


The use of Speckled Computing in COPD

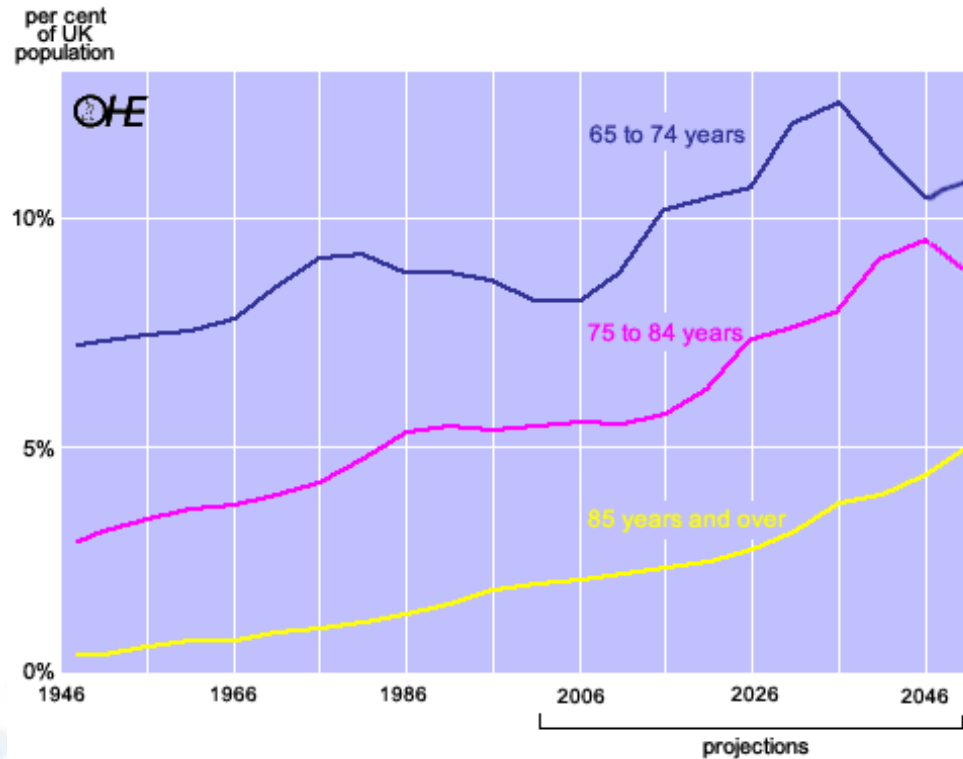
Brian McKinstry Janet Hanley

Overview

- Brief exploration of the background to Telehealth
 - Overview of our research programme
 - Problems with measurements in COPD
 - The need for a way of measuring respiratory rate
 - Early experiments with specks
 - Potential for the future
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Rapidly Aging Population

