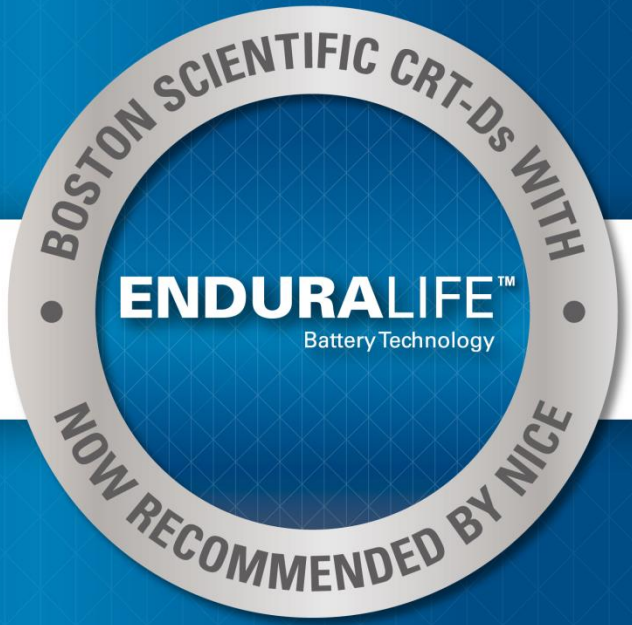
Boston Scientific

ENDURALIFE™ Battery Technology

Now recommended by NICE

smart solutions | **PROVEN TO LAST**



NICE ENDURALIFE™ Guidance

NICE **ENDURA**LIFE Guidance

What is the NICE Medical Technology Evaluation Programme?

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NICE have published a recommendation on Boston Scientific's **ENDURA**LIFE-powered CRT-Ds

The National Institute of Health and Care Excellence (NICE) have recommended Boston Scientific's **ENDURA**LIFE-powered CRT-D devices, following an evaluation by their Medical Technologies Evaluation Committee (MTEP):

> *"The case for adopting ENDURALIFE-powered cardiac resynchronisation therapy-defibrillator (CRT-D) devices for treating heart failure is supported by the published evidence. Extended battery life is of clinical and patient benefit and associated with fewer replacement procedures"*[1]

1 MTG 294. NICE medical technology guidance: ENDURALIFE-powered CRT-D devices for treating heart failure. March 2017.

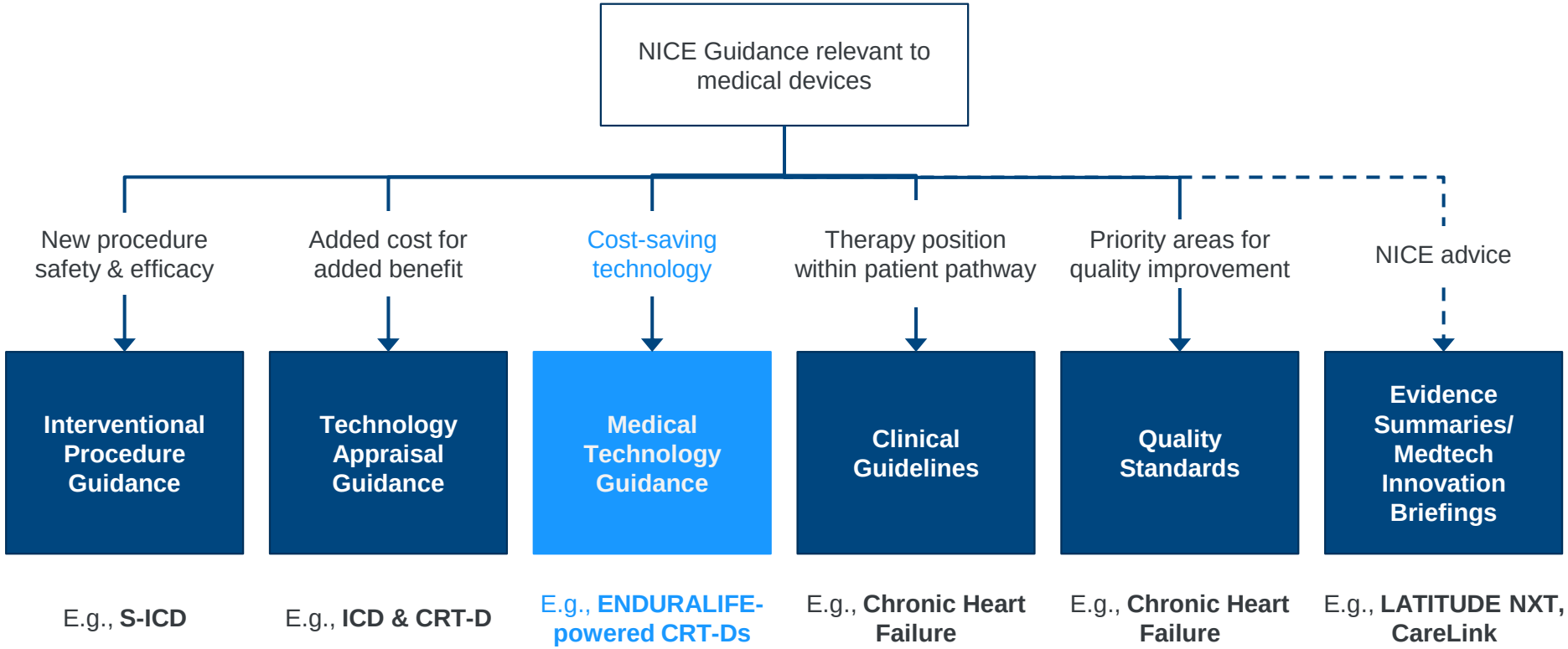
The published evidence demonstrated clinical and economic benefits to **ENDURA**LIFE-powered CRT-Ds

