

Wireless Health

Case Study: Wireless Health

- Category : Utilitarian
- Requirements: Continuous monitoring, Wearable – part of a plaster attached to the chest, unobtrusive, automatic download of data, no recharging – 6 mo battery life, no on-off switch
- Users: Patients, GP, Nurses, Hospital consultants
- Sensors: 3-D Accelerometer at 12.5 Hz
- Actuators: Visual display on tablet/smart phone
- Data Analysis: Calculate respiratory rate from sensor data which can vary between 8 to 50 breaths/minute
- Wireless protocol: Bluetooth LE to tablet/phone, WLAN to server

Identify unmet healthcare needs
Engage with the stakeholders
Create strong evidence base

Unmet Healthcare Need

Managing COPD



- Patients reported symptoms – unreliable and inaccurate
- Indicators of exacerbation
 - Increase in breathlessness
 - Changes in respiratory rate and breathing pattern
 - Reduction in activity
- Pulmonary rehabilitation to reduce recurrence of exacerbation

Continuous remote monitoring of Respiration and Activity

Unmet Healthcare Need



- Respiration – one of the four vital signs monitored in a SEWS chart
- Identify early exacerbation in COPD
- Support pulmonary rehabilitation post exacerbation

“Monitoring of patients with COPD at home may help NHS boards avoid costs of £1,000 per patient per year”

Source : A Review of Telehealth in Scotland, 2011

COPD Monitoring Service



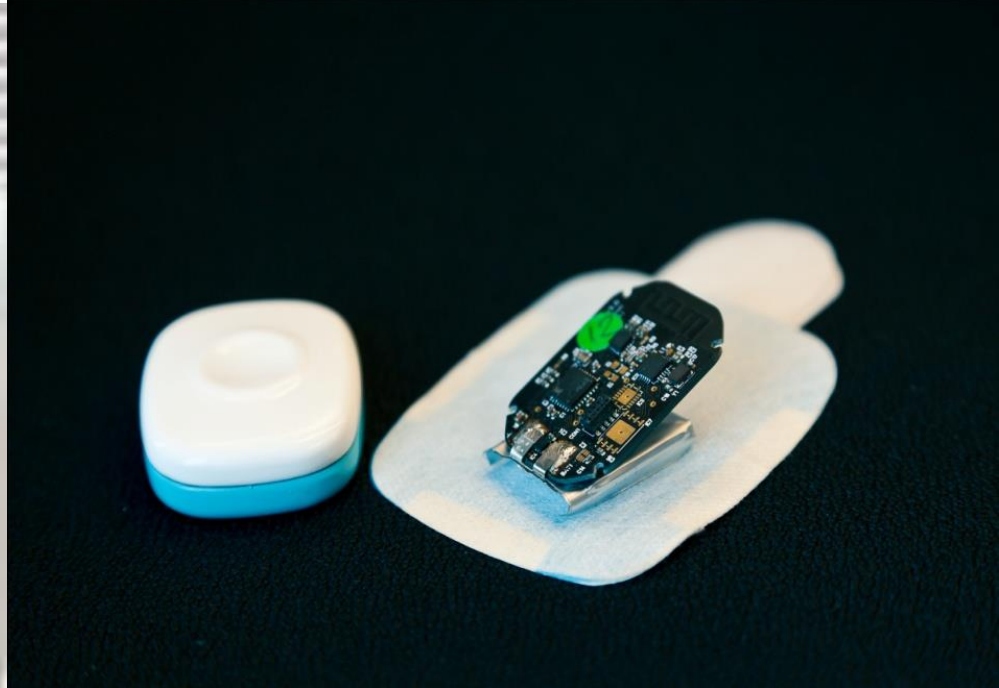
- Daily reports summarising hourly trends
- Option to access historical data
- Respiratory rate, respiratory effort/flow, activity
- Remote examination of patient's breathing in real-time
- Predictive models for exacerbation

Engagement with stakeholders

Focus Group

Patients, Carers, Hospital Consultants, General Practitioners, Nurses

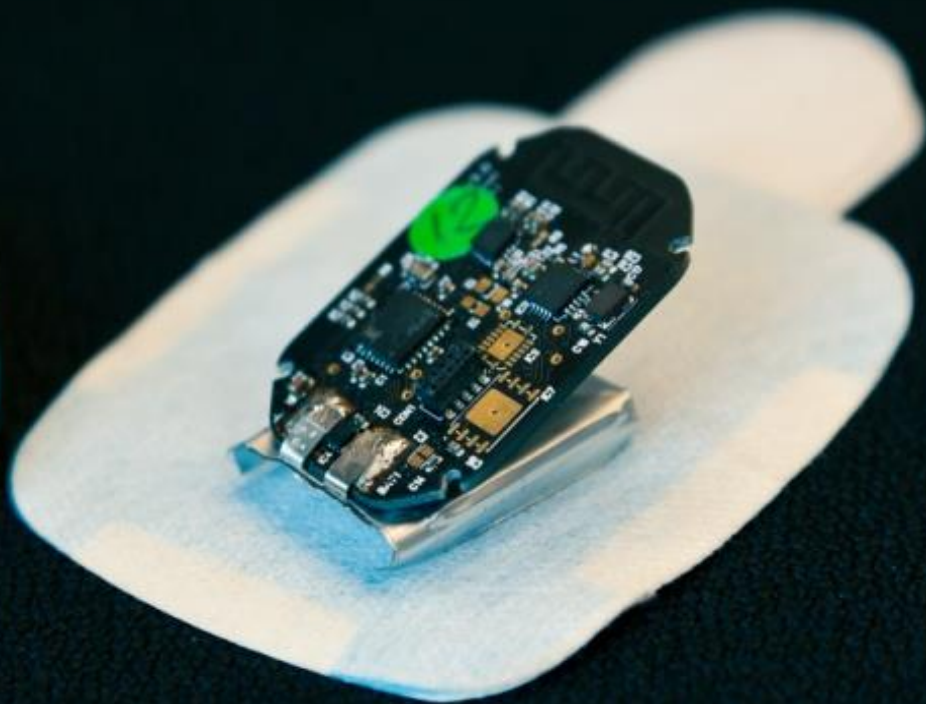
- Continuous (24/7) monitoring
- Wearability issues
- No on/off switches
- No battery recharging
- Automatic download of data



