

# Remote monitoring- The future of device follow up

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# Introduction

- Remote device monitoring has long been established in the US
- Adopted in Europe within the past 5 years
- Use has increasing with 2008 the publication of ACC/AHA/HRS guidelines
- Remote monitoring systems are currently provided by the four major device companies for a wide range of implantable devices

## Transmitters currently available from the four main device manufacturers



Biotronik Cardiomessenger™ mobile transmitter of the Home Monitoring system



St-Jude Medical Merlin@home™ wireless transmitter



Boston Scientific wireless transmitter, weight scale, and blood pressure monitor of the Latitude Patient Management™ system



Medtronic transmitter (Home Monitor) of the CareLink™ network

	Biotronik Home Monitoring™	Medtronic CareLink™	Boston Scientific Latitude™	St Jude Merlin.net™
Wireless communication with implanted device	Radiofrequency	Radiofrequency	Radiofrequency	Radiofrequency
Data transmission	GSM network	Analogue phonenumber	Analogue phonenumber	Analogue phonenumber
Transmitter	Mobile	Stationary	Stationary	Stationary
Frequency of transmissions	Daily FU; Alert events	Scheduled FU; Alert events	Scheduled FU; Alert events	Scheduled FU; Alert events
Remote follow-up	Yes	Yes	Yes	Yes
Remote monitoring	Yes	Yes	Yes	Yes
Physician notification	SMS, e-mail, fax	SMS, e-mail	Fax, phone	Fax, e-mail, SMS
Feedback to patient via transmitter	LED indicating normal status or call to clinic	LED indicating normal status or call to clinic	Automatic text and audio messages	LED indicating call to clinic, automated phone calls
IEGM (real-time at remote follow-up)	30 s (monthly periodic EGMs)	10 s	10 s	30 s
IEGM (arrhythmic episodes)	All memorized episodes	All memorized episodes	All memorized episodes	All memorized episodes
Special features	Alerts fully configurable online	Automatic RA, RV and LV (only Consulta) pacing thresholds	Optional wireless weight scales and BP cuffs	Alerts fully configurable online
	Automatic RV and LV thresholds (only Lumax 500/540)	Optivol® lung fluid status alert	Configurable data transmission to associated caregivers	Possibility of sending automated phone calls to patients
	Wireless PMs	Configurable red and yellow alerts	Configurable red and yellow alerts	Automatic RA, RV, and LV pacing thresholds (next generation of ICDs)
			Electronic health record data export capability	

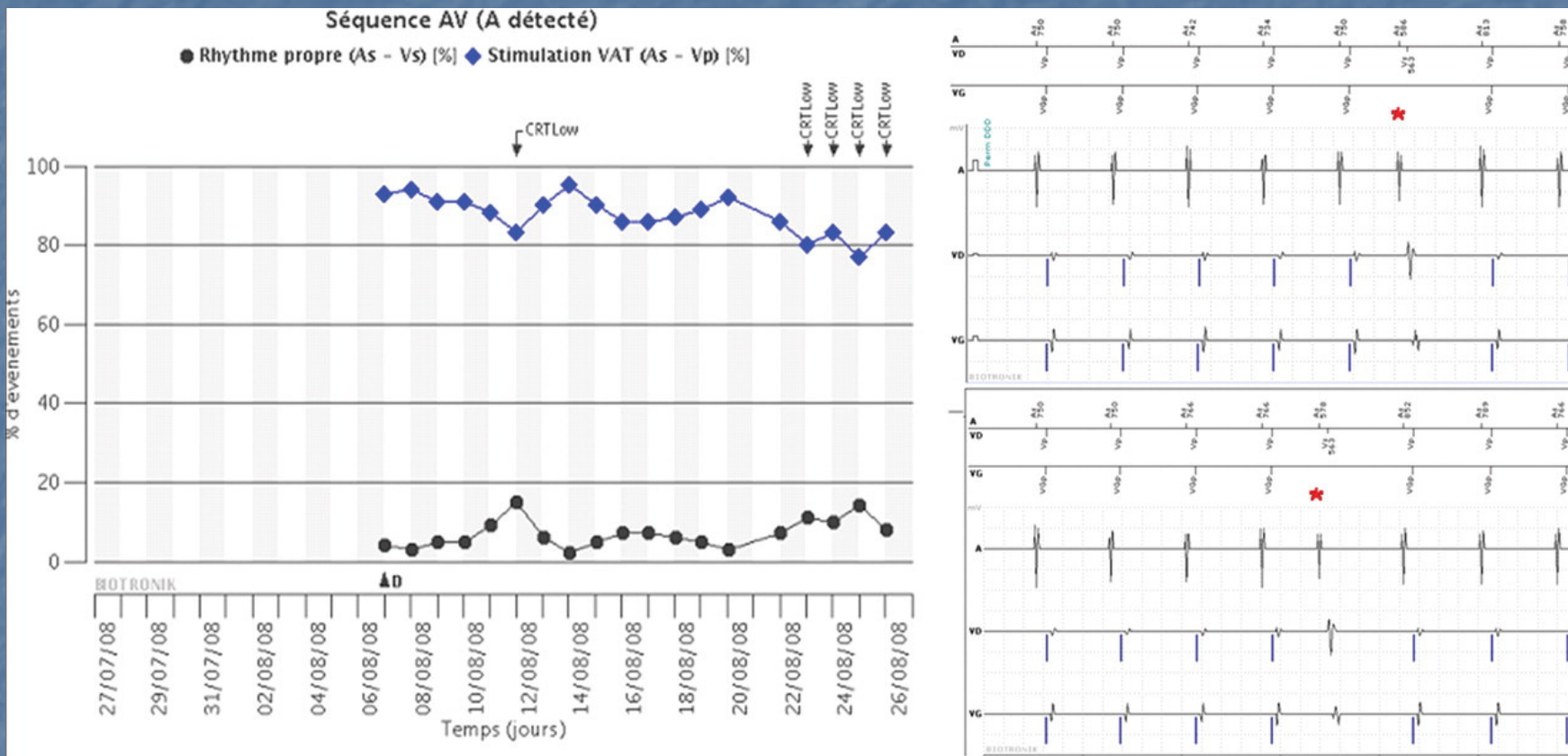
# Gathering of data

- Information can be gathered manually using wand or automatically using wireless technology
- Data is then forwarded to a central database
- Information can be viewed via a secure web page
- Clinician can be informed by text, fax or email

