contribute to the evaluation
- Types of leads
- Polarity
- Steroid
- CE and U.S. market release dates
- Worldwide quantity of products that have been distributed
- U.S. registered implants (number of products included in this report)
- Estimated active U.S. implants
- Number of U.S. qualifying complications

- Number of U.S. acute lead observations
- Number of U.S. confirmed malfunctions
- Number of U.S. leads or partial leads returned post-implant for analysis with a complaint

The survival plots provide:

Total Survival

The cumulative survival probability free of component malfunction or unconfirmed observation of an anomaly. Removals for clinical reasons unrelated to the device's performance (i.e., infections) are excluded.

Products or subgroups of products may become subject to advisory notifications that can significantly impact the overall product performance.

Current advisories are listed in chapter 11 of this report, however to date, BIOTRONIK has never had a pacing or ICD lead safety advisory notification, therefore no summary of lead advisories is provided.

The cumulative survival data and the 95 % confidence intervals according to the Greenwood's formula¹ are shown in numerical form for the observed sample population.

¹ Greenwood, M. The natural duration of cancer. Reports on Public Health and Medical Subjects
33, London: Her Majesty's Stationery Office, 1–26, 1926

Performance of BIOTRONIK Leads

Based on Returned Products
and Complaint Data

6.1 Pacing Leads

6.2 ICD Leads

6.3 CRT Leads



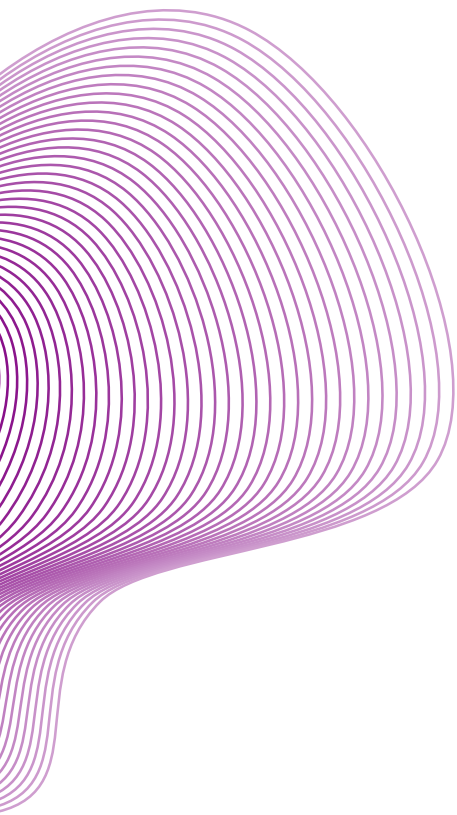
Performance of BIOTRONIK Leads

Based on Returned Products
and Complaint Data

6.1 Pacing Leads

6.2 ICD Leads

6.3 CRT Leads



6.1 Pacing Leads

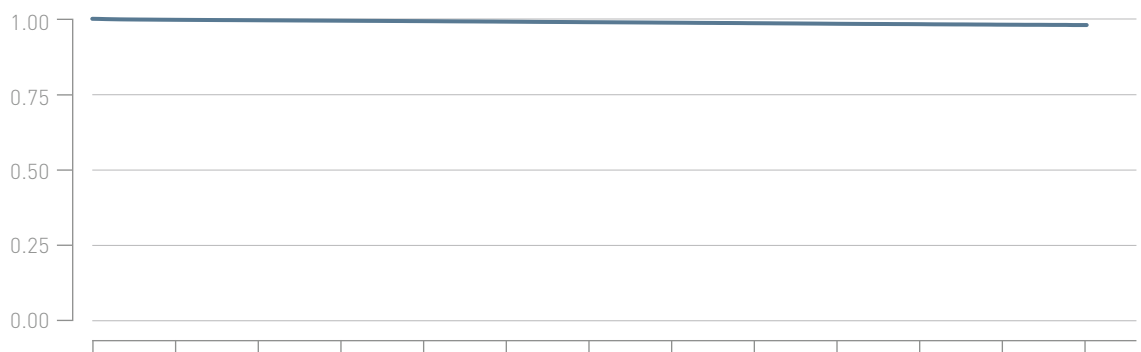
Dextrus

Product Versions	4135, 4136, 4137
Lead Type	straight, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Apr 2007
CE Market Release	May 2007
Worldwide Distributed Devices	480 000
Registered U.S. Implants	379 656
Estimated Active U.S. Implants	240 000
U.S. Total Returned	2 333

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	3 847	1.00%	U.S. Confirmed Malfunctions	338	0.09%
Abnormal Pacing Impedance	338	0.09%	Conductor Fracture	123	0.03%
Cardiac Perforation	25	0.01%	Insulation Breach	210	0.05%
Conductor Fracture	112	0.03%	Other	5	0.00%
Extracardiac Stimulation	20	0.01%			
Failure to Capture	1 016	0.26%	U.S. Acute Lead Observations	1 646	0.43%
Failure to Sense	146	0.04%	Abnormal Pacing Impedance	36	0.01%
Insulation Breach	79	0.02%	Cardiac Perforation	66	0.02%
Lead Dislodgement	533	0.14%	Extracardiac Stimulation	15	0.00%
Oversensing	898	0.23%	Failure to Capture	235	0.06%
Other	680	0.18%	Failure to Sense	65	0.02%
			Insulation Breach	9	0.00%
			Lead Dislodgement	659	0.17%
			Oversensing	46	0.01%
			Other	515	0.13%

• Total survival

Cumulative survival probability



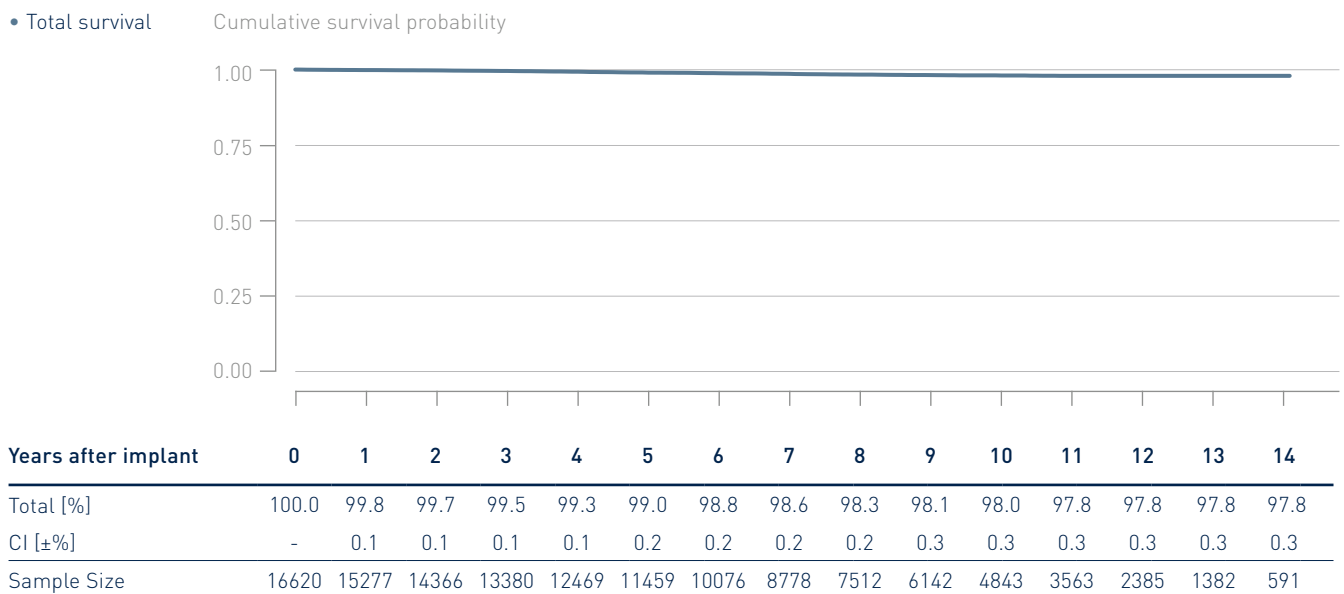
Years after implant	0	1	2	3	4	5	6	7	8	9	10	11	12
Total [%]	100.0	99.7	99.5	99.3	99.2	99.0	98.8	98.7	98.5	98.3	98.2	98.0	97.8
CI [±%]	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1	0.1	0.1	0.1
Sample Size	379656	337261	315966	295664	263506	215862	171150	132234	100498	73295	48162	25034	6703

6.1 Pacing Leads

Selox JT

Product Versions	45, 53
Lead Type	J-shape, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Nov 2004
CE Market Release	Nov 2004
Worldwide Distributed Devices	157 000
Registered U.S. Implants	16 620
Estimated Active U.S. Implants	12 400
U.S. Total Returned	122

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	219	1.32%	U.S. Confirmed Malfunctions	9	0.05%
Abnormal Pacing Impedance	32	0.19%	Insulation Breach	9	0.05%
Cardiac Perforation	1	0.01%			
Conductor Fracture	8	0.05%	U.S. Acute Lead Observations	45	0.27%
Extracardiac Stimulation	1	0.01%	Failure to Capture	8	0.05%
Failure to Capture	97	0.58%	Lead Dislodgement	34	0.20%
Failure to Sense	9	0.05%	Other	3	0.02%
Insulation Breach	12	0.07%			
Lead Dislodgement	34	0.20%			
Oversensing	8	0.05%			
Other	17	0.10%			



6.1 Pacing Leads

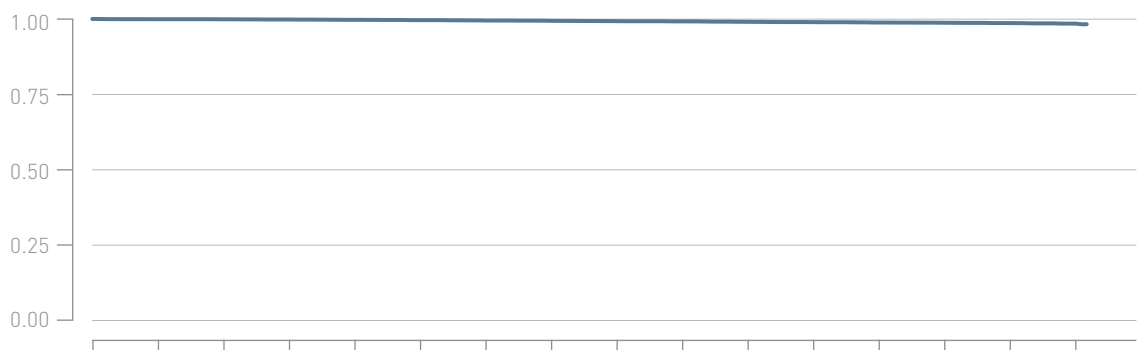
Selox SR

Product Versions	45, 53, 60
Lead Type	straight, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Mar 2004
CE Market Release	Feb 2004
Worldwide Distributed Devices	172 000
Registered U.S. Implants	14 340
Estimated Active U.S. Implants	7 080
U.S. Total Returned	62

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	116	0.81%	U.S. Confirmed Malfunctions	12	0.08%
Abnormal Pacing Impedance	8	0.06%	Insulation Breach	12	0.08%
Conductor Fracture	10	0.07%			
Extracardiac Stimulation	2	0.01%	U.S. Acute Lead Observations	21	0.15%
Failure to Capture	43	0.30%	Cardiac Perforation	1	0.01%
Failure to Sense	1	0.01%	Failure to Capture	11	0.08%
Insulation Breach	6	0.04%	Insulation Breach	1	0.01%
Lead Dislodgement	14	0.10%	Lead Dislodgement	8	0.06%
Oversensing	18	0.13%			
Other	14	0.10%			

• Total survival

Cumulative survival probability



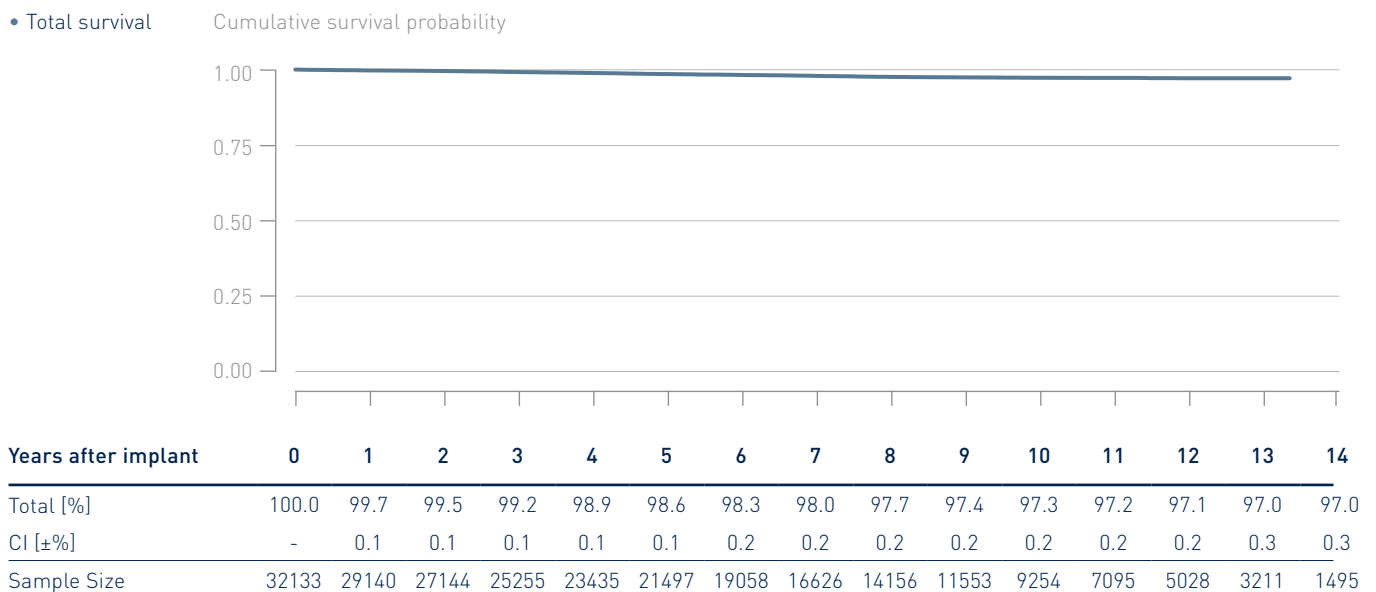
Years after implant	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total [%]	100.0	99.9	99.9	99.8	99.7	99.6	99.5	99.4	99.3	99.2	99.0	98.9	98.8	98.7	98.6	98.5
CI [±%]	-	< 0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3
Sample Size	14340	12428	11654	10857	10039	9351	8728	8231	7874	7600	7382	7195	7110	7029	5879	2015

6.1 Pacing Leads

Selox ST

Product Versions	53, 60
Lead Type	straight, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Nov 2004
CE Market Release	Nov 2004
Worldwide Distributed Devices	379 000
Registered U.S. Implants	32 133
Estimated Active U.S. Implants	22 900
U.S. Total Returned	178

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	576	1.79%	U.S. Confirmed Malfunctions	17	0.05%
Abnormal Pacing Impedance	133	0.41%	Conductor Fracture	1	0.00%
Cardiac Perforation	3	0.01%	Crimps, Welds and Bonds	1	0.00%
Conductor Fracture	61	0.19%	Insulation Breach	15	0.05%
Extracardiac Stimulation	6	0.02%			
Failure to Capture	275	0.85%	U.S. Acute Lead Observations	49	0.15%
Failure to Sense	1	0.00%	Abnormal Pacing Impedance	1	0.00%
Insulation Breach	38	0.12%	Failure to Capture	21	0.07%
Lead Dislodgement	22	0.07%	Lead Dislodgement	21	0.07%
Oversensing	12	0.04%	Other	6	0.02%
Other	25	0.08%			



6.1 Pacing Leads

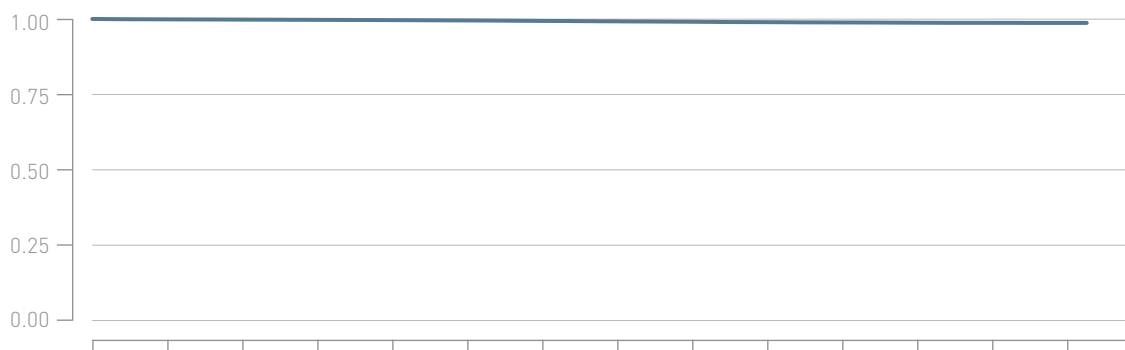
Setrox S

Product Versions	45, 53, 60
Lead Type	straight, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Apr 2006
CE Market Release	Mar 2006
Worldwide Distributed Devices	676 000
Registered U.S. Implants	245 226
Estimated Active U.S. Implants	198 000
U.S. Total Returned	1 633

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	1 541	0.63%	U.S. Confirmed Malfunctions	170	0.07%
Abnormal Pacing Impedance	128	0.05%	Conductor Fracture	57	0.02%
Cardiac Perforation	8	0.00%	Insulation Breach	111	0.05%
Conductor Fracture	89	0.04%	Other	2	0.00%
Extracardiac Stimulation	12	0.00%			
Failure to Capture	530	0.22%	U.S. Acute Lead Observations	272	0.11%
Failure to Sense	41	0.02%	Abnormal Pacing Impedance	1	0.00%
Insulation Breach	72	0.03%	Cardiac Perforation	24	0.01%
Lead Dislodgement	327	0.13%	Failure to Capture	35	0.01%
Oversensing	229	0.09%	Failure to Sense	3	0.00%
Other	105	0.04%	Insulation Breach	4	0.00%
			Lead Dislodgement	189	0.08%
			Other	16	0.01%

• Total survival

Cumulative survival probability



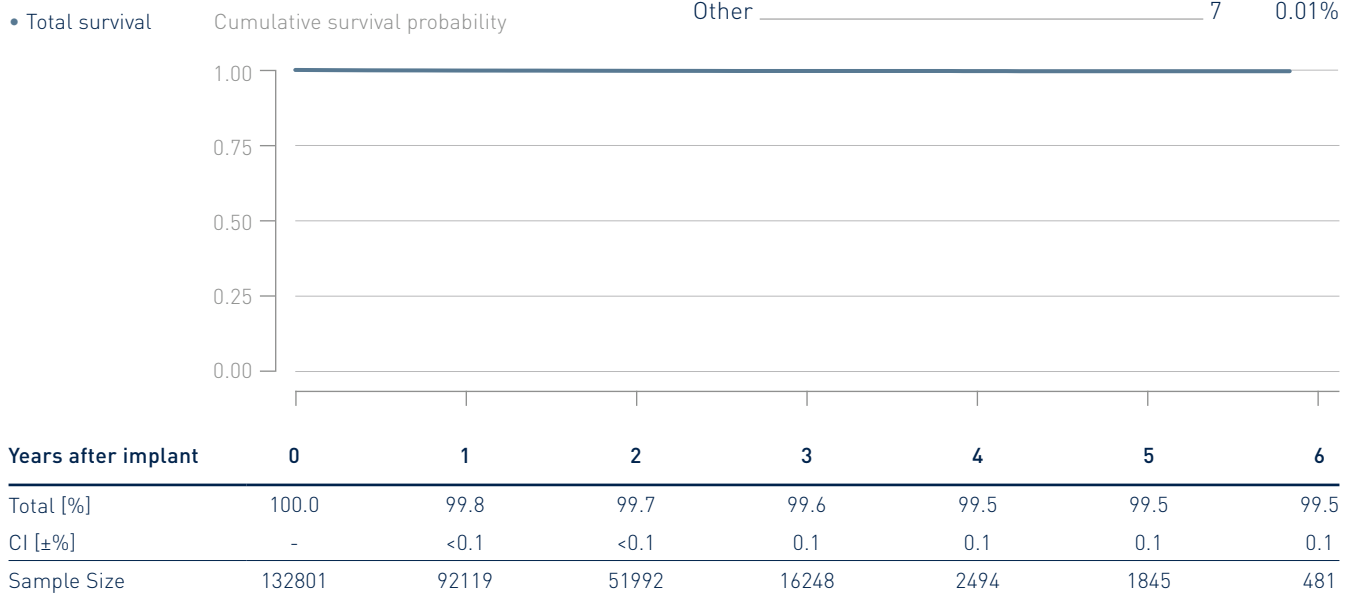
Years after implant	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Total [%]	100.0	99.9	99.8	99.7	99.6	99.5	99.3	99.2	99.1	98.9	98.8	98.7	98.7	98.6
CI [±%]	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	0.1
Sample Size	245226	228632	219244	210054	182796	147604	119908	96929	75368	56331	39085	24395	12634	4363