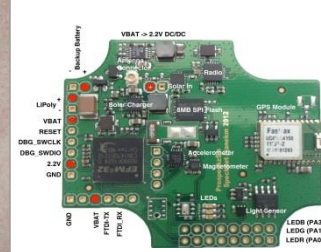
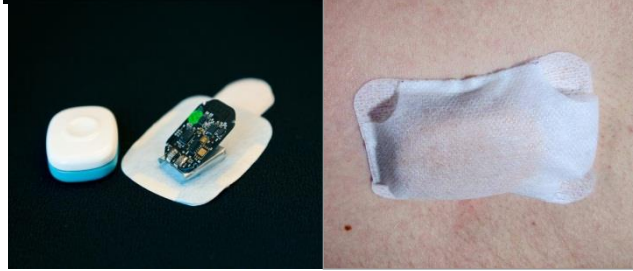
Patient-centric design



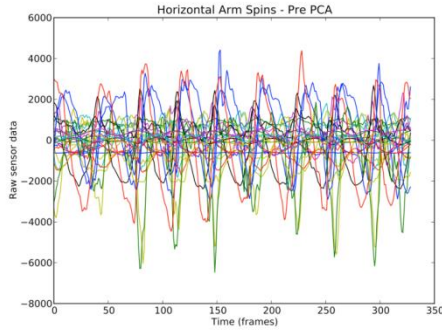
- Long-term wear
 - Light-weight - 17gms (incl. battery)
 - Unobtrusive - 4.5 x 3.7 x 1.3 cm
 - Battery lifetime - 6 months
- Ease of use & no manual intervention
 - No recharging of batteries
 - Data stored on wireless patch and downloaded to the base-station when within range
 - Always on



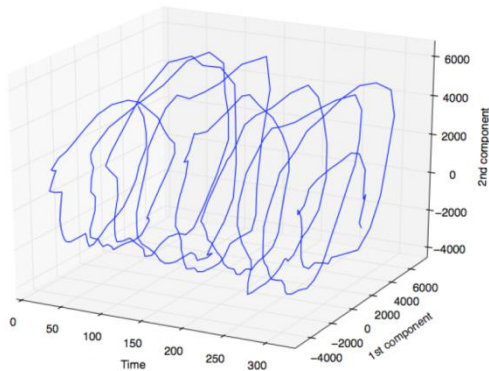
-
- Specks: miniature devices combine sensing, processing and wireless networking
 - Wireless patch for measuring respiratory rate, respiratory effort and activity
 - Continuous remote monitoring which transmits data to a secure server via fixed line broadband connection or 3G cellular network