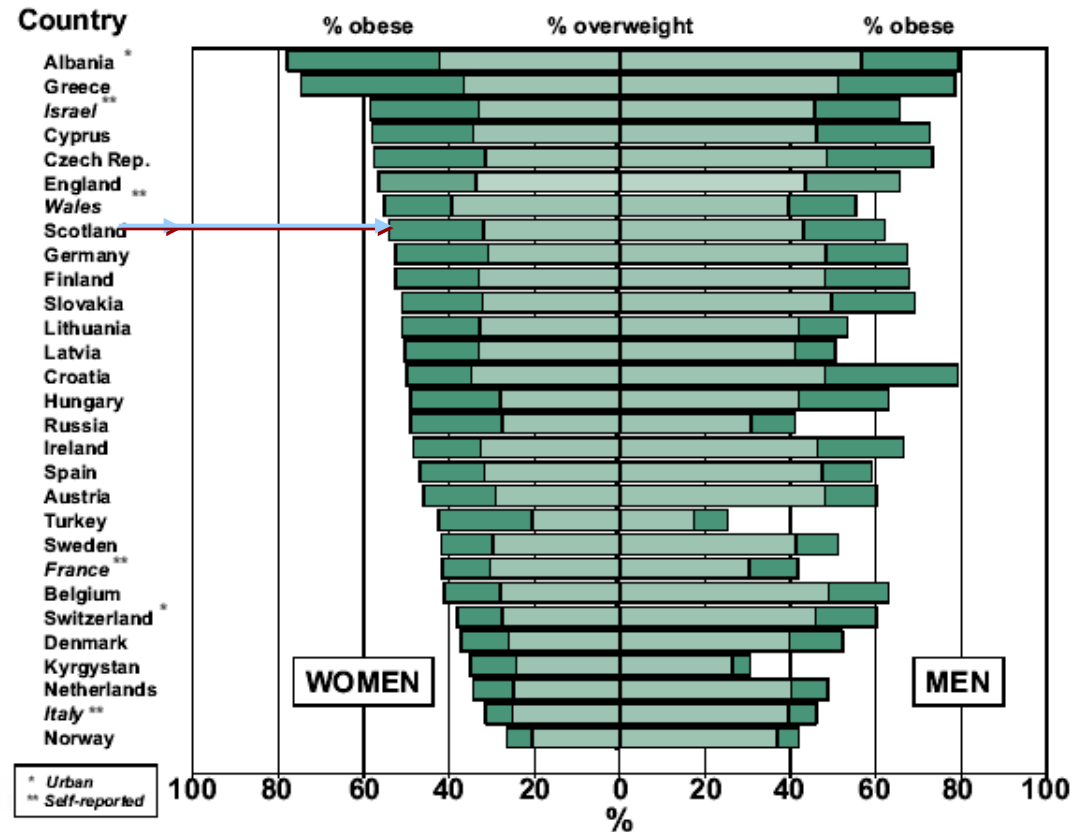
Expected growth in elderly population



Increasingly Unhealthy




Figure 1: Obesity levels in Europe



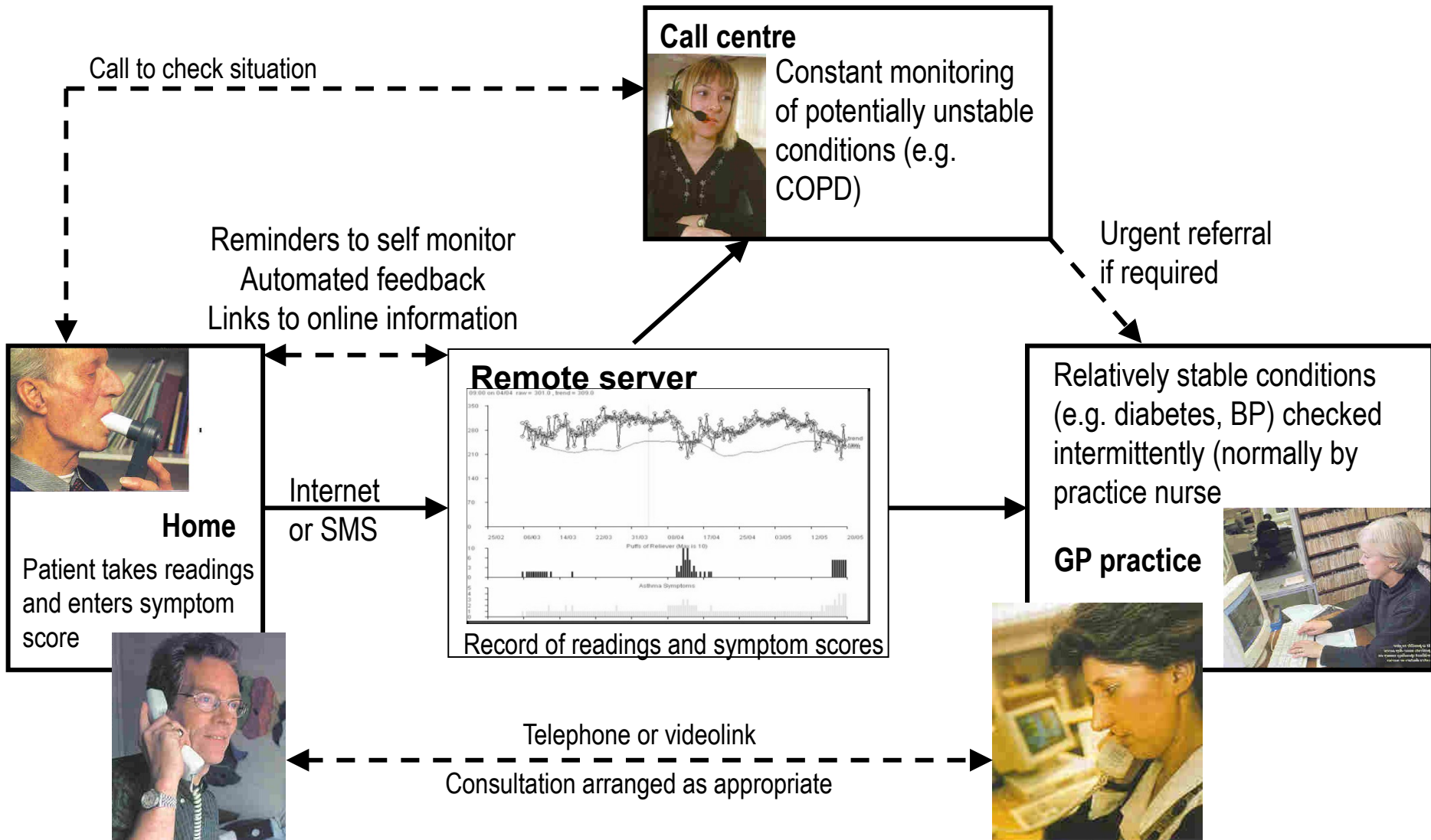
Source: International Obesity Task Force

Rise in Long Term Conditions

- **17.5 million** UK adults are living with a chronic disease
 - **By 2030** the incidence of chronic disease will double
- 