6.1 Pacing Leads

Siello S/Solia S

Product Versions	45, 53, 60
Lead Type	straight, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jun 2016
CE Market Release	Jul 2009
Worldwide Distributed Devices	1419 000
Registered U.S. Implants	132801
Estimated Active U.S. Implants	127 000
U.S. Total Returned	524

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	351	0.26%	U.S. Confirmed Malfunctions	25	0.02%
Abnormal Pacing Impedance	16	0.01%	Conductor Fracture	9	0.01%
Cardiac Perforation	12	0.01%	Insulation Breach	15	0.01%
Conductor Fracture	8	0.01%	Other	1	0.00%
Extracardiac Stimulation	3	0.00%			
Failure to Capture	97	0.07%	U.S. Acute Lead Observations	217	0.16%
Failure to Sense	11	0.01%	Abnormal Pacing Impedance	2	0.00%
Insulation Breach	6	0.00%	Cardiac Perforation	22	0.02%
Lead Dislodgement	163	0.12%	Conductor Fracture	1	0.00%
Oversensing	23	0.02%	Failure to Capture	45	0.03%
Other	12	0.01%	Failure to Sense	4	0.00%
			Insulation Breach	2	0.00%
			Lead Dislodgement	131	0.10%
			Oversensing	3	0.00%
			Other	7	0.01%



6.1 Pacing Leads

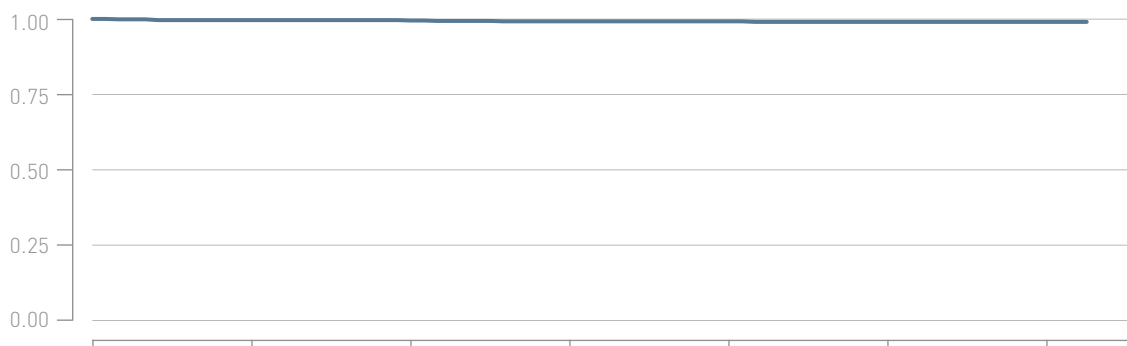
Tilda JT

Product Versions	45, 53
Lead Type	J-shape, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Feb 2012
CE Market Release	Sep 2011
Worldwide Distributed Devices	17300
Registered U.S. Implants	809
Estimated Active U.S. Implants	786
U.S. Total Returned	0

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	7	0.87%	U.S. Confirmed Malfunctions	0	0.00%
Abnormal Pacing Impedance	2	0.25%			
Failure to Capture	2	0.25%	U.S. Acute Lead Observations	1	0.12%
Lead Dislodgement	3	0.37%	Lead Dislodgement	1	0.12%

• Total survival

Cumulative survival probability



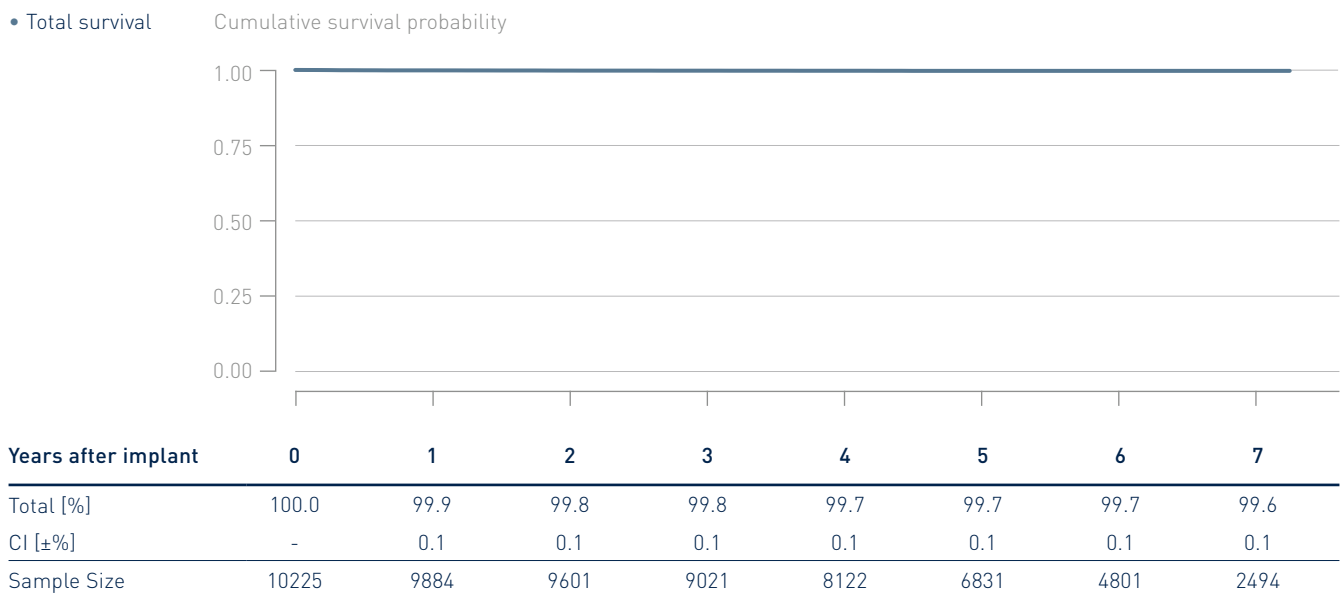
Years after implant	0	1	2	3	4	5	6
Total [%]	100.0	99.6	99.5	99.2	99.2	99.1	99.1
CI [±%]	-	0.4	0.5	0.6	0.6	0.7	0.7
Sample Size	809	782	753	717	637	498	352

6.1 Pacing Leads

Tilda R

Product Versions	45, 53, 60
Lead Type	straight, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Dec 2011
CE Market Release	Aug 2011
Worldwide Distributed Devices	41300
Registered U.S. Implants	10225
Estimated Active U.S. Implants	9840
U.S. Total Returned	16

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	32	0.31%	U.S. Confirmed Malfunctions	1	0.01%
Abnormal Pacing Impedance	1	0.01%	Conductor Fracture	1	0.01%
Conductor Fracture	4	0.04%	U.S. Acute Lead Observations	9	0.09%
Extracardiac Stimulation	1	0.01%	Failure to Capture	1	0.01%
Failure to Capture	8	0.08%	Lead Dislodgement	8	0.08%
Insulation Breach	2	0.02%			
Lead Dislodgement	9	0.09%			
Oversensing	3	0.03%			
Other	4	0.04%			



6.1 Pacing Leads

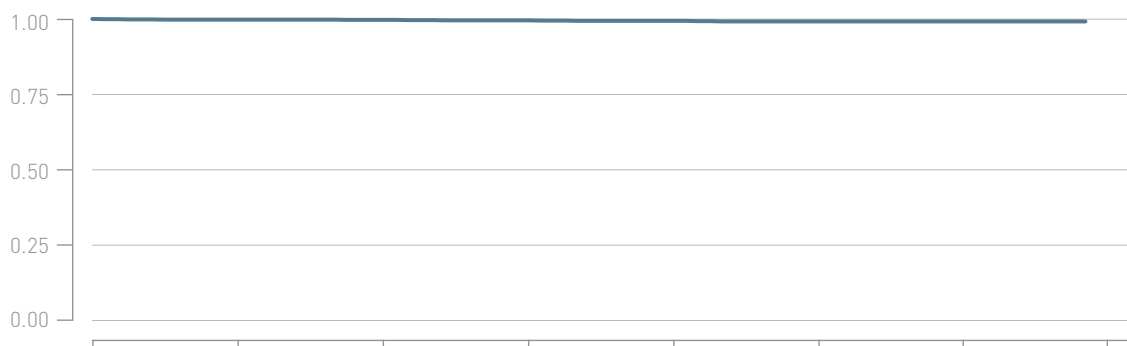
Tilda T

Product Versions	53, 60
Lead Type	straight, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Dec 2011
CE Market Release	Aug 2011
Worldwide Distributed Devices	22400
Registered U.S. Implants	1357
Estimated Active U.S. Implants	1310
U.S. Total Returned	2

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	10	0.74%	U.S. Confirmed Malfunctions	0	0.00%
Abnormal Pacing Impedance	4	0.29%			
Conductor Fracture	1	0.07%	U.S. Acute Lead Observations	0	0.00%
Insulation Breach	1	0.07%			
Lead Dislodgement	4	0.29%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7
Total [%]	100.0	99.8	99.7	99.5	99.4	99.2	99.2	99.2
CI [±%]	-	0.3	0.3	0.4	0.4	0.5	0.5	0.5
Sample Size	1357	1313	1287	1233	1114	976	691	316

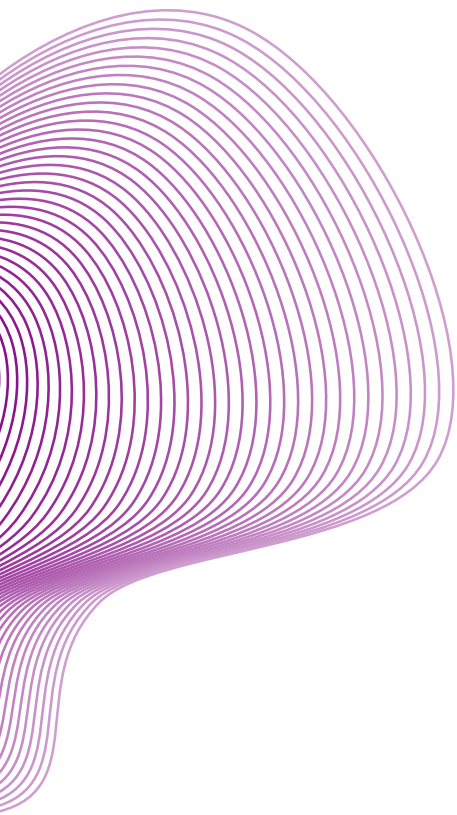
Performance of **BIOTRONIK Leads**

Based on Returned Products
and Complaint Data

6.1 Pacing Leads

6.2 ICD Leads

6.3 CRT Leads



6.2 ICD Leads

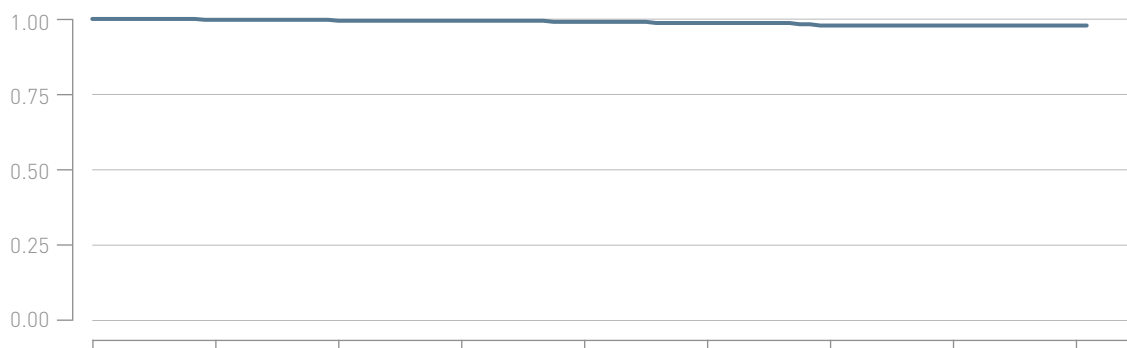
Kentrox RV

Product Versions	65, 75, -Steroid
Lead Type	single-coil, passive fixation
Polarity	bipolar
Steroid	yes/no
U.S. Market Release	Mar 2002 / Oct 2004
CE Market Release	Jan 2001 / Dec 2004
Worldwide Distributed Devices	5470
Registered U.S. Implants	406
Estimated Active U.S. Implants	172
U.S. Total Returned	8

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	8	1.97%	U.S. Confirmed Malfunctions	2	0.49%
Conductor Fracture	1	0.25%	Conductor Fracture	1	0.25%
Failure to Capture	2	0.49%	Insulation Breach	1	0.25%
Insulation Breach	1	0.25%			
Oversensing	4	0.98%	U.S. Acute Lead Observations	0	0.00%

• Total survival

Cumulative survival probability



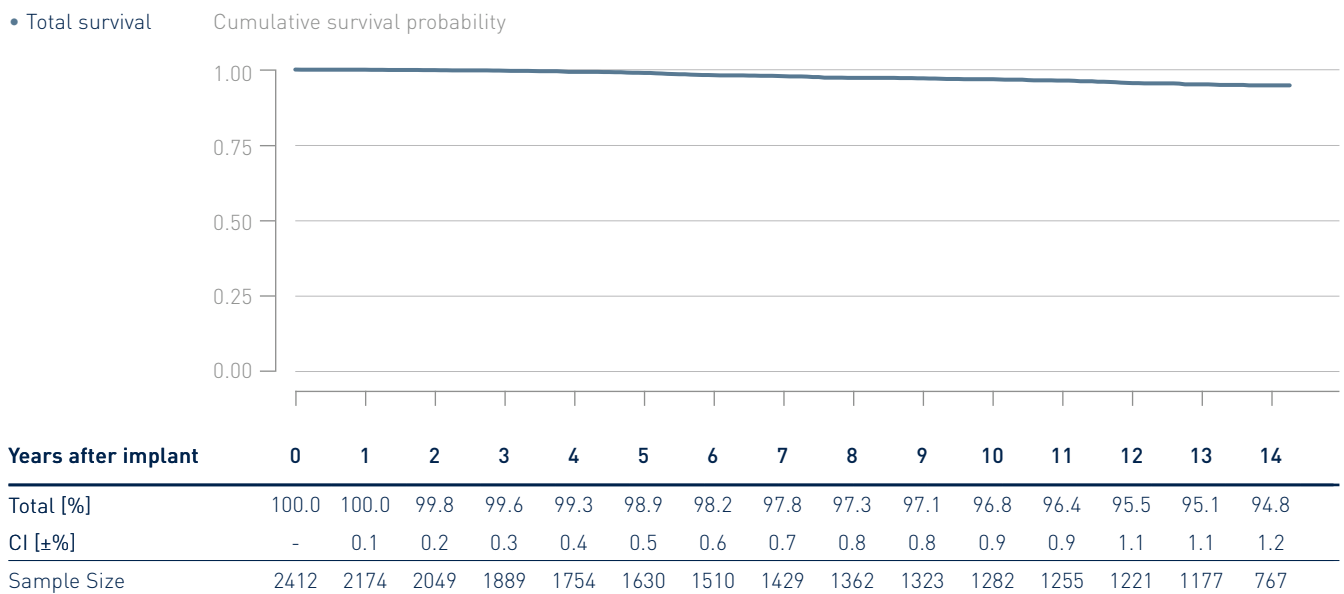
Years after implant	0	1	2	3	4	5	6	7	8
Total [%]	100.0	99.7	99.4	99.4	99.0	98.6	97.8	97.8	97.8
CI [±%]	-	0.6	0.8	0.8	1.1	1.3	1.8	1.8	1.8
Sample Size	406	353	318	286	269	243	228	211	201

6.2 ICD Leads

Kentrox SL-S

Product Versions	65/16, 18 -Steroid
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes/no
U.S. Market Release	Oct 2004
CE Market Release	Jun 2004
Worldwide Distributed Devices	8740
Registered U.S. Implants	2412
Estimated Active U.S. Implants	1220
U.S. Total Returned	41

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	63	2.59%	U.S. Confirmed Malfunctions	14	0.58%
Abnormal Defibrillation Impedance	1	0.04%	Insulation Breach	14	0.58%
Abnormal Pacing Impedance	4	0.16%			
Conductor Fracture	5	0.21%	U.S. Acute Lead Observations	2	0.08%
Failure to Capture	3	0.12%	Insulation Breach	1	0.04%
Failure to Sense	1	0.04%	Oversensing	1	0.04%
Insulation Breach	3	0.12%			
Lead Dislodgement	2	0.08%			
Oversensing	41	1.69%			
Other	3	0.12%			



6.2 ICD Leads

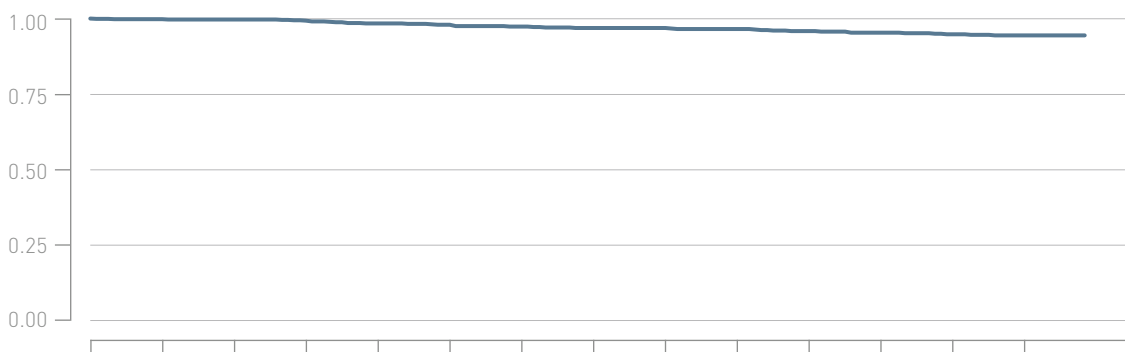
Kentrox SL

Product Versions	65, 75, 100, -Steroid
Lead Type	dual coil, passive fixation
Polarity	bipolar
Steroid	yes/no
U.S. Market Release	Oct 2004
CE Market Release	Dec 2003 / Dec 2004
Worldwide Distributed Devices	8440
Registered U.S. Implants	1000
Estimated Active U.S. Implants	528
U.S. Total Returned	19

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	33	3.27%	U.S. Confirmed Malfunctions	5	0.50%
Abnormal Defibrillation Impedance	1	0.10%	Insulation Breach	5	0.50%
Abnormal Pacing Impedance	3	0.30%			
Conductor Fracture	3	0.30%	U.S. Acute Lead Observations	0	0.00%
Failure to Capture	2	0.20%			
Insulation Breach	6	0.60%			
Oversensing	16	1.59%			
Other	2	0.20%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Total [%]	100.0	99.8	99.7	99.3	98.4	97.9	97.3	96.8	96.8	96.5	95.8	95.3	94.8	94.4	94.2
CI [±%]	-	0.3	0.4	0.6	0.9	1.0	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.8	1.8
Sample Size	1000	895	831	774	704	659	613	593	574	562	549	540	529	510	296

6.2 ICD Leads

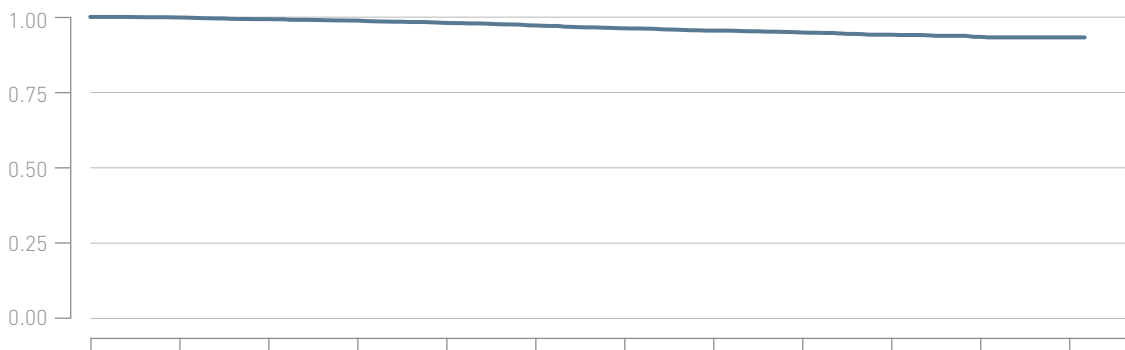
Linux S

Product Versions	65, 75
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Feb 2007
CE Market Release	Mar 2007
Worldwide Distributed Devices	32 700
Registered U.S. Implants	2 465
Estimated Active U.S. Implants	1 650
U.S. Total Returned	82

