



The research commercialisation office of the University of Oxford, previously called **Isis Innovation**, has been renamed **Oxford University Innovation**

All documents and other materials will be updated accordingly.
In the meantime the remaining content of this Isis Innovation document is still valid.

URLs beginning www.isis-innovation.com/... are automatically redirected to our new domain, www.innovation.ox.ac.uk/...

Phone numbers and email addresses for individual members of staff are unchanged

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Disruptive innovation in medical technology

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Director, Oxehealth Ltd

30 June 2015

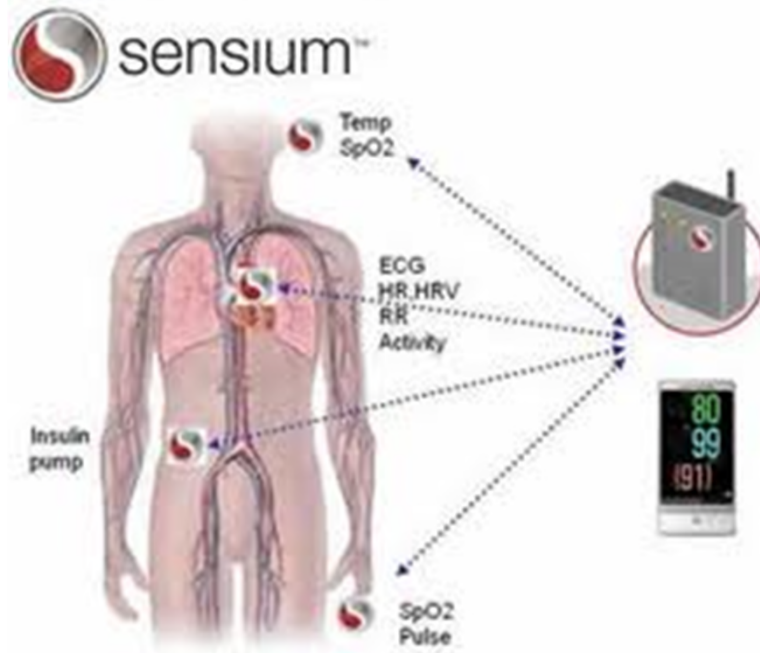
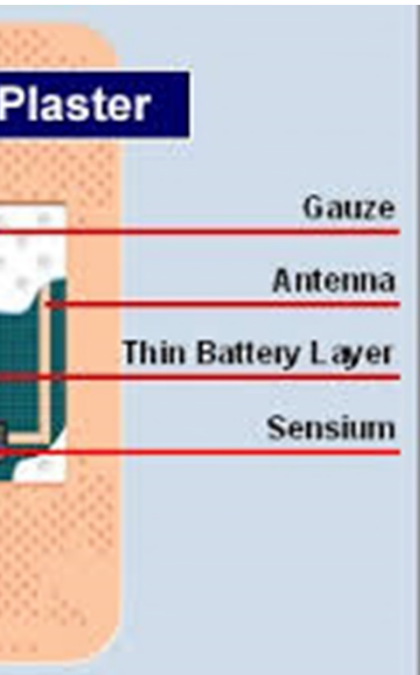
Measurement of the five vital signs allows the assessment of physiological well-being of an individual or patient.

signs:

Temperature: infection or inflammation
Heart rate: abnormal heart rhythms (e.g. atrial fibrillation)
Respiratory rate: apnoea (cessation of breathing)
Blood pressure: internal bleeding
Oxygen saturation: impaired lung function

All of these can be measured non-invasively

Wearables for vital sign monitoring



vantage:

continuous monitoring

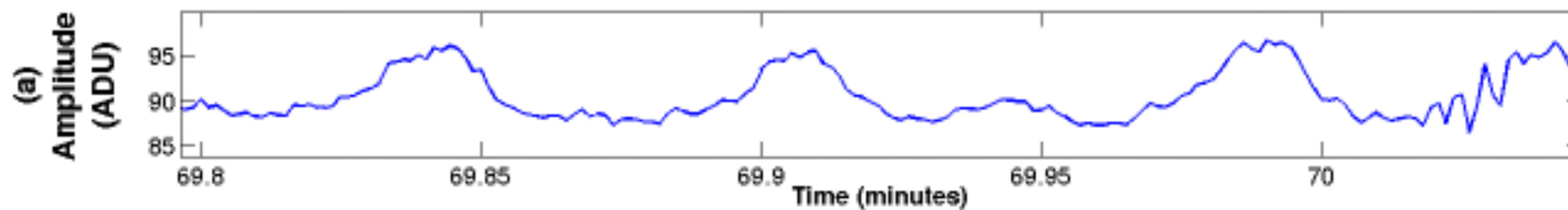
sadvantages:

limited battery life (7-day limit)

