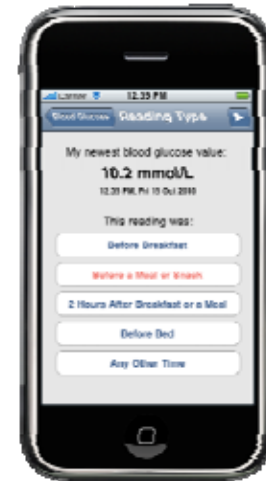




Mobile phones for healthcare



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25 years ago:

The launch of the UK cellular telephony service



10 years ago – Mobile phones and health

CNN.com

August 2nd, 2000

Are companies liable for cell-phone health risks?

CIOs need to ensure that their companies' employees operate cell phones and other wireless devices in a manner that reduces health risks associated with radiation... or face the legal consequences.



All mobile phones banned inside hospitals

Today – Mobile phones and health

- In the US, Verizon launched in November 2009 a healthcare focused business unit, Verizon Connected Health.
- In the UK, Vodafone and Orange outlined plans in December 2009 for the healthcare sector with announcement of new initiatives.
- Haiti earthquake survivor used health application on his iPhone to “treat his leg injury” while stuck under rubble (NBC Miami).



Mobile phones and health

What has changed between 2000 and 2010?

- Studies (e.g. Stewart report, WHO reports, BMJ paper) have shown minimal health risks associated with mobile phone use.
 - General Packet Radio Service (GPRS) was launched in Europe in 2002:
 - GPRS and now 3G allow for the *real-time transfer of data* (including medical data) to and from a remote computer, using the mobile phone for both data entry and/or review.
 - Mobile phones are now seen as sophisticated tools to facilitate delivery of healthcare – mHealth
 - The biggest impact of mHealth is likely to be on non-acute, *long-term conditions* requiring regular management integrated into the individual's life.
-

Long-term conditions: a 21st century epidemic

- Department of Health website: Long-term conditions are chronic illnesses that can limit lifestyle, such as diabetes, heart disease, and chronic obstructive pulmonary disease (COPD).
 - In the UK, there are 17.5 million people with a long-term condition (approximately 12 million of these have diabetes, hypertension, asthma or COPD).
 - Diabetes (which affects 2.75 million people) accounts for approximately a tenth of the NHS budget each year, a total exceeding £9bn.
 - 5.1 million people in the UK are currently receiving treatment for asthma: 1.4 million children (1 in 8) and 3.7 million adults (1 in 13).
-

Why are long-term conditions such a problem?

- Currently, 80% of primary care consultations in the UK relate to long-term conditions and patients with such conditions or their complications use over 60% of hospital days.
- 41.5% of UK diabetic population have an HbA_{1C} greater than the 7.5% target (2007 National Review of Diabetes). People with diabetes spend 1.1 million days in hospital each year.
- From April 2006 to March 2007 there were 80,593 hospital admissions in the UK for people experiencing an asthma attack. An estimated 75% of all hospital admissions for asthma are preventable (Asthma UK).



