I devices per il trattamento dei pazienti scompensati: cosa offrono le nuove tecnologie

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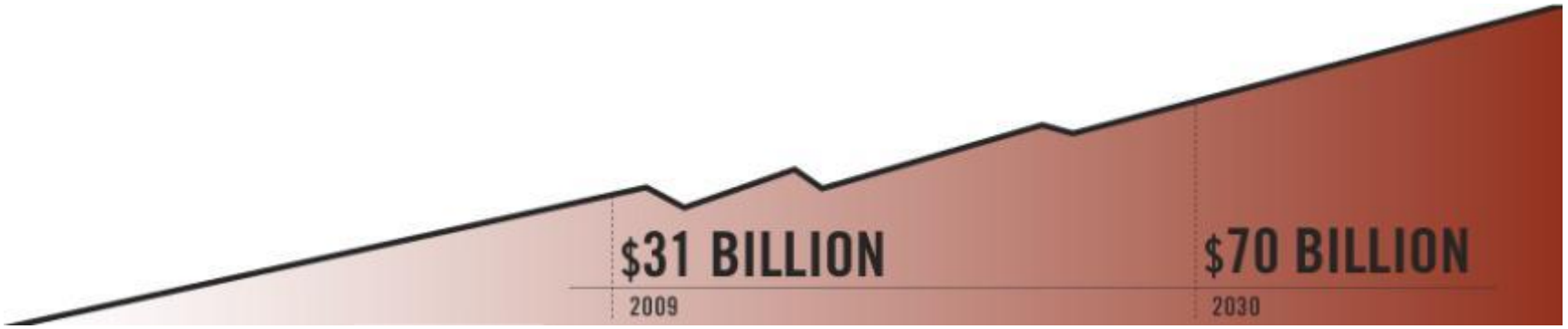
Ascea Marina 30 settembre 2019

AISC
Associazione Italiana
Scompensati Cardiaci

Economic Burden of HF Will Continue to Rise Through 2030*

- The AHA estimates that the total medical costs for HF are projected to increase to $70B by 2030 → a 2-fold increase from 2013.[1]
- 50% of the costs are attributed to hospitalization.[2]

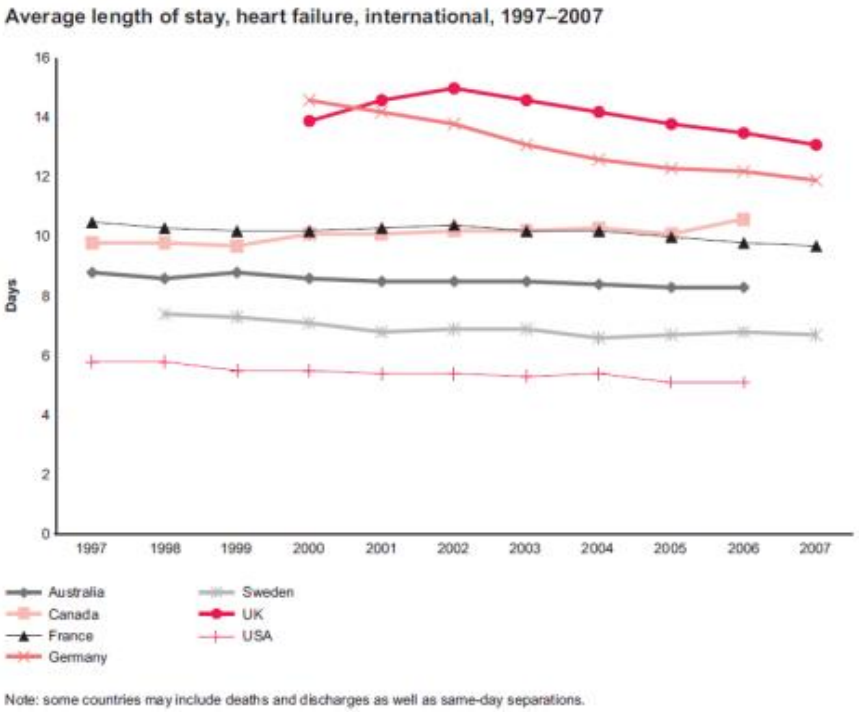


Graph: Heidenreich PA, et al. Circulation Heart Failure 2013.
*Study projections assumes HF prevalence remains constant and continuation of current hospitalization practices

1. Heidenreich PA, et al. Circulation Heart Failure 2013.
2. Yancy CW, et al. Circulation 2013.

Heart Failure Is Associated with High Hospitalization and Readmission Rates

- In 2010, there were 1 million hospitalizations in the US with HF as the principal diagnosis[1]
  - Hospitalization rate did not change significantly from 2000[1]
- Average length of hospital stay
  - Approximately 5 days (US)[2]
  - 11 days (Europe)[3]
- HF is also associated with high readmission rates:
  - ~25% all-cause readmission within 30 days and ~50% within 6 months[4,5]

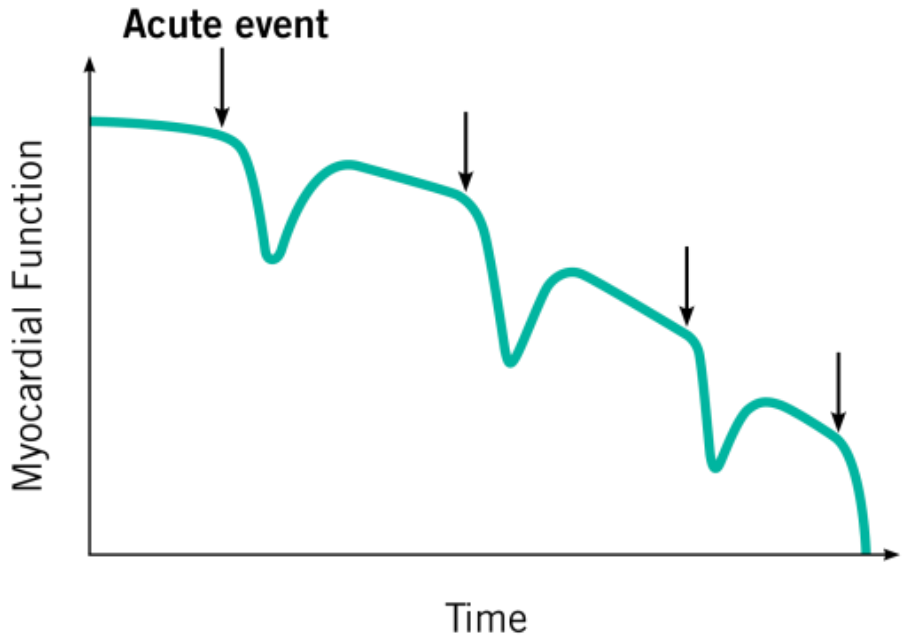


Graph from www.health.org.uk. Bridging the gap: Heart Failure, 2010.
Data from Organization for Economic Cooperation and Development, 2009.

1. CDC NCHS National Hospital Discharge Survey, 2000-2010
2. Yancy et al. JACC, 2006.
3. Cleland et al. EuroHeart, 2003.
4. Krumholz HM, et al. Circ Cardiovas Qual Outcomes 2009.
5. Wexler DJ, et al. Am Heart J 2001.

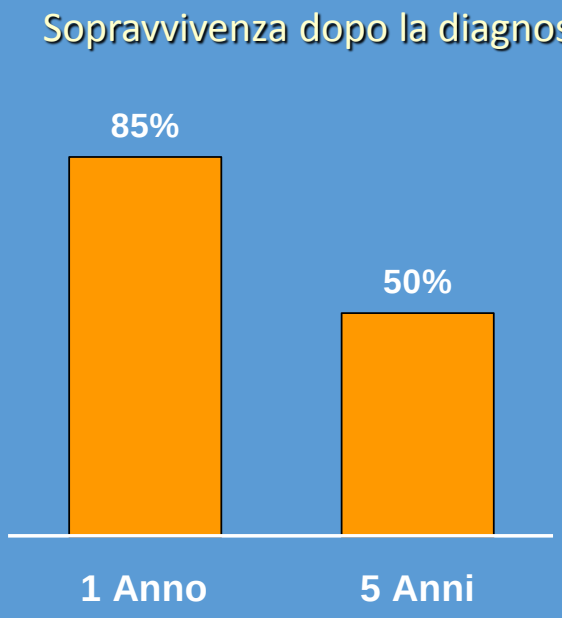
Worsening Heart Failure Leading to HF Hospitalizations Contributes to Disease Progression

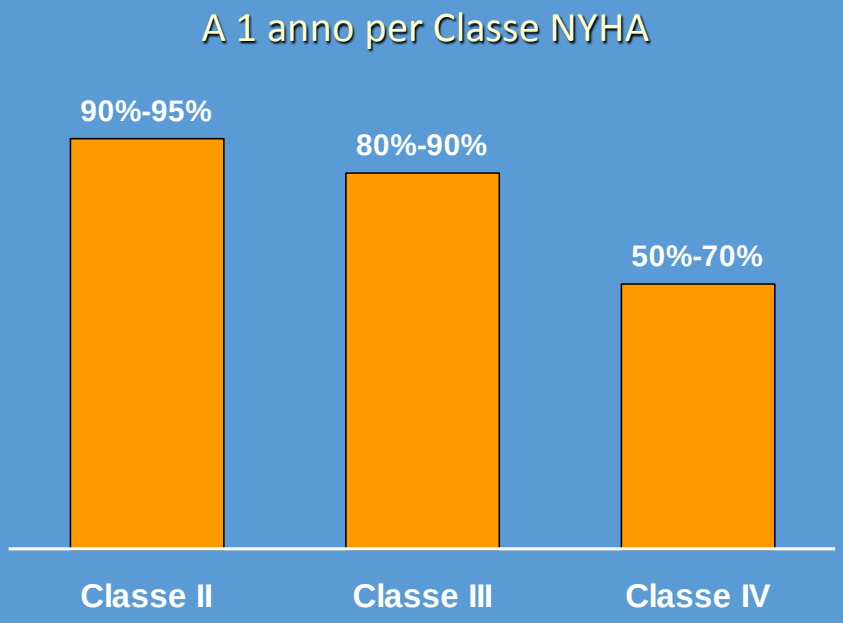
- With each subsequent HF-related admission, the patient leaves the hospital with a further decrease in cardiac function.



Graph adapted from: Gheorghiade MD, et al. Am J. Cardiol. 2005

Sopravvivenza nello Scompenso Cardiaco: importanza della classe NYHA di appartenenza





Source: F.L. Kalon, et al., "Survival After the Onset of Congestive Heart Failure in Framingham Heart Study Subjects," *Circulation*, July 1993; ACHPR CHF Clinical Practice Guidelines

Scompenso Cardiaco e Morte Improvvisa

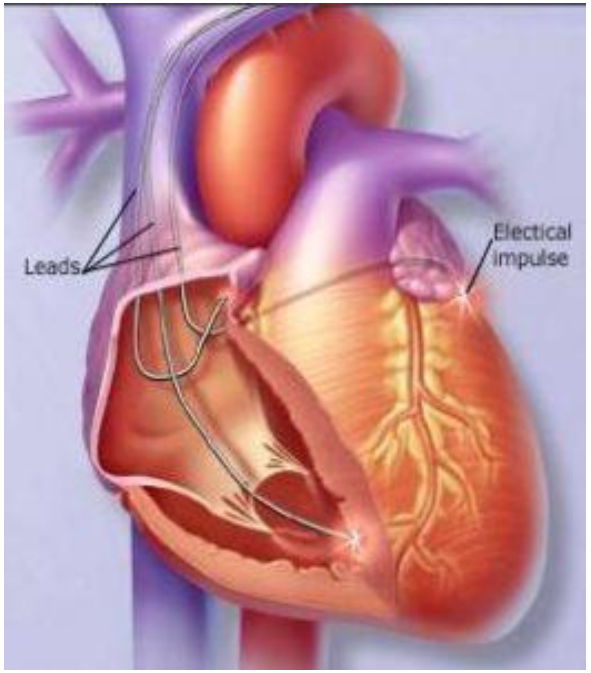
- Negli studi sullo scompenso, la SCD è stata calcolata di avere un'incidenza variabile tra il 23% e il 55% della mortalità totale.
- La mortalità ad un anno dei Pz. In Classe NYHA II è del 5% to 15% all'anno, con una mortalità da SCD compresa tra il 50% e l' 80%.
- Per Pz con Scompenso Cardiaco Avanzato, la mortalità è pressoché legato a "pump failure", mentre il rischio di SCD è significativamente inferiore.

