Smart Cities and Digital Healthcare: Transforming Health and Wellness of Citizens and Communities

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Joint Editor-in-Chief, Digital Health, SAGE

Motivation: vision for the future of healthcare

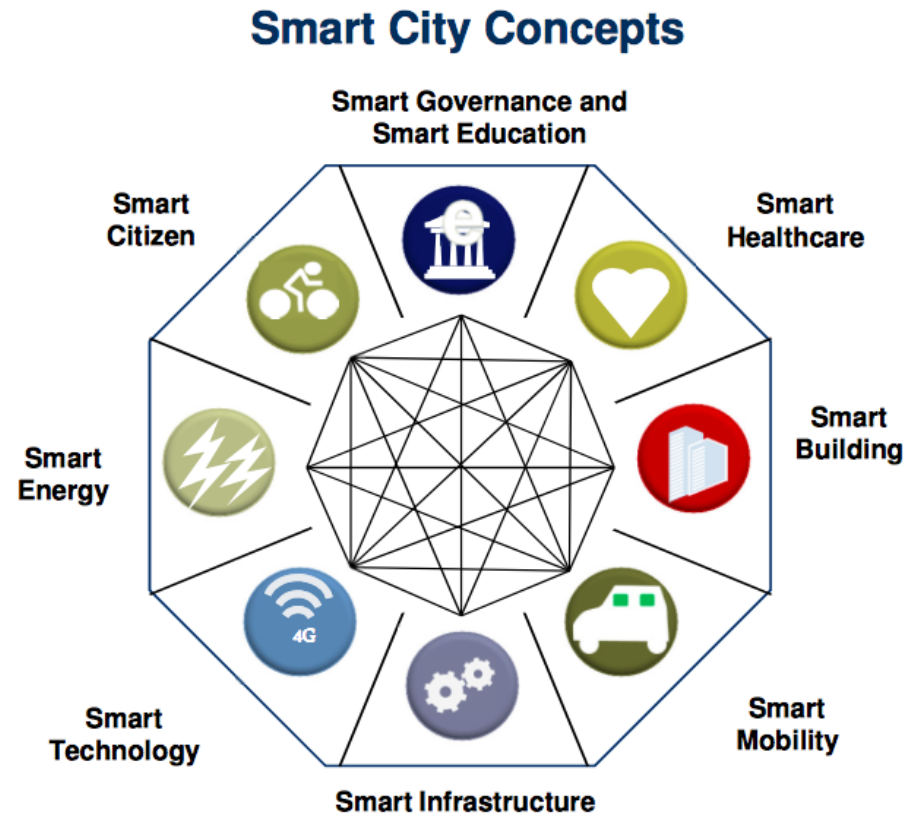- people have the best possible start to life
- health is protected, wellbeing is promoted, and avoidable deaths and diseases are prevented
- people are enabled to live independent and fulfilling lives, and take control of the care they need
- people who are ill or need support receive safe and effective care and are treated with dignity, including at the end of life
- health and care inequalities become a thing of the past

- "Going digital means that public services can be more efficient, more transparent and more effective. The Government's Digital Strategy has a bold and simple ambition: to redesign government services, to place them online and to make them straightforward and convenient."

- Digital Strategy in Healthcare – "Smart" Health
  - Leading the culture change in health and social care

Source DOH,
Digital Strategy Report, 2012

Smart Cities and Healthcare

- Smart cities are cities built on Smart' and 'Intelligent' solutions and technology that will lead to the adoption of at least 5 of the 8 smart parameters

- "Smart healthcare is the use of eHealth and mHealth systems and intelligent and connected medical devices. It also involves the implementation of policies that encourage health, wellness, and well-being for its citizens, in addition to health monitoring and diagnostics as opposed to treatment"