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	80	3.21%	U.S. Confirmed Malfunctions	42	1.68%
Abnormal Defibrillation Impedance	8	0.32%	Conductor Fracture	6	0.24%
Abnormal Pacing Impedance	6	0.24%	Insulation Breach	36	1.44%
Conductor Fracture	7	0.28%			
Failure to Capture	9	0.36%	U.S. Acute Lead Observations	2	0.08%
Failure to Sense	1	0.04%	Lead Dislodgement	1	0.04%
Insulation Breach	4	0.16%	Other	1	0.04%
Oversensing	39	1.56%			
Other	6	0.24%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8	9	10	11
Total [%]	100.0	99.8	99.3	98.8	98.0	97.2	96.2	95.5	94.8	94.0	93.5	92.9
CI [±%]	-	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
Sample Size	2465	2260	2128	2017	1924	1848	1785	1742	1674	1166	690	392

6.2 ICD Leads

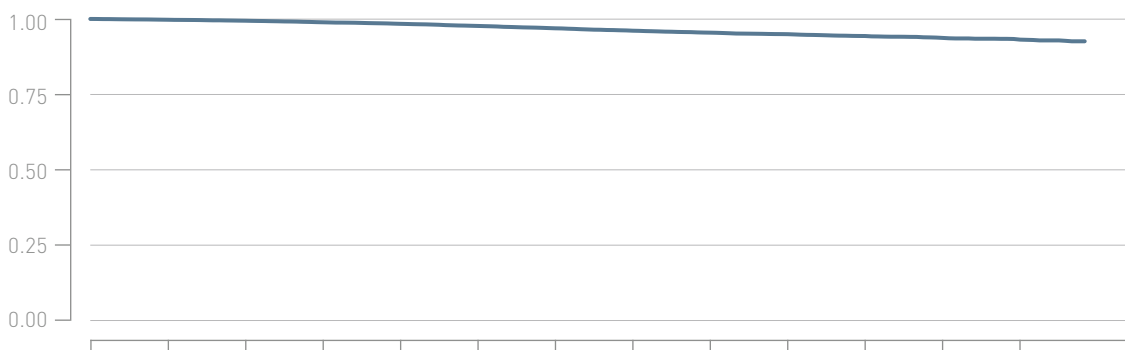
Linux SD

Product Versions	60/16, 65/16, 65/18, 75/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Apr 2006
CE Market Release	Aug 2006
Worldwide Distributed Devices	55 100
Registered U.S. Implants	22 087
Estimated Active U.S. Implants	14 300
U.S. Total Returned	503

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	811	3.64%	U.S. Confirmed Malfunctions	208	0.93%
Abnormal Defibrillation Impedance	69	0.31%	Conductor Fracture	30	0.13%
Abnormal Pacing Impedance	57	0.26%	Insulation Breach	177	0.80%
Cardiac Perforation	3	0.01%	Other	1	0.00%
Conductor Fracture	90	0.40%			
Failure to Capture	70	0.31%	U.S. Acute Lead Observations	11	0.05%
Failure to Sense	15	0.07%	Abnormal Pacing Impedance	1	0.00%
Insulation Breach	58	0.26%	Cardiac Perforation	1	0.00%
Lead Dislodgement	31	0.14%	Failure to Capture	1	0.00%
Oversensing	371	1.67%	Lead Dislodgement	6	0.03%
Other	47	0.21%	Oversensing	1	0.00%
			Other	1	0.00%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Total [%]	100.0	99.7	99.4	98.9	98.4	97.7	96.9	96.1	95.4	94.9	94.3	93.7	93.1	92.4
CI [±%]	-	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.6
Sample Size	22087	20076	18837	17782	16934	16200	15601	15141	14727	13195	8991	5603	2803	821

6.2 ICD Leads

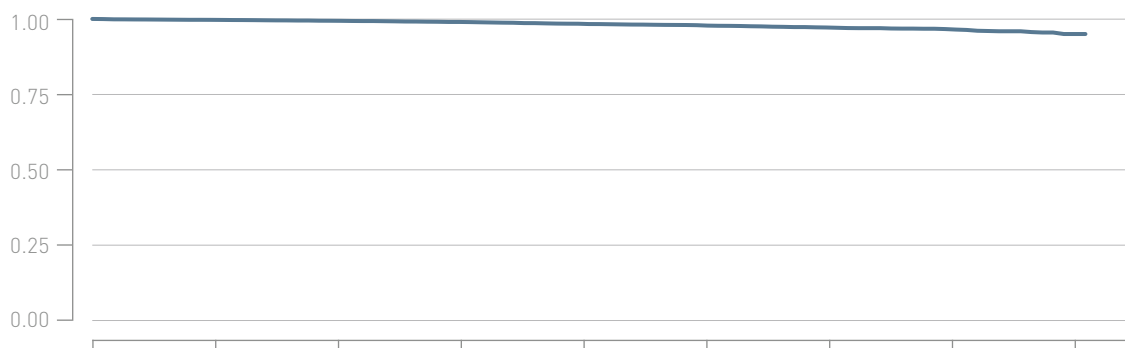
Linux^{smart} S

Product Versions	60, 65, 75
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Aug 2011
CE Market Release	Dec 2010
Worldwide Distributed Devices	46 700
Registered U.S. Implants	7 595
Estimated Active U.S. Implants	6 290
U.S. Total Returned	173

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	161	2.10%	U.S. Confirmed Malfunctions	63	0.82%
Abnormal Defibrillation Impedance	10	0.13%	Conductor Fracture	8	0.10%
Abnormal Pacing Impedance	13	0.17%	Insulation Breach	55	0.72%
Cardiac Perforation	1	0.01%	U.S. Acute Lead Observations	10	0.13%
Conductor Fracture	17	0.22%	Abnormal Pacing Impedance	1	0.01%
Failure to Capture	21	0.27%	Cardiac Perforation	1	0.01%
Failure to Sense	5	0.07%	Lead Dislodgement	7	0.09%
Insulation Breach	5	0.07%	Other	1	0.01%
Lead Dislodgement	14	0.18%			
Oversensing	66	0.86%			
Other	9	0.12%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8
Total [%]	100.0	99.7	99.3	98.9	98.2	97.7	96.9	95.9	95.0
CI [±%]	-	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.9
Sample Size	7595	7133	6846	6514	6022	5138	3580	1981	388

6.2 ICD Leads

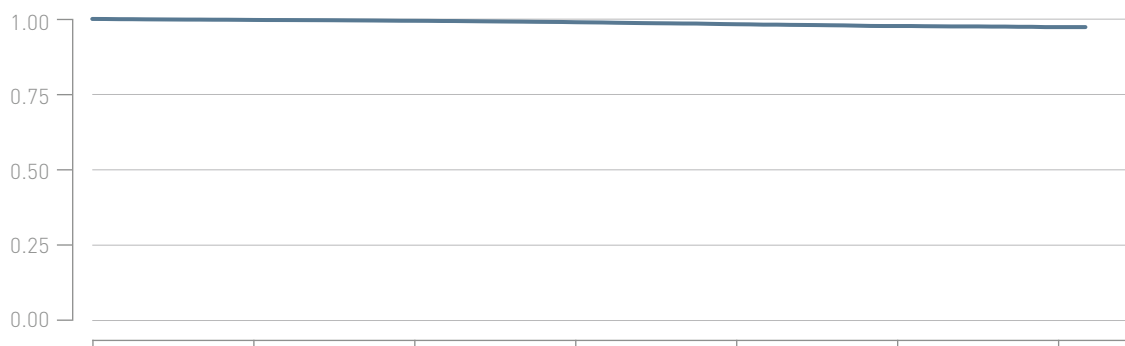
Linux^{smart} S DX

Product Versions	65/15, 65/17
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Feb 2013
CE Market Release	Mar 2010
Worldwide Distributed Devices	36300
Registered U.S. Implants	16297
Estimated Active U.S. Implants	14700
U.S. Total Returned	317

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	228	1.39%	U.S. Confirmed Malfunctions	76	0.46%
Abnormal Defibrillation Impedance	25	0.15%	Conductor Fracture	4	0.02%
Abnormal Pacing Impedance	14	0.09%	Insulation Breach	72	0.44%
Conductor Fracture	26	0.16%			
Failure to Capture	21	0.13%	U.S. Acute Lead Observations	39	0.24%
Failure to Sense	8	0.05%	Cardiac Perforation	4	0.02%
Insulation Breach	5	0.03%	Failure to Capture	9	0.05%
Lead Dislodgement	38	0.23%	Lead Dislodgement	16	0.10%
Oversensing	85	0.52%	Oversensing	3	0.02%
Other	6	0.04%	Other	7	0.04%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6
Total [%]	100.0	99.7	99.4	98.9	98.2	97.4	97.0
CI [±%]	-	0.1	0.1	0.2	0.2	0.3	0.4
Sample Size	16297	15476	14860	12228	8355	5105	2066

6.2 ICD Leads

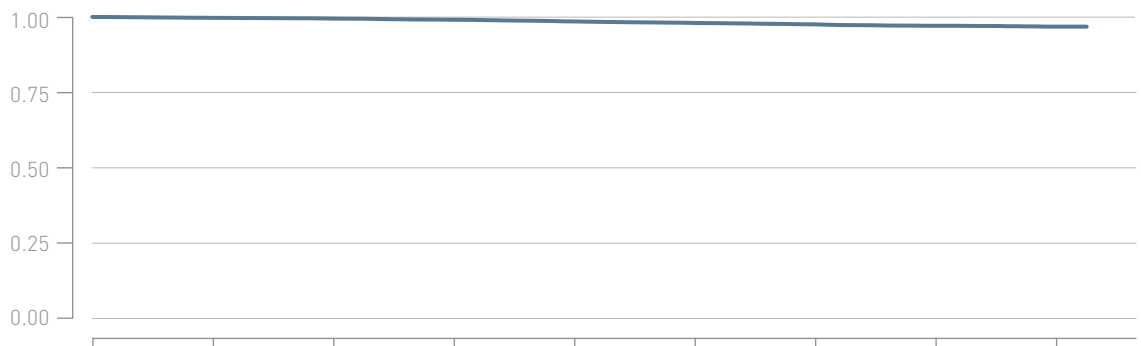
Linux^{smart} SD

Product Versions	60/16, 65/16, 65/18, 75/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jan 2011
CE Market Release	Oct 2009
Worldwide Distributed Devices	55 700
Registered U.S. Implants	13 123
Estimated Active U.S. Implants	10 700
U.S. Total Returned	238

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	278	2.10%	U.S. Confirmed Malfunctions	62	0.47%
Abnormal Defibrillation Impedance	22	0.17%	Conductor Fracture	8	0.06%
Abnormal Pacing Impedance	13	0.10%	Insulation Breach	53	0.40%
Cardiac perforation	1	0.01%	Other	1	0.01%
Conductor Fracture	37	0.28%			
Extracardiac Stimulation	1	0.01%	U.S. Acute Lead Observations	29	0.22%
Failure to Capture	23	0.17%	Abnormal Defibrillation Impedance	1	0.01%
Failure to Sense	7	0.05%	Cardiac Perforation	2	0.02%
Insulation Breach	8	0.06%	Failure to Capture	4	0.03%
Lead Dislodgement	24	0.18%	Insulation Breach	1	0.01%
Oversensing	135	1.02%	Lead Dislodgement	12	0.09%
Other	7	0.05%	Oversensing	2	0.02%
			Other	7	0.05%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8
Total [%]	100.0	99.7	99.5	99.0	98.5	98.0	97.5	96.9	96.4
CI [±%]	-	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4
Sample Size	13123	12169	11759	11263	10688	9876	8322	5957	2503

6.2 ICD Leads

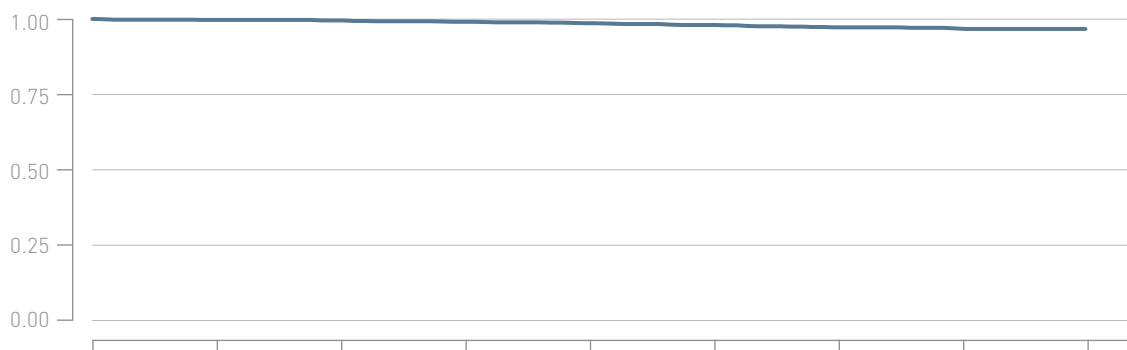
Linux^{smart} TD

Product Versions	65/16, 65/18, 75/18
Lead Type	dual-coil, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jan 2011
CE Market Release	Oct 2009
Worldwide Distributed Devices	7720
Registered U.S. Implants	1265
Estimated Active U.S. Implants	1020
U.S. Total Returned	21

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	36	2.82%	U.S. Confirmed Malfunctions	1	0.08%
Abnormal Defibrillation Impedance	5	0.39%	Insulation Breach	1	0.08%
Abnormal Pacing Impedance	4	0.31%			
Conductor Fracture	3	0.24%	U.S. Acute Lead Observations	3	0.24%
Failure to Capture	9	0.71%	Lead Dislodgement	3	0.24%
Insulation Breach	2	0.16%			
Lead Dislodgement	4	0.31%			
Oversensing	9	0.71%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8
Total [%]	100.0	99.7	99.2	98.9	98.3	97.6	97.2	96.4	96.1
CI [±%]	-	0.3	0.5	0.6	0.7	0.9	1.0	1.2	1.3
Sample Size	1265	1174	1138	1096	1035	946	792	561	239

6.2 ICD Leads

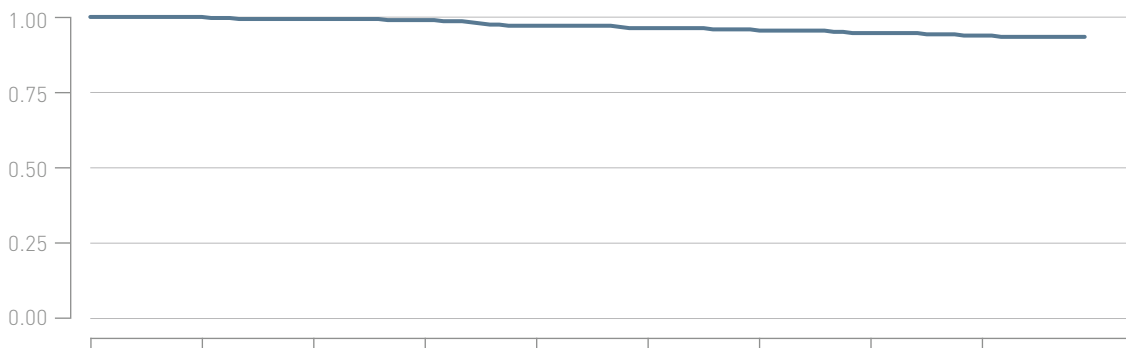
Linux T

Product Versions	65, 75
Lead Type	single-coil, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Feb 2007
CE Market Release	Mar 2007
Worldwide Distributed Devices	2260
Registered U.S. Implants	319
Estimated Active U.S. Implants	220
U.S. Total Returned	4

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	16	4.97%	U.S. Confirmed Malfunctions	3	0.93%
Abnormal Pacing Impedance	2	0.62%	Conductor Fracture	1	0.31%
Conductor fracture	1	0.31%	Insulation Breach	2	0.62%
Failure to Capture	4	1.24%			
Insulation Breach	1	0.31%	U.S. Acute Lead Observations	1	0.31%
Oversensing	7	2.17%	Other	1	0.31%
Other	1	0.31%			

• Total survival

Cumulative survival probability



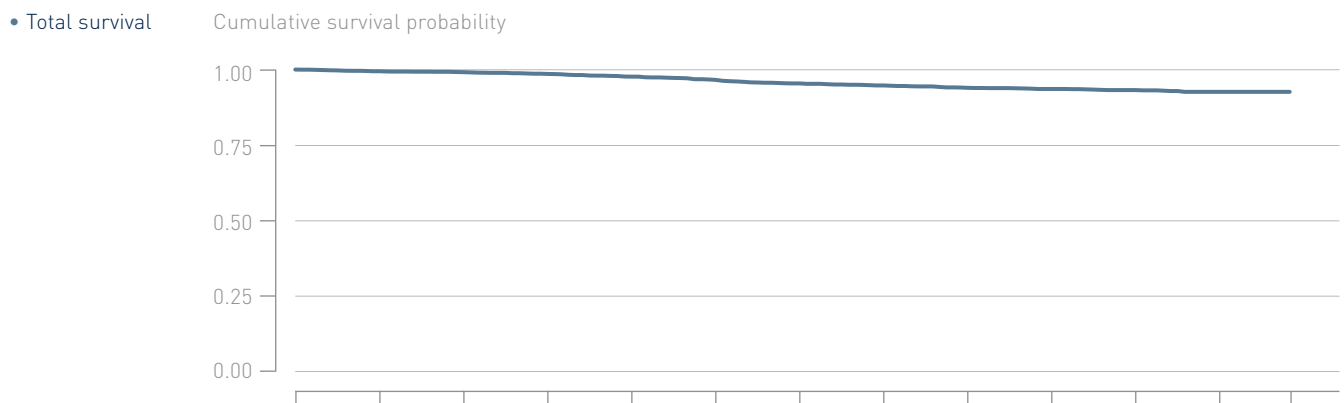
Years after implant	0	1	2	3	4	5	6	7	8	9
Total [%]	100.0	100.0	99.3	99.0	97.1	96.3	95.5	94.6	93.8	93.4
CI [±%]	-	< 0.1	0.9	1.2	2.0	2.3	2.5	2.7	2.9	3.0
Sample Size	319	295	283	272	251	241	234	230	227	210

6.2 ICD Leads

Linux TD

Product Versions	65/16, 75/16, 100/16, 100/18
Lead Type	dual-coil, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Oct 2006
CE Market Release	Oct 2006
Worldwide Distributed Devices	14 600
Registered U.S. Implants	3 021
Estimated Active U.S. Implants	2 020
U.S. Total Returned	79

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	131	4.29%	U.S. Confirmed Malfunctions	37	1.21%
Abnormal Defibrillation Impedance	13	0.43%	Conductor Fracture	6	0.20%
Abnormal Pacing Impedance	13	0.43%	Insulation Breach	31	1.02%
Conductor Fracture	17	0.56%			
Failure to Capture	20	0.66%	U.S. Acute Lead Observations	3	0.10%
Failure to Sense	4	0.13%	Failure to Capture	1	0.03%
Insulation Breach	13	0.43%	Lead Dislodgement	2	0.07%
Lead Dislodgement	4	0.13%			
Oversensing	44	1.44%			
Other	3	0.10%			



Years after implant	0	1	2	3	4	5	6	7	8	9	10	11	12
Total [%]	100.0	99.4	99.1	98.5	97.6	96.6	95.4	94.7	93.9	93.5	93.2	92.7	92.3
CI [±%]	-	0.3	0.3	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.0	1.1	1.3
Sample Size	3021	2730	2598	2451	2338	2238	2150	2088	2026	1785	1249	748	319

6.2 ICD Leads

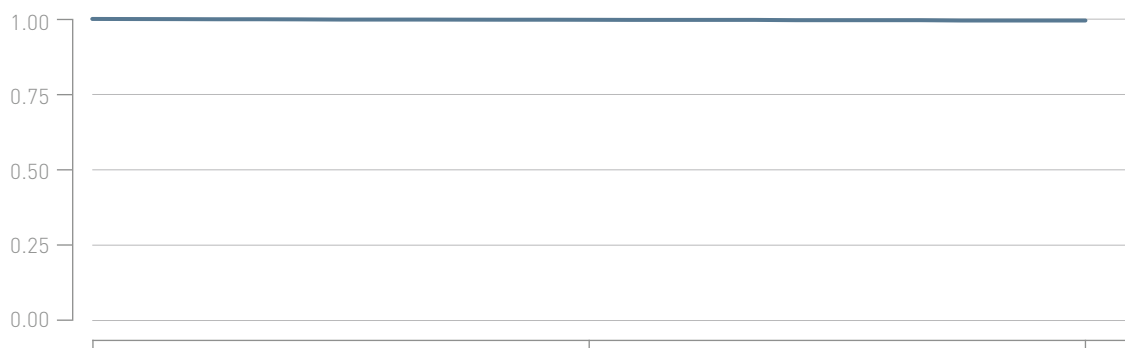
Plexa S

Product Versions	60, 65, 75
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Mar 2017
CE Market Release	Feb 2017
Worldwide Distributed Devices	55700
Registered U.S. Implants	9249
Estimated Active U.S. Implants	8860
U.S. Total Returned	53