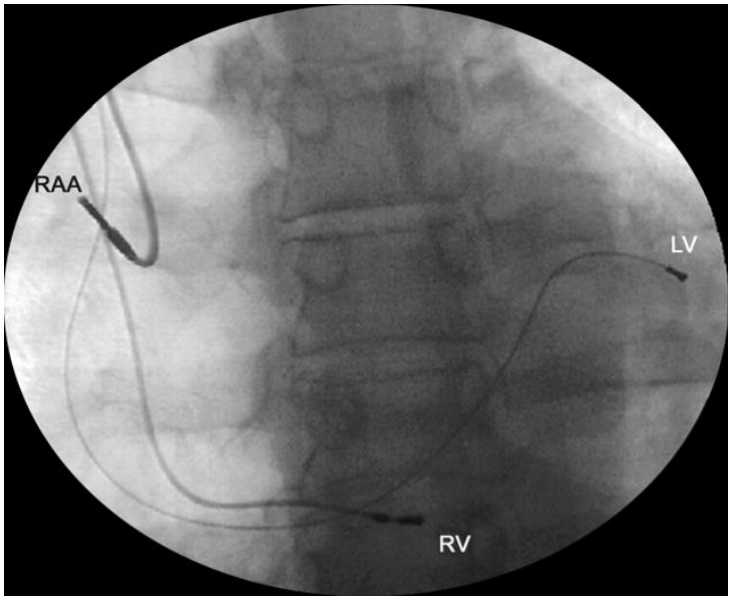
Tedesco C, Reigle J, Bergin J, et al. Sudden cardiac death in heart failure.
J Cardiovasc Nurs. 2000;14(4):38-56.

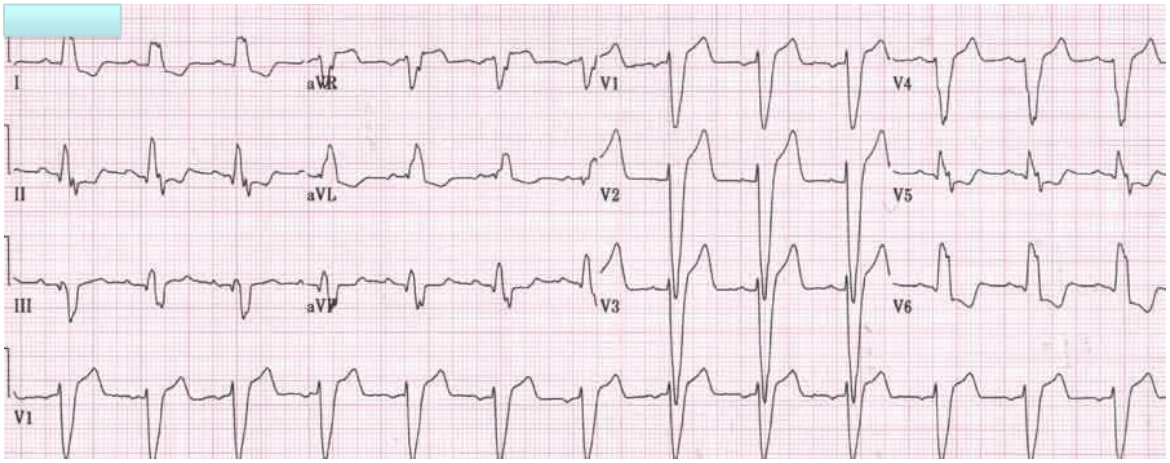
L' ICD è come un Pace Maker

Immagine al Rx Torace

Cardiac Resynchronization Therapy (CRT)

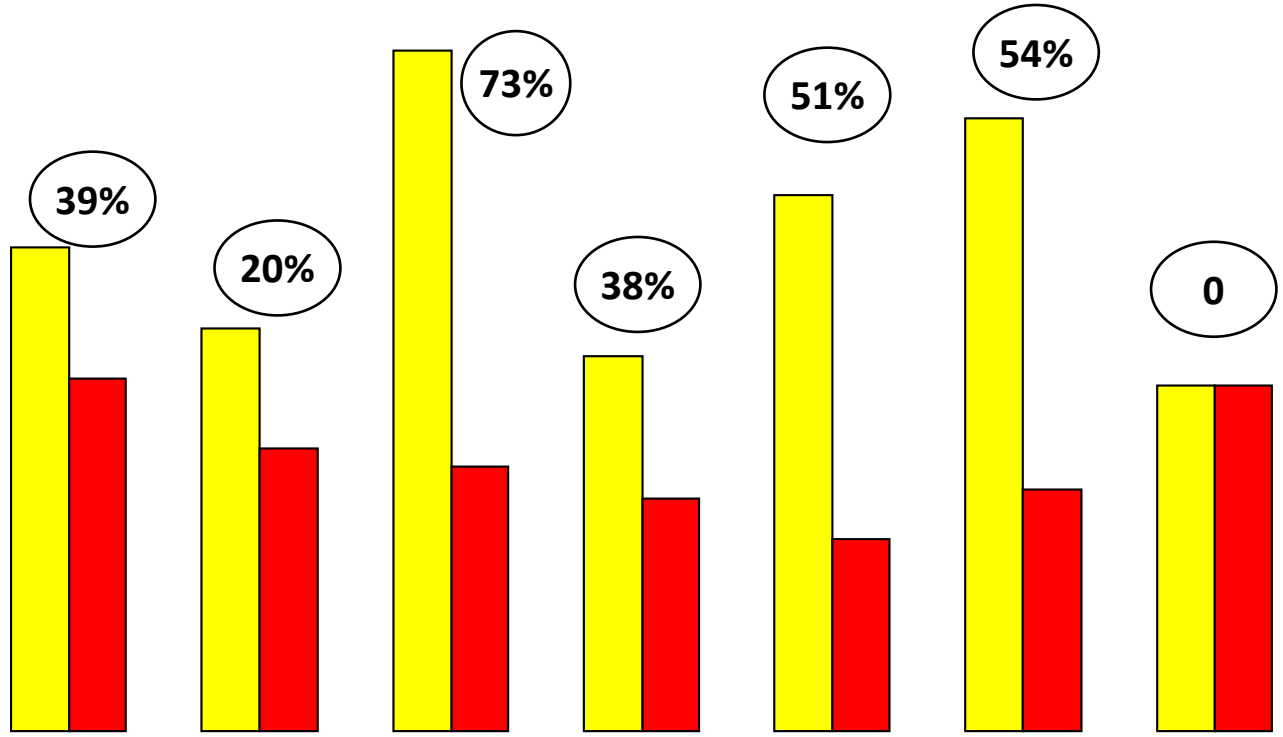






Gli ICD riducono la mortalità del ~ 40%...

Sia nella prevenzione secondaria sia primaria



Nisam S. 2000

Controllo

MC

Studi sulla prevenzione secondaria

Studi sulla prevenzione primaria

CRT migliora la mortalità in classe III e IV

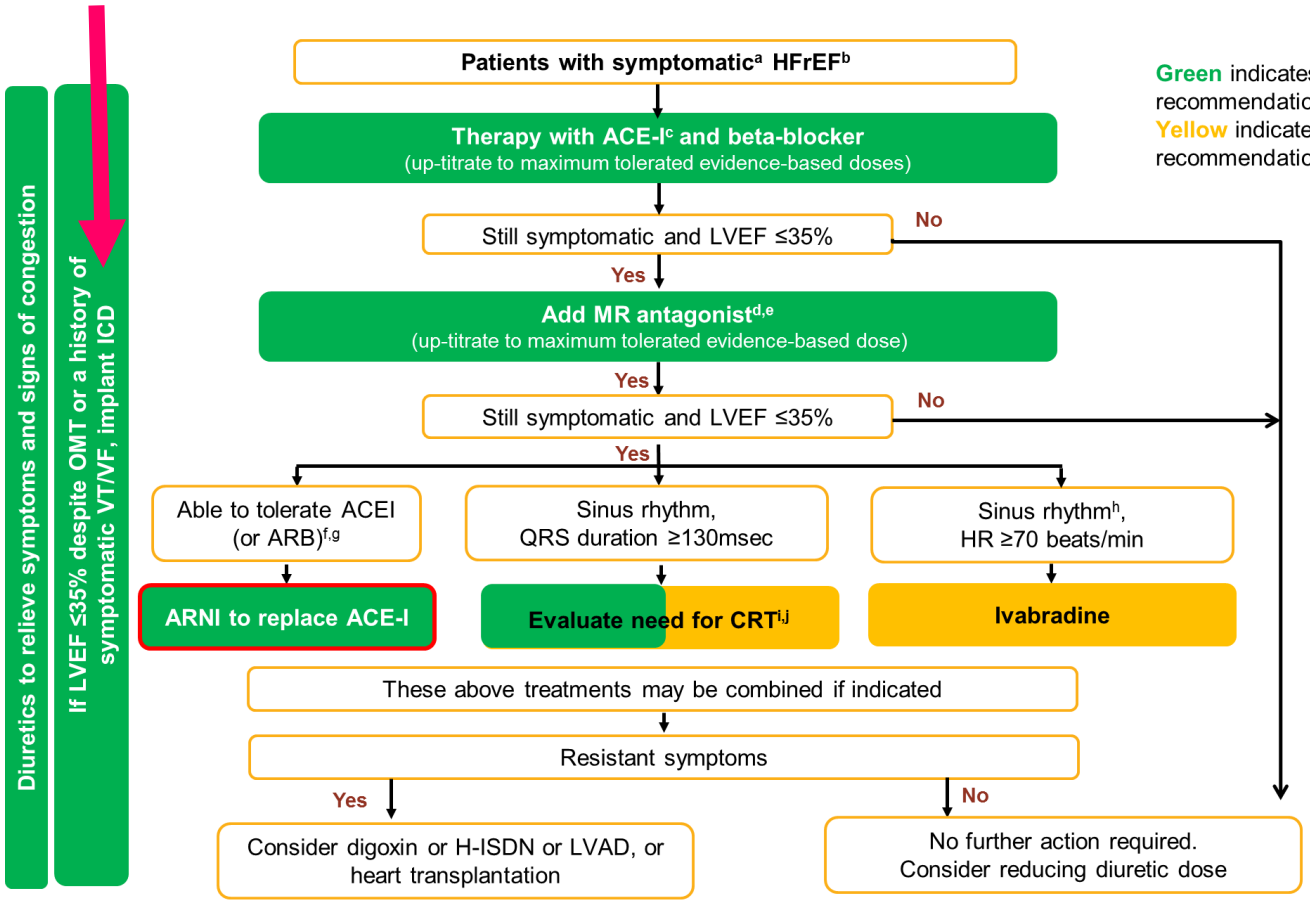
Studio	Follow-up	Trattamento	Mortalità e ricoveri	Mortalità
Studi singoli				
COMPANION[1] (n=1.520)	12m	CRT-D	↓ 20%	↓ 36%
		CRT-P	↓ 19%	↓ 24%
CARE-HF[2] (n=813)	29m	CRT-P	↓ 37%	↓ 36%
	36m (est.)			↓ 40%
Metanalisi				
Ann Intern Med [3] (n=3.216)	1–12m	CRT-P		↓ 21%
JAMA[4] (n=1.634)*	3–6m	CRT-P		↓ 23%

Endpoint primario

Endpoint secondario

* Comprende MIRACLE. Fonte: Abraham W. *Rev Cardiovasc Med* 2003;4 (Suppl 2):S30–7. 1. Bristow M et al. *N Engl J Med* 2004;350:2140–50. 2. Cleland J et al. *N Engl J Med* 2005;352:1539–49. 3. McAlister F et al. *Ann Intern Med* 2004;141:381–90. 4. Bradley D et al. *JAMA* 2003;289:730–40.