# Data gathered from device

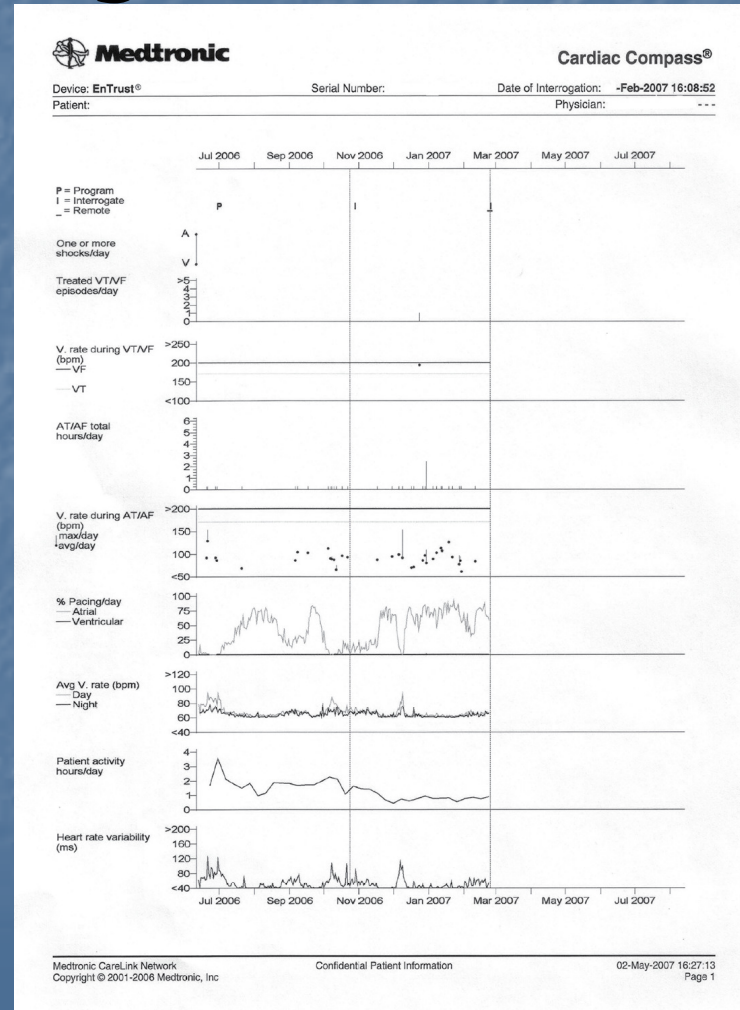
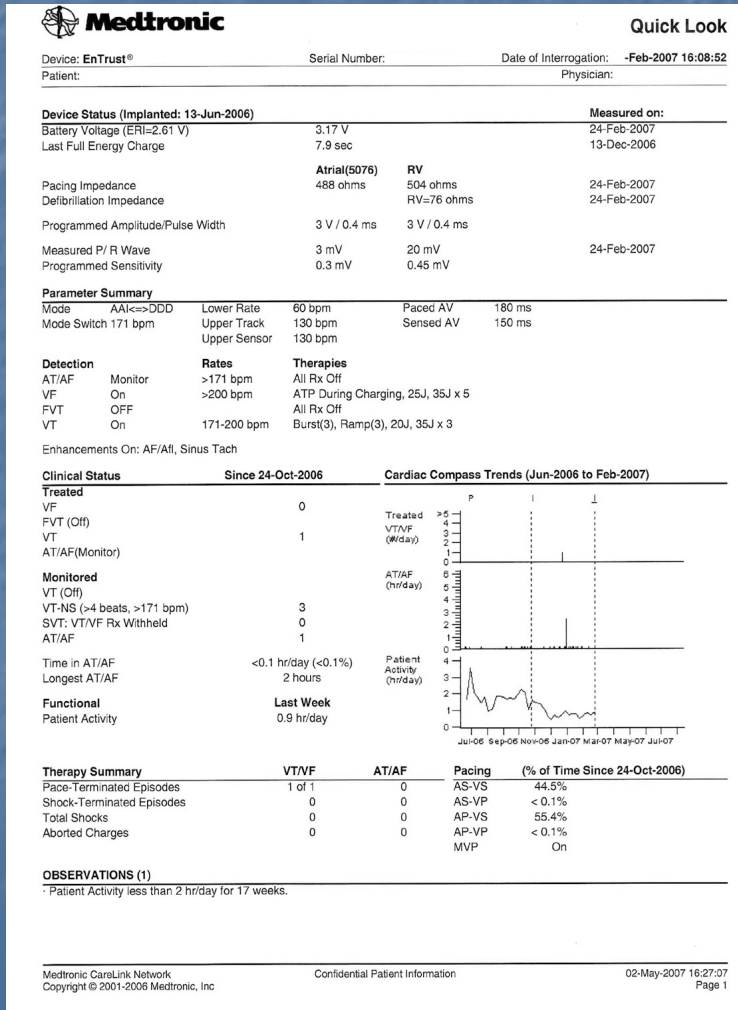
- Battery and lead information
- Programmed parameters
- Current EGM
- Episodes-list and EGMs
- Threshold tests
- Intrinsic amplitude
- Patient specific alerts