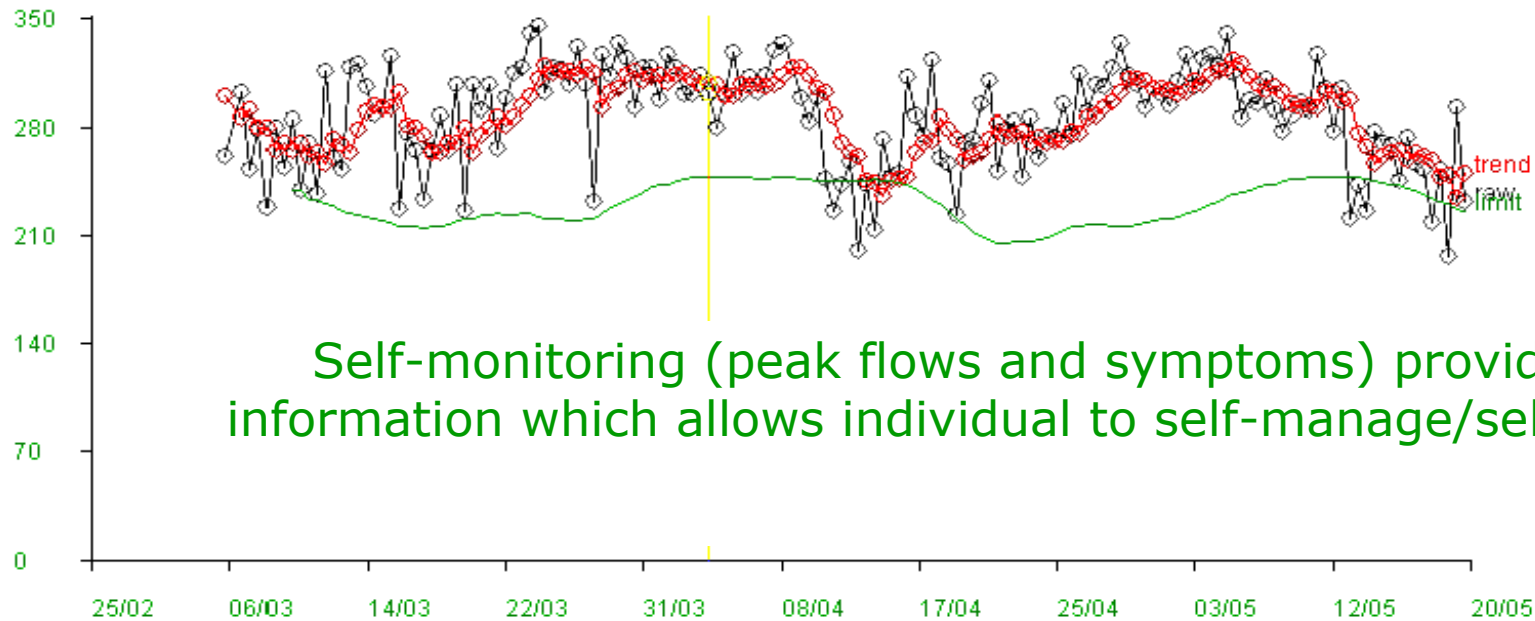
8,759 hours 15 minutes alone

**45 minutes
Managed Care**

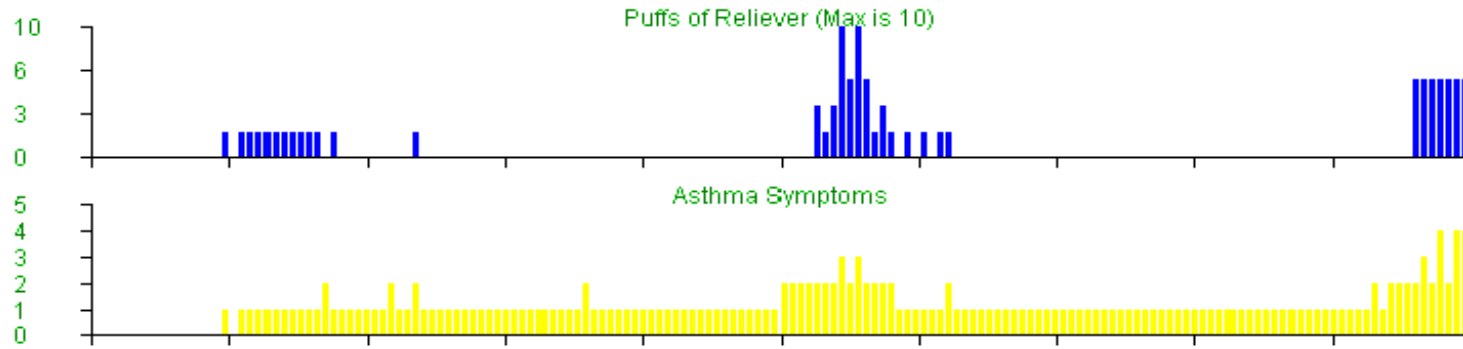
Typical Annual Care Plan for a Patient with a LTC

What happens between visits to the Asthma Clinic?