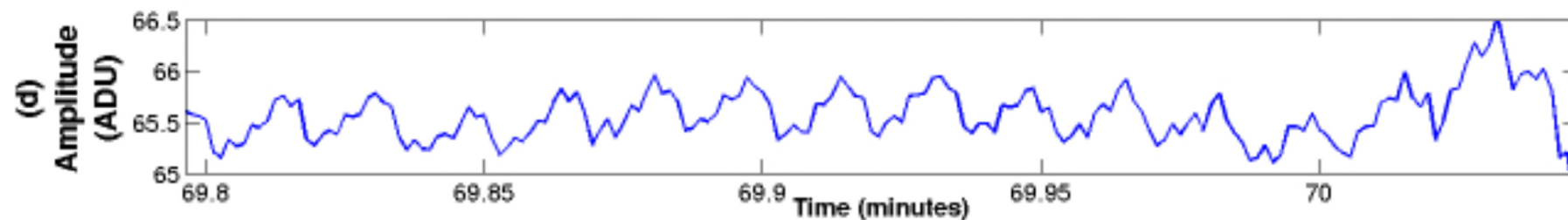
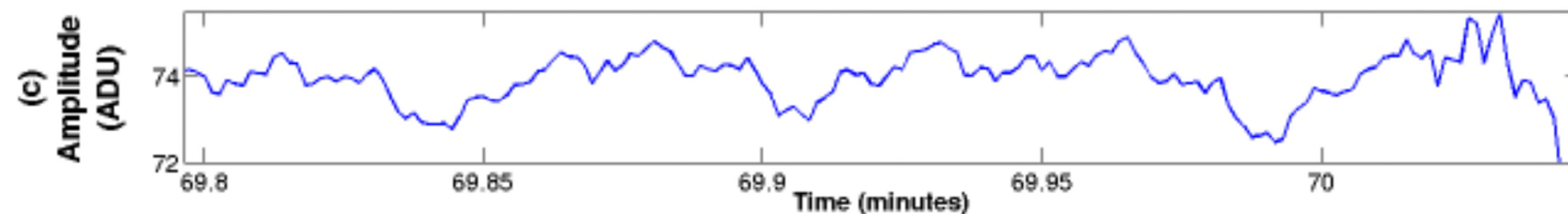
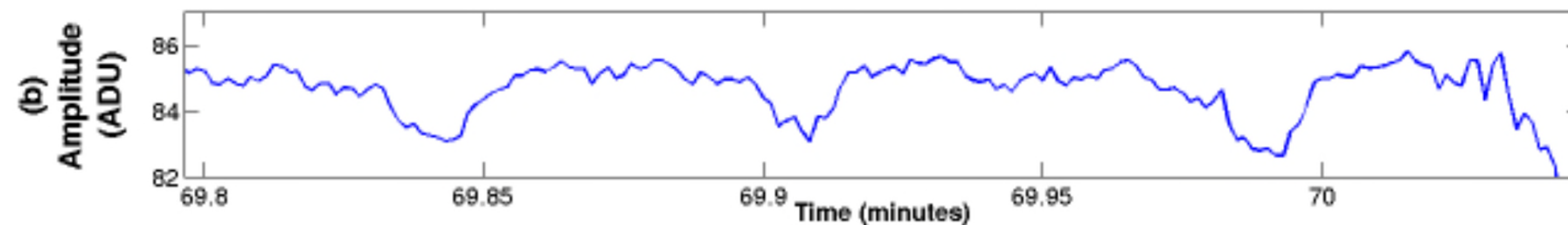


ebcam sensors:

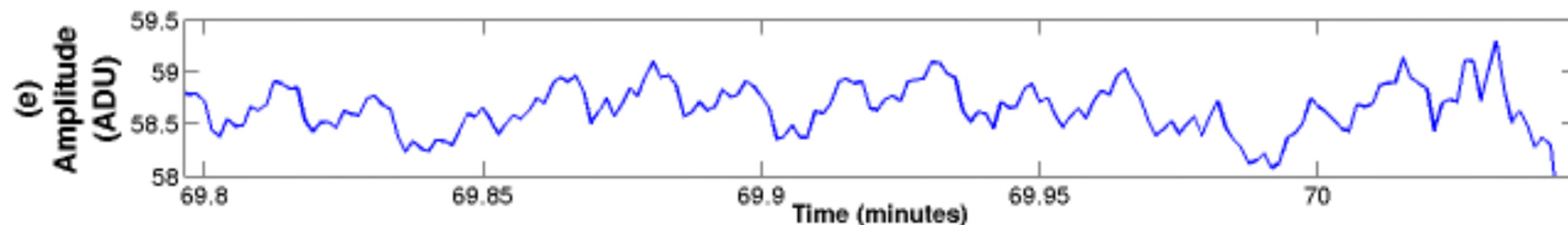
Measurement of ambient light reflected from a region of interest on the face (e.g. forehead) using a webcam and ambient light sensor to provide real-time values of cardio-respiratory **vital signs** (heart rate, blood pressure, etc.)



