From e-Health to m- and p-Health

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Who are we?
“ICT for Health” Unit, Information Society and Media DG
European Commission

- Supported > 500 eHealth projects with > €1 Billion since 1989
- Current support (~ €100 Mil/year)
- Major focus in 90’s:
  - Regional Health Information Networks, Electronic Health Records, Homecare/telemedicine
- Today’s focus:
  - a) Research:
    - Personal health systems (wearable, portable monitoring)
    - Patient safety (Clinical information systems for safer outcomes)
    - Modelling and Simulation of diseases (Virtual Physiological Human)
  - b) Policy and support to deployment
    - eHealth Action plan, Lead market initiative
    - Recommendation on Interoperability, Communication on Telemedicine
    - Large Scale Pilots, certification of Electronic Health Record Systems
DG INFSO / ICT for Health – Research areas

- **Personalisation of Healthcare**
  - Personal Health Systems (PHS)
    - € 135 million in 2007-2010

- **Virtual Physiological Human (VPH)**
  - Predictive Medicine – Modelling/simulation of diseases
    - € 140 million in 2007-2010

- **Patient safety - avoiding medical errors**
  - € 60 million in 2007-2010
Challenges for European Health Systems

- **Pressure on healthcare systems:**
  - Citizens’ expectations for high-quality care
  - Demographic changes
  - Increased prevalence of chronic diseases
  - Increased mobility of citizens and patients
  - Staff shortages, unequal territorial distribution
  - Reactive model of healthcare delivery
  - Rising healthcare costs

How to offer high-quality & affordable care?
How: By sharing information
Tools: Electronic Health Records, Regional Information Networks, Portable Systems
The EU roadmap for eHealth

1. Linking all the points of care

2. Connecting individuals with Health Information Networks

3. Towards full picture of the individual’s health status

Time:
- 1990s
- Today
Step 1 – Linking all the points of care

Secure data networks and interoperable applications

Hospitals
General Practitioners
Health Authorities
Social Service
Nursing Homes
Labs
Homecare
Large Scale Pilot on cross-border eHealth interoperability

- “epSOS – Smart Open Services for European Patients”
  - Patient Summary for EU Citizens
  - ePrescription for EU Citizens
Step 2 – Connecting individuals with Health Information Networks

Data acquisition

Data communication and feedback

Data processing & analysis

Patient at home

Devices for multi-parametric monitoring

Hospital

General Practitioner

Homecare

Medical Expertise

Decision Support System

Intelligent Analysis
A new generation of disruptive eHealth tools

- Place the individual person in the centre of the healthcare delivery process
  - Person-centric care
- Aim for high quality, personalised care at the point of need
- Better use of the available healthcare resources

Key facilitators for:

- Ubiquitous personalised care
- Continuity of care (in time and space)
- Supporting the shift to preventive care
PHS characteristics

Realised as:
- **Wearable, implantable, portable** systems
- Integration of various components and technologies
  - e.g., sensors, implants, signal processing algorithms, user interfaces, mobile and wireless communications
- Used by the patient or healthy individual
- Coupled with telemedicine platforms to provide personalised services

Non-/minimally-invasive monitoring and management
- Remote & continuous health status monitoring and disease management
- Personalised medical advice, recommendations & treatment
- Available at anytime and location beyond hospitals
The First Approaches in PHS: “Telehealth”

Telehealth solutions for home care employing:

- **Sensing and monitoring equipment**
  - ECG (event) recorders, blood glucose monitors, etc…

- **Communication networks**
  - Via telephone lines

- **Services provided by call centres**
  - 24 hours a day, all year round
  - Linked with networks of health professionals
  - Medical response and guidance

- **Example: Telecardiology - Boario Home Care Project, IT**
Telehealth becomes “interactive”

Interactive TV:

- Remote care at home
- Easy to use interface
- Patient education (through personalised videos)
- Feedback and motivational messages
- Supporting doctor-patient interaction

- Example: MOTIVA by PHILIPS

Source: Philips
Introducing mobile technology: the move to “m-Health”

- **Mobile monitoring of health status**
  - Body sensors (wearable, wireless)
  - Measurement of vital signs (ECG, heart rate, blood pressure, blood glucose, …)

- **Mobile/Wireless communication networks**
  - Wirelessly from sensor network to PDA or mobile phone
  - GPRS / UMTS mobile networks to servers in medical centres