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	42	0.45%	U.S. Confirmed Malfunctions	2	0.02%
Abnormal Defibrillation Impedance	5	0.05%	Insulation Breach	2	0.02%
Abnormal Pacing Impedance	1	0.01%			
Cardiac Perforation	1	0.01%	U.S. Acute Lead Observations	13	0.14%
Failure to Capture	5	0.05%	Cardiac Perforation	2	0.02%
Failure to Sense	1	0.01%	Failure to Capture	3	0.03%
Lead Dislodgement	15	0.16%	Lead Dislodgement	8	0.09%
Oversensing	10	0.11%			
Other	4	0.04%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2
Total [%]	100.0	99.6	99.2
CI [±%]	-	0.1	0.3
Sample Size	9249	5222	1654

6.2 ICD Leads

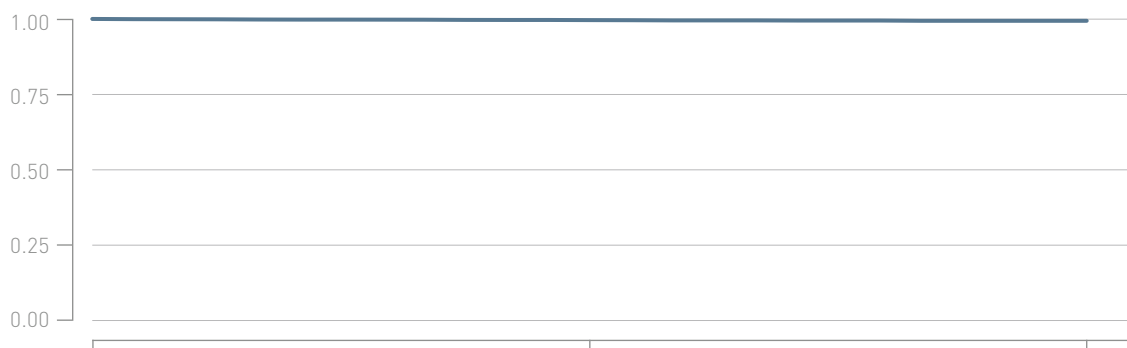
Plexa S DX DF1

Product Versions	65/15, 65/17
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Mar 2017
CE Market Release	Feb 2017
Worldwide Distributed Devices	17200
Registered U.S. Implants	8211
Estimated Active U.S. Implants	7880
U.S. Total Returned	72

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	33	0.40%	U.S. Confirmed Malfunctions	11	0.13%
Abnormal Pacing Impedance	2	0.02%	Insulation Breach	11	0.13%
Conductor Fracture	1	0.01%			
Failure to Capture	3	0.04%	U.S. Acute Lead Observations	16	0.19%
Failure to Sense	4	0.05%	Cardiac Perforation	1	0.01%
Lead Dislodgement	12	0.15%	Failure to Capture	2	0.02%
Oversensing	11	0.13%	Failure to Sense	1	0.01%
			Lead Dislodgement	10	0.12%
			Oversensing	1	0.01%
			Other	1	0.01%

• Total survival

Cumulative survival probability



Years after implant	0	1	2
Total [%]	100.0	99.6	99.3
CI [±%]	-	0.1	0.2
Sample Size	8211	5636	1661

6.2 ICD Leads

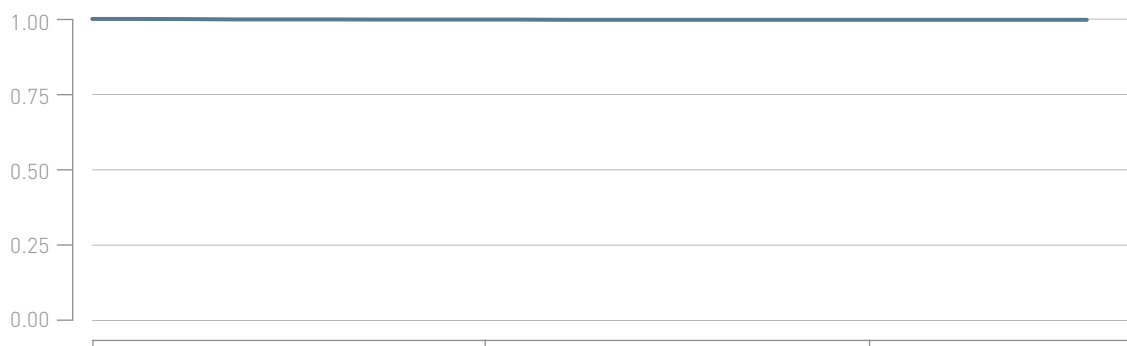
Plexa SD

Product Versions	65/16, 65/18, 75/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Mar 2017
CE Market Release	Feb 2017
Worldwide Distributed Devices	7590
Registered U.S. Implants	2650
Estimated Active U.S. Implants	2530
U.S. Total Returned	10

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	11	0.41%	U.S. Confirmed Malfunctions	0	0.00%
Extracardiac stimulation	1	0.04%			
Failure to Capture	1	0.04%	U.S. Acute Lead Observations	5	0.19%
Failure to Sense	1	0.04%	Cardiac Perforation	1	0.04%
Lead Dislodgement	5	0.19%	Failure to Capture	1	0.04%
Oversensing	3	0.11%	Lead Dislodgement	1	0.04%
			Oversensing	1	0.04%
			Other	1	0.04%

• Total survival

Cumulative survival probability



Years after implant	0	1	2
Total [%]	100.0	99.6	99.4
CI [±%]	-	0.3	0.4
Sample Size	2650	1513	421

6.2 ICD Leads

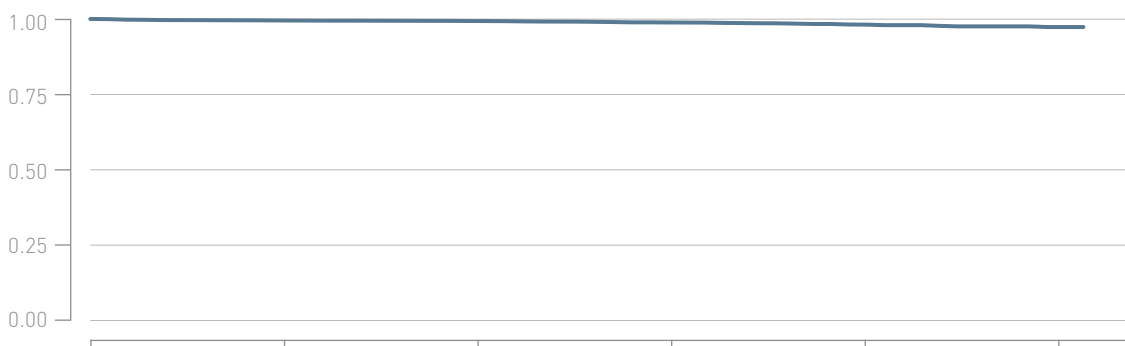
Protego S

Product Versions	60, 65, 75
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jul 2014
CE Market Release	Feb 2014
Worldwide Distributed Devices	54 700
Registered U.S. Implants	8 271
Estimated Active U.S. Implants	7 370
U.S. Total Returned	94

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	114	1.37%	U.S. Confirmed Malfunctions	27	0.32%
Abnormal defibrillation impedance	3	0.04%	Conductor Fracture	4	0.05%
Abnormal Pacing Impedance	7	0.08%	Insulation Breach	22	0.26%
Cardiac Perforation	1	0.01%	Other	1	0.01%
Conductor Fracture	10	0.12%			
Extracardiac Stimulation	1	0.01%	U.S. Acute Lead Observations	28	0.34%
Failure to Capture	17	0.20%	Cardiac Perforation	2	0.02%
Failure to Sense	4	0.05%	Extracardiac Stimulation	1	0.01%
Insulation Breach	2	0.02%	Failure to Capture	3	0.04%
Lead Dislodgement	24	0.29%	Lead Dislodgement	13	0.16%
Oversensing	40	0.48%	Other	9	0.11%
Other	5	0.06%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5
Total [%]	100.0	99.5	99.2	98.6	97.7	97.0
CI [±%]	-	0.2	0.2	0.3	0.4	0.6
Sample Size	8 271	7 761	7 227	5 202	2 174	343

6.2 ICD Leads

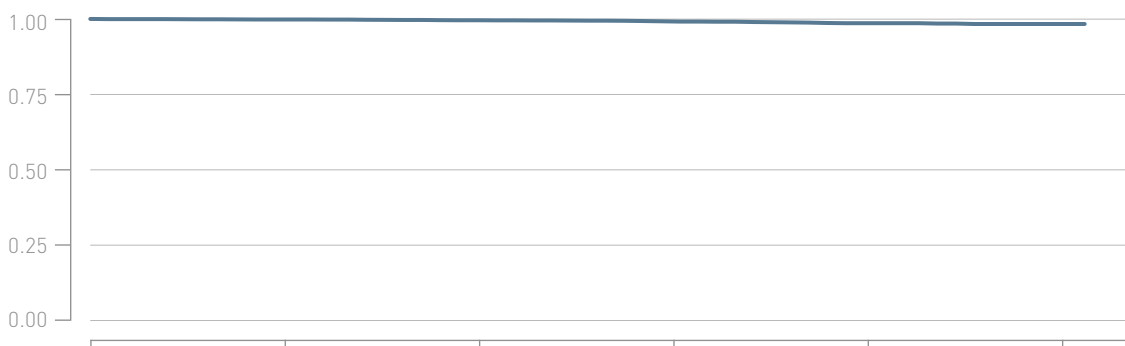
Protego SD

Product Versions _____	60/16, 65/16, 65/18, 75/18
Lead Type _____	dual-coil, active fixation
Polarity _____	bipolar
Steroid _____	yes
U.S. Market Release _____	Jul 2014
CE Market Release _____	May 2013
Worldwide Distributed Devices _____	18400
Registered U.S. Implants _____	3409
Estimated Active U.S. Implants _____	3060
U.S. Total Returned _____	35

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications _____	40	1.16%	U.S. Confirmed Malfunctions _____	7	0.20%
Abnormal Defibrillation Impedance _____	4	0.12%	Insulation Breach _____	7	0.20%
Abnormal Pacing Impedance _____	2	0.06%			
Conductor Fracture _____	5	0.15%	U.S. Acute Lead Observations _____	3	0.09%
Failure to Capture _____	4	0.12%	Lead Dislodgement _____	2	0.06%
Insulation Breach _____	1	0.03%	Other _____	1	0.03%
Lead Dislodgement _____	4	0.12%			
Oversensing _____	18	0.52%			
Other _____	2	0.06%			

• Total survival

Cumulative survival probability



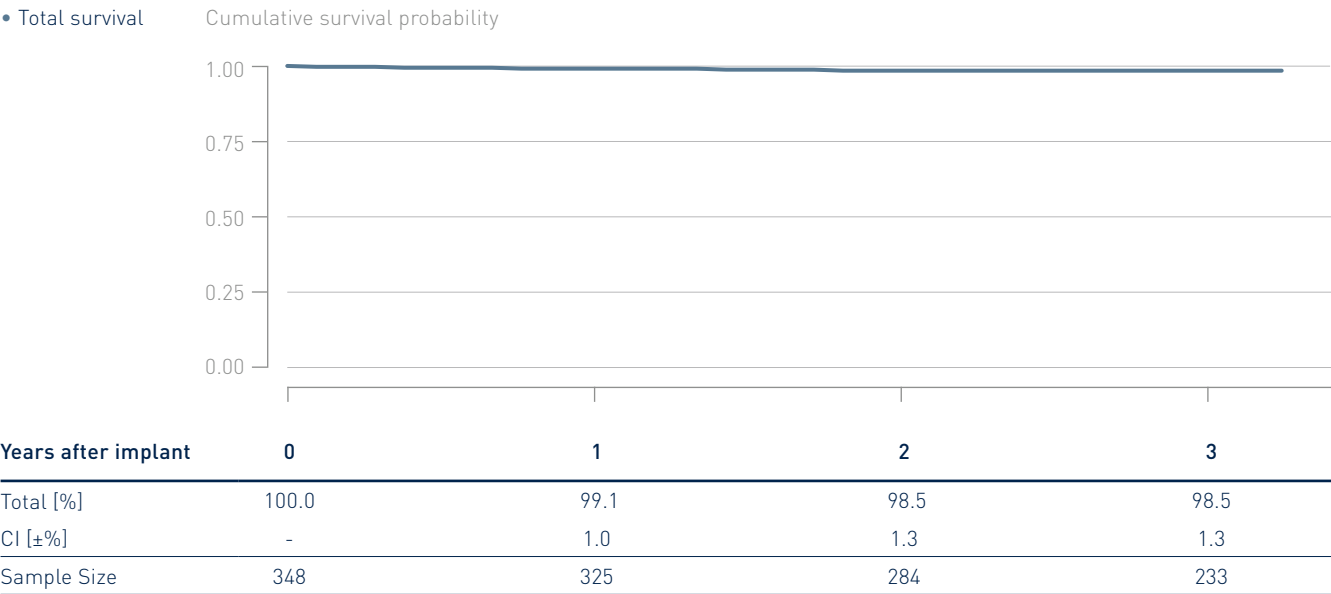
Years after implant	0	1	2	3	4	5
Total [%]	100.0	99.8	99.5	99.0	98.2	97.9
CI [±%]	-	0.1	0.2	0.4	0.5	0.7
Sample Size	3409	3234	3074	2343	1197	231

6.2 ICD Leads

Protego TD

Product Versions	65/16, 65/18, 75/18
Lead Type	dual-coil, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jul 2014
CE Market Release	Jan 2014
Worldwide Distributed Devices	1450
Registered U.S. Implants	348
Estimated Active U.S. Implants	313
U.S. Total Returned	4

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	7	1.99%	U.S. Confirmed Malfunctions	0	0.00%
Conductor fracture	2	0.57%			
Failure to Capture	2	0.57%	U.S. Acute Lead Observations	0	0.00%
Failure to Sense	1	0.28%			
Insulation Breach	1	0.28%			
Other	1	0.28%			



6.2 ICD Leads

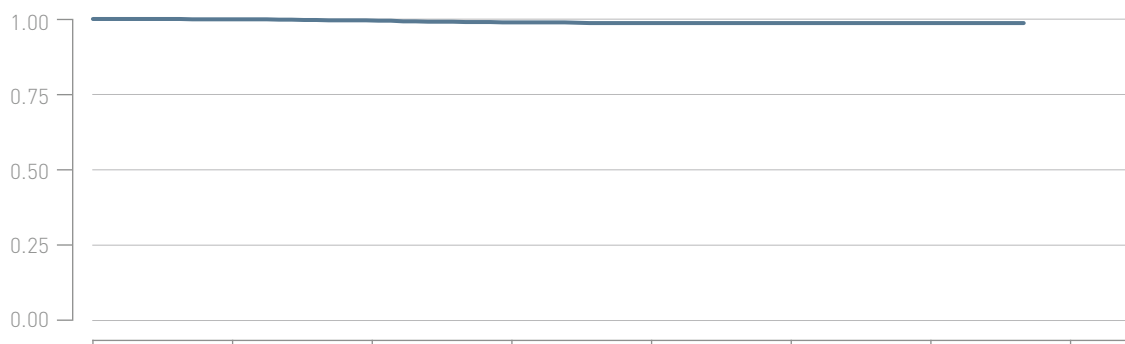
Vigila 2CR

Product Versions	60/16, 65/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Feb 2012
CE Market Release	Oct 2011
Worldwide Distributed Devices	2730
Registered U.S. Implants	795
Estimated Active U.S. Implants	724
U.S. Total Returned	12

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	11	1.38%	U.S. Confirmed Malfunctions	4	0.50%
Abnormal pacing impedance	1	0.13%	Insulation Breach	4	0.50%
Conductor Fracture	1	0.13%			
Lead dislodgement	3	0.38%	U.S. Acute Lead Observations	0	0.00%
Oversensing	6	0.75%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7
Total [%]	100.0	99.9	99.3	98.7	98.3	98.3	98.3	97.9
CI [±%]	-	0.3	0.6	0.8	0.9	0.9	0.9	1.1
Sample Size	795	764	747	733	726	726	648	313

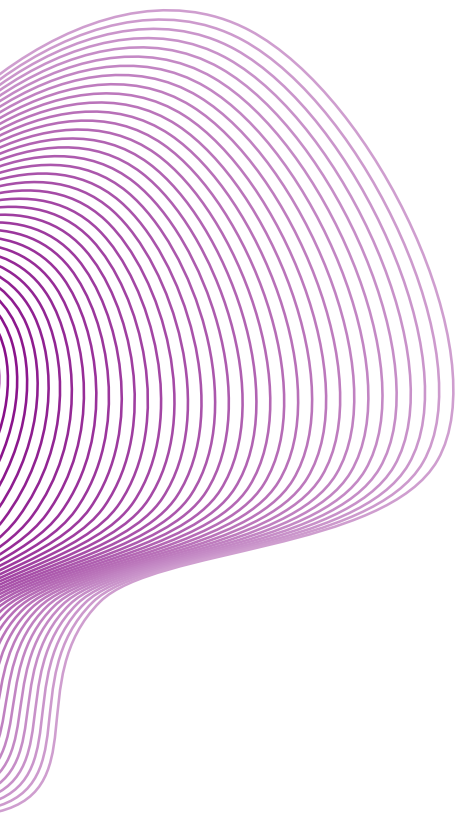
Performance of **BIOTRONIK Leads**

Based on Returned Products
and Complaint Data

6.1 Pacing Leads

6.2 ICD Leads

6.3 CRT Leads



6.3 CRT Leads

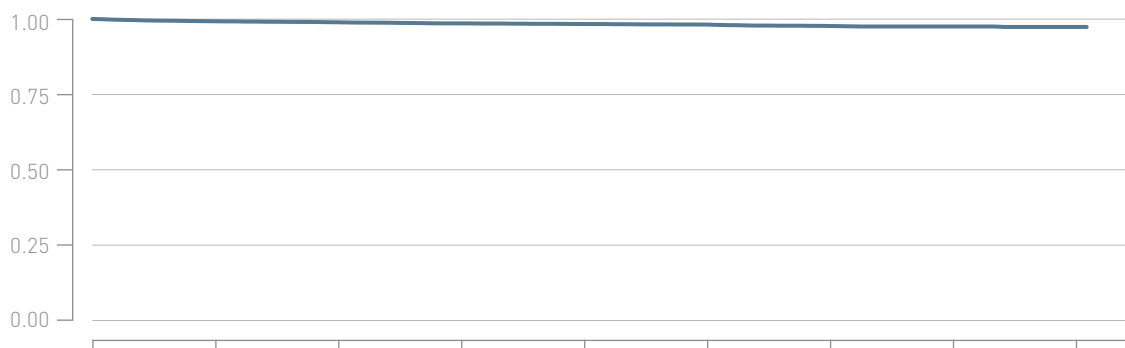
Corox OTW-L

Product Versions	75, 85
Lead Type	dual-curve fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jan 2011
CE Market Release	Dec 2009
Worldwide Distributed Devices	32 000
Registered U.S. Implants	6 252
Estimated Active U.S. Implants	5 030
U.S. Total Returned	76

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	120	1.90%	U.S. Confirmed Malfunctions	4	0.06%
Abnormal Pacing Impedance	1	0.02%	Conductor Fracture	3	0.05%
Conductor Fracture	5	0.08%	Insulation Breach	1	0.02%
Extracardiac Stimulation	20	0.32%			
Failure to Capture	49	0.78%	U.S. Acute Lead Observations	21	0.33%
Failure to Sense	1	0.02%	Extracardiac Stimulation	6	0.10%
Insulation Breach	2	0.03%	Failure to Capture	2	0.03%
Lead Dislodgement	35	0.56%	Lead Dislodgement	10	0.16%
Oversensing	1	0.02%	Other	3	0.05%
Other	6	0.10%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8
Total [%]	100.0	99.2	98.9	98.5	98.2	98.1	97.6	97.4	97.2
CI [±%]	-	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.6
Sample Size	6252	5695	5435	4905	4148	3299	2400	1384	584

6.3 CRT Leads

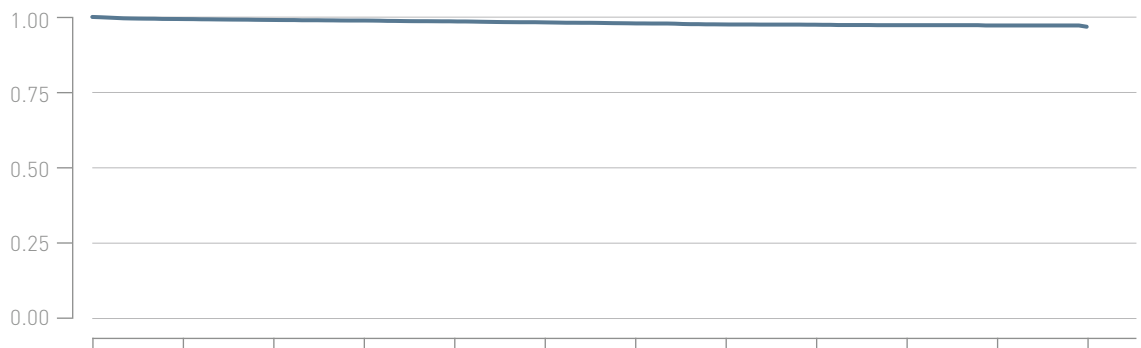
Corox OTW-S

Product Versions	75, 85
Lead Type	thread fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	May 2008
CE Market Release	Dec 2006
Worldwide Distributed Devices	26 400
Registered U.S. Implants	8 157
Estimated Active U.S. Implants	5 780
U.S. Total Returned	127

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	154	1.87%	U.S. Confirmed Malfunctions	13	0.16%
Abnormal Pacing Impedance	7	0.09%	Conductor Fracture	8	0.10%
Conductor Fracture	5	0.06%	Insulation Breach	4	0.05%
Extracardiac Stimulation	15	0.18%	Other	1	0.01%
Failure to Capture	45	0.55%			
Failure to Sense	1	0.01%	U.S. Acute Lead Observations	33	0.40%
Insulation Breach	4	0.05%	Cardiac Perforation	1	0.01%
Lead Dislodgement	56	0.68%	Extracardiac Stimulation	5	0.06%
Oversensing	3	0.04%	Failure to Capture	6	0.07%
Other	18	0.22%	Lead Dislodgement	20	0.24%
			Other	1	0.01%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8	9	10	11
Total [%]	100.0	99.3	99.0	98.8	98.5	98.1	97.8	97.4	97.2	97.2	97.0	96.8
CI [±%]	-	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.6
Sample Size	8157	7167	6756	6206	5564	4873	4176	3472	2850	2123	1036	330

6.3 CRT Leads

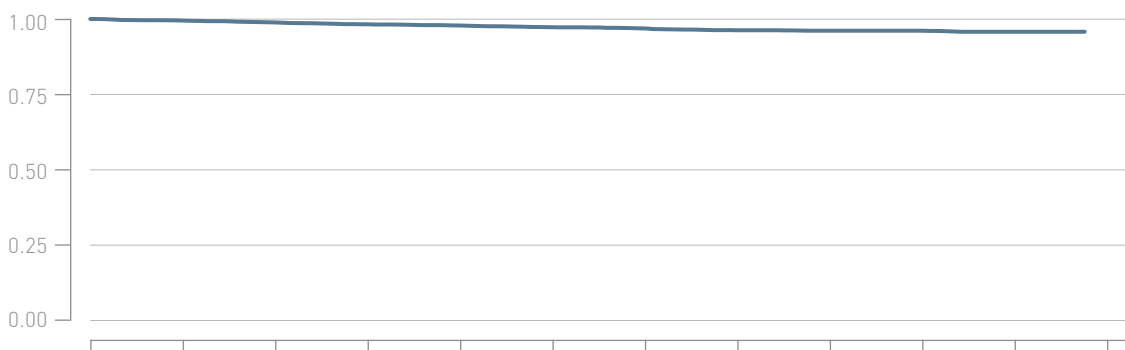
Corox OTW

Product Versions	75, 85
Lead Type	helix fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	May 2008
CE Market Release	Dec 2006
Worldwide Distributed Devices	28 700
Registered U.S. Implants	4 115
Estimated Active U.S. Implants	2 700
U.S. Total Returned	76

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	110	2.66%	U.S. Confirmed Malfunctions	16	0.39%
Abnormal Pacing Impedance	6	0.15%	Conductor Fracture	15	0.36%
Conductor Fracture	3	0.07%	Insulation Breach	1	0.02%
Extracardiac Stimulation	8	0.19%			
Failure to Capture	39	0.94%	U.S. Acute Lead Observations	9	0.22%
Insulation Breach	3	0.07%	Lead Dislodgement	7	0.17%
Lead Dislodgement	38	0.92%	Other	2	0.05%
Oversensing	2	0.05%			
Other	11	0.27%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8	9	10	11
Total [%]	100.0	99.5	98.8	98.2	97.8	97.3	96.9	96.3	96.2	96.2	95.7	95.5
CI [±%]	-	0.2	0.4	0.4	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.9
Sample Size	4115	3555	3310	3084	2887	2688	2461	2171	1912	1576	892	317

6.3 CRT Leads

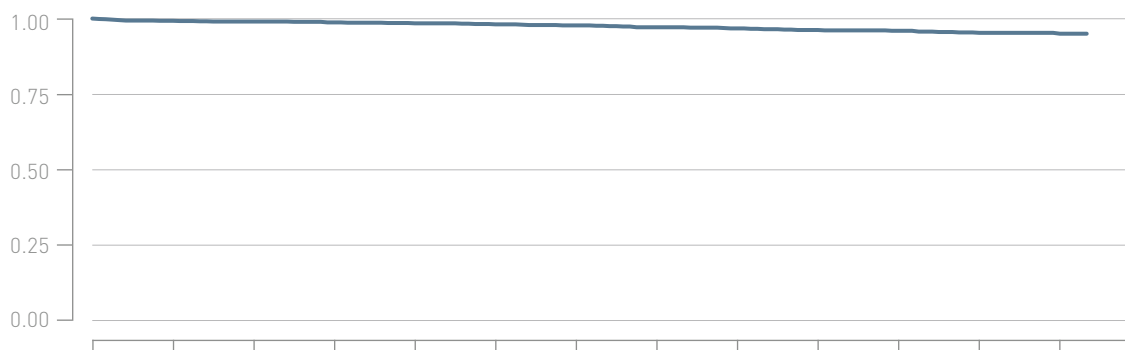
Corox OTW

Product Versions	75, 85
Lead Type	helix fixation
Polarity	unipolar
Steroid	yes
U.S. Market Release	Aug 2006
CE Market Release	Apr 2004
Worldwide Distributed Devices	10400
Registered U.S. Implants	1423
Estimated Active U.S. Implants	699
U.S. Total Returned	26

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	44	3.09%	U.S. Confirmed Malfunctions	2	0.14%
Abnormal pacing impedance	1	0.07%	Insulation Breach	2	0.14%
Conductor fracture	2	0.14%			
Extracardiac Stimulation	7	0.49%	U.S. Acute Lead Observations	4	0.28%
Failure to Capture	16	1.12%	Failure to Capture	3	0.21%
Insulation Breach	2	0.14%	Lead Dislodgement	1	0.07%
Lead Dislodgement	10	0.70%			
Oversensing	1	0.07%			
Other	5	0.35%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5	6	7	8	9	10	11	12
Total [%]	100.0	99.3	99.0	98.7	98.4	98.1	97.7	97.1	96.7	96.2	95.9	95.3	95.1
CI [±%]	-	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.4
Sample Size	1423	1237	1121	1016	932	865	810	773	747	730	713	700	534

6.3 CRT Leads

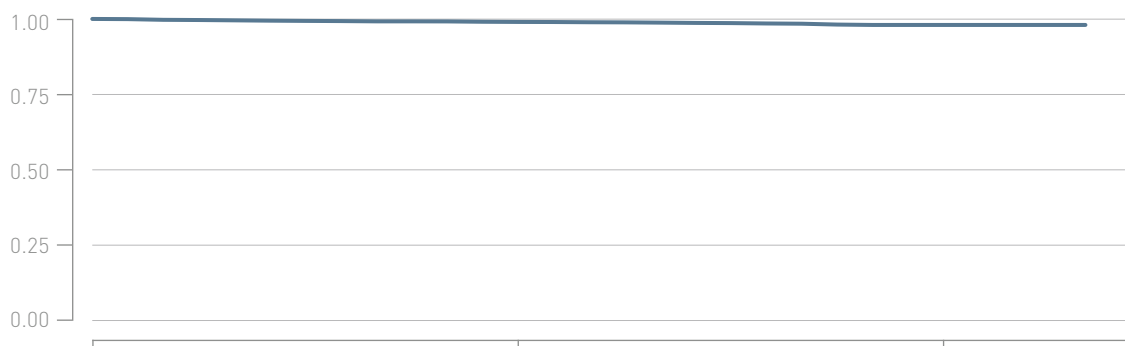
Sentus OTW QP L

Product Versions	75, 75/49, 85, 85/49
Lead Type	dual-curve fixation
Polarity	quadripolar
Steroid	yes
U.S. Market Release	May 2017
CE Market Release	Dec 2014
Worldwide Distributed Devices	65 900
Registered U.S. Implants	9 004
Estimated Active U.S. Implants	8 130
U.S. Total Returned	76

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	103	1.12%	U.S. Confirmed Malfunctions	13	0.14%
Abnormal Pacing Impedance	12	0.13%	Conductor Fracture	13	0.14%
Extracardiac Stimulation	8	0.09%			
Failure to Capture	21	0.23%	U.S. Acute Lead Observations	29	0.32%
Lead Dislodgement	50	0.54%	Abnormal Defibrillation Impedance	1	0.01%
Oversensing	7	0.08%	Abnormal Pacing Impedance	1	0.01%
Other	5	0.05%	Extracardiac Stimulation	6	0.07%
			Failure to Capture	1	0.01%
			Lead Dislodgement	18	0.20%
			Oversensing	1	0.01%
			Other	1	0.01%

• Total survival

Cumulative survival probability



Years after implant	0	1	2
Total [%]	100.0	98.8	97.9
CI [±%]	-	0.3	0.4
Sample Size	9004	4975	1683

6.3 CRT Leads

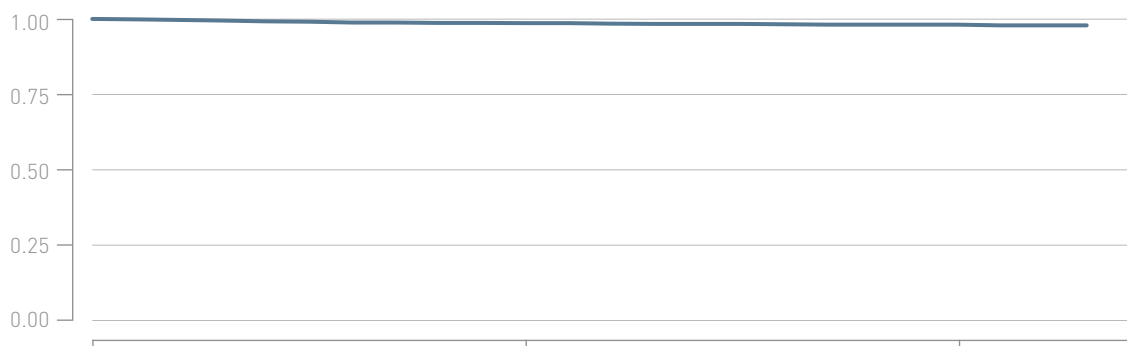
Sentus OTW QP S

Product Versions	75, 75/49, 85, 85/49
Lead Type	thread fixation
Polarity	quadripolar
Steroid	yes
U.S. Market Release	May 2017
CE Market Release	Dec 2014
Worldwide Distributed Devices	15700
Registered U.S. Implants	2828
Estimated Active U.S. Implants	2340
U.S. Total Returned	71

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	49	1.68%	U.S. Confirmed Malfunctions	3	0.10%
Abnormal pacing impedance	1	0.03%	Conductor Fracture	3	0.10%
Conductor Fracture	1	0.03%			
Extracardiac Stimulation	3	0.10%	U.S. Acute Lead Observations	49	1.68%
Failure to Capture	11	0.38%	Abnormal pacing impedance	1	0.03%
Lead Dislodgement	29	1.00%	Extracardiac Stimulation	4	0.14%
Oversensing	4	0.14%	Failure to Capture	4	0.14%
			Failure to Sense	1	0.03%
			Lead Dislodgement	39	1.34%

• Total survival

Cumulative survival probability



Years after implant	0	1	2
Total [%]	100.0	98.0	97.4
CI [±%]	-	0.6	0.7
Sample Size	2828	1668	668



Methodology for Lead Survival Estimates Based on Clinical Studies

- 7.1 Introduction
- 7.2 BIOTRONIK's Clinical Studies
- 7.3 Lead Complications
- 7.4 Lead Product Performance Graphs and Data

7. Methodology for Lead Survival Estimates Based on Clinical Studies

7.1 Introduction

All leads and lead segments returned to BIOTRONIK are thoroughly analyzed to determine whether or not they meet BIOTRONIK's long term quality standards.

Although analysis of returned product is an excellent method for gaining insight into lead failure mechanisms, this data relies on the return of explanted leads. For the majority of complications the lead is not received for analysis as challenging clinical environments may not allow for the return, e.g. the extraction of an implanted lead may not be possible.

BIOTRONIK includes all reported chronic complications in the calculation of the survival estimates as described in chapter 6, i.e. reports with returned and without returned products.

However, BIOTRONIK can only report events in the survival estimates if those events were reported to BIOTRONIK. In order to eliminate possible biased survival estimates due to underreporting, BIOTRONIK performs clinical surveillance studies with active follow-up's under FDA guidance yielding the most reliable lead performance data.

In the following chapter BIOTRONIK shows – in addition to the survival data based on returned product analysis and chronic complication information – the lead performance data from clinical trials. These studies are designed to record clinical observations representative of the total clinical experience.

7.2 BIOTRONIK's Clinical Studies

7.2.1 GALAXY and CELESTIAL

BIOTRONIK's GALAXY and CELESTIAL Registries are prospective, non-randomized, observational studies. The key purpose of these registries is to confirm the long-term safety and reliability of BIOTRONIK leads as used in conjunction with a BIOTRONIK ICD (GALAXY) or CRT (CELESTIAL) system. All devices in the registries are legally marketed and available to physicians according to approved FDA indications for use. GALAXY and CELESTIAL Registries are registered on clinicaltrials.gov under NCT00836589 and NCT00810264 respectively.

The evaluation of safety for GALAXY is based on the analysis of BIOTRONIK Linx ICD lead-related adverse events. The evaluation of safety for CELESTIAL is based on the analysis of BIOTRONIK Corox LV pacing lead-related adverse events. However, many CELESTIAL patients also have a Linx ICD lead implanted and the Linx clinical studies data in this report represents combined data from the GALAXY and CELESTIAL registries. Both registries are designed to continue for a 5 year follow-up duration per patient. As of the January 2018 PPR, incremental updates to Linx data originate from the CELESTIAL Registry, as the GALAXY Registry is complete. To ensure a sufficiently large and representative source of data, participating clinical sites must meet pre-specified selection criteria.

Every effort is made to ensure participants are representative of the range of clinical environments in which BIOTRONIK's cardiac rhythm products are used.

Patients will be seen for routine follow-up visits per their institutional standard of care until they can no longer be followed (e.g., death, lost to follow-up, etc.). However, to ensure regular patient status assessments are completed, follow-up windows consistent with typical care practices have been established with a minimum of once every six months follow-up requirement.

During each follow up at a study center the following steps are required during the follow-up visit:

- Interrogate programmed parameters
- Determine lead electrical parameters
- Evaluate device diagnostics and programmed parameters to ensure the device is providing appropriate therapy
- Determine if there are any reportable lead-related, pulse generator-related or implant procedure-related adverse events. If there are, complete an adverse event electronic case report form (eCRF)
- Complete all appropriate eCRFs

This active surveillance model ensures a robust dataset for effectively monitoring product performance.

Patient Enrollment Criteria

To support the objectives of these registries, participants are required to meet the following inclusion criteria prior to enrollment:

- Successfully implanted BIOTRONIK ICD (GALAXY) or BIOTRONIK CRT (CELESTIAL) system, including the study lead
- Able to understand the nature of the registry and give informed consent
- Available for follow-up visits on a regular basis at the study site
- Age greater than or equal to 18 years

Each site must inform BIOTRONIK whenever a lead complication has

occurred or when a patient is no longer participating.

All leads that experience a complication and are subsequently explanted and returned to BIOTRONIK undergo root-cause analyses. Product performance is analyzed as a function of time using the survival analysis method. Root causes for any failures, regardless of the incidence rates, are investigated.

7.2.2 SIELLO Clinical Study

BIOTRONIK's SIELLO Clinical Study is a prospective, non-randomized, combined Pre-Market Study and Post-Approval Registry designed to demonstrate the safety and effectiveness of the Siello pacing lead as used in conjunction with any market-released BIOTRONIK pacemaker device. The SIELLO Clinical Study is registered on clinicaltrials.gov under NCT01791127.

For the Pre-Market Study, the evaluation of safety is based on the analysis of Siello lead-related adverse events through a follow-up time of 12 months post-implant, while the evaluation of effectiveness is based on analysis of the success rate of the implanted system including one or two Siello leads to sense and deliver pacing at 12 months post-implant.

For the Post-Approval Registry, the evaluation of long-term safety is based on the analysis of Siello lead-related adverse events through a follow-up time of 5 years post-implant. To ensure a sufficiently large and representative source of data, participating clinical sites must meet pre-specified selection criteria.

Every effort is made to ensure participants are representative of the range of clinical environments in which BIOTRONIK's cardiac rhythm products are used. Patients will be seen for routine follow-up visits until they can no longer be followed (e.g., death, lost to follow-up, etc.). However, to ensure regular patient status assessments are completed, a study

follow-up schedule consistent with typical care practices has been established, with required follow-ups at 3 and 6 months post-implant and every 6 months thereafter.

During each study follow-up visit the following steps are required:

- Interrogate programmed parameters
- Record electrical parameters of the implanted leads. Perform all pacing threshold measurements at 0.4 ms or 0.5 ms pulse width when feasible
- Evaluate device diagnostics, electrical parameters and programmed parameters to ensure the device is correctly pacing and sensing
- Determine if there are any lead-related, pulse generator-related or procedure related adverse events. If any are recorded, complete the Adverse Event eCRF
- Complete all appropriate eCRFs

This active surveillance model ensures a robust dataset for effectively monitoring product performance.

Patient Enrollment Criteria

To support the objectives of the study, participants are required to meet the following inclusion criteria prior to enrollment:

- Candidate for de novo implantation of a market-released BIOTRONIK pacemaker system, including one or two Siello leads. Candidate meets recommendation for pacemaker system implant put forth by guidelines of relevant professional societies
- Able to understand the nature of the study and provide informed consent
- Available for follow-up visits on a regular basis at the investigational site for the expected 5 years of follow-up
- Age greater than or equal to 18 years

Each site must inform BIOTRONIK whenever a lead complication has

occurred or when a patient is no longer participating.

All leads that experience a complication and are subsequently explanted and returned to BIOTRONIK undergo root-cause analyses. Product performance is analyzed as a function of time using the survival analysis method. Root causes for any failures, regardless of the incidence rates, are investigated.

7.2.3 Protego Post-Approval Registry

BIOTRONIK's Protego Post-Approval Registry is a prospective, single-arm, non-randomized registry to confirm the long-term safety and reliability of the Protego DF4 ICD lead when used in conjunction with a BIOTRONIK DF4 compatible ICD or CRT-D pulse generator. The Protego DF4 Post-Approval Registry is registered on clinicaltrials.gov under NCT02243696.

The evaluation of safety will be based on the analysis of Protego DF4 lead related or header related adverse events through a follow-up time of 5 years post-implant. To ensure a sufficiently large and representative source of data, participating clinical sites must meet pre-specified selection criteria.

Every effort is made to ensure participants are representative of the range of clinical environments in which BIOTRONIK's cardiac rhythm products are used. Patients will be seen for routine follow-up visits per their institutional standard of care until they can no longer be followed (e.g., death, lost to follow-up, etc.). However, to ensure regular patient status assessments are completed, a study follow-up schedule consistent with typical care practices has been established, with required follow-ups at 3 and 6 months post-implant, and every 6 months thereafter.

