Seminar Overview

- Health technology challenges and potential impacts.
- Health-related research projects and clinical collaborations.
- Overview of anaphylaxis, anaphylaxis management and the AllergiSense smartphone and sensing system.
- New research in health informatics and health technology.

Challenges in Health Technology Research

- Lack of translation from prototypes to practice.
- Lack of "clinical prototyping" [Bardram, 2008]
- Lack of theoretical models underpinning developments.
- Lack of formal evaluations.
- Mismatch between clinical and technology timescales.
- Clinically relevant health technology research is demanding in terms of permissions, protocols and processes.
  Challenging within the 3 years of a PhD.

The Quantified Out-Patient

- PhD research of David Infante Sanchez.
- Piloted as "CircadianSense" - a 24hr system monitoring physiological and environmental parameters relevant to the circadian cycle and combined with a quantified subjective report.
- Used and evaluated by healthy participants and collaborating clinicians - included clinician use during hospital working hours.
- "Big data"
  - Multi-modal recording (physiological and ambient sensors and subjective reports)
  - High sampling rates
  - Long-term recording (several days and nights)

Potential Impacts

- The potential impacts of new health technologies are really significant.
- Assistive and monitoring technologies have amazing potential to:
  - relieve the pressures on centralised health resources,
  - dramatically improve health outcomes,
  - aid independent living, and
  - significantly improve quality of life.
The Quantified Out-Patient

- Many interesting patient monitoring challenges but huge potential for positive impacts.
- Enormous scope for collaborative research. For example, contributing toward:
  - data acquisition and recording
  - establishing “normal” and cohort patterns
  - data mining ...
  - ... and data mining and clinicians ...
  - visual analytics

RGB-D Camera Person Re-identification

PHD research by Hafizuddin Yusof.
View-invariant multi-modal person re-identification for natural interaction in smart spaces ... and, for example, applications in intelligent monitoring of people with dementia.

Dementia Study - Activity Monitoring

- Technology for a study with participants with dementia.
- There are significant challenges in the deployment of health monitoring technology in clinical studies.
- Device validation is a substantial undertaking. Current methods don’t account for the dynamic software and firmware upgrades of new systems.
- A lightweight protocol is needed for validation. and ...

Activity Monitoring

- ... the accuracy at reduced activity levels is very poor,
- and different monitors and different sites produce substantially different values.

Activity and Exercise Monitoring

- Step count poor at low walking speeds
- Pulse reporting very variable ...
  - ... until jogging with arms raised

Other Healthcare and Well-being Projects

Precision ICU Ventilation:
- New project on ventilator data acquisition and data mining.
- Collaboration with MMU, Queen Elizabeth Hospital and Birmingham University.
- Analysis of sensor data acquired by ventilators and bedside monitors in hospital ICU.

Undergraduate EEG projects:
- Brain-Computer Interfacing with OpenEEG.
Anaphylaxis

- Anaphylaxis is a severe life-threatening allergic condition.
- It has significantly increased in prevalence.
- Management requires avoidance of allergens and preparation for an anaphylactic reaction.
- Adrenaline auto-injectors are prescribed for anaphylaxis.
- Unfortunately, people who carry auto-injectors and doctors who prescribe them, fail to use them correctly.

AllergiSense

- AllergiSense is a Smartphone app and sensing system for anaphylaxis management designed at the University of Birmingham by my Electronic Engineering PhD student, Luis Hernandez-Munoz.
- AllergiSense was designed with the participation of clinicians, and people with anaphylaxis and their carers.
- Evaluated quantitatively in terms of usability, performance and self-efficacy and qualitatively by clinical staff in five hospitals in the Midlands.

Self-efficacy - One's belief in one's own ability

Self-efficacy and its four sources were defined by psychologist Professor Albert Bandura.

The four sources of self-efficacy are:
1. Experience, or "Enactive Attainment" – Experiencing mastery.
2. Modelling or "Vicarious Experience" – Seeing others achieve.
3. Social Persuasion – Encouragement or discouragement from others.
4. Physiological Factors – Perceiving one's own physical responses.

"Whether you think you can, or you think you can't—you're right." – Harry Ford
Self-efficacious in Every Case!

Fig. 1. Participatory design methodology embedded with self-efficacy components.

AllergiSense Performance Results

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Primary outcome: Number of people correctly completing the four injection stages.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session</td>
<td>Paper only</td>
</tr>
<tr>
<td>Group 1: Paper only</td>
<td>4 (94.4%)</td>
</tr>
<tr>
<td>Group 2: AllergiSense without feedback</td>
<td>7</td>
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</tbody>
</table>

Thank You

[These are summarised slides from a November 2016 Keele Computing Seminar. Please email me or check ResearchGate if you would like more details on current health technology research.]

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