2016 ESC HFrEF Guideline Treatment Algorithm



Green indicates a **class I** recommendation;
Yellow indicates a **class IIa** recommendation.

[a]Symptomatic=NYHA Class II-IV; [b]HFrEF=LVEF<40%; [c]If ACEI not tolerated/contra-indicated, use ARB; [d]If MR antagonist not tolerated/contra-indicated, use ARB; [e]With a hospital admission for HF within the last 6 months or with elevated natriuretic peptides (BNP >250 pg/ml or NTproBNP >500 pg/ml in men and 750 pg/ml in women); [f]With an elevated plasma NP level (BNP ≥150 pg/mL or plasma NT-proBNP ≥ 600 pg/mL, or if HF hospitalization within recent 12 months plasma BNP ≥ 100 pg/mL or plasma NT-proBNP ≥ 400 pg/mL); [g]In doses equivalent to enalapril 10 mg *b.i.d.*; [h]With a hospital admission for HF within the previous year; [i]CRT is recommended if QRS ≥ 130 msec and LBBB (in sinus rhythm); [j]CRT should/may be considered if QRS ≥ 130 msec with non-LBBB (in a sinus rhythm) or for patients in AF provided a strategy to ensure bi-ventricular capture in place (individualized decision)

Ponikowski P et al. Eur Heart J. 21 May 2016. doi:10.1093/eurheartj/ehw128

Sopravvivenza dei pazienti

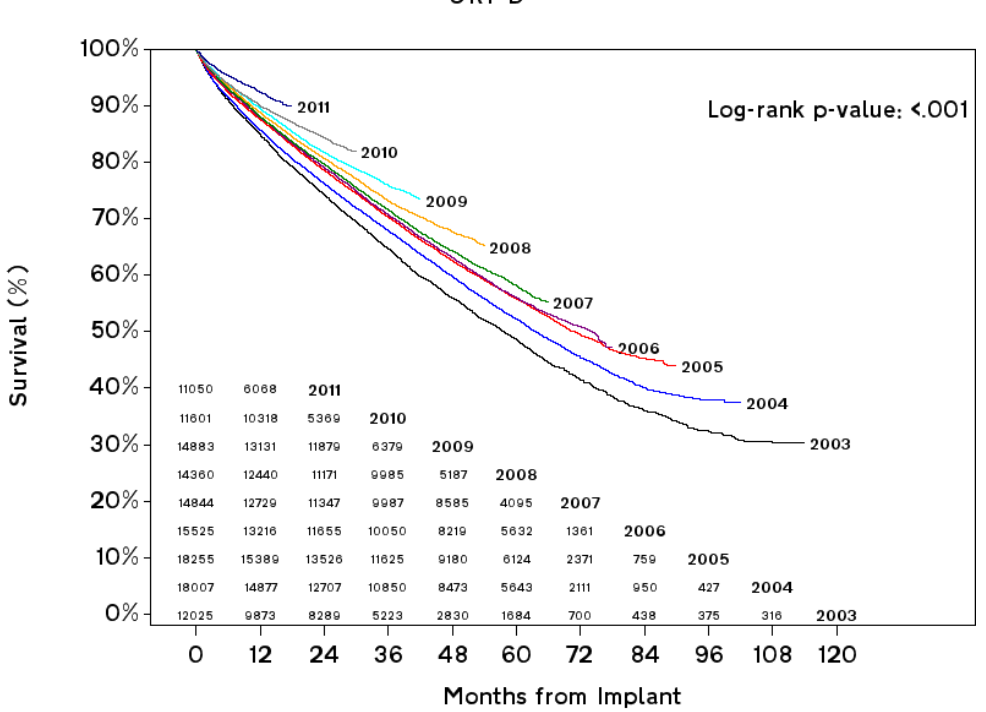
L'aspettativa di vita dei pazienti con CRT-D è migliorata

Una analisi dallo studio ALTITUDE della sopravvivenza dei pazienti ha mostrato:

- è in aumento ogni anno
- La sopravvivenza media dei pazienti è migliorata da:
  - 2003: 5 anni
  - 2006: 6 anni
  - 2010 (stimata): 8 anni

Mortality of Patients with Heart Failure and Reduced Ejection Fraction (HFrEF) Who Receive Either ICD or CRT-D Has Improved Yearly from 2003 to 2010: The Altitude Registry

JoAnn Lindenfeld[1], Brian D. Powell[2], David L. Hayes[3], Niraj Varma[4], Paul Jones[5], Nicholas Wold[5], Leslie A. Saxon[6]; [1]Univ of Colorado, Aurora, CO; [2]Carolina HealthCare, Charlotte, NC; [3]Mayo CLinic, Rochester, MN; [4]Cleveland Clinic Foundation, Cleveland, CO; [5]Boston Scientific, St. Paul, MN; [6]University of Southern California, Los Angeles, CA



Lindenfeld J, et al. *J. Cardfail*. 2013;19:S21-S22

ALTITUDE is an observational retrospective, non-randomized post market analysis not a prospectively defined clinical trial. There is a lack of clinical profile data and specific knowledge of co-morbidities for these patients, which limits interpretation of the observations from this study.

La problematica…2015

Clin Res Cardiol (2015) 104:456–460
DOI 10.1007/s00392-014-0807-y

REVIEW

The mismatch between patient life expectancy and the service life of implantable devices in current cardioverter-defibrillator therapy: a call for larger device batteries

Jörg Neuzner

Review aggiornata nel 2015:

- La maggior parte dei pazienti vive più di 5 anni dall'impianto
- Molti device durano meno di 5 anni
- Una vita del device superiore a 10 anni sarebbe una opzione realistica per avere dispositivi con batterie più longeve

Neuzner J. *Clin Res* Cardiol (2015) 104:456-460.

Complicanze associate alla sostituzione

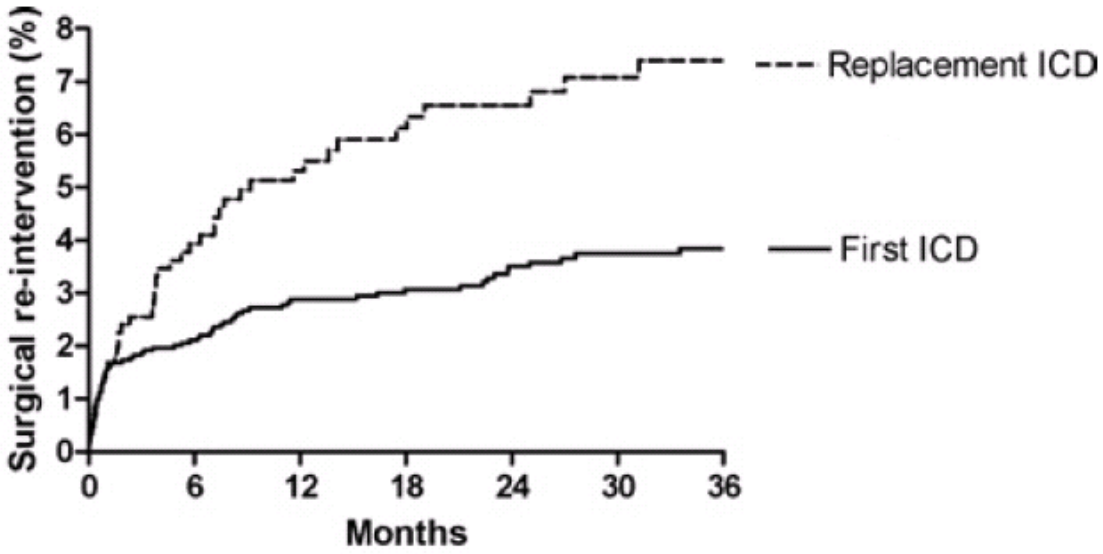
- Il **9%** dei pazienti che si sottopone ad una sostituzione di device va incontro ad una complicanza
- Aumentato rischio infettivo

  Il tasso di infezioni aumenta dal <1% negli impianti fino a **2.6-7%** dopo una sostituzione

- Il rischio di un re-intervento chirurgico legato alla tasca raddoppia

  Rischio di infezione aumentato di **2.5** volte

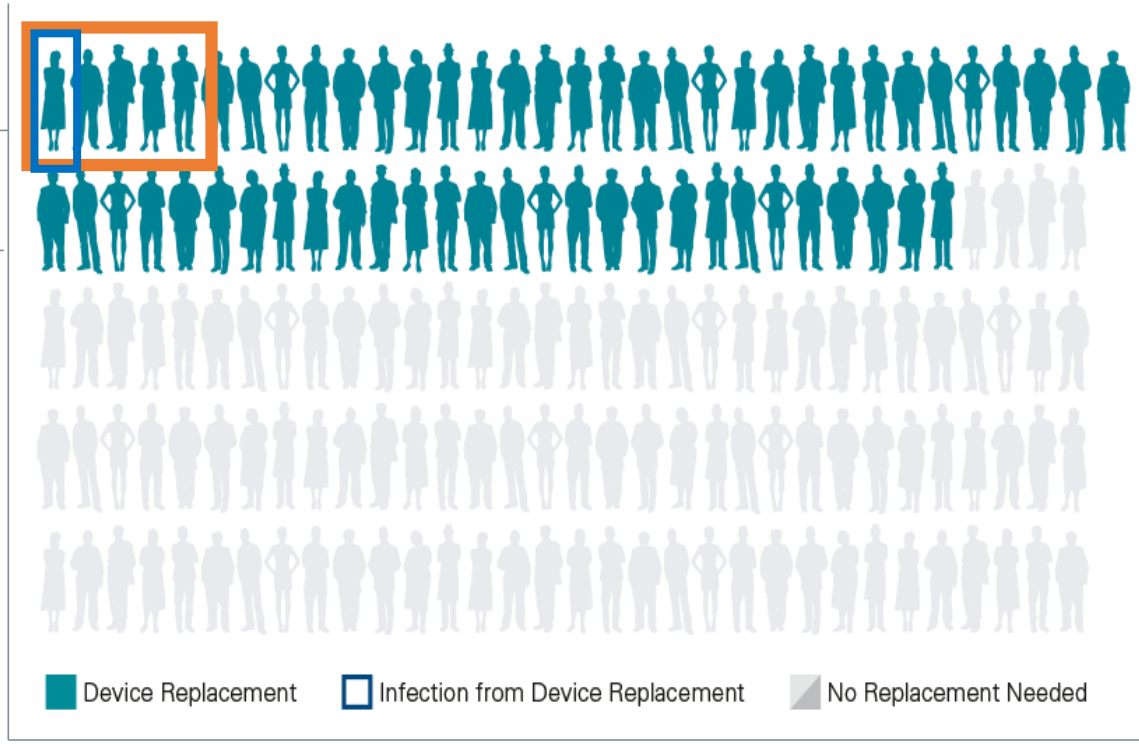
  Rischio di altre complicanze aumentato di **1.7** volte



[1]de Bie, MK. et al. *Heart Rhythm* 2012; 9:494-498. [2]Ramachandra. *PACE* 2010; 33:314–319. [3]Tarakji, Khaldoun G. et al. *Heart Rhythm* Aug 2010; 7:1043-1047. [4]Lekkerkerker, J.C. et al. *HEART* 2009; 95:715-720 . [5]Sohail MR, et al. *Arch Intern Med*,;171:1821-1828. [6]Borleff CJ, et al. *PACE* 2010;33:1013–1019.