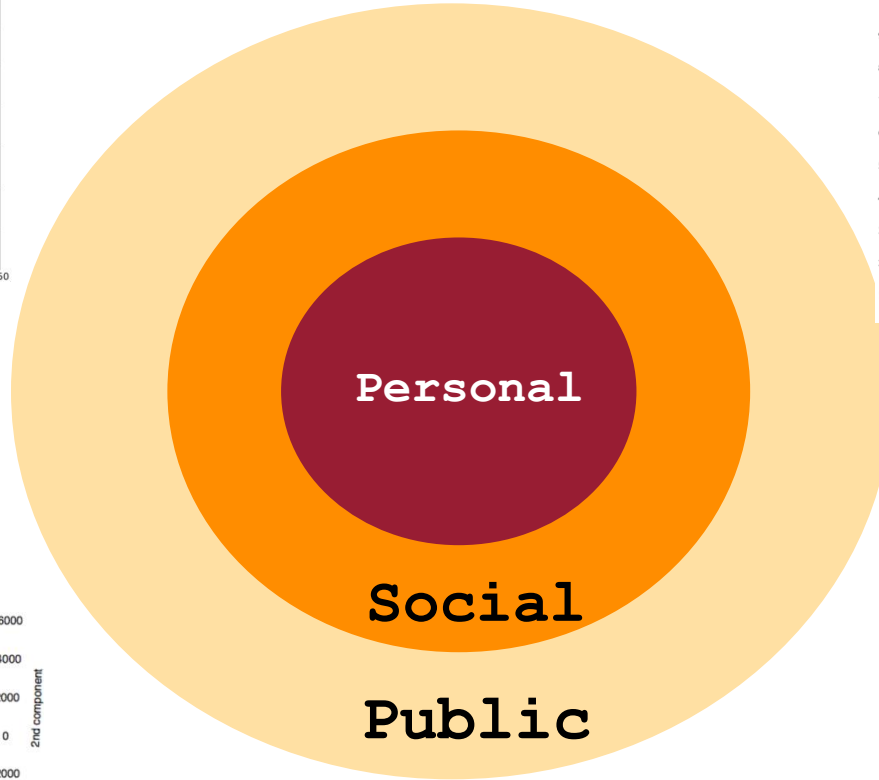
Sense – Learn -- Act



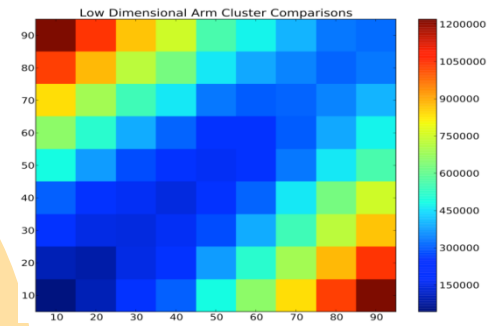
Computation



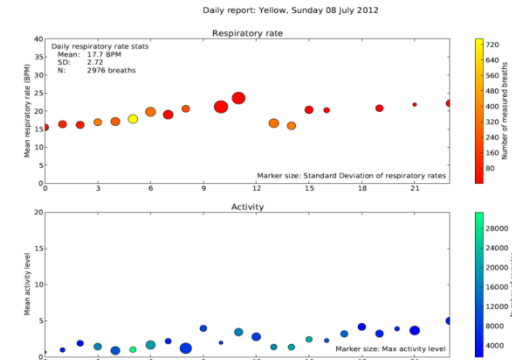
Speckled Computing



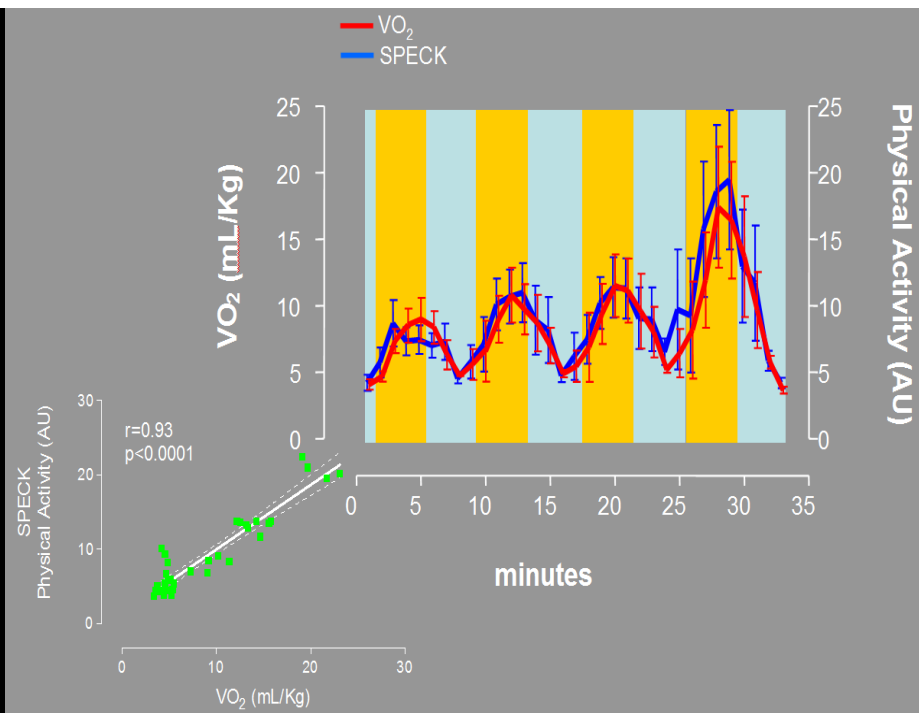
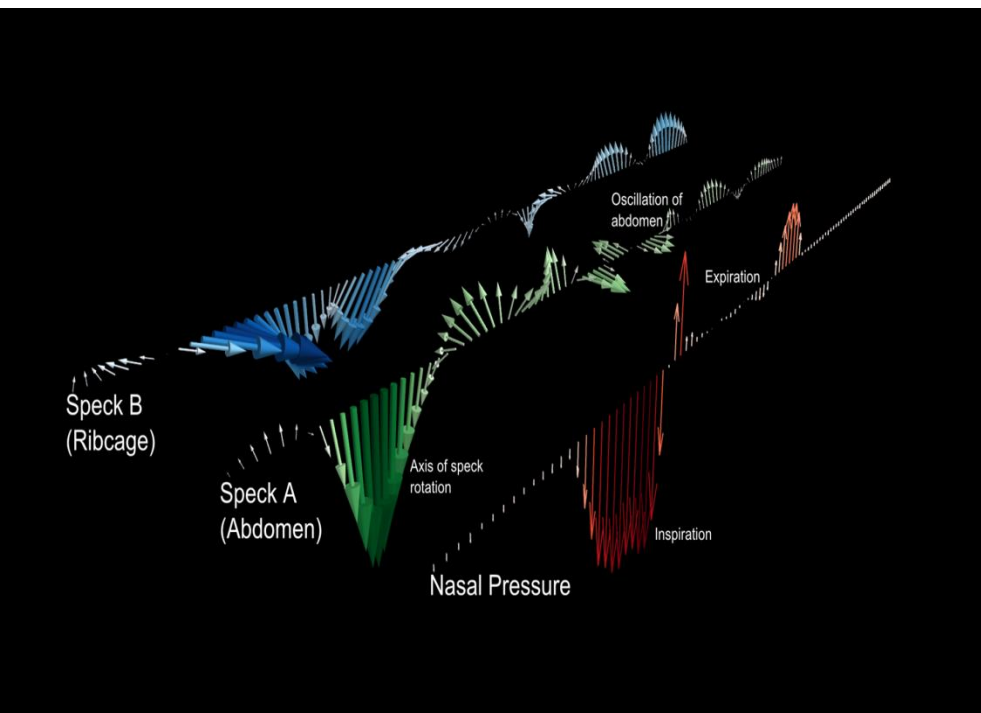
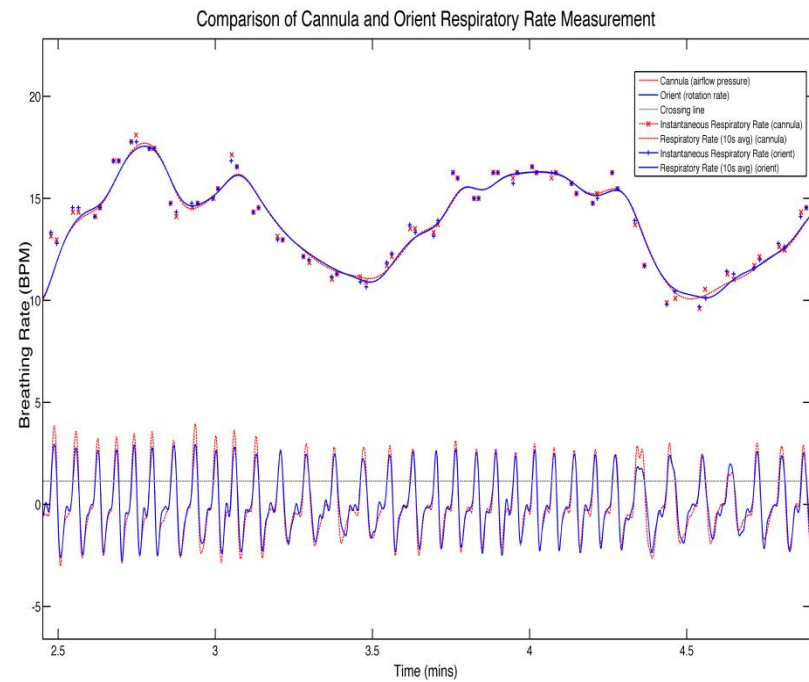
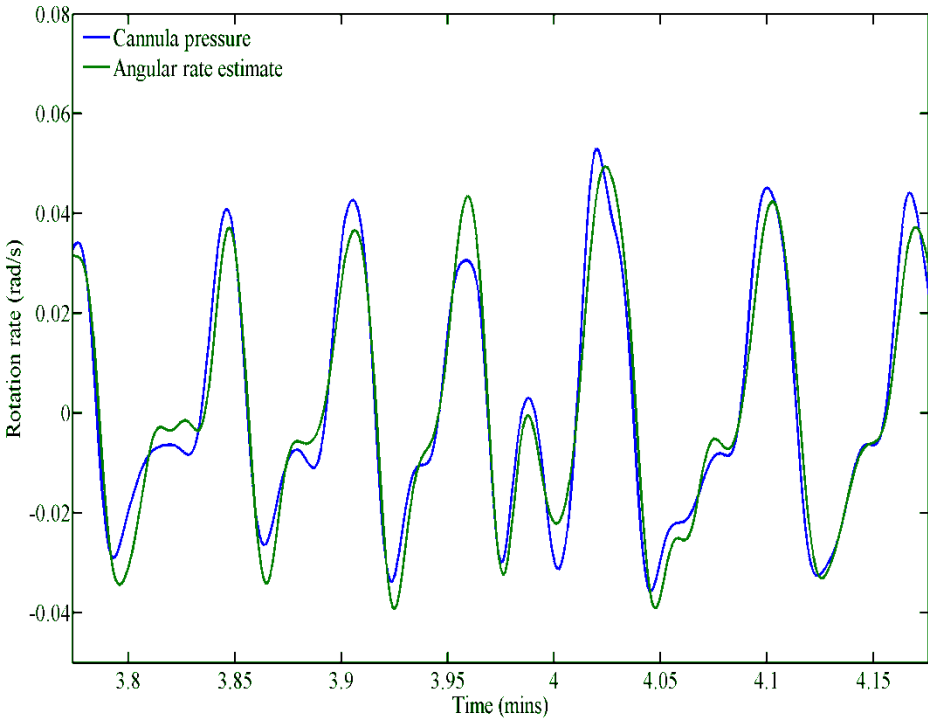
Communication



