SUMMARY OF SAFETY AND EFFECTIVENESS DATA (SSED)

I. GENERAL INFORMATION

Device Generic Name: Cardiovascular permanent pacemaker electrode

Device Trade Name: Model 5071 Lead

Device Product Code: DTB

Applicant's Name and Address: Medtronic, Inc.
8200 Coral Sea St. NE
Mounds View, MN 55112

Date(s) of Panel Recommendation: None

Premarket Approval Application (PMA) Number: P120017

Date of FDA Notice of Approval: April 27, 2015

The Model 5071 lead has been commercially available since September 26, 1990 when it was first cleared by FDA in K902002. P120017 has been submitted in response to the Final Rule issued July 6, 2012 in the Federal Register Volume 77 Number 130, Docket No. FDA-2011-N-00505, requiring premarket approval of marketed pre-amendment Class III cardiovascular permanent pacemaker electrode, product code DTB. A product affected by this Rule is the Model 5071 Lead. A combination of post market experience data, relevant literature, and in-vitro bench testing has been reviewed to demonstrate a reasonable assurance of safety and effectiveness for the Model 5071 Lead.

II. INDICATIONS FOR USE

The Medtronic Model 5071 Lead is indicated for unipolar ventricular pacing and sensing. The lead has application where permanent ventricular or dual-chamber pacing systems are indicated. Two leads may be used for bipolar pacing.

III. CONTRAINDICATIONS

The lead should not be used on a patient with a thin-walled, heavily infarcted, or fibrotic myocardium. It is also contraindicated for patients whose myocardium is suffused with fat.

IV. WARNINGS AND PRECAUTIONS

The warnings and precautions can be found in the Model 5071 Lead labeling.

V. DEVICE DESCRIPTION

The Medtronic Model 5071 sutureless, unipolar, myocardial, screw-in lead is designed for ventricular pacing and sensing. The lead has application where permanent ventricular or dual-chamber pacing systems are indicated. Two (2) leads may be used for bipolar pacing.

The lead's screw-in electrode is designed to be secured to the myocardium with two (2) clockwise turns. A polyester mesh allows fibrous ingrowth for additional fixation.

Epicardial/myocardial leads are attached to the exterior surface of the heart through a surgical approach. Epicardial leads are typically used when transvenous leads are not feasible, such as congenital heart disease, abnormalities of the tricuspid valve, or when the leads are placed during other intrathoracic surgeries. In patients indicated for Cardiac Resynchronization Therapy (CRT), non-transvenous leads may be placed on the left ventricle under the above conditions, or when transvenous left ventricular lead placement is unsuccessful.

The Model 5071 epicardial lead is used as part of a system which also includes an implantable device. The lead may be used to treat bradycardia when used with an Implantable Pulse Generator (IPG) or heart failure when used with a CRT device. The lead may also be used for sensing or pacing applications with an Implantable Cardioverter Defibrillator (ICD).

The surgical approaches used to implant the Model 5071 lead include limited thoracotomy, subxiphoid, transxiphoid, and transmediastinal. It is also possible to place the Model 5071 endoscopically using standard laparoscopic or thoracoscopic tools and the Model 10626 implant tool.

Refer to the Technical Manual for additional details.

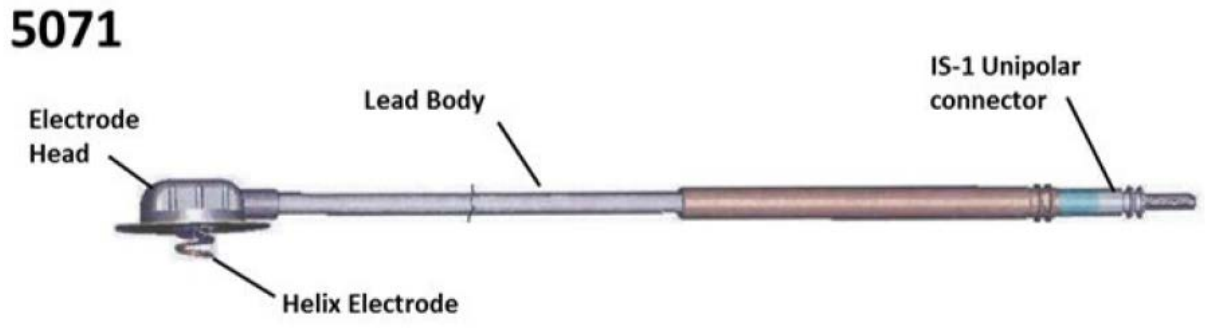


Figure 1. Myocardial Lead Model 5071

VI. ALTERNATIVE PRACTICES AND PROCEDURES

There is no direct alternative device available. Epicardial leads involve increased surgical invasiveness compared to non-transvenous leads and are not usually a first-line choice for pacing or sensing. There are two (2) other epicardial pace/sense leads approved in the U.S. They are the Medtronic CapSure Epi Models 4965 (P950024) and 4968 (P950024/S002). These leads require sutures for cardiac fixation, limiting where they can be placed compared to the Model 5071 lead. Each alternative has its own advantages and disadvantages. A patient should fully discuss these alternatives with his/her physician to select the method that best meets expectations and lifestyle.

VII. MARKETING HISTORY

Medtronic first marketed a sutureless myocardial unipolar pacemaker lead in the U.S. in 1973. The current distal lead design using a 2-turn helix and a 6.6mm^2 exposed surface electrode was cleared for U.S. distribution on the predicate Model 6917A-T in 1978. This design was updated and became the Model 5071 Lead to comply with the IS-1 connector standard in 1990. This device has not been withdrawn from marketing for any reason related to its safety or effectiveness. Medtronic has sold over 200,000 sutureless myocardial leads in the 40 year history including over 55,000 Model 5071 leads.

VIII. POTENTIAL ADVERSE EFFECTS OF THE DEVICE ON HEALTH

Below is a list of the potential adverse effects (e.g., complications) associated with the use of the device. These potential complications include, but are not limited to, the following patient-related conditions that can occur when the lead is being inserted or repositioned:

- cardiac tamponade
- fibrillation and other arrhythmias
- heart wall damage
- infection
- muscle or nerve stimulation
- pericardial rub

Other potential complications related to the screw-in lead and the programmed parameters include, but are not limited to, the complications listed in the following table.

Complication	Symptom	Corrective action to be considered
Cardiac Strangulation	Chest pain, general fatigue, syncope, symptoms of myocardial infarction, heart failure, new cardiac murmur	Reposition or replace the lead
Lead dislodgement	Intermittent or continuous loss of capture or sensing*	Reposition the lead
Lead conductor or helix fracture or insulation failure*	Intermittent or continuous loss of capture or sensing*	Replace the lead
Threshold elevation or exit block	Loss of capture*	Adjust the implantable device output. Replace or reposition the lead.
Bipolar pacing indicated (use two (2) leads)	Increased risk of inducing tachyarrhythmia due to equal surface area or anodal and cathodal electrodes.	If the paced stimuli are observed to be falling on the T-Wave, it may help to unipolarize the system.

*Transient loss of capture or sensing may occur for a short time following surgery until lead stabilization takes place. If stabilization does not occur, lead dislodgment may be suspected.

For the specific adverse events that occurred in the clinical study, please see Section X below.

IX. SUMMARY OF PRECLINICAL STUDIES

A. Laboratory Studies

Bench testing performed on the Model 5071 lead is summarized in the table below.