During each study visit, the following are required:

- Interrogate programmed parameters
- Record electrical parameters of the implanted leads. Perform all pacing threshold measurements at 0.4 ms or 0.5 ms pulse width when feasible
- Evaluate device diagnostics and programmed parameters to ensure the device is providing appropriate therapy
- Determine if there are any lead-related, pulse generator-related or procedure related adverse events. If any are recorded, complete the Adverse Event eCRF
- Complete all appropriate eCRFs

This active surveillance model ensures a robust dataset for effectively monitoring product performance.

Patient Enrollment Criteria

To support the objectives of the study, participants are required to meet the following inclusion criteria prior to enrollment:

- Candidate for implant or successfully implanted with a BIOTRONIK ICD or BIOTRONIK CRT-D system, including a Protego lead
- Able to understand the nature of the registry and give informed consent
- Available for follow-up visits on a regular basis at the study site
- Age greater than or equal to 18 years

Each site must inform BIOTRONIK whenever a lead complication has occurred or when a patient is no longer participating.

All leads that experience a complication and are subsequently explanted and returned to BIOTRONIK undergo root-cause analyses. Product performance is analyzed as a function of time using the survival analysis method. Root causes for any failures, regardless of the incidence rates, are investigated.

7.2.4 QP ExCELS

BIOTRONIK's QP ExCELS Clinical Study is a combined Pre-Market and Post-Approval, non-randomized, multi-center registry designed to confirm the safety and efficacy of BIOTRONIK's Sentus QP leads in a clinical investigation to support regulatory approval as well as a long-term post-approval evaluation of the devices in the United States. The QP ExCELS Clinical Study is registered on clinicaltrials.gov under NCT02290028.

For the Pre-Market Study, the evaluation of safety is based on the analysis of Sentus QP lead-related adverse events through a follow-up time of 6 months post-implant, while the evaluation of effectiveness is based on analysis on the percentage of subjects with an acceptable LV pacing threshold in the permanently programmed vector at 3-months post-implant.

For the Post-Approval Study, the evaluation of safety will be based on the analysis of Sentus QP lead-related adverse events through a follow-up time of 5 years post-implant. To ensure a sufficiently large and representative source of data, participating clinical sites must meet pre-specified selection criteria.

Every effort is made to ensure participants are representative of the range of clinical environments in which BIOTRONIK's cardiac rhythm products are used. Patients will be seen for routine follow-up visits per their institutional standard of care until they can no longer be followed (e.g., death, lost to follow-up, etc.). However, to ensure regular patient status assessments are completed, a study follow-up schedule consistent with typical care practices has been established, which required follow-ups at discharge/wound check, 3 and 6 months post-implant, and every 6 months thereafter.

Patient Enrollment Criteria

To support the objectives of the study, participants are required to meet the

following inclusion criteria prior to enrollment:

- Standard CRT-D indication according to clinical routine
- De novo implantation or upgrade from existing ICD or pacemaker implant (with no prior attempt at LV lead placement) utilizing a BIOTRONIK CRT-D system with IS4 LV port and Sentus QP LV lead
- Patient is able and willing to complete all routine study visits at the investigational site through 5 years of follow-up
- Patient is able to understand the nature of the clinical investigation and provide written informed consent
- Patient accepts Home Monitoring concept
- Age greater than or equal to 18 years

Each site must inform BIOTRONIK whenever a lead complication has occurred or when a patient is no longer participating.

All leads that experience a complication and are subsequently explanted and returned to BIOTRONIK undergo root-cause analyses. Product performance is analyzed as a function of time using the survival analysis method. Root causes for any failures, regardless of the incidence rates, are investigated.

7.3 Lead Complications

The data presented characterizes chronic lead performance by estimating lead-related complication free survival probabilities. Following industry practice, for analysis purposes, the complication criteria, which align with the AdvaMed "Industry Guidance for Uniform Reporting of Clinical Performance of Cardiac Rhythm Management Pulse Generators and Leads", are defined below.

7.3.1 GALAXY and CELESTIAL

All reported lead-related adverse events within the GALAXY and CELESTIAL Registries are classified by the reporting investigator and are adjudicated by an independent event adjudication committee. A lead related complication is considered to have occurred if a clinical observation happens after successful implantation, is classified with at least one of the following event classifications and at least one of the following clinical actions is made. Any Clinical Event without a related Clinical Action is not considered a Qualifying Complication. Events with an onset date 30 days or less after the implant are acute observations and are listed separately.

Event Classifications

- Failure to capture
- Failure to sense/undersensing
- Oversensing
- Abnormal pacing impedance (based on lead model, but normal range is typically 200 - 2,000 Ohm)
- Abnormal defibrillation impedance (based on lead model, but normal range is 25 to 150 Ohm)
- Insulation breach
- Conductor fracture, confirmed electrically, visually or radiographically
- Extracardiac stimulation
- Cardiac perforation
- Lead dislodgement

Clinical Actions

- Lead surgically abandoned/capped
- Lead electrically abandoned
- Lead explanted
- Lead replaced
- Lead conductor taken out of service
- Lead use continued based on medical judgment despite a known clinical performance issue
- Other lead-related surgery

7.3.2 SIELLO

All reported lead-related adverse events within the SIELLO Clinical Study are classified by the reporting investigator and are adjudicated by an independent event adjudication committee. A lead related complication is considered to have occurred if a clinical observation happens after successful implantation and is classified with at least one of the following event classifications. Events with an onset date 30 days or less after the implant are acute observations and are listed separately.

Event Classifications

- Failure to capture
- Failure to sense/undersensing
- Oversensing
- Abnormal pacing impedance (based on lead model, but normal range is typically 200 - 2,000 Ohm)
- Insulation breach
- Conductor fracture, confirmed electrically, visually or radiographically
- Extracardiac stimulation
- Cardiac perforation
- Lead dislodgement

7.3.3 Protego

All reported lead-related adverse events within the Protego Registry are classified by the reporting investigator and are adjudicated by an independent event adjudication committee. A lead related complication is considered to have occurred if a clinical observation happens after successful implantation and is classified with at least one of the following event classifications. Events with an onset date 30 days or less after the implant are acute observations and are listed separately.

Event Classifications

- Failure to capture
- Failure to sense/undersensing
- Oversensing

- Abnormal pacing impedance (based on lead model, but normal range is typically 200 - 2,000 Ohm)
- Abnormal defibrillation impedance (based on lead model, but normal range is 25 to 150 Ohm)
- Insulation breach
- Conductor fracture, confirmed electrically, visually or radiographically
- Extracardiac stimulation
- Cardiac perforation
- Lead dislodgement

7.3.4 QP ExCELS

All reported lead-related adverse events within the QP ExCELS registry are classified by the reporting investigator and are adjudicated by an independent event adjudication committee. A lead related complication is considered to have occurred if a clinical observation happens after successful implantation and is classified with at least one of the following event classifications. Events with an onset date 30 days or less after the implant are acute observations and are listed separately.

Event Classifications

- Failure to capture
- Failure to sense/undersensing
- Oversensing
- Abnormal pacing impedance (based on lead model, but normal range is typically 200 - 2,000 Ohm)
- Insulation breach
- Conductor fracture, confirmed electrically, visually or radiographically
- Extracardiac stimulation
- Cardiac perforation
- Lead dislodgement

7.4 Lead Product Performance Graphs and Data

The clinical data presented on the following page is intended to show the long term clinical performance of leads based on clinical studies. The same analysis methods as described in chapter 6 are applied.

Returned Product Analysis Results

Although the returned product analysis data is not used to generate the survival estimates for the clinical data, it provides valuable insight into the causes of lead malfunction. Following the same approach as for complaint data, a malfunction is reported as described in section 6.3 of this report.



Performance of BIOTRONIK Leads Based on Clinical Study Data

8.1 Performance of Pacing Leads

8.2 Performance of ICD Leads

8.3 Performance of CRT Leads

8.1 Performance of Pacing Leads - Study Data

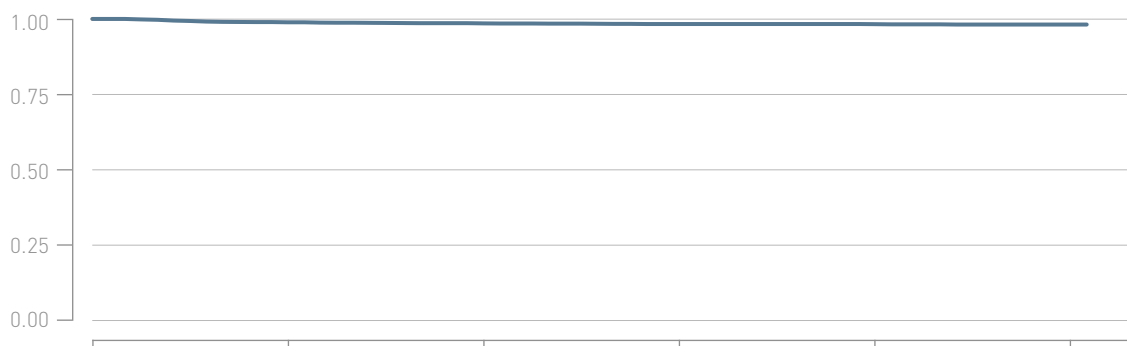
Siello S / Solia S

Product Versions	45, 53, 60
Lead Type	straight, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jun 2016
CE Market Release	Jul 2009
Worldwide Distributed Devices	1 420 000
Registered U.S. Implants	3245

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	54	1.66%	U.S. Confirmed Malfunctions	3	0.09%
Abnormal Pacing Impedance	4	0.12%	Conductor Fracture	1	0.03%
Cardiac Perforation	3	0.09%	Insulation Breach	1	0.03%
Conductor Fracture	2	0.06%			
Failure to Capture	23	0.71%	U.S. Acute Lead Observations	26	0.80%
Failure to Sense (undersensing)	11	0.34%	Cardiac Perforation	8	0.25%
Lead Dislodgement	9	0.28%	Extracardiac Stimulation	2	0.06%
Oversensing	1	0.03%	Failure to Capture	6	0.18%
Other	1	0.03%	Failure to Sense (undersensing)	5	0.15%
			Lead Dislodgement	5	0.15%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5
Total [%]	100.0	98.9	98.5	98.3	98.2	98.1
CI [±%]	-	0.4	0.4	0.5	0.5	0.5
Sample Size	3245	2793	2479	2200	1769	293



Performance of BIOTRONIK Leads Based on Clinical Study Data

8.1 Performance of Pacing Leads

8.2 Performance of ICD Leads

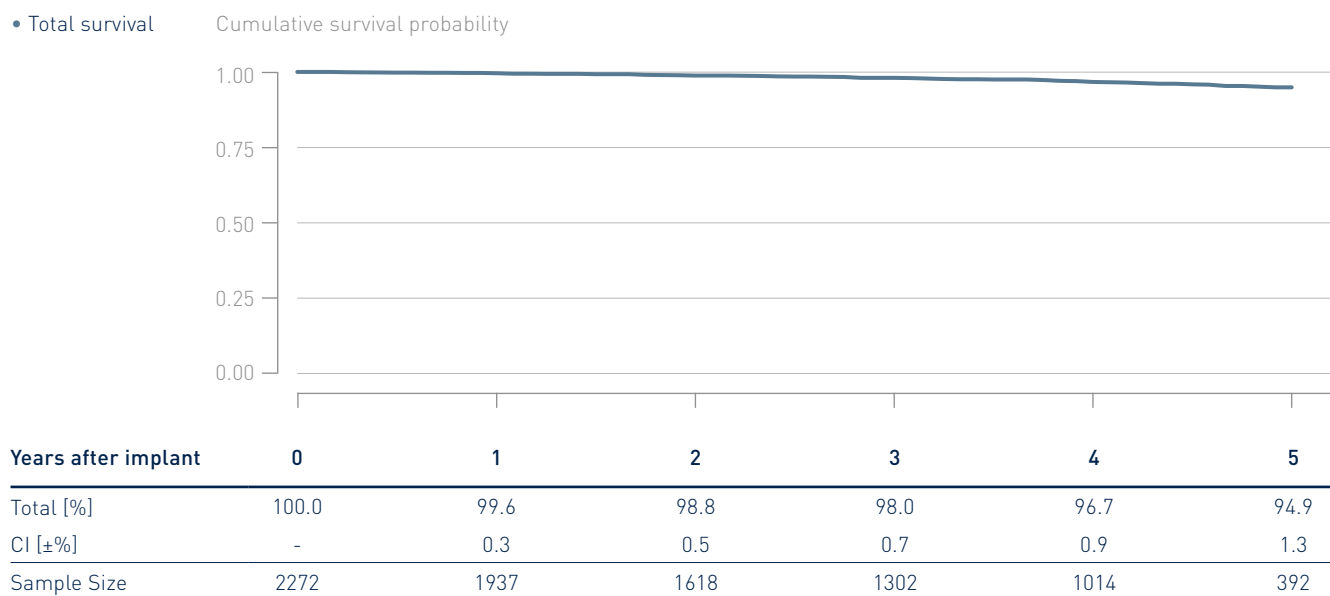
8.3 Performance of CRT Leads

8.2 Performance of ICD Leads - Study Data

Linux SD

Product Versions	60/16, 65/16, 65/18, 75/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Apr 2006
CE Market Release	Aug 2006
Worldwide Distributed Devices	55 100
Registered U.S. Implants	2 272

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	68	2.99%	U.S. Confirmed Malfunctions	24	1.06%
Abnormal Defibrillation Impedance	4	0.18%	Conductor Fracture	3	0.13%
Abnormal Pacing Impedance	10	0.44%	Insulation Breach	21	0.92%
Cardiac Perforation	1	0.04%			
Conductor Fracture	10	0.44%	U.S. Acute Lead Observations	8	0.35%
Failure to Capture	7	0.31%	Cardiac Perforation	4	0.18%
Failure to Sense	3	0.13%	Conductor Fracture	1	0.04%
Insulation Breach	13	0.57%	Failure to Capture	1	0.04%
Lead Dislodgement	3	0.13%	Lead Dislodgement	1	0.04%
Oversensing	17	0.75%	Other	1	0.04%

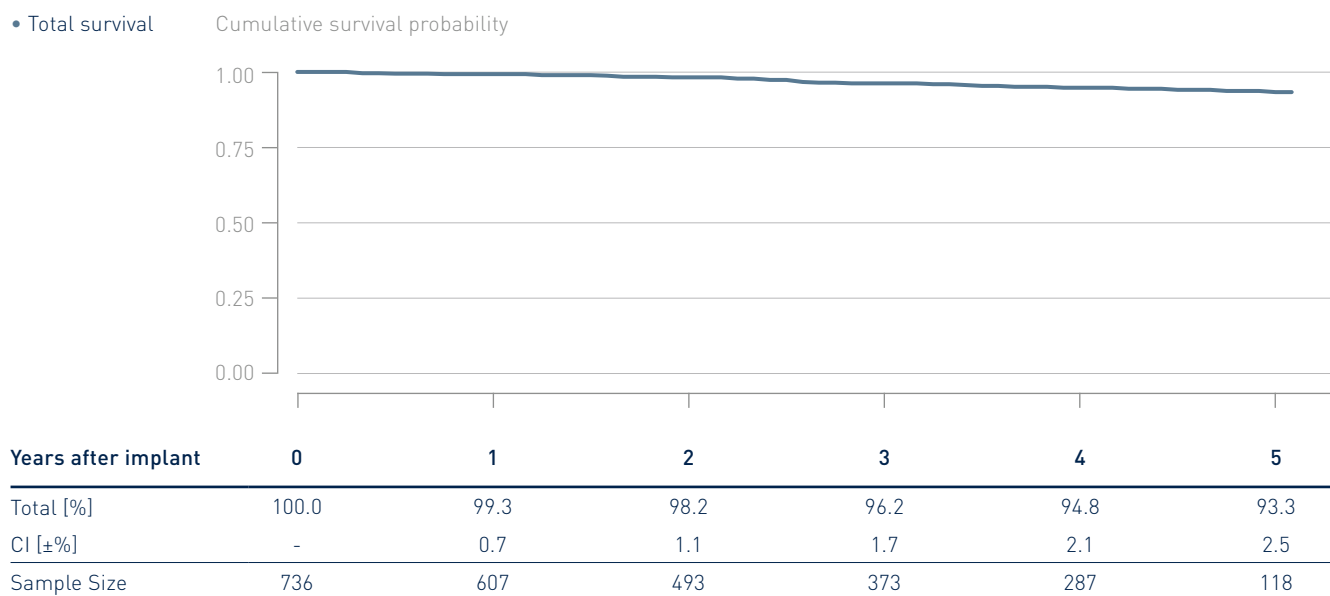


8.2 Performance of ICD Leads - Study Data

Linux^{smart} SD

Product Versions	60/16, 65/16, 65/18, 75/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jan 2011
CE Market Release	Oct 2009
Worldwide Distributed Devices	55700
Registered U.S. Implants	736

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	29	3.94%	U.S. Confirmed Malfunctions	7	0.95%
Abnormal Defibrillation Impedance	2	0.27%	Insulation Breach	7	0.95%
Abnormal Pacing Impedance	2	0.27%			
Conductor Fracture	3	0.41%	U.S. Acute Lead Observations	2	0.27%
Failure to Capture	3	0.41%	Lead Dislodgement	2	0.27%
Insulation Breach	4	0.54%			
Lead Dislodgement	6	0.82%			
Oversensing	9	1.22%			



8.2 Performance of ICD Leads - Study Data

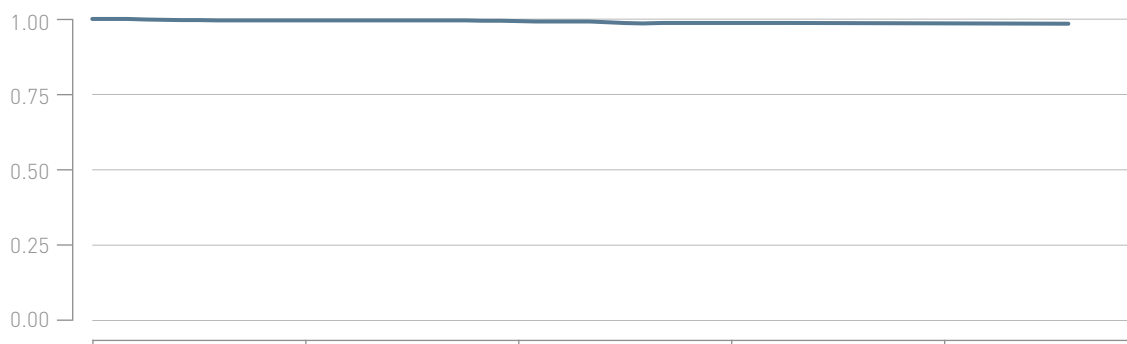
Protego S

Product Versions	60, 65, 75
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jul 2014
CE Market Release	Feb 2014
Worldwide Distributed Devices	54 900
Leads registered in study	1 090

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	10	0.92%	U.S. Confirmed Malfunctions	8	0.73%
Conductor Fracture	2	0.18%	Conductor Fracture	2	0.18%
Failure to Capture	1	0.09%	Insulation Breach	6	0.55%
Failure to Sense (undersensing)	1	0.09%			
Lead Dislodgement	2	0.18%	U.S. Acute Lead Observations	4	0.37%
Oversensing	4	0.37%	Cardiac Perforation	3	0.28%
			Lead Dislodgement	1	0.09%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4
Total [%]	100.0	99.5	99.3	99.0	98.7
CI [±%]	-	0.5	0.6	0.7	0.9
Sample Size	1090	934	804	393	24

8.2 Performance of ICD Leads - Study Data

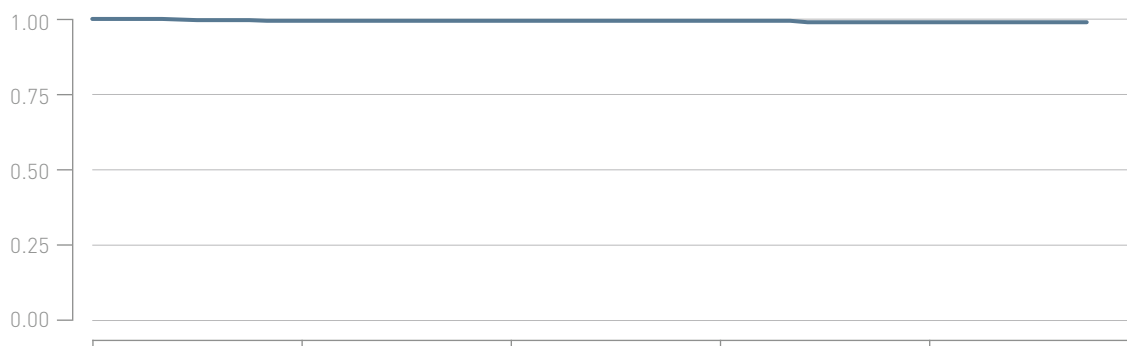
Protego SD

Product Versions _____ 60/16, 65/16, 65/18, 75/18
Lead Type _____ dual-coil, active fixation
Polarity _____ bipolar
Steroid _____ yes
U.S. Market Release _____ Jul 2014
CE Market Release _____ May 2013
Worldwide Distributed Devices _____ 18400
Leads registered in study _____ 533