> *"The case for adopting ENDURALIFE-powered cardiac resynchronisation therapy-defibrillator (CRT-D) devices for treating heart failure is supported by the published evidence. Extended battery life is of clinical and patient benefit and associated with fewer replacement procedures"*[1]

- From its evaluation of submitted evidence, NICE concluded that the extended battery life observed with **ENDURA**LIFE -powered CRT-Ds is likely to reduce the number of avoidable replacement procedures a patient may have to undergo, thereby offering improved outcomes for patients and potential savings to the NHS of approximately £6 million in the first five years.

1 MTG 294. NICE medical technology guidance: ENDURALIFE-powered CRT-D devices for treating heart failure. March 2017.

The NICE MTEP guidance is designed to promote adoption of cost-saving technologies



NICE MTEP guidance is focused on branded medical technologies which are cost saving

Medical Technologies Evaluation Programme (MTEP) guidance considers:

- A **branded**, CE marked medical device
- Whether the device is either **new or an innovative modification** of an existing technology
- Whether the device has the potential to offer substantial **benefits to patients and/or the NHS**
- If it provides **equivalent or enhanced clinical outcomes**
- If it is an equivalent or **reduced cost**

The **'case for adoption'** is based on the claimed advantages of introducing the specific technology compared with current management of the condition. This case is reviewed against the evidence submitted and expert advice. If the case for adopting the technology is supported, then the technology has been found to offer advantages to patients and the NHS

We submitted clinical evidence and economic data to support our **ENDURA**LIFE powered CRT-Ds

Boston Scientific
Advancing science for life™

Economic data

- Cost-consequence is a NICE requirement
- Modelled using published data

Replacement-related complications

- The case for reduced complications and infections
- Comprehensive literature review

Real-world device longevity

- 6 studies on CRT-D superiority
- Product Performance Reports
- Internal battery information

BOSTON SCIENTIFIC CRT-Ds WITH ENDURALIFE™ Battery Technology NOW RECOMMENDED BY NICE

The Result:
*A NICE **ENDURA**LIFE Recommendation*

NICE

NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Medical technology guidance

ENDURALIFE-powered CRT-D devices for treating heart failure

17 March 2017

1 Recommendations

1.1 The case for adopting ENDURALIFE-powered cardiac resynchronisation therapy-defibrillator (CRT-D) devices for treating heart failure is supported by the published evidence. Extended battery life is of clinical and patient benefit and associated with fewer replacement procedures.

Published March 2017

6 Conclusions

6.1 The committee concluded that there is good evidence to support the clinical benefit of longer battery life and the associated reduction in cardiac resynchronisation therapy-defibrillator (CRT-D) replacements.

6.2 The committee concluded that developments in CRT-D technology are ongoing and that the evidence available suggests that the advantages of longer battery life have not been surpassed by other types of technical advances.

6.3 The committee noted the potential hazards of a clinical service relying solely on a single manufacturer's CRT-D devices.

6.4 The committee encouraged further studies that provide data on the battery life of different CRT-Ds, including an analysis of currently available UK NHS clinical data.

6.5 Based on cost modelling, the committee concluded that using ENDURALIFE-powered CRT-Ds in patients with heart failure is likely to save costs by reducing the number of replacement procedures.

Published March 2017

NICE **ENDURA**LIFE Guidance

The Case for Adoption: Clinical and Economic Evidence

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The evidence review evaluated 16 published studies and 5 product performance reports

To assess **ENDURA**LIFE-powered CRT-D devices, NICE reviewed 6 observational studies on CRT-D battery life, 6 studies on adverse events arising from cardiac device replacement, 5 product performance reports, 4 studies on cost implications of longevity and an economic model.

CLINICAL DATA

- Published clinical studies demonstrated that **ENDURA**LIFE-powered CRT-D devices lasted longer than other devices implanted during the same time period
- Clinical adverse events data demonstrated that there are complications associated with device replacement and that fewer device replacements may be beneficial to patient outcomes
- Product Performance Reports (PPRs) from manufacturers confirm that normal battery depletion was the main cause of device replacement