Bench Testing Performed on the Model 5071 Lead

Test	Requirement	Results	Analysis Type
Environmental Testing			
ETO Sterilization	No signs of damage or degradation upon visual examination (minimum magnification 3X). All samples must pass. ETO sterilization is pre-conditioning for subsequent mechanical and electrical tests.	Passed	Attribute

Test	Requirement	Results	Analysis Type
Thermal Shock	No signs of damage or degradation upon visual examination (minimum magnification 3X). All samples must pass. Thermal shock is pre-conditioning for subsequent mechanical and electrical tests.	Passed	Attribute
Mechanical Testing			
Connector Mating Insertion/ Withdrawal	Insertion Force ≤ 3.0 lbs. Withdrawal Force ≤ 2.5 lbs. Sealing rings must not buckle or roll back during insertion.	Passed	Variables
Lead Composite	Lead withstands 1.0 lbs. minimum tensile load.	Passed	Variables
Lead Body Flex	B50 flex life ≥ 2.0 X 10^5 cycles at a bend radius of 0.236". Tested according to EN 45502-2-1, Section 23.5	Passed	Attribute
Connector Flex	Proximal end of lead withstands oscillation at 45° to each side of vertical for at least 82,000 cycles. Tested according to EN 45502-2-1, Section 23.5	Passed	Attribute
Long Term Distal Fatigue	Estimated 90% reliability with 90% confidence at 10 years	Passed	Variables
Electrical Testing			
DC Resistance	Circuit resistance = 39 Ω ± 7 Ω (35 cm lead) Circuit resistance = 59 Ω ± 12 Ω (53 cm lead)	Passed	Variables

Test	Requirement	Results	Analysis Type
IS-1 Connector Leakage/ Medtronic AC Impedance Test of Unipolar Leads	Impedance > 50 kOhms	Passed	Attribute
Sterilization			
Sterilization	100% EtO sterilization process is used. It is considered an overkill sterilization cycle and is performed in accordance with EN ISO 11135-1:2007. Devices must have a sterility assurance of at least 10^{-6}. Sterilization validation was performed by comparison to "worst case" devices.	Passed	20 partial leads (model 4068). Proximal and distal ends of the leads were cut and capped to create a worst case condition.

B. Animal Studies

Due to the age of the original preclinical work for the Model 5071 lead, the following peer reviewed publication is the report that best represents premarket animal testing safety and effectiveness endpoints. The Hunter article [1]describes testing performed with the predicate to the Model 5071 lead, the Model 6917 sutureless myocardial lead. The table below provides a comparison of the two (2) leads.

Feature	Model 6917A-T	Model 5071
Silicone Rubber	Electrode Head Material	Electrode Head Material
Platinum Iridium	Helix Material	Helix Material
Polyester mesh disk	Epicardial Pad	Epicardial Pad
Helix wire diameter	0.5mm	0.5mm
Helix diameter	3mm	3mm
Number of helix turns	2	2
Maximum helix penetration	3.5mm	3.5mm
Connector	5mm	IS-1 Unipolar
Exposed helix dimension	$6.6mm^2$	$6.6mm^2$
Conductor	Platinum Ribbon Tinsel Wire	MP35N coil

From a comparison between the Model 6917A-T and the Model 5071, there are only two (2) differences; the connector and the conductor. The overall lead construction and functions remain similar; therefore the Model 6917A-T is an appropriate surrogate for the testing to support the Model 5071.

X. SUMMARY OF PRIMARY CLINICAL STUDY

The Medtronic Model 5071 lead is studied within the Medtronic System Longevity Study (SLS). The SLS is a prospective, non-randomized, multi-center study of implanted commercially available cardiac therapy products. This study is currently being conducted in the United States (US), Canada, and EMEA (Europe, Middle East and Africa).

As of the January 31, 2013 cutoff date, a total of 290 Model 5071 leads in 212 subjects have been enrolled in the Medtronic System Longevity Study (SLS). The first 5071 implant occurred on date February 17, 1994. There have been 21 (in 17 subjects) reported Model 5071 lead related complications, and a total of 146 exits (including 37 deaths). The observed survival rate of freedom from Model 5071 lead-related complications at 5 years was 85.4%, with a 2-sided 95% confidence interval of (76.8%, 91.1%).

The study of Model 5071 within the System Longevity Study Protocol did not intensively exam the effectiveness performance of the lead (i.e., there were no specific requirements regarding lead electrical testing done at each follow-up visit). Model 5071 lead effectiveness performance data are summarized based on data collected from patients who are implanted with Model 5071 (n=3794) leads and Medtronic generators, and are registered in the Medtronic CareLink remote monitoring system. The Model 5071 lead observed mean LV pacing threshold (weekly max) was 2.39±1.05V at implant and 2.33 ± 0.98V at 5 years. The electrical performance was stable over time and was within expected values, with 23.9-35.1% < 3V through 5 years post implant.

A. Study Design

The Medtronic System Longevity Study (SLS) is a world-wide, multi-center, non-randomized single arm prospective registry. A key purpose of the registry is to provide continuing evaluation and periodic reporting of the long-term reliability and performance of Medtronic market-released cardiac therapy products. Product-related adverse events, indicating the status of the product, are collected to measure survival probabilities. As one of the Medtronic cardiac therapy products, Model 5071 leads have been enrolled in the Medtronic SLS in the past decade since the lead model became commercially available worldwide.

1. Clinical Inclusion and Exclusion Criteria

Enrollment in the SLS registry was limited to patients who meet the following inclusion criteria:

Subjects or appropriate legal guardians provide written informed consent and/or authorization for access to and use of health information, as required by an institution's IRB/MEC/REB.

AND one of the following (a or b) must also apply:

a. Subjects indicated for implant or within six (6) months post-implant of a Medtronic market-released lead connected to a market-released IPG, ICD, or CRT Device. The Medtronic lead must be used for a pacing, sensing, or defibrillation application.

b. Subjects who participated in a qualifying study of a Medtronic cardiac therapy product and for whom:

    - product is market-released
    - complete implant and follow-up data, including product-related adverse events, are available
    - subject or appropriate legal guardian authorizes release of subject study data to SLS

Patients were not permitted to enroll in the SLS registry if they met any of the following exclusion criteria:

Subjects receiving an implant of a Medtronic lead at a non-participating center and the implant data and current status cannot be confirmed within 30 days after implant.

Subjects who are, or will be, inaccessible for follow-up at a SLS center.

Subjects implanted with a Medtronic cardiac therapy device whose predetermined enrollment limit for that specific product has been exceeded.

Subjects with exclusion criteria required by local law (Europe, Middle East and Africa (EMEA) only).

Data included in this clinical Safety and Efficacy Summary is a subset of the SLS dataset. The subset criteria are:

- A subject who is implanted with at least one (1) Model 5071 lead with valid implant date and product serial number.
- A subject is enrolled in a verifiable study center.

2. Follow-up Schedule

Enrolled subjects are followed in accordance with the standard care practices of their care provider from their implant date until they can no longer be followed (e.g., death, lost to follow-up, etc.). Product-related adverse events, system modifications, and changes in patient status (e.g., death and withdrawal from the study) are required to be reported upon occurrence.

3. Clinical Endpoints

The study objective is to evaluate long-term performance of the Medtronic market-released Model 5071 leads by analyzing product survival probabilities. The primary clinical endpoint is the Model 5071 lead related complications.

All adverse events reported are critically evaluated by a Medtronic technical review committee and/or a physician review committee. A lead-related complication is considered to have occurred if a clinical observation occurs more than 30 days after implant, is adjudicated with at least one of the following event classifications, and at least one of the following clinical actions is made. Events with an onset date 30 days or less after the implant are considered procedure related and therefore not included as chronic lead-related complications.

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 ohms)
- 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 (polarity reprogrammed to remove defective conductor, e.g. bipolar to unipolar)
- Lead use continued based on medical judgment despite a known clinical performance issue
- Other lead-related surgery performed (e.g., lead mechanical alteration or unsuccessful repositioning)

B. Accountability of PMA Cohort

The SLS protocol recommended subjects be followed by their respective center in accordance with the center's established practices for routine follow-up or prompted by symptoms or complaints.

As of the January 31, 2013 cutoff date, a total of 290 Model 5071 leads in 212 subjects have been enrolled. The first 5071 implant occurred on February 17, 1994. The cumulative device follow-up time for the 290 enrolled Model 5071 leads (in 212 subjects) was 7950.6 months, with the follow-up period range (min – max) of 0 - 160.0 months, and a median of 12.2 months. Device follow-up time was calculated from implant date to the latest patient in-office visit. If no visit occurred post-implant, device month was set to zero.

C. Study Population Demographics and Baseline Parameters

As of the cut-off date, 212 subjects have been enrolled in the study with a Model 5071 lead, 91(42.9%) subjects are female and 121(57.1%) are male. The average age was 53.4 years with 32 (15.1%) subjects younger than 19 and 94(44.3%) subjects older than 65 years of age. The following tables describe the subject population.

Table 1: Subject Age at Implant

Analysis Variable: AGE							
N	**Minimum**	**Lower Quartile**	**Median**	**Upper Quartile**	**Maximum**	**Mean**	**Std. Dev.**
212	0.0	35.9	62.7	72.6	99.2	53.4	25.0

Table 2: Subject Age Group

Age Group		
Age Group	**Frequency**	**Percent**
< 19yr	32	15.1%
19-65yr	86	40.6%
> 65yr	94	44.3%

Table 3: Subject Gender Distribution

GENDER		
GENDER	**Frequency**	**Percent**
Female	91	42.9%
Male	121	57.1%

Table 4: Subject Race/Ethnical Origin

RACE		
RACE	**Frequency**	**Percent**
Asian	1	0.5%
Black or African American	6	2.8%
Hispanic or Latino	6	2.8%
White	33	15.6%
Information not provided	6	2.8%
Not reportable per local laws or regulation	1	0.5%
DATA NOT COLLECTED*	159	75.0%

*data not required in previous versions of Case Report Forms

D. Safety and Effectiveness Results

1. Safety Results

   As of the data cut-off date, 21 Model 5071 lead related complications were observed in 21 Model 5071 leads. The survival curve is presented in Figure 1. All enrolled Model 5071 leads were included in this analysis. Subjects who exited the study due to a non-Model 5071 lead related reason were censored at the date of study exit. Censored subjects were included in the survival analysis up to the point when the study was no longer able to monitor the status of the lead. The observed survival rate of freedom from Model 5071 lead-related complications at 5 years was 85.4%, with a 2-sided 95% confidence interval of (76.8%, 91.1%). Table 5 presents the complication free survival probability at different time points

estimated using the Kaplan-Meier method. Of the 290 Model 5071 leads, no post implant visits or events were reported in 13 leads (in 13 subjects). Therefore, the total number at risk after implant (time 0) was 277. At the time of this analysis, forty eight (48) Model 5071 leads had been followed-up for 60 months or longer in the study.

Table 5: Model 5071 Complication Free Survival Estimates

Months Post Implant (*t*)	Survival	Failure	Survival Standard Error	Number Failed	Number Left*
0	1.0000	0	0	0	277
6	0.9629	0.0371	0.0129	8	190
12	0.9521	0.0479	0.0148	10	145
18	0.9455	0.0545	0.0161	11	124
24	0.9124	0.0876	0.0225	15	102
30	0.9124	0.0876	0.0225	15	88
36	0.8893	0.1107	0.0272	17	77
42	0.8893	0.1107	0.0272	17	65
48	0.8893	0.1107	0.0272	17	62
54	0.8893	0.1107	0.0272	17	58
60	***0.8544***	***0.1456***	***0.0356***	***19***	***48***
66	0.8544	0.1456	0.0356	19	43

*****Number of Model 5071 leads at risk immediately after time ***t*** in the study.

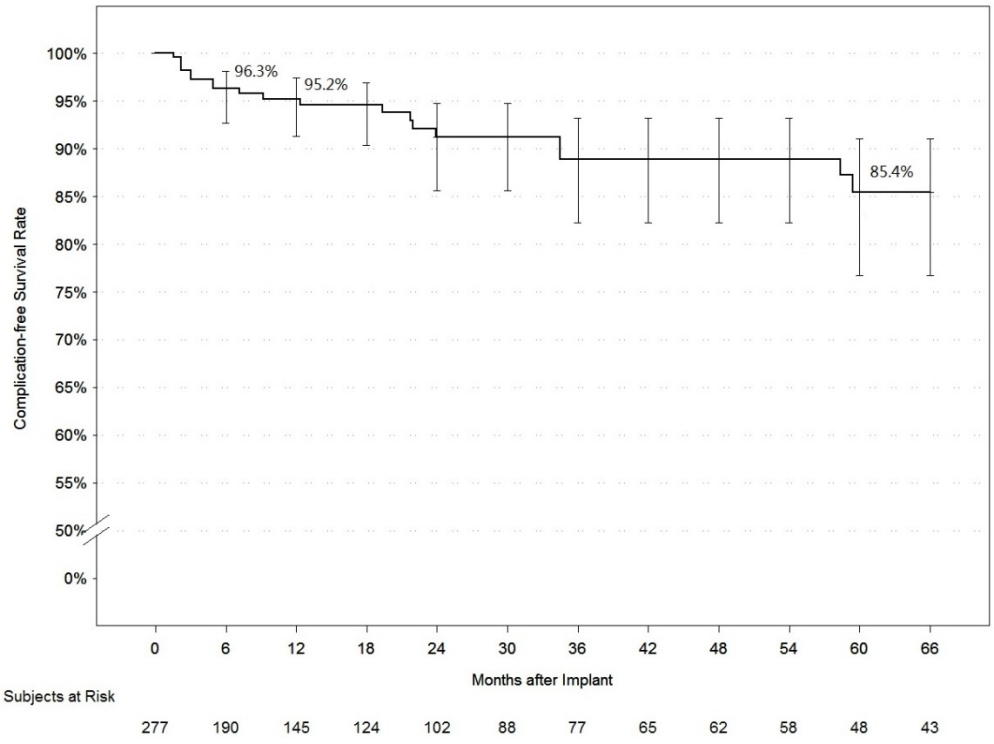


Figure 2: Kaplan-Meier Estimate of Model 5701 Complication Free Survival Probability

Adverse effects that occurred in the PMA clinical study:

As of the data cut-off date, there have been 21 (in 21 implanted Model 5071 lead, in 17 subjects) reported Model 5071 lead related chronic complications. Table 6 is a summary of Model 5071 related complications (or failure models).

Table 6: Summary of Complication Rates

Complication	Number of Leads (in # subjects)	Complication Rate (n=290)	95% Confidence Interval**
Abnormal Impedance	1(1)	0.003	(0.0001, 0.0191)
Elevated Thresholds	3 (2)	0.010	(0.0021, 0.0299)
Failure to Capture	12 (10)	0.041	(0.0216, 0.0712)
Oversensing	2(1)	0.007	(0.0008, 0.0247)
Undersensing	1(1)	0.003	(0.0001, 0.0191)
Other*	2(2)	0.007	(0.0008, 0.0247)
Overall	21(17)	0.072	(0.0454, 0.1086)

* The cause of two (2) lead revisions was not reported. These two (2) events were conservatively counted as lead related complications.

**2-sided 95% Confidence Intervals are calculated using the Exact binomial method.

2. Effectiveness Results

The study of Model 5071 within the System Longevity Study Protocol did not intensively exam the efficacy performance of the lead (i.e., there were no specific requirements regarding lead electrical testing done at each follow-up visit). Model 5071 lead efficacy performance data are summarized based on data collected from (de-identified) subjects who are implanted with Model 5071 leads and Medtronic generators, and are registered in the Medtronic CareLink remote monitoring system.

Table 7 and Table 8 present the summary statistics for weekly minimum and maximum pacing capture thresholds (PCT) over time. For the reporting purposes, time 0 (zero) included the average of weekly PCT data measured on the date of implant through 30 days post implant for each device, 6-month time point includes PCT measured within 5.5 – 7.5 months post implant, and similar window was applied to every 6 months thereafter until 5 years post implant. The box-plots (Figure 2 and Figure 3) illustrate the minimum, 1st quartile, median, 3rd quartile, and maximum and mean PCT values over time.