- Thesis: Digitally-enabled integrate care for Smart Healthcare

Smart City Concepts

Smart Governance and Smart Education

Smart Citizen

Smart Healthcare

Smart Energy

Smart Building

Smart Technology

Smart Mobility

Smart Infrastructure

Source: Frost & Sullivan, Strategic Opportunity Analysis of the Global, Smart City Market 2012-2020

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Smart-Connected World

A technologist's viewpoint:
The Internet of Things …and People
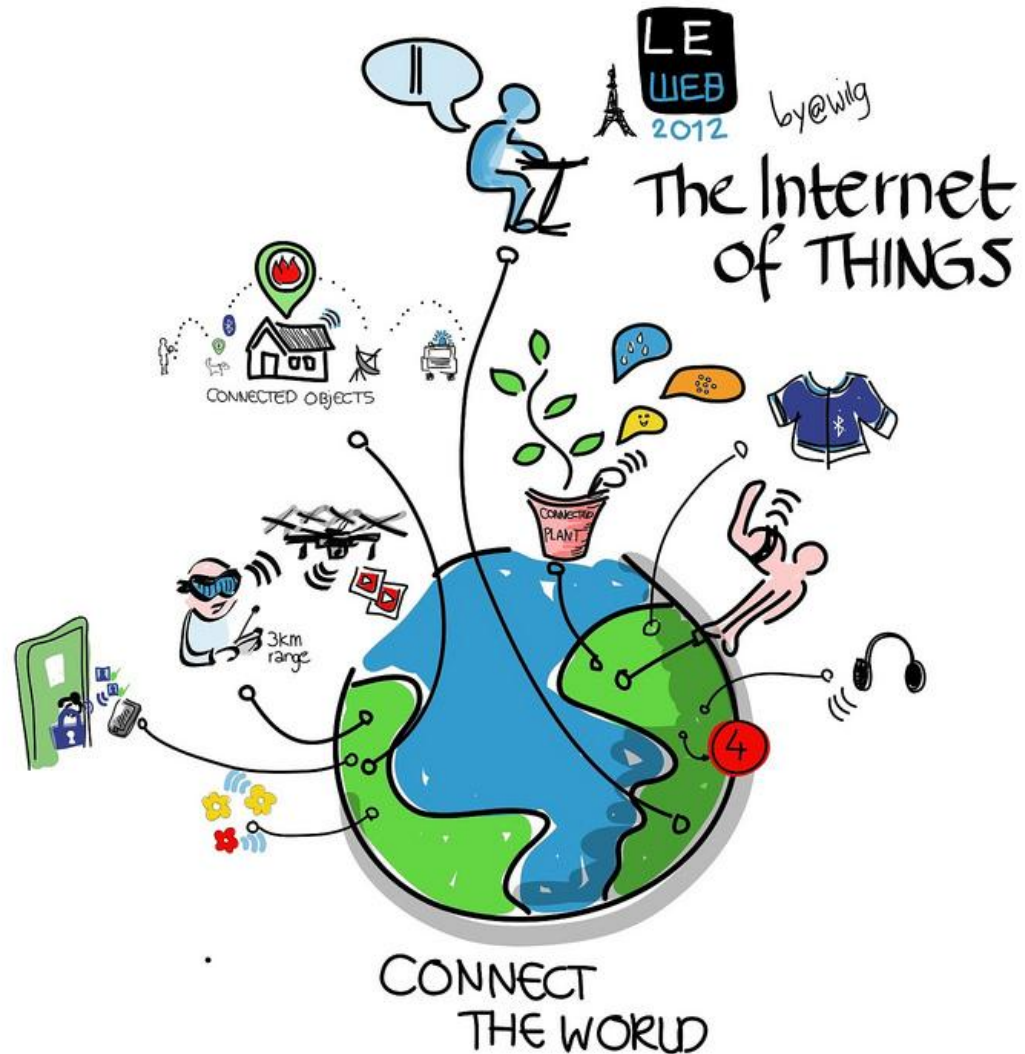
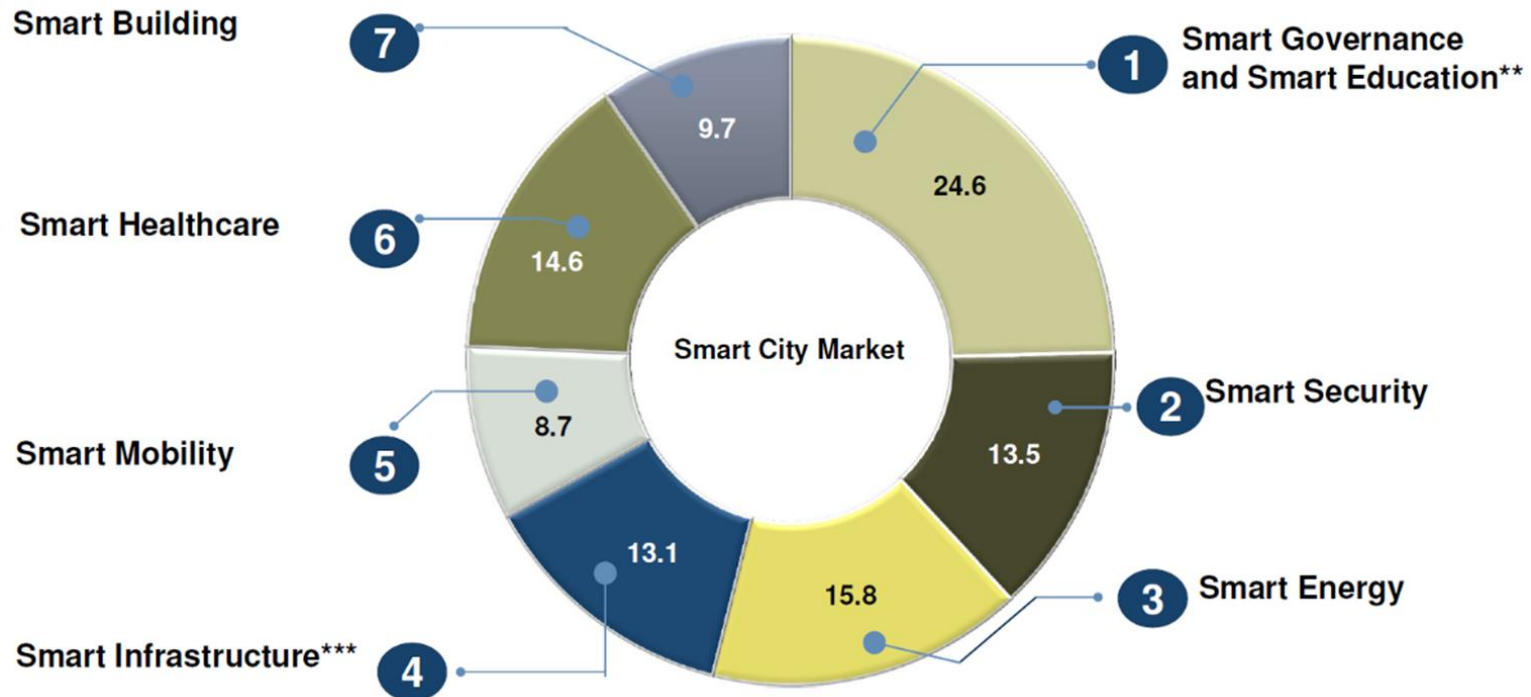# Smart Healthcare: Digital/Connected Health and Social Care
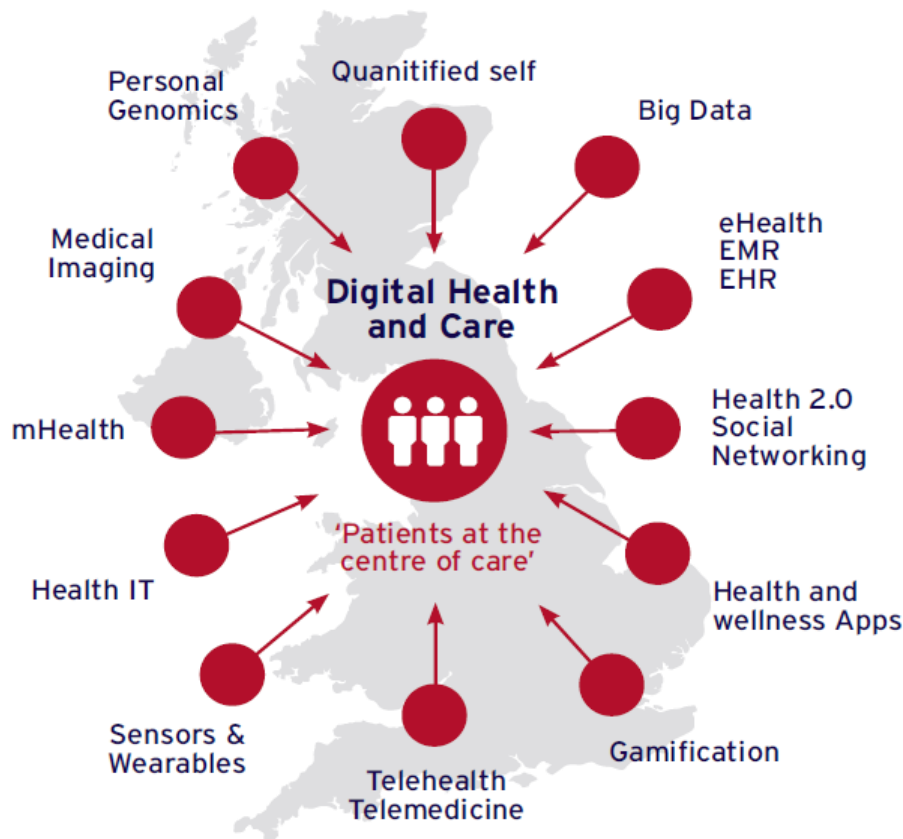
The impact technology can have in healthcare is profound and transformative.