“Intelligence”



Evidence Base



Summary of results of clinical trials at RIE

248 hours of breathing were studied

Successful transmission 94% of the time

119,765 valid cannula breaths

105,416 matched to Orient breaths

Instantaneous respiratory rates agree to within 2BPM
for 86% of matched breaths

Mean absolute difference: 0.6BPM

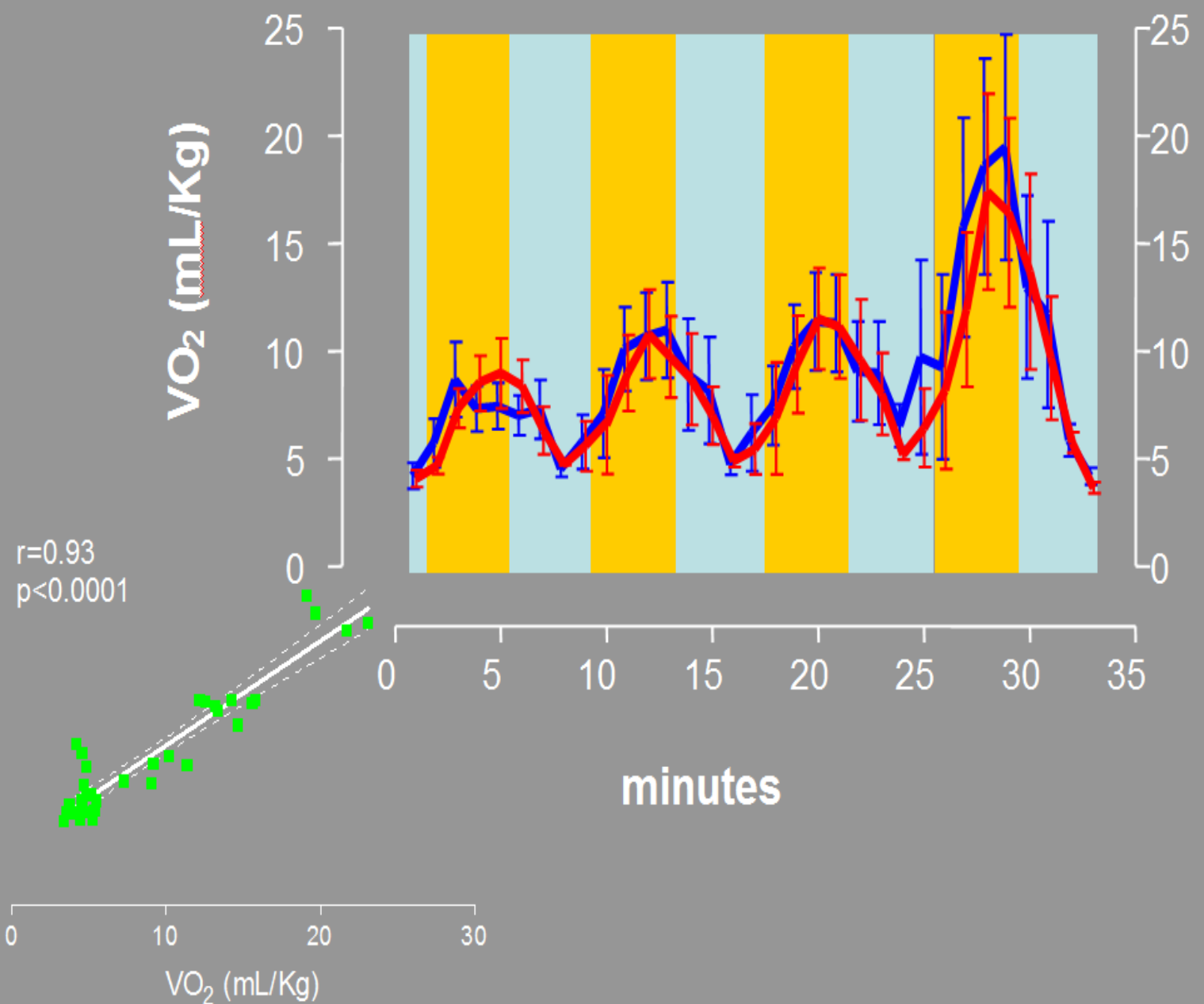
A reliable measure of respiratory rate was possible in
95.4% of the 5 minute epochs