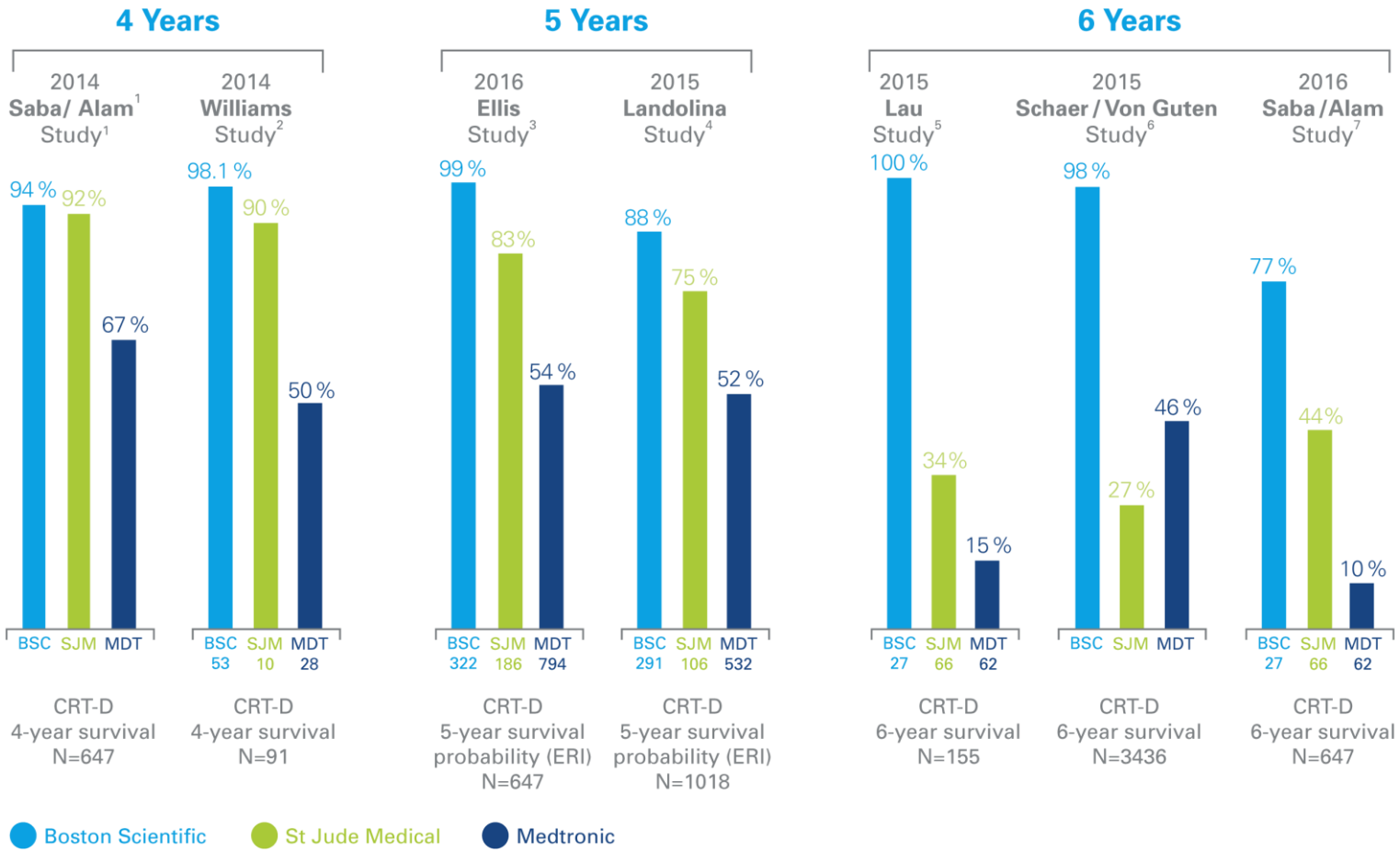
ECONOMIC DATA

- Published economic evidence showed that there is a relationship between longevity and cost savings
- An economic model calculated the UK savings of using **ENDURA**LIFE-powered CRT-D devices

Superior longevity of **ENDURA**LIFE-powered CRT-Ds was demonstrated by independent device survival studies

CLINICAL DATA | ECONOMIC DATA

NICE reviewed 6 observational studies on CRT-D battery life, which demonstrated that **ENDURA**LIFE-powered CRT-D devices lasted longer than other devices implanted during the same time period



BOSTON SCIENTIFIC CRT-Ds WITH ENDURALIFE Battery Technology NOW RECOMMENDED BY NICE

Independent Device Survival Studies: In Detail

CLINICAL DATA | ECONOMIC DATA

Alam, Saba et al 6 year data follow-up compared CRT-D longevity across manufacturers

Alam / Saba (2014/2016*)

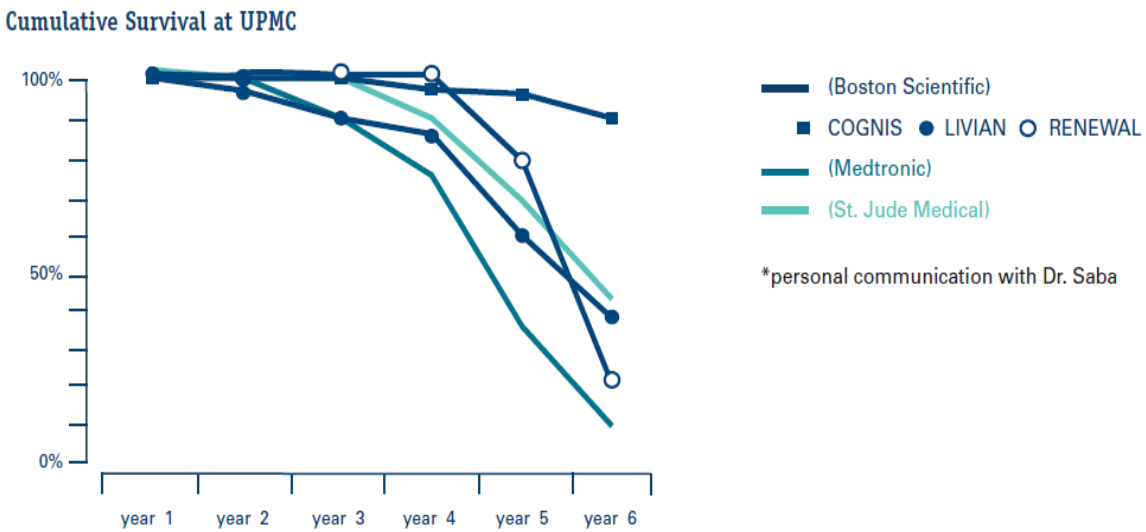
Ellis (2016)

Landolina (2015)

Schaer / von Gunten (2015)

Lau (2015)

Williams (2014)



Battery Longevity in Cardiac Resynchronization Therapy Implantable Cardioverter Defibrillators was an independent study comparing contemporary CRT-D longevity: 6 Year Data Follow-up. At the 6 year follow-up, Boston Scientific had 77% of devices still in service, St. Jude had 44% and Medtronic had 10% still in service. In unpublished analysis of Boston Scientific model families, the COGNIS performance was even better. See graph.

