Managing Systems in Remote Monitoring
A Complex Challenge Turned into an Important Clinical Tool

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Institute of Physiology, Faculty of Medicine of Lisbon

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Imagine relaxing in the comfort of your home. At the same time, your doctor is getting important information from your cardiac device.
• great differences in implanting rates among EHRA members
• the number of implants is increasing in almost all countries

*Lubinski, et al, Europace 2011*

- Clinical trials have consistently demonstrated the ability of ICDs and CRTs to reduce mortality in selected pts with moderate-to-severe LV systolic dysfunction and HF.

indications for CIEDs expanded dramatically

- ICDs »» 149/million
- PMs »» 947/million
- CRT-P »» 26/million
- CRT-D »» 85/million

*Eucomed 2009*

total implants in 2009 in ‘Europe 27’ of 471 284 PMs and 74 151 ICDs!
in 2007 over 1.6 million CIDs were implanted in the USA and Europe, which would translate to > 5.5 million patient-encounters per year…
Congestive Heart Failure - *scope of the problem*

>22 million individuals worldwide

2% of European population

>500,000 new cases/year

What is the percentage of HF patients candidates for CRT?

Euro Heart Failure Survey, 2007
Increase in the Use of Implantable Cardioverter-Defibrillators

- follow-up visits are scheduled at 3 or 6-month intervals
- additional unscheduled visits are often required to investigate symptoms, shocks, alarms
- in “conventional” follow-up any device problem which occurs will not be identified quickly!

**THERE IS A (REAL BIG) ROLE FOR REMOTE MONITORING**

Remote monitoring of cardiac implantable devices is an alternative to frequent visits

- Everyone with an implantable device must have **regular monitoring** to make sure that it is working properly.

- Remote device monitoring allows us to **check the device between follow-ups**.

- Remote monitoring can support more timely **comprehensive care for heart health**.
Remote, Wireless, Ambulatory Monitoring
of Implantable Pacemakers, Cardioverter Defibrillators,
and Cardiac Resynchronization Therapy Systems:
Analysis of a Worldwide Database

ARNAUD LAZARUS, M.D.
From the InParys Clinical Research Group, Paris, France

Study Objective: To describe the daily routine application of a new telemonitoring system in a large population of cardiac device recipients.

Conclusions: This broad clinical application of a new monitoring system strongly supports its capability to improve the care of cardiac device recipients, enhance their safety, and optimize the allocation of health resources. (PACE 2007; 30:S2–S12)

Conclusions: Home monitoring technology allowed optimization of medical treatment and device programming with low consumption of healthcare resources (Europace 2008; 10:164-170)

Home monitoring remote control of pacemaker and implantable cardioverter defibrillator patients in clinical practice: impact on medical management and health-care resource utilization

Renato Pietro Ricci*, Loredana Morichelli, and Massimo Santini

Department of Cardiovascular Disease, San Filippo Neri Hospital, Via Martinotti 20, 00135 Rome, Italy
How Does Remote Monitoring Work?

Remote monitoring allows you to send comprehensive device information to your clinic over a standard phone line.

Your clinic then reviews your device information on a secure website, allowing routine device follow-up or a special situation to be reviewed quickly and efficiently.

All remote monitoring systems are slightly different and use slightly different technology.
Remote Monitoring Systems
Implantable Cardiac Devices

- generator interrogation
  (manual or automatic)
- regular transmission of data
  (programmable)
- time between transmissions
  (team decision)

stored and measured information about the lead(s), sensor(s), battery and the implanted pulse generator function, as well as data collected about the patient’s heart rhythm, heart rate and rhythm treatment settings.
The 3 Legged Stool of Telemonitoring: The Device, the Patient and the Health Team

Who deal with the telemonitoring information?