Digital Ambitions for health and social service to:

• Integrate solutions around the patient

• Widespread use of technology

• Electronic health records to become norm

• National standards throughout the health and social care sector

Adapted from source
UK Trade & Investment, The UK digital health and care opportunity

Smart Healthcare and the Global Smart Cities Market

Smart Building

7

9.7

Smart Healthcare

6

14.6

Smart Mobility

5

8.7

Smart Infrastructure***

4

13.1

Smart City Market

Smart Governance and Smart Education**

1

24.6

Smart Security

2

13.5

Smart Energy

3

15.8

*These numbers represent the entire smart solutions eco-system in each segment for both urban and non-urban panoramas.
**Smart Education includes eLearning services for schools, universities, enterprises, and government entities.
***Smart Infrastructure includes sensor networks and digital management of water utilities not included in other segments.

Smart cities are anticipated to create huge business opportunities with a market value of €1.26190 trillion by 2020.

Source: Frost & Sullivan, Strategic Opportunity Analysis of the Global, Smart City Market 2012-2020

2015-2035: Three Domains of Global Health Challenges

THE LANCET   GLOBAL HEALTH 2035

High rates of avertable infectious, child, and maternal deaths	Demographic change and shift in GBD towards NCDs and injuries	Impoverishing medical expenses, unproductive cost increases
Unfinished agenda	Emerging agenda	Cost agenda
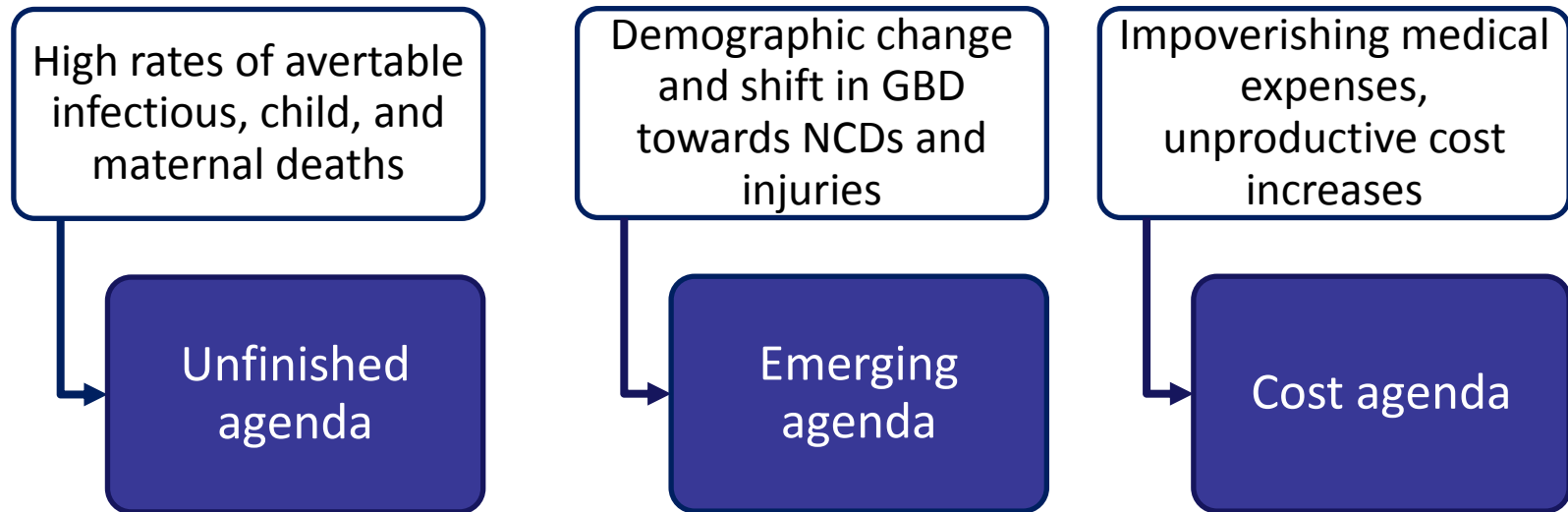
Source: The Commission on Investing in Health

▸ Long-term care needs experience shortcomings, especially **within and between health and social care** delivery organisations.

▸ **Financial burden** in the delivery of complex care demands

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The Context:
The Case for "Smart" Care Delivery

▶ Chronic diseases are the main reason for **poor health and restricted activity**, affecting over one third of Europe's population and accounting for 70% of healthcare expenditure in Europe.

▶ Ageing is associated increased accumulation of multiple chronic conditions known as *multi-morbidity*, including a growing number of functional and cognitive impairments.

– More than half of all older people have at least three chronic conditions, and a significant proportion has five or more

▶ The clinical management of patients with multi-morbid chronic conditions is much more complex and time-consuming for the healthcare system.

▶ Further burden on social care services to enable such patients perform everyday activities, supported by informal carer or home / community care services.