— VO₂
— SPECK

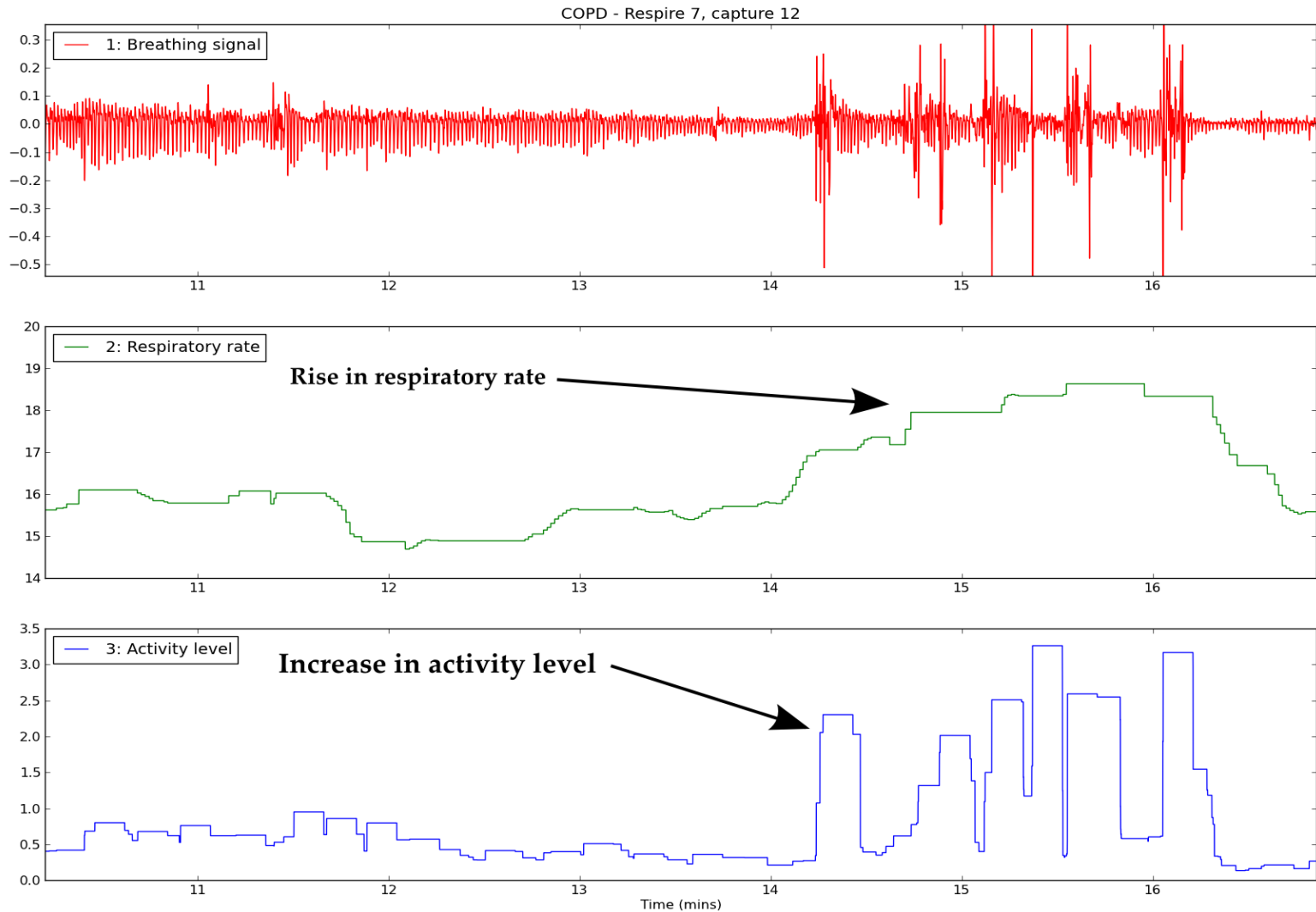
Physical Activity (AU)

VO₂ (mL/Kg)

SPECK
Physical Activity (AU)

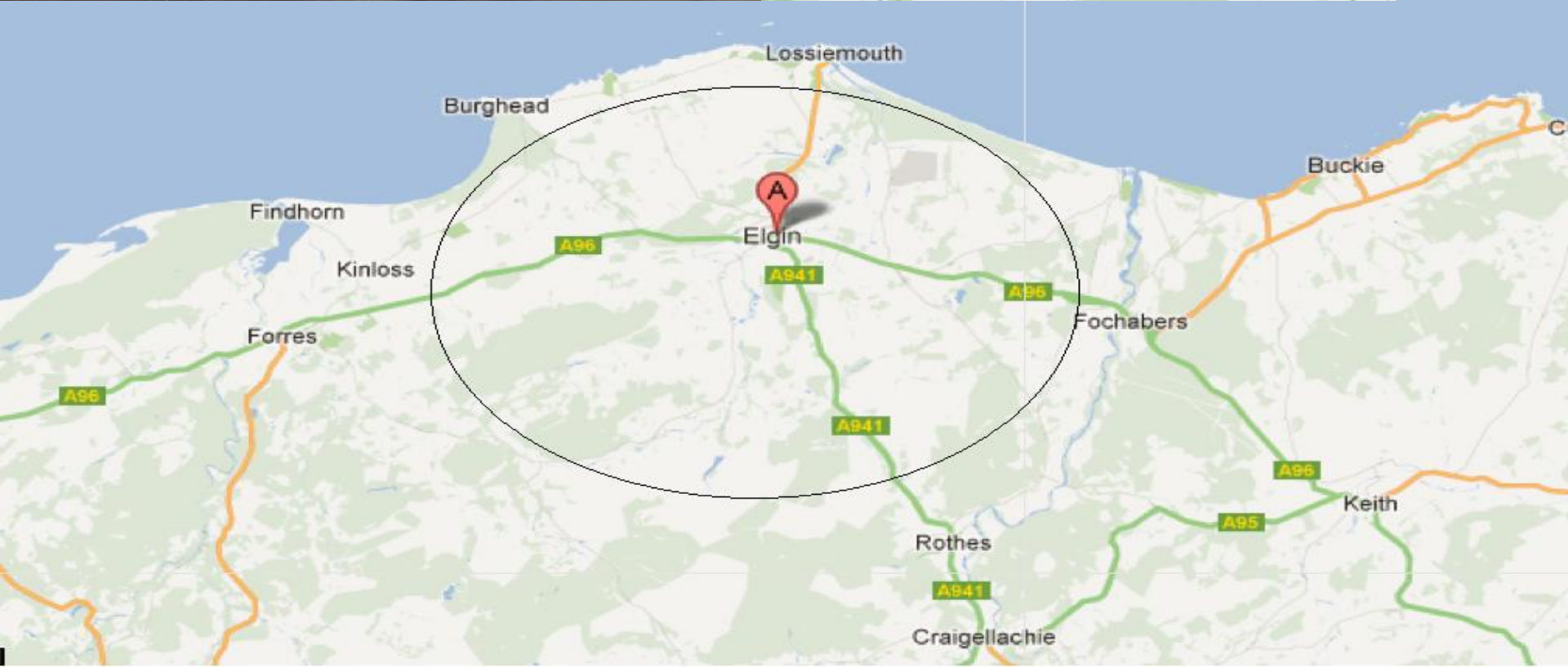
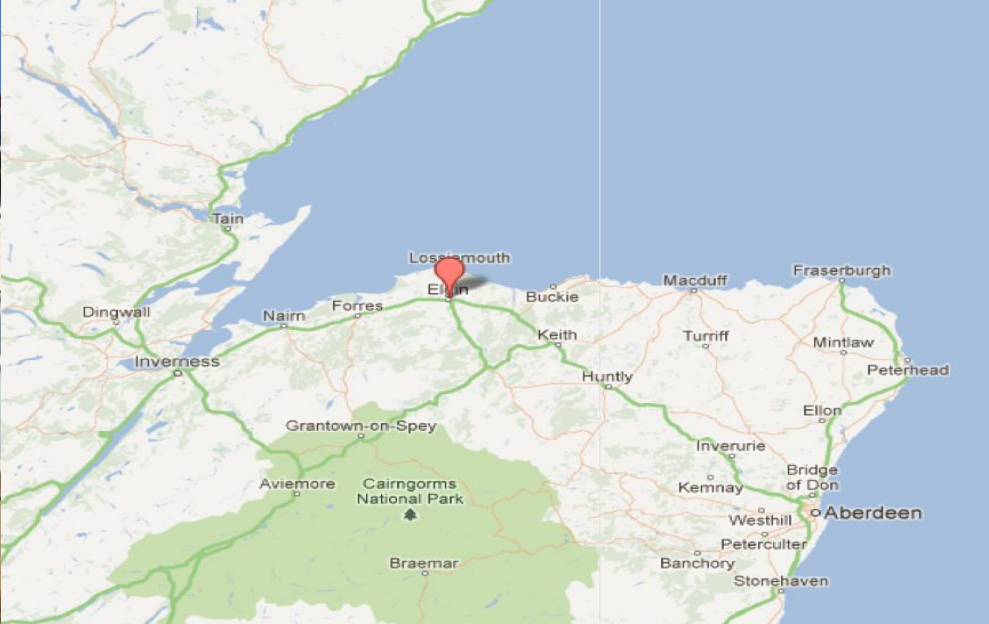