Boston Scientific = 173 patients
Medtronic = 416 patients
St. Jude Medical = 57 patients

*Survival rate calculated using device replacements for battery depletion as indicated by ERI.

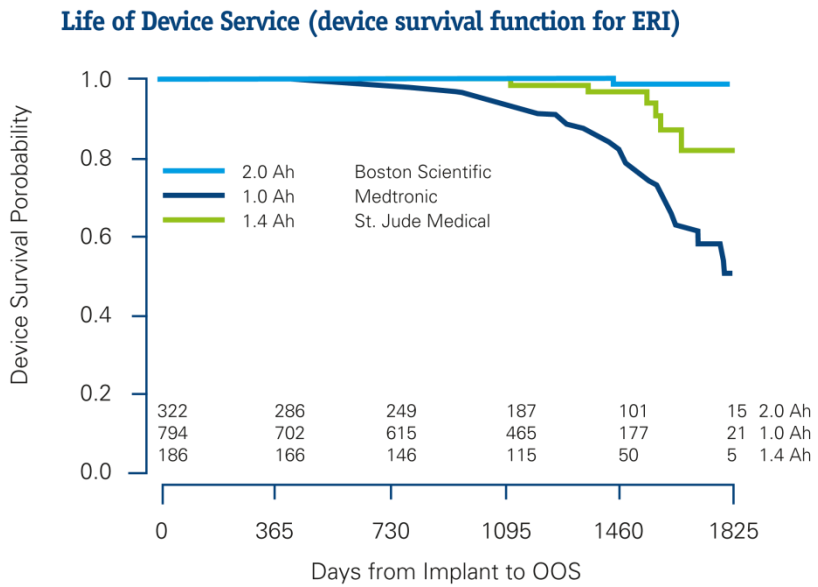
*Alam (2014) and Alam (2016) are retrospective observational studies, both reporting on the same cohort

Independent Device Survival Studies: In Detail

CLINICAL DATA | ECONOMIC DATA

The 2016 Ellis Study confirmed that battery capacity (a.k.a., Ampere Hours) is a predictor of longevity.

- Alam / Saba (2014/2016)
- **Ellis (2016)**
- Landolina (2015)
- Schaer / von Gunten (2015)
- Lau (2015)
- Williams (2014)



Ampere Hour (Ah) as a Predictor of CRT-ICD Pulse Generator Battery Longevity was a multi-center, retrospective, observational study comparing battery longevity of contemporary cardiac resynchronization therapy defibrillators (CRT-Ds) of all patients implanted with CRT-ICDs from Aug. 1, 2008, to Dec. 31, 2010, at 5 major institutions.[4]

Boston Scientific = 322 patients
Medtronic = 794 patients
St. Jude Medical = 186 patients

*Survival rate calculated using device replacements for battery depletion as indicated by ERI.

References in notes

Independent Device Survival Studies: In Detail

CLINICAL DATA | ECONOMIC DATA

The 2015 Landolina study confirmed that Boston Scientific devices were associated with the lowest risk of replacement at 5 years.

Alam / Saba (2014/2016)

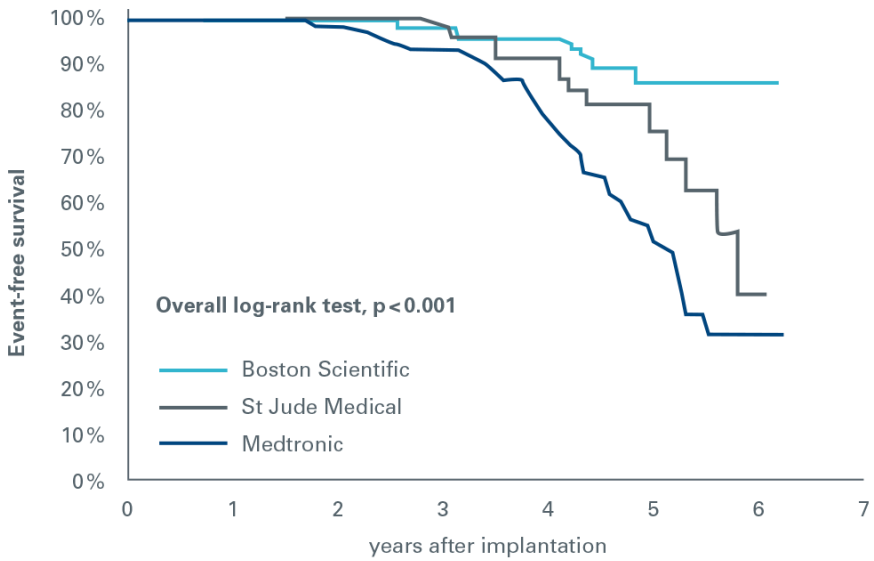
Ellis (2016)

Landolina (2015)

Schaer / von Gunten (2015)

Lau (2015)

Williams (2014)