Table 7: Averaged Minimum LV Pacing Thresholds Over Time

Months Post Implant	N	Mean	Std Dev	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
0	1161	1.70	0.79	0.25	1.16	1.50	2.00	6.00
6	1224	2.30	1.14	0.25	1.50	2.00	2.90	6.00
12	1113	2.20	1.07	0.25	1.50	1.89	2.75	6.00
18	996	2.14	1.01	0.25	1.50	1.89	2.67	6.00
24	905	2.15	1.04	0.25	1.50	1.89	2.56	6.00
30	884	2.15	0.99	0.25	1.50	1.93	2.67	6.00
36	924	2.14	0.93	0.25	1.50	2.00	2.56	5.71
42	956	2.10	0.87	0.50	1.50	1.95	2.50	5.75
48	995	2.01	0.82	0.50	1.50	1.88	2.44	5.50
54	1012	1.98	0.82	0.50	1.44	1.83	2.44	5.50
60	961	1.94	0.81	0.25	1.33	1.81	2.40	5.13

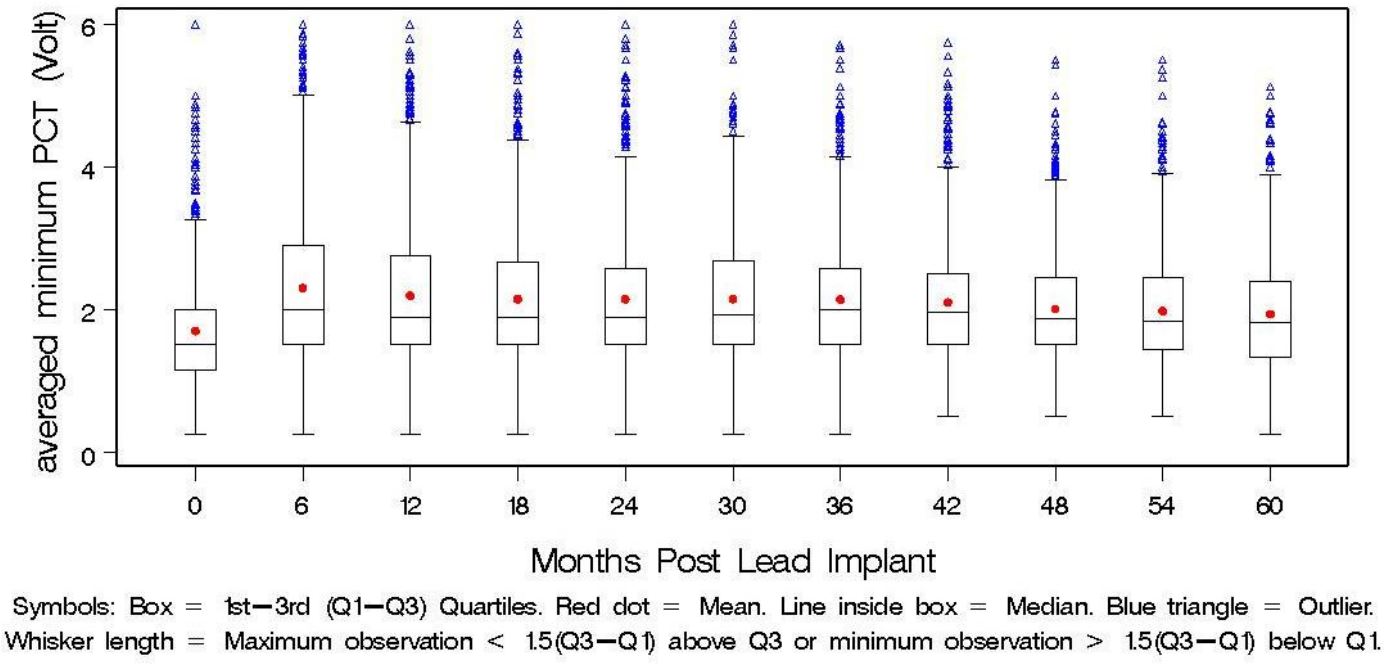


Figure 3: Averaged Minimum LV Pacing Thresholds Over Time – Boxplot

Table 8: Averaged Maximum LV Pacing Thresholds over Time

Months Post Implant	N	Mean	Std Dev	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
0	1161	2.39	1.09	0.25	1.59	2.13	2.88	6.00
6	1224	2.83	1.37	0.25	1.79	2.44	3.61	6.00
12	1113	2.68	1.30	0.25	1.67	2.28	3.44	6.00
18	996	2.60	1.24	0.25	1.62	2.20	3.25	6.00
24	905	2.59	1.26	0.25	1.58	2.18	3.25	6.00
30	884	2.58	1.19	0.25	1.63	2.25	3.25	6.00
36	924	2.58	1.13	0.25	1.69	2.38	3.15	6.00
42	956	2.53	1.08	0.50	1.73	2.30	3.06	6.00
48	995	2.41	1.00	0.50	1.61	2.16	2.97	6.00
54	1012	2.37	1.00	0.50	1.56	2.12	2.96	6.00
60	961	2.33	0.98	0.25	1.51	2.10	2.88	6.00

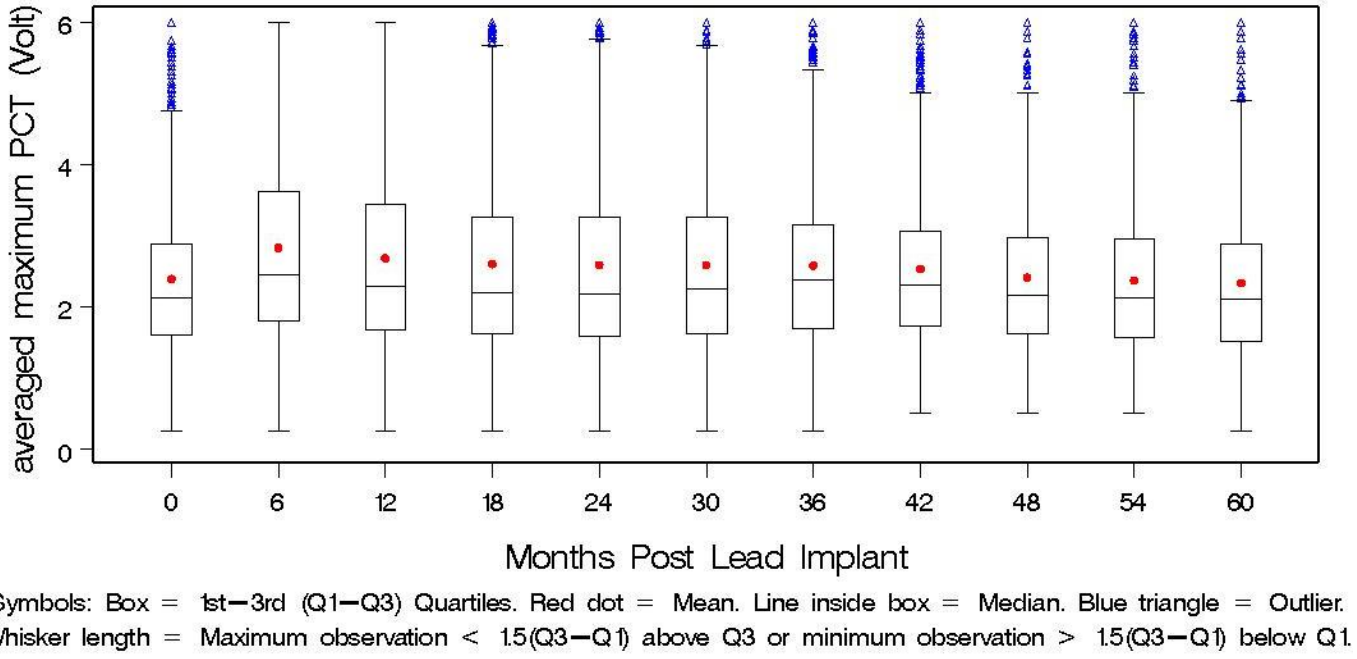


Figure 4: Averaged Maximum LV Pacing Thresholds Over time – Boxplot

The distribution of LV lead PCT > 3Volts at each follow-up reporting time window is presented in Table 9. To be conservative, if there was any weekly LV PCT measure being greater than 3Volts during a reporting window, the patient is counted as having LV PCT greater than 3V for the window. While a greater proportion of subjects have PCTs that are higher than current steroid-eluting transvenous LV leads, the rate remains stable with slight decrease over 60 months of follow up.

