Cardiologie connectée : Quel avenir ?

Prof Haran Burri
Unité d'électrophysiologie
Service de Cardiologie

Hôpitaux Universitaires Genève

Déclarations d'intérêt

- Biotronik, Boston Scientific, Medtronic, Sorin, St-Jude

  - research grants, speaker honoraria, consulting fees, institutional fellowship support

Cardiologie connectée

- Moniteurs de pression/poids
- Moniteurs de rythme
- Stimulateurs cardiaques / DAI

Noninvasive Home Telemonitoring for Patients With Heart Failure at High Risk of Recurrent Admission and Death

The Trans-European Network–Home-Care Management System (TEN-HMS) Study

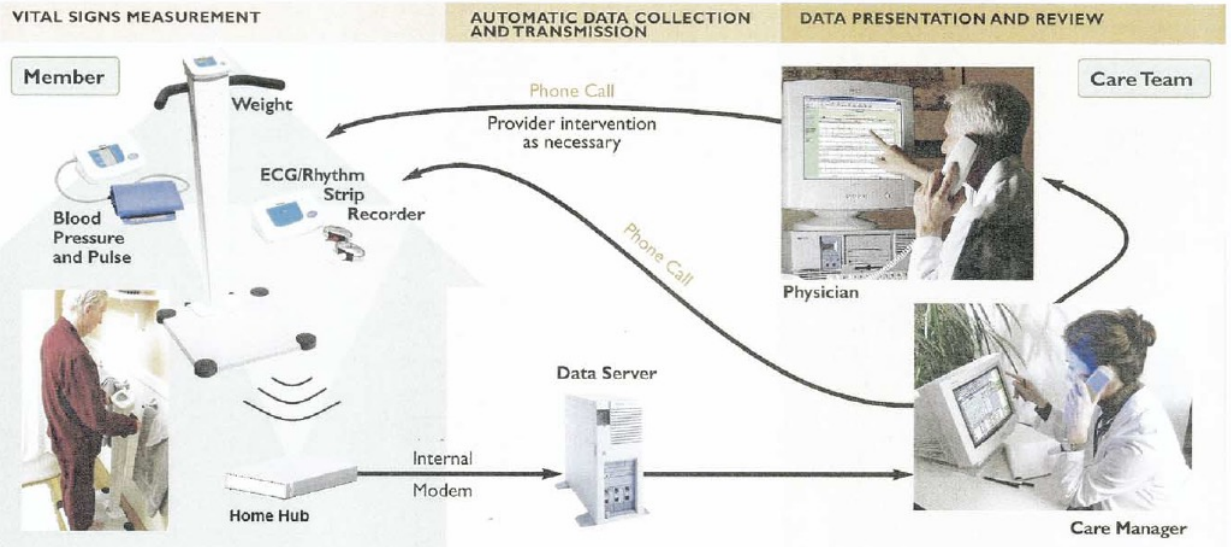
John G. F. Cleland, MD,* Amala A. Louis, MD,* Alan S. Rigby, PHD,* Uwe Janssens, MD,† Aggie H. M. M. Balk, MD,‡ on behalf of the TEN-HMS Investigators

JACC 2005;45:1654–64

486 pts with
- HF hosp within 6 wks
- LVEF<40%
- diuretic Rx

Randomization

Usual care | Nurse tel. support | Telemonitoring



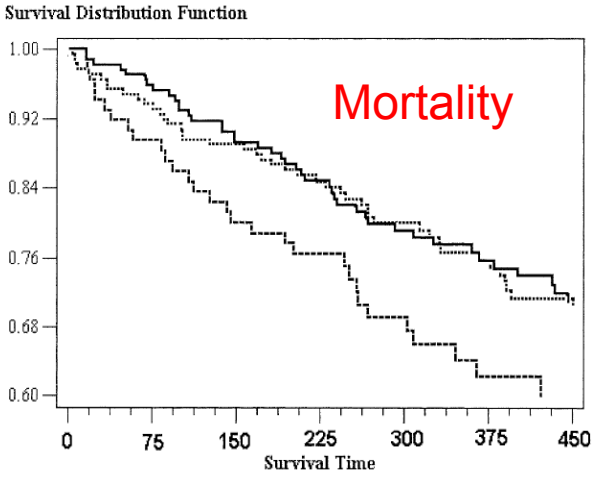


Figure 3. Mortality in each of the randomized groups. A difference was found between usual care and either nurse telephone support or home telemonitoring (chi-squared test: p = 0.0397). The absolute difference in mortality at one year was 16% to 18%. **Dashed line** = usual care; **dotted line** = nurse support; **solid line** = telemonitoring.

⇨ No difference in primary endpoint (days dead or hospitalized)

⇨ Significant reduction in hospital duration with HM compared to NTS

Telemonitoring in Patients with Heart Failure

Sarwat I. Chaudhry, M.D., Jennifer A. Mattera, M.P.H., Jeptha P. Curtis, M.D., John A. Spertus, M.D., M.P.H., Jeph Herrin, Ph.D., Zhenqiu Lin, Ph.D., Christopher O. Phillips, M.D., M.P.H., Beth V. Hodshon, M.P.H., J.D., R.N., Lawton S. Cooper, M.D., M.P.H., and Harlan M. Krumholz, M.D.

NEJM 2010

Tele-HF trial

1653 pts admitted for HF within 30 days

Randomization
Usual care vs. Telemonitoring:
- daily automated phone questionnaire
- data on symptoms and weight
Daily review of data by coordinators

86% of patients called
- 90.2%, during the first week
- **decreased to 55.1% by week 26**

End Point	Telemonitoring (N=826)	Usual Care (N=827)	P Value
Primary end point: death or readmission — no. (%)	432 (52.3)	426 (51.5)	0.75
Secondary end points			
Death — no. (%)	92 (11.1)	94 (11.4)	0.88
Readmission — no. (%)	407 (49.3)	392 (47.4)	0.45
Readmission for heart failure — no. (%)	227 (27.5)	223 (27.0)	0.81
No. of days in hospital	7.2±14.6	7.0±14.9	0.27

Boston Scientific Latitude

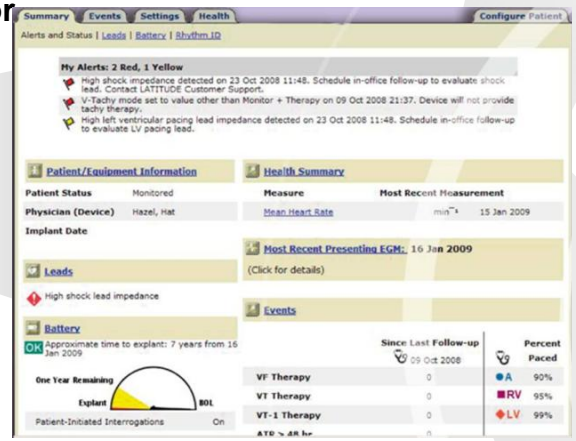
Patient's Home

Boston Scientific CRM Device

Phone line

LATITUDE® Communicator

Web Server



Health Following Physician

Objectives

- Collaborative patient management
- HF management

Device Managing Physician

Objectives

- Device management
- Arrhythmia management

LATITUDE Patient Management - Windows Internet Explorer

https://www.latitude.bostonscientific-international.com/apm/physician/dispositioning/beginReview.do

Fichier Edition Affichage Favoris Outils ?

LATITUDE Patient Management

LATITUDE® Patient Management | PATIENT SEARCH | HELP/CONTACT US | LOG OUT

Boston Scientific

Patient Detail (Burri, Haran)

Logged In: Burri 14 A

Language: Engl

PATIENTS FOR REVIEW | ALL PATIENTS | PATIENT UTILITIES | CONFIGURE

Reports Menu | Dismiss Patient

Patient: **Date of Birth:** 28 Nov 1

Patient ID: delorl

Device: COGNIS 100-D P107/000418 | Monitor + Therapy

Last Office Interrogation: 23 Jun 2009 15:50

Latest Send: 12 Aug 2009 10:23

Summary | Events | Settings | Health | Config

Alerts and Status | Leads | Battery | Rhythm ID

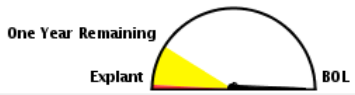
Patient/Equipment Information

Patient Status	Monitored
Physician (Device)	Burri, Haran
Implant Date	10 Jul 2008

Leads

Battery

OK Approximate time to explant: 7 years from 12 Aug 2009



Patient-Initiated Interrogations	On
Since Last Remote Follow-up	
Since Implant	1

Health Summary

Measure	Most Recent Measurement	
Weight	67.1 kg	12 Aug
Blood Pressure	105 / 75 mmHg	12 Aug
Mean Heart Rate	72 min⁻¹	12 Aug

Most Recent Presenting EGM: 12 Aug 2009

(Click for details)

Events

	Since Last Follow-up 23 Sep 2008
VF Therapy	0
VT Therapy	0
VT-1 Therapy	2
ATR > 48 hr	0

Settings Summary

VF	220 min⁻¹ ATP	41 J, 41
VT	185 min⁻¹ ATP	14 J, 41
VT-1	150 min⁻¹ ATP	Shocks
LRL - MTR	50 - 140 min⁻¹	

démarrer | LATITUDE Patient Ma...

Boston Scientific

LATITUDE® Patient Management

Report Created 03 Mar 2009

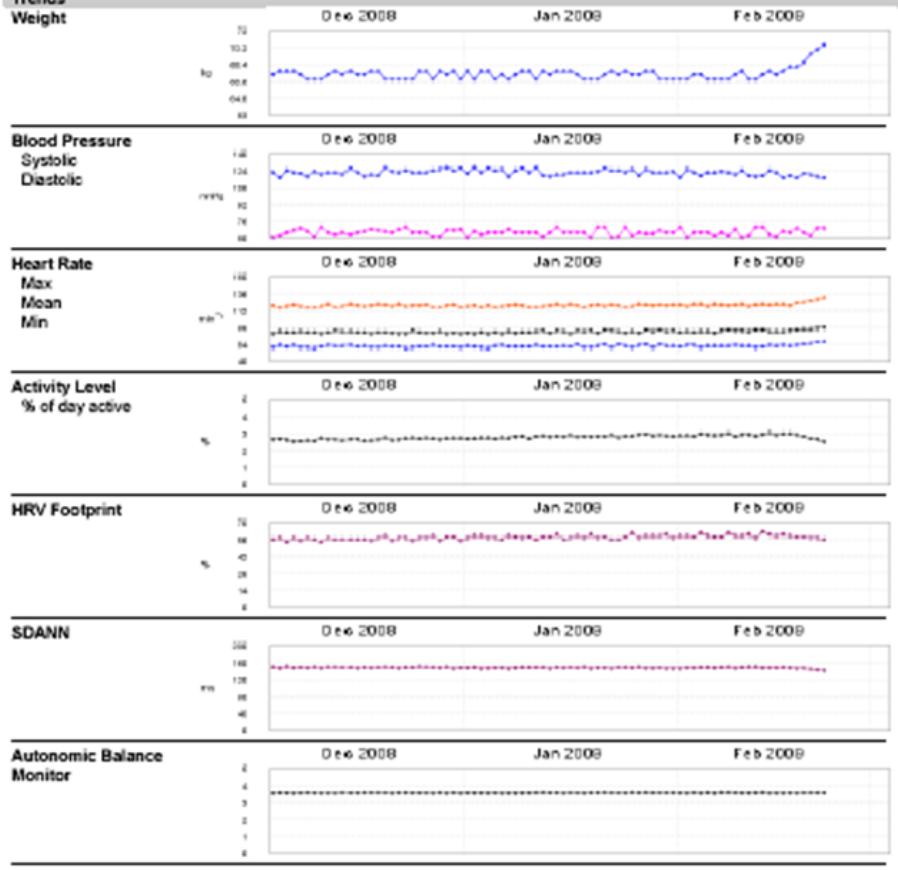
Heart Failure Management Report

Patient ID	100220584	Latest Send	23 Feb 2009
Date of Birth	05 Mar 1958	Last Office Interrogation	17 Dec 2008
Device	COGNIS 100-D P107/610186	Implant Date	10 Mar 2008
Tachy Mode	Monitor + Therapy		

My Alerts

- 23 Feb 2009 - Weight gain of at least 2.27 kg in a week or at least 0.91 kg average over a two or more day period
- 23 Feb 2009 - Cardiac Resynchronization Therapy pacing of < 90% (52%).

Trends

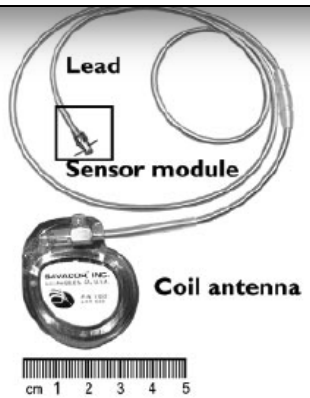


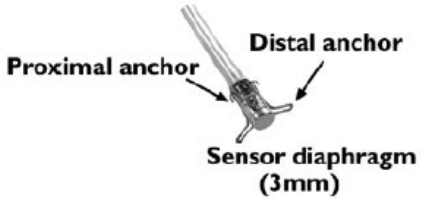
Physician-Directed Patient Self-Management of Left Atrial Pressure in Advanced Chronic Heart Failure

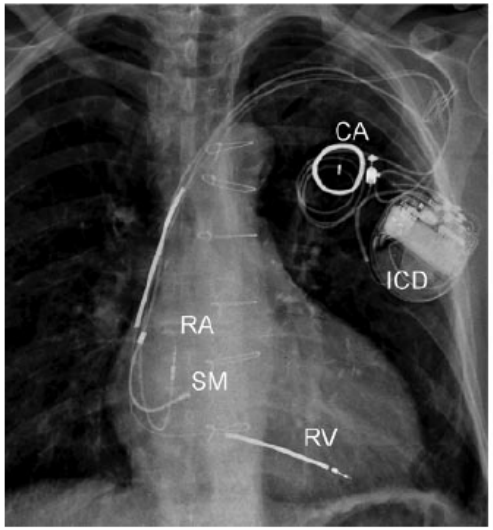
Jay Ritzema, Richard Troughton, Iain Melton, Ian Crozier, Robert Doughty, Henry Krum, Anthony Walton, Philip Adamson, Saibal Kar, Prediman K. Shah, Mark Richards, Neal L. Eigler, James S. Whiting, Garrie J. Haas, J. Thomas Heywood, Christopher M. Frampton, William T. Abraham and on Behalf of the Hemodynamically Guided Home Self-Therapy in Severe Heart Failure Patients (HOMEOSTASIS) Study Group

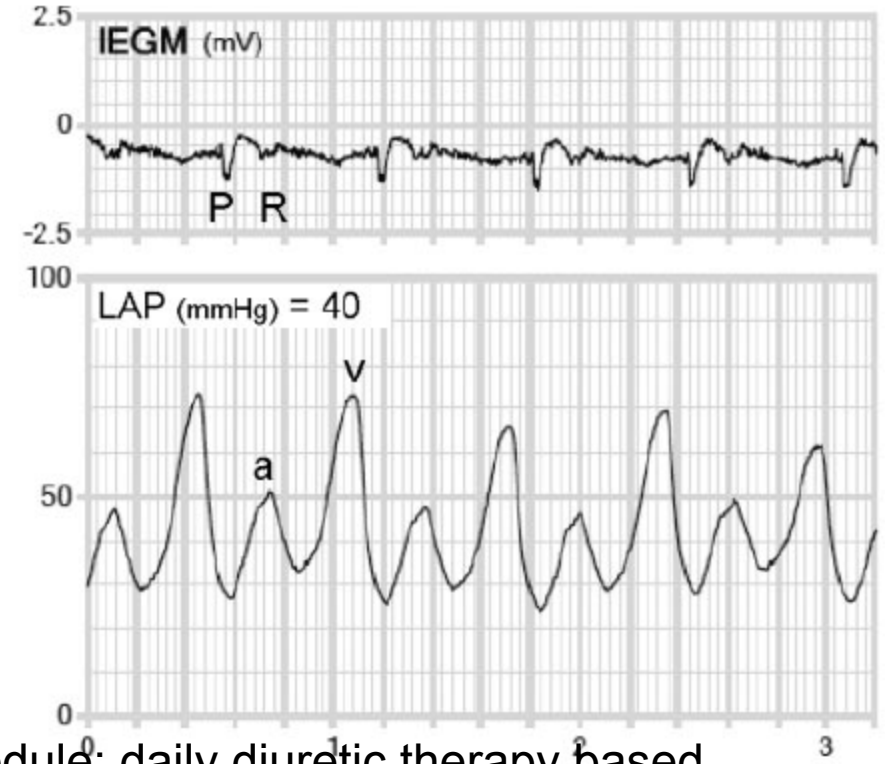
Circulation 2010 Mar 9;121(9):1086-95

Heart POD



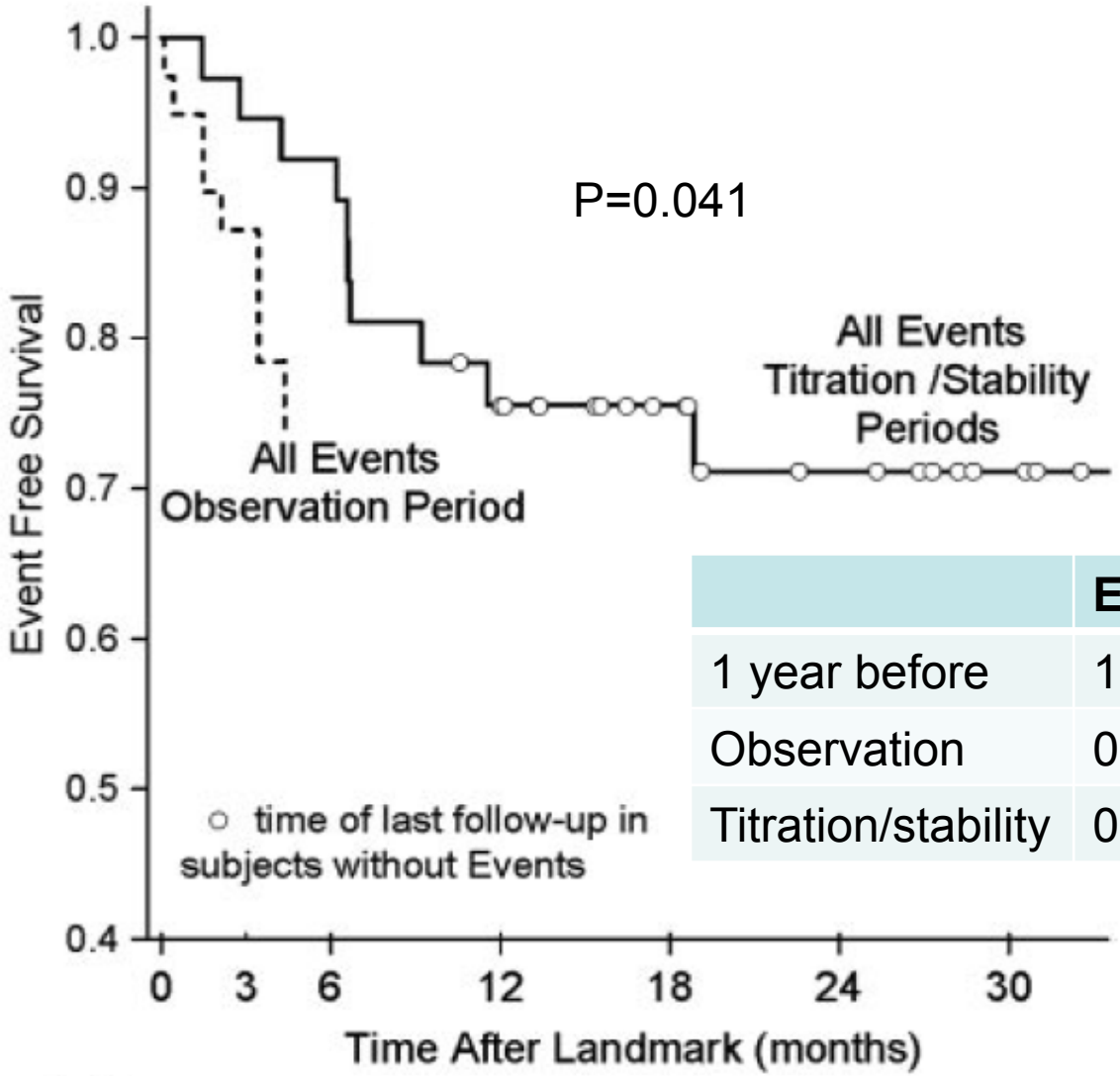






Patient advisor module: daily diuretic therapy based upon morning LAP

HOMEOSTASIS: results
Death or HF requiring iv treatment



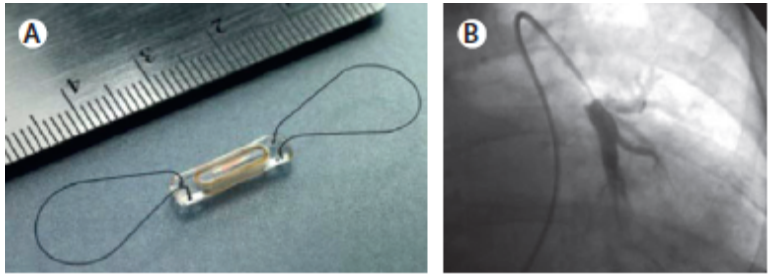
	Event rate (/yr)
1 year before	1.4 (1.1-1.9)
Observation	0.68 (0.33-1.4)
Titration/stability	0.28 (0.18-0.45)

Wireless pulmonary artery haemodynamic monitoring in chronic heart failure: a randomised controlled trial

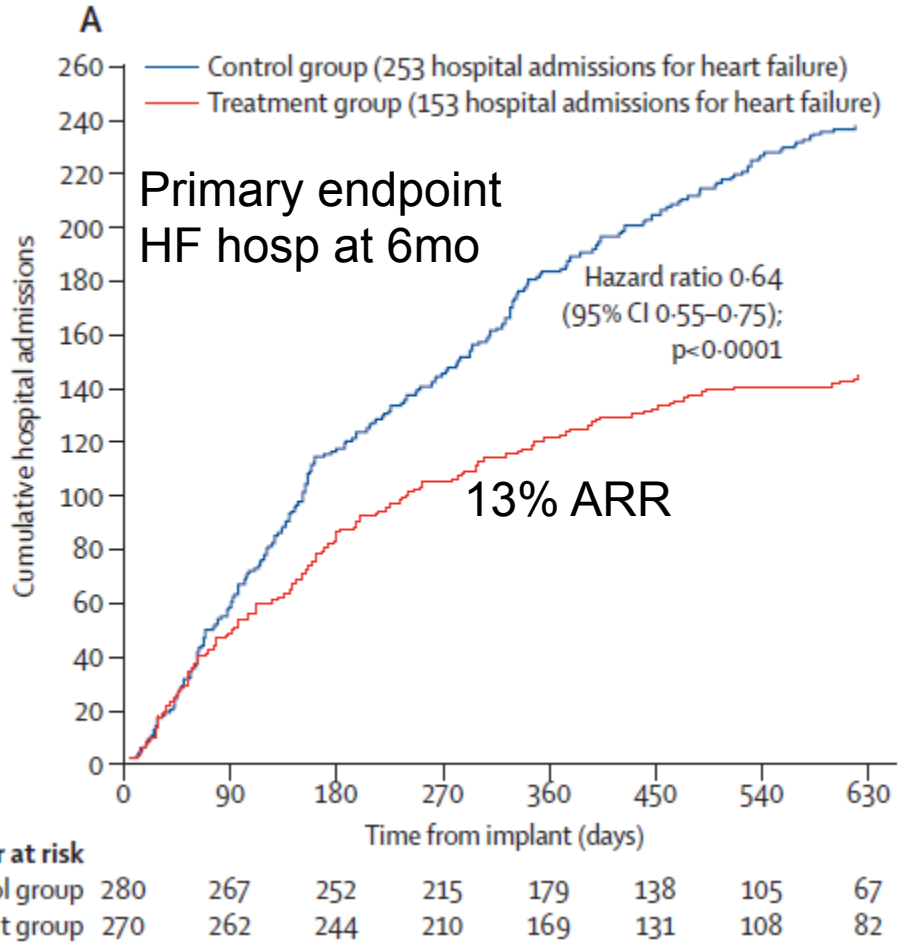
William T Abraham, Philip B Adamson, Robert C Bourge, Mark F Aaron, Maria Rosa Costanzo, Lynne W Stevenson, Warren Strickland, Suresh Neelagaru, Nirav Raval, Steven Krueger, Stanislav Weiner, David Shavelle, Bradley Jeffries, Jay S Yadav, for the CHAMPION Trial Study Group*

Lancet 2011; 377: 658–66

Single-blind, randomized study
NYHA III HF, irrespective of LVEF
HF hosp. Within 12 mo
35% had CRT
n=550, all implanted



Remote monitoring (≥ 1x weekly check + automatic e-mail alerts)



Wireless Pulmonary Artery Pressure Monitoring Guides Management to Reduce Decompensation in Heart Failure With Preserved Ejection Fraction

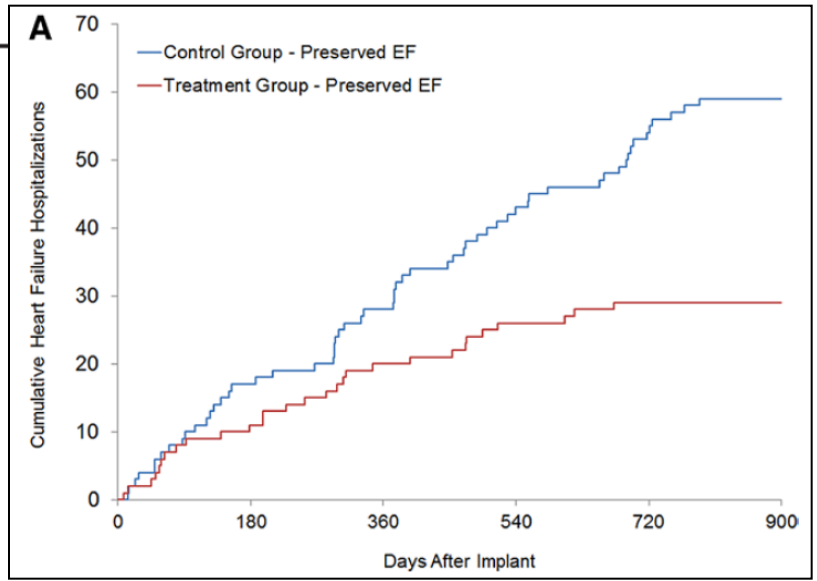
Philip B. Adamson, MD; William T. Abraham, MD; Robert C. Bourge, MD; Maria Rosa Costanzo, MD; Ayesha Hasan, MD; Chethan Yadav; John Henderson, BS; Pam Cowart, RN; Lynne Warner Ste

Circ Heart Fail. 2014;7:935-944

Table 5. Heart Failure Hospitalization Rates by Baseline Ejection Fraction Subgroup: 6-Month Primary End Point Period

Ejection Fraction	Randomization Group	No. of Heart Failure Hospitalizations	6 mo Rates of Hospitalization for Heart Failure	Incidence Rate Ratio (95% CI; *P* Value)
≥40%	Treatment group (n=62)	11	0.18	0.54 (0.38–0.70; <0.0001)
	Control group (n=57)	19	0.33	
≥50%	Treatment group (n=35)	9	0.18	0.50 (0.29–0.86; 0.0129)
	Control group (n=31)	10	0.35	
<40%	Treatment group (n=208)	73	0.36	0.76 (0.61–0.91; 0.0085)
	Control group (n=222)	101	0.47	

HF hospitalizations LVEF≥0.40



Cardiologie connectée

- Moniteurs de pression/poids
- Moniteurs de rythme
- Stimulateurs cardiaques / DAI

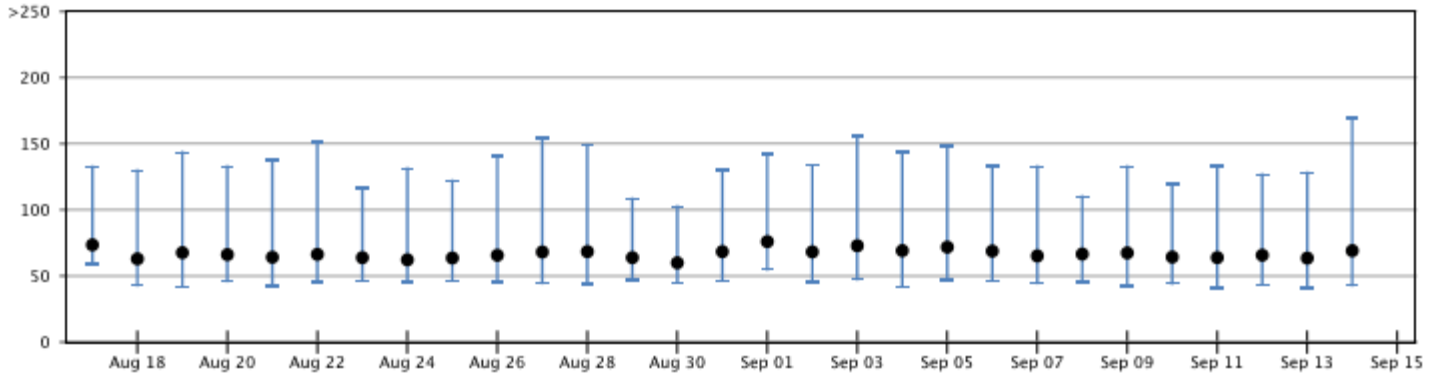
Medtronic SEEQ

1 week loop recorder (continous recording possible but not currently available)

Remote transmission to interpreting centre

Water resistant

Heart Rate (bpm)