- **Patient’s Home**
  - CRM Device
  - External Sensors

- **Web Server**
  - Communicator

- **Device Managing Team**
  - Objectives
    - Device management
    - Arrhythmia management

- **Health Following Team**
  - Objectives
    - Collaborative patient management
    - HF management

- **a comprehensive set of tools to monitor HF progression**
- **healthcare team access to patient’s clinical status**
 manual transmissions
 automatic scheduled transmissions
 transmission of Care Alerts
 “testing” sessions

Transmission to a Central Information Service data base
(each center has access limited to its patient’s using a password code in a web page)

- sensing and impedances
- % of pacing
- arrhythmic events (EGMs)

- system integrity
- events (arrhythmias, > “thoracic fluid”)
- other (“team decision”)

alerts can be selected and reconfigured for individual patients

Clinical staff may schedule automatic transmissions
**MyCareLink™ - Website**

**Arrhythmia**
- List
- EasyEGM™ Summary

**V. Sensing**
- List

**Rate Drop Response**
- List

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**Current EGM**
02-Dec-2013 12:18 AM

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**Arrhythmia Episodes with EGM since: 01-Nov-2013**

**Non sustained VT**
- Episodes: 3
- With EGM: 3

<table>
<thead>
<tr>
<th>Type</th>
<th>ID#</th>
<th>Date</th>
<th>Time hh:mm</th>
<th>Duration hh:mm:ss</th>
<th>Avg bpm A/V</th>
<th>Full EGM</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT-NS</td>
<td>#103</td>
<td>24-Nov-2013</td>
<td>14:00</td>
<td>01</td>
<td>101/176</td>
<td></td>
</tr>
</tbody>
</table>

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**Graphs and Waveforms**

- Atip to Aring
- Can to RVcoil
- Sense | Pace

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**Device Information**
- Device: Protecta™ XT CRT-D 354TR-3
- Serial Number: PSF0105825
- Date of Interrogation: 02-Dec-2013 00:18:00
Remote Yellow Alert Reconfiguration

Yellow Alerts can be remotely re-configured according to each patient’s clinical indications through the secure website without bringing the patient into the hospital.

- **Arrhythmias**
  - Shock therapy delivered to convert arrhythmia
  - Accelerated arrhythmia episode (ventricular)
  - Atrial Arrhythmia Burden
  - Patient-triggered event stored

- **Weight change**
  - At least .91 kg average over two days or at least 2.27 kg in a week

- **Battery**
  - Voltage was too low for projected remaining capacity
  - Explant indicator reached

- **Cardiac Resynchronization Therapy Pacing**
  - Right Ventricular Pacing
  - Therapy history corruption detected

- **Ventricular pacing leads**
  - Low right ventricular intrinsic amplitude
  - Low left ventricular intrinsic amplitude
  - Low left ventricular pacing lead impedance
  - High left ventricular pacing lead impedance

- **Atrial pacing leads**
  - Low atrial intrinsic amplitude
  - Low atrial pacing lead impedance
  - High atrial pacing lead impedance
Remote monitoring disabled due to limited battery capacity
- High or low shock lead impedance
- High or low shock lead impedance detected when attempting to deliver a shock
- High or low right ventricular pacing lead impedance
- High voltage detected on shock lead during charge
- Tachy mode set to value other than Monitor + Therapy
- PG has detected a possible device malfunction
- Device parameter error

remote monitoring is not a substitute for calling the emergency system!

AND IF SOMETHING FAILS?!

Hospitals are experts in health domain, not in information systems and knowledge representation. Even the best monitoring systems in the world are not foolproof!
Defined as the number of patients who received an alert during 73,215 Patient Monitoring Years in 2008, where Patient Monitoring Years is defined as the total number of days each patient was active in LATITUDE® in 2008 converted into years. Yellow alerts are individually selected. Not all alerts were enabled for all patients. Patients may have triggered more than one alert simultaneously and some patients may have triggered more than one type of alert.
### Reports

**Medtronic CARELINK® NETWORK**

**HOME** | **TRANSMISSIONS** | **MANAGE MY PATIENTS** | **MANAGE MY CLINIC**
---|---|---|---

**Active Transmissions**

<table>
<thead>
<tr>
<th>Transmission</th>
<th>Patient Name</th>
<th>Received</th>
<th>Status</th>
<th>Battery</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stevens, Kimberly</td>
<td>28-Jun-2012 13:47</td>
<td>None</td>
<td>RoVo™ 6-Aug-2011</td>
<td>Not Scheduled</td>
</tr>
<tr>
<td></td>
<td>Johnson, Rob</td>
<td>28-Jun-2012 09:45</td>
<td>Tachy, AF Episode</td>
<td>None</td>
<td>RoVo™ 1-Mar-2012</td>
</tr>
<tr>
<td></td>
<td>Gomez, Maria</td>
<td>28-Jun-2012 09:15</td>
<td>Tachy, ATAF Episodes</td>
<td>None</td>
<td>RoVo™ 1-Mar-2012</td>
</tr>
<tr>
<td></td>
<td>Coleman, Edward</td>
<td>25-Jun-2012 09:00</td>
<td>No Events</td>
<td>None</td>
<td>RoVo™ 10-Jan-2012</td>
</tr>
</tbody>
</table>