Table 9: Proportion of Patients with LV Pacing Thresholds Greater than 3 Volts

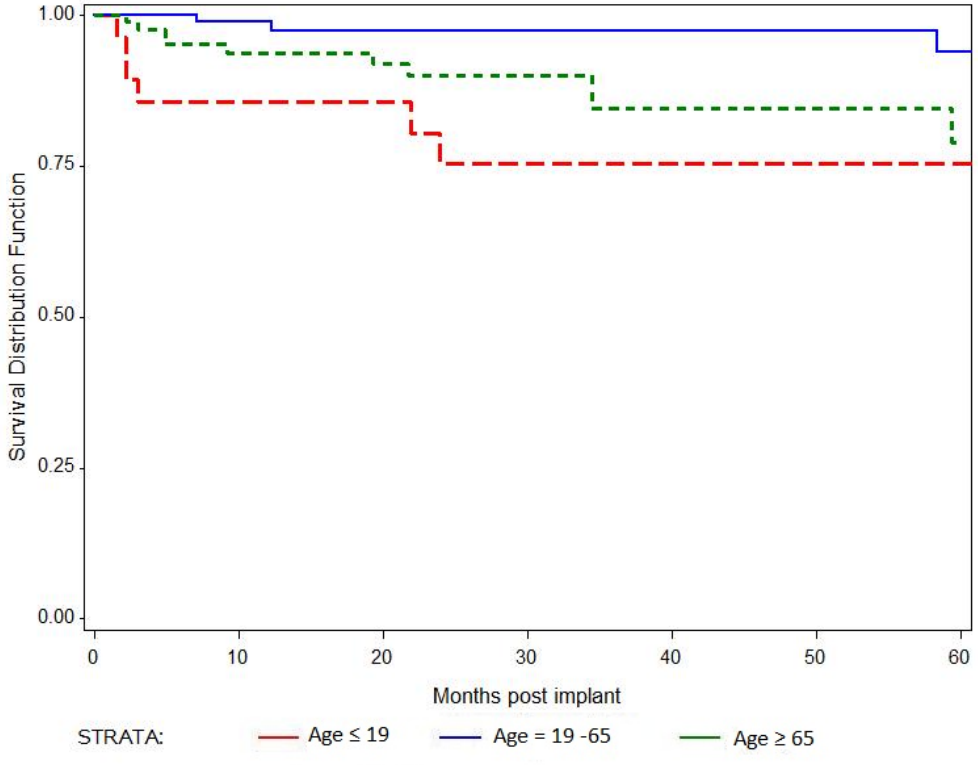
Visit	n	# of Pts with PCT > 3V (%)
0	1161	407(35.1%)
6	1224	459(37.5%)
12	1113	377(33.9%)
18	996	306(30.7%)
24	905	283(31.3%)
30	884	279(31.6%)
36	924	290(31.4%)
42	956	266(27.8%)
48	995	252(25.3%)
54	1012	247(24.4%)
60	961	230(23.9%)

3. Subgroup Analyses

   Additional analyses were carried out to further present Model 5071 lead safety performance in different age, gender, and geographic groups. There was no significant difference observed comparing male to female, or across geographic regions. It was observed that Model 5071 leads implanted in patients in the age group of 19-65 year of age experienced better complication free survival (93.9% at 5 years), comparing to either younger or older patient group (75.5% and 79.0% at 5 years, respectively). The survival probabilities are presented in following tables and figures.

Table 10: Survival Probability Stratified by Age

0 - 19 Years				19 - 65 Years			65 + Years		
Months Post Implant	**Survival**	**Number Failed**	**Number Left**	**Survival**	**Number Failed**	**Number Left**	**Survival**	**Number Failed**	**Number Left**
0	100.0%	0	36	100.0%	0	123	100.0%	0	118
6	85.6%	4	23	100.0%	0	96	95.2%	4	71
12	85.6%	4	19	98.9%	1	69	93.8%	5	57
18	85.6%	4	17	97.5%	2	56	93.8%	5	51
24	75.5%	6	15	97.5%	2	45	90.1%	7	42
30	75.5%	6	12	97.5%	2	39	90.1%	7	37
36	75.5%	6	12	97.5%	2	34	84.6%	9	31
42	75.5%	6	10	97.5%	2	34	84.6%	9	21
48	75.5%	6	10	97.5%	2	34	84.6%	9	18
54	75.5%	6	10	97.5%	2	31	84.6%	9	17
60	75.5%	6	10	93.9%	3	24	79.0%	10	14
66	75.5%	6	10	93.9%	3	21	79.0%	10	12

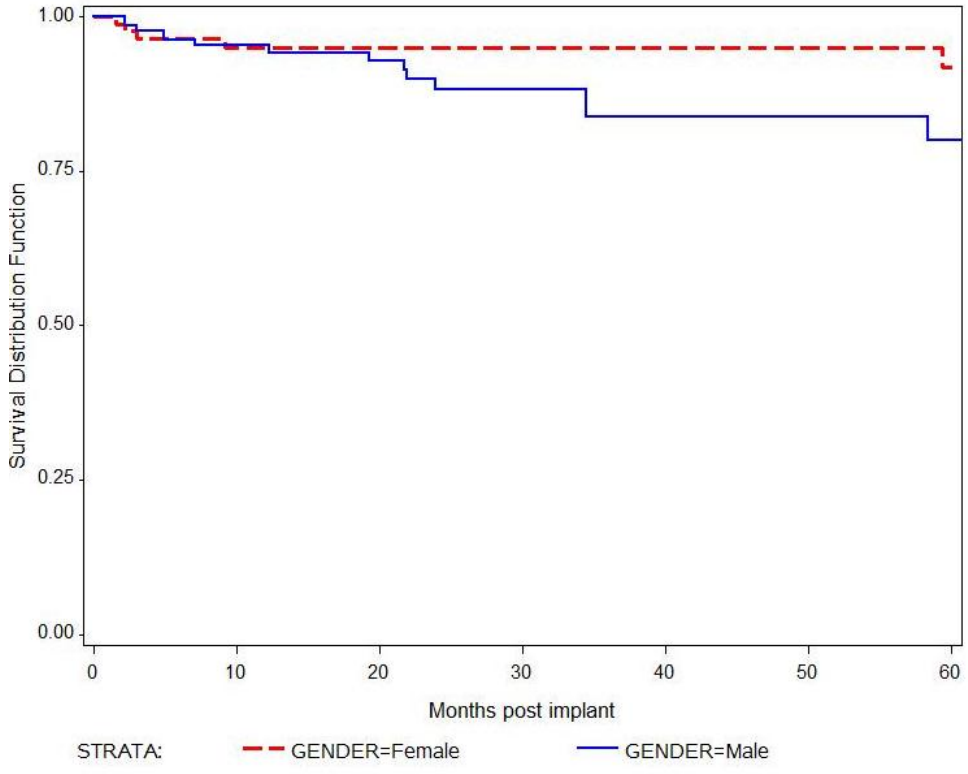


*p = 0.0112, log-rank test

Figure 5: Model 5071 Lead Survival Curves Stratified by Age Group

Table 11: Model 5071 Lead Survival Probability Stratified by Gender

Female				Male		
Months Post Implant	**Survival**	**Number Failed**	**Number Left**	**Survival**	**Number Failed**	**Number Left**
0	100.0%	0	118	100.0%	0	159
6	96.5%	3	75	96.2%	5	115
12	95.1%	4	60	95.3%	6	85
18	95.1%	4	55	94.2%	7	69
24	95.1%	4	47	88.3%	11	55
30	95.1%	4	44	88.3%	11	44
36	95.1%	4	40	83.8%	13	37
42	95.1%	4	32	83.8%	13	33
48	95.1%	4	32	83.8%	13	30
54	95.1%	4	32	83.8%	13	26
60	91.9%	5	29	79.9%	14	19
66	91.9%	5	27	79.7%	14	16