09:00 on 04/04 raw = 301.0 , trend = 309.0



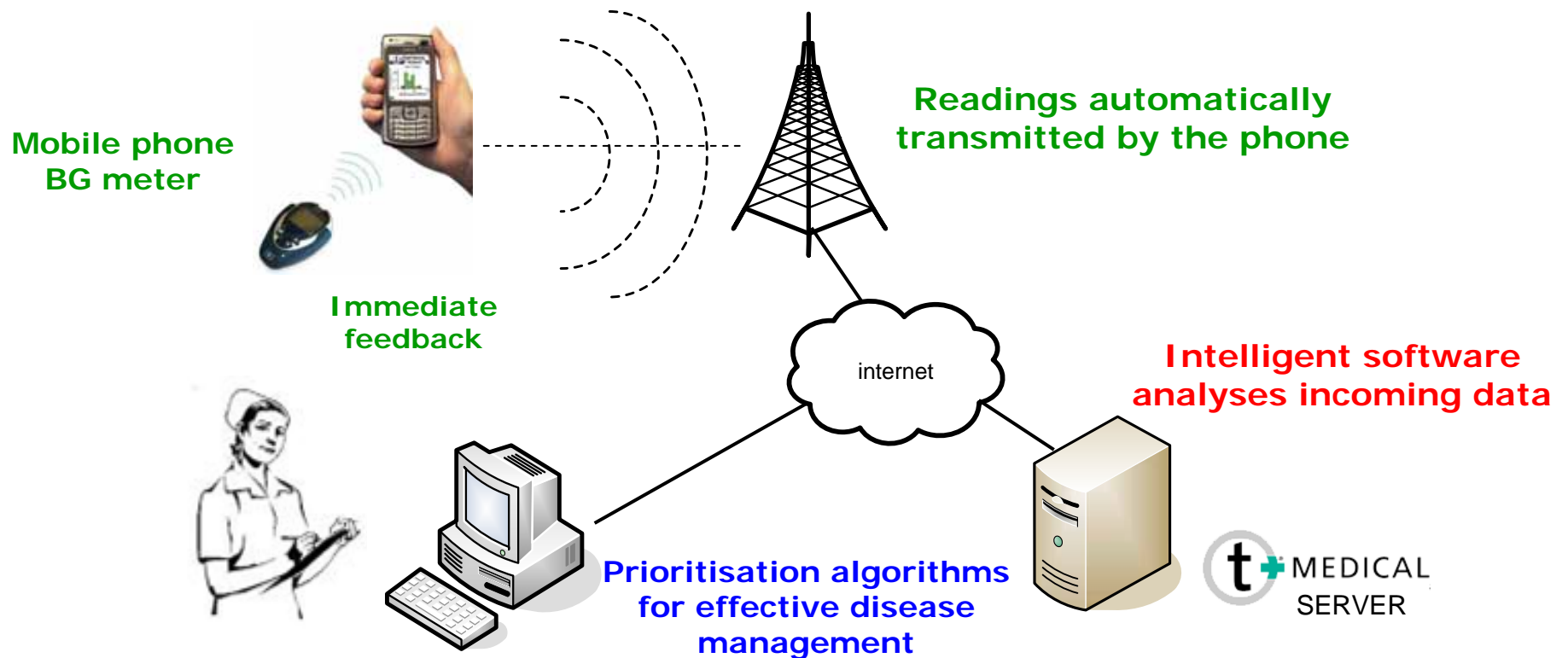
Self-monitoring (peak flows and symptoms) provides information which allows individual to self-manage/self-care