Telemetrically supported supervised self-monitoring





Models of telemetric supported self monitoring

Does it work

- Do patients and healthcare services like it?
 - Are outcomes improved?
 - Does it actually save time and resources?
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telescot Randomised Controlled Trials



- Hypertension

- A common largely asymptomatic condition (n=400)



- Diabetes

- A condition requiring multiple measurements, blood pressure, blood glucose and weight (n=270)

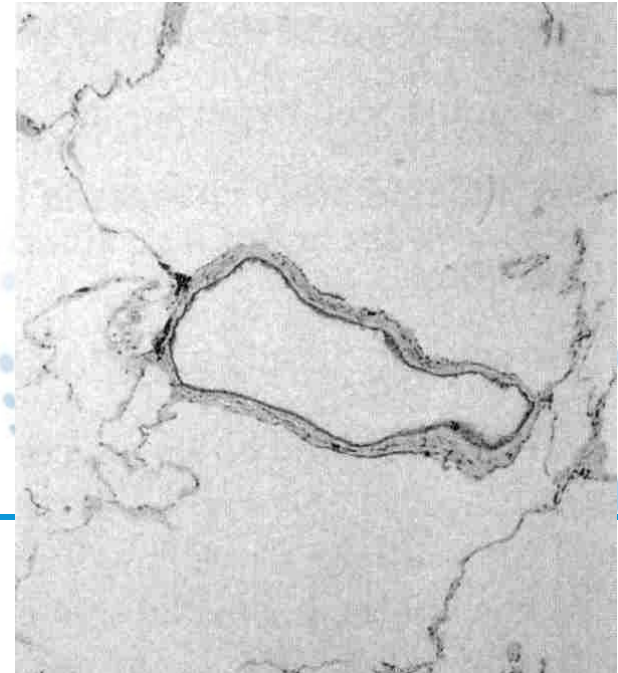
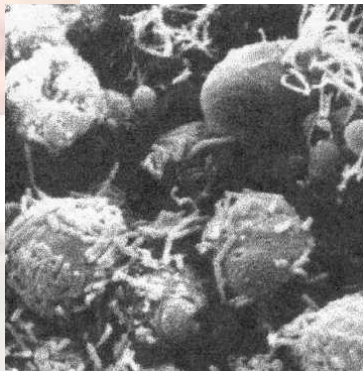
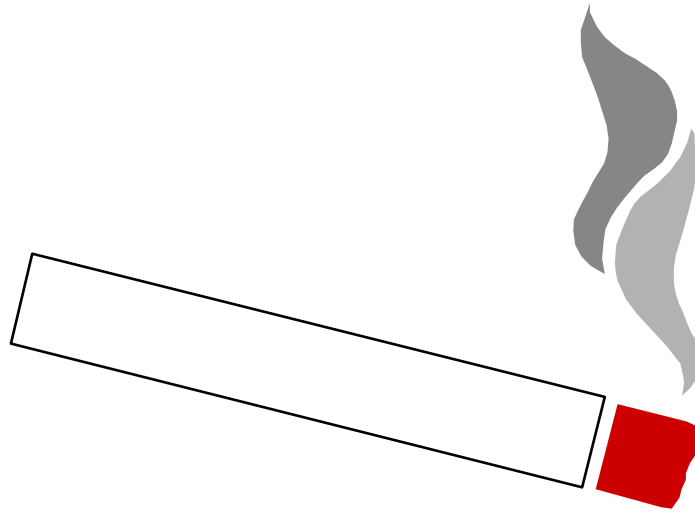
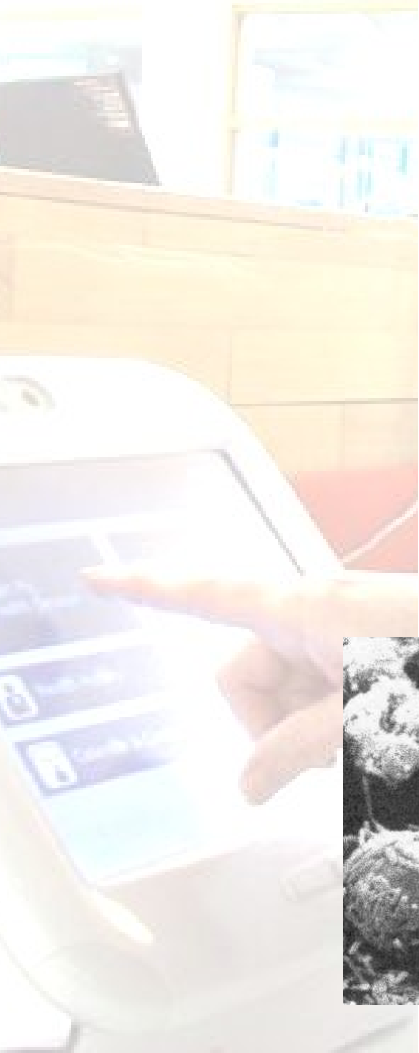


- COPD

- A symptomatic potentially unstable progressive condition (n=300)
- Additional descriptive studies in monitoring hypertension after stroke and early detection of deterioration in heart failure