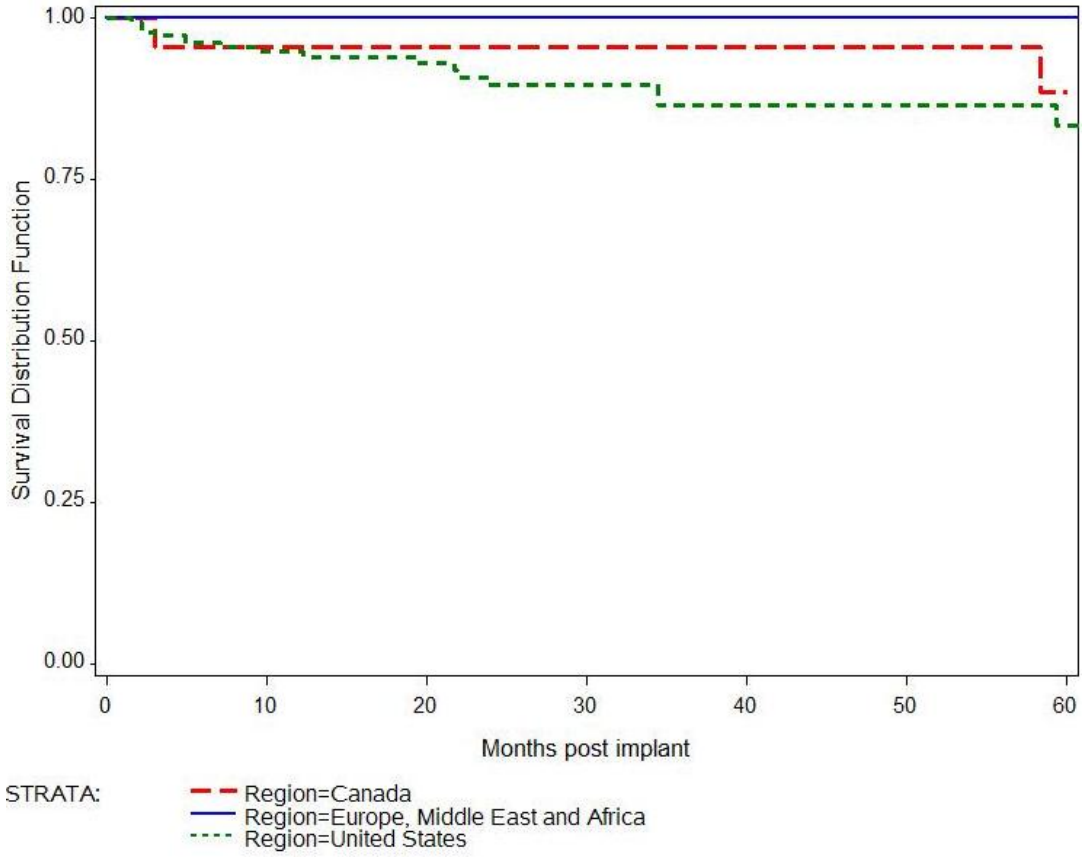


*p = 0.1677, log-rank test

Figure 6: Model 5071 Lead Survival Curves Stratified by Gender

Table 12: Model 5071 Lead Survival Probability Stratified by Region

	Canada			EMEA			US		
Months Post Implant	**Survival**	**Number Failed**	**Number Left**	**Survival**	**Number Failed**	**Number Left**	**Survival**	**Number Failed**	**Number Left**
0	100.0%	0	23	100.0%	0	18	100.0%	0	236
6	95.5%	1	19	100.0%	0	14	96.1%	7	157
12	95.5%	1	16	100.0%	0	12	94.8%	9	117
18	95.5%	1	15	100.0%	0	11	94.0%	10	98
24	95.5%	1	15	100.0%	0	11	89.7%	14	76
30	95.5%	1	15	100.0%	0	10	89.7%	14	63
36	95.5%	1	15	100.0%	0	10	86.4%	16	52
42	95.5%	1	15	100.0%	0	10	86.4%	16	40
48	95.5%	1	15	100.0%	0	10	86.4%	16	37
54	95.5%	1	14	100.0%	0	10	86.4%	16	34
60	88.6%	2	13	100.0%	0	7	83.4%	17	28
66	88.6%	2	11	100.0%	0	6	83.4%	17	26



*p=0.3480, Log-rank test

Figure 7: Model 5071 Lead Survival Curves Stratified by Geographical Region

E. Financial Disclosure

The Financial Disclosure by Clinical Investigators regulation (21 CFR 54) requires applicants who submit a marketing application to include certain information concerning the compensation to, and financial interests and arrangement of, any clinical investigator conducting clinical studies covered by the regulation. The study subjects were enrolled in a post market registry and compensation for conducting the study was calculated based on fair market values. It is for these reasons that we believe that none of the clinical investigators had disclosable financial interests/arrangements as defined in sections 54.2(a), (b), (c), and (f). The information provided does not raise any questions about the reliability of the data.

XI. SUMMARY OF SUPPLEMENTAL CLINICAL INFORMATION

Most of the studied Model 5071 leads were enrolled in the SLS registry after their successful implant procedure. Therefore, the clinical study does not provide sufficient data to provide an unbiased evaluation of implant tools, implant success rates, and implanter experiences. Nonetheless, Model 5071 leads were researched and published in several peer reviewed Journals.

Implanting technique and experience for cardiac epicardial leads, including Model 5071 leads, was discussed in the Mair[2] paper which was published in *The Heart Surgery Forum* (2003). The paper studied three (3) epicardial lead implantation techniques: (1) left lateral mini-thoracotomy; (2) a video-assisted thoracoscopy approach using lead implantation tools; and (3) a robotically enhanced telemanipulation system. In a total of 80 patients, the study observed that intended lead location on the LV was achieved in all patients. Acute and 3-month LV lead thresholds were satisfactory in 79 patients (99%). The paper detailed the thoracoscopic approach using the Medtronic 10626 epicardial lead implant tool for the Medtronic 5071 epicardial pacing lead and concluded that the thoracoscopic approaches with further improvements in the leads and implantation devices were at least equivalent or possibly better treatment options than the coronary sinus approach for BiV pacing.

Screw-in epicardial lead implant techniques were also discussed in the Navia[3] paper published in *The Annuals of Thoracic Surgery* (2005). This study enrolled patients for undergoing surgical epicardial implantation after transvenous implantation failure. Surgical approach was either endoscopic (video-assisted thoracoscopic surgery or robotic) or by means of minithoracotomy. The paper compared safety and efficacy of these two (2) approaches and concluded that both procedures were safe, with short procedure times, no implant failure, no mortality, and minimal morbidity. HF conditions were improved in most patients.

Doll[4] reported 7 cases of Model 5071 implant procedure using Medtronic Model 10626 epicardial lead placement tool in *The Annals of Thoracic Surgery* (2003). In five (5) patients, the procedure was performed at the same time as biventricular defibrillator implantation. Two (2) patients underwent isolated epicardial lead placement 1 day and

10 days after failed transvenous LV lead placement. The paper concluded that the implanting tool was safe and efficient.