**Alerts**

- **Ellis, Susan**
  - 1A28865
  - Virtuoso® DR D164AWG (ICD)
  - 04-May-2011 2:43 PM
  - AT/AF Daily Burden > Threshold

- **Harris, Elizabeth**
  - 1A9520
  - Maximo™ II DR D284DRG (ICD)
  - 04-May-2011 9:43 AM
  - 1 Shock Delivered for Episode #10

- **Smith, Devon**
  - 1A7883
  - Virtuoso® VR D15-IVWC (ICD)
  - 04-May-2011 6:55 AM
  - RV Pacing Lead Impedance "High"
Comparison of different remote monitoring systems

<table>
<thead>
<tr>
<th>Biotronik Home Monitoring™</th>
<th>Medtronic CareLink™</th>
<th>Boston Scientific Latitude™</th>
<th>St Jude Merlin.net™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireless communication with implanted device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data transmission</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmitter</td>
<td></td>
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<td></td>
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<tr>
<td>Frequency of transmissions</td>
<td></td>
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<tr>
<td>Remote follow-up</td>
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<tr>
<td>Remote monitoring</td>
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<tr>
<td>Physician notification</td>
<td></td>
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<tr>
<td>Feedback to patient via transmitter</td>
<td></td>
<td></td>
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<tr>
<td>IEGM (real-time at remote follow-up)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEGM (arrhythmic episodes)</td>
<td></td>
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</tbody>
</table>

The actual remote monitoring systems still centralized, server-based, highly dependent on the vendor’s model.

- **2001**: Mobile, Daily FU; Alert events (Yes), SMS, e-mail, fax (Yes), LED indicating normal status or call to clinic (Yes), 30 s (monthly periodic EGMs), All memorized episodes
- **2005**: Stationary, Scheduled FU; Alert events (Yes), SMS, e-mail (Yes), LED indicating normal status or call to clinic (Yes), 10 s, All memorized episodes
- **2006**: Stationary, Scheduled FU; Alert events (Yes), Fax, phone (Yes), Automatic text and audio messages (Yes), 10 s, All memorized episodes
- **2007**: Stationary, Scheduled FU; Alert events (Yes), Fax, e-mail, SMS (Yes), LED indicating call to clinic, automated phone calls (Yes), 30 s, All memorized episodes

*Burri H, Senouf D. Europace (2009) 11, 701–709*
### Why Remote Monitoring?

<table>
<thead>
<tr>
<th>Accessibility</th>
<th>Quality</th>
<th>Efficiency</th>
<th>Costs</th>
<th>Financial incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients</strong></td>
<td>Increased, especially if remote</td>
<td>Better care received</td>
<td>Less travel</td>
<td>No extra cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quality of life</td>
<td>Less time spent</td>
<td>Less costs (travel, meals, accompanying person, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced mortality and morbidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Medical personnel</strong></td>
<td>Increased access to patient data</td>
<td>Better care given</td>
<td>Quicker follow-up</td>
<td>No extra cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased satisfaction</td>
<td>Fewer missed visits</td>
<td>Possibility to increase total number of follow-ups</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Increased flexibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Less administrative work</td>
<td></td>
</tr>
<tr>
<td><strong>Hospital</strong></td>
<td>Networking of patient data</td>
<td>Reputation</td>
<td>More efficient use of hospital resources</td>
<td>Transmitter purchase^b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased satisfaction</td>
<td></td>
<td>Data analysis</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>Patient education</td>
</tr>
<tr>
<td><strong>Device manufacturer</strong></td>
<td>Data centralization</td>
<td>Product quality control</td>
<td>Increased (avoids participation in in-office follow-up)</td>
<td>Transmitter^b</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td>Telecom</td>
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<td>Database servicing</td>
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<td>Helpline</td>
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<td></td>
<td></td>
<td>Scientific studies</td>
</tr>
<tr>
<td><strong>Insurance company</strong></td>
<td>Data on healthcare use</td>
<td>Better patient care</td>
<td>Management of healthcare system</td>
<td>Cost control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fewer cost-intensive clinical events^b</td>
</tr>
<tr>
<td><strong>State</strong></td>
<td>Increased access of patient care</td>
<td>Better public service</td>
<td>Management of healthcare system</td>
<td>Cost control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fewer cost-intensive clinical events^a</td>
</tr>
</tbody>
</table>