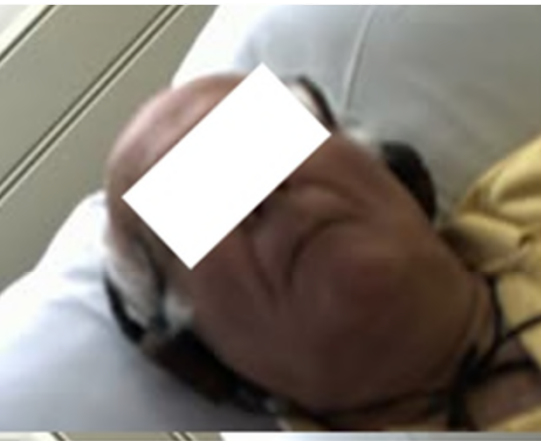
Respiratory frequency from 10×10^{-3} Hz



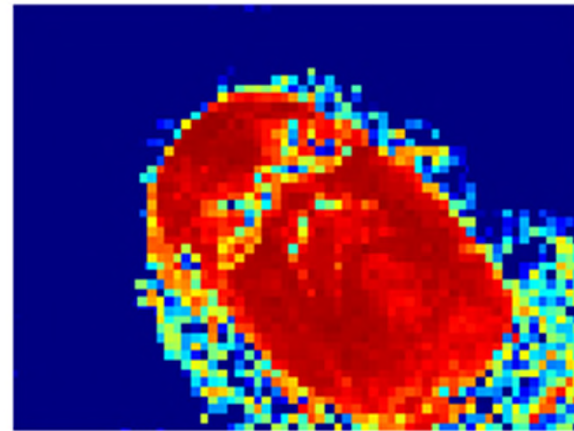
Cardiac frequency from 100×10^{-3} Hz



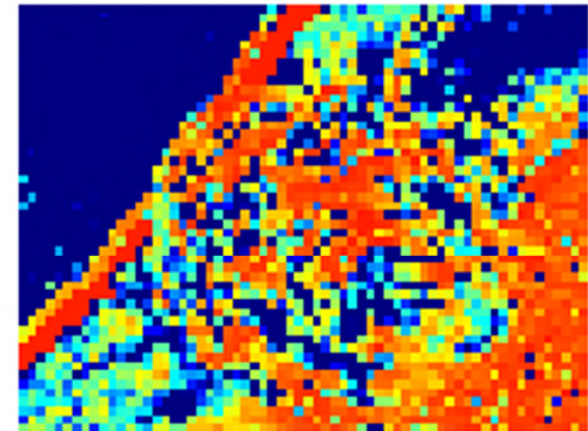
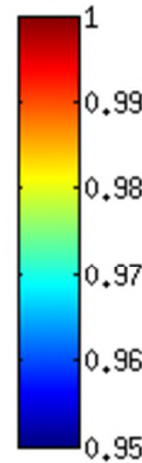
size of the region of interest (ROI) can be tuned to the detection of amplitude changes in the reflected signal caused by cardiac and respiratory activity.



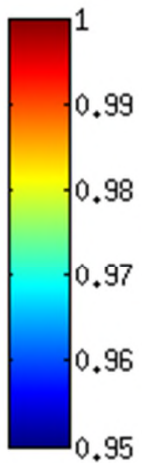
(a)



(b)



(c)



Patient resting while listening to music through headphones during dialysis session

(b) Image colour-coded according to strength of cardiac-frequency information

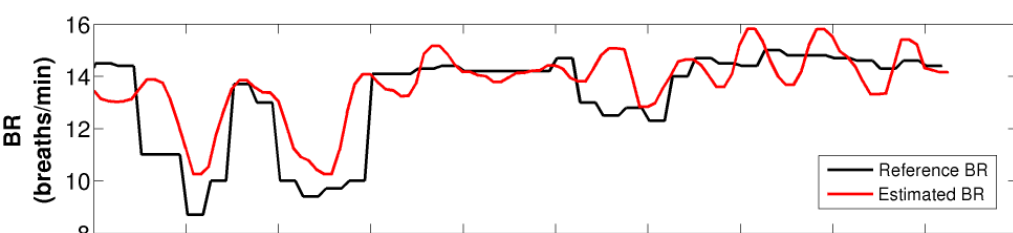
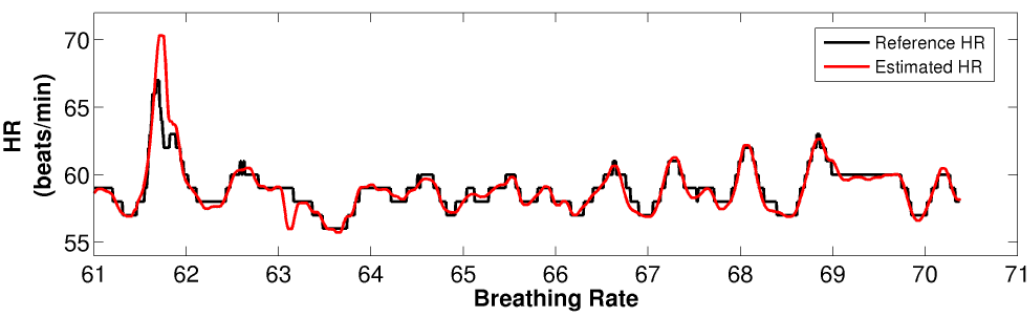
(c) Image colour-coded according to strength of respiratory-frequency information

cardiac-synchronous colour changes are equally strong over the entire face, except around the eyes (the patient is wearing glasses) and under the nostrils.

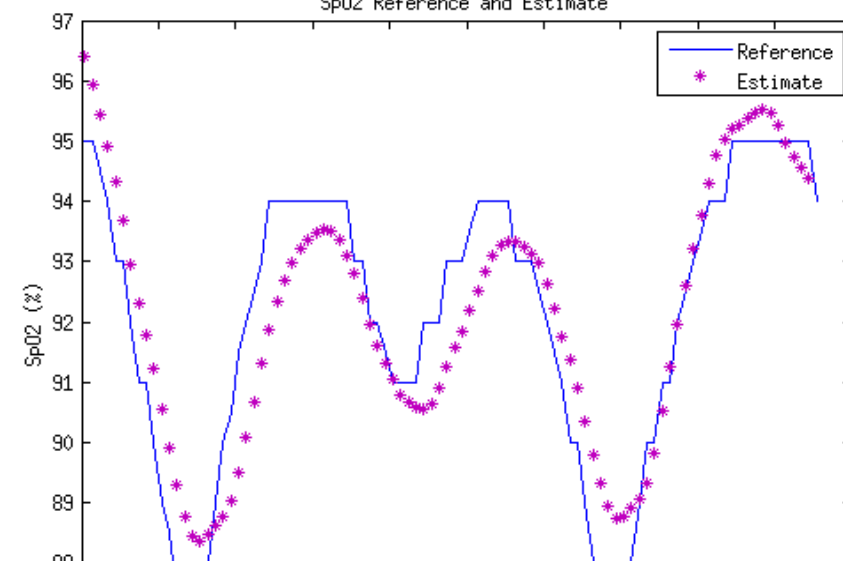
Highest-magnitude respiratory changes can be found in the upper thorax region (as on the edge of the pillow). However, there are also high-strength respiratory changes on the patient's forehead and close to the nose, indicating where the breathing motion is present in the image of the patient's face.