Lead placement technique and CRT response after Model 5071 lead implantation were studied in the Edgerton[5] paper published in *The Annals of Thoracic Surgery* (2007). A total of 29 patients with heart failure class III or IV and had failed transvenous LV lead placement were included in this study. All patients were prepared for thoracoscopic placement of a Medtronic 5071 lead. A follow-up telephone survey was carried out to measure change in the patients' quality of life. The Model 5071 lead placements were 100% successful. The study reported that Quality of Life scores improved in 90.9% of patients with mapped lead placement and in 66.6% of the patients without mapped lead placement.

In summary, this peer-reviewed clinical evidence demonstrates that Model 5071 implanting tools are acceptable and that the implanting technique is mature. Patient clinical outcome after receiving a Model 5071 lead is acceptable.

A. Clinical Study Results Update

The PMA Clinical Report (version 1, May 6, 2013) included Model 5071 lead performance data on or before January 31, 2013. Medtronic Product Surveillance Registry (PSR) continued following those enrolled subjects. Data previously collected under the SLS and/or subjects who were enrolled in the SLS protocol were integrated into the PSR

All reported lead-related adverse events are classified by the reporting investigator and reviewed by an independent event adjudication committee for event diagnosis classification and relativeness to device components. A lead-related event that is final adjudicated as a complication and occurs more than 30 days after implant is considered a product performance event and will contribute to the survival analysis endpoint.

For the lead survival analysis, a statistical method to incorporate data from post implant enrollment (i.e., left truncation[6]), was applied to minimize potential bias caused by post implant enrollments. The calculated survival probability at a given time *t* is an estimator of survival probability beyond *t*, conditional on a lead surviving to the entry time (post implant) to the registry.

The following displays Model 5071 lead performance related complication free survival function estimate using an updated dataset with a data cut-off date of January 29, 2015.

As shown in Figure 1, the 5-year lead survival probably was 88.6%, with 95% Confidence Interval (82.5%, 92.3%). This result is consistent with reported 5-year lead survival rate of 85.4% in the original PMA submission.

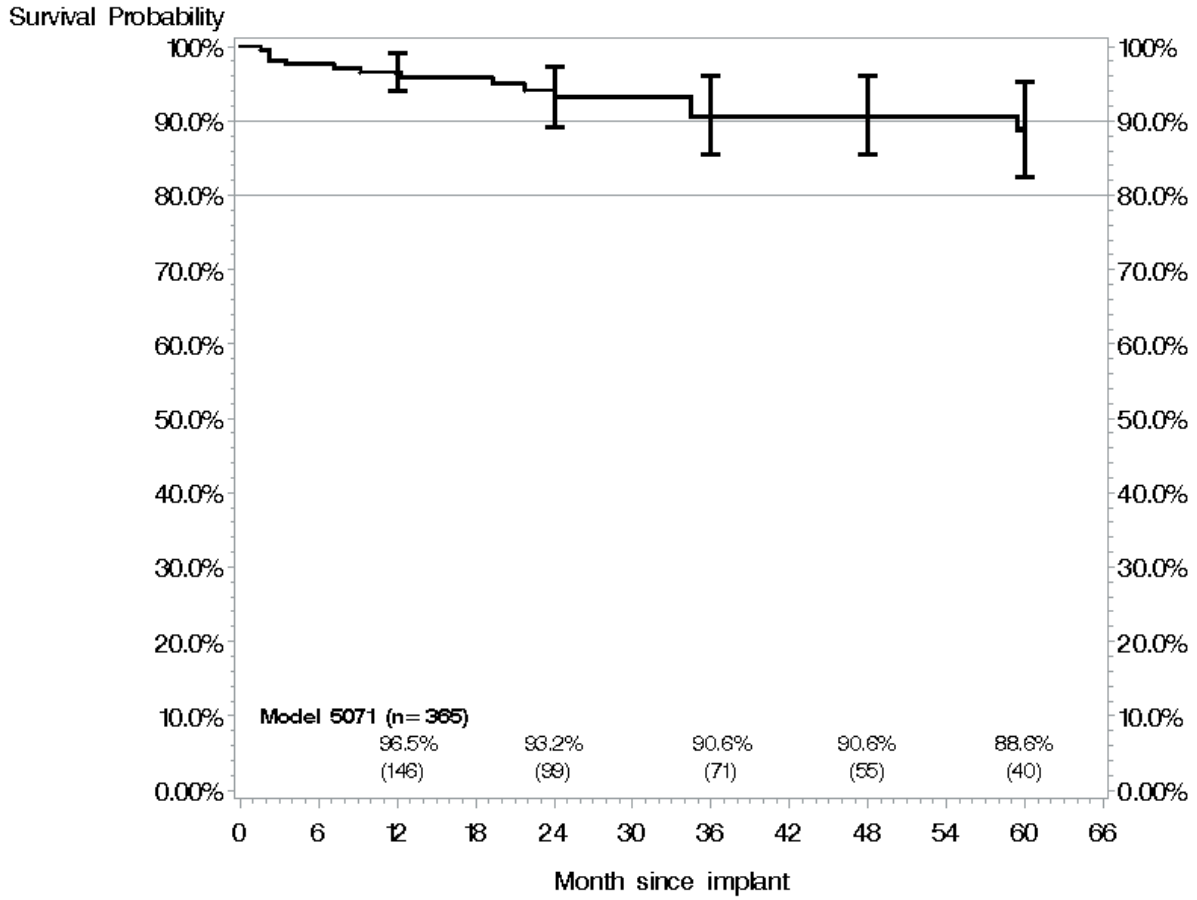


Figure 8. Model 5071 Lead Related Complication Free Survival Probability (data as of 29 JAN 2015)

The PSR is an on-going study. Model 5071 performance will be updated biannually on Medtronic CRHF Product Performance Report (PPR) eSource: http://wwwp.medtronic.com/productperformance/model/5071-screw-in.html.

B. Clinical Performance Comparing to other Epicardial Leads

As the PSR enrolls all eligible Medtronic cardiac therapeutic products following its market release, informative comparisons of clinical performance may be conducted across Medtronic products.

Medtronic Models 4965 and 4968 leads were US market released epicardial leads since year 1996 and 1999, respectively. To date, both leads are still actively in use. Indications for implant of all these three (3) epicardial lead models are the same. Table 13 presents Model 4965, Model 4968 and Model 5071 lead performance related complications observed in the PSR.

Table 13: Medtronic Surveillance Registry Clinical Experience (as of 29 JAN 2015)

Lead Model		Model 4965 (n = 228)	Model 4968 (n = 864)	Model 5071 (n = 365)
Cumulative Device Experience	(month)	6718	43771	7649
Chronic Complications	Conductor Fracture	6 (2.6%)	14 (1.6%)	1 (0.3%)
	Failure to Capture	3 (1.3%)	20 (2.3%)	14 (3.8%)
	Elevated threshold*	0 (0%)	2 (0.2%)	0 (0%)
	Oversensing	2 (0.9%)	13 (1.5%)	2 (0.5%)
	Failure to Sense	1 (0.4%)	3 (0.3%)	0 (0%)
	Insulation Breach	1 (0.4%)	3 (0.3%)	0 (0%)
	Abnormal Impedance	0 (0%)	4 (0.5%)	1 (0.3%)
	Extracardiac Stimulation	0 (0%)	2 (0.2%)	0 (0%)

**Elevated threshold events are reported as "Other" on the PPR.*

Lead survival functions for the three (3) lead models are presented in Figure 9. Since the survival estimates can become imprecise with small effective sample sizes, survival curves for all three (3) models are displayed for time points when the number of leads entering an interval is at least 50.