Longevity of Implantable Cardioverter-Defibrillators for Cardiac Resynchronization Therapy in Current Clinical Practice: An Analysis According to Influencing Factors, Device Generation and Manufacturer was a multi-center, retrospective, observational study comparing battery longevity of CRT-Ds of patients implanted with CRT-ICDs from January 2008 to March 2010, at 7 major institutions.
5-year survival rates of modern devices:

Boston Scientific = 88% survival
Medtronic = 52% survival
St. Jude Medical = 75% survival

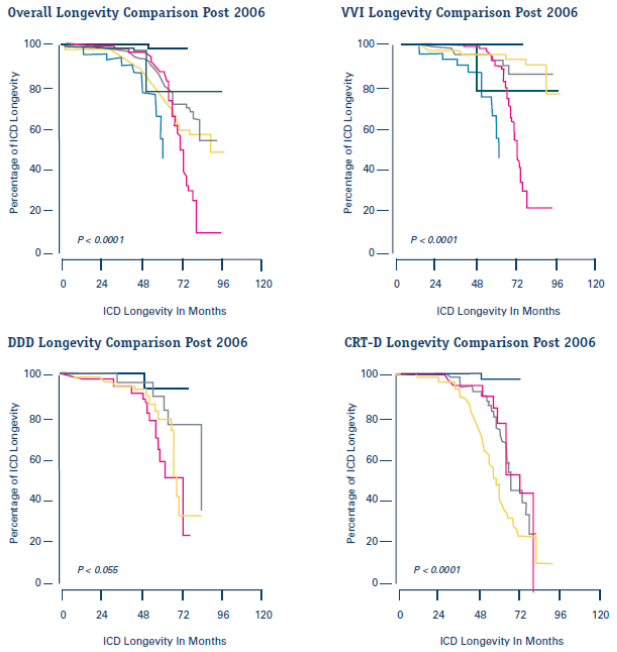
References in notes

Independent Device Survival Studies: In Detail

CLINICAL DATA | ECONOMIC DATA

Schaer / von Gunten was the first study to show Boston Scientific was the longevity leader across the high voltage platform: VR, DR, and CRT-Ds

- Alam / Saba (2014/2016)
- Ellis (2016)
- Landolina (2015)
- **Schaer / von Gunten (2015)**
- Lau (2015)
- Williams (2014)



Longevity of Implantable Cardioverter Defibrillators:
A Comparison Among Manufacturers and Over Time was the largest independent study, from two large European centers, to investigate multiple manufacturer ICD longevity to date and the first study showing BSC's advantage across the ICD platform. The study looked at devices implanted over nearly 20 years, March 1994 to January 2014, with a median follow-up of 53 months. The study includes representation of both early and modern devices—cutoff of 2006.

Total patients = 3436

Devices Implanted Post 2006

Device Type	BSC Device Survival at 6 years	MDT Device Survival at 6 years	SJM Device Survival at 6 years	BIO Device Survival at 6 years
VR	100%	85.9%	92.6%	45.6%
DR	93.3%	76.5%	35.3%	26.3%
CRT-Ds	97.6%	46.3%	26.5%	44.9%

*Survival rate calculated using device replacements for battery depletion as indicated by ERI.

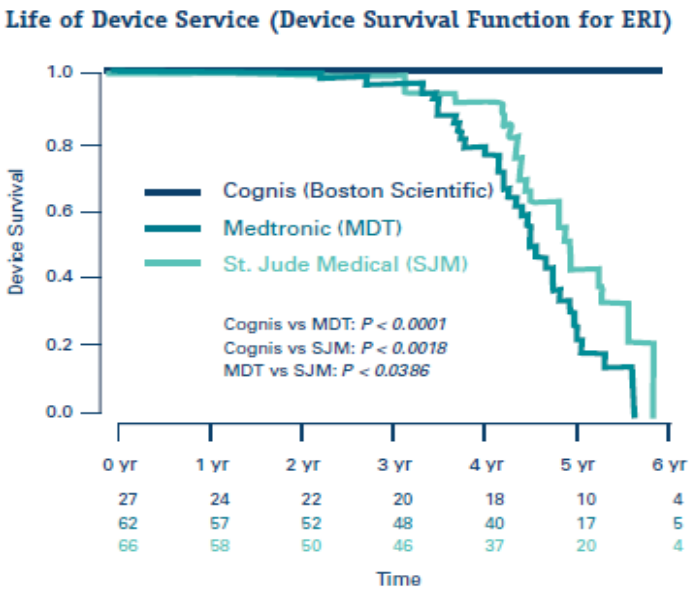
References in notes

Independent Device Survival Studies: In Detail

CLINICAL DATA | ECONOMIC DATA

The 2015 Lau study showed that Boston Scientific CRT-Ds were associated with the lowest risk of replacement in 6 years.[6-8]

- Alam / Saba (2014/2016)
- Ellis (2016)
- Landolina (2015)
- Schaer / von Gunten (2015)
- **Lau (2015)**
- Williams (2014)



Large Capacity LiMnO2 Batteries Extended CRT-D Longevity in Clinical Use Compared to Smaller Capacity LiSVO Batteries Over 6 Years was an independent, retrospective observational study comparing battery longevity of contemporary CRT-Ds of all patients implanted with CRT-ICDs from 2008 through 2009 at Royal Victoria Hospital in Belfast, Northern Ireland.1

Boston Scientific = 27 patients
Medtronic = 62 patients
St. Jude Medical = 66 patients

*Survival rate calculated using device replacements for battery depletion as indicated by ERI.