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	4	0.75%	U.S. Confirmed Malfunctions	2	0.38%
Abnormal Defibrillation Impedance	2	0.38%	Insulation Breach	2	0.38%
Conductor Fracture	1	0.19%	U.S. Acute Lead Observations	2	0.38%
Failure to Capture	1	0.19%	Lead Dislodgement	2	0.38%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4
Total [%]	100.0	99.4	99.4	99.4	98.9
CI [±%]	-	0.9	0.9	0.9	1.4
Sample Size	533	431	363	268	81



Performance of BIOTRONIK Leads Based on Clinical Study Data

8.1 Pacing Leads Performance

8.2 ICD Leads Performance

8.3 CRT Leads Performance

8.3 CRT Leads Performance - Study Data

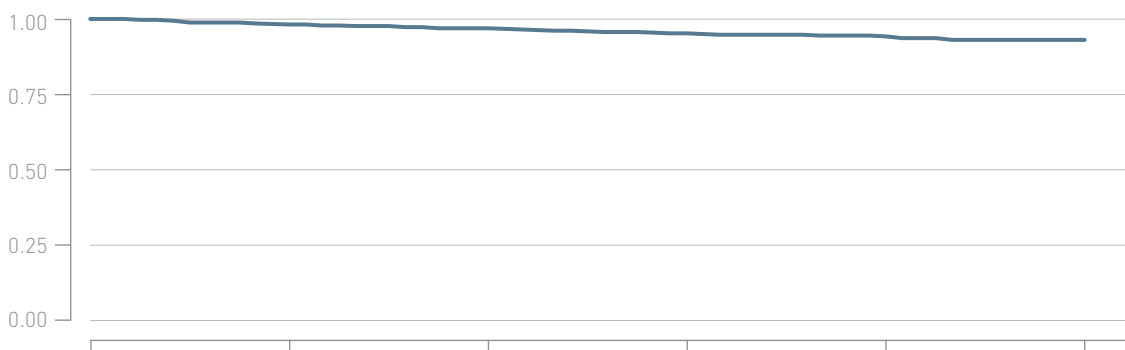
Corox OTW

Product Versions	75, 85
Lead Type	helix fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	May 2008
CE Market Release	Dec 2006
Worldwide Distributed Devices	28 700
Leads registered in study	696

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	35	5.03%	U.S. Confirmed Malfunctions	6	0.86%
Abnormal Pacing Impedance	6	0.86%	Conductor Fracture	6	0.86%
Conductor Fracture	5	0.72%	U.S. Acute Lead Observations	4	0.57%
Extracardiac Stimulation	3	0.43%	Extracardiac Stimulation	1	0.14%
Failure to Capture	5	0.72%	Lead Dislodgement	3	0.43%
Lead Dislodgement	16	2.30%			

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5
Total [%]	100.0	98.2	96.9	95.2	94.2	93.0
CI [±%]	-	1.1	1.4	1.8	2.1	2.3
Sample Size	696	589	489	407	329	135

8.3 CRT Leads Performance - Study Data

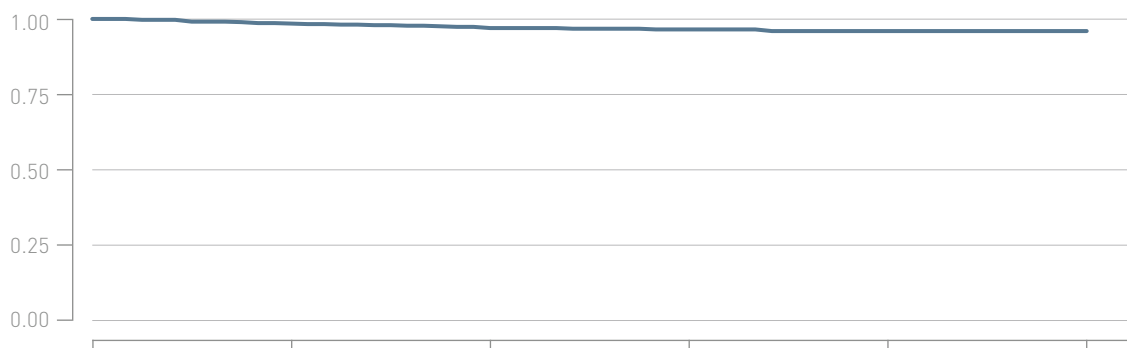
Corox OTW-L

Product Versions	75, 85
Lead Type	dual-curve fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jan 2011
CE Market Release	Dec 2009
Worldwide Distributed Devices	32 000
Leads registered in study	699

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	22	3.15%	U.S. Confirmed Malfunctions	0	0.00%
Extracardiac Stimulation	4	0.57%			
Failure to Capture	8	1.14%	U.S. Acute Lead Observations	4	0.57%
Lead Dislodgement	10	1.43%	Extracardiac Stimulation	3	0.43%
			Lead Dislodgement	1	0.14%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5
Total [%]	100.0	98.5	97.0	96.5	96.0	96.0
CI [±%]	-	1.0	1.4	1.6	1.7	1.7
Sample Size	699	584	475	382	303	130

8.3 CRT Leads Performance - Study Data

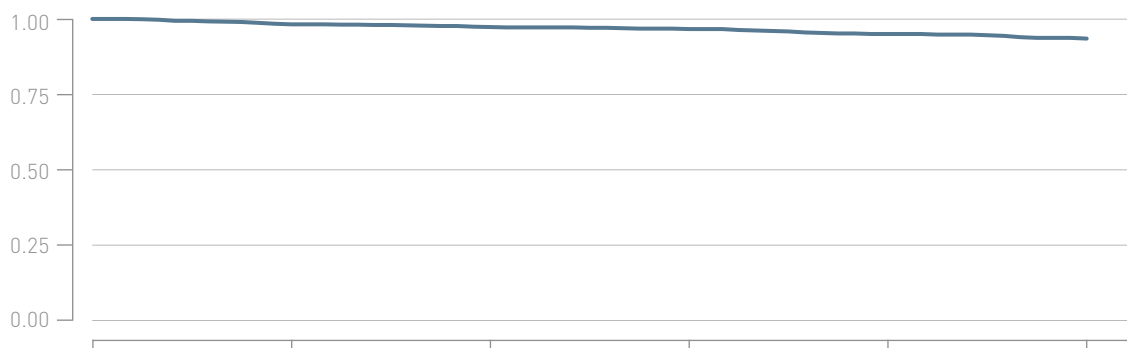
Corox OTW-S

Product Versions	75, 85
Lead Type	thread fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	May 2008
CE Market Release	Dec 2006
Worldwide Distributed Devices	26 400
Leads registered in study	1 141

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	49	4.29%	U.S. Confirmed Malfunctions	1	0.09%
Abnormal Pacing Impedance	13	1.14%	Insulation Breach	1	0.09%
Extracardiac Stimulation	9	0.79%			
Failure to Capture	9	0.79%	U.S. Acute Lead Observations	5	0.44%
Lead Dislodgement	18	1.58%	Extracardiac Stimulation	1	0.09%
			Failure to Capture	1	0.09%
			Lead Dislodgement	3	0.26%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4	5
Total [%]	100.0	98.2	97.3	96.6	95.0	93.5
CI [±%]	-	0.8	1.0	1.2	1.5	1.9
Sample Size	1141	963	813	648	505	192

8.3 CRT Leads Performance - Study Data

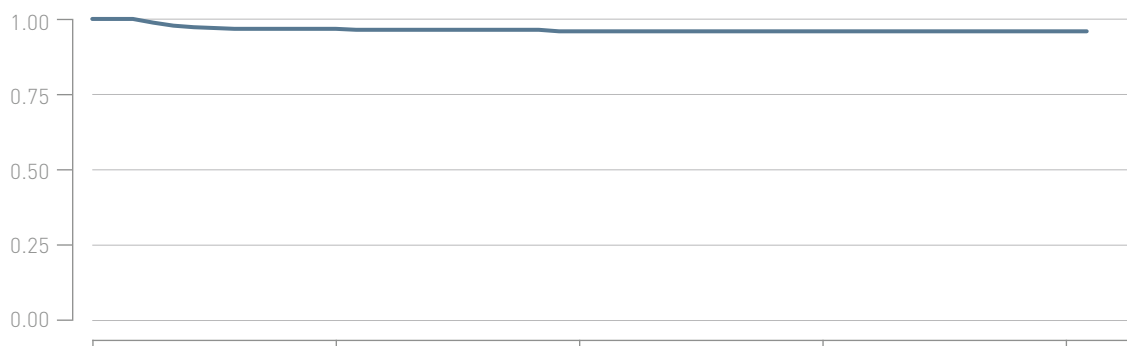
Sentus OTW QP S

Product Versions	75, 75/49, 85, 85/49
Lead Type	thread fixation
Polarity	quadripolar
Steroid	yes
U.S. Market Release	May 2017
CE Market Release	Dec 2014
Worldwide Distributed Devices	15 700
Registered U.S. Implants	436

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	15	3.44%	U.S. Confirmed Malfunctions	2	0.46%
Conductor Fracture	1	0.23%	Conductor Fracture	2	0.46%
Extracardiac Stimulation	1	0.23%			
Failure to Capture	3	0.69%	U.S. Acute Lead Observations	10	2.29%
Lead Dislodgement	10	2.29%	Cardiac Perforation	1	0.23%
			Failure to Capture	1	0.23%
			Lead Dislodgement	8	1.83%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4
Total [%]	100	96.7	95.9	95.9	95.9
CI [±%]	-	1.8	2.2	2.2	2.2
Sample Size	436	299	170	55	0

8.3 CRT Leads Performance - Study Data

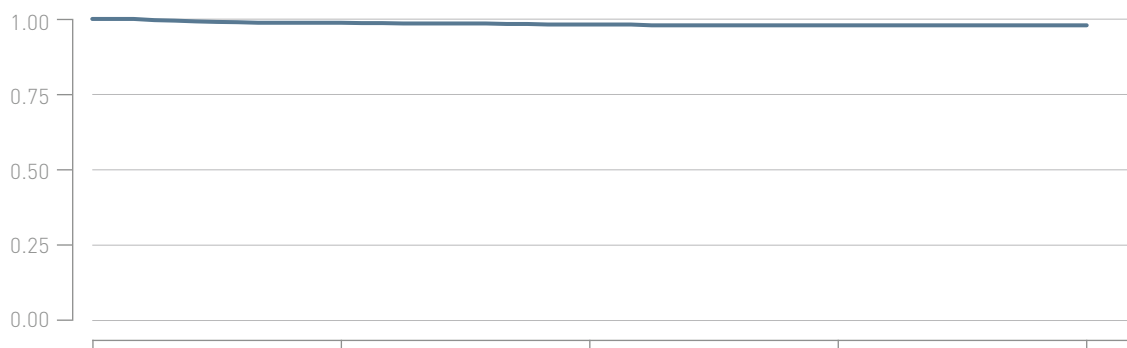
Sentus OTW QP L

Product Versions	75, 75/49, 85, 85/49
Lead Type	dual-curve fixation
Polarity	quadripolar
Steroid	yes
U.S. Market Release	May 2017
CE Market Release	Dec 2014
Worldwide Distributed Devices	65 900
Registered U.S. Implants	1 308

	Quantity	Rate		Quantity	Rate
U.S. Qualifying Complications	21	1.61%	U.S. Confirmed Malfunctions	4	0.31%
Abnormal Pacing Impedance	3	0.23%	Conductor Fracture	4	0.31%
Conductor fracture	1	0.08%			
Extracardiac Stimulation	2	0.15%	U.S. Acute Lead Observations	7	0.54%
Failure to Capture	4	0.31%	Extracardiac Stimulation	1	0.08%
Lead Dislodgement	11	0.84%	Failure to Capture	4	0.31%
			Lead Dislodgement	2	0.15%

• Total survival

Cumulative survival probability



Years after implant	0	1	2	3	4
Total [%]	100.0	98.7	98.1	97.9	97.9
CI [±%]	-	0.7	0.9	1.1	1.1
Sample Size	1308	863	418	138	0



Methodology for Lead Survival Estimates based on Insurance Claims Data

9.1 Introduction

9.2 Claims Data Methodologies
and Data Sets

9. Methodology for Lead Survival Estimates based on Insurance Claims Data

9.1 Introduction

All leads and lead segments returned to BIOTRONIK are thoroughly analyzed to determine whether or not they meet BIOTRONIK's long term quality standards. Although analysis of returned product is an excellent method for gaining insight into lead failure mechanisms, this data relies on the return of explanted leads. For the majority of complications the lead is not received for analysis as challenging clinical environments may not allow for the return, e.g. the extraction of an implanted lead may not be possible.

BIOTRONIK includes all reported chronic complications in the calculation of the survival estimates as described in chapter 6, i.e. reports with returned and without returned products. However, BIOTRONIK can only report events in the survival estimates if those events were reported to BIOTRONIK. In order to eliminate possible biased survival estimates due to underreporting, active surveillance methodologies utilizing extant real-world data sources have been developed in collaboration with FDA and other key stakeholders under the Device Pilot Project EP PASSION, established under Section 708 of the FDA Reauthorization Act of 2017 (FDARA). Identical methodology is being applied to the analysis provided in this PPR.

In the following chapter BIOTRONIK shows – in addition to the survival data based on returned product analysis and chronic complication information from customer reported complaints as well as clinical studies – the lead performance data from active surveillance of real-world data sources. These analyses are designed to record clinical observations representative of the total real-world clinical experience.

9.2 Claims Data Methodologies and Data Sets

To perform real-world analysis, insurance claims data obtained via the Centers for Medicare and Medicaid Services (CMS), as well as data from BIOTRONIK's device tracking database, are utilized to identify lead-related complications. As the source of the claims data is CMS, the U.S. federal health insurance program, the analysis is limited to the sub-set of patients with a device implant that receive benefits through CMS with coverage that was active at the time of device implant. Diagnosis and procedure codes from CMS insurance claims that correspond to lead-related complications are identified and each event is evaluated to identify the related system component(s). This approach combines the advantages from passive complaint reporting (large device populations) with the advantage from clinical studies (reliable, consistent reporting) to ensure statistically sound device performance figures. However, due to the nature of insurance claims, fewer details of the device complications are known.

As part of the Device Pilot Project EP PASSION, the real-world methodology developed in collaboration with the stakeholders was validated in a proof of concept analysis. Results demonstrated high agreement of 99.7% between the real-world data outcomes and results from a respective study¹. Based on the proof of concept results, BIOTRONIK received FDA approval to utilize this methodology to fulfil post-approval reporting requirements for both low and high voltage leads.

For PPR analysis, the complication criteria are aligned with the AdvaMed "Industry Guidance for Uniform

Reporting of Clinical Performance of Cardiac Rhythm Management Pulse Generators and Leads".

Specifically, the codes identify lead-related complications that would result in a cardiac lead being removed or replaced, or result in a new lead being implanted as a result of the lead-related complication. Identified complications are limited to events with an onset date of more than 30 days after implant. Acute complications, those with an onset date of 30 days or less after implant, are excluded from analysis.

To protect patient confidentiality, CMS restricts direct reporting of data cell values of 1 to 10. Therefore, lead models with 10 or less identified complications will not be reported within the PPR. In addition, lead models that are no longer distributed with less than 500 leads available for analysis are excluded.

Lead Tracking and Reporting Patients implanted with a BIOTRONIK lead after U.S. market approval as identified in BIOTRONIK's U.S. device registration system are directly linked with CMS beneficiary information and claims data. The claims datasets will be updated for each Product Performance Report.

Lead-related complications identified from CMS claims data and identified to be related to the BIOTRONIK leads are reported. The overall lead-related complication rate by lead model is provided. In order to provide statistically sound data, sample sizes of less than 100 subjects are not reported.

¹ Hicks J, Keith M, Moll P, Simeles J, Offer E, Diani C, Rock A, and Mitchell K. Novel Method to Identify Lead Complications in Pacemaker Systems from Real-World Data: Proof of Concept for the Siello S Pacing Lead. Heart Rhythm. 2019; 16(5), Supplement, S-PO03-089.



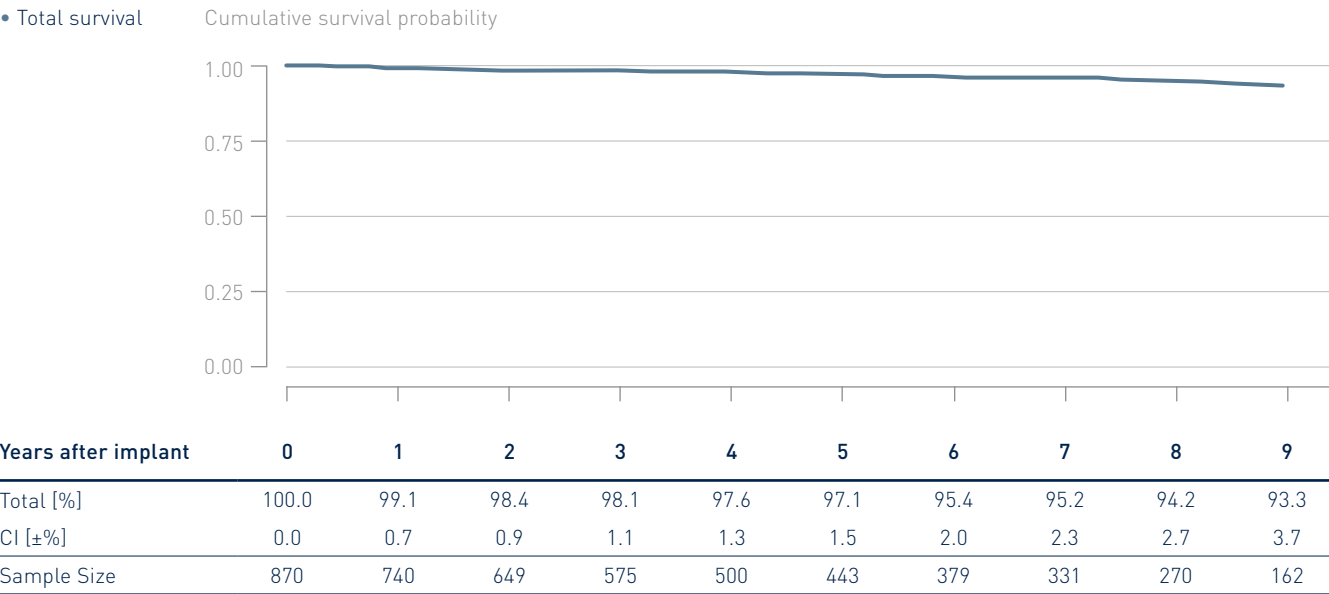
Performance of BIOTRONIK Leads Based on Insurance Claims Data

ICD Leads Performance – Insurance
Claims Data

10. ICD Leads Performance – Insurance Claims Data

Linux S

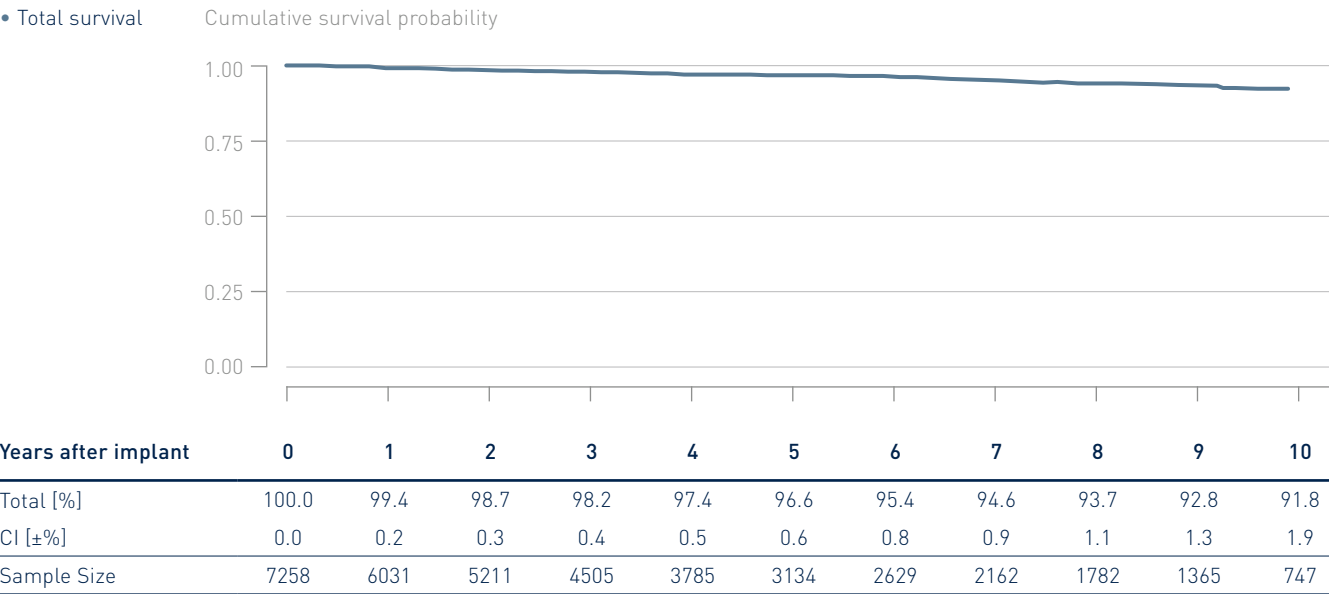
Product Versions	65, 75
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Feb 2007
CE Market Release	Mar 2007
Worldwide Distributed Devices	32 700
Registered U.S. Implants	870