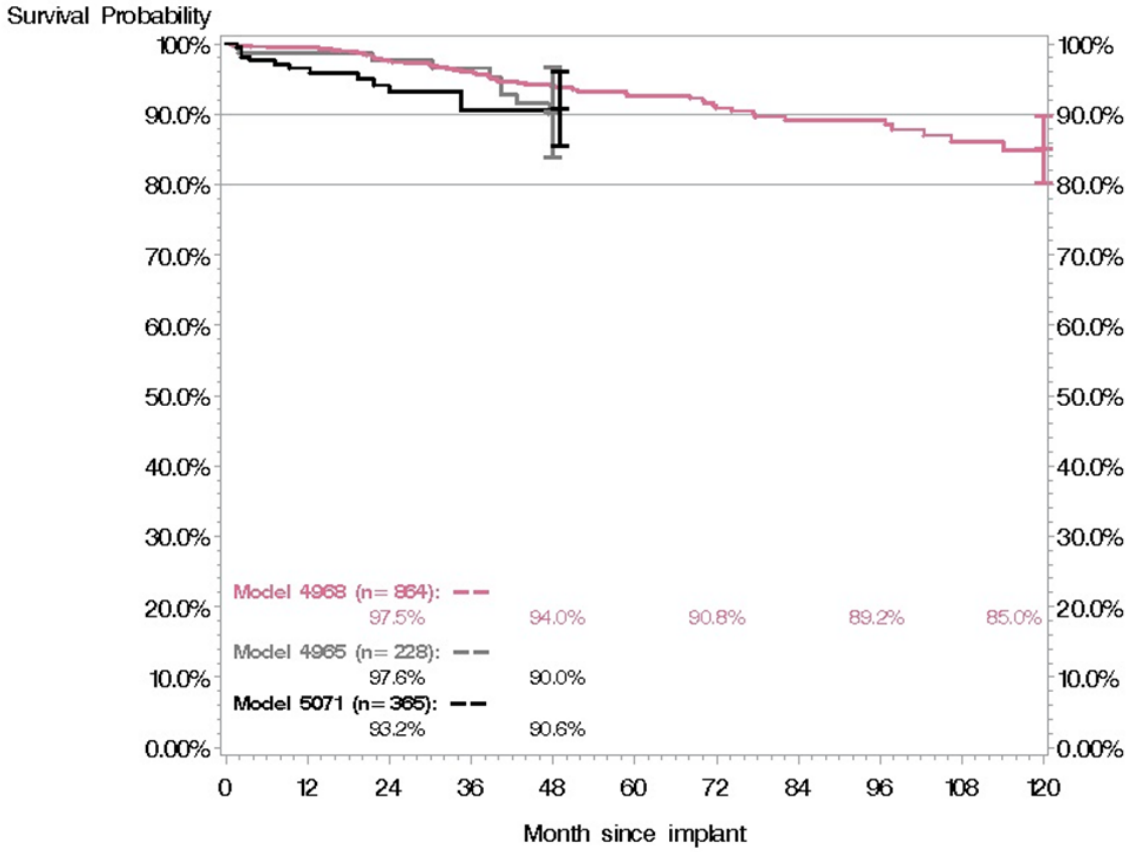


Figure 9. Chronic Lead Survival Probabilities (as of January 29, 2015)

While the PSR results intend to measure chronic (>30 days) performance of a lead, information about the clinical experience in the first month of service is included in the US Acute Lead Observations Table on PPR. Table 15 presents frequencies of reported acute lead observations for the three (3) Medtronic epicardial leads. The source for this information is Medtronic's complaint handling system database.

The lead event reported to Medtronic may or may not have involved clinical action or product returned to Medtronic. The lead may have remained implanted and in service.

Table 14: US Acute Lead Observations

Lead Model		Model 4965	Model 4968	Model 5071
US Market Release (Year)		1996	1999	1992
Registered US Implants (rate*)		21,855	33,661	47,810
Acute Lead Observations	Cardiac Perforation	0	0	1 (0.002%)
	Conductor Fracture	1 (0.005%)	2 (0.006%)	0
	Extra Cardiac Stimulation	0	1 (0.003%)	5 (0.010%)
	Failure to Capture	4 (0.018%)	22 (0.065%)	44 (0.092%)
	Failure to Sense	5 (0.023%)	1 (0.003%)	2 (0.004%)
	Impedance Out of Range	6 (0.027%)	3 (0.009%)	1 (0.002%)
	Insulation Breach	0	1 (0.003%)	0
	Lead Dislodgement	0	4 (0.012%)	0
	Oversensing	1 (0.005%)	4 (0.012%)	0
	Unspecified Clinical Failure	3 (0.014%)	0	1 (0.002%)

*rates were calculated based on reported events relative to number of registered US implants.

XII. PANEL MEETING RECCOMENDATION AND FDA'S POST PANEL ACTION

In accordance with the provisions of section 515(c)(3) of the act as amended by the Safe Medical Devices Act of 1990, this PMA was not referred to the Cardiovascular Device Panel, an FDA advisory committee, for review and recommendation because the information in the PMA substantially duplicates information previously reviewed by this panel.

XIII. CONCLUSIONS DRAWN FROM PRECLINICAL AND CLINICAL STUDIES

A. Effectiveness Conclusions

The effectiveness analysis was conducted utilizing device data (n=3794) collected via Medtronic CareLink system. The Model 5071 lead observed mean LV pacing threshold (weekly max) was 2.39±1.05V at implant and 2.33 ± 0.98V at 5 years. The electrical performance was stable over time and was within expected values, with 23.9-35.1% > 3V through 5 years post implant.

B. Safety Conclusions

The safety analyses were performed on the Model 5071 lead subject cohort using a data cut-off of January 31, 2013. The observed freedom from Model 5071 lead-related complications at 5 years was 85.4%, with a 2-sided 95% confidence interval of (76.8%, 91.1%).

The lead survival analysis was again conducted using an updated dataset with data cut-off as of January 29, 2015. The observed freedom from Model 5071 lead performance related complications at 5 years was 88.6%, with a 2-sided confidence interval of (82.5%, 92.3%), consistent with estimates obtained in previous analysis.

Comparing to other market released Medtronic epicardial leads (models 4965 and 4968), Model 5071 presented slightly higher rate of failure to capture (3.8% vs 1.3%, and 2.3%, respectively). This may be due to the fact there is no steroid on the model 5071 helix electrode.

C. Benefit Risk Conclusion

There are known risks/complications associated with epicardial lead implantation (e.g., sterility issue, increased procedure time, surgical complication, hematoma, chronic dislodgment, lead related failure leading to oversensing or undersensing, material degradation, lead fracture, lead insulation failure, etc.). To date, there have been no unanticipated device effects.

The current scientific literature indicates that the overall benefit of the use of epicardial leads meets the requirements set forth by the American Heart Association (AHA) / American College of Cardiology (ACC) / European Society of Cardiology (ESC) guidelines. The benefits of pacing and CRT therapy include increased exercise capacity, improved quality of life, decreased mortality and hospitalization, and improved VO2, LVEF and LV dimensions. In addition, IPGs, ICDs, and CRTs provide therapies to patients who are at risk for various medical conditions such as cardiac arrest due to ventricular arrhythmias, unexplained syncope, and/or left ventricular dysfunction. The available clinical data on the Model 5071 lead demonstrates that the outcomes are in line with clinical data on other Medtronic epicardial leads that are currently in use on the market, specifically models 4965 and 4968.

Based on the critical evaluation of the available clinical data, the overall benefit of the use of the Medtronic model 5071 myocardial lead outweighs the risk.

D. **Overall Conclusions**

The data in this application suport the reasonable assurance of safety and effectiveness of this device for patients indicated for permanent ventricular or dual-chamber pacing.

XIV. CDRH DECISION

CDRH issued an approval order on April 27, 2015.

The applicant's manufacturing facility was inspected and found to be in compliance with the device Quality System (QS) regulation (21 CFR 820).

XV. APPROVAL SPECIFICATIONS

Directions for use: See device labeling.

Hazards to Health from Use of the Device: See Indications, Contraindications, Warnings, Precautions, and Adverse Events in the device labeling.

Post-approval Requirements and Restrictions: See approval order.

XVI. REFERENCES

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