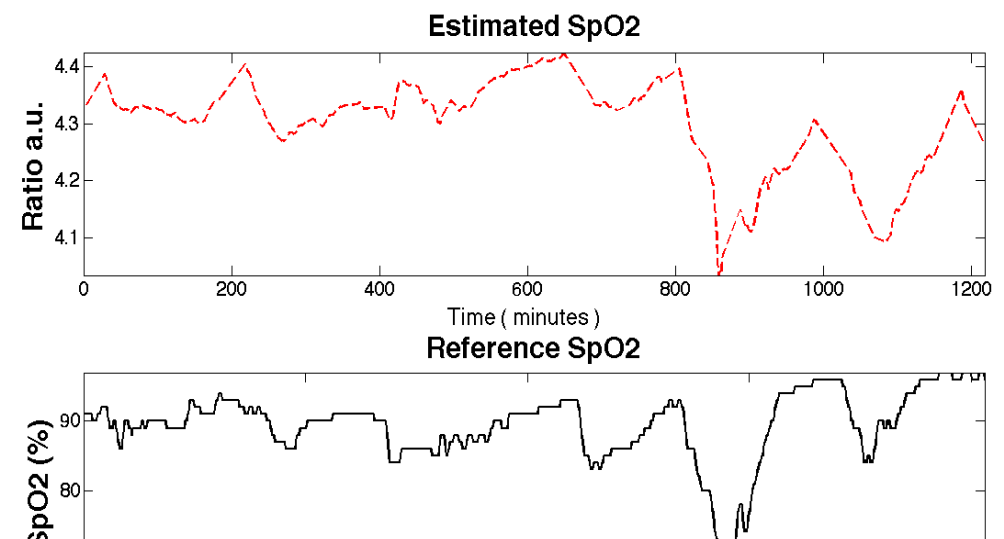
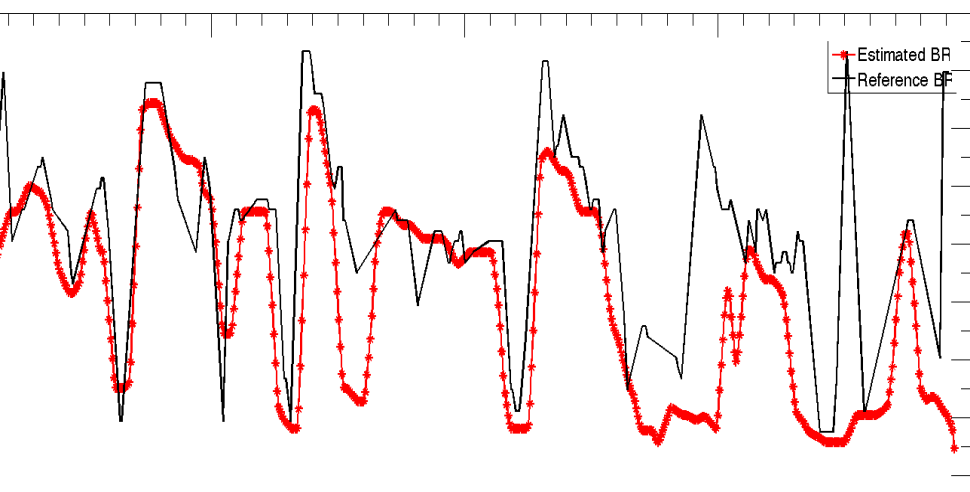
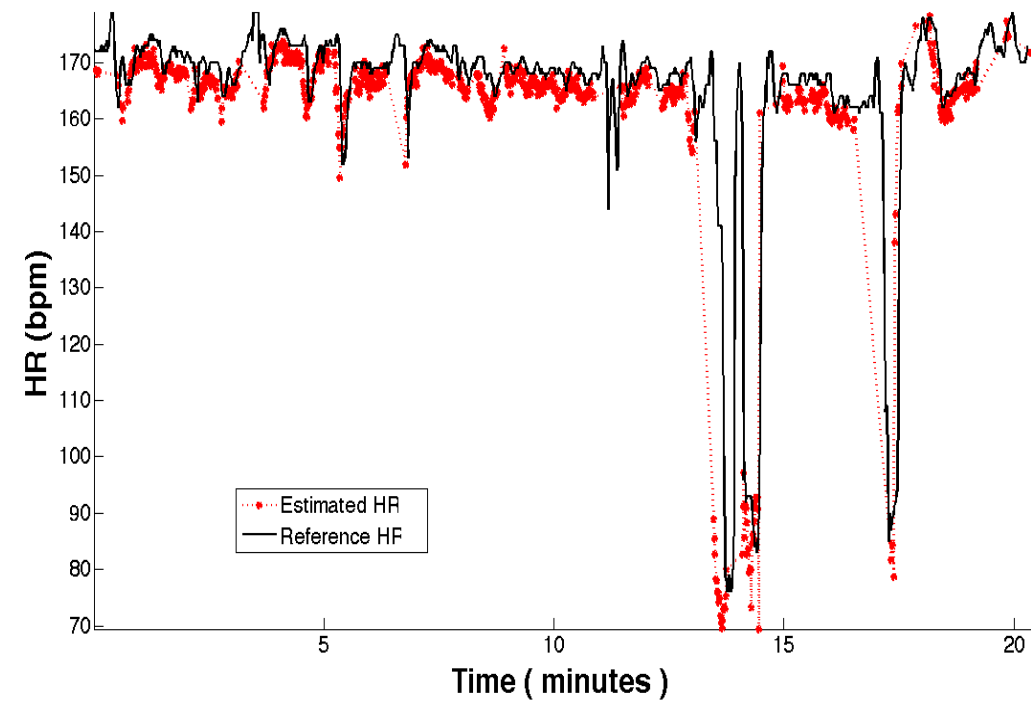
Heart Rate