10. ICD Leads Performance – Insurance Claims Data

Linux SD

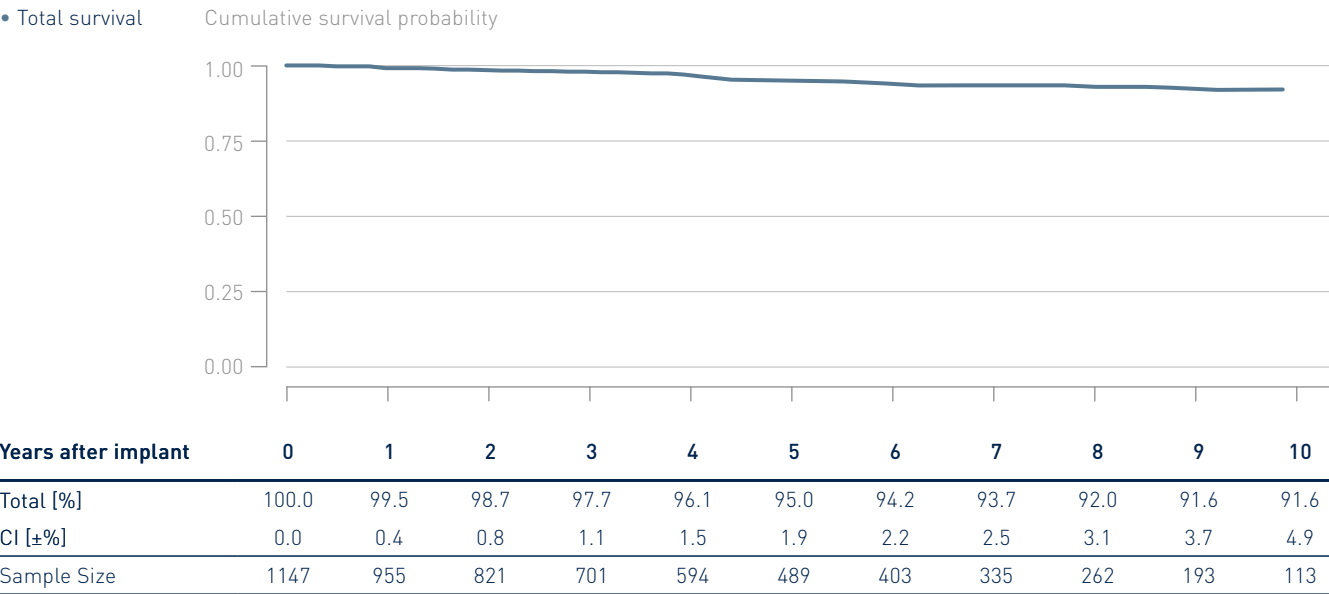
Product Versions	60/16, 65/16, 65/18, 75/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Apr 2006
CE Market Release	Aug 2006
Worldwide Distributed Devices	55 100
Registered U.S. Implants	7 258



10. ICD Leads Performance – Insurance Claims Data

Linux TD

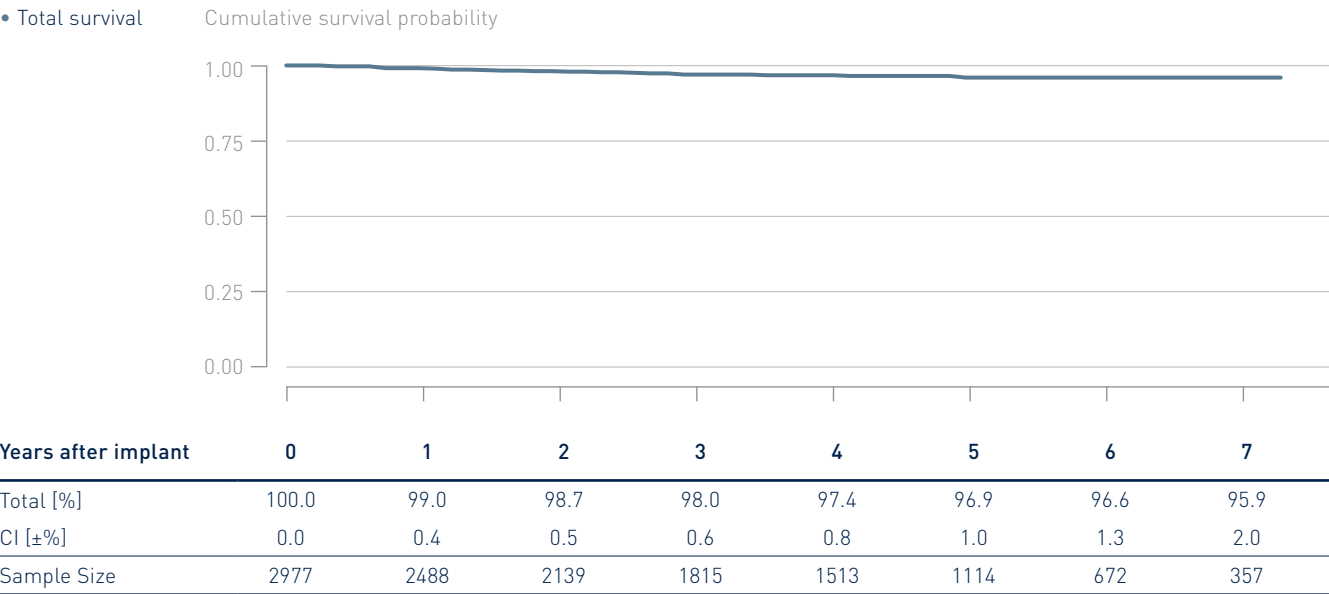
Product Versions	65/16, 75/16, 100/16, 100/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Oct 2006
CE Market Release	Oct 2006
Worldwide Distributed Devices	14 600
Registered U.S. Implants	1 147



10. ICD Leads Performance – Insurance Claims Data

Linux Smart S

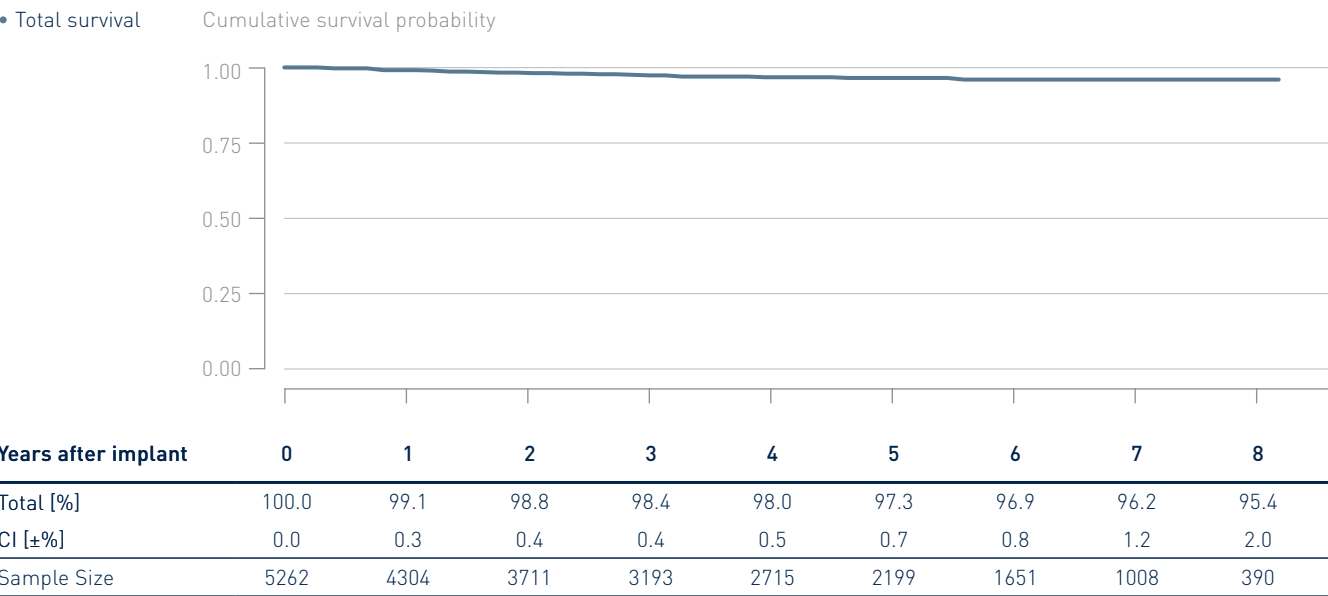
Product Versions	60, 65, 75
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Aug 2011
CE Market Release	Dec 2010
Worldwide Distributed Devices	46 700
Registered U.S. Implants	2 977



10. ICD Leads Performance – Insurance Claims Data

Linux Smart SD

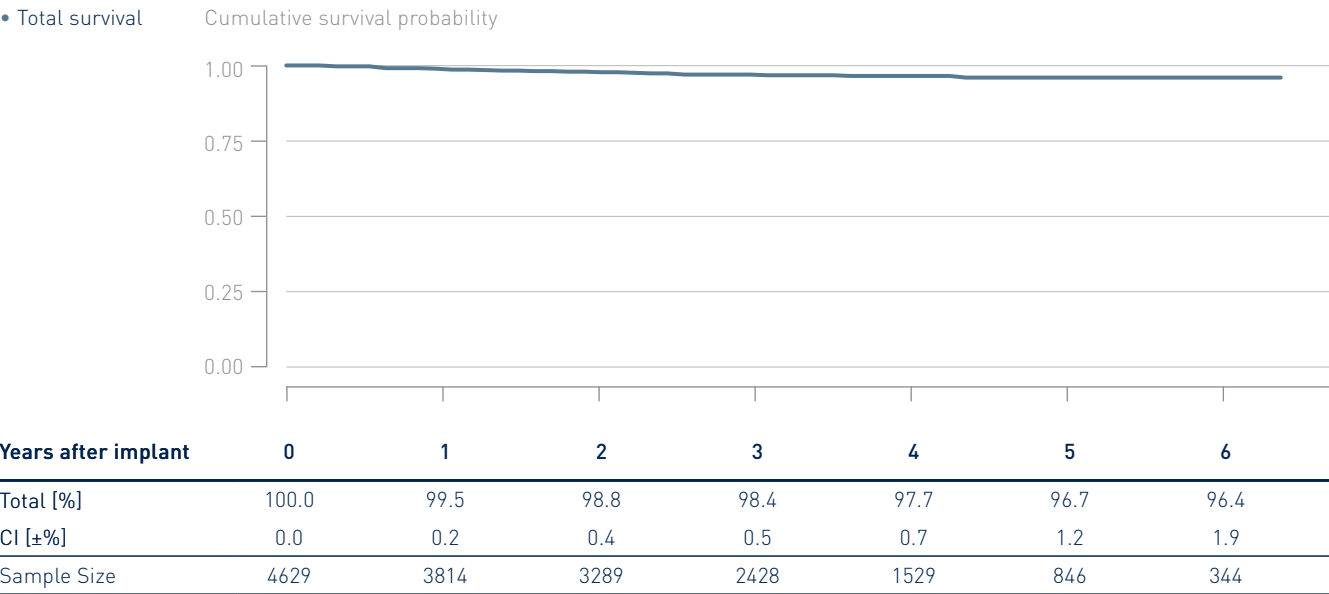
Product Versions	60/16, 65/16, 65/18, 75/18
Lead Type	dual-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jan 2011
CE Market Release	Oct 2009
Worldwide Distributed Devices	55 700
Registered U.S. Implants	5 262



10. ICD Leads Performance – Insurance Claims Data

Linux Smart S DX

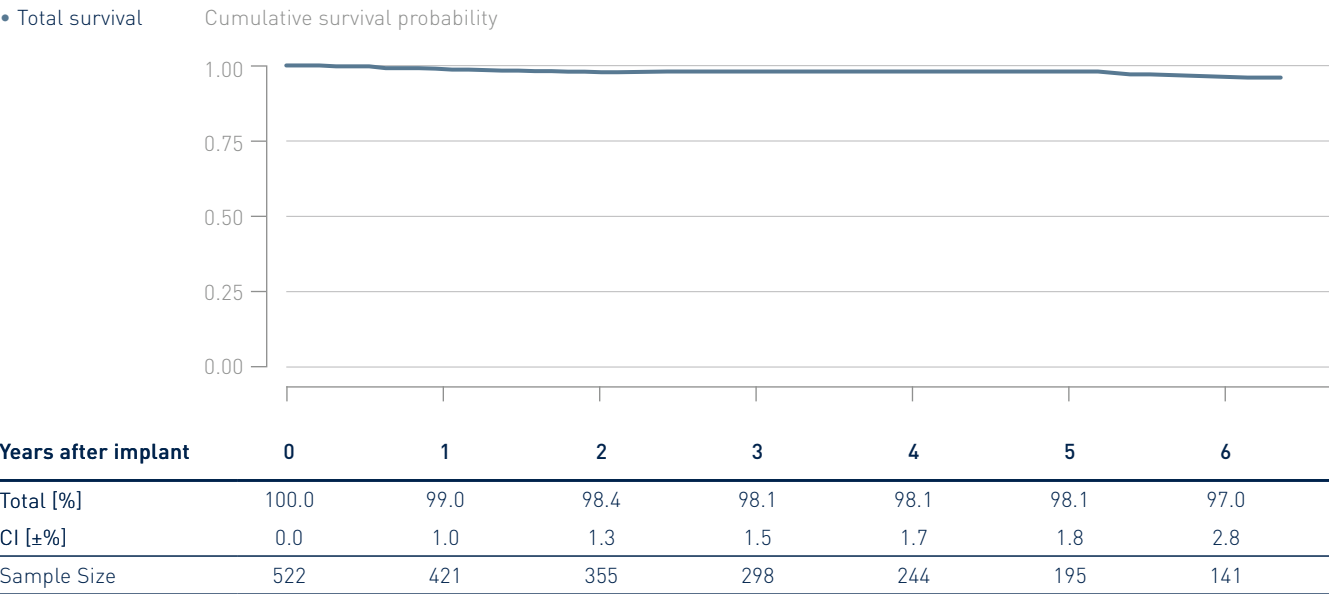
Product Versions	65/15, 65/17
Lead Type	single-coil, active fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Feb 2013
CE Market Release	Mar 2010
Worldwide Distributed Devices	36300
Registered U.S. Implants	4 629



10. ICD Leads Performance – Insurance Claims Data

Linux Smart TD

Product Versions	65/16, 65/18, 75/18
Lead Type	dual-coil, passive fixation
Polarity	bipolar
Steroid	yes
U.S. Market Release	Jan 2011
CE Market Release	Oct 2009
Worldwide Distributed Devices	7 720
Registered U.S. Implants	522





Advisories

11. Advisories

Stratos LV-T Potentially Defective Low Voltage Capacitors 84 Devices World-wide, None in the United States

Status Update As of October, 2019

- No reports of malfunctioning pacemakers associated with this capacitor lot were received.
- No reports of deaths or serious injuries were received associated with this advisory.
- An extended test program yielded no malfunctions of the capacitors under question.

Original communication July 2006

A limited number of our Stratos LV-T pacemakers may exhibit a device malfunction resulting in increased battery current and in **loss of output**, very likely simultaneously on all channels.

BIOTRONIK has identified a specific batch of low voltage capacitors from a single component supplier as the root cause. Please be assured that the capacitors from this batch are no longer being used in any BIOTRONIK device, and that no other pacemaker or ICD manufactured by BIOTRONIK is affected.

To date, no field reports related to this phenomenon were received.

The anomaly is limited to 84 devices world-wide. BIOTRONIK has taken immediate action to retrieve all potentially affected devices not yet delivered to hospitals. According to our records, 14 devices were delivered to

hospitals and may have been implanted.

Based on preliminary data received from the component supplier, the projected rate of occurrence is expected to less than 1 out of 1000 devices.

Our records show that you are the implanting and/or follow-up physician for one or more patients with an affected device. We recommend the following actions:


- If Home Monitoring is **activated**, please check the Cardio Report and the pacing impedance history. A rapid and significant increase of the pacing impedance on one or more channels may indicate a possible loss of output. In this case we recommend to schedule a patient follow-up as soon as possible.
- If Home Monitoring is **not activated** or pacing impedance data from Cardio Reports are not available we recommend to schedule a patient follow-up as soon as possible.
- During a **follow-up session** please perform the "Battery Lead Telemetry" test. A significantly increased pacing impedance on one or more channels or a significantly increased battery current may indicate a possible loss of output.
- If no anomaly is detected please **activate Home Monitoring**. You may use regular follow-up intervals if Home Monitoring is used for remote monitoring between follow-ups.
- **In any case we recommend to replace the device of a pacemaker-dependent patient without underlying intrinsic rhythm.**

We have tried to be as specific as possible with our recommendations. As always, individual circumstances and medical judgement determine

decisions about patient care, the urgency of follow-ups and possible replacement of devices.

If a Stratos LV-T is replaced for the reason explained in this notification, BIOTRONIK will provide a replacement device consistent with the terms of our warranty. For activation of the warranty, please return the explanted device to BIOTRONIK within 30 days of the explantation.

X-Ray Identifiers for Pacemakers and ICDs

Pacemaker/ICD Product Versions	X-Ray ID
Cylos DR, DR-T, VR	RZ
Cylos 990 DR, DR-T, VR	FV
Edora 8 DR, DR-T, SR, SR-T, HF-T	
Entovis DR, DR-T, SR, SR-T	SF
Eluna 8 DR, DR-T	SF
Estella SR, SR-T, DR, DR-T	SF
Etrinsa 8 SR-T, DR-T, HF-T	SF
Evia DR, DR-T, SR, SR-T, HF, HF-T	SF
Iforia 7 VR-T DX, DR-T	NT
Ilesto 7 DR-T, HF-T, VR-T DX, VR-T, DR-T DF4	NT
Ilivia 7 VR-T, DR-T, DR-T DF4, VR-T DX, VR-T DF4, HF-T DF4	NK
Intica 7 VR-T DX, HF-T	NK
Inventra 7 VR-T DX, HF-T DF4	AH
Iperia 7 VR-T, DR-T, VR-T DX, VR-T DF4, HF-T DF4	NH
Itrevia 7 VR-T, DR-T, VR-T DX, DR-T DF4, HF-T, HF-T DF4	NH
Lumax 340 DR-T, HF-T, VR-T	HR
Lumax 540 DR-T, HF-T, VR-T	SH
Lumax 740 DR-T, HF-T, VR-T, VR-T DX	RH
Philos II DR, D, S, SLR, SR	ET
Philos II DR-T	KP
Stratos LV, LV-T	SV
Talos DR, D, SLR, SR, S	PV

Contacting BIOTRONIK

Regarding this Report

BIOTRONIK invites your suggestions and questions related to this Product Performance Report. Please send your comments to:

PPR Support Team

Phone +49 (0) 30 68905 1368

Fax +49 (0) 30 68905 96 1920

E-mail PPR@biotronik.com

Address

BIOTRONIK SE & Co. KG
Attn: Quality Patient Safety
Woermannkehre 1
12359 Berlin, Germany

Regarding Products

BIOTRONIK invites customers to call the following locations with suggestions, comments or specific questions related to BIOTRONIK products:

CRM Technical Service

Phone + 49 (0) 30 689 05 2200

Fax + 49 (0) 30 689 05 96 2200

Email technical.services@biotronik.com

Address

BIOTRONIK SE & Co. KG
Attn: Technical Services CENEMEA
Woermannkehre 1
12359 Berlin, Germany

Within the U.S.:

Phone (800) 547 0394

Fax (800) 451 8529

E-mail advancedproductsupport@biotronik.com

Address

BIOTRONIK, Inc.
Attn: Advanced Product Support
6024 Jean Road
Lake Oswego, OR 97035