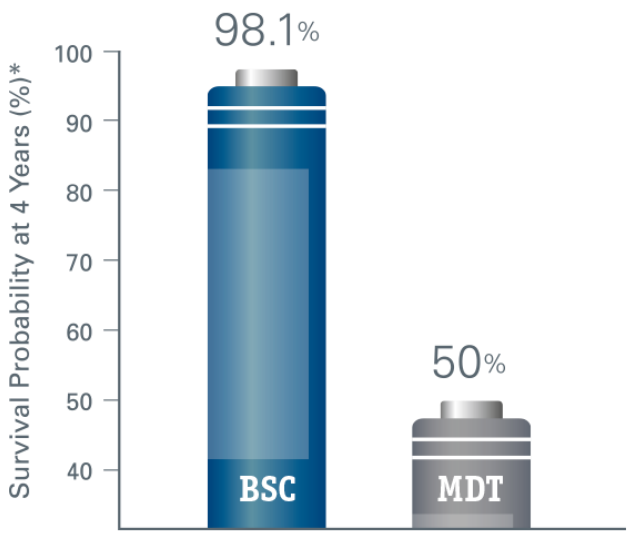
References in notes

Independent Device Survival Studies: In Detail

CLINICAL DATA | ECONOMIC DATA

The 2014 Wiliams study demonstrated that Boston Scientific CRT-Ds outperformed Medtronic CRT-Ds.[6-8]

- **Alam / Saba** (2014/2016)
- **Ellis** (2016)
- **Landolina** (2015)
- **Schaer / von Gunten** (2015)
- **Lau** (2015)
- **Williams** (2014)



Contemporary Cardiac Resynchronization Implantable Cardioverter Defibrillator Battery Longevity in a Community Hospital Heart Failure Cohort was an independent, retrospective observational study comparing battery longevity of contemporary cardiac resynchronization therapy defibrillators (CRT-Ds) of all patients implanted with CRT-ICDs from July 1, 2008, to October 31, 2010, at The Good Samaritan Hospital in Lebanon, PA.[6]

Boston Scientific = 53 patients
Medtronic = 28 patients

*Survival rate calculated using device replacements for battery depletion as indicated by ERI.

BOSTON SCIENTIFIC CRT-Ds WITH ENDURALIFE™ Battery Technology NOW RECOMMENDED BY NICE

References in notes

Further evidence demonstrated the adverse events from avoidable replacement procedures

CLINICAL DATA | ECONOMIC DATA

The committee considered 6 studies that looked at adverse events in patients. These studies showed that there were complications associated with device replacement and that fewer device replacements may be beneficial to patient outcomes

Lewis et al (2016) Systematic review of 17 studies looking at patients undergoing pulse generator replacements	• The median rate for major complications was 4.05%[1] • The median rate for minor complications was 3.5%[1]
Polyzos et al (2015) Systematic review of 60 studies looking at patients undergoing de novo or replacement PM, ICD or CRT-D procedures	• The pooled OR for the risk of infection associated with generator change was 1.74[2] • Device replacement or revision was associated with a pooled OR of 1.98 for infection[2]
Nichols et al (2016) Registry claims data analysis on 45,000 patients undergoing PM, ICD or CRT-D replacement	• Lead damage incidence was 1.94% for patients with CRT-Ds[3]

References in notes

Further evidence demonstrated the adverse events from avoidable replacement procedures

CLINICAL DATA | ECONOMIC DATA

The committee considered 6 studies that looked at adverse events in patients. These studies showed that there were complications associated with device replacement and that fewer device replacements may be beneficial to patient outcomes.

Zeitler et al (2015) Review of 7 studies on complications associated with replacements of PMs, ICDs and CRT-Ds (1,435 patients)	• Device replacement following FDA recall was associated with a combined major complication rate of 2.60%[1] • Five of the 7 included studies reported mortality, which showed an overall mortality of 0.4%[1] • The rate of re-operation/pocket revision was 2.7%[1]
Lovelock et al (2014) Multicentre study looking at patients undergoing BSC ICD and CRT-D generator exchange from the Latitude database	• Patients who had device replacement showed a 5-times higher lead alert rate compared with those who did not[2]
Kirkfeldt et al (2014) Danish study of 5,918 patients undergoing PM, ICD, CRT-P and CRT-D procedures	• The overall complication rate was 5.9% following a device replacement[3] • The infection rate for generator replacement was 1.5%, which is 2.5x higher than the rate for de novo implants[3]

References in notes

Precedence was given to real-world observational data during the evaluation

CLINICAL DATA | ECONOMIC DATA

- Longevity projections from manuals was discussed by the committee but deemed to be less reliable than real-world evidence
- Product performance reports were identified as being prone to differences in specifications across manufacturers – i.e., not comparable between manufacturers
- These product performance reports served only to demonstrate that normal battery depletion, rather than device malfunction, was the main reason for replacement

Economic studies showed the relationship between longevity and cost savings

CLINICAL DATA | ECONOMIC DATA

In total, the committee assessed 4 economic studies on **ENDURA**LIFE-powered CRT-D battery life. This evidence showed that there was a relationship between longevity and cost savings

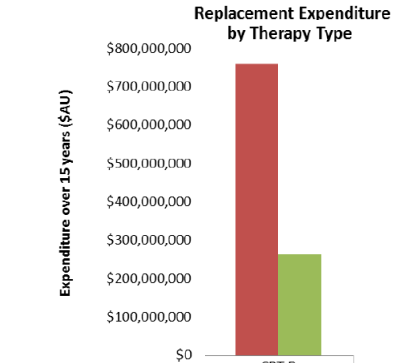
Gadler (2016)