mHealth for long-term conditions

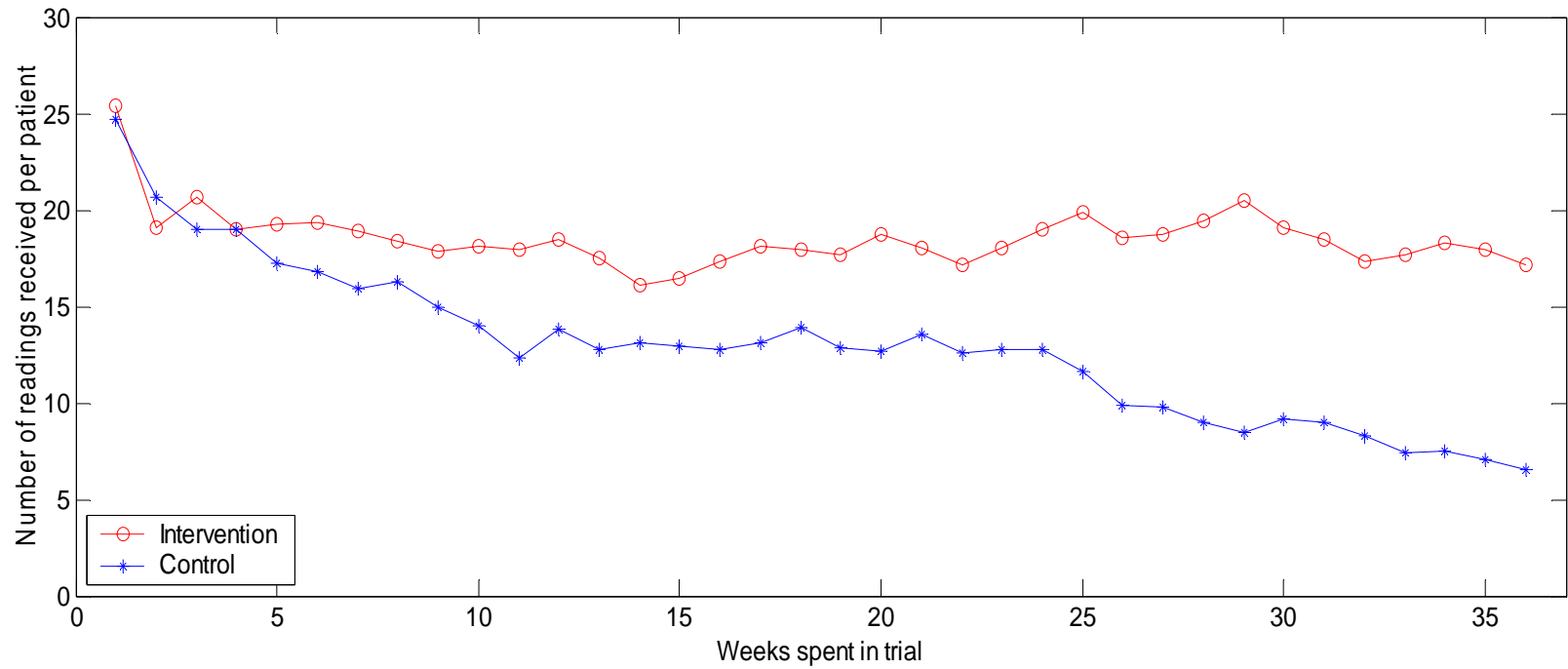
- Wilson *et al.* (BMJ, 2005): “The evidence backing the use of disease-specific self-management programmes like diabetes is strong. The challenge is how to move to a *programme that can support the many millions of patients who might benefit.*”
 - Focus on mobile phone:
 - Equality of care – 90% of UK population owns a mobile phone
 - Portable device for real-time data entry and review (feedback)
 - Ease of communication with “remote nurse” (telehealth nurse), based on shared data
 - The cost-effectiveness of using the individual’s own mobile phone makes the mHealth solution a financially viable proposition (model based on 18% reduction in unplanned hospital admissions)
-

mHealth for long-term conditions



- + Mobile phone as an interactive tool to promote self-management
 - + Regular support from telehealth nurse (based on real-time data)
-

Mobile phone application enhances compliance



Evidence-based medicine

Summary of clinical studies and trials

- Asthma 3 published clinical studies, 1 with Asthma UK
- COPD 1 trial at Bristol Royal Infirmary published in *Thorax*
- Type 1 diabetes 1 RCT at OCDEM published in *Diabetes Care*
1 study in progress in Dubai; 1 pending in Oxford
- Type 2 diabetes 3 published clinical studies (inc one in *Informatics in Primary Care*)
1 study recruiting in Oxfordshire GP Practices
- Hypertension 1 trial presented at *European Stroke Conference*
1 study in progress in Oxfordshire GP Practices
- Cystic fibrosis 1 published clinical trial (data submitted to NICE)
- Cancer 1 study published in *Annals of Oncology*
1 study in progress at Churchill Hospital
- Health Economics 1 RCT in progress with the UK Department of Health

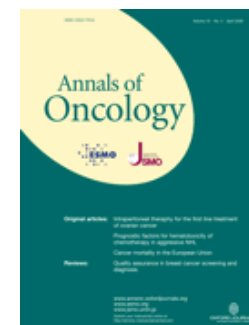


Diabetes Care



e s c
e s e
european stroke conference

Thorax



The medical case for mHealth

Evidence-based medicine

- 20 clinical trials or studies (type 1 & type 2 diabetes, asthma, COPD, cystic fibrosis, hypertension, chemotherapy)

 - Asthma:
 - 31% reduction in uncontrolled use of reliever inhaler
 - 78% of patients reporting reduced symptoms

 - COPD:
 - 57% reduction in acute admissions (from 1.64 to 0.70 per annum)

 - Diabetes:
 - 0.62% reduction in HbA_{1c} in people with Type 1 diabetes, with four-fold increase in number of patients showing good control
 - 0.7% reduction in HbA_{1c} in people with Type 2 diabetes

 - Hypertension:
 - Mean reduction of 21 mmHg in systolic BP (from 148 to 127 mmHg) in six months for patients following discharge after minor stroke
-

Monitoring blood pressure in stroke patients

- Patients with acute Transient Ischaemic Attack (minor stroke) in Oxford are now being monitored post discharge.
- After leaving hospital with a prescription of standard Blood Pressure lowering therapy, patients measure their blood pressure three times daily at home for one to three months, depending on control.
- Measurements transmitted automatically in real time by the mobile phone are checked daily on a secure web page in the Stroke Unit.



