Health and care at home using assistive technologies.

The Rehabilitation and Assistive Technology Research Group ScHARR

Mark Hawley, Gail Mountain, Debbie Fitzsimmons
Changing health and social care environment

- Ageing population & increasing prevalence of long-term conditions and disability
- Health consumerism and increasing expectations
- Move from acute to primary and community care with mixed economy of providers
- Increased emphasis on self-care but reduction in family care
- Reducing public sector budgets
‘The situation is becoming unsustainable and will only worsen in the future as chronic diseases and the demographic change place additional strains on healthcare systems around Europe’

(EU Commission, 2006)

‘new healthcare delivery model based on preventative and person-centred health systems. This new model can only be achieved through proper use of ICT, combined with appropriate organisational changes and skills’
Assistive Technology research

- Telehealth, e-health
- Telecare
- Telerehabilitation
- Assistive technology

...wide range of technology and technology-supported services that assist older and disabled people to maximise their independence
Rehabilitation and Assistive Technology Research Group

Therapist

Communication

NHS Direct

Hospital

District nurse

Broadband

Informal carers

Mobile

Housing & care

Social services

GP

MONITORING AND RESPONSE

ASSISTANCE AND SUPPORT

USER Needs

THERAPY AND REHABILITATION

PREVENTION AND SELF-CARE
Proof of concept Prototype product & service

Research for Technology Development

Phase 1 & 2 trials

Phase 3 clinical trials and economic evaluation

Initial concept Proof of concept Prototype product & service Product/service adoption

User-centred design, HCI, Psychology

Computer Sciences, Engineering

Health Services Research

Health Economics

Industry

Health and social care (Practice & Policy)
SMART2: Potential of Technology in the Self Management of Long Term Conditions

The SMART Consortium

www.thesmartconsortium.org
Why self management?

“as long as the acute care model dominates health care systems, health care expenditures will continue to escalate, but improvements in populations’ health status will not.”

World Health Organisation, 2002
Why technology for self management and rehabilitation?

- NHS Plan (2000): New funding models, payment by results, reduced length of stay
- Our Health, Our Care, Our Say (2006): Self management for long term conditions using technological innovations
- Innovations for Health (2007): Use of medical devices
- Darzi Review (final report, 2008): Personalised care, choice and personal control
Policy and Practice

- “there is considerable national and international evidence to show that supporting self care results in health benefits for the people and therefore overall gain for the care system.” Department of Health

- Over 400 studies worldwide report self management can lead to dramatically improved outcomes for patients. British Medical Association

- Expert Patient Programme (1000 participants), 4-6 months after the course (a) GP consultations decreased by 7%, (b) Outpatient visits decreased by 10%, (c) A&E attendances decreased by 16%, (d) Pharmacy visits increased by 18%.
Research Questions

• Can the impact of long term conditions be effectively monitored, modelled and analysed using technology?

• Can assistive technology solutions be identified to deliver self management interventions in key target, high volume, chronic conditions?

• Can technology which situates behaviour change in everyday life improve traditional self-management strategies?

• Can technology, remote from a therapist, promote health behaviour change?
For people with one of three long term conditions; stroke, chronic pain, chronic heart disease

Creation of a home based personalised self management system out of commonly encountered technologies

Users (therapists, end users and carers) centrally involved to inform prototype design and function

Project commenced January 2008 for 4 years
SMART2: Fundamental underpinnings

- Technology for independent use in domestic/community settings with a health care component
- Focus on activity
- Use of personalised goal setting to promote behavioural change
Project phases (in brief)

Phase 1: project set up
- Technical and policy reviews
- Ethics and governance

Phase 2: exploratory work
- Scenarios of use
- Technical specification

Phase 3: evaluation
- Formative: iterative testing of prototypes
- Summative evaluation; final prototype
Mary has had SMART technology installed in her home to assist with her continued rehabilitation and to help her to regain her independence. This technology includes trainers with sensors embedded in the soles to help her to correct her balance and a bracelet to remind her to relax her left hand.

The bracelet also connects with sensors placed in each room in the house. Activity data from the sensors is processed by a computer within the existing TV.

**Daniel’s story**

The key to this behavioral strategy is to change the unit of measurement from task completion (or pain level) in the short term to consistency of activity over the long term.

The strategy of activity pacing fits well with a therapy based on the patient carrying out tasks related to his or her personal goals and values, in order to increase quality of life up to a desirable level.