Burri H, et al. EUROPACE 2011

…the consensus document of the *Heart Rhythm Society* and *European Heart Rhythm Association* suggests annual hospital visits for ICD/CRT-D patients in a regular remote monitoring follow-up.
...an individualized approach
...an individualized approach

...early detection of a lead fracture »» replacement before symptoms
DEVICE BASED MONITORING FEATURES IN HEART FAILURE

- % BIV pacing in CRT devices (... but also % RV pacing in ICD patients)
- Arrhythmias (VT, VF, NSVT, AF, AT)
- Heart Rate, Heart Rate Variability
- Physical Activity, Respiratory Rate
- IntraThoracic Impedance
- Hemodynamics – intracardiac pressure, pulmonary pressure, heart sound amplitude
- Body Weight, Blood Pressure

Pressure or fluid index (derived from intrathoracic impedance) or autonomics can predict HF events and change outcomes.

In ALTITUDE, pts followed remotely showed higher survival rates than those followed in-clinic. Also, survival outcomes were better than those observed previously in clinical trials, suggesting that closer management with remote monitoring allows to intervene more effectively with impact on survival.

Catanzariti D, et al. PACE 2009
Saxon, et al. Circulation 2010
Comprehensive patient Heart Failure Report through integration of device diagnostics

Who should deal with the information?

DATA RECORDED

- Weight
- Blood Pressure
- Heart Rate
- HRV
- Activity
- AF Burden
- Events

Increases in body weight are associated with hospitalization for HF and begin at least 1 week before admission

- compared with control pts, HF cases experienced gradual weight gain beginning 30 days before hospitalization
- within the week before hospitalization, the risk of HF hospitalization increases in a monotonic fashion with increasing amounts of weight gain
- any weight gain of ≥1 kg is associated with increased risk of HF hospitalization

“Pts should weigh themselves on a regular basis to monitor weight change, preferably as part of a regular daily routine”

ESC Guidelines, 2008

Chaudhry et al, Circulation 2007
Activity level as predictor of CRT outcome:

“Early physical activity”, measured by the accelerometer on implanted CRT-D and ICD devices, is a strong predictor of outcome in patients with CHF.

Conraads et al. (submitted)
Whellan DJ, et al. JACC 2010

Combined Heart Failure Device Diagnostics Identify Patients at Higher Risk of Subsequent Heart Failure Hospitalizations

Results From PARTNERS HF (Program to Access and Review Trending Information and Evaluate Correlation to Symptoms in Patients With Heart Failure) Study