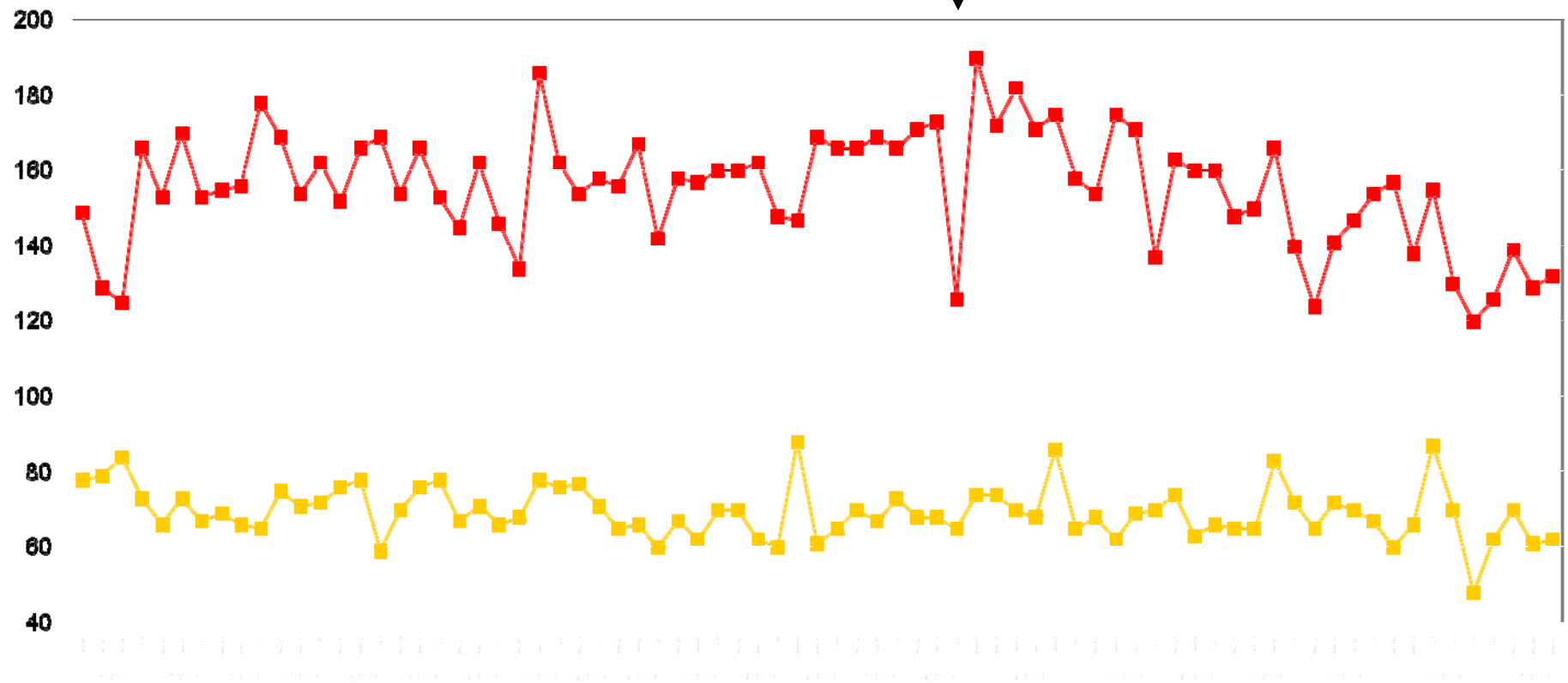
Blood Pressure monitoring following a TIA