Impatto clinico

- Impatto della longevità degli ICD sulla necessità di sostituire il device



61 pazienti
Hanno sostituito il device per scarica della batteria

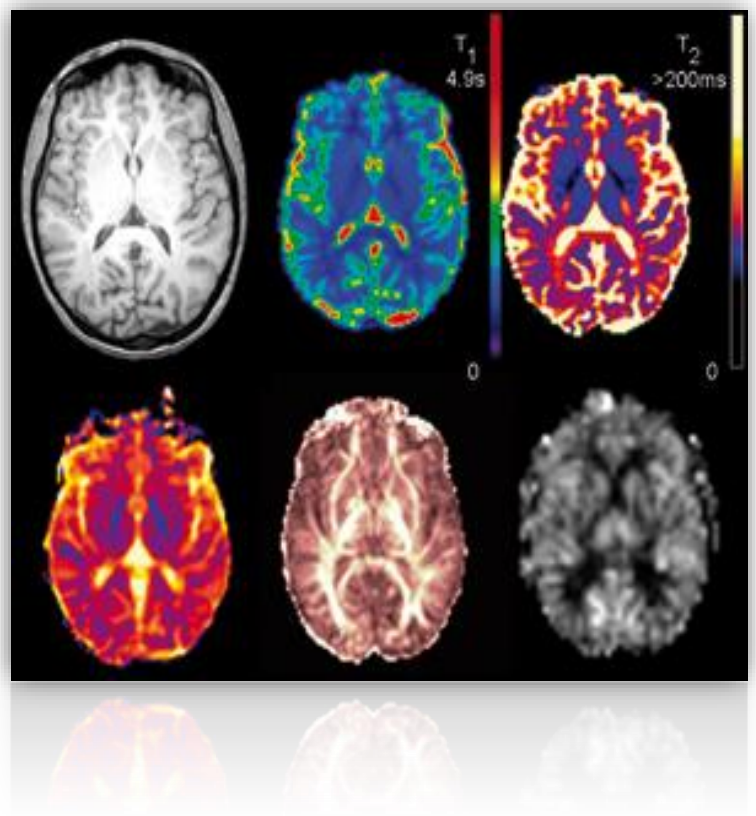
Di questi, **5 pazienti** hanno avuto una infezione a seguito della sostituzione ICD

Con una longevità di 9 anni, l'**84% delle procedure di sostituzione** sarebbero state evitate. Con una diminuzione dell' **80% delle infezioni**

Ramachandra. Impact of ICD Battery Longevity on Need for Device Replacements. *PACE* 2010; 33:314–319.

Longevity + MRI

- A device need to be ready for MRI, even if the patient has an MRI in 13 years



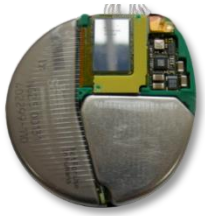
MRI

Not All Pacemakers Are Created Equal: MRI Conditional Pacemaker and Lead Technology

- Pacemaker Patients have a 50-75% chance of having a clinical indication for an MRI during their lifetime
- MRI Induced heating of the lead tip is a recognized risk in patients
- The weak link in every system… is the LEAD
- Main Limitation of MRI implants aside from Financial:
  - Not all MRI conditional leads have the SAME HANDLING and SAFETY RECORDS as their non-conditional ones.

Path to MR Conditional Labeling

MR-conditional labeling requires a combination of design, testing, and clinical data.



Hardware Design

Provides Protection from MRI

- EMI Protection
- Circuitry Protection
- Integrated Circuit
- Hall Sensor
- Minimal Magnetic Materials
- MRI Projection Mode Software Configures Hardware

Technical Specification 10974

Testing

Confirms Design is Robust to Potential MRI Hazards

- Heating
- Vibration
- Force
- Torque
- Unintended Stimulation
- Malfunction

Clinical

Demonstrated Safety & Efficacy

- No MRI-related Events
- No Threshold Changes
- No R-wave changes

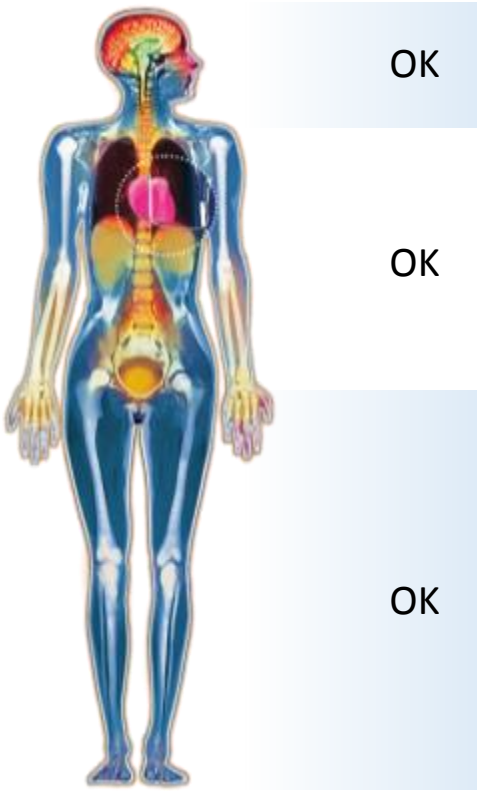
MR-conditional Labeling Update

MRI Labeling Approval

- Labeling defines Cardiology and Radiology Conditions of Use

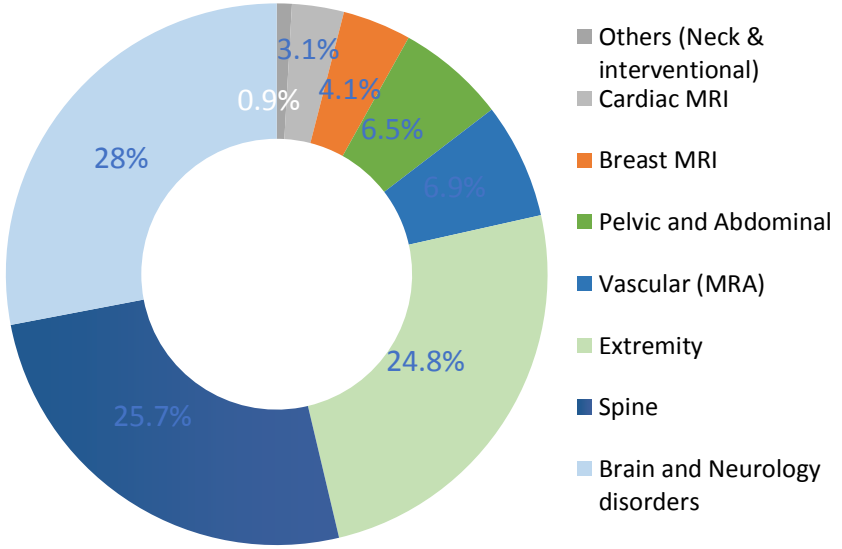
Full Body MRI, No exclusion zones

- Full body MRI scan, with **no thoracic exclusion zone**[1]. Allowing patients unrestricted access to future MRI scans.



1/3

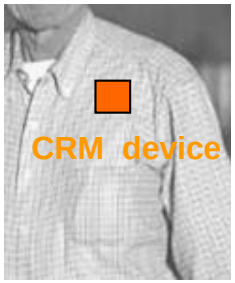
Over 1/3 of patients will require an MRI between the hip and neck.[4]



HOME MONITORING

1

Il **Paziente** ha un dispositivo con trasmettitore senza fili



2

I dati dal dispositivo tramite comunicazione wireless vengono automaticamente trasmessi all'unità ricevente domestica

Unità ricevente

Trasmette tutti I dati e le informazioni che un medico normalmente valuta ad un follow-up

Esempi: impostazioni del dispositivo, diagnostica, ECG, stato della batteria, eventi clinici, ecc.

3

Tutti i dati vengono aggiornati al centro server, rivisti e archiviati

Il Call-center fornisce anche assistenza ai clienti e supporto ai pazienti

4

*In seguito **i medici** vengono avvertiti sulle anomalie misurate dal dispositivo, in accordo con regole stabilite*

I medici possono accedere a tutte le informazioni cliniche dei pazienti e ai dati del dispositivo da qualsiasi computer con accesso a Internet

Anche i pazienti possono visualizzare i dati ma con accesso limitato

5

***Medici dello scompenso** vengono avvertiti in caso di variazioni significative delle misure del peso o della pressione dei loro pazienti*

Modello Organizzativo

MEDICAL PROFESSIONALS/ COLLABORATIVE CARE MODEL

I benefici del monitoraggio remoto

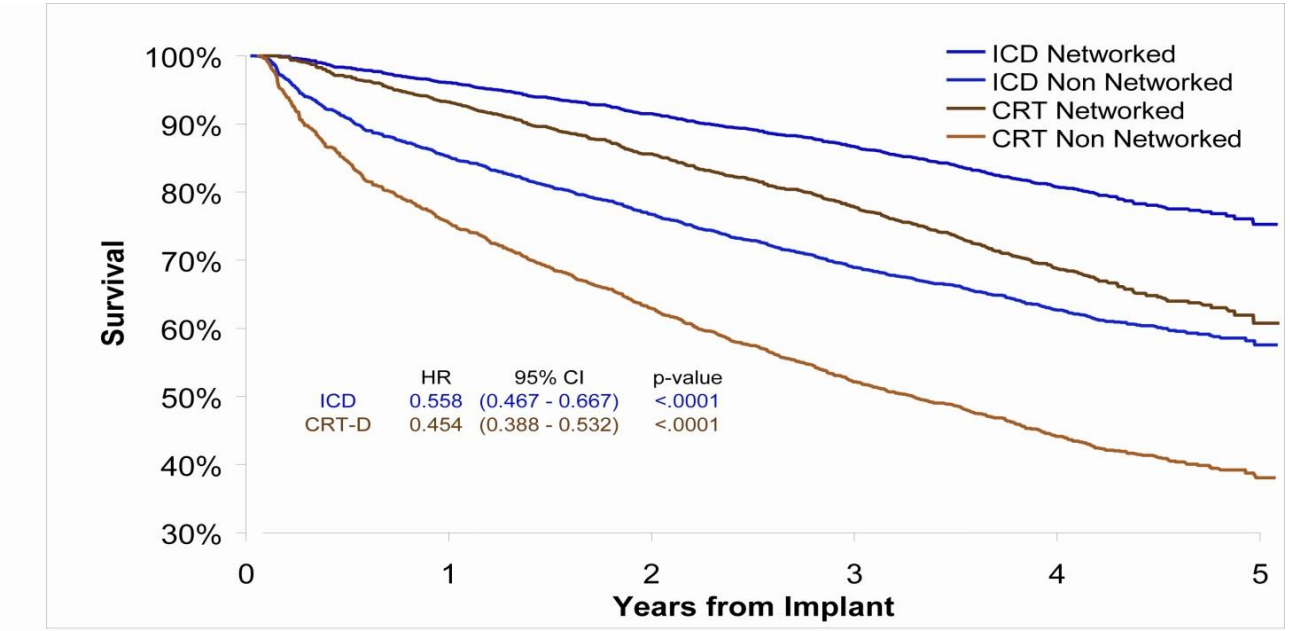
- HRS
- Heart Rhythm Society
- EHRA European Heart Rhythm Association
- AIAC Associazione Italiana Aritmologia e Cardiostimolazione