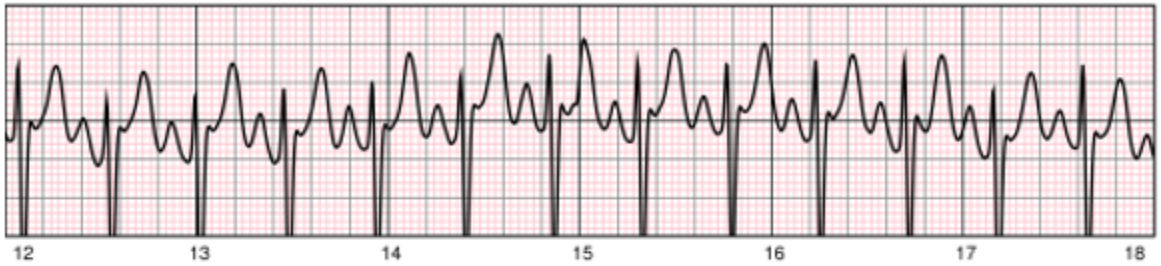


Episode Summary

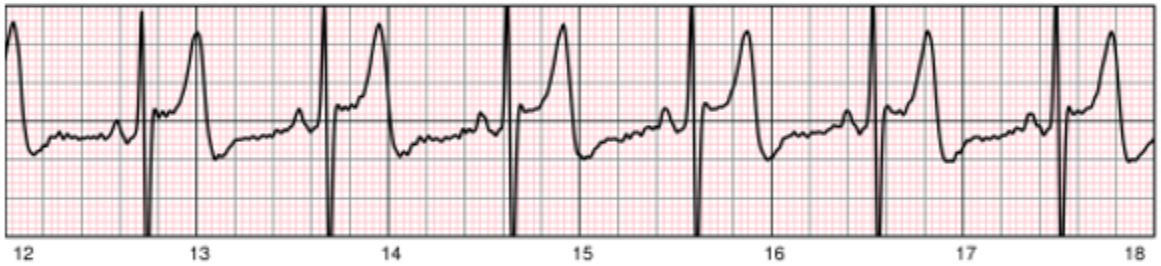
Date	Time	Notify	Preliminary Observation	Trigger Type	Ref ID
Aug 17, 2015	16:56:42 CEST		Rhythm:Sinus Tachycardia HR: Min: 100bpm, Max: 130bpm, Avg: 115bpm	Baseline	2103757
Aug 24, 2015	18:37:38 CEST	. .	Rhythm:Sinus Rhythm HR: Avg: 65bpm	Baseline	2613233
Sep 01, 2015	00:14:11 CEST		Rhythm:Sinus Rhythm HR: Min: 70bpm, Max: 80bpm, Avg: 75bpm	Baseline	2256326
Sep 07, 2015	19:02:15 CEST		Rhythm:Artifact, Sinus Tachycardia HR: Min: 120bpm, Max: 120bpm, Avg: 120bpm Observations: Sinus Tachycardia	Baseline	2333510
Aug 29, 2015	09:15:02 CEST		Rhythm:Sinus Rhythm HR: Min: 60bpm, Max: 60bpm, Avg: 60bpm (Received Oct 02, 2015 19:08:34 CEST)	Patient	2613280
Aug 19, 2015	21:04:36 CEST		Rhythm:Sinus Tachycardia HR: Min: 120bpm, Max: 130bpm, Avg: 125bpm	Auto	2130542

Episode Details

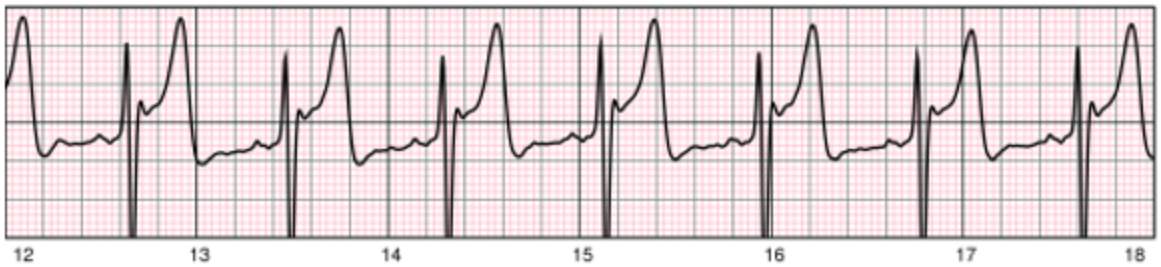
Aug 17, 2015 16:56:42 CEST — Rhythm:Sinus Tachycardia — Baseline
HR: Min: 100bpm, Max: 130bpm, Avg: 115bpm



Aug 24, 2015 18:37:38 CEST — Rhythm:Sinus Rhythm — Baseline
HR: Avg: 65bpm



Sep 01, 2015 00:14:11 CEST — Rhythm:Sinus Rhythm — Baseline
HR: Min: 70bpm, Max: 80bpm, Avg: 75bpm



Comparison of 24-hour Holter Monitoring with 14-day Novel Adhesive Patch Electrocardiographic Monitoring☆

Paddy M. Barrett, MB, BCh, BAO,[a] Ravi Komatireddy, MD,[a] Sharon Haaser, RN, BSN, CCRC,[a] Sarah Topol, RN, BSN, BA,[a] Judith Sheard, MPH,[a] Jackie Encinas, MS,[a] Angela J. Fought, MS,[b] Eric J. Topol, MD[a,c]

[a]Scripps Translational Science Institute, La Jolla, Calif; [b]Fought Statistical Consulting, Chicago, Ill; [c]Scripps Health, La Jolla, Calif.

Am J Med (2014) 127, 95.e11-95.e17

Water-resistant
14-day continuous ECG recording
Offline analysis
Trigger button

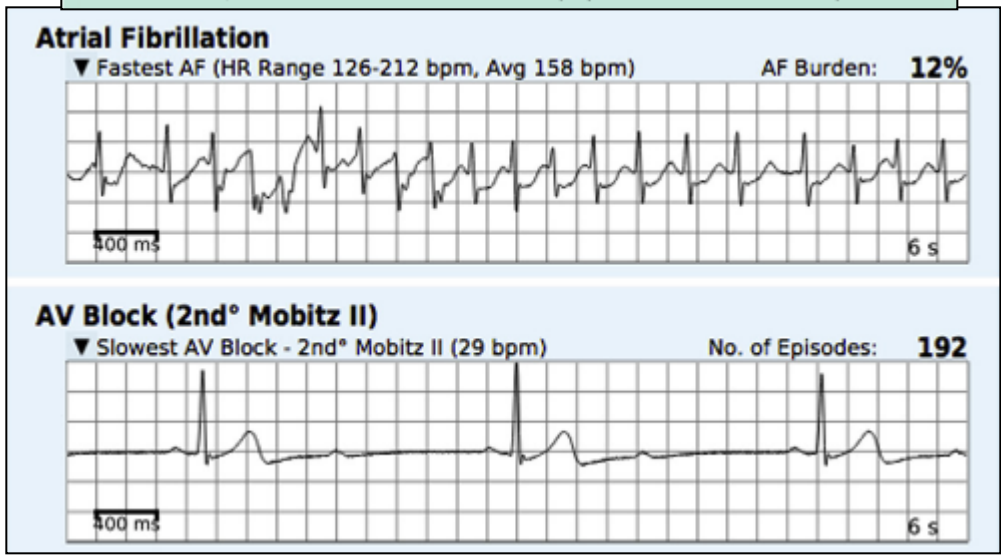
Figure 1 The Zio Patch (iRhythm Technologies, Inc, San Francisco, Calif) is an FDA-cleared, single-use, noninvasive, water-resistant, 14-day, ambulatory ECG monitoring adhesive patch.

Table 1 Total Wear Time for Both Devices (Holter 24 Hours, Zio Patch [iRhythm Technologies, Inc, San Francisco, Calif] Up to 14 Days)

n=146

		Holter Any 6 (24 h)	
		No	At least 1
Patch any 6 (total wear time)	No	49	1
	Yes	36	60

Any arrhythmias (of the 6 types → atrioventricular block, pause, polymorphic ventricular tachycardia, supraventricular tachycardia, ventricular tachycardia, or atrial fibrillation) (McNemar's $P < .001$).



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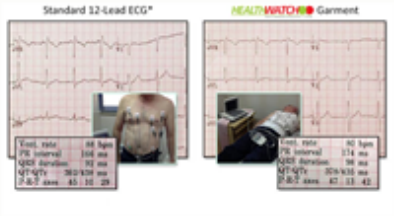
hWear Digital Garments

Comfort. Quality. Safety.

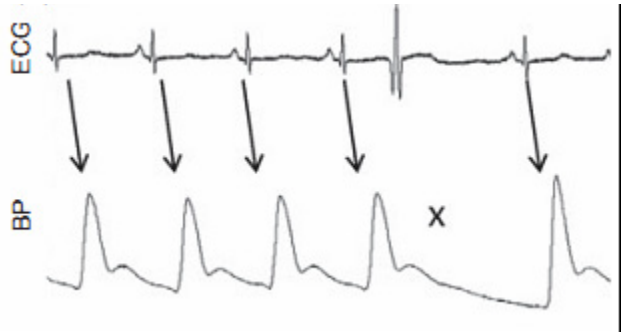
Digital, heart-sensing, seamless **garments** incorporating interwoven **textile electrodes** for continuous monitoring in the hospital, at home, for fitness or health. Compare the signal **quality** for yourself:



These "wear-and-forget" garments provide **3-to-15 lead ECGs** without adhesives or shaving preparations for both men and women.

hWear™ garments are **machine washable** (warm wash, tumble dry, no softeners), compatible with most cardiac telemetry systems, safe for use under electrical cardioversion, and CE/FDA registered.

Smartphone/smartwatch heart rate monitor



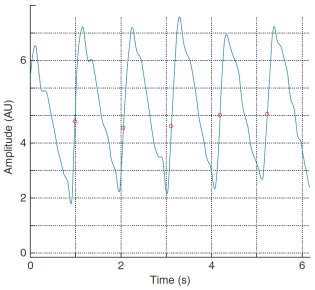
Smart detection of atrial fibrillation†

Lian Krivoshei[1,4‡], Stefan Weber[2‡], Thilo Burkard[3], Anna Maseli[1], Noe Brasier[1], Michael Kühne[5], David Conen[1], Thomas Huebner[6], Andrea Seeck[6], and Jens Eckstein[1*]

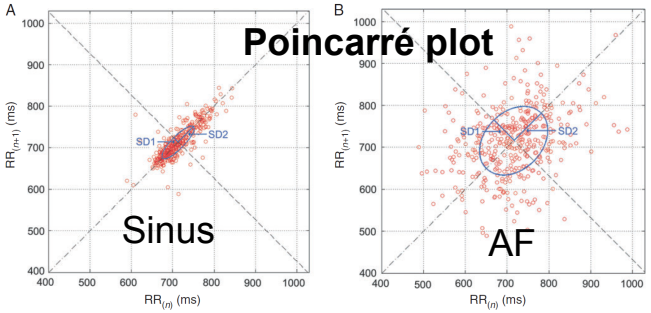
[1]Department of Internal Medicine, Basel University Hospital, Petersgraben 4, Basel 4031, Switzerland; [2]Department of Internal Medicine, University Hospital Regensburg, Franz-Josef-Strauß-Allee 11, Regensburg 93053, Germany; [3]Medical Outpatient Clinic, Basel University Hospital, Petersgraben 4, Basel 4031, Switzerland; [4]Department of Cardiology, Bern University Hospital, Freiburgstrasse 10, Bern 3010, Switzerland; [5]Department of Cardiology, Basel University Hospital, Petersgraben 4, Basel 4031, Switzerland; and [6]Preventicus GmbH, Tatzendpromenade 2, Jena 07745, Germany

Europace 2016 *in press*

iPhone 4S



Bandpass filter 0.5-7 Hz
Algorithm based on frequency and waveform analysis



	SR (mean ± SD)	AF (mean ± SD)	P-value	AUC	Sensitivity (%)	Specificity (%)
Method 1 2-min						
nRMSSD	0.103 ± 0.093	0.298 ± 0.121	<0.001	0.892	50	95
ShE	3.858 ± 0.711	5.350 ± 0.825	<0.001	0.912	85	95
nRMSSD + **ShE**	–	–	–	0.917	82.5	95
Method 2 2-min + filter						
nRMSSD	0.034 ± 0.026	0.146 ± 0.067	<0.001	0.938	87.5	95
ShE	3.710 ± 0.643	5.007 ± 0.790	<0.001	0.911	77.5	95
nRMSSD + **ShE**	–	–	–	0.926	87.5	95
Method 3 5-min + filter						
nRMSSD	0.039 ± 0.026	0.154 ± 0.070	<0.001	0.942	77.5	95
ShE	4.030 ± 0.697	5.187 ± 0.885	<0.001	0.872	57.5	95
SD1/SD2	0.447 ± 0.202	0.757 ± 0.141	<0.001	0.903	77.5	90
nRMSSD + **ShE**	–	–	–	0.966	80	95
ShE + SD1/SD2	–	–	–	0.959	50	95
nRMSSD + **SD1**/SD2	–	–	–	0.931	95	95

Handheld ECG recorders

Lohmann tech AFibAlert®
AF detection + feedback
45s ECG. 95% accuracy (unpublished)
USA, FDA
249 USD

Dimitek ®
Various models
China

HeartCheck ®
Canada, FDA
ECG interpretation (12.50USD in 24h)
259 USD

Reka E 100®
Singapore, FDA + CE

DailyCare® InstantCheck
Taiwan, FDA + CE

Creative Medical ® PC-80BT
China, FDA+CE
100Euros

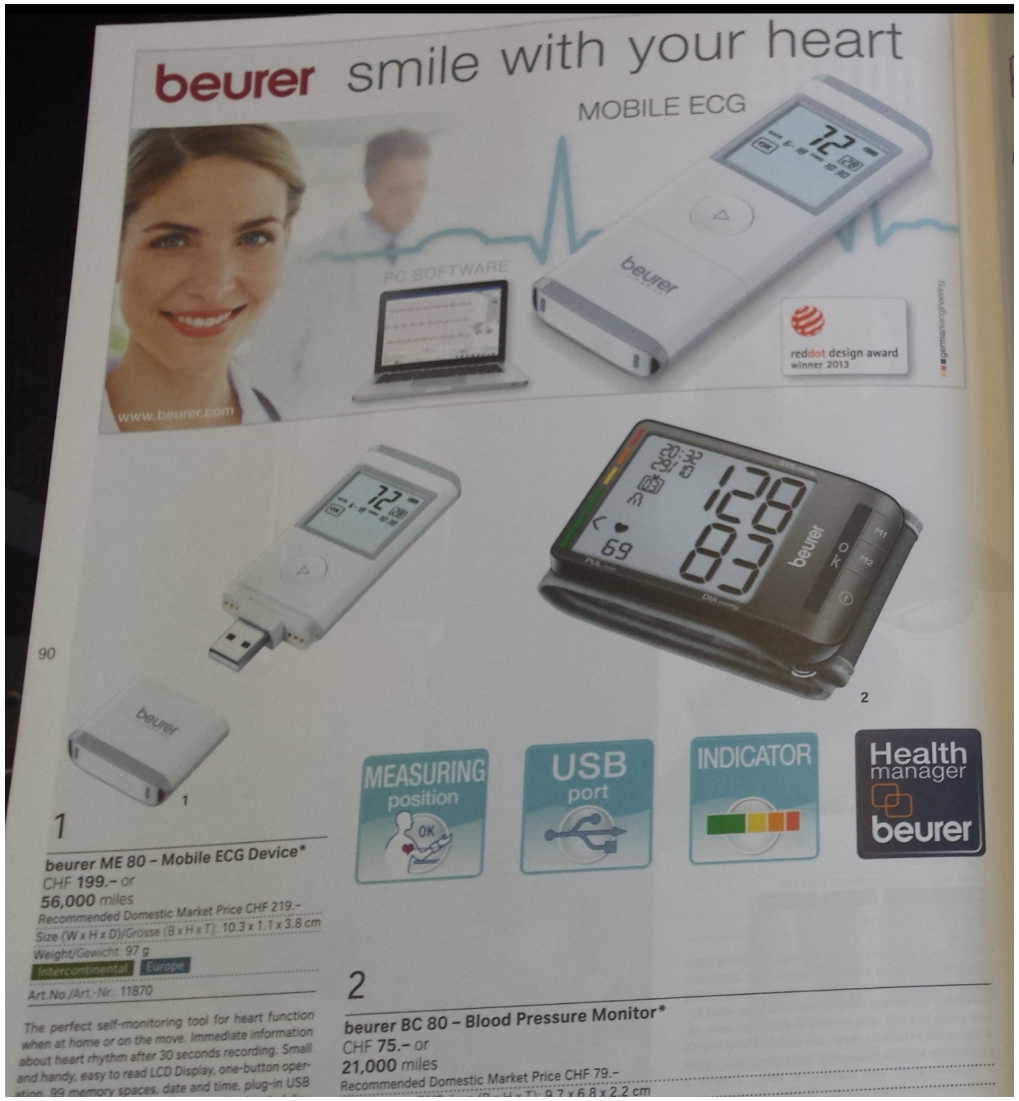
CardiacDesigns®ECGCheck
USA
AF detection + feedback
139 USD

Zenicor®
Sweden

MyDiagnostick®
Holland

Beurer® ME 80/90
Germany
170 Euros

AliveCor ® Kardia
USA
99 USD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MOBILE ECG
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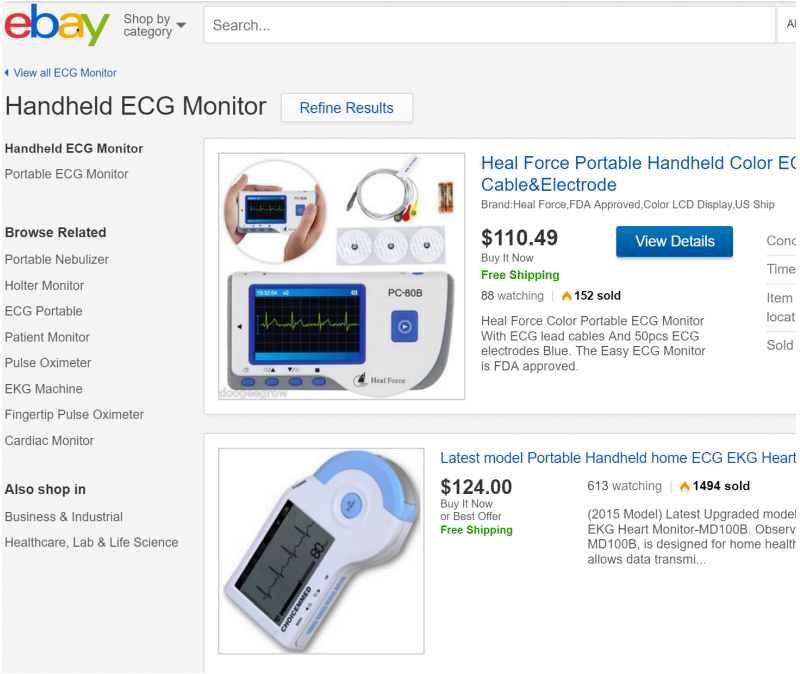
www.beurer.com
reddot design award winner 2013
MEASURING position
USB port
INDICATOR
Health manager
beurer
1
beurer ME 80 – Mobile ECG Device*
CHF 199.– or
56,000 miles
Recommended Domestic Market Price CHF 219.–
Size (W x H x D)/Grösse (B x H x T): 10.3 x 1.1 x 3.8 cm
Weight/Gewicht: 97 g
Intercontinental
Europe
Art.No./Art.-Nr.: 11870
The perfect self-monitoring tool for heart function when at home or on the move. Immediate information about heart rhythm after 30 seconds recording. Small and handy, easy to read LCD Display, one-button operation, 99 memory spaces, date and time, plug-in USB
2
beurer BC 80 – Blood Pressure Monitor*
CHF 75.– or
21,000 miles
Recommended Domestic Market Price CHF 79.–

amazon

fnac


ebay
Shop by category
Search...
View all ECG Monitor
Handheld ECG Monitor
Refine Results
Handheld ECG Monitor
Portable ECG Monitor
Browse Related
Portable Nebulizer
Holter Monitor
ECG Portable
Patient Monitor
Pulse Oximeter
EKG Machine
Fingertip Pulse Oximeter
Cardiac Monitor
Also shop in
Business & Industrial
Healthcare, Lab & Life Science
Heal Force Portable Handheld Color EC Cable&Electrode
Brand:Heal Force,FDA Approved,Color LCD Display,US Ship
$110.49
Buy It Now
Free Shipping
View Details
88 watching | 152 sold
Heal Force Color Portable ECG Monitor With ECG lead cables And 50pcs ECG electrodes Blue. The Easy ECG Monitor is FDA approved.
PC-80B
Latest model Portable Handheld home ECG EKG Heart
$124.00
Buy It Now
or Best Offer
Free Shipping
613 watching | 1494 sold
(2015 Model) Latest Upgraded model EKG Heart Monitor-MD100B. Observ MD100B, is designed for home health allows data transmi...

SMART Monitoring

With HeartCheck™ SMART Monitoring, you can enjoy the peace of mind of having your heart rhythm analyzed and interpreted by a physician, ECG Coordinating Centre, or both, at any time from anywhere in the world with an internet connection*

Using the HeartCheck™ PEN device, simply take heart readings the moment you feel any symptoms.

Using the USB cable provided, connect the device to your PC and run GEMS™ Home to upload your heart rhythm files containing your ECGs to a physician or ECG Coordinating Centre.

Once uploaded, a physician, ECG Coordinating Centre technician, or both, will view and analyze the results of your ECG and heart rhythms.

The ECG Coordinating Centre or physician will create an ECG report on your heart analysis identifying any potential issues. The report will be made available on your PC through the GEMS™ Home application.

SMART Monitoring Rates

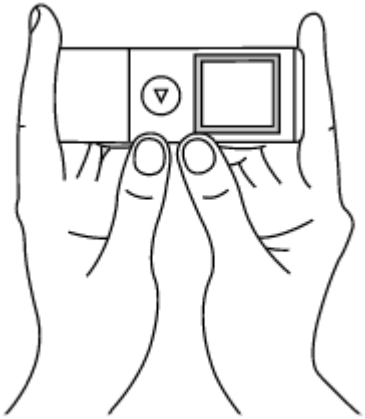
READINGS IN UNDER ONE HOUR.

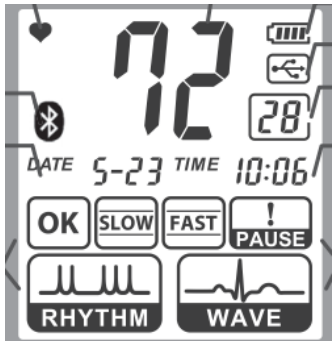
ECG Review and Report:	USD$ 4.99

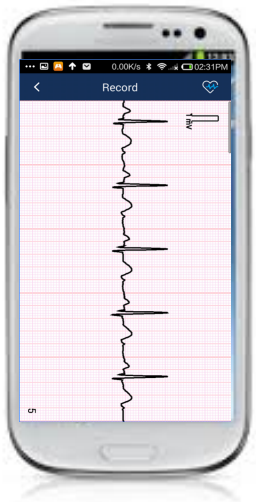
INTERPRETATIONS WITHIN 24 HOURS.

ECG interpretation by Physician:	USD$ 12.50

Beurer ME 90

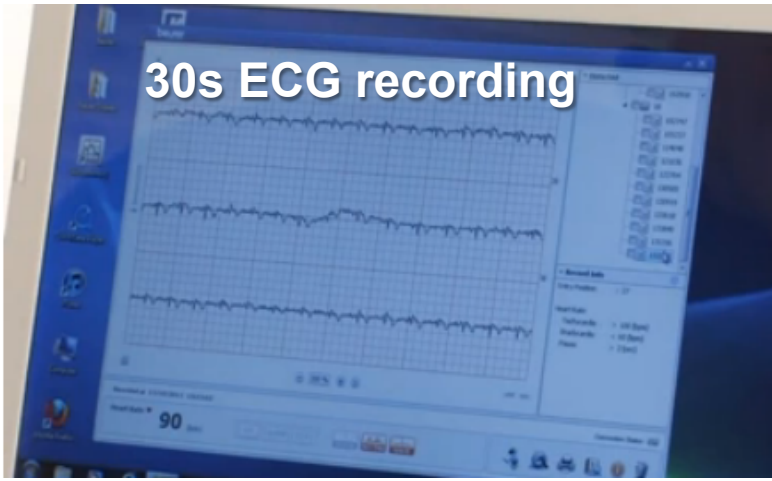






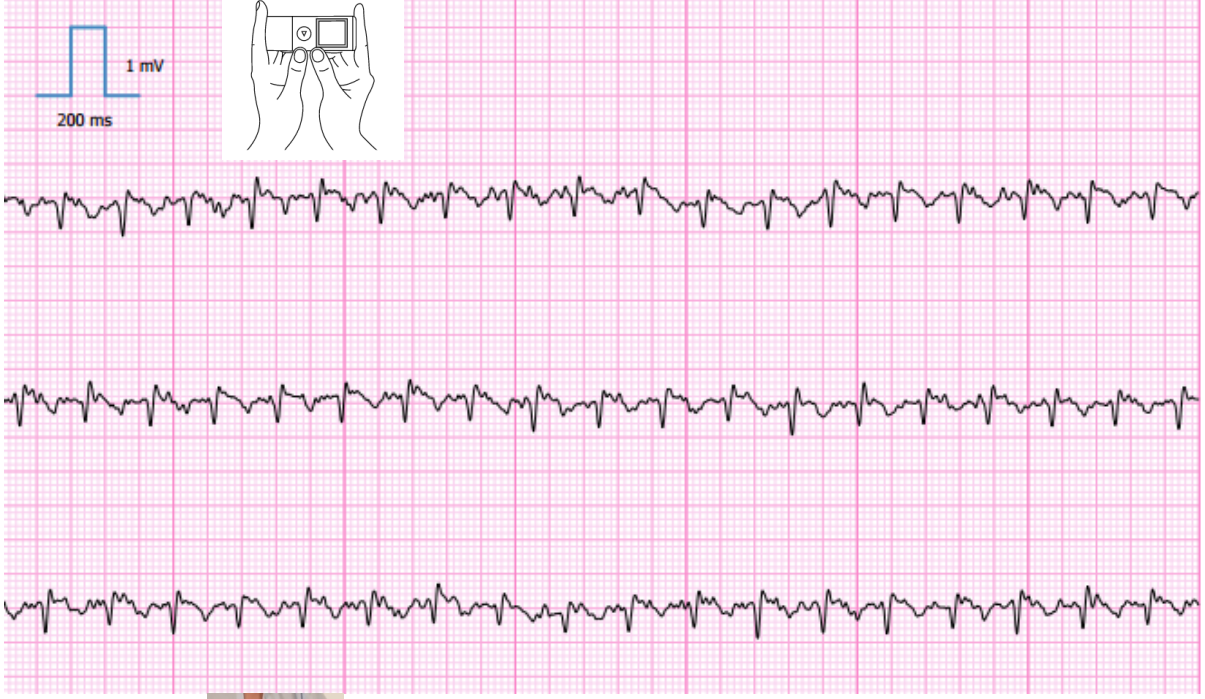
CardioExpert

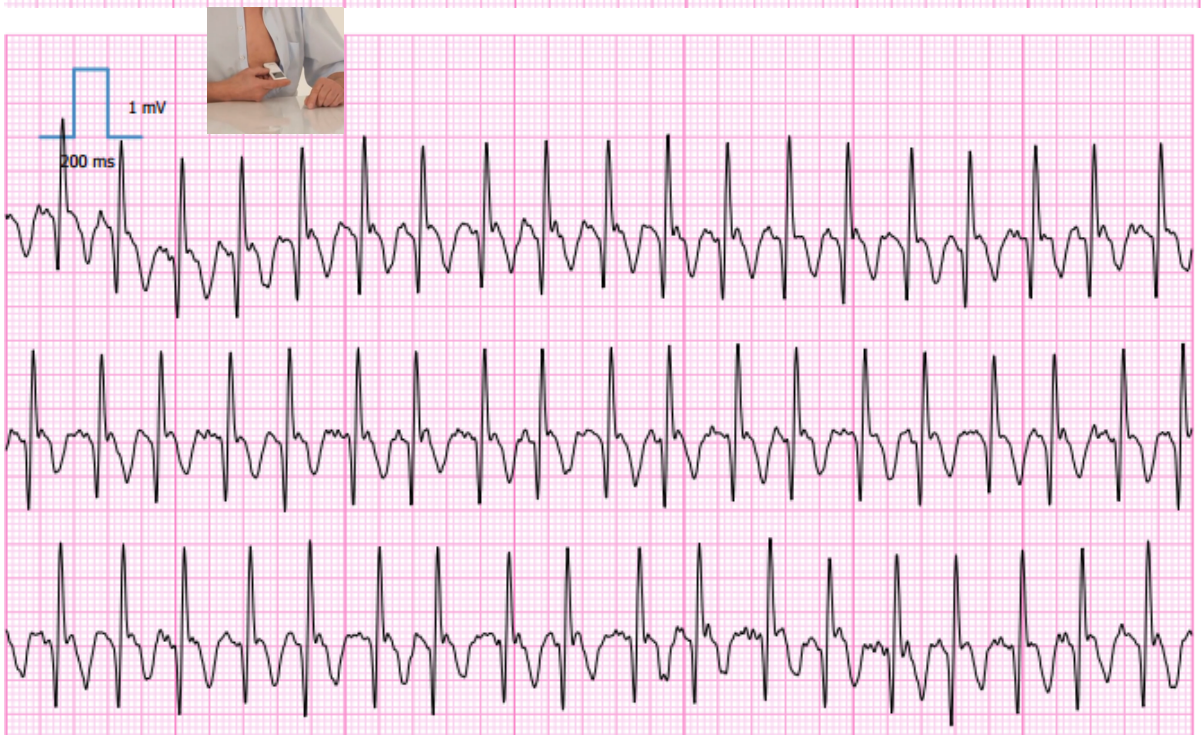
AFIB + PVC detection



58 yr old male
Scheduled for AT ablation
Complains of palpitations during several hours (AF?)

Recording during palpitations which lasted 2 hours





Zenicor thumb ECG

30s ECG transferred via mobile network to online server.
Automated analysis *(data on accuracy are pending)*

Hendrikx *et al. BMC Cardiovascular Disorders* 2014, **14**:41
http://www.biomedcentral.com/1471-2261/14/41

BMC Cardiovascular Disorders

RESEARCH ARTICLE Open Access

Intermittent short ECG recording is more effective than 24-hour Holter ECG in detection of arrhythmias

Tijn Hendrikx[1*], Mårten Rosenqvist[2], Per Wester[3], Herbert Sandström[1] and Rolf Hörnsten[4]

EUROPEAN SOCIETY OF CARDIOLOGY®

Europace (2012) **14**, 1112–1116
doi:10.1093/europace/eur431

CLINICAL RESEARCH
Atrial Fibrillation

Improved screening for silent atrial fibrillation after ischaemic stroke

Piotr Doliwa Sobocinski[1]*, Elisabeth Änggårdh Rooth[2], Viveka Frykman Kull[1], Magnus von Arbin[2], Håkan Wallén[1], and Mårten Rosenqvist[3,4]

249 ischemic stroke pts without known AF
10s ECG 2x/d + symptoms for 30d + 1x24h Holter
AF in 6.8% pts (13/15 pts with handheld ECG)

Mass Screening for Untreated Atrial Fibrillation
The STROKESTOP Study

Emma Svennberg, MD; Johan Engdahl, MD, PhD; Faris Al-Khalili, MD, PhD; Leif Friberg, MD, PhD; Viveka Frykman, MD, PhD; Mårten Rosenqvist, MD, PhD

Circulation. 2015;131:2176-2184.

7173 Swedish pts aged 75-76yrs
30s ECG 2x/d + symptoms for 2 weeks
ECG analyzed by nurses + check by physician
Prevalence of AF 12.3% pts
Unknown AF in 3% pts

AliveCor™
Mobile Heart Monitor

Kardia
Alive Cor

30s ECG

Acoustic transmission to smartphone microphone at 19'000 Hz

FDA and CE approved

AF detection algorithm (P-wave detection + RR stability)

- 204 pts , Kardia vs 12 lead ECG
  98% sensitivity, 97% specificity and accuracy of 97%
  Lau JK, Int J Cardiol 2013;165:193-212

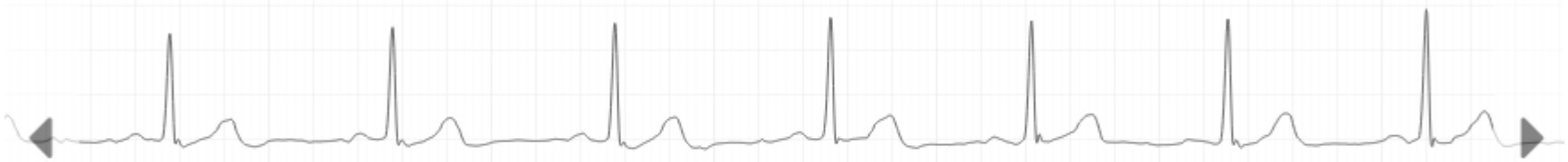
AliveCor™
Mobile Heart Monitor

AliveCor Kardia Band

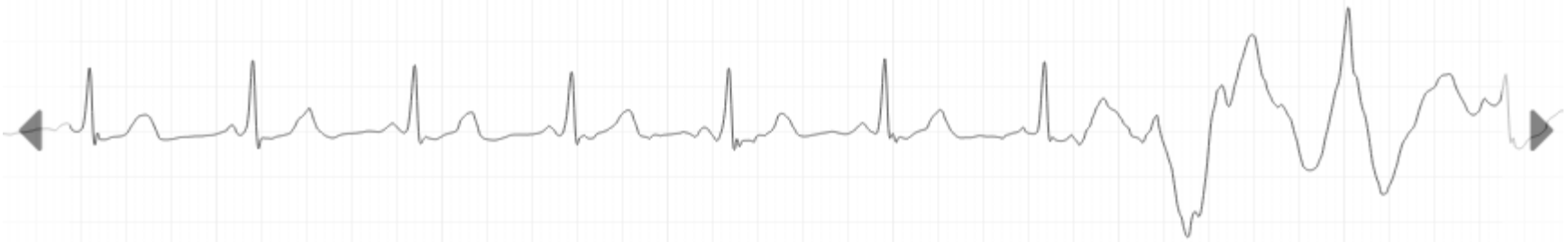
Apple watch

AliveCor™
Mobile Heart Monitor

25.0mm/s Paper speed **10.0mm/mV** Gain **11 seconds** Duration



25.0mm/s Paper speed **10.0mm/mV** Gain **30 seconds** Duration



Surface 12 lead electrocardiogram recordings using smart phone technology

Giselle A. Baquero, MD [a] ... MD, [b] Shameer Ahmed, MD, [a] ... y C. Luck, MD [a,*]

Feasibility and cost-effectiveness of stroke prevention through community screening for atrial fibrillation using iPhone ECG in pharmacies

The SEARCH-AF study

Nicole Lowres[1,2,3]; Lis Neube... Tom Briffa[9]; Adrian Bauma... S. Ben Freedman[1,2,3]

... Bennett[7,8]; ... ulkeld[6]; Ines Krass[7] ... Christopher ...

Wireless Smartphone ECG Enables Large-Scale Screening in Diverse Populations

ZACHARY C. HABERMAN, B.A., RYAN T. JAHN, B.A., RUPAN BOSE, M.B., HAN TUN, M.P.H., M.B.B.S., JEROLD S. SHINBANE, M.D., RAHUL N. DOSHI, M.D., PHILIP M. CHANG, M.D., and LESLIE A. SAXON, M.D.

From the Keck School of Medicine of USC, Los Angeles, California, USA

iPhone ECG application for community screening to detect silent atrial fibrillation: A novel technology to prevent stroke

Jerrett K. Lau [a], Nicole Lowres [a,b], Lis Neubeck [b,c,d], David B. Brieger [a,c], Raymond W. Sy [a], Connor D. Galloway [e], David E. Albert [e], Saul B. Freedman [a,b,*]

[a] Concord Hospital Department of Cardiology, University of Sydney, Australia
[b] Anzac Research Institute, University of Sydney, Australia
[c] George Institute, Sydney, Australia
[d] Sydney Nursing School, University of Sydney, Australia
[e] AliveCor, Oklahoma City, USA

Using a novel wireless system for monitoring patients after the atrial fibrillation ablation procedure: The iTransmit study CP

Khaldoun G. Tarakji, MD, MPH, FHRS, Oussama M. Wazni, MD, FHRS, Thomas Callahan, MD, FHRS, Mohamed Kanj, MD, Ali H. Hakim, ... Bruce L. Wilkoff, MD, FHRS, Walid Saliba, MD, FHRS, Bruce D. Lir...

Performance of handheld electrocardiogram devices to detect atrial fibrillation in a cardiology and geriatric ward setting

Lien Desteghe[1,2*], Zina Raymaekers[1], Mark Lutin[3], Johan Vijgen[2], Dagmara Dilling-Boer[2], Pieter Koopman[2], Joris Schurmans[2], Philippe Vanduynhoven[2], Paul Dendale[1,2], and Hein Heidbuchel[1,2]

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Europace 2017 *in press*

MyDiagnostick

AliveCor

7% of patients excluded because unable to use the device
4% of tracings of too poor quality for manual interpretation

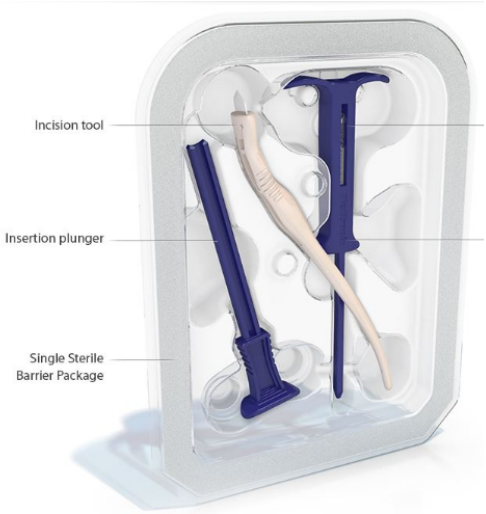
Table 1 Performance of both devices for atrial fibrillation screening at the cardiology ward, based on automated analysis and manual interpretation by both electrophysiologists

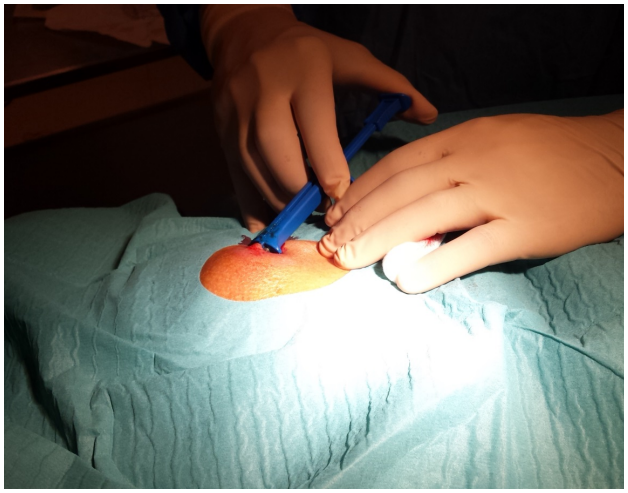
	True-positive (*n*)	False-negative (*n*)	False-positive (*n*)	True-negative (*n*)	Illegible (*n*)	Sensitivity[a] (%)	Specificity[a] (%)	PPV (%)	NPV (%)	Kappa (κ)
MyDiagnostick										
PM/ICD patients excluded ($n = 265$)										
Automated algorithm vs. 12-lead ECG	18	4	14	229	–	**81.8**	94.2	56.3	98.3	0.63
Electrophysiologist 1 vs. 12-lead ECG	17	3	11	226	8	77.3	93.0	60.7	98.7	0.58
Electrophysiologist 2 vs. 12-lead ECG	16	4	4	233	8	72.7	**95.9**	80.0	98.3	**0.65**
AliveCor										
PM/ICD patients excluded ($n = 265$)										
Automated algorithm vs. 12-lead ECG	12	10	6	237	–	54.5	**97.5**	66.7	96.0	0.57
Electrophysiologist 1 vs. 12-lead ECG	20	0	5	230	10	**90.9**	94.7	80.0	100.0	0.71
Electrophysiologist 2 vs. 12-lead ECG	20	2	3	234	6	**90.9**	96.3	87.0	99.2	**0.76**

AF missed by algorithms and manual interpretation
55% sensitivity with automatic AliveCor algorithm

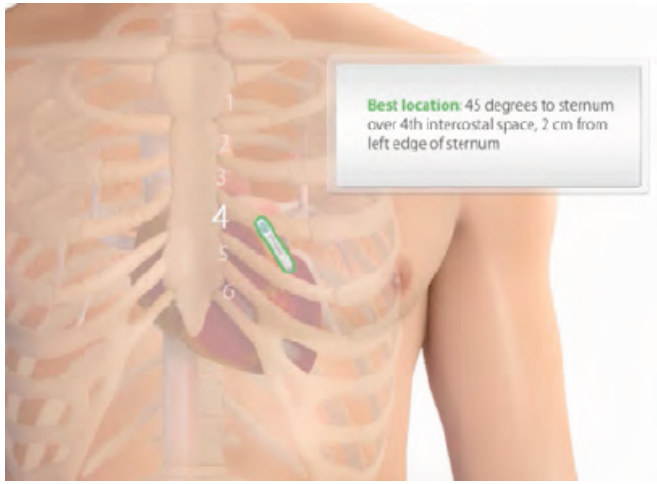
Best values for sensitivity, specificity and kappa values are displayed in bold.
ECG, electrocardiogram; ICD, implantable cardioverter defibrillator; NPV, negative predictive value; PM, pacemaker; PPV, positive predictive value.
[a]Unreadable recordings are taken into account when calculating the sensitivity and specificity.

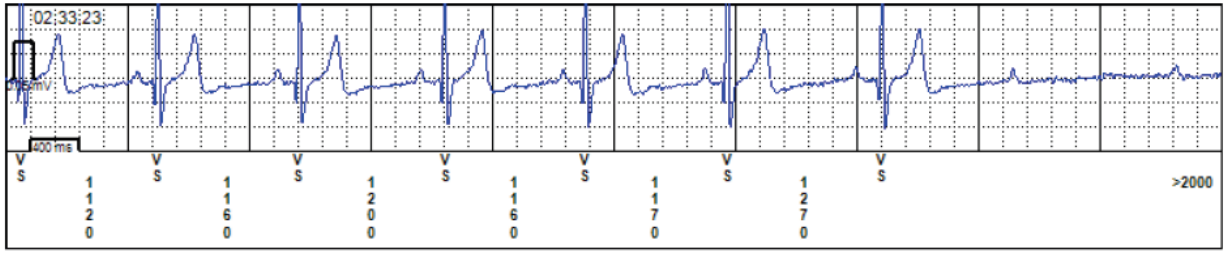
Implantable loop recorder

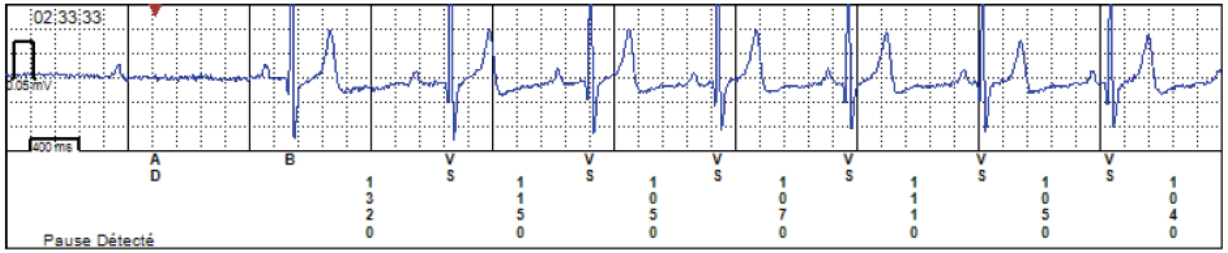


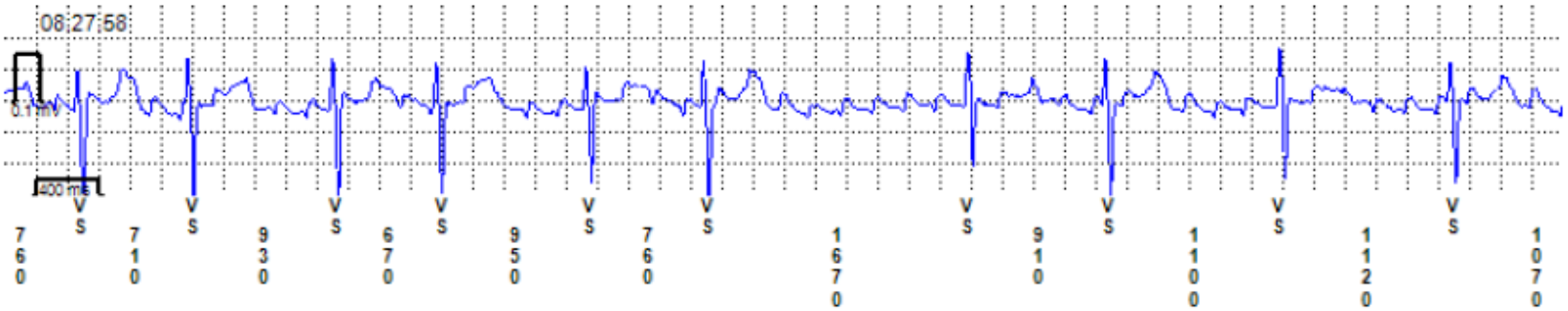


- 59 min of storage
- Automatic daily remote transmission
- Projected Longevity: 3 years
- MRI conditional: 1.5 & 3.0 T









FA la plus longue (90 jours derniers) :*(ID n° 61) 16-Apr-2014, Durée : 01:44:00*

Europace (2009) 11, 671–687
doi:10.1093/europace/eup097

EHRA POSITION PAPER

Indications for the use of diagnostic implantable and external ECG loop recorders

Task Force members: Michele Brignole (Chairperson), Lavagna, Italy; Panos Vardas (Co-chairperson), Herakleion, Greece; Ellen Hoffman, Munich, Germany; Heikki Huikuri, Oulu, Finland; Angel Moya, Barcelona, Spain; Renato Ricci, Rome, Italy; Neil Sulke, Eastbourne, UK; Wouter Wieling, Amsterdam, The Netherlands

EHRA Scientific Documents Committee: Angelo Auricchio (Chairperson), Lugano, Switzerland; Gregory Y.H. Lip, Birmingham, UK; Jesus Almendral, Madrid, Spain; Paulus Kirchhof, Muenster, Germany; Etienne Aliot, Nancy, France; Maurizio Gasparini, Milan, Italy; Frieder Braunschweig, Stockholm, Sweden

Document Reviewers: Gregory Y.H. Lip, Birmingham, UK; Jesus Almendral, Madrid, Spain; Paulus Kirchhof, Muenster, Germany; Gian Luca Botto, Como, Italy

Severe, infrequent palpitations
Cryptogenic stroke

Recommendations

Indications for ILRs and ELRs in patients with syncope

ILRs

Class I. ILR is indicated:

- In an early phase of evaluation of patients with recurrent syncope of uncertain origin who have:
  - –absence of high-risk criteria that require immediate hospitalization or intensive evaluation, i.e. those listed in the *Table 5*; and
  - –a likely recurrence within battery longevity of the device *(Level of evidence A)*
- In high-risk patients in whom a comprehensive evaluation (that listed in *Table 5*) did not demonstrate a cause of syncope or lead to specific treatment *(Level of evidence B)*

Class II A. ILR may be indicated:

- To assess the contribution of bradycardia before embarking on cardiac pacing in patients with suspected or certain neurally mediated syncope presenting with frequent or traumatic syncopal episodes *(Level of evidence B)*

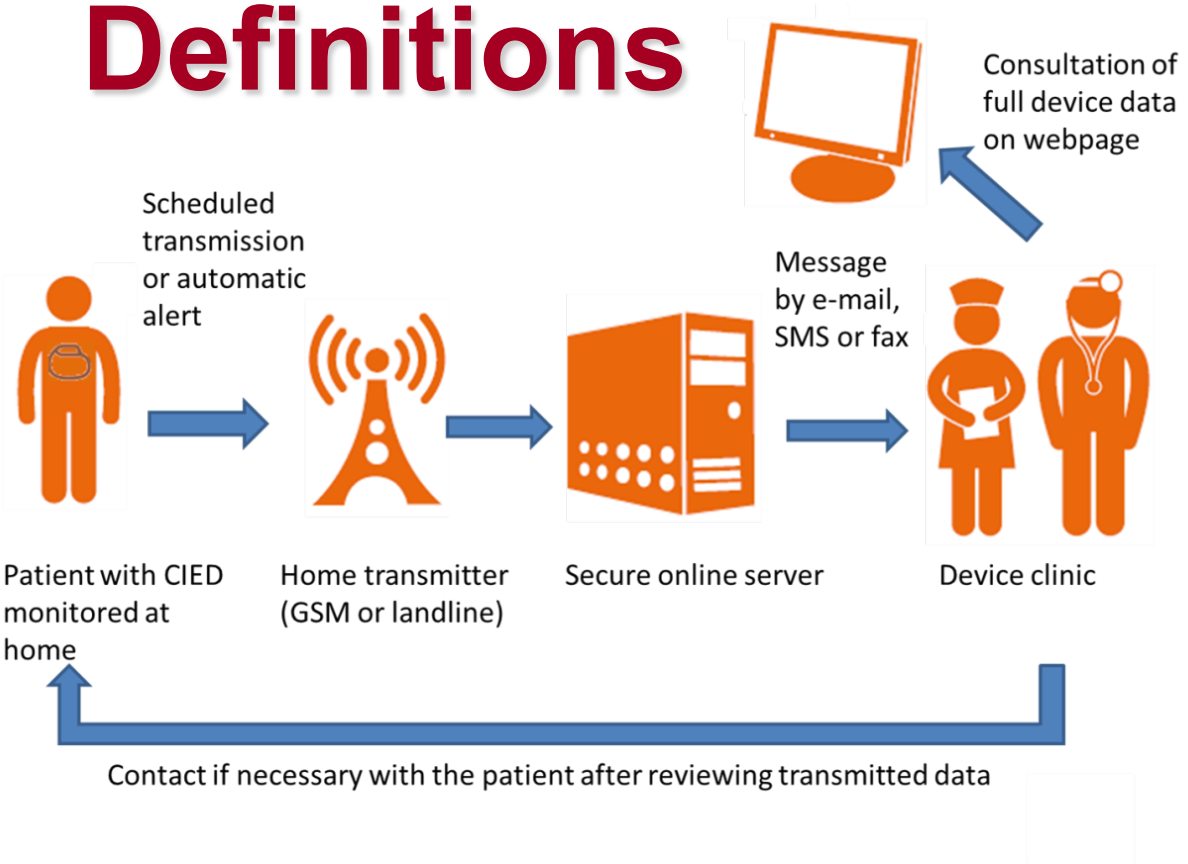
Class II B. ILR may be indicated:

- In patients with T-LOC of uncertain syncopal origin in order to definitely exclude an arrhythmic mechanism *(Level of evidence C)*

Cardiologie connectée

- Moniteurs de pression/poids
- Moniteurs de rythme
- Stimulateurs cardiaques / DAI

Definitions



- ***Remote follow-up***: full remote device interrogation at scheduled intervals
- ***Remote monitoring***: unscheduled transmission of pre-defined alert events
- ***Patient-initiated follow-up:*** non-scheduled interrogations as a result of a patient experiencing a real or perceived clinical event

Medtronic

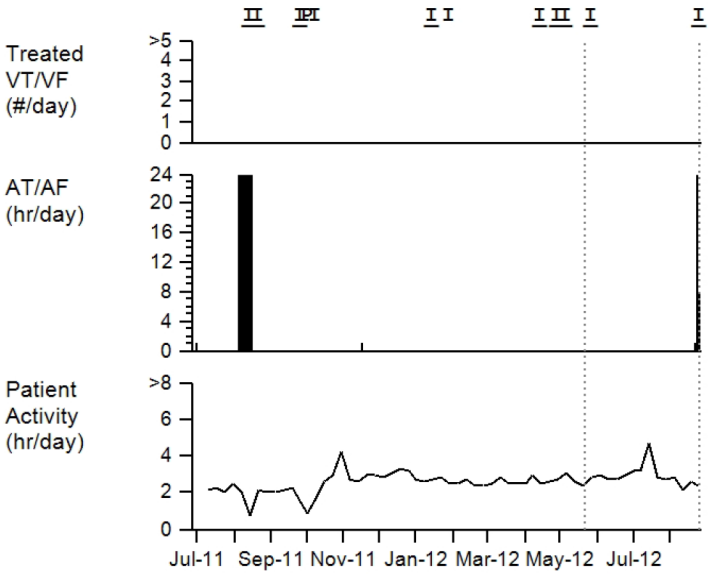
Comments and Notes

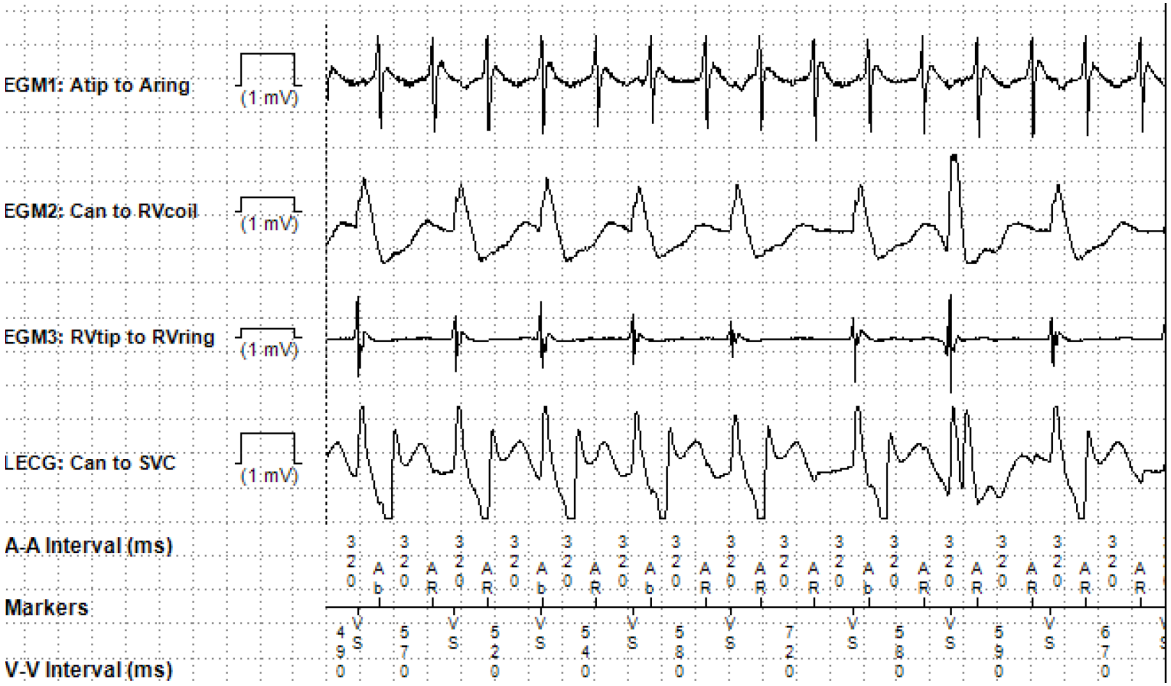
Device: Protecta™ XT CRT-D D354TRG Serial Number: PSF600909S Date of Interrogation: 26-Aug-2012 08:01:19

Patient: PitAla, 160448 ID: 4P 010

Received: 26-Aug-2012 08:01

Event Summary: Wireless Alert, Patient Alert, AT/AF Daily Burden > Threshold, Capture Management Warning, 366 V. Sensing Episodes, 38 hours in AT/AF Since Last Session





Home Monitoring Service Center - 3.19.0 07/07/12 - Mozilla Firefox

Fichier Édition Affichage Historique Marque-pages Outils ?

Informations générales sur le Wake S... | Patient MerGil,050145: Nouveau résul... | Home Monitoring Service Center - 3....

biotronik-homemonitoring.com https://www.biotronik-homemonitoring.com/hmsc_guiWeb/patient/monitoring/DisplayPatientContext.jsf?PatientIdentifier=60421243_6(

BIOTRONIK Home Monitoring Service Center

Vue de l'historique

- Statut précédent
- Statut suivant
- Historique
- Statut actuel

Historique patient de: MerGil,050145

Madame Gilda MERCANTI, DdN 5 janv. 1945

Statut le 19 août 2012 09:16

Lumax 540 HF-T / NS: 60421243
Implantation: 2 sept. 2008

Statut | Réglages | Enregistrements | Historique | Profil du patient | Options

Exporter | Sauvegarder/imprimer (PDF)

Résumé | Appareil implanté | Sonde | Brady/CRT | Arythmie atr. | Arythmie vent. | Param. physiol. | Moniteur IC

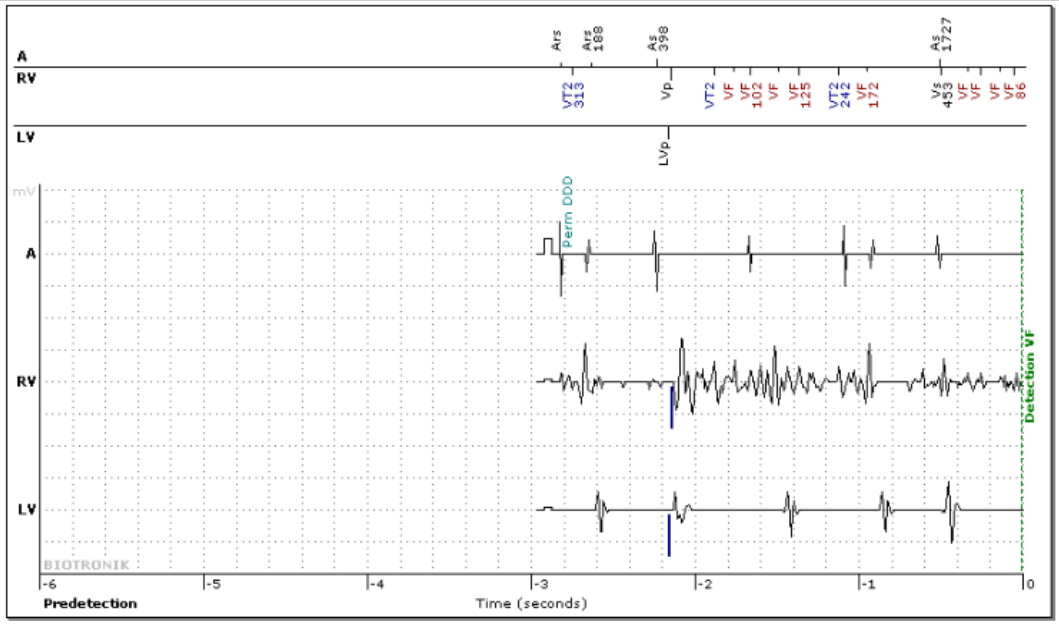
Arythmie vent.	**Choc(s) à énergie max. inefficace(s)** 1 choc(s) à énergie max. inefficace entre le 19 août 2012 00:55:36 et le 19 août 2012 07:05:06		Nouveau.
	FV classifiée 1 FV classifiée entre le 19 août 2012 00:55:36 et le 19 août 2012 07:05:06		Nouveau.
Enregistrements / Episode	**Episode ventr. avec 2 chocs démarrés ou plus** FV épisode classifié le 19 août 2012 07:03:32 - Il contenait 2 chocs délivrés et 1 annulés		Nouveau.
	EGM p EGM p		
	Détails Détails classifi		
Remarque	Suivi re		

Quick View

Afficher Quick View

Historique

IEGM



2013 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy

The Task Force on cardiac pacing and resynchronization therapy of the European Society of Cardiology (ESC). Developed in collaboration with the European Heart Rhythm Association (EHRA).

Recommendations	Class [a]	Level [b]	Ref. [c]
Device-based remote monitoring should be considered in order to provide earlier detection of clinical problems (e.g. ventricular tachyarrhythmias, atrial fibrillation) and technical issues (e.g. lead fracture, insulation defect).	IIa	A	174–176

HRS Expert Consensus Statement on remote interrogation and monitoring for cardiovascular implantable electronic devices

Heart Rhythm 2015 Jul;12(7):e69-100

	Class of Recommendation	Level of Evidence
A strategy of remote CIED monitoring and interrogation, combined with at least annual IPE, is recommended over a calendar-based schedule of in-person CIED evaluation alone (when technically feasible).	I	A
All patients with CIEDs should be offered RM as part of the standard follow-up management strategy.	I	A
Before implementing RM, it is recommended that each patient be educated about the nature of RM, their responsibilities and expectations, potential benefits, and limitations. The occurrence of this discussion should be documented in the medical record.	I	E
It is recommended that all CIEDs be checked through direct patient contact 2–12 weeks postimplantation.	I	E
It may be beneficial to initiate RM within the 2 weeks of CIED implantation.	IIa	C
All patients with an implantable loop recorder with wireless data transfer capability should be enrolled in an RM program, given the daily availability of diagnostic data.	I	E

Device and Disease Management	Class of Recommendation	Level of Evidence
RM should be performed for surveillance of lead function and battery conservation.	I	A
Patients with a CIED component that has been recalled or is on advisory should be enrolled in RM to enable early detection of actionable events.	I	E
RM is useful to reduce the incidence of inappropriate ICD shocks.	I	B-R
RM is useful for the early detection and quantification of atrial fibrillation.	I	A
The effectiveness of RM for thoracic impedance alone or combined with other diagnostics to manage congestive heart failure is currently uncertain.	IIb	C

J Interv Card Electrophysiol (2012) 34:317–324
DOI 10.1007/s10840-012-9675-4

Patient satisfaction and suggestions for improvement of remote ICD monitoring

Helen Høgh Petersen · Mie Christa Jensen Larsen · Olav Wendelboe Nielsen · Finn Kensing · Jesper Hastrup Svendsen

Table 2 Overview of selected answers to the questionnaire

Questionnaire from 385/1100 patients on CareLink

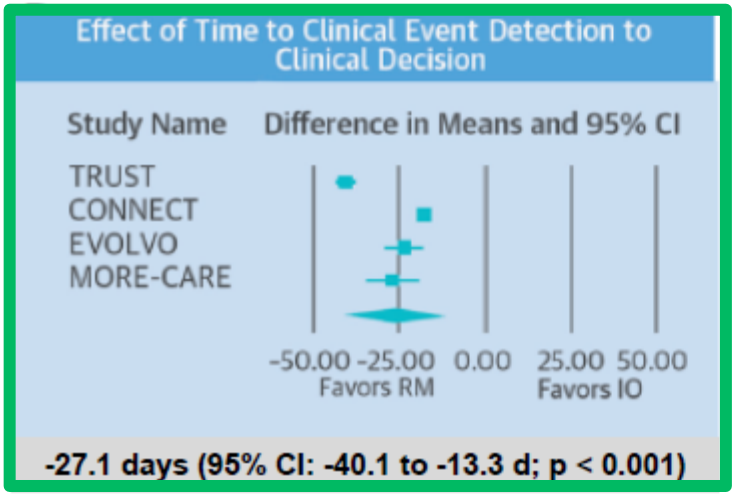
Question	*N*					
Unscheduled transmissions	343	Yes	No			
		28%	72%			
Contentment with remote FU	344	Very content	Content	Less content	Not content	
		65%	30%	3%	2%	
Wish for physician during remote FU	346	Yes	No			
		13%	87%			
Wish for frequency of in-clinic FU	324	Every 6 month	Every 12 month	Every 18 month	Every 24 month	Other
		16%	29%	10%	27%	18%

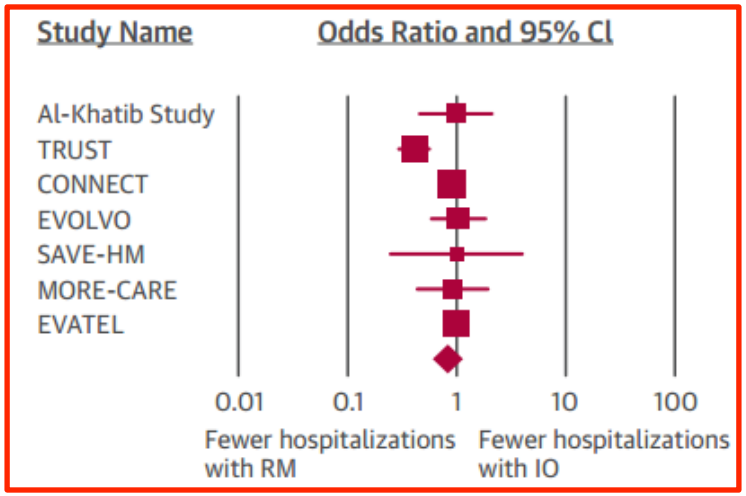
Remote Monitoring of Implantable Cardioverter-Defibrillators

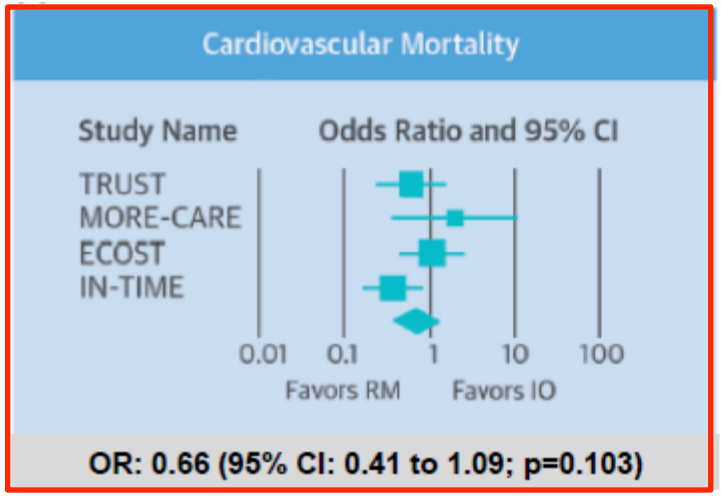
A Systematic Review and Meta-Analysis of Clinical Outcomes

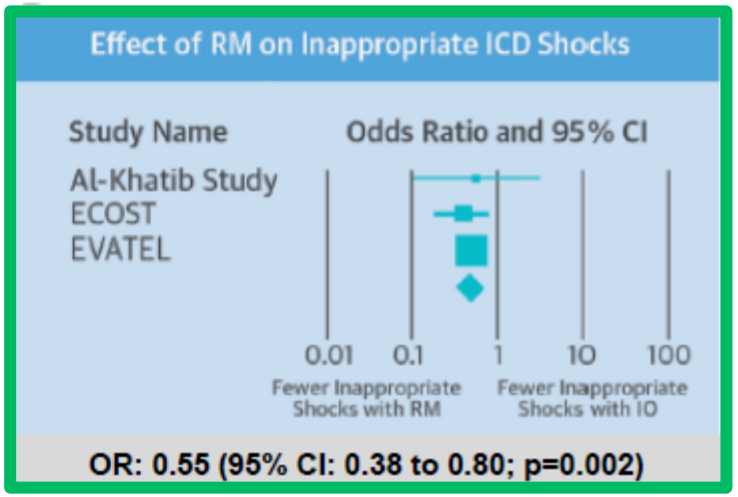
Nirmalatiban Parthiban,*† Adrian Esterman, PhD,‡ Rajiv Mahajan, MD, PhD,* Darragh J. Twomey, MBBS,* Rajeev K. Pathak, MBBS,* Dennis H. Lau, MBBS, PhD,* Kurt C. Roberts-Thomson, MBBS, PhD,* Glenn D. Young, MBBS,* Prashanthan Sanders, MBBS, PhD,* Anand

JACC 2015;65:2591–600









EuroEco

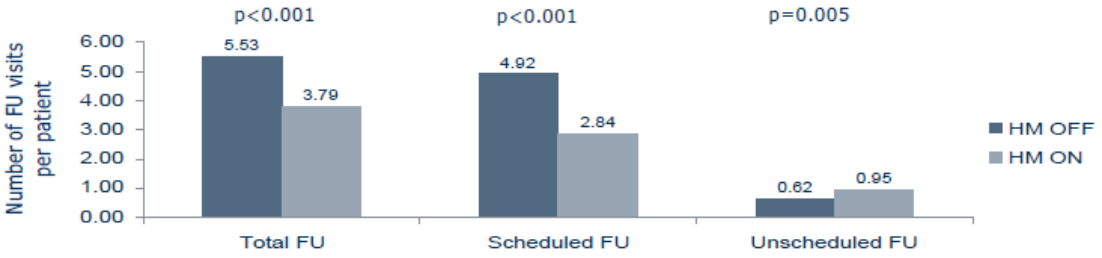
Ressource utilization

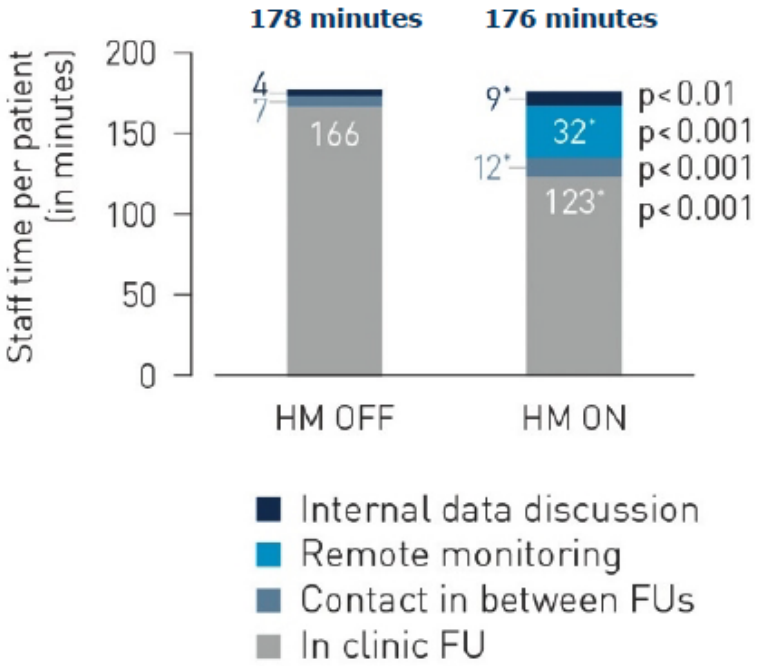
	Ctrs	Pts
DE	4	88
BE	3	87
ES	4	54
UK	3	47
NL	1	25
FI	1	2
	17	303

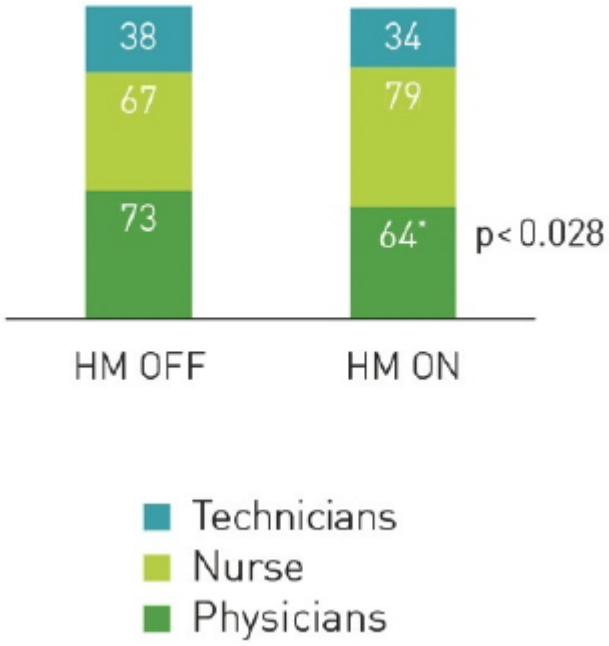
312 ICD VR/DR pts randomized to HM on vs off

In-office visits at 12 + 24 mo in both groups

Additional visits as usual care in HM off group only







Heidbuchel EHJ 2015 14;36(3):158-69

Legal issues

- Physician responsibility
  e.g. delayed response to transmission of a life-threatening event

- Manufacturer responsibility

  Data protection, system maintainance

- Patient responsibility
  System setup, attainability

  ⇨ **Contract between manufacturer and hospital**

  ⇨ **Signed patient informed consent**

Pacemakers and Implantable Cardiac Defibrillators: Software Radio Attacks and Zero-Power Defenses

Halperin et al. 2008 IEEE Symposium on Security and Privacy

Medtronic Maximo DR ICD

	Commercial programmer	Software radio eavesdropper	Software radio programmer
Determine whether patient has an ICD	✔	✔	✔
Determine what kind of ICD patient has	✔	✔	✔
Determine ID (serial #) of ICD	✔	✔	✔
Obtain private telemetry data from ICD	✔	✔	✔
Obtain private information about patient history	✔	✔	✔
Determine identity (name, etc.) of patient	✔	✔	✔
Change device settings	✔		✔
Change or disable therapies	✔		✔
Deliver command shock	✔		✔

TABLE I
RESULTS OF EXPERIMENTAL ATTACKS. A CHECK MARK INDICATES A SUCCESSFUL IN VITRO ATTACK.

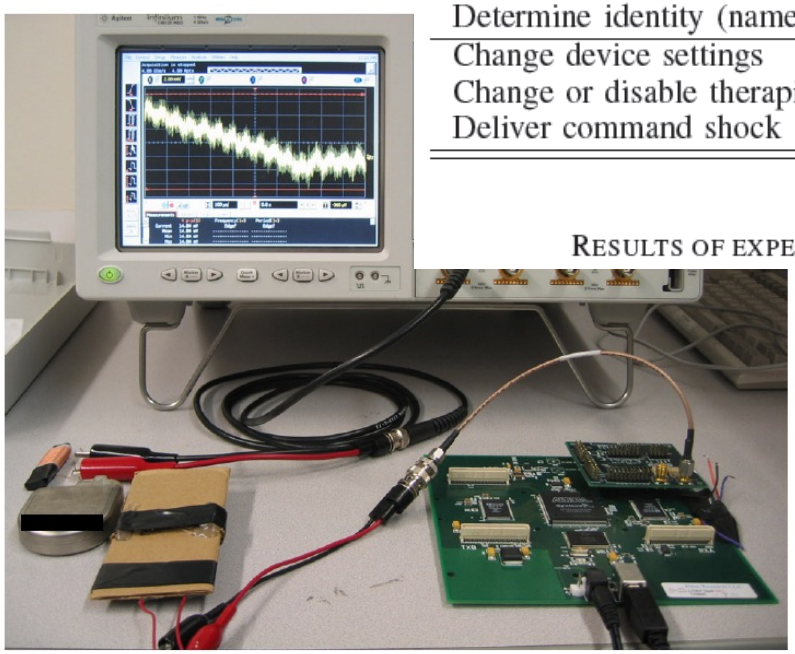
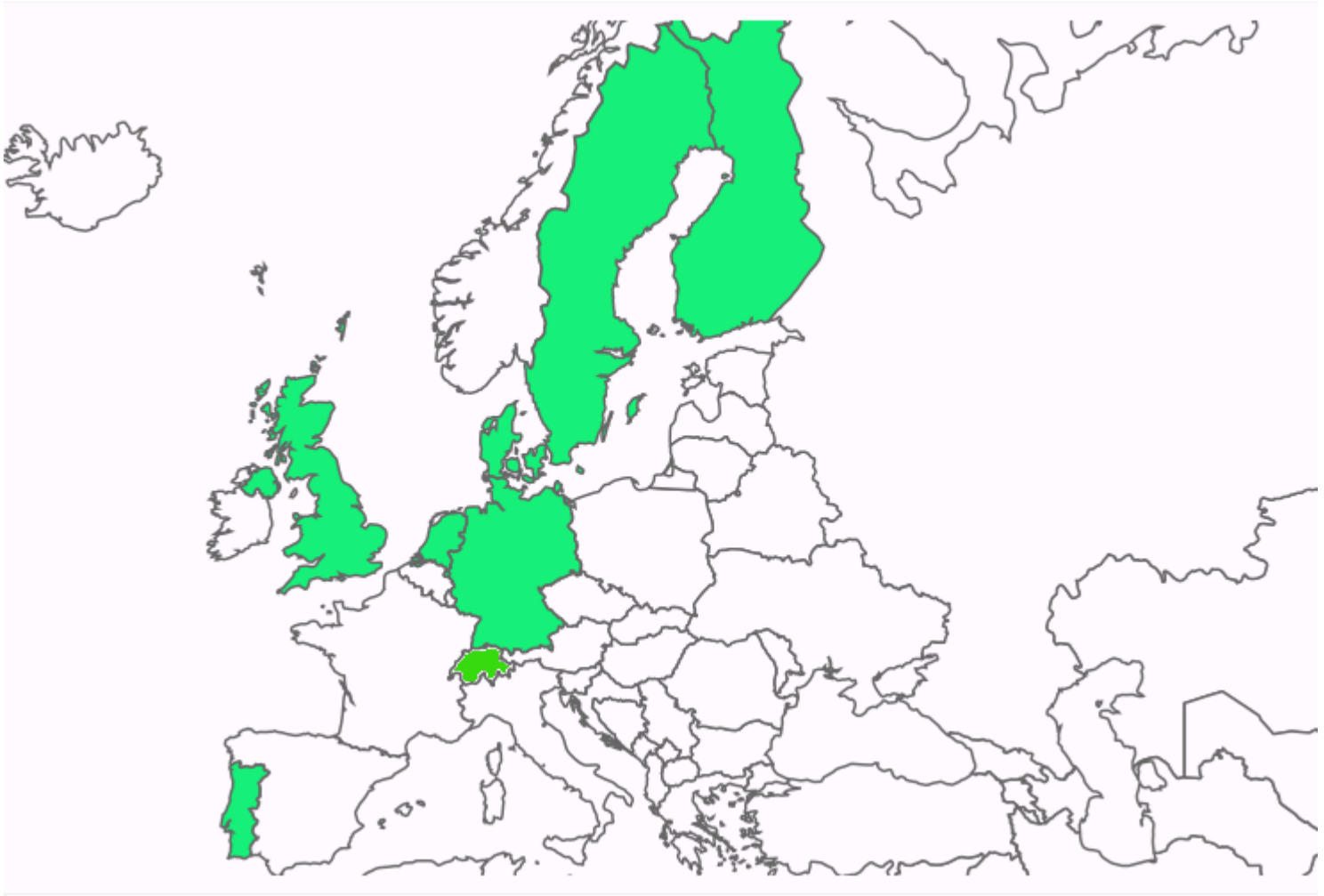
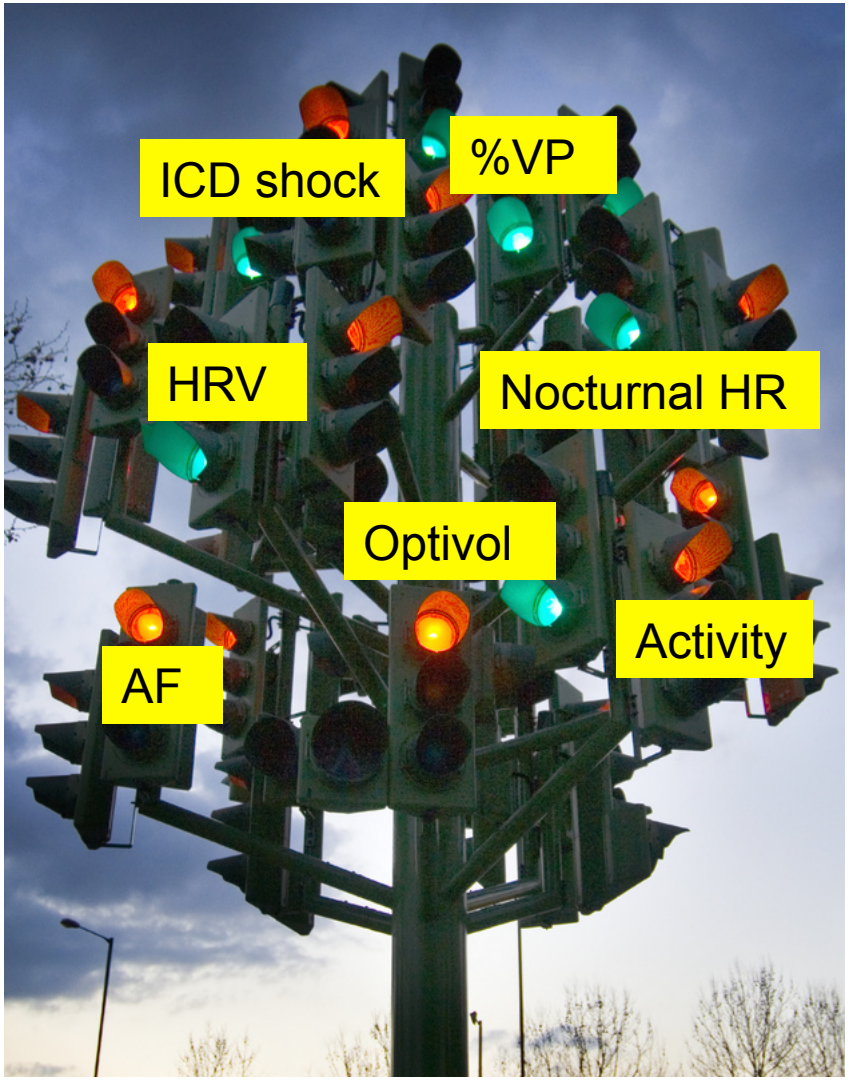


Fig. 2. Equipment used in our experiments. At top is a 4 GSa/s oscilloscope. At bottom, from left to right, are: our eavesdropping antenna, an ICD, our transmitting antenna (mounted on cardboard), and a USRP with a BasicTX card attached.

Reimbursement of remote device management in Europe

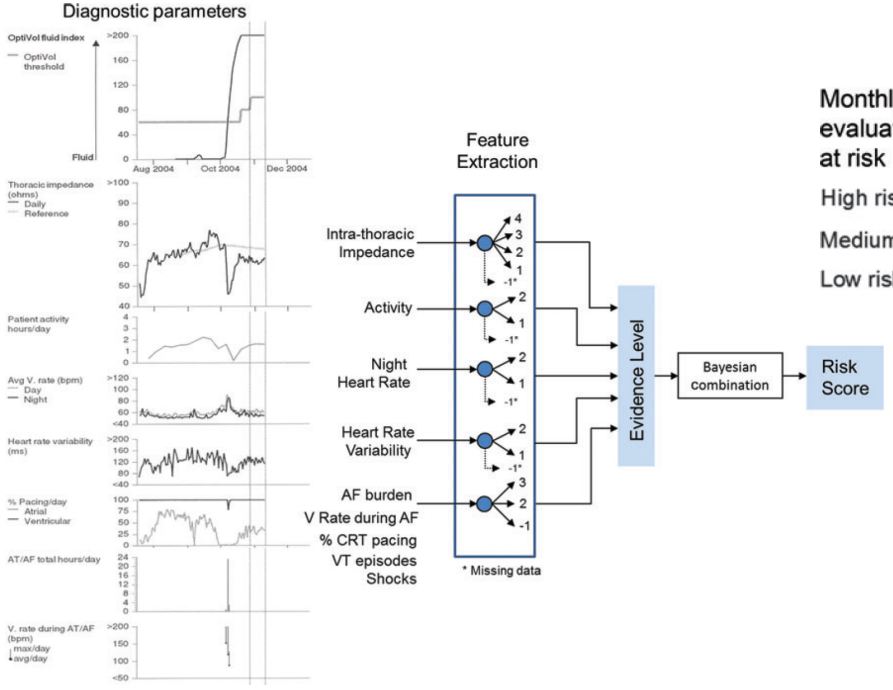


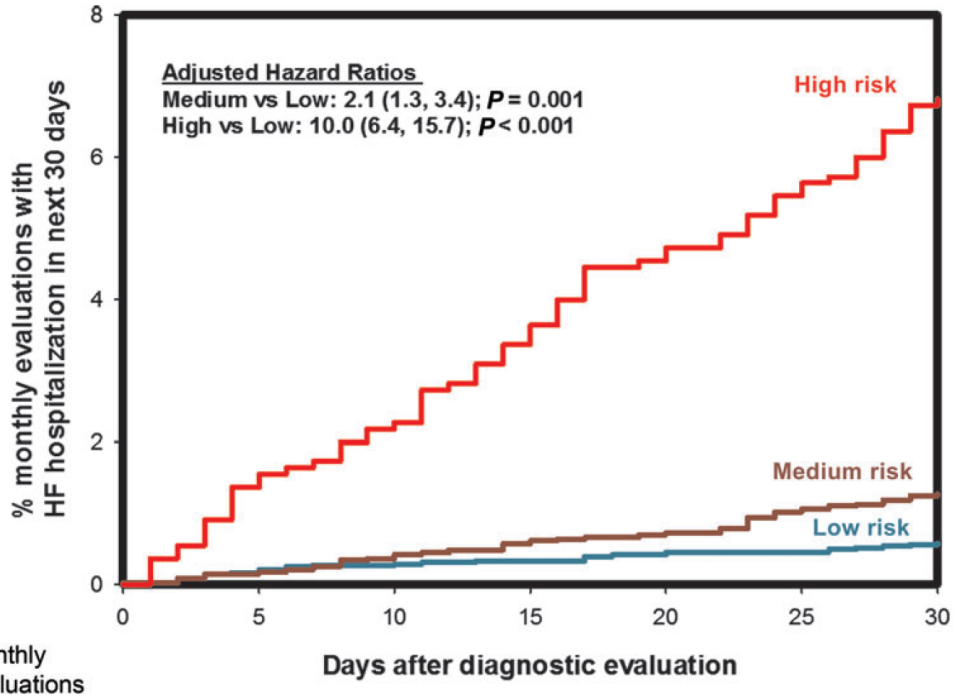

ICD shock
%VP
HRV
Nocturnal HR
Optivol
Activity
AF

European Heart Journal (2013) **34**, 2472–2480
doi:10.1093/eurheartj/eht083

Development and validation of an integrated diagnostic algorithm derived from parameters monitored in implantable devices for identifying patients at risk for heart failure hospitalization in an ambulatory setting

Martin R. Cowie[1,2]*, Shantanu Sarkar[3], Jodi Koehler[3], David J. Whellan[4], George H. Crossley[5], Wai Hong Wilson Tang[6], William T. Abraham[7], Vinod Sharma[3], and Massimo Santini[8]





Monthly evaluations at risk							
High risk	1100	1085	1076	1063	1050	1040	1026
Medium risk	4717	4710	4700	4690	4684	4669	4658
Low risk	4838	4830	4825	4822	4818	4816	4811

Heart Failure Management Report - Last 90 Day Zoom

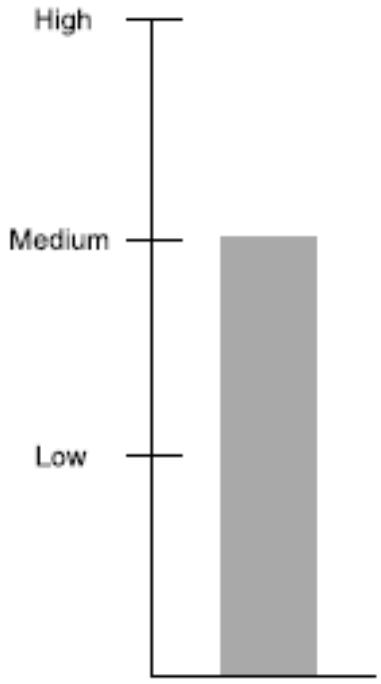
Heart Failure Risk

Device: **Consulta™ CRT-D D234TRK** Serial Number: **PUD022200H** Date of interrogation: **15-Sep-2010 09:53:15**

Last 90 Day Zoom (16-Jun-2010 to 15-Sep-2010)

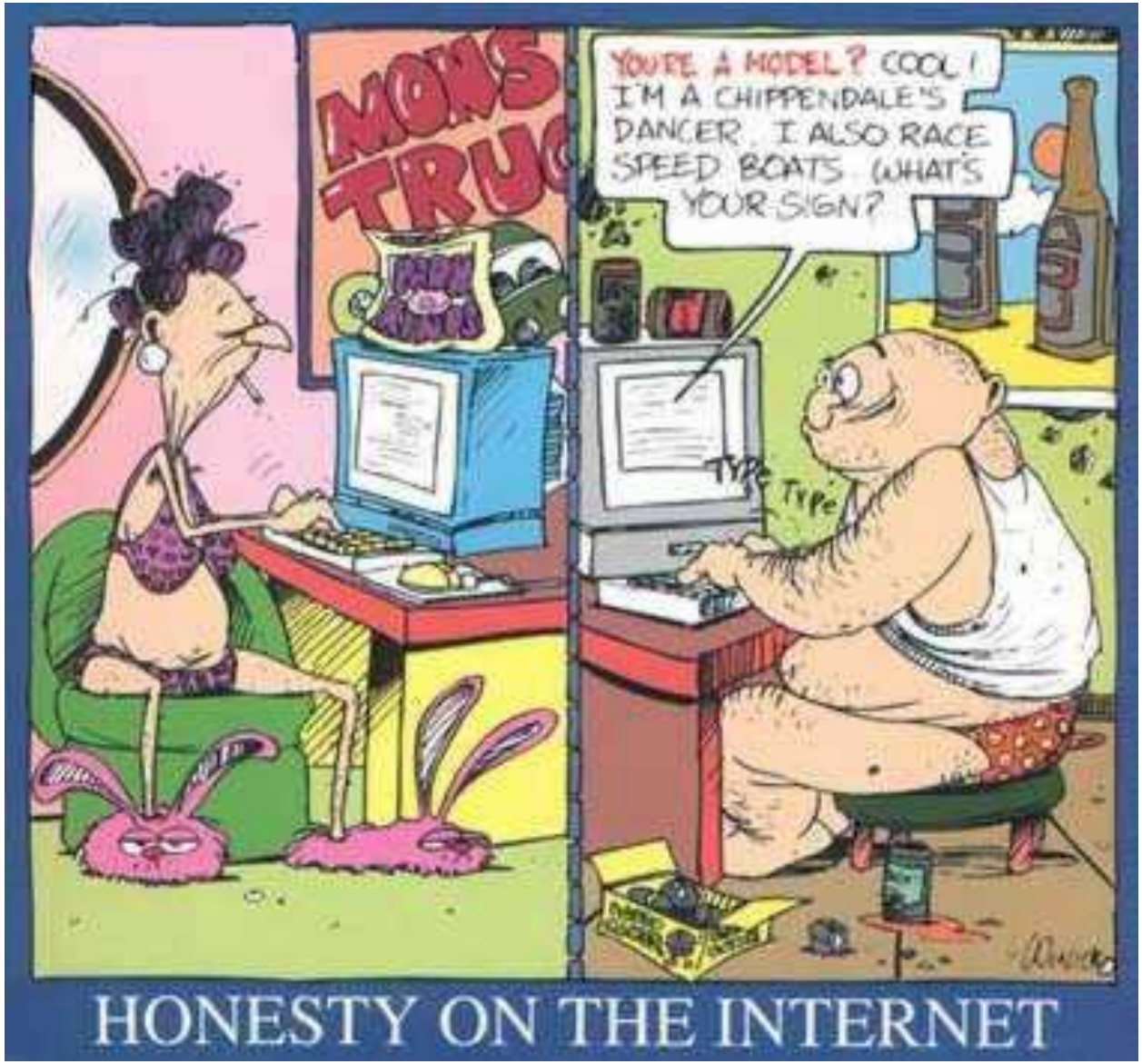
Heart Failure Risk Status on 15-Sep-2010 is Medium*

Risk of Heart Failure Event in Next 30 days
(based on maximum daily risk status in prior 30 days)



Risk factors

OptiVol	☐
Patient activity	☐
AT/AF	☒
Ventricular rate during AT/AF	☒
% Ventricular pacing	☒
Shocks	☐
Treated VT/VF	☐
Night ventricular rate	☒
Heart rate variability	☐



HONESTY ON THE INTERNET


OK
BIOTRONIK


10
35
Steps goal reached!

Telemédecine

- Atouts
  qualité des soins, recommandations, efficience

- Difficultés
  surcharge travail, gestion des données, remboursement, aspect legal?

- ⇨ Gestion des données
  triage, scores automatiques

- Evolution de la technologie


Hôpitaux
Universitaires
Genève
Merci!