- **Services**
  - Health service providers
  - Linked with health professionals
  - Real-time feedback to patient
  - Messages, reminders
Introducing mobile technology: the move to “m-Health”

EMH

EMH Core System

- Objective Vital Values
- Subjective Diary Data
- Messaging

GPRS/UMTS

Mobile Networks

Patient Feedback Loop in Real-Time

Prototype PHS in the hands of the users
(from FP5 and FP6 research projects)

Examples for monitoring vital signs

- Wrist-worn devices
- Body Sensor Networks
- Biomedical clothes
Prototype PHS in the hands of the users
(from FP5 and FP6 research projects)

The MyHeart system for closed-loop management of Heart Failure

- Patient self management: taking measurements at home, morning and night
- Detect trends in measurements prior to medical events
- Early prediction of patient “decompensation”

T-shirt
- Respiration
- ECG
- Activity

Smart Bed
- ECG
- Pressure
- •Heart Rate
- •Respiration Rate
- •Activity

Reference
- Weight
- Blood Pressure
- Implant
- •ECG
- •Activity
Personal Health Systems: the bigger picture

Data acquisition

Sensors for multi-parametric monitoring

Data processing & analysis

Intelligent analysis

Medical expertise

Support to diagnosis decision & treatment

Other data: clinical, images, lab, genomics

Data communication and feedback

Health / call Centre

Hospital

Treatment, Rehabilitation
Prototype PHS in the hands of the users
(from FP5 and FP6 research projects)

In neurological applications
- Textiles with embedded sensors to assist rehabilitation

MYHEART
PHS - research on Point-of-care systems

**Portable systems for prevention/early identification of a disease**

- Lab-on-Chip, microfluidics, integrated sensors
  - Integration of different functions in miniature devices (preparation, mixing, analysis, etc.)
  - Parallel measurements from small samples
  - High throughput screening
  - Identify predisposition to diseases
Considering personalised context and characteristics:

the complete move to “p-Health”

- Enrich information
  - from surrounding environment, activities, emotions, genetic …
- Account for measurements in non-clinically controlled environments
  - give “context” to a value, i.e. under which conditions it was measured
- Adapt to specific characteristics of the individual
  - we are all different from each other
  - a blood pressure level may be high for person X but normal for person Y
- Consider all the above in:
  - reducing false alarms
  - medical decision making
  - providing services
- PHS research moves in this direction
  - … but we are not quite there yet
Does all this work?

- Is there evidence that specific eHealth applications improve clinical (health) outcomes and/or are cost effective?

- Can anybody get in “trouble” for NOT deploying eHealth solution today?

- Need for a commonly used set of assessment & evaluation methodologies in order to pool evidence about eHealth

- Such evidence to be
  - in large scale settings
  - using scientifically sound methods
What are the benefits and evidence?

- **UK Department of Health on potential of self-care:**
  - Reduce GP visits by 40%
  - Reduce outpatient visits by 17%
  - Reduce hospital admissions by 50%
  - Reduce length of hospital stay by 50%
  - Reduce days off work by 50%

- **Boario telecardiology:**
  - Estimated annual benefit cost ratio > 3.3:1 by 2012
  - Net benefit even from the first year
  - 35-47% reduction in hospital admissions (in various studies)
  - 12% reduction in outpatient visits
What are the benefits and evidence?

- **Practical:**
  - More than 4 billion mobile phones in use worldwide
  - Quick and low-cost solution for a large population

- **Clinical:**
  - Patient mobility, quality of life
  - Clinical efficacy
  - Evidence from TEN-HMS study on home telemonitoring of heart failure:
    - Improved survival rates by 15% over usual care
    - 26% reduction in hospital days per patient
  - Evidence from trials on cardiovascular diseases
    (Source: Ericsson & HealthServices24):
    - Admissions reduced by 60%
    - 90% of the patients claimed to feel more reassured
What are the benefits and evidence?

- **Economic:**
  - Evidence from COPD trials (Source: Ericsson & HealthServices24):
    - Reduced hospitalisation days
    - 38% reduction in patient costs
  
  - Evidence from TEN-HMS study on home telemonitoring of heart failure:
    - 10% overall cost savings with respect to nurse telephone support
  
  - Potential of Mobile Monitoring in Germany (Source: GesundheitScout 24 GmbH & Bayerisches Rotes Kreuz):
    - Up to €1.5 billion/year savings through early patient discharge
    - Assuming 3 days less hospital stay for 20% of patients
What are the benefits and evidence?