Il monitoraggio remoto può sostituire a tutti gli effetti il controllo standard ambulatoriale

- Valutazione costante della funzionalità del dispositivo (es. stato batteria, ..) e delle condizioni cliniche del paziente, come ad esempio episodi aritmici atriali (FA) e ventricolari (TV e FV), stato dello SC
- Diagnosi precoce degli episodi di instabilizzazione clinica

Survival: ALTITUDE DATABASE

- ALTITUDE: retrospective analysis of data collected via LATITUDE
- Patients matched by: age, gender, implant year, device, and implant center
- 50% relative reduction in the hazard of death



Networked	ICD	3,026	2,651	2,034	1,353	554	31
	CRT-D	2,110	1,913	1,479	1,065	470	20
Non-Networked	ICD	3,026	2,592	1,988	1,304	530	34
	CRT-D	2,110	1,813	1,407	1,003	452	26
Networked	ICD		96%	92%	87%	81%	75%
	CRT-D		93%	86%	78%	69%	61%
Non-Networked	ICD		85%	77%	69%	63%	58%
	CRT-D		76%	63%	52%	44%	38%

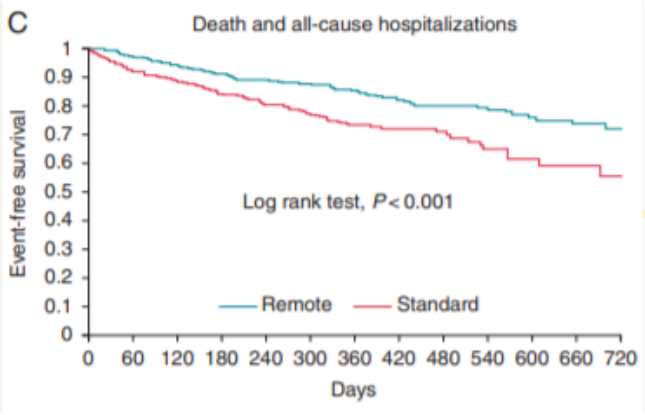
The subset of patients who transmitted weight and blood pressure data had an additional 10% relative reduction in the hazard of death

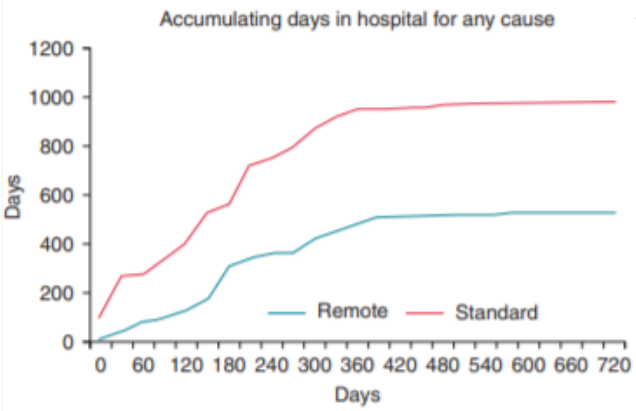
Saxon et al. Circulation. 2010;122(23):2359-2367

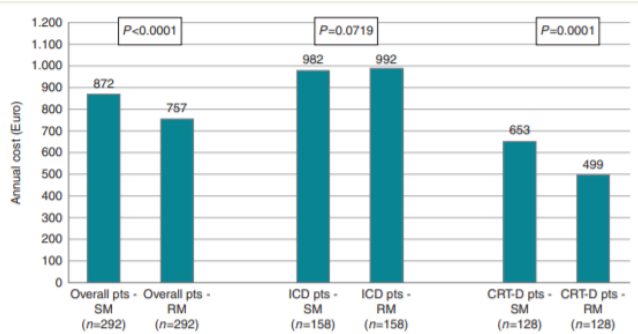
Europace (2015) **17**, 1267–1275
doi:10.1093/europace/euu318

Remote monitoring improves outcome after ICD implantation: the clinical efficacy in the management of heart failure (EFFECT) study

Antonio De Simone[1]*, Loira Leoni[2], Mario Luzi[3], Claudia Amellone[4],





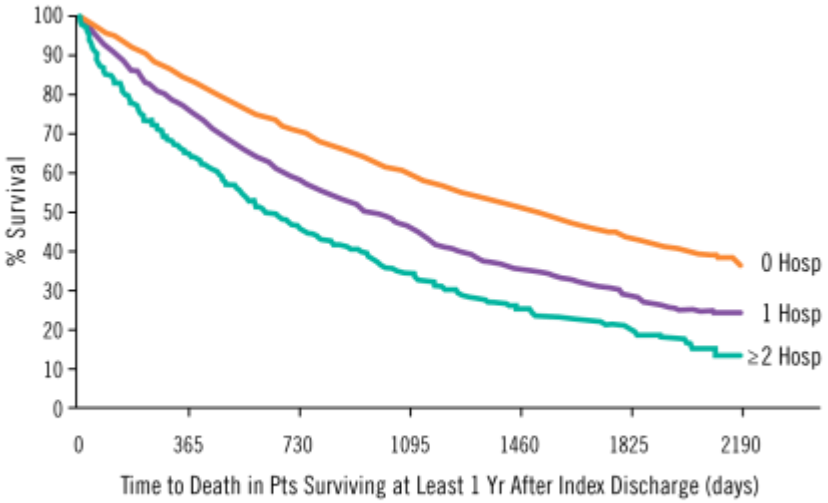


Compared with the standard follow-up through in-office visits, remote monitoring is associated with reduced death and cardiovascular hospitalizations in patients with ICD in clinical practice.

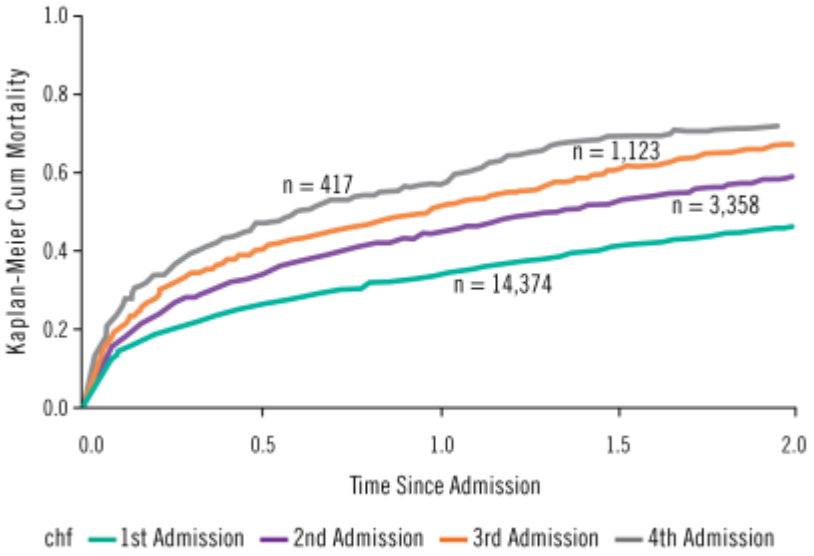
There is a reduction in direct healthcare costs of RM for HF patients with ICDs, particularly CRT-D, compared with standard monitoring

HF Hospitalizations are a Strong Predictor of Mortality[1,2]

Data from the EFFECT study, n = 9138 patients[1]



Data from Setoguchi et al., n = 14,374 patients[2]



Studies show each admission decreases a patient's chance of survival.

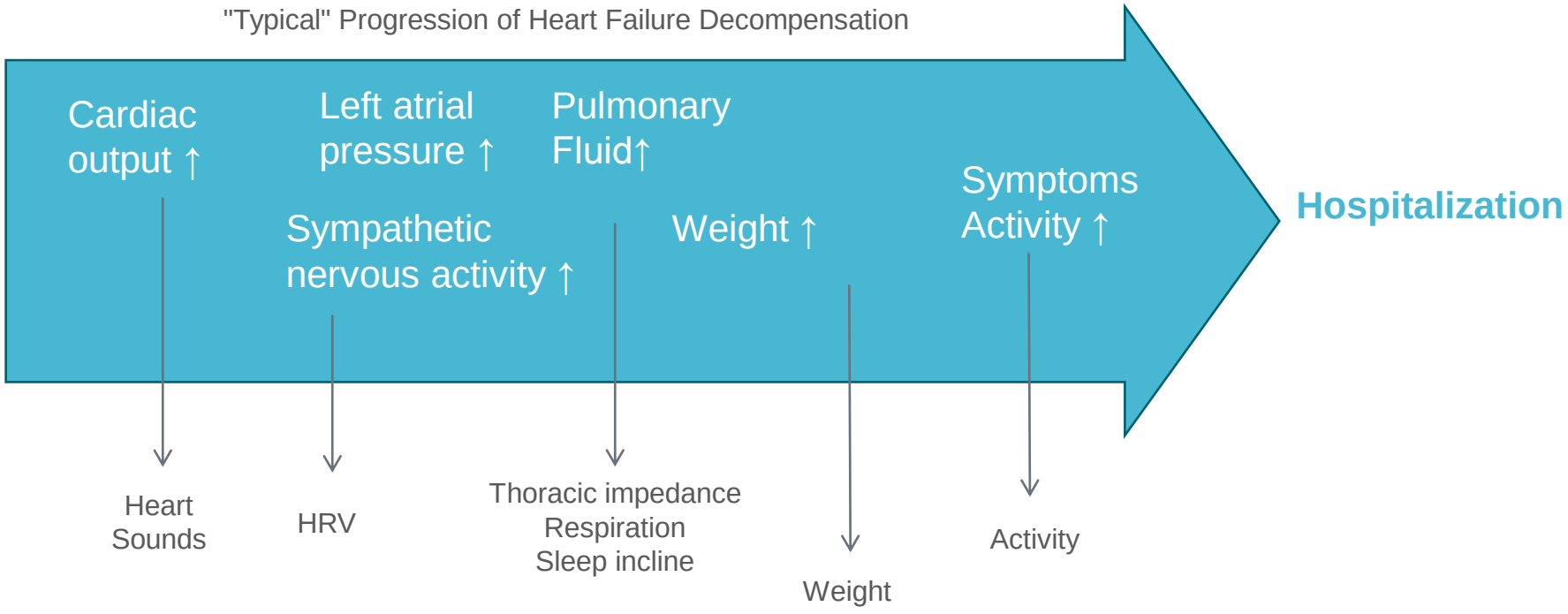
Among 1 year survivors after index EFFECT-HF discharge, the number of heart failure hospitalizations in the preceding year stratified the risk of death in crude analysis.[1]

KP cumulative mortality curve for all-cause mortality after each subsequent hospitalization for HF.[2]

1. Lee DS, et al. Am J of Med, 2009.
2. Setoguchi S, et al. Am Heart J, 2007.

Heart failure symptoms of decompensation are possible to identify

Symptoms can vary in presentation and time course, nevertheless, several patterns may precede a decompensation



Sensors enable the early detection of heart failure decompensation symptoms

Sensors are intended to represent typical in-office tests and questions

Our sensors:	What Clinicians ask/do during a physical exam
Heart Sounds	Listen to the heart S3 heart sound
Heart Sounds	Listen to the heart S1 heart sound
Thoracic Impedance	Take chest X-ray for signs of pulmonary edema
Respiratory Rate	"Are you out of breath? Have difficulty breathing?"
Activity Level	"Are you able to get your mail/go upstairs?"
Weight	"Have you gained weight?"
Night Heart Rate	Is resting heart rate elevated?