# Biotronik Home Monitor showing trends of AS-VS events (black dots) and As-Vp events (blue diamonds)



Burri, H. et al. Europace 2009 11:701-709; doi:10.1093/europace/eup110

# Medtronic Quicklook and Heart failure management



# Advantages of remote device monitoring

## ■ **Device**

- Automatic transmission if alert active e.g.. Lead impedance out of range
- Battery voltage
- Decreased intrinsic amplitude
- Deactivation of therapies
- Atrial or ventricular arrhythmias/ therapy

## ■ **Patient**

- Reduced hospital appointments
- Increased QOL
- Greater reassurance
- Monitoring and management of heart failure
- Monitoring and management of arrhythmias
- Scheduled or automatic transmissions reduced non compliance

## Remote monitoring alert parameters

Biotronik		Medtronic
<b>Notification interval for missing messages</b> <span style="float: right;">7 days ▾</span>		<b>Red Alerts</b>
<b>Implant</b>	<input checked="" type="checkbox"/> ERI, EOS, Special implant status, Backup mode, VT/VF detection inactive, Emergency pacing <input checked="" type="checkbox"/> Programmer triggered message received	<input checked="" type="checkbox"/> Electrical Reset <input checked="" type="checkbox"/> Low Battery Voltage Recommended Replacement Time <input checked="" type="checkbox"/> Excessive Charge Time End of Service <input checked="" type="checkbox"/> Charge Circuit Timeout <input checked="" type="checkbox"/> VF Detection/Therapy Off <input checked="" type="checkbox"/> Atrial Pacing Impedance Out of Range <input checked="" type="checkbox"/> Right Ventricular Pacing Impedance Out of Range <input checked="" type="checkbox"/> Left Ventricular Pacing Impedance Out of Range <input checked="" type="checkbox"/> Ventricular Defibrillation Impedance Out of Range <input checked="" type="checkbox"/> SVC (HVX) Defibrillation Impedance Out of Range <input checked="" type="checkbox"/> AT/AF Daily Burden > Threshold <input checked="" type="checkbox"/> Fast Ventricular Rate during AT/AF <input checked="" type="checkbox"/> All Therapies in a Zone Exhausted <input checked="" type="checkbox"/> Number of Shocks Delivered in an Episode <input checked="" type="checkbox"/> Pacing Mode DOO, VOO, or AOO <input checked="" type="checkbox"/> Active Can Off without SVC <input checked="" type="checkbox"/> RV Lead Integrity
<b>Lead</b>	<input checked="" type="checkbox"/> RA pacing impedance < 250 ▾ ohm or > 1500 ▾ ohm <input checked="" type="checkbox"/> Mean RA sensing amplitude < 0.5 ▾ mV <input checked="" type="checkbox"/> RV pacing impedance < 250 ▾ ohm or > 1500 ▾ ohm <input checked="" type="checkbox"/> RV pacing amplitude: safety margin < 1.0 ▾ V (only Lumax 500/540) <input checked="" type="checkbox"/> Minimum RV sensing amplitude < 2.0 ▾ mV <input checked="" type="checkbox"/> LV pacing impedance < 250 ▾ ohm or > 1500 ▾ ohm <input checked="" type="checkbox"/> LV pacing amplitude: safety margin < 1.0 ▾ V (only Lumax 500/540) <input checked="" type="checkbox"/> Minimum LV sensing amplitude < 2.0 ▾ mV <input checked="" type="checkbox"/> Daily shock lead impedance < 30 ▾ ohm or > 100 ▾ ohm <input checked="" type="checkbox"/> Impedance of last shock < 30 ▾ ohm or > 100 ▾ ohm	<input checked="" type="checkbox"/> SVC (HVX) Defibrillation Impedance Out of Range <input checked="" type="checkbox"/> AT/AF Daily Burden > Threshold <input checked="" type="checkbox"/> Fast Ventricular Rate during AT/AF <input checked="" type="checkbox"/> All Therapies in a Zone Exhausted <input checked="" type="checkbox"/> Number of Shocks Delivered in an Episode <input checked="" type="checkbox"/> Pacing Mode DOO, VOO, or AOO <input checked="" type="checkbox"/> Active Can Off without SVC <input checked="" type="checkbox"/> RV Lead Integrity
<b>Bradycardia/CRT</b>	<input checked="" type="checkbox"/> CRT pacing < 90 ▾ %	<input checked="" type="checkbox"/> Pacing Mode DOO, VOO, or AOO <input checked="" type="checkbox"/> Active Can Off without SVC <input checked="" type="checkbox"/> RV Lead Integrity
<b>Atrial arrhythmia</b>	<input checked="" type="checkbox"/> Long atrial episode <input type="checkbox"/> Atrial monitoring episode detected <input type="checkbox"/> SVT detected	<input checked="" type="checkbox"/> Optivol Fluid Alert
<b>Ven. arrhythmia</b>	<input checked="" type="checkbox"/> VT1 detected <input checked="" type="checkbox"/> VT2 detected <input checked="" type="checkbox"/> VF detected <input checked="" type="checkbox"/> Ineffective maximum energy shock	<input checked="" type="checkbox"/> Optivol Fluid Alert
<b>HF Monitor</b>	<input type="checkbox"/> Mean ven. heart rate > 90 ▾ ppm <input type="checkbox"/> Mean heart rate at rest > 90 ▾ ppm <input type="checkbox"/> Atrial burden > 25 ▾ % <input type="checkbox"/> Mean VES / h > 50 ▾	<input checked="" type="checkbox"/> Optivol Fluid Alert
<b>Episode</b>	<input checked="" type="checkbox"/> Ven. episode with 2 or more started shocks <input checked="" type="checkbox"/> Ven. episode with acceleration of ven. rhythm <input checked="" type="checkbox"/> Ven. episode with acceleration of atr. rhythm below 500 ▾ ms <input checked="" type="checkbox"/> Ven. episode with fulfilled ATP time-out criterion <input checked="" type="checkbox"/> Ven. therapy episode duration > 2 min ▾ <input type="checkbox"/> Ven. monitoring episode: > 5 min ▾ duration <input checked="" type="checkbox"/> Periodic IEGM received	<input checked="" type="checkbox"/> Optivol Fluid Alert