The Challenge

Transformation of care delivery
In which setting care is delivered for chronic patients*?
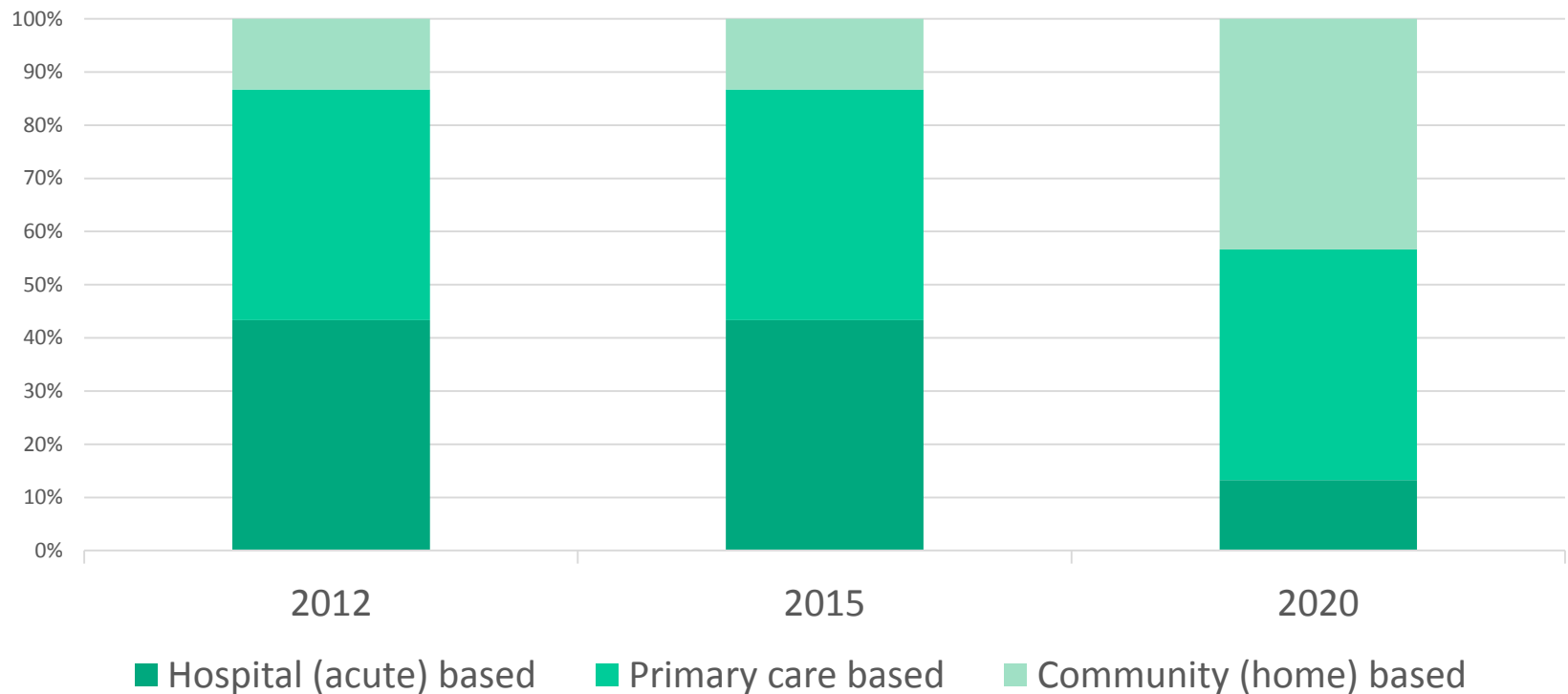
*European Innovation Partnership on Active and Healthy Ageing, Action Plan on 'Replicating and tutoring integrated care for chronic diseases, including remote monitoring at regional levels'. http://ec.europa.eu/research/innovation-union/pdf/active-healthy-ageing/b3_action_plan.pdf

Digitally-Enabled Integrated Care

▶ Integrated Care – Smart Healthcare

- The management and delivery of health and social care services so that citizens receive a continuum of preventive and curative services.

  - According to their needs over time and across different levels of the health system.

- Can potentially provide a co-ordinated approach within the context of Smart Healthcare and Smart Cities.

▶ Digitally-enabled approaches and models can provide more <u>adaptive and radical solutions</u> to the provision of integrated care.

Why Digital?
Healthcare is Transforming through Technology

In healthcare, **digital technology systems** are no longer confined to the intensive care unit or the GP's desktop computer.

▶ linked **electronic records** to support the delivery of care;

▶ **harnessing data** to support research and real-time public health **decision making**;

▶ **integrated decision support systems** which aim to maximