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Remote Monitoring of Cardiac Patients

- Background
- Remote Monitoring, why
- Remote Monitoring, how
- Lessons learned
- Challenges



Background (mine)

- M.Sc.EE (1987)
- Medical Electronics
- Care2Wear A/S, co-owner
- HiQ Copenhagen, consultant



Background (domain)

- Hospitalized cardiac patients are frequently monitored (24x7)
 - Stationary – bedside monitoring
 - Telemetry – restricted mobility
 - Scandinavia is leading in use of telemetry
- Technologies exist
 - Portable devices
 - Wireless data transport



Remote Monitoring, why?

- Patient mobility – send the patients home
 - Comfort – avoid or reduce hospitalization
 - Diagnostic context – monitor in 'real life' – quick feedback
 - Reduced risk of infections
- Multi-diagnosis patients
 - Orthopedic
 - Surgical
 - Psychiatric
- 'Expert backup'
 - Telemedicine

Remote Monitoring, how?

■ ECGLink

- Small, battery-driven, portable ECG device
- Mobile phone (gateway)
- Server (transformation, logging, link supervision)
- Interfacing to hospital
- 24x7 operation



ECG device

- Commercially available 3rd party device
 - 2 channels of ECG
 - Battery (24h continuous operation)
 - Bluetooth

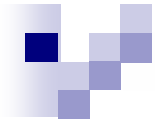


Gateway

■ Nokia N70

- Fairly simple software
- Interfaces BT and TCP/IP (over GPRS)
- Autostart
- Link supervision
- No user interaction





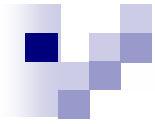
Server

- Proprietary communications server
 - Moves data from Gateway to Interface
 - Logs usage (billing)
 - Supervises links, reports status and usage

Interface box

- Receives data from Server
- Interfaces to existing monitoring system in hospital
- Indicates link status to staff





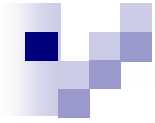
Economy

- Cardiac-ward bed
 - 2500-7500 DKK/day
- ECGLink
 - Max 1500 DKK/day
 - Depends on license agreement, usually somewhat lower



Status

- Stable technology
 - Matured for several years
- Commercially available
 - Since mid-2006
- In daily use at DK hospitals
 - Moving approx. 30MB / patient
- Even the media found out...
 - <http://www.berlingske.dk/article/20080313/danmark/703130052/>



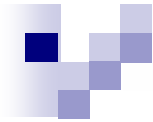
Limitations

- Patient selection is important
 - Non-risk patients only
 - Response time
- GPRS coverage
 - DK not a problem
- GPRS cost
 - Roaming



Lessons learned

- Extreme focus on ease-of-use is required
 - Battery change
 - Charging
 - Power-on
 - Indicators
 - Checklists and guidelines
- Training is vital
 - and follow-up
- Users like it



- more lessons

■ Patient contact

- Simple solutions work well
- VideoCall tried

■ TCP/IP over GPRS works well

- Also from an S61...

■ BT effective range is sensitive

- Varies from 20cm to 10m
- Device location is important



Challenges

- Gateway platform
 - Need few restrictions for software
 - Product market life
- Market inertia
 - Budget owners <> decision makers <> users
- Roaming cost
 - International
- Internet access from hospitals



Remote Monitoring of Cardiac Patients

- Commercially available
- Happy users
- Works well
- Market inertia





Thank you!