<table>
<thead>
<tr>
<th>HF Device Diagnostic Parameter</th>
<th>Description</th>
<th>Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF duration</td>
<td>The AF duration trend records the total time spent in AF on a daily basis; the detection algorithm for AF has been proven to be highly accurate (11).</td>
<td>AF $\geq$ 6 h on at least 1 day in patients without persistent AF (7 consecutive days with $\geq$ 23 h AF)</td>
</tr>
<tr>
<td>Ventricular rate during AF</td>
<td>This trend computes the daily average ventricular rate occurring during AF on that day (12).</td>
<td>AF = 24 h and the average ventricular rate during AF $\geq$ 90 beats/min on at least 1 day</td>
</tr>
<tr>
<td>Fluid index (OptiVol)</td>
<td>The fluid index corresponds to changes in thoracic fluid levels. The fluid index trend is the cumulative difference between the daily average and patient-specific reference intrathoracic impedances. The intrathoracic impedance is calculated from the voltage measured from an asynchronous current applied between the right ventricular lead and the device case (8,9).</td>
<td>High fluid index on at least 1 day; thresholds included $\geq$ 60, $\geq$ 80, and $\geq$ 100</td>
</tr>
<tr>
<td>Patient activity</td>
<td>This trend measures the total time active per day using a capacitive accelerometer. A minute is considered active if the counts exceed a threshold equal to walking approximately 70 steps/min (7).</td>
<td>Average patient activity $&lt;$ 1 h over 1 week (nonoverlapping weekly windows)</td>
</tr>
<tr>
<td>Night heart rate</td>
<td>This trend measures the average ventricular rate from 12 AM (midnight) to 4 AM (7).</td>
<td>Average night heart rate $&gt;$ 85 beats/min for 7 consecutive days (nonoverlapping weekly windows)</td>
</tr>
<tr>
<td>HRV</td>
<td>The median atrial heart rate is determined every 5 min, and a variability value is computed each day. HRV is not computed if $&gt;$ 80% of the time is atrial pacing or AT/AF (7).</td>
<td>HRV $&lt;$ 60 ms everyday for 1 week (minimum 5 measured days) (nonoverlapping weekly windows)</td>
</tr>
<tr>
<td>% of pacing CRT</td>
<td>This trend records the percentage of ventricular pacing on each day (13).</td>
<td>Ventricular pacing $&lt;$ 90% for 5 of 7 days (nonoverlapping weekly windows)</td>
</tr>
<tr>
<td>ICD shock for potentially lethal VT/VF</td>
<td>This trend records whether a patient has received an automatic ICD shock for an episode detected as VT/VF and includes both appropriate and inappropriate shocks (14).</td>
<td>$\geq$ 1 shocks during the evaluation period</td>
</tr>
</tbody>
</table>

Whellan DJ, et al. JACC 2010
Powerful Cardiac Monitoring

Small. Nearly 90% Smaller.

Simple. Minimally Invasive

Connected. Continuous, Wireless Monitoring

Precise. Superior Data Quality
CareWireless Transmissions

- Daily audit at scheduled time
- Device wirelessly sends
  - Lifetime Episode Counters and Histograms
  - 10 sec Current ECG
  - 30 sec of ECG for 1 episode, if any new episodes have been detected
  - 10 sec Longest AF of the day
- A report is auto-generated **if**:
  - Your CareAlert criteria are met, triggering an Event Report
  - You have scheduled a Summary Report
**CareAlerts**

**Patient Details:** Johnson, Rea

- **Reveal LINQ™** Date of Implant: 7-Mar-2012

**CareAlert Notification**

Change the alert groupings just for this patient by making selections below. This does not impact the patient's device settings, only how specific alerts for this patient are categorized on the Transmissions list.

- [ ] Display more
- [ ] Use Clinic’s 🎇 Alert Groups for this patient.
- [ ] Override Clinic’s 🎇 Alert Groups and customize for this patient.

### Clinic Settings

<table>
<thead>
<tr>
<th>Clinical Management Alerts</th>
<th>Red Alerts</th>
<th>Yellow Alerts</th>
<th>Website Only Alerts</th>
<th>No Alerts</th>
<th>Red Alerts</th>
<th>Yellow Alerts</th>
<th>Website Only Alerts</th>
<th>No Alerts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom (Patient Activated) Episode</td>
<td>🎇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptom (Patient Activated) + Detected Episode</td>
<td>🎇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tachy Episode</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Pause Episode</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Brady Episode</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>AF Episode</td>
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<td></td>
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<td></td>
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<tr>
<td>AT Episode</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Customized Patient Settings

- **AT/AF Daily Burden > Threshold**
  - **Time:** 12 hrs/day
  - [ ] Enable notification on patient home monitor.
  - Phone: 555-555-5555
  - Note: Displays on patient home monitor when triggered. Phone
Remote monitoring is presently a safe technology, widely accepted by patients and physicians, for its convenience, reassurance, and diagnostic potential.  **ADVANTAGE**

Before remote monitoring can be routinely used, technical, procedure, and ethical/legal issues should be addressed.  **DISADVANTAGE**

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**Benefits of Remote Monitoring Systems**

- ✔ reducing the number of hospital visits
- ✔ patient and health team satisfaction
- ✔ efficacy and safety
- ✔ survival & ↓ hospitalization due to HF

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**EASY TO USE**
The clinical relevance of remote monitoring