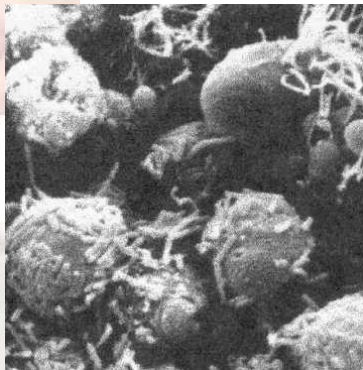
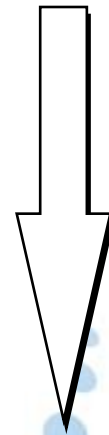
COPD – the disease



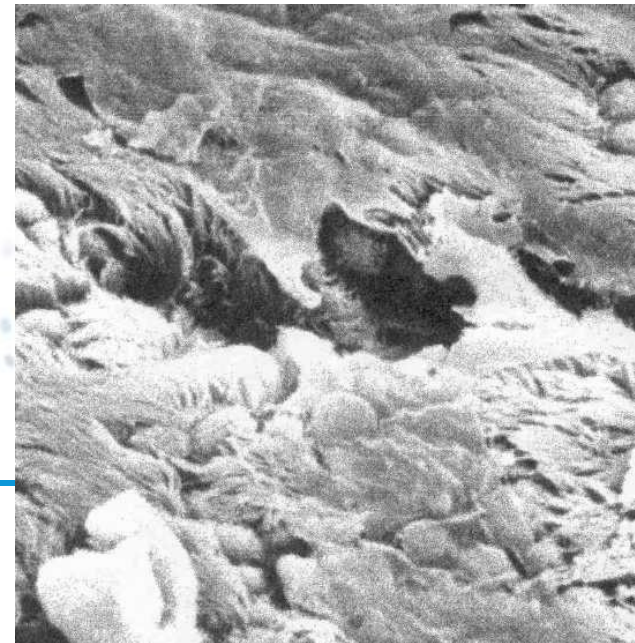
COPD – the disease



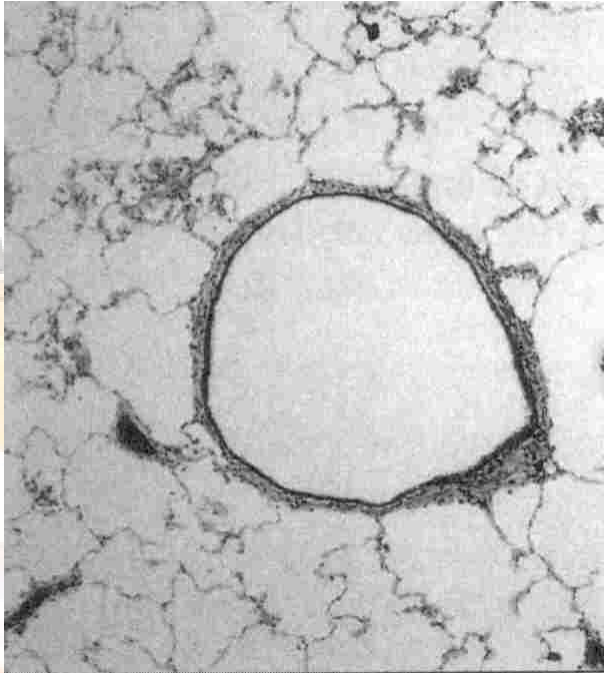
Hyperplasia of mucous glands
Increase mucus production
Paralysis of cilia