- Study across nearly 1000 homecare agencies in USA*
  - Significant benefits of telehealth applications for homecare
  - >76% of the agencies reported reductions in unplanned hospitalisations and in emergency room visits
  - >71% of the agencies reported improved patient satisfaction from telehealth services

* “National study on the future of technology & telehealth in home care”
  by National Association for Home Care & Hospice, Philips Home Healthcare Solutions and Fazzi Associates, Inc.
• Systematic support to R&D so far has helped to:
  ➢ overcome many technological challenges
  ➢ realise the first generations of prototype PHS

• Early evidence suggests significant benefits to healthcare systems and individuals

• Two parallel streams of activities:
  ➢ Assistance towards the wide deployment/integration of first PHS generations in healthcare systems
  ➢ Continued research activities towards new PHS generations: moving to personalised care
Large Scale Pilot on Telemedicine:

- Allocated €7M within the Competitiveness and Innovation Framework Programme (CIP ICT-PSP) for the deployment of a large-scale pilot "(...) to validate in real life settings the use of existing PHS for innovative types of Telemedicine services and to prepare for their wider deployment".

- Focus on three chronic conditions: diabetes, cardiovascular diseases and COPD, a statistically significant sample size of the population to be monitored for each disease and the same methodology to be used in all testing sites.
Large Scale Pilot on Telemedicine:

- Targets *six to eight regional healthcare authorities or local healthcare organisations* directly responsible for the deployment of existing or planned telemedicine services.

- Operations starting early in **2010** for a duration of **three years**.

- The initiative is expected to build up the *largest multi-centre clinical trial* ever deployed in Europe to measure the effectiveness and cost effectiveness of Telemedicine solutions.
Step 3 – Towards full picture of individual’s health status

Biosensors

Environmental Data

Biochips

Genomic data

Phenomic data

ICT Systems
The Virtual Physiological Human (VPH) concept
Based on the ideas of the International Physiome project

A VPH definition within ICT context:

• The Virtual Physiological Human is a methodological and technological framework that once established will enable the investigation of the human body as a single complex system.

Personalised (patient-specific) healthcare solutions aiming at:

• Early diagnostics & predictive medicine

• Understanding diseases for the first time across several biological levels
Computational Models of the Human Body

- **Reproduce Anatomical and Functional properties of physiological systems at various scales**
  - molecules, proteins, cells, tissues, organs, systems, body, etc.

- **Integrate Geometry, Physics, Chemistry, Physiology...**

- **Help understand normal or pathological evolutions:**
  - systems: cardio-vascular, Central Nervous, Digestive, Reproductive, etc.

N. Ayache, INRIA
The Virtual Physiological Human (VPH)

Vision:

**Personalised medicine** (e.g. drug specific to a set of patients, personalised healthcare)

**Preventive and predictive medicine** (e.g. moving from costly medical intervention after symptom and diseases to early detection of predisposition and the cause of diseases).

Solutions:

**Use of ICT for simulation of the human body** (zoom in/out from organ to cell/gene levels)

 e.g. Models of patient’s cerebral un-ruptured aneurysm can be used to decide on surgery or not and to treat the cause.

 e.g. models of patient’s heart can be used to decide on optimal/personalised treatment or to plan the surgery.

Potential Market:

**Pharmaceutical industry** (to shorten drug development, avoid animal testing, personalised drug)

**Medical industry** (devices and imaging benefit from simulation)

**Software industry** (development of models/simulators)
**euHeart** is about the development, personalisation and validation of computational models of the heart to improve:
- Diagnosis,
- Treatment planning,
- Interventions and
- Design of implantable devices

**5 clinical focus areas:**
- Cardiac Resynchronization Therapy
- Radiofrequency Ablation
- Heart Failure
- Coronary Artery Diseases
- Valves and Aorta

Project coord.: Philips Research
Scientific coord.: University of Oxford

17 partners (6 companies, 6 universities, 5 clinics)

Budget ~19M€ (~14M€ EU funding)
To find more on ICT for Health activities / eHealth?

- **Policy and Research:** http://europa.eu.int/information_society/eHealth
- **Regular eHealth e-Newsletter:** http://ec.europa.eu/information_society/activities/health/newsletter/index_en.htm

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