- Better patient compliance when compared to conventional follow-up - TRUST
- Decreases the number of patients lost to follow-up - TRUST
- Detection of events with clinical impact on ICD programming/intervention 79% more rapidly than in conventional follow-up - CONNECT
- Detection of events with impact on PM programming/intervention more rapidly than in conventional follow-up\(^3\) - PREFER
- 18% reduction of emergency care visits and non-scheduled out-patient visits in heart failure patients - EVOLVO
- Time consuming for the remote evaluation is 60% less\(^5\)

\(^4\)Evolvo Study: Circulation. 2012;125:2965-2967
\(^5\)Raatikainen MJ et al. Europace, 2008; (10): 1145-51
FOLLOW-UP OF CARDIAC IMPLANTABLE DEVICES

- human resources with specific training (doctors, nurses, AP)
- multidisciplinarity (EP & HF team)
- scheduled every 3-6 months + alerts (ALL EQUIPMENTS!)
- detection and resolution of problems
- identification and interpretation of detected arrhythmias (EGMs)
- CRT patients »»» higher complexity!
- population with important co-morbidities

COMPLEX (AND AMBICIOUS) TASK

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Questions regarding medico legal implications related to the use of remote monitoring have been raised.

REMOTE MONITORING IS NOT AN EMERGENCY CARE TOOL!!
Practical issues in Remote Monitoring

implementation methodology
management and organization
“remote monitoring for all”?...

maintaining (high) performance levels
develop algorithms for alert notifications
legal aspects / responsibility
data protection
reimbursement

HUMAN (AND LOGISTIC) RESOURCES
Informed Consent

► it is not an emergency service!!!
► benefits and limitations!!
► authorization of transmission, recording, analysis, use of data for clinical and scientific purposes
► respect for privacy and confidentiality
data obtained by RM should be reviewed within reasonable time and frequency during office hours and immediate action should be undertaken when problems are identified.

active communication between the treating physicians provide comprehensive information about the findings.
Efficacy and Safety of Remote Monitoring in ICD Patients

- 30% reduction in the number of scheduled visits (1 year follow-up)
- VT/VF, SVT/AF, arrhythmic storm, inappropriate shocks, electrode dysfunction in 35 patients
And if the patient has symptoms? What is the recommended approach?

With the physician’s permission, communication can be initiated by the patient, who simply has to push a button on the communicator to begin the ad-hoc interrogation process in addition to scheduled interrogations.

Examples of clinical impact of remote monitoring

<table>
<thead>
<tr>
<th>Early identification of ...</th>
<th>Clinical Action taken ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial Fibrillation</td>
<td>- Anticoagulation</td>
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<tr>
<td></td>
<td>- Cardioversion</td>
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<td></td>
<td>- Ablation</td>
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<tr>
<td>Ventricular Tachycardia</td>
<td>- Device reprogramming</td>
</tr>
<tr>
<td></td>
<td>- Ablation</td>
</tr>
<tr>
<td>Heart Failure Progression</td>
<td>- Office visit</td>
</tr>
<tr>
<td></td>
<td>- Medication</td>
</tr>
<tr>
<td>Loss of CRT Therapy</td>
<td>- Electronic Repositioning</td>
</tr>
</tbody>
</table>
uniformity and consensus in the team's response to the transmission of alerts.

expand the debate (multidisciplinarity), justifying the studies focused on relevant aspects of clinical practice.

reorganization of the functions in the arrhythmology/HF team:

- analysis data transmitted (daily basis/weekly “shifts” - AP → EP/HF physician)
- decision-making in the management of the "alerts"
- contact with patients and type of information available
- request unscheduled visits
- possibility for remote monitoring intensification
- guidance for reprogramming or for revision of the equipment
Remote monitoring of cardiac implantable devices: present and future

✓ Is a major issue in the follow-up of implantable cardiac devices.  
✓ Is a safe technology, widely accepted by the patients and health team.  
✓ It allows physicians to respond more proactively, both for monitoring device status and treatment, and to identify potential harmful situations more efficiently.  
✓ It may contribute to cost (and time) savings in healthcare.  
✓ It still needs to be determined which pts will benefit most and in which cohort this modality proves to be more cost-effective.  
✓ Further studies are needed to address technical issues, organization of hospital resources and ethical/legal questions.