Simultaneous RR/Activity in COPD patient

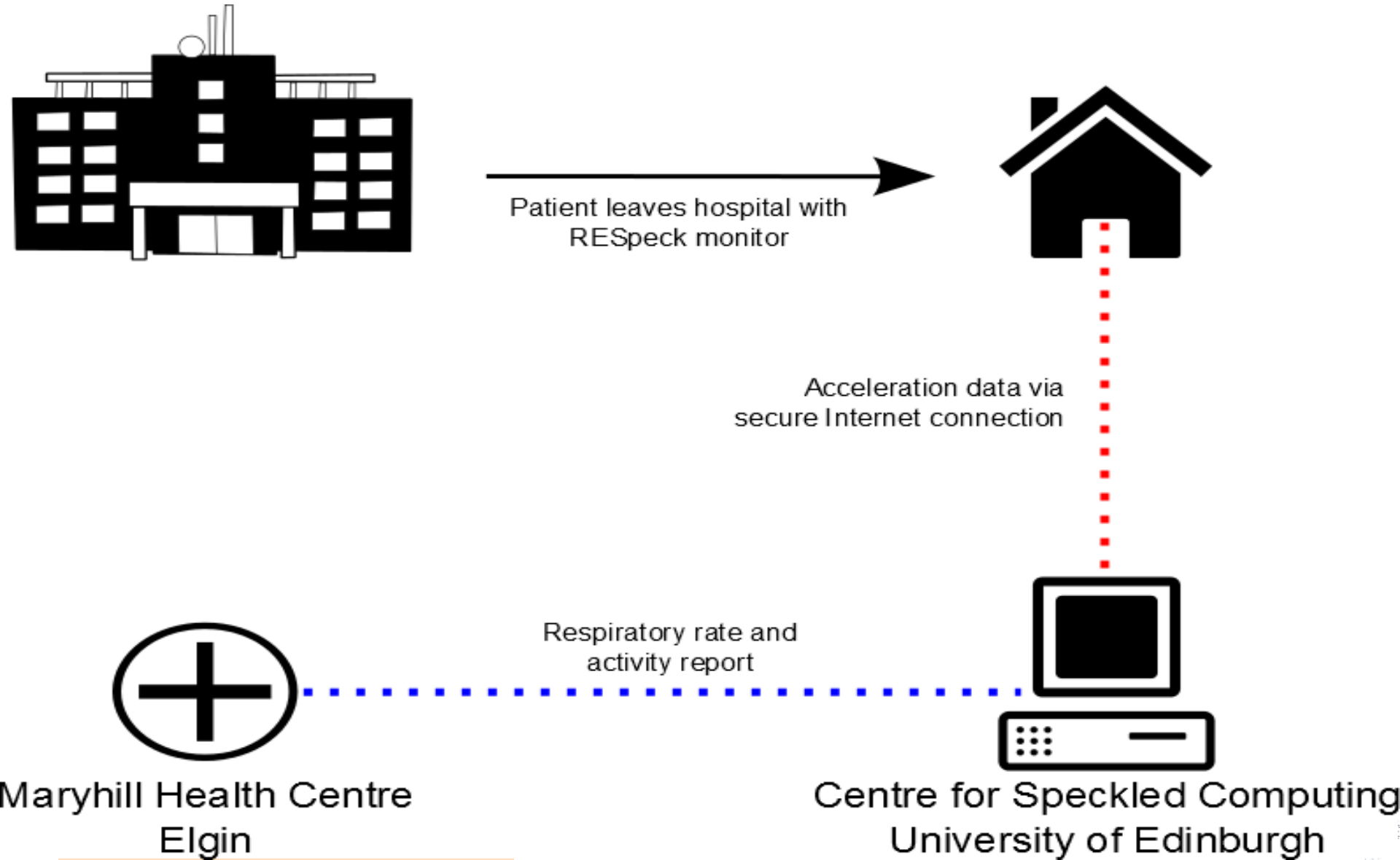


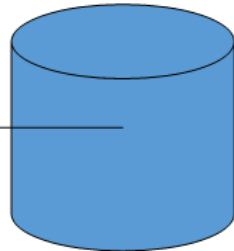
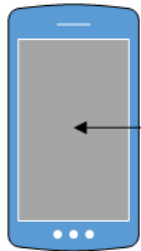
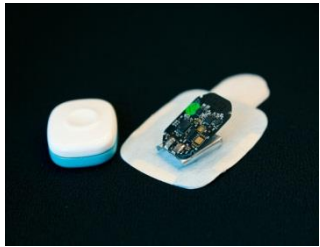
The Moray Study