79 year old female

BP in outpatients: 130/70 mmHg



Intervention



Monitoring blood pressure in stroke patients

- 203 (92.3%) of 220 patients (mean age = 70; 29% ≥80 years) were willing and able to undertake Bluetooth home monitoring, and all continued for at least one month.
 - **Monitoring led to 192 changes in BP lowering medication in 128 patients (63%).**
 - **Mean systolic BP was 148/82 mmHg at entry and 127/73 mmHg at the 6-month follow-up clinic.**
 - Patient satisfaction (0 poor to 100 excellent) with home monitoring was high (mean score = 88.3), with 90% approving of intensive monitoring and 88% being reassured by the automated surveillance.
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From 2002 to 2010 - the beginning of mHealth

Phase 1: Proof of concept and building up the clinical evidence (hundreds of patients on pilot studies/ clinical trials)

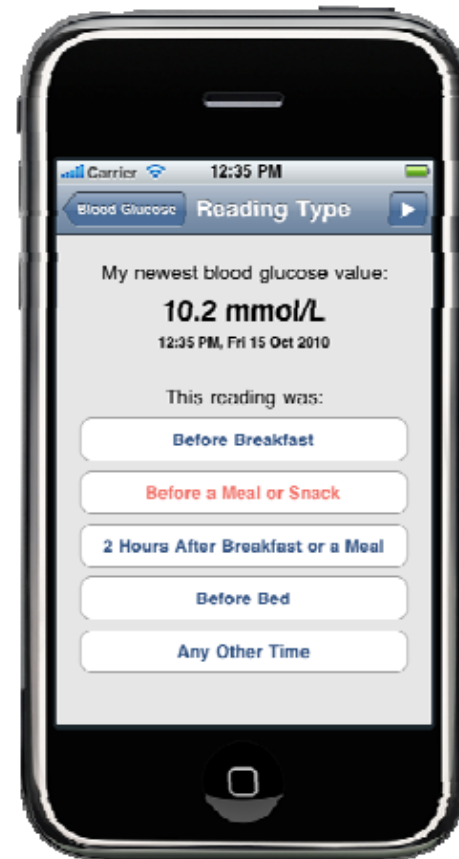


Phase 2: Delivering mHealth applications using new generation of smart phones (iPhone, Android phones).



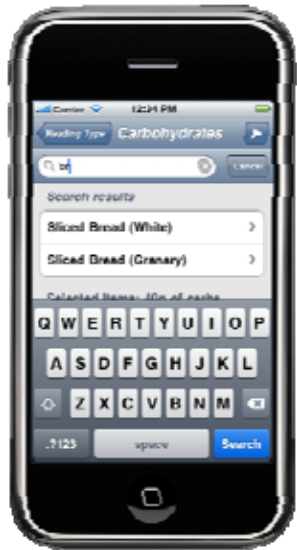
iPhone Type 1 diabetes application

Learning how to integrate carbohydrate counting, physical activity monitoring and insulin dosage in Type 1 diabetes



iPhone Type 1 diabetes application

Carbohydrate counting



- Total carbohydrate content of a meal is calculated from a selection of food items.
- Items can be selected through hierarchical groups, or by searching.
- (Patients can also be shown food calorie content).

iPhone Type 1 diabetes application

Activity monitoring



- Patients are asked to type in a step count from a pedometer.
- We are incorporating the iPhone's GPS to allow walk route mapping, and the accelerometer to validate step detection.
- GPS-derived speed, total distance and duration can be recorded.

iPhone Type 1 diabetes application “Insulin wizard”



- Feedback from patients indicated that they would benefit from a “wizard” guiding them through the insulin dose calculation.
- Pop-up hints explain the insulin dose calculation based on patient-specific parameters.

iPhone Type 1 diabetes application “Insulin wizard”



- Feedback from patients indicated that they would benefit from a “wizard” guiding them through the insulin dose calculation.
 - Pop-up hints explain the insulin dose calculation based on patient-specific parameters.
 - The patient decides which dose to inject, and enters the value.
-

mHealth – conclusions

- “mHealth is the most cost-effective form of telehealth available, as it uses the patient’s own mobile phone.” (Dr Rowan Hillson, National Clinical Director for Diabetes).
 - Only those applications which have been validated in a clinical context will survive. Evidence of the effectiveness of the intervention is required before it is adopted by Health Care Professionals.
 - Clinically-validated mHealth applications will be available on smart phones for £10 per annum within 2 years.
 - mHealth could be used to incentivise patients to improve their self-management, e.g. reduced data costs for individuals with evidence of regular self-monitoring.
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