Sensors Specific to HeartLogic™ Algorithm

Heart Sounds

- Heart Sounds uses the pulse generator's accelerometer to detect cardiac vibrations, which are used to measure the intensity in milligravities(mG) [2,3,5,6]
- Worsening heart failure may be associated with an increase in S3 or a decrease in S1, or both[1]

Thoracic Impedance

- A measure of lung resistance between RV coil and Pulse Generator correlates with pulmonary capillary wedge pressure[4]
- Thoracic impedance may decrease prior to a heart failure decompensation[4]

Respiratory Rate

- MultiSENSE study analysis showed that patients with a higher range of respiratory rate in the previous 30-days had 4.9-fold increased risk of heart failure hospitalization within the next 30-days[7]

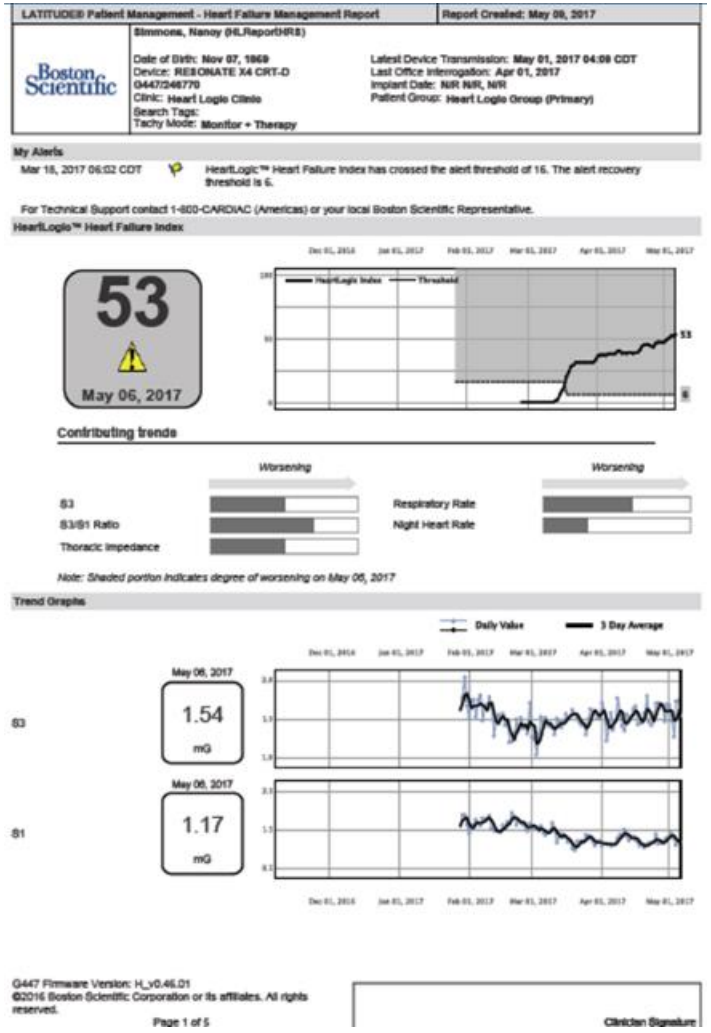
Activity Level

- Changes in device-measured activity have been correlated with a 6-Minute Walk Test[9]
- Device activity level at 1-month was found to be an independent predictor for clinical response to CRT[8]

Night Heart Rate

- Average heart rate from approximately 12am-6am tends to capture close to resting heart rate for most patients[10]
- Look for increases

Introducing HeartLogic Heart Failure Diagnostic


LATITUDE® Patient Management - Heart Failure Management Report

Report Created: May 09, 2017

Simmons, Nancy (HLReportDHR8)

Boston Scientific

Date of Birth: Nov 07, 1969
Device: RESONATE X4 CRT-D
G447/246770
Clinic: Heart Logic Clinic
Search Tags:
Tachy Mode: Monitor + Therapy

Latest Device Transmission: May 01, 2017 04:09 CDT
Last Office Interrogation: Apr 01, 2017
Implant Date: N/R N/R, N/R
Patient Group: Heart Logic Group (Primary)

My Alerts

Mar 18, 2017 06:02 CDT — HeartLogic™ Heart Failure Index has crossed the alert threshold of 16. The alert recovery threshold is 6.

For Technical Support contact 1-800-CARDIAC (Americas) or your local Boston Scientific Representative.

HeartLogic™ Heart Failure Index

53

May 06, 2017

Contributing trends

Worsening

Worsening

S3

S3/S1 Ratio

Thoracic Impedance

Respiratory Rate

Night Heart Rate

Note: Shaded portion indicates degree of worsening on May 06, 2017

Trend Graphs

Daily Value

3 Day Average

S3

May 06, 2017

1.54

mG

S1

May 06, 2017

1.17

mG

G447 Firmware Version: H_v0.46.01

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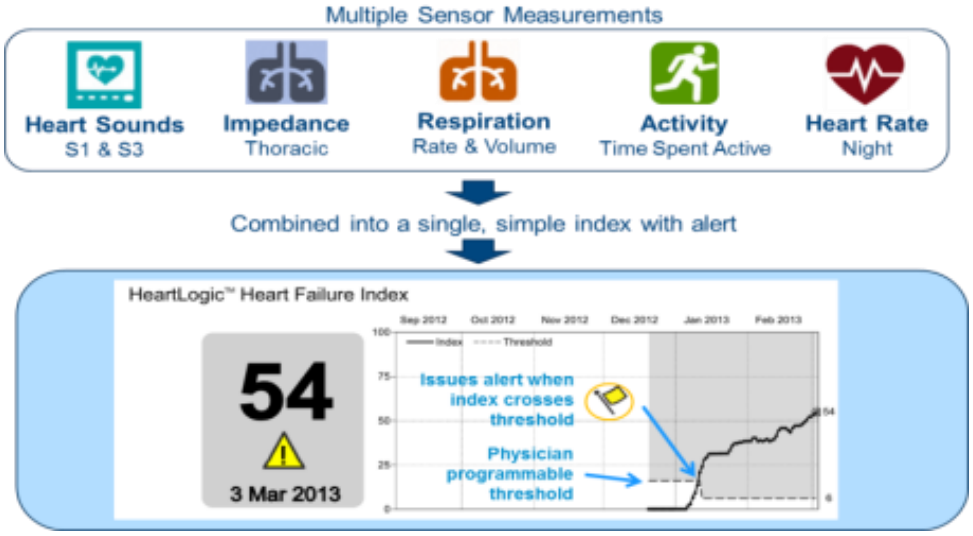
Clinician Signature

HeartLogic™ enables **proactive care** of heart failure patient management **with a multifactorial approach**

Incorporates Multiple Sensors with a Single Composite Alert

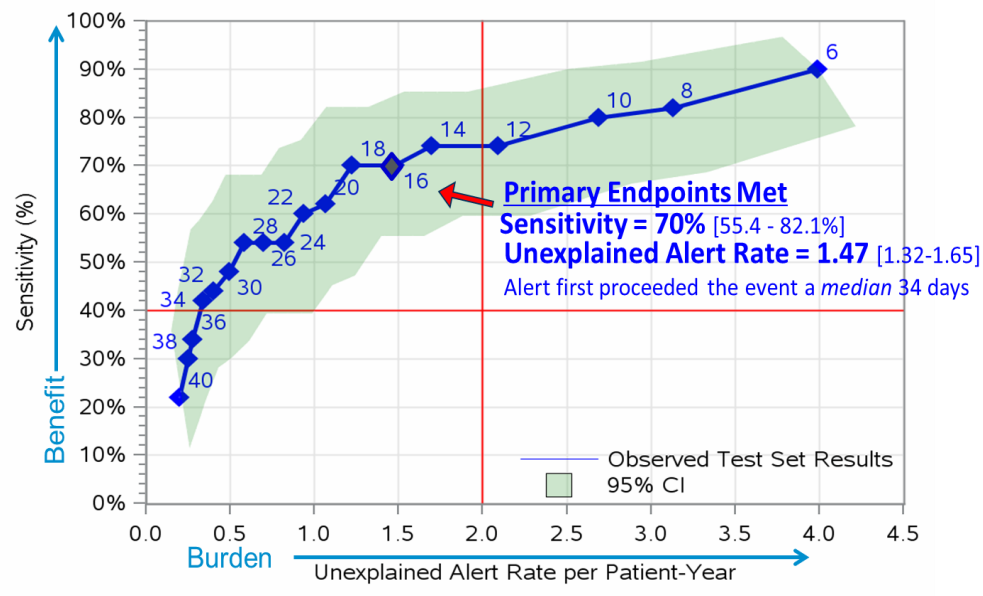


Boehmer, J et al., JACC-HF, 2017;5(3),2 1 6 – 2 5.

Primary Results from the MultiSENSE Study

The MultiSENSE Study data demonstrated that HeartLogic™:

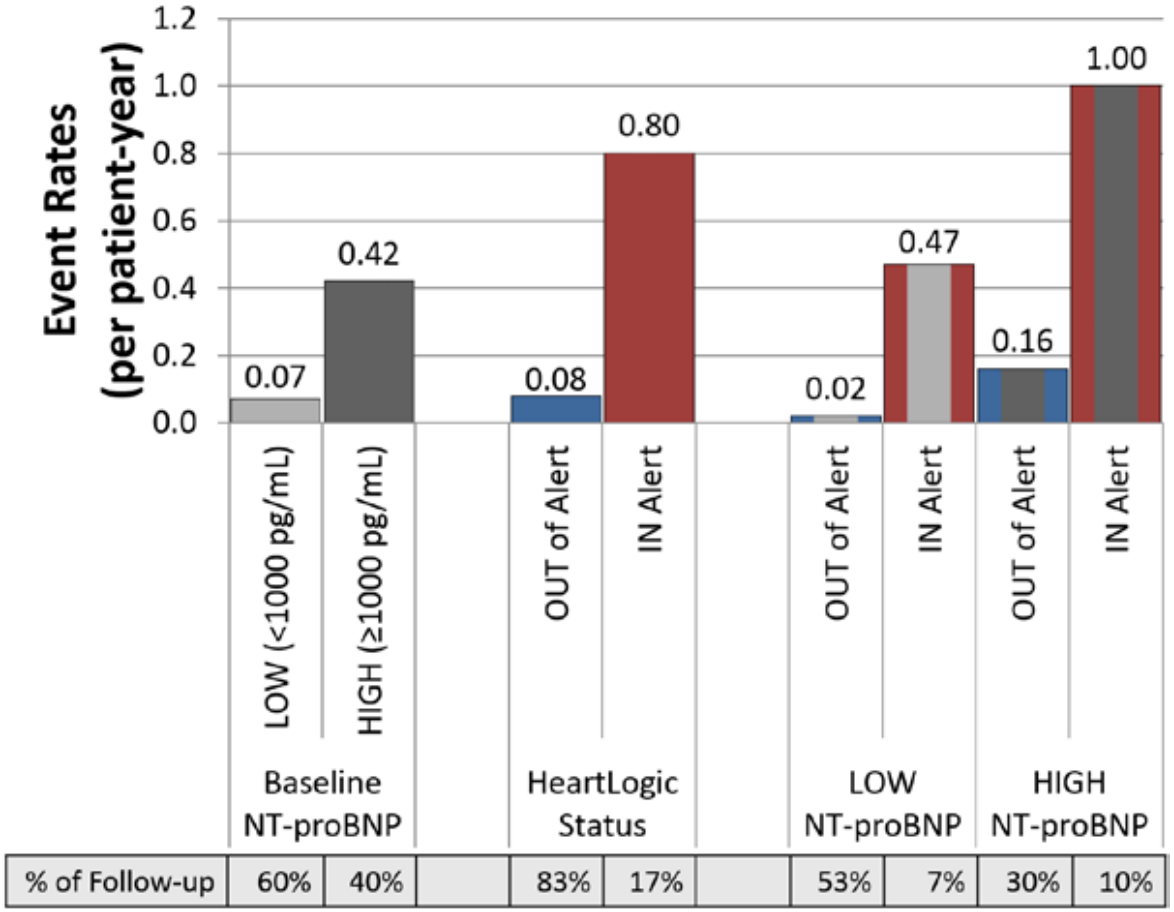
- Had **high sensitivity** of 70 % in detecting heart failure events
- Had a very **low burden** of less than 2 alerts per patient per year
- (specificty of 85%)
- May allow several **weeks of advanced notice** to clinicians of a potential event



Boehmer, J et al., JACC-HF, 2017;5(3),2 1 6 – 2 5.

Event Rate Ratio

HeartLogic Significantly Augments The Prognostic Ability Of NT-proBNP Assessment



Caso: Storia Clinica

- 71 anni
- CMD - 35% FE
- BBS
- Ipertensione
- Diabete ID

- Impianto CRT-D 22/03/2018

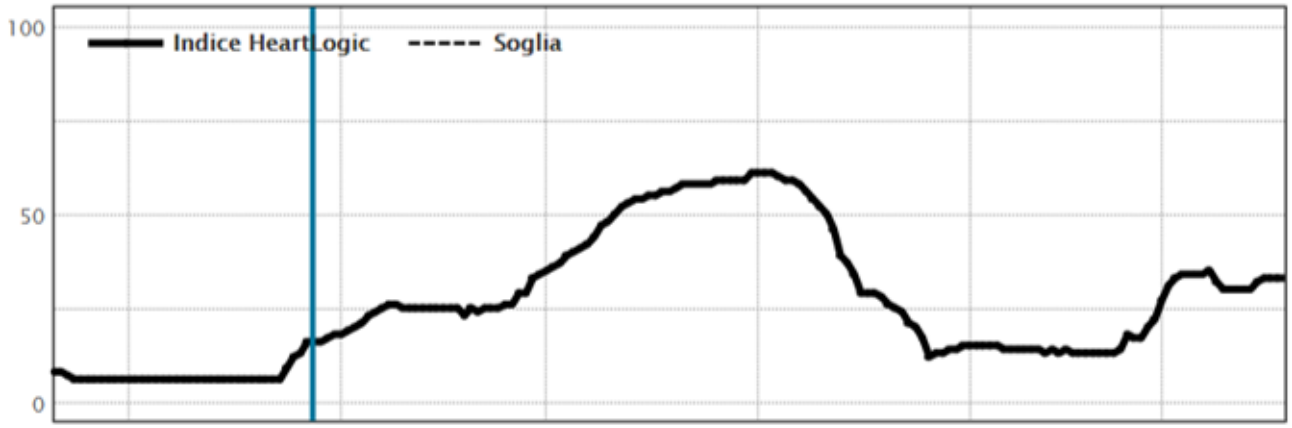
Al controllo riferisce **pregresso ricovero per scompenso ad inizio Aprile 2019**. Viene attivato HL per verificare l'andamento dell'indice nei giorni precedenti al ricovero.

HL può essere attivato anche successivamente all'impianto. In questo caso una volta scaricati i dati pregressi il sistema ricostruisce l'andamento dell'indice anche per il passato in modo da associare l'indice HL anche ad eventi già risolti

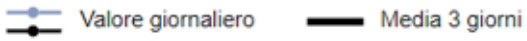
Indice insufficienza cardiaca HeartLogic™

16

28 ott 2018



Grafici dei trend

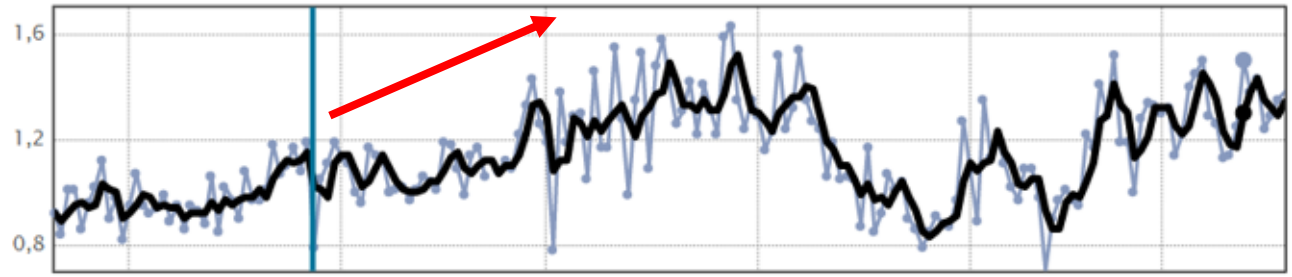


S3

28 ott 2018

0,79

mG

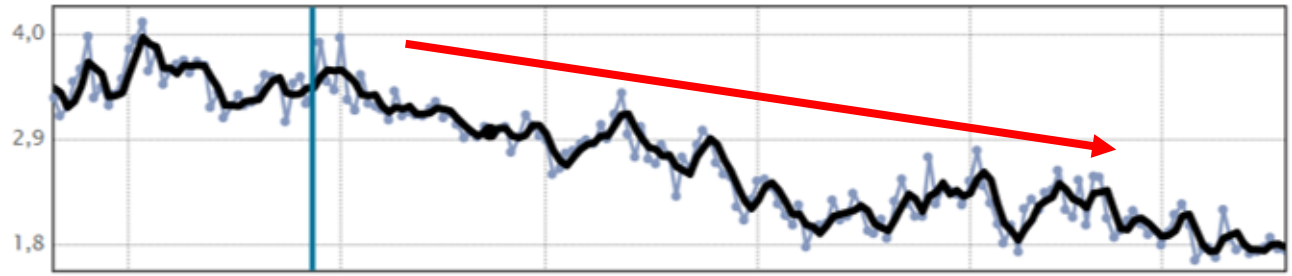


S1

28 ott 2018

3,45

mG



28/10/2018
HL > 16

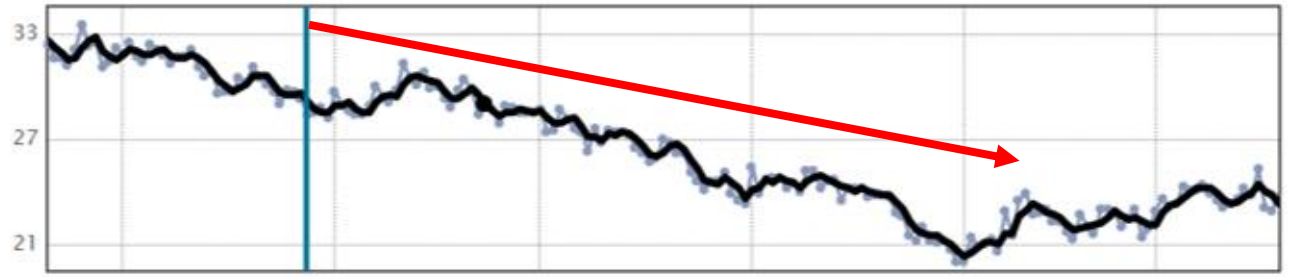
L'indice aveva oltrepassato il valore soglia di 16 ben 6 mesi prima del ricovero per scompenso