- Study use of wireless respiratory and activity monitoring in a community setting
- Evaluate impact on the stakeholders: patients, clinicians, nurses, health authority
- Confirm usefulness of data in Primary care setting



Home Monitoring Data Flow

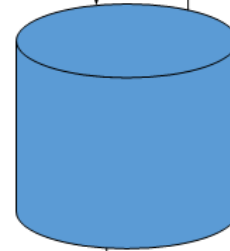




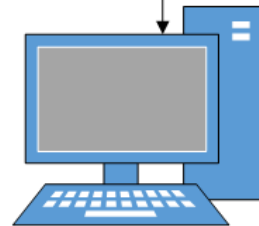
iPhone

SQLite DB

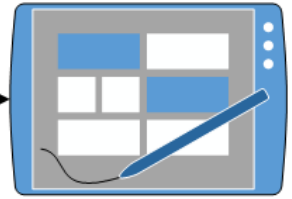
Server



Server DB

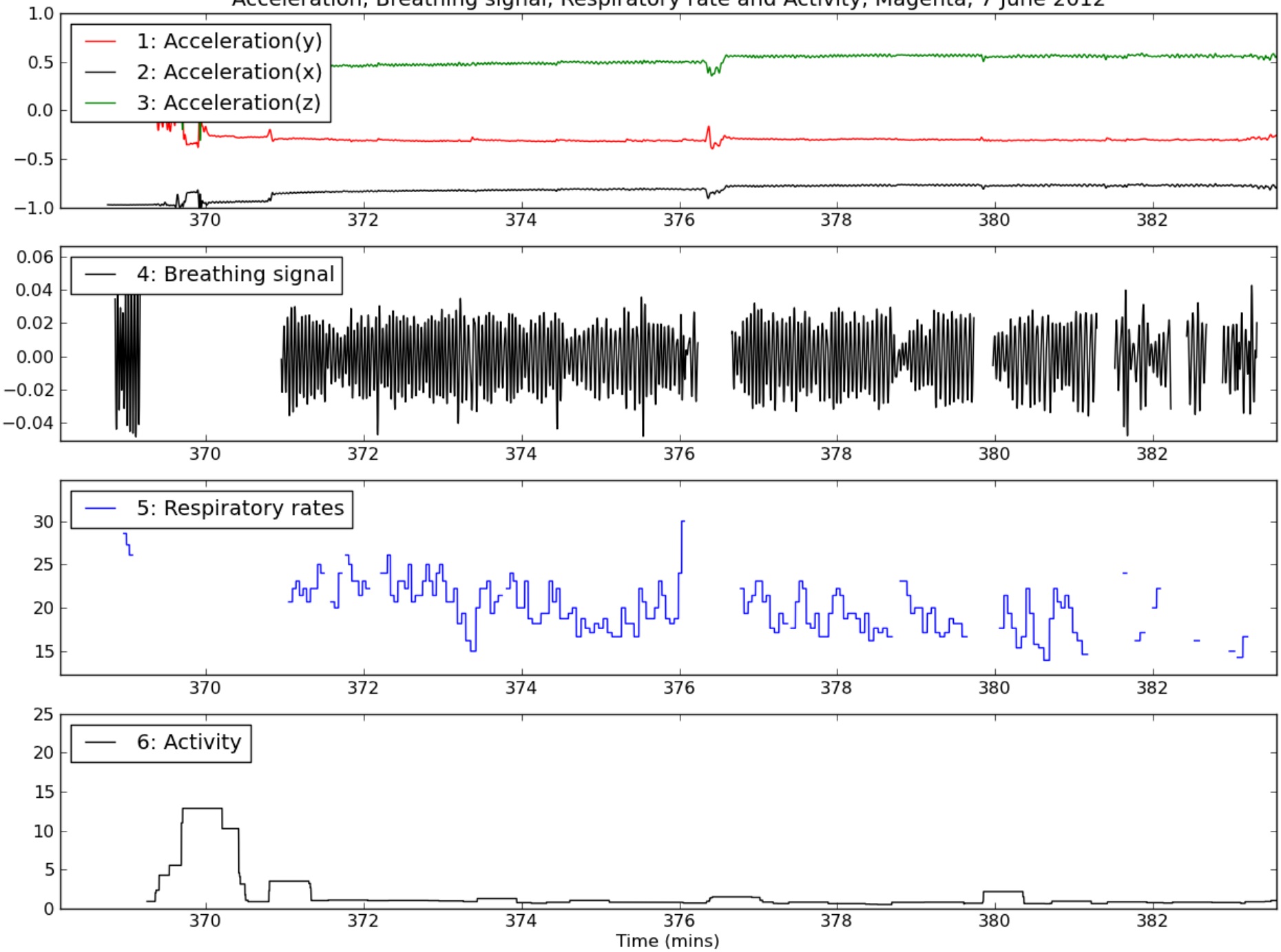


Desktop

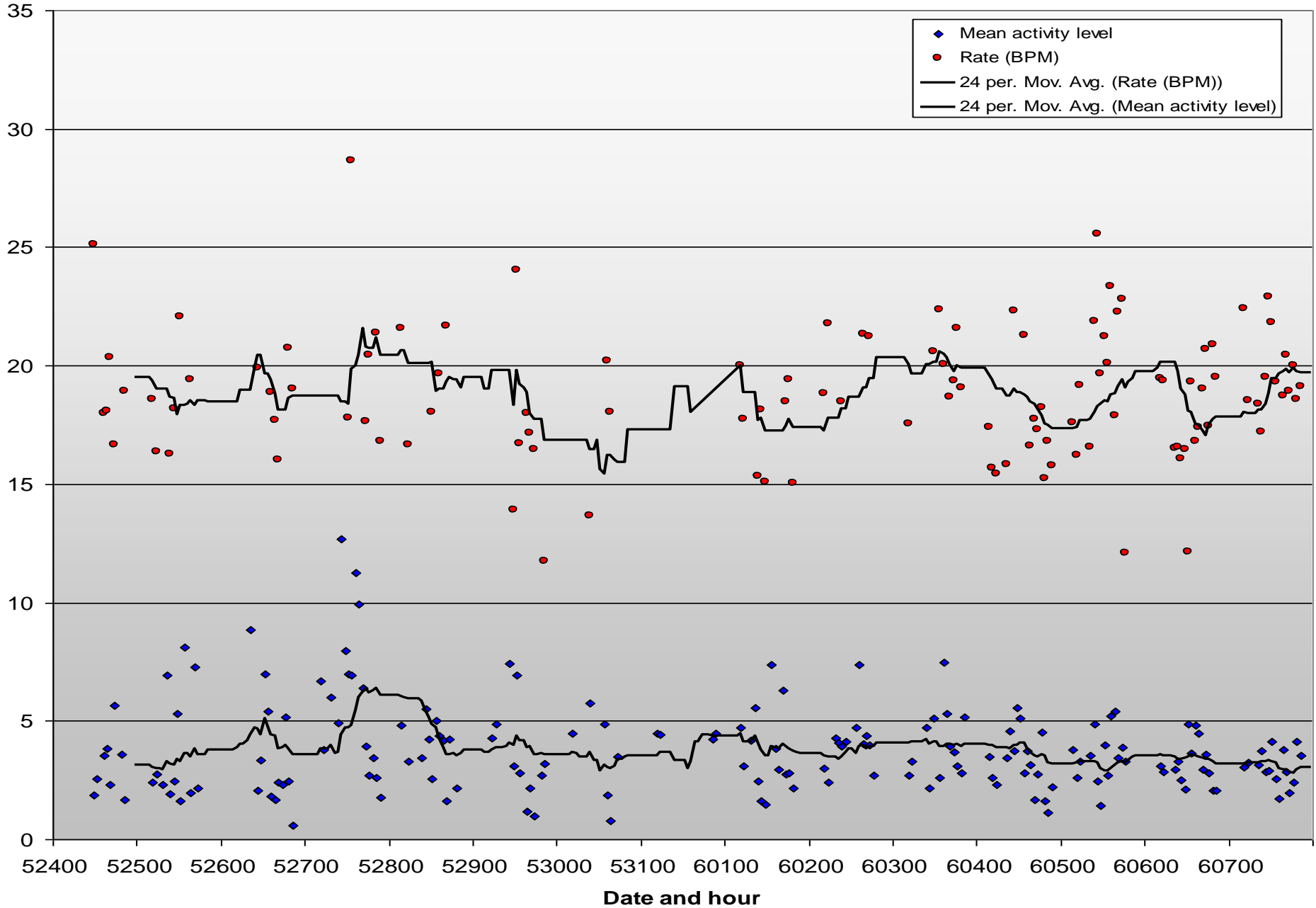


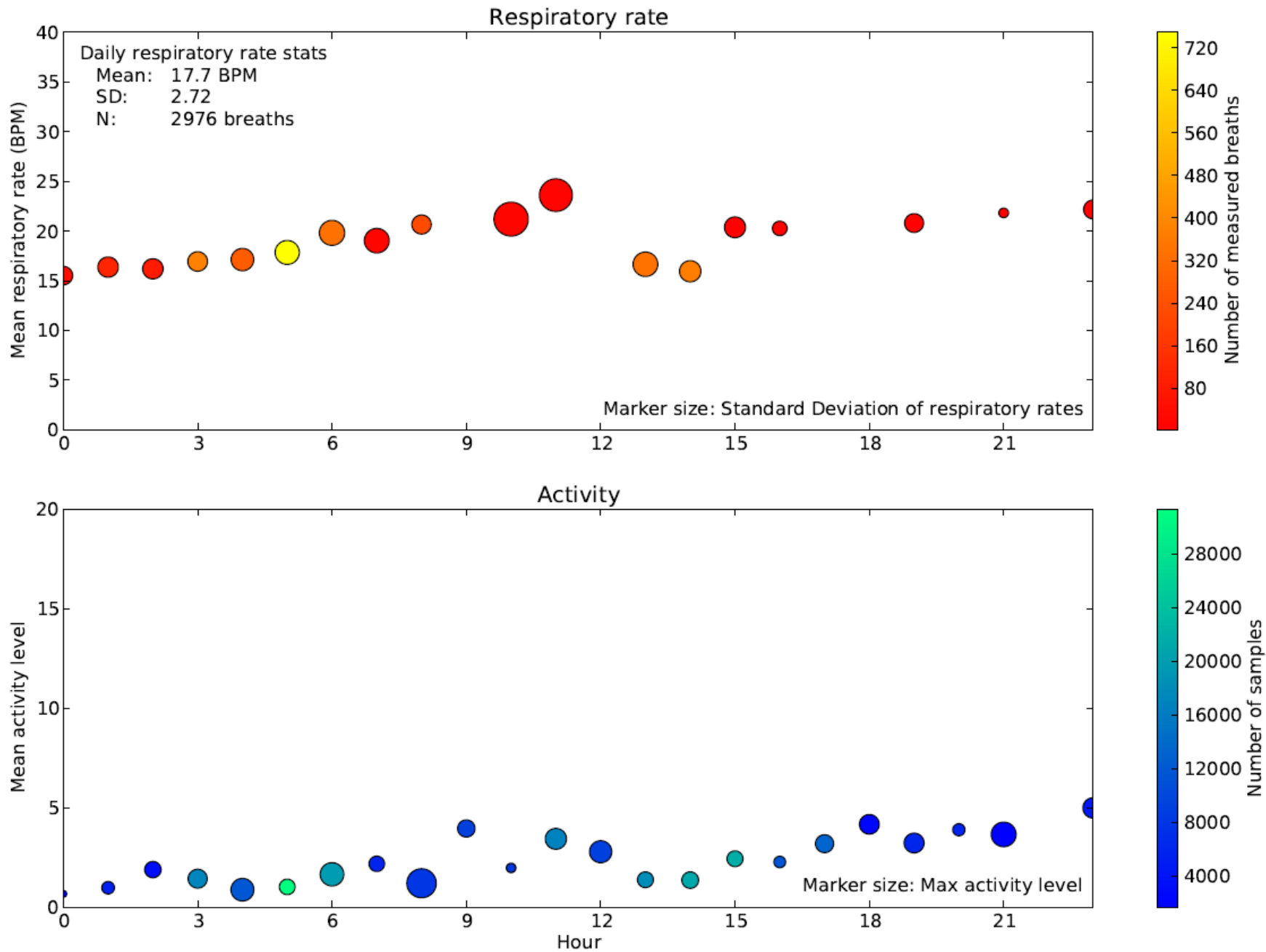
iPad

Acceleration, Breathing signal, Respiratory rate and Activity, Magenta, 7 June 2012



Respiratory Rate and Activity
Magenta, 24 May - 7 June





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