**Albert:** Bored. I am watching much more daytime TV and spending much less time in my garden and greenhouse.
Prototype System Architecture

Home hub; touch screen computer

Mobile device with inbuilt GPS and accelerometry

Other devices added to meet the specific needs of people with each of the LTCs
The scale of underpinning clinical and HCI work

Comprehensive clinical reviews to identify:

- Best practice/optimal self management interventions for people with each of the long term conditions
- Life goals
- Outcome measures
We know that any device should be:

- Compact, simple to operate and maintain
- Useable, preferably without the assistance of the carer
- Complement the contribution of health professionals
- Capable of giving encouraging feedback even when progress is slow
Work with Users

- Understanding user needs and requirements through home visits to obtain narratives including how they interact with technology in their own homes
- Development of detailed scenarios to inform prototype development
- 1:1 cooperative evaluation and focus group evaluation of prototypes with users
Usability issues

'It used to be everything’s going to get smaller and smaller but like with the mobile phone, if they make that any smaller forget it I can’t use it. You get to the point where the human hand isn’t getting any smaller so they’ve got to stop’. (User 4)
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Information Pathways

Sensor Platform Layer
- Smart Shoe
- Upper-limb Bracelet
- Mobile Device
- PIR Sensor

Physical Layer
- Stroke

Service Layer
- Healthcare Professional
- Stationary Device
- Mobile Device

Application Layer
- Feedback
  - Audio – Visual - Sensory

System Interaction
- User Interaction
- Life Goal
- MySQL Database / Server

Therapist and Patient enter life goals
- System assigns life goals based on profile matching
- Patient enters own life goals

Life Goal
- Attend Church

MySQL Database / Server

IF Day == Sunday AND patientLocation != Outside THEN sendFeedback

It’s Sunday, wouldn’t you like to go to church?

Sensor Platform
Using the current CHF prototype as an exemplar

- Includes:
- Promotion of self monitoring of vital signs and symptoms
- Encouragement of exercise

Educative element to be included in next iteration
‘My Homepage (CHF)
MY GOAL

Your activity plan for today is:

5 Minute Warm Up
5 Minutes Walking
5 Minute Warm Down

To start the activity use your mobile phone and select the goals option.
The user is asked to perform their 5 minute Warm Up Risk Assessment Early stages of activity goal, showing feedback.

Halfway alert
Goal completion alert
Halfway alert

The user is asked to assess the difficulty of the activity they have just completed and allowed to increase or decrease the goal target for the next time.
Evaluation {so far}

- initial workshops
- prototype 1 interaction
  - CHF: 5 therapists, 8 users
  - STROKE: 6 therapists, ...
  - PAIN: 11 therapists, ...
- prototype 2 interaction
  - CHF: 5 users to date
  - STROKE: -----------------
  - PAIN: -----------------
- prototype 3 interaction
  - CHF: 20 users (target)
  - STROKE: 20 users (target)
  - PAIN: 20 users (target)
Final year: summative evaluation

- In-home evaluation planned with 20 users with CHF, 20 with stroke and 20 with chronic pain

- On-going feedback on usability anticipated
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Self-management and self-care of long term conditions

Chronic conditions
- COPD
- Diabetes
- Stroke
- Obesity

Application of technologies
- Genetics
- Tele-health and Tele-Care

Achieving translation
- User-centred Healthcare Design
- Knowledge into action
- Intelligent commissioning
- Inequalities in health
Our research questions

• What technologies are being adopted in practice and for whom?
  • What is being rejected / abandoned?

• How can robust evidence to support technology use be generated?

• What are workforce needs for training and support to implement technologies?

• What are the user experiences of new technologies?

• How can new technologies be developed that support care and, especially, self-care for people with LTC?
TaCT Theme activities

Special Interest Group

Horizon scanning for technology innovation

User needs for Long Term Conditions

Limited evaluation trials of prototypes

Identifying & Supporting Innovation

RCT of telehealth for COPD
The Intervention

Patient uses Doc@HOME technology to take daily readings.

Readings are sent via telephone line to the Doc@HOME secure server.

PCT SDS staff access the server daily to check patient data and prioritise their workload.

SDS staff will contact patients if an alert is triggered by the doc@HOME system.

Doc@HOME system provides patient education through feedback of their readings.
During service delivery and for six months post hospital discharge, tele-health monitoring will test whether tele-health will:

- Reduce hospital admissions for management of COPD; and
- Improve the quality of life for patients
  (measured by a change from baseline in the St Georges Respiratory Questionnaire)

Other measures:
- Patient satisfaction with care (service questionnaire based on modelling phase);
- Use of health services in 6 months post hospital discharge;
- Health care costs; and
- Patient ability to self-manage their COPD (St. Georges and service questionnaire).
Phases of the RCT

- Modelling Phase (4 months)
- Pilot Phase (3 months)
- Definitive Trial (12 months)
Modelling Phase

Primary Objective
Test feasibility of planned research and intervention processes against supportive discharge processes:
• Information collected through routine clinical practice?
• Additional information required to inform a larger scale trial?

Secondary Objective
Fidelity of discharge pathways including appropriateness/acceptability of the service to providers and users:
• Management of care pathway across network of providers (acute/PCT/LA)?
• Is the care pathway acceptable to all stakeholders?
• Are any adjustments required?

User opinion of service – tele-health / standard services
How do individuals react to having the technology removed after 8 weeks?
The “pragmatic external internal” pilot

1. External pilot
2. Definitive trial
3. Internal pilot
4. Definitive trial

Ethics