Infection
+/- inflammation



COPD – the disease



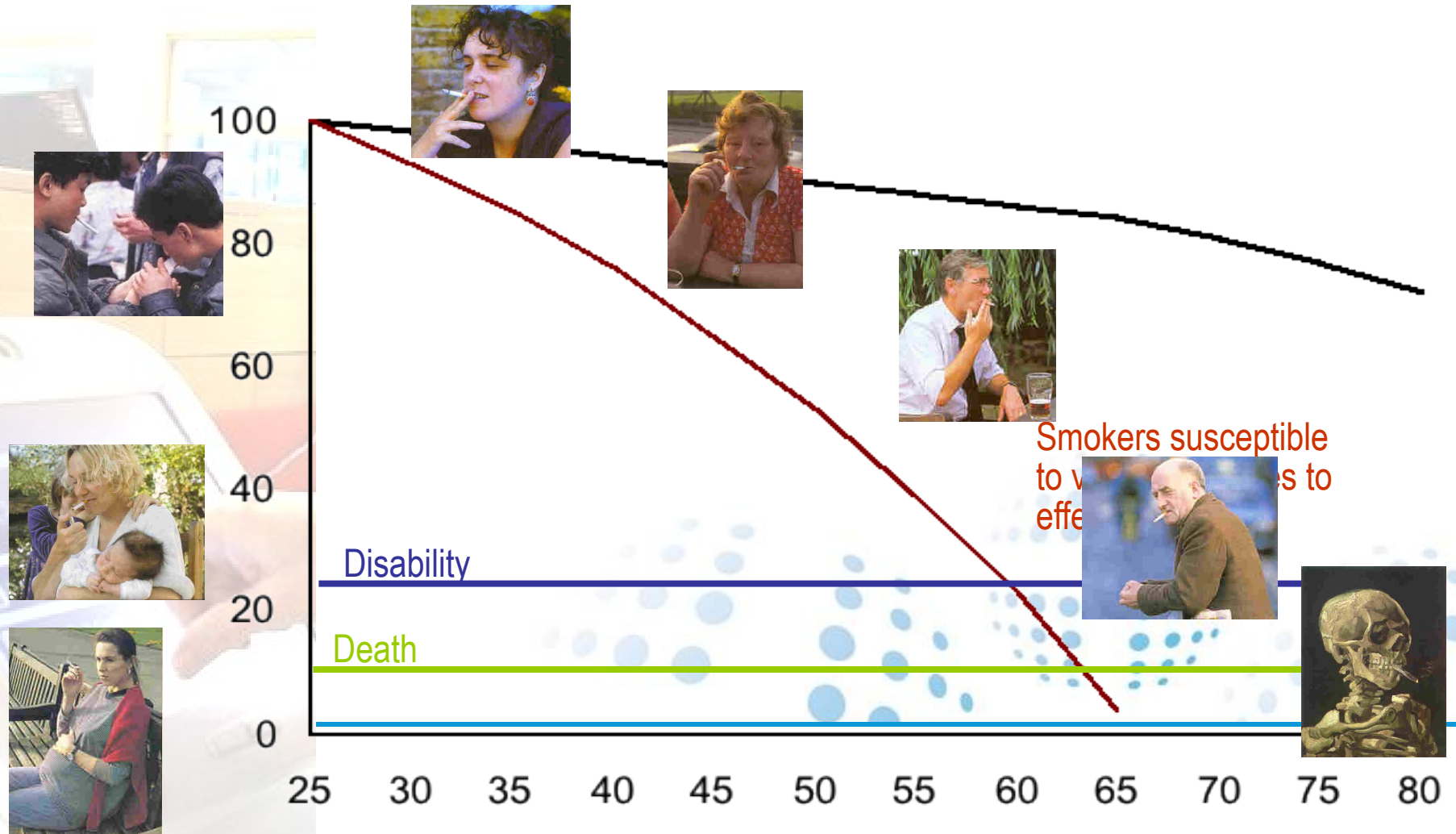
Dilatation of air spaces
Destruction of alveolar walls
Damage to lung structure




Loss of elasticity
+/- 'bullae'



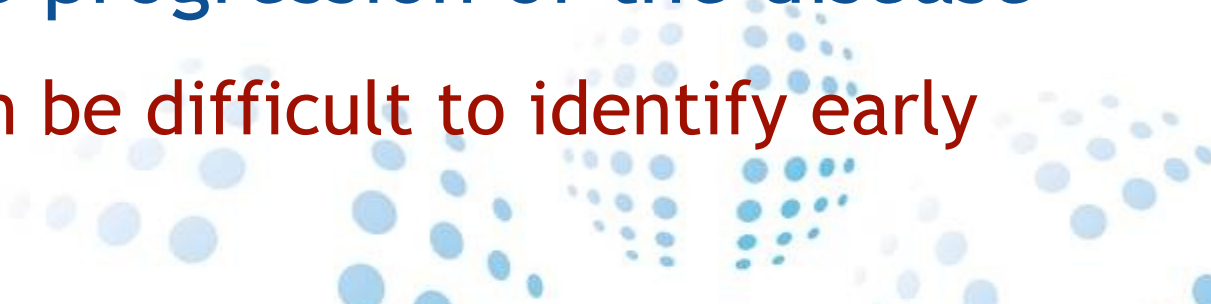
COPD – the disease



Interventions

- Stopping smoking
 - Early intervention in exacerbations with antibiotics and steroids
 - May reduce admissions to hospital
 - May reduce progression of the disease
 - However, it can be difficult to identify early exacerbations
- 

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- Stopping smoking
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Early Results COPD

- Complete questionnaire each day
- Physiological measures as needed
- Call centre/specialist service monitors



COPD monitoring

Each day, please record any WORSENING of symptoms from your usual daily level.

I am more breathless than usual

My sputum has increased in colour

My sputum has increased in amount

I have a cold (such as runny or blocked nose)

I have increased wheeze or chest tightness

I have an increased cough

I have a fever

I have a sore throat


<3 is OK

3-4 watch next day

5+ take action




COPD monitoring

- Check Forced Expiratory Volume
 - Difficult for patients to measure properly
 - Uncertain relationship with exacerbations
 - Check pulse and Oxygen saturation
 - Simple accurate measure but O₂ saturation is the last measure to fall
- 

Making sense of the symptom and telemetry data: Patients

- Some patients have difficulty distinguishing ‘bad days’ from significant deterioration

“You’d think you would find it easy to tell when you’re ill but it’s only afterwards that you know you are not well. But this technology is really brilliant.”




Making sense of the symptom and telemetry data: Clinicians

- Physiological measures did not always relate well to symptoms and deteriorations

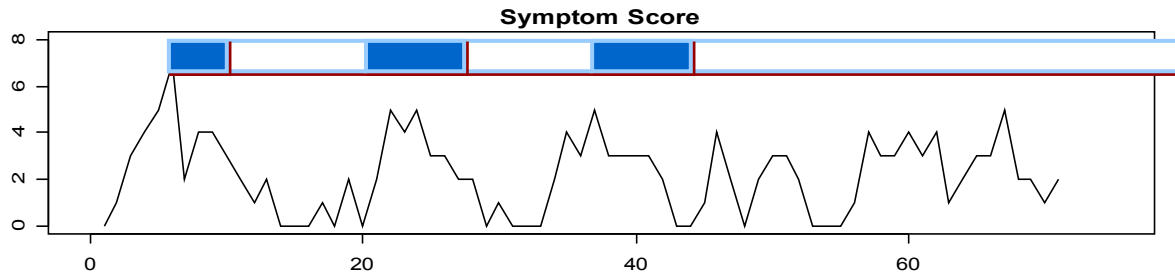
“Scores are only part of the picture. You need to see the person as well”

“You really need a sort of second layer (VC) to make sense of the scores, and decide if they need a visit. M’s scores are OK but I know... because I spoke to her that she’s really bad. Others score high and they’re fine”

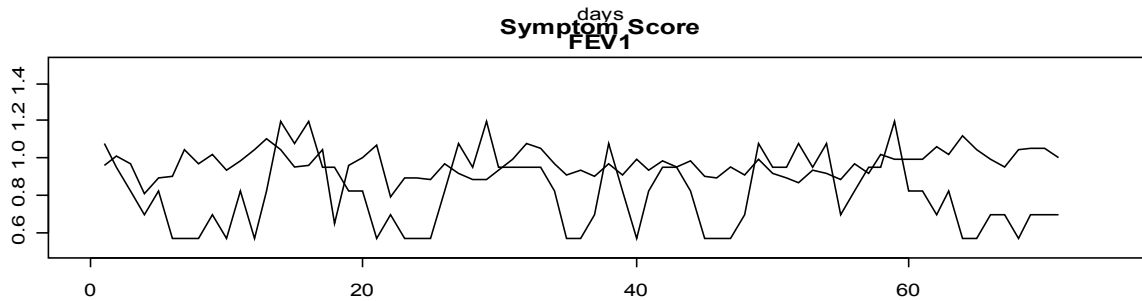


Variation in events and data

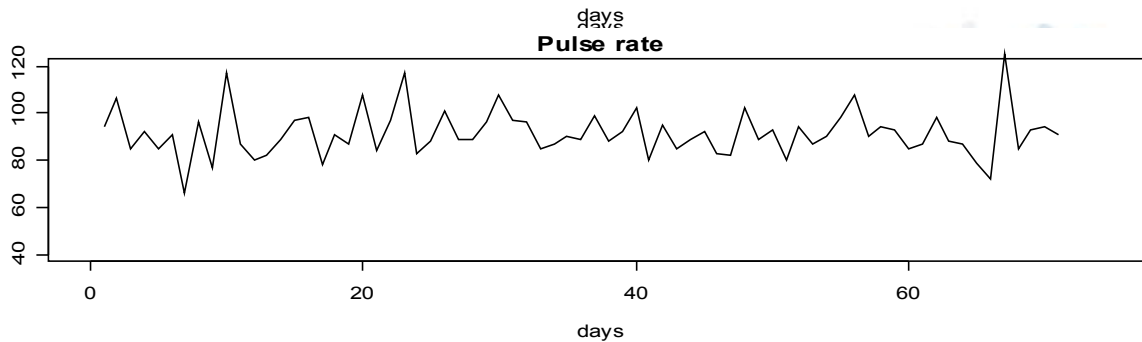
Symptom Score



FEV1




Pulse




Challenge


To find an easily measured physiological parameter that might help patients and clinicians distinguish bad days from exacerbations



Contenders

- Temperature
 - Activity
 - Oxygen saturation
 - Pulse rate
 - Respiratory rate
- 

Contenders

- Temperature
 - **Activity**
 - Oxygen saturation
 - Pulse rate
 - **Respiratory rate**
- 

Existing Methods - Chest Strap

- The most common solution uses a wired strain gauge strap, which is worn around the chest.
- The expansion of the strap is measured as the wearer breathes.
- The strap is difficult to fit, uncomfortable to wear and can make breathing more difficult.



PTAF2 Pressure Transducer

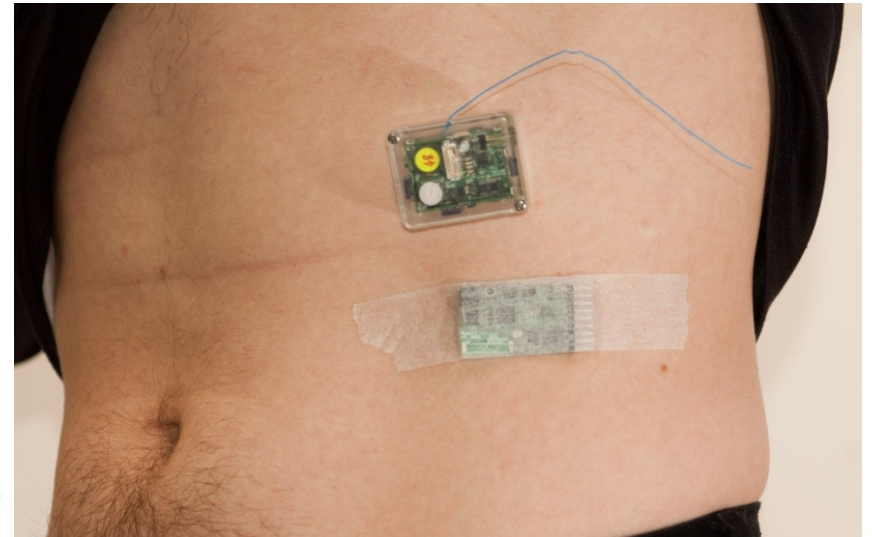
Can provide
synchronous
measurements

Intrusive but well
respected measurement
method




Speck


- Easy to attach with standard tape
- Not restrictive



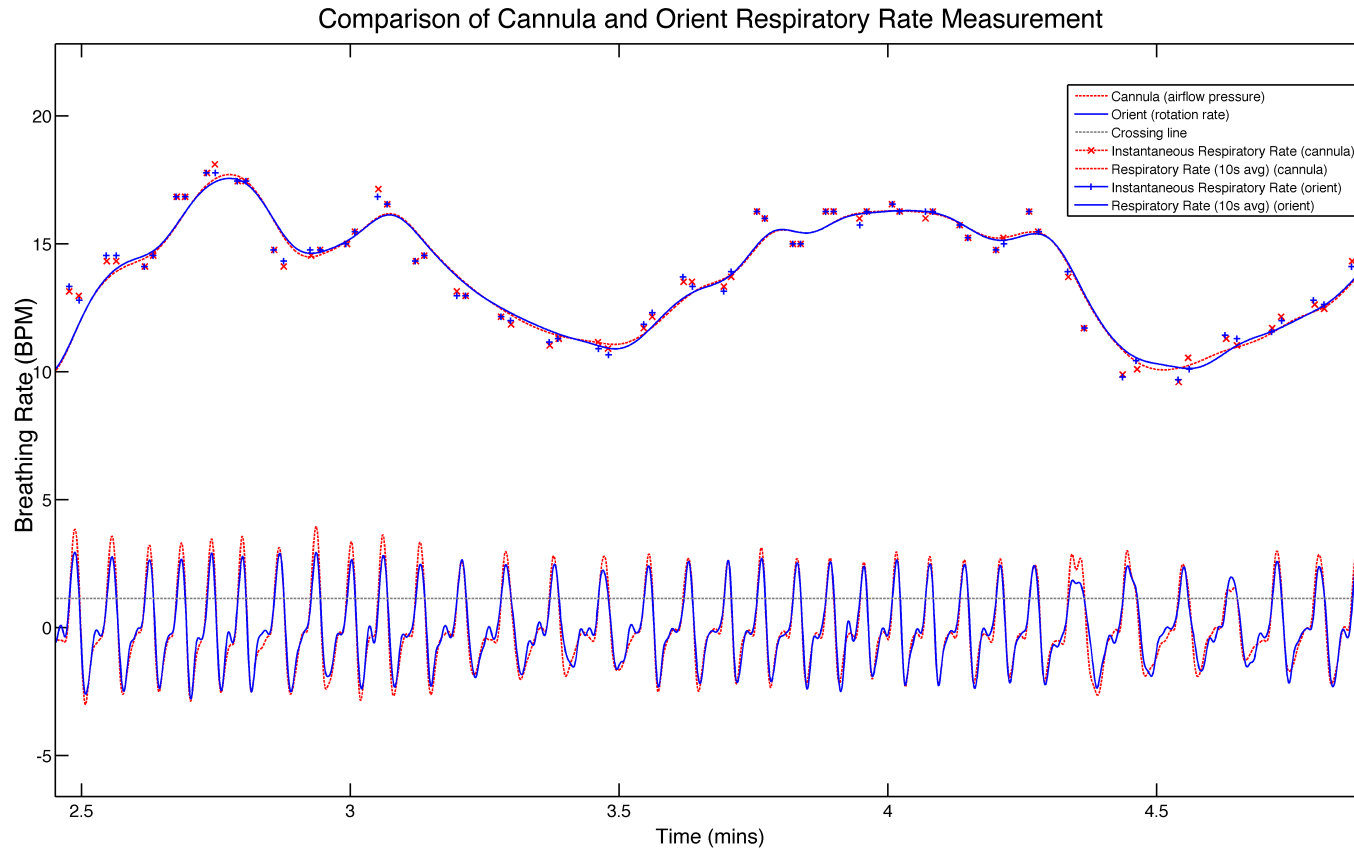
Does it work?