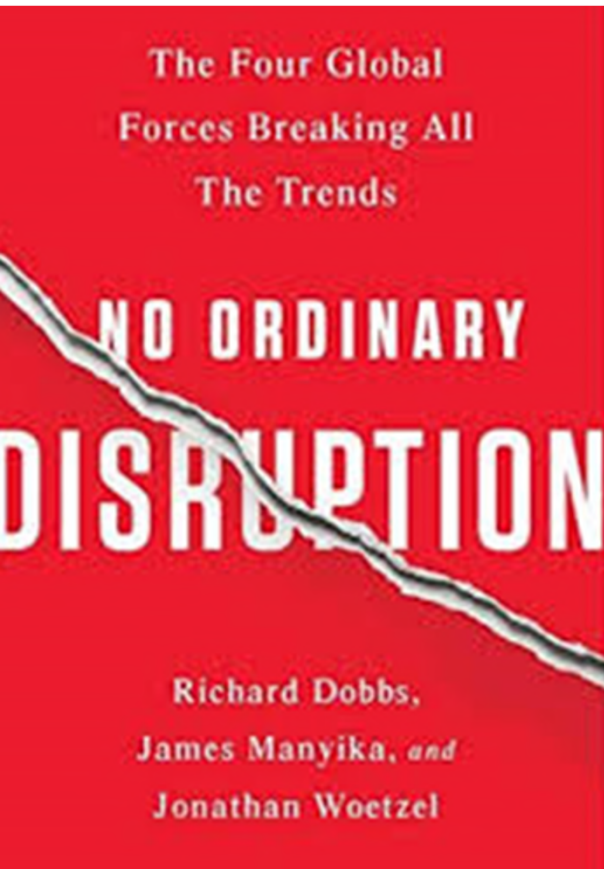
SpO2 Reference and Estimate



(Neonatal Intensive Care Unit)



“Webcams for health”



Disruptive forces:

1. Rise of emerging markets
2. Accelerating impact of technology
3. Demographics – the ageing population
4. Flow of trade, capital and people

Key issue:

Privacy

Baby Monitor



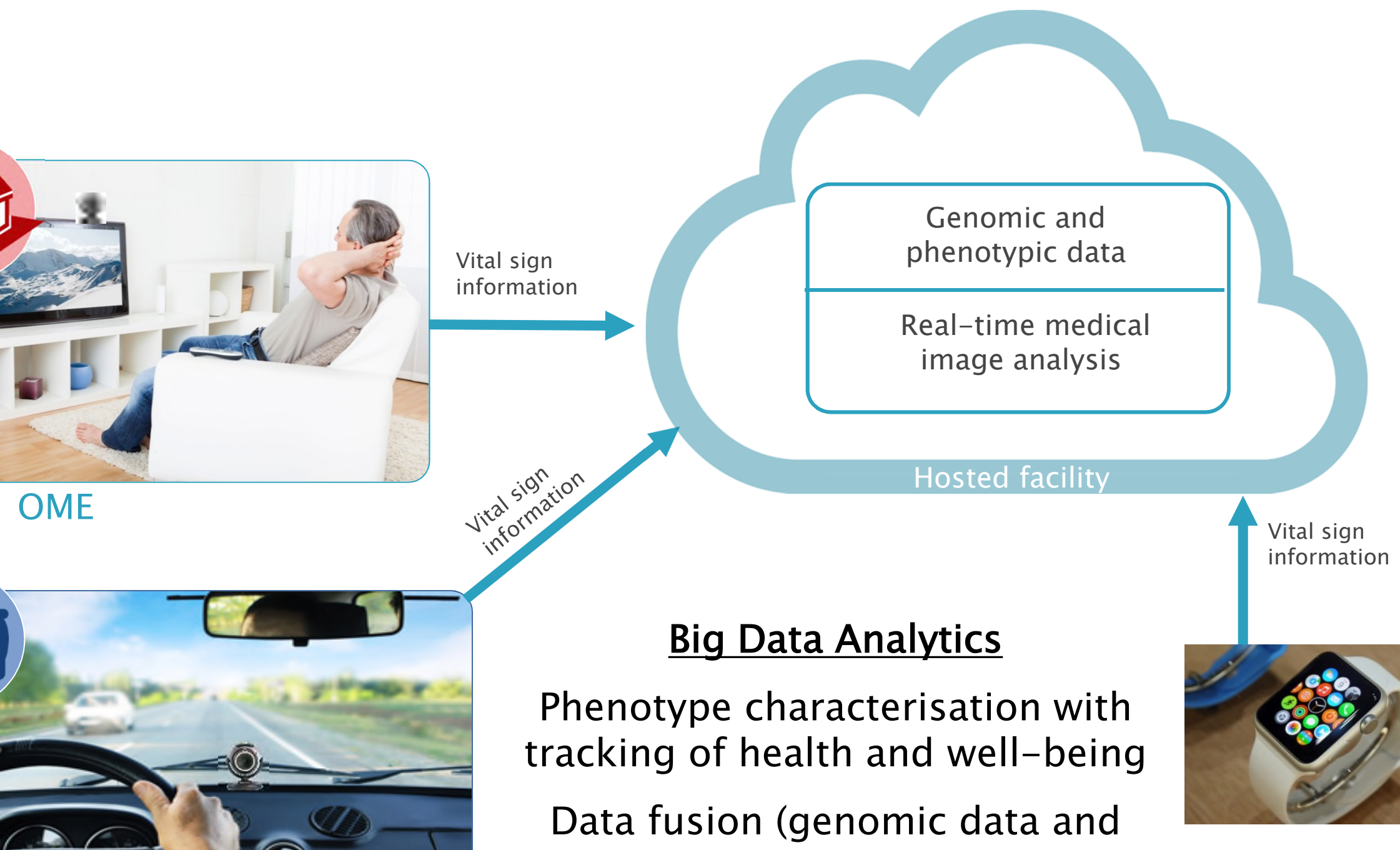
Add webcam monitoring of vital signs to iPhone baby monitor (100,000 sold per annum in the UK) and include predictive analy

Secure Room Monitor



roadmoor to test camera that monitors vital signs
y Adam Brimelow, Health Correspondent, BBC News

Personalised Cancer Treatment



FUNDING OF TOP SIX 2014 CATEGORIES

2011-2014

VENTURE
FUNDING

\$2.0B

\$1.5B

\$1.0B

\$0.5B

2014
FUNDING

\$393M

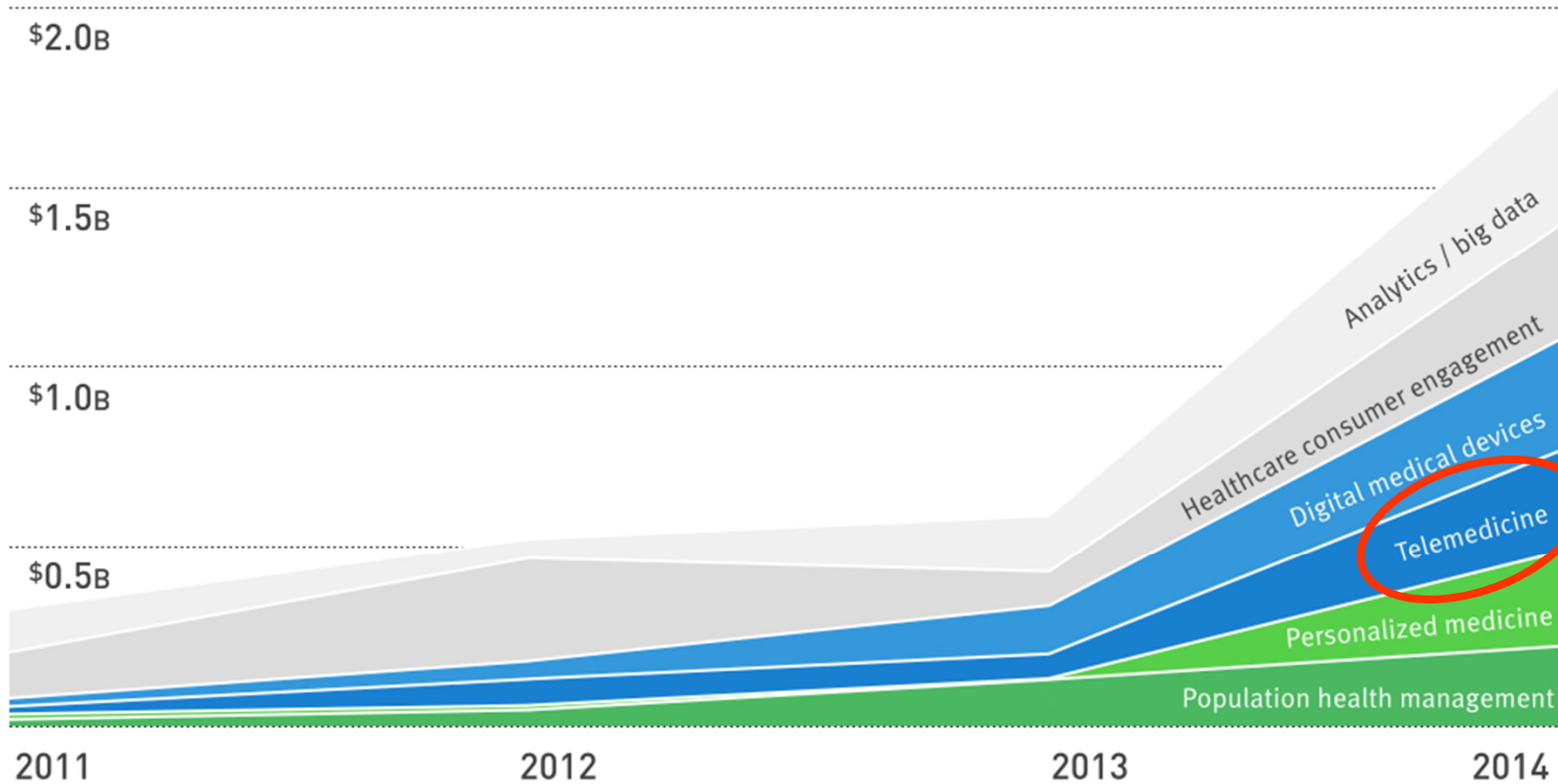
\$323M

\$312M

\$285M

\$268M

\$225M



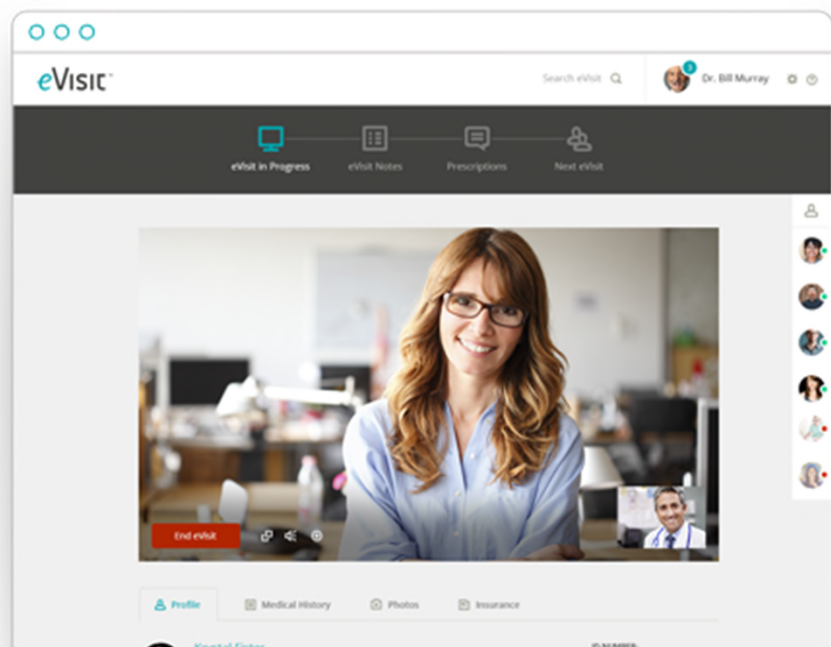
TOP 6
FUNDING
CATEGORIES
2011-2013

*Also a top 6
category in 2014

1	Healthcare consumer engagement*	Healthcare consumer engagement*	EHR and clinical workflow
2	Analytics and big data*	EHR and clinical workflow	Analytics and big data*
3	Digital diagnostics	Personal health tools and tracking	Digital medical devices*
4	EHR and clinical workflow	Care coordination	Population health management*
5	Post-acute solutions	Wearables and biosensing	Wearables and biosensing
6	Hospital administration	Telemedicine*	Healthcare consumer engagement*

The Ageing Population

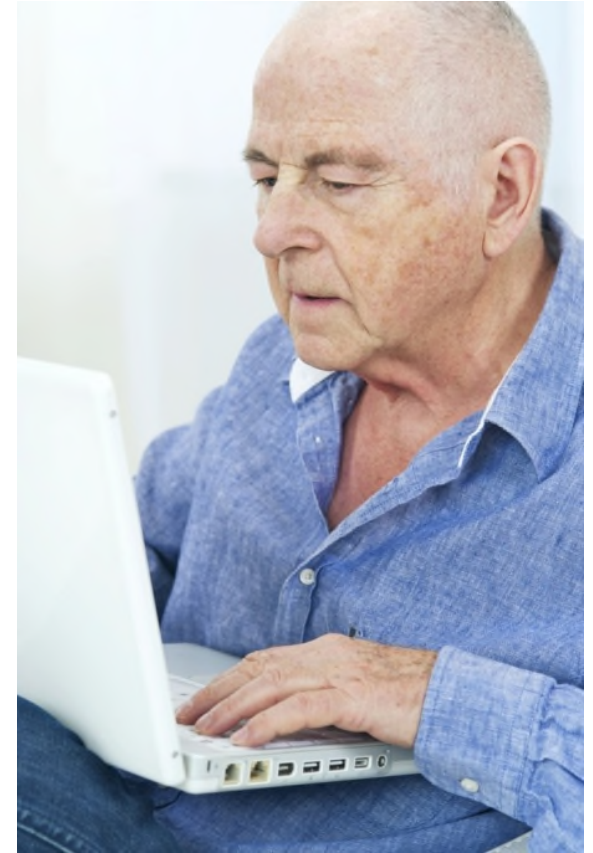
telemedicine allows healthcare professionals to evaluate, diagnose and treat patients remotely using telecommunications technology.



eVisit's easy-to-use, two-way video HIPPA-compliant platform makes it easy to connect with patients, while ensuring that all data is 100% safe and secure.



The Ageing Population



The addition of webcam sensing for the non-contact monitoring of vital signs will transform telemedicine.

This type is not HIPPA-compliant but webcam sensing data from Skype conversations can be used to build up a database for personalization.



1. Rise of emerging markets
2. Accelerating impact of technology
3. Demographics – the ageing population
4. Flow of trade, capital and people

urrent trends in demographics underpin the need for remote consultations.

tal signs can be monitored through a webcam with no sensor attached to the individual.

ivacy and regulatory issues are being addressed.