Impedenza toracica

28 ott 2018

28,4

Ω

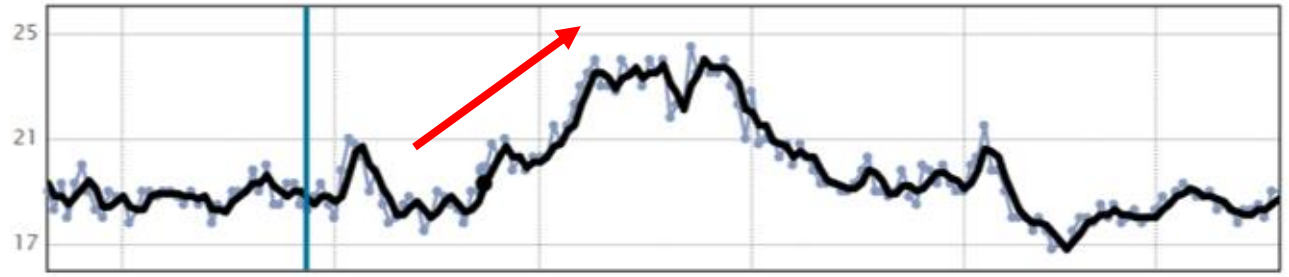


Frequenza respiratoria

28 ott 2018

18,3

min^{-1}

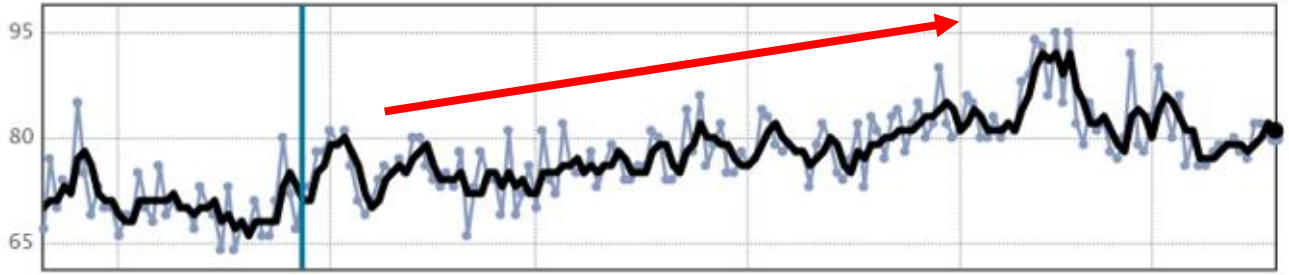


Frequenza cardiaca notturna

28 ott 2018

73

min^{-1}

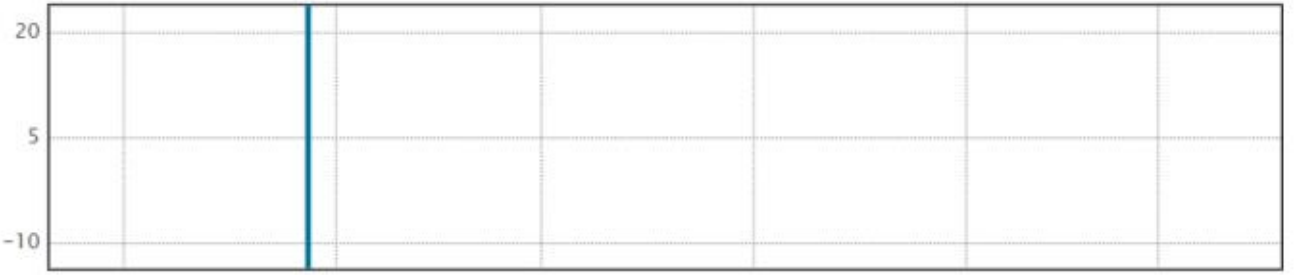


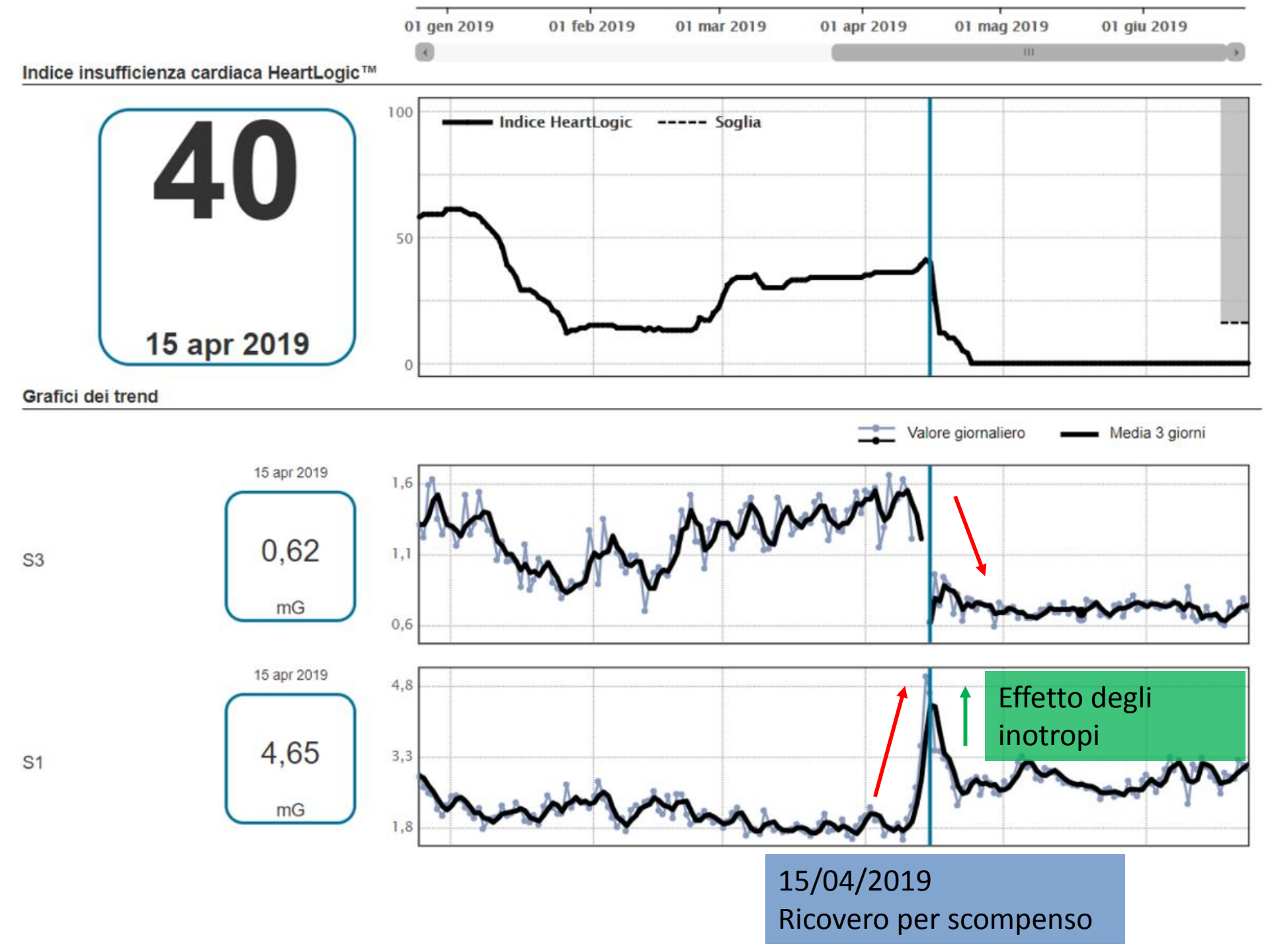
Inclinazione sonno

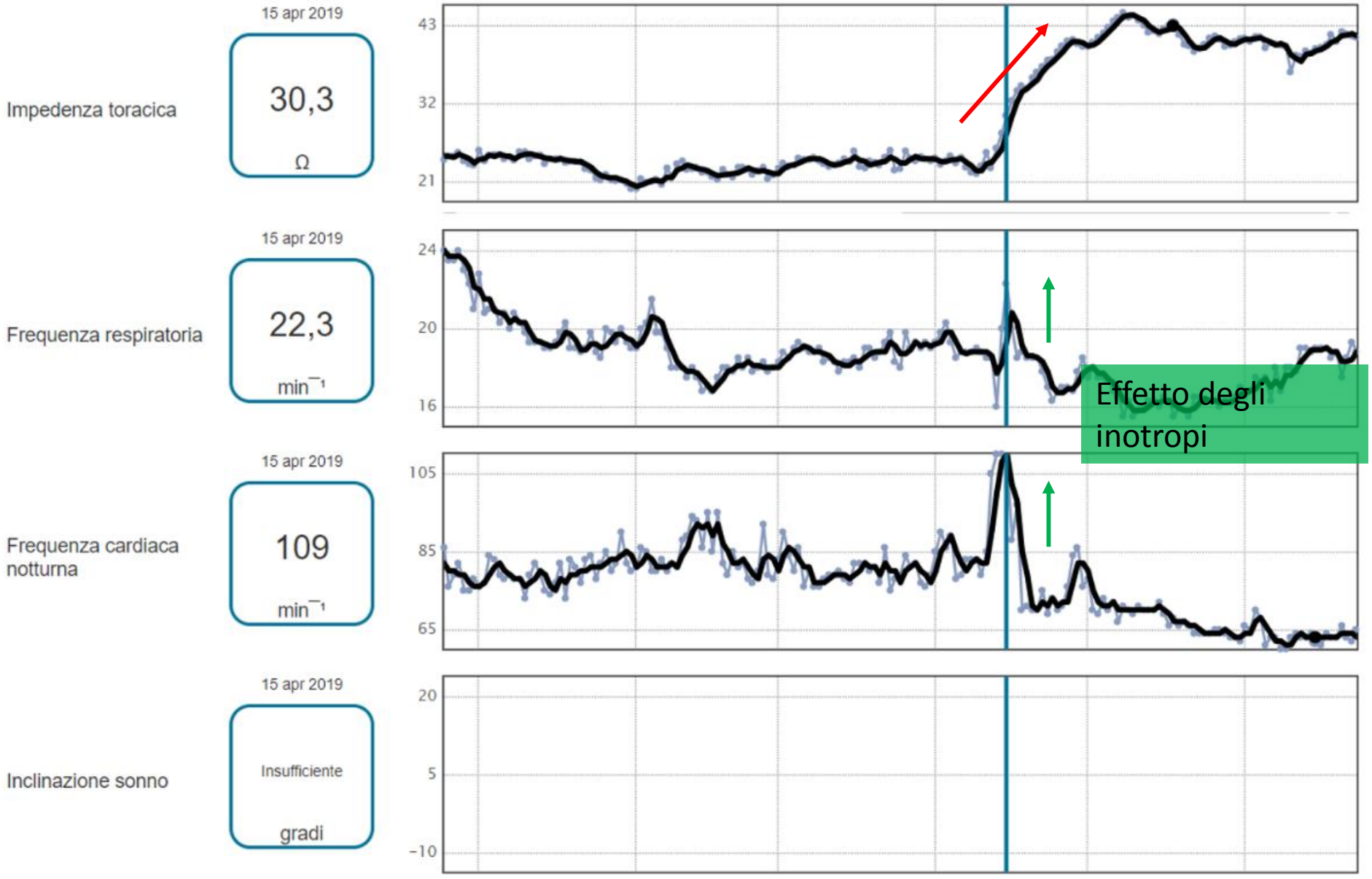
28 ott 2018

Insufficiente

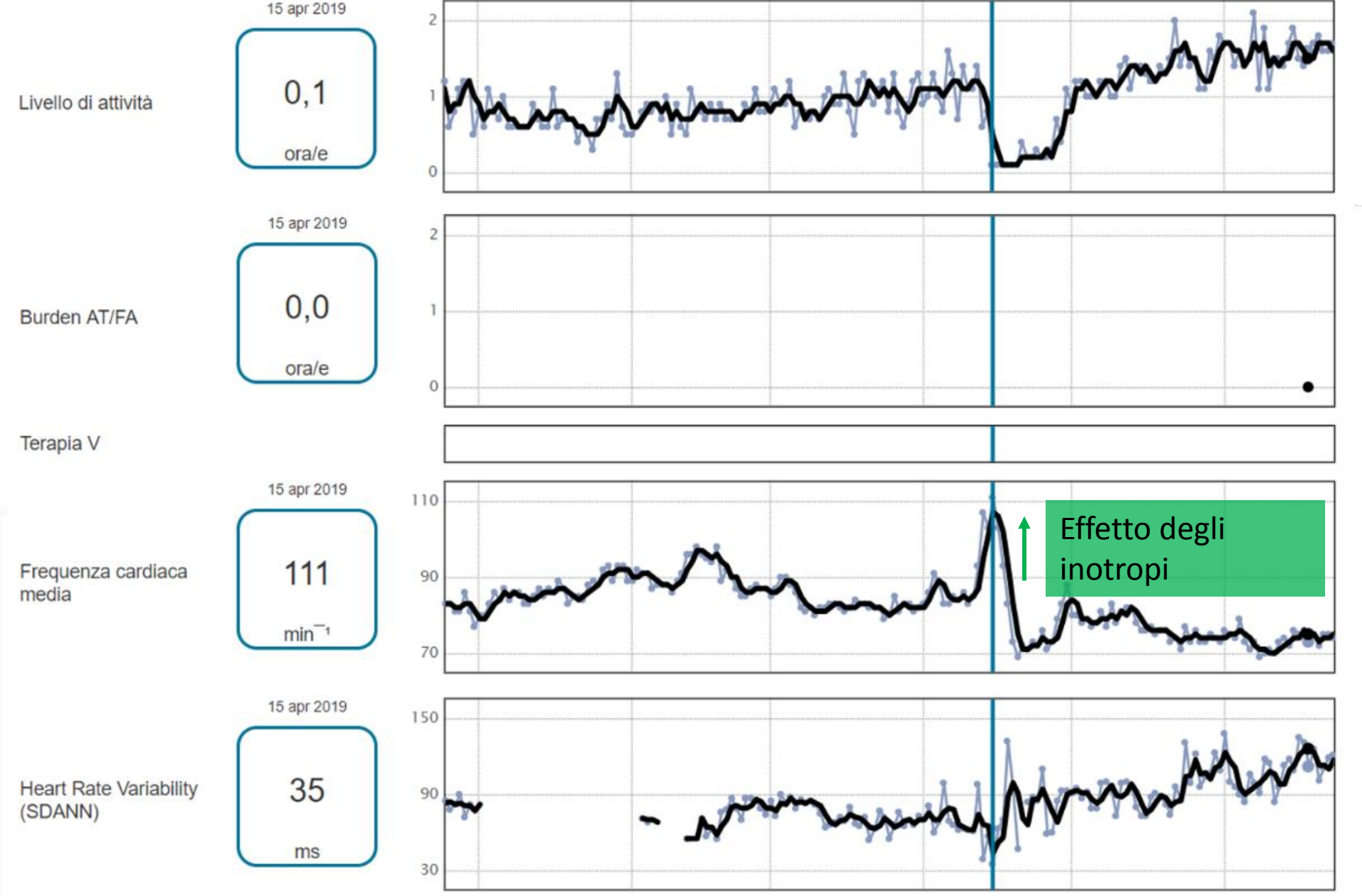
gradi




01 gen 2019
01 feb 2019
01 mar 2019
01 apr 2019
01 mag 2019
01 giu 2019
Indice insufficienza cardiaca HeartLogic™
40
15 apr 2019
100
50
0
Indice HeartLogic
Soglia
Grafici dei trend
Valore giornaliero
Media 3 giorni
15 apr 2019
S3
0,62
mG
1,6
1,1
0,6
15 apr 2019
S1
4,65
mG
4,8
3,3
1,8
Effetto degli inotropi
15/04/2019
Ricovero per scompenso



Si nota l'effetto della terapia al ricovero sia dai toni che dall'impedenza transtoracica


15 apr 2019
Livello di attività
0,1
ora/e
2
1
0
15 apr 2019
Burden AT/FA
0,0
ora/e
2
1
0
Terapia V
15 apr 2019
Frequenza cardiaca media
111
min⁻¹
110
90
70
Effetto degli inotropi
15 apr 2019
Heart Rate Variability (SDANN)
35
ms
150
90
30

conclusioni

I recenti miglioramenti tecnologici :

AICD con batterie longeve
device sempre più MRI compatibili
device in grado di consentire diagnosi di scompenso cardiaco in remoto