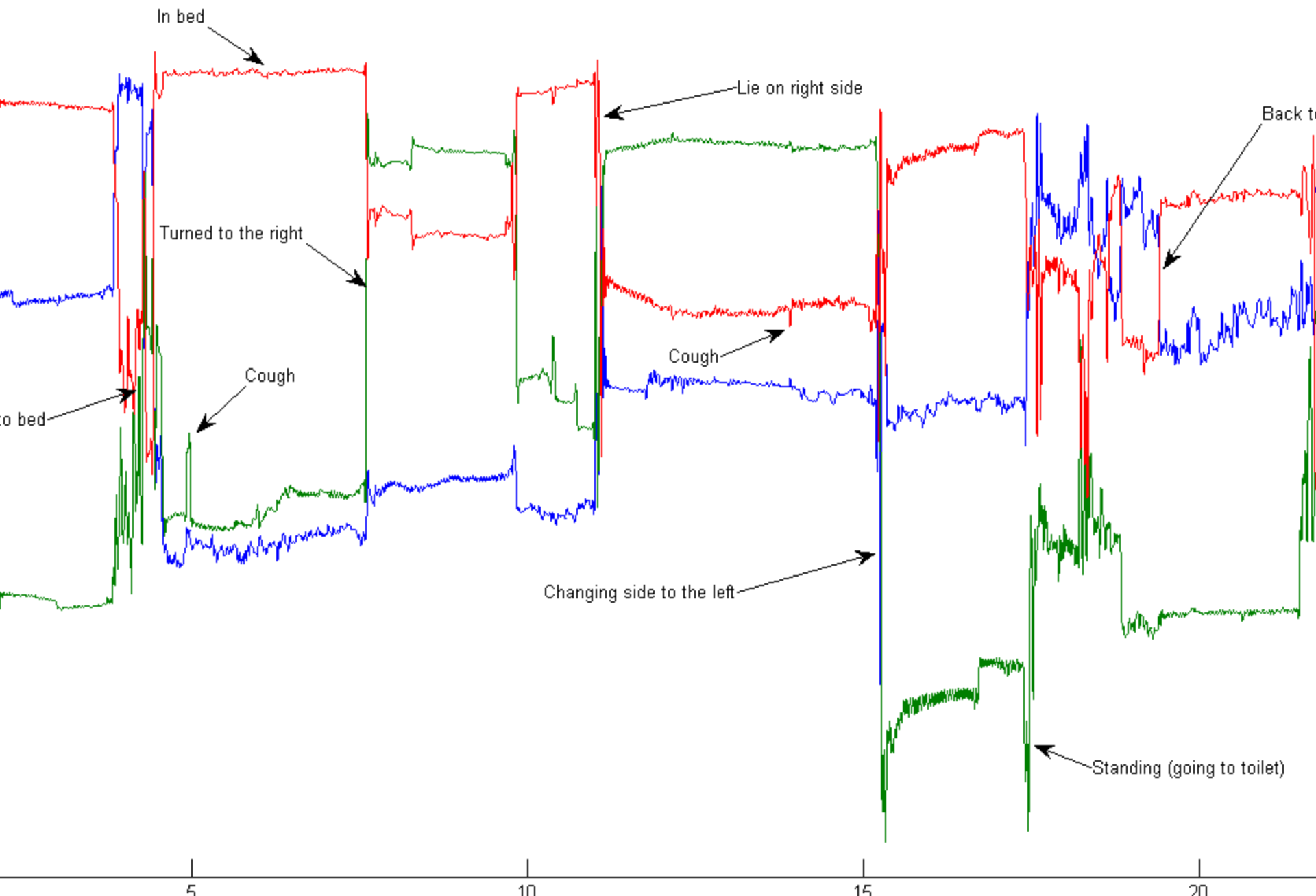
- Is it easy to wear?
 - Does it transmit information reliably?
 - How accurate are the measurements?
 - What information does it tell us?
- 

What we have found so far


- Patients have found it very comfortable to wear
 - Results are generally reliably transmitted and can be stored for intermittent transmission
 - Early field trials in the patient home have been promising
 - The measurements are accurate when compared with the PTAF2 Pressure Transducer
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Accuracy of measurement





What next? Questions and Challenges

- How well does this work on different types of patients?
 - Which respiratory rate is most useful to measure (resting, exercise)
 - How does change in respiratory rate relate to symptoms and exacerbations
 - Can we derive a more accurate algorithm to predict exacerbations based on symptoms, O₂, pulse, respiratory rate and activity?
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Conclusions

- Speckled computing has great potential as means of non-invasively measuring respiratory rate in cardio-pulmonary illnesses
 - Further work is required to establish how best it can be used in these contexts
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