Economic impact of longer battery life of cardiac resynchronization therapy defibrillators in Sweden was a study quantifying the impact of longer battery life of CRT-D devices has on reducing the number of device replacements & associated costs of these replacements from a Swedish healthcare system perspective:

Outcome measure	
Avoided replacement procedures over 6 years	Reduction number
BSC vs SJM	323
BSC vs MDT	603
Cost savings for device replacements[a]	Over 6 years
BSC vs SJM	SEK 30.2 million
BSC vs MDT	SEK 60.4 million

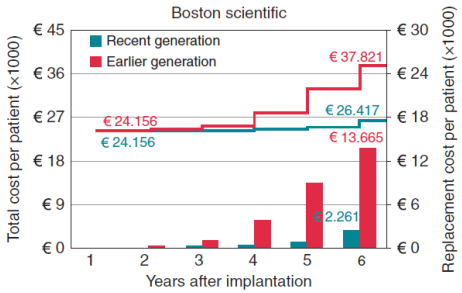
Priest (2015)

Economic value of improved ICD and CRT-D battery longevity in devices with a 1.7-2.0 Amp capacity and Li/MnO_2 chemistry in Australia was an abstract assessing the long-term economic benefits of improved ICD and CRT-D battery longevity. Results were calculated based on a 15 year time horizon and average longevity:



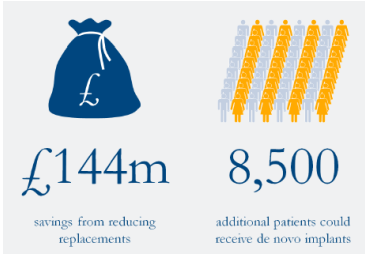
Landolina (2016)

The economic impact of battery longevity in implantable cardioverter-defibrillators for cardiac resynchronization therapy: the hospital and healthcare system perspectives was an Italian study assessing the economic impact of battery depletion on the overall costs of CRT-D treatment for earlier- and recent-generation devices. The analysis was based on Landolina's 2015 clinical publication reporting device survival probabilities for earlier- and recent-generation devices by manufacturer.



Duxbury (2014)

The NHS cannot afford not to implant extended longevity devices to implement the NICE guidance on ICD and CRT: Modelling the budget impact over 10 years was a UK abstract estimating the collective impact of extended longevity for both ICDs and CRT-D devices:



References in notes

An economic model helped NICE calculate the UK cost savings **ENDURA**LIFE-powered CRT-Ds could offer

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Advancing science for life™

CLINICAL DATA | ECONOMIC DATA

NICE based their final estimates on cost savings from ENDURALIFE-powered CRT-D devices on an economic model adapted from Gadler (2016)[1]

Key model parameters:

Time horizon	• 15 years
Patient survival	• Annual probability • Unpublished analysis from NICOR registry
Device survival	• Annual probability • Based on Landolina 2015[2], 5 year data extrapolated to 15 years
Follow-ups	• 2 per year plus 1 post-implant/replacement • Based on NHS England ICD & CRT-D service specification guidance[3] • Cost based on HRG tariffs
Device costs	• £12,404 (system) & £11,858 (box) for all manufacturers • Based on average market selling price from NICE's 2014 ICD & CRT-D guidance (TA314)[4]
Procedural complications	• Rate from Tang (2010)[5] • Cost from NICE's 2014 ICD & CRT-D guidance (TA314)[4]
Procedural costs	• Based on HRG tariffs
Discount rate	• 3.5% per year (for cost discounting)

"ENDURALIFE-powered CRT-Ds may save between **£2,120** and **£5,627** per patient over 15 years [vs St Jude & Medtronic respectively][6]"

NICE **ENDURA**LIFE Guidance

Boston Scientific **ENDURA**LIFE
Battery Technology

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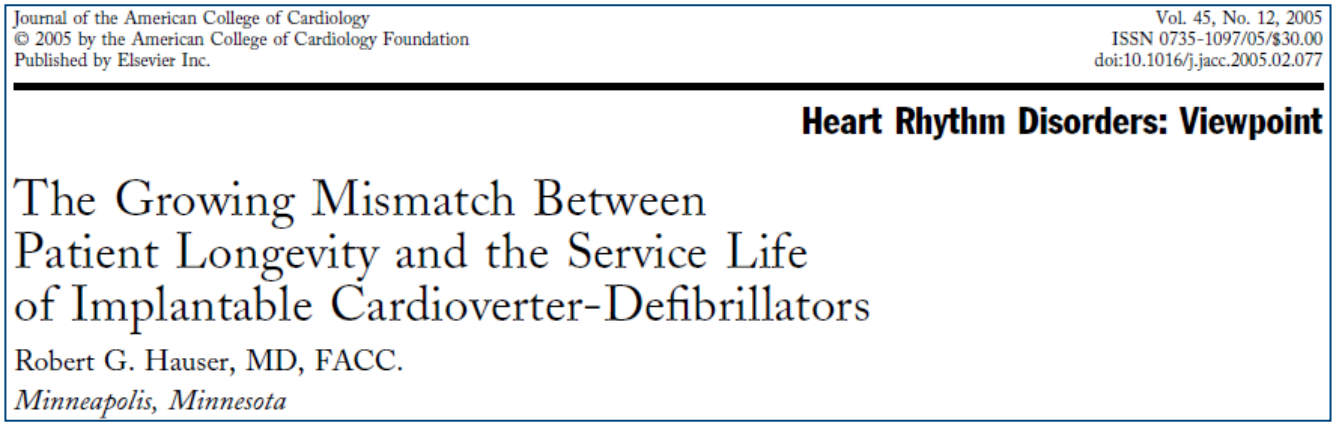
History: Boston Scientific heard from the clinical community that patients were outliving their defibrillators



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Heart Rhythm Disorders: Viewpoint

The Growing Mismatch Between Patient Longevity and the Service Life of Implantable Cardioverter-Defibrillators

Robert G. Hauser, MD, FACC.
Minneapolis, Minnesota

In this 2005 piece, Dr. Hauser walked-through his finding: service life of contemporary ICD models was far less than the expected patient longevity

Further, he explained that the growing economic burden of ICD therapy is likely to accelerate as more ICD implants include CRT. These devices are more expensive and use more energy than standard ICDs.

European Society of Cardiology 2009

Dr. Hauser reported that the average industry longevity (pre-EnduraLife devices) was: 3.5 years for a CRT-D, 4.6 years for a DR ICD, and 5.1 years for VR ICD

References in notes

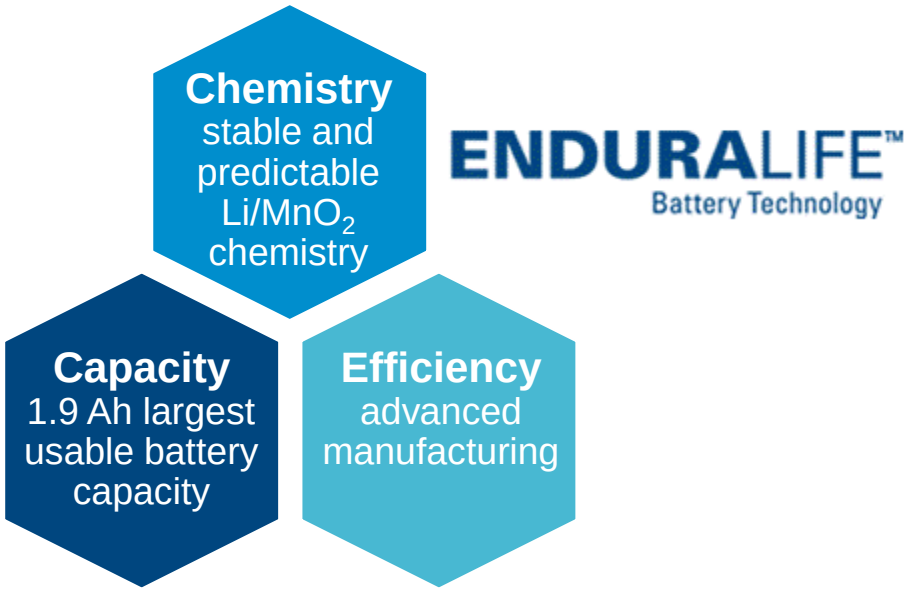
Boston Scientific's Response:

We set out to create the longest lasting defibrillators in industry

Boston Scientific
Advancing science for life™

ENDURALIFE™ Battery Technology

A proprietary combination of a 1.9 Amp-hours usable battery capacity, Li/MnO_2 battery chemistry and features designed to optimize energy efficiency.



ENDURALIFE™
Battery Technology

ENDURALIFE™ Battery Technology was developed by Boston Scientific's highly skilled team of battery engineers and are manufactured in-house, because traditional batteries were struggling to deliver the longevity and flexibility required for high voltage devices

Key Take-aways

ENDURALIFE™ Battery Technology provides clinically-proven, industry-leading longevity.*

9 independent studies* reported industry leading longevity for CRT-Ds powered by **ENDURA**LIFE™ Battery Technology

Optimize therapy as needed by leveraging features such as MultiSite pacing, remote patient monitoring, and device diagnostics

Powered by ENDURALIFE™ Battery Technology

Unlike other manufacturers, Boston Scientific's EnduraLife™ battery enables physicians to **optimize not for device battery life, but for patients**

Our **ENDURA**LIFE battery **significantly outperforms industry averages***, even with enhanced features and capabilities turned on—confirmed by real-world, independent post-market studies

* 9 studies reported industry leading longevity for our CRT-Ds powered by ENDURALIFE™, www.bostonscientific.eu/enduralife, of which 6 evaluated by NICE for MTG294 guidance

NICE's positive recommendation for Boston Scientific **ENDURA**LIFE-powered CRT-Ds

> *"The case for adopting ENDURALIFE-powered cardiac resynchronisation therapy-defibrillator (CRT-D) devices for treating heart failure is supported by the published evidence. Extended battery life is of clinical and patient benefit and associated with fewer replacement procedures*[1]*"*

From its evaluation of submitted evidence, NICE concluded that the extended battery life observed with **ENDURA**LIFE-powered CRT-Ds is likely to reduce the number of avoidable replacement procedures a patient may have to undergo, thereby offering improved outcomes for patients and potential savings to the NHS of approximately £6 million in the first five years.

1 MTG 294. NICE medical technology guidance: ENDURALIFE-powered CRT-D devices for treating heart failure. March 2017.

Disclaimer

CAUTION: The law restricts these devices to sale by or on the order of a physician. Indications, contraindications, warnings and instructions for use can be found in the product labelling supplied with each device. Information for use only in countries with applicable health authority registrations. Material not intended for use in France.