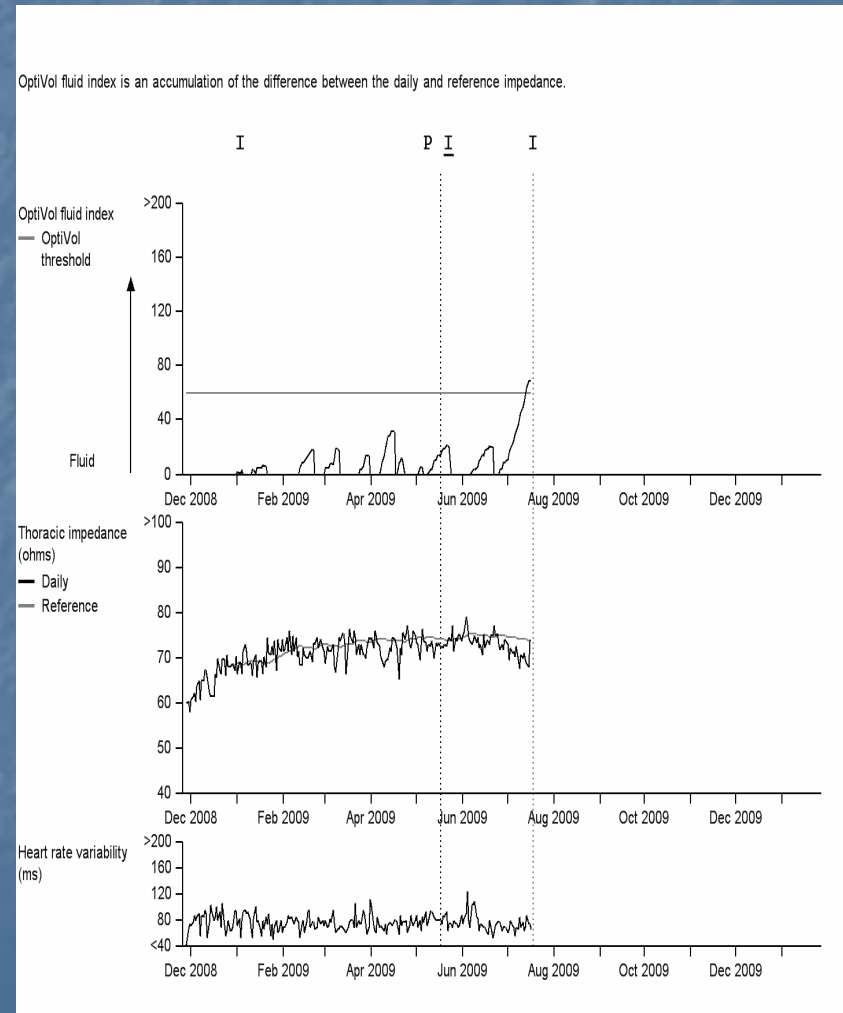
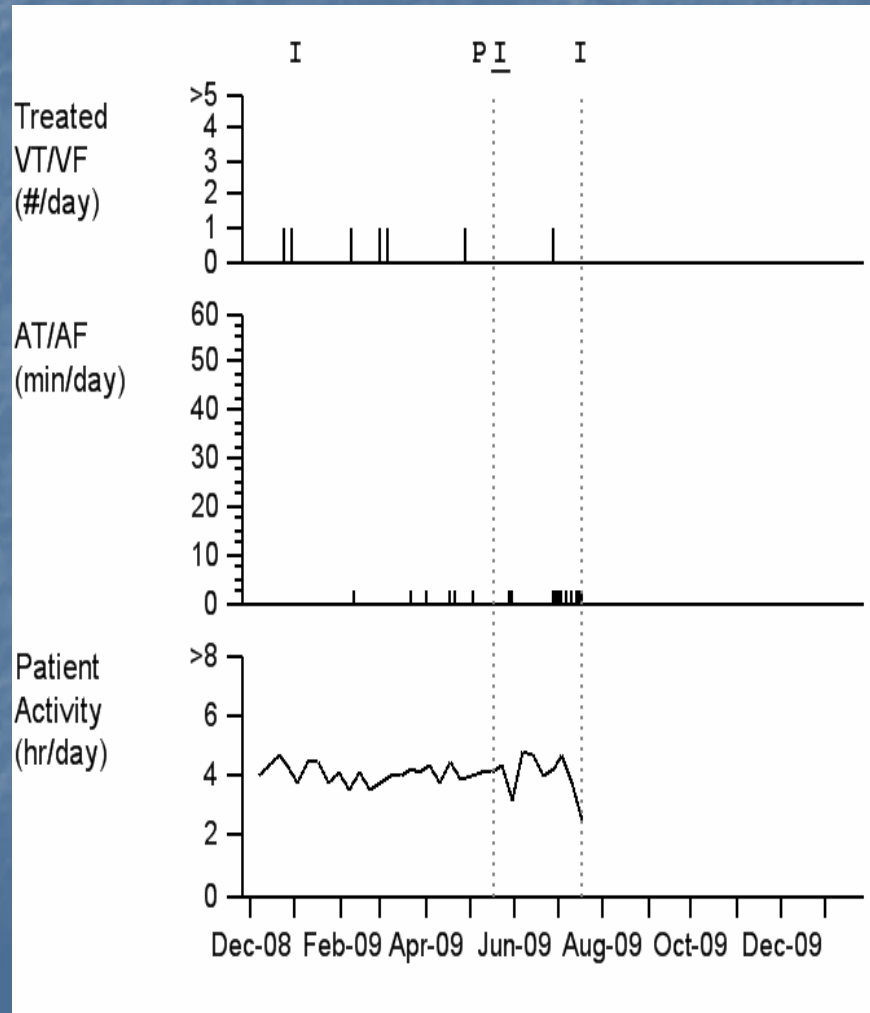
# Limitations of remote monitoring

- Technology and the elderly
- Differences between manufacturers
- Use of landline only in some systems
- Compliance with manual systems
- Extra paperwork when enrolling and scheduling patients
- Transmission of unwanted information

# Case study 1

- 53 year old Male
- H/O MI, EF 15%, NSVT
- Insync ICD implanted 2004
- Box changed to Consulta 2008
- Transmitted due to device alarm

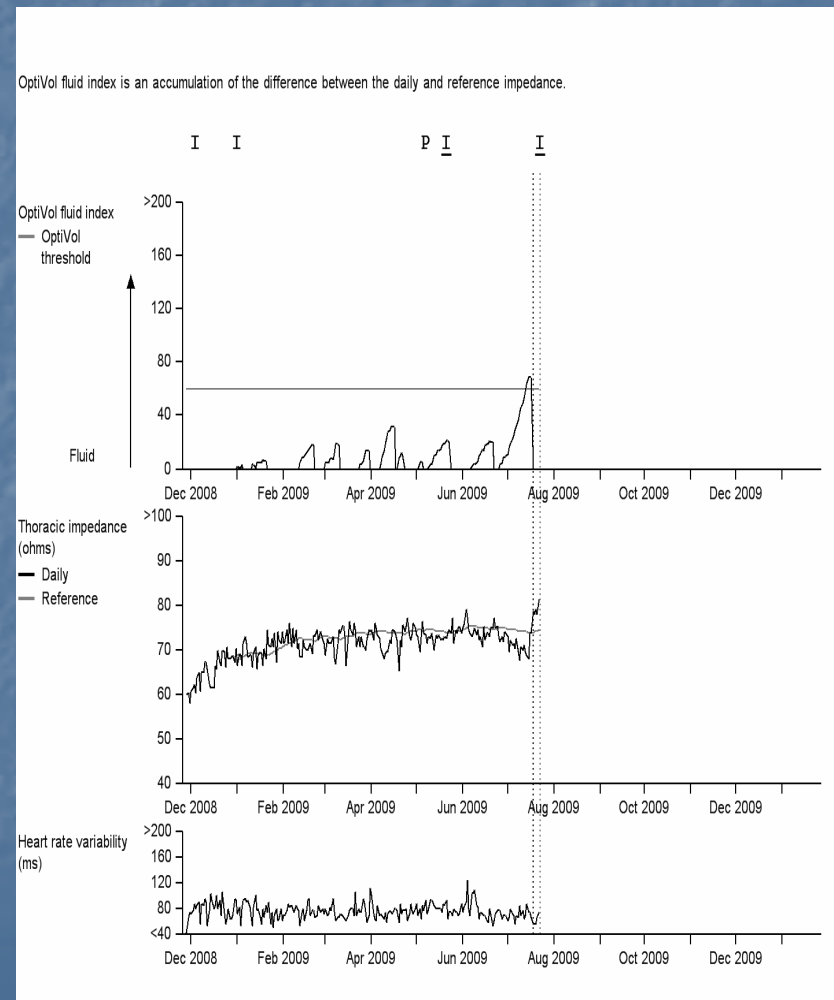
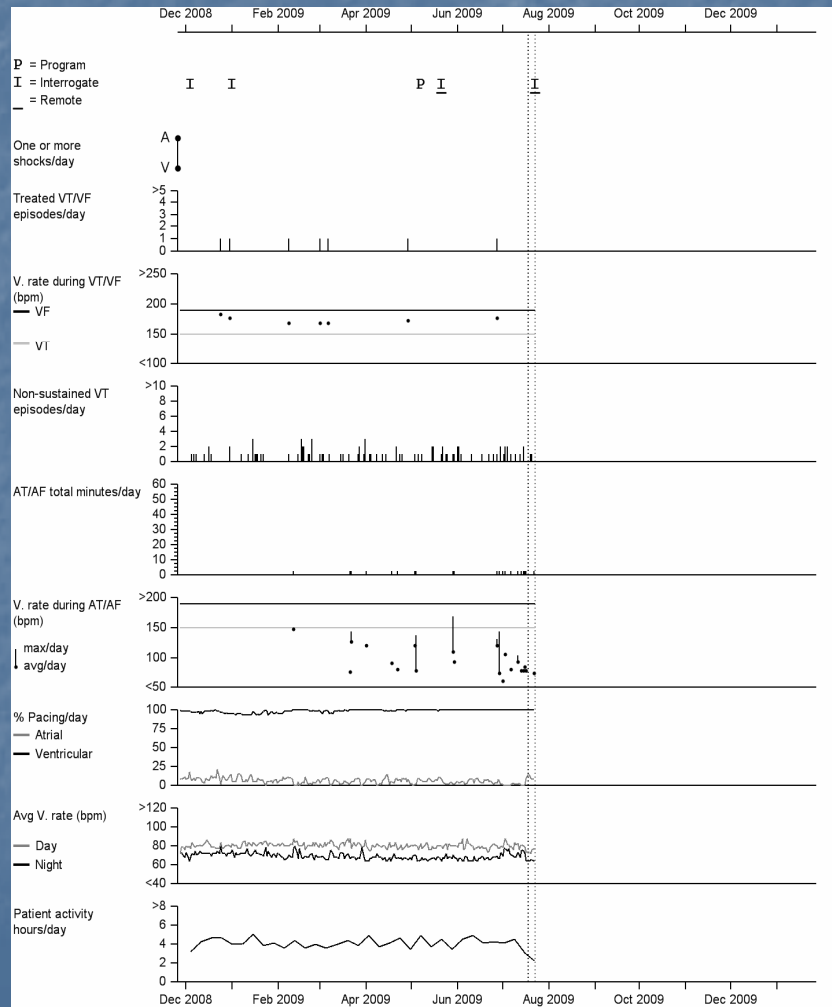
# Initial transmission 18.7.09



# Case study 1

- Optivol above threshold
- Patient currently a little SOB
- Recently returned from holidays in Majorca
- ? Excessive fluid intake
- No action taken- monitor patient

# Repeat transmission 23.7.09



# Case study 1

- Optivol back to baseline
- Patient extremely unwell and bed bound for past 6 days
- Family diagnosed with swine flu after returning from Majorca
- Carelink prevented patient from attending hospital

# Case Study 2

- 82 year old Male
- Biotronic Lumax implanted 2007
- H/O ICM, VF arrest, CABG, EF 35%
- Automatic transmission due to recurrent episodes of VT over the past number of days
- Patient feeling unwell when contacted

# Cardio Report Home Monitoring Service

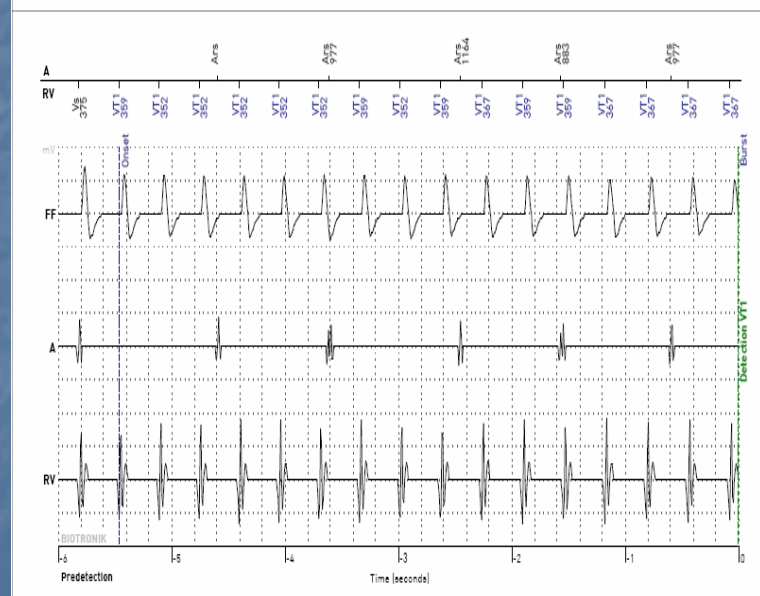


To: pacemaker clinic		BIOTRONIK Service Center Tel.: +49 30 68905 2440 Fax: +49 30 68905 2941
Report	Patient ID: Acton, Francis	
from 07-Oct-2009	Implant / Implant SN:	Patient device SN:
11:34	Lumax 340 DR-T / 60403793	46801017

## Holter

### Holter - Episode list:

No.	Detection time	Type	Details	Predetection PP/RR	Prermination PP/RR
	25-Sep-2009 15:36:58	Follow-up			
43	24-Sep-2009 15:02:59	VT1	ATP: 1	1199 / 365	961 / 862
41	24-Sep-2009 07:04:15	VT1	ATP: 1	1121 / 365	1270 / 1272
40	24-Sep-2009 06:34:08	VT1	ATP: 1	> 1998 / 367	1444 / 1442
39	24-Sep-2009 06:00:09	VT1	ATP: 1	1145 / 365	1242 / 1243
38	24-Sep-2009 03:13:38	VT1	ATP: 1	1044 / 367	1077 / 1075
37	23-Sep-2009 22:43:32	VT1	ATP: 1	976 / 367	1148 / 1147
36	23-Sep-2009 16:18:55	VT1	ATP: 2	999 / 365	1109 / 1088
35	23-Sep-2009 16:16:36	VT1	ATP: 1	992 / 364	1338 / 1336
31	23-Sep-2009 14:14:21	VT1	ATP: 1	1296 / 366	1034 / 1035
27	23-Sep-2009 08:17:42	VT1	ATP: 1	420 / 364	972 / 971
25	23-Sep-2009 07:09:05	VT1	ATP: 1	> 1998 / 367	1309 / 1308
24	22-Sep-2009 16:13:55	VT1	ATP: 1	1087 / 367	1320 / 1319
23	22-Sep-2009 15:55:25	VT1	ATP: 1	1125 / 367	1274 / 1273
20	15-Sep-2009 23:47:24	VT1	ATP: 1	902 / 366	1132 / 1132
19	15-Sep-2009 23:42:11	VT1	ATP: 1	852 / 366	934 / 934
15	08-Sep-2009 08:46:31	Atr. monitoring	Monitoring only	310 / 548	923 / 913
14	22-Jul-2009 11:40:42	Periodic IEBM	Monitoring only	--- / ---	--- / ---
	06-Jul-2009 11:26:55	Follow-up			
13	23-Apr-2009 11:40:42	Periodic IEBM	Monitoring only	--- / ---	--- / ---
12	16-Apr-2009 12:09:29	Atr. monitoring	Monitoring only	237 / 547	866 / 791
	15-Apr-2009 15:19:32	Follow-up			
11	19-Feb-2009 09:19:54	Atr. monitoring	Monitoring only	207 / 645	924 / 921
10	10-Feb-2009 10:18:10	Atr. monitoring	Monitoring only	261 / 560	953 / 951
9	23-Jan-2009 11:40:42	Periodic IEBM	Monitoring only	--- / ---	--- / ---
	07-Jan-2009 15:25:23	Follow-up			
8	11-Dec-2008 09:10:03	Atr. monitoring	Monitoring only	227 / 515	826 / 829
7	25-Oct-2008 11:40:42	Periodic IEBM	Monitoring only	--- / ---	--- / ---
	19-Sep-2008 13:28:05	Follow-up			
6	07-Sep-2008 14:22:55	Atr. monitoring	Monitoring only	144 / 689	1051 / 1046
5	18-Aug-2008 08:04:36	Atr. monitoring	Monitoring only	237 / 690	977 / 924
4	27-Jul-2008 00:40:43	Periodic IEBM	Monitoring only	--- / ---	--- / ---
	06-Jun-2008 10:07:19	Follow-up			
3	28-Apr-2008 00:40:42	Periodic IEBM	Monitoring only	--- / ---	--- / ---
	29-Feb-2008 11:44:32	Follow-up			
2	29-Jan-2008 00:40:42	Periodic IEBM	Monitoring only	--- / ---	--- / ---
	05-Dec-2007 11:39:48	Follow-up			



# Case study 2

- Patient had been admitted to local DGH on 22.9.09 with Troponin –ve chest pain and non sustained VT
- Discharged with calcium and vitamin D tablets
- Transmission noted frequent episodes of ATP terminated VT since 22.9.09
- D/W Cardiologist on call and patient admitted to BCH on 24.9.09
- Commenced on Amiodarone and discharged after 4 days monitoring

# Conclusion

- Remote monitoring helped prevent the spread of infection and allowed rapid treatment of patient with recurrent VT
- Allows patients to be assessed and treated from the comfort of their own home
- Increases flexibility of patient review clinics
- Saves time and money
- Increases patient safety and improves quality of care

# The future?????

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Working from home.

Search ID: rb0n642

# The Future of device follow up????



Casual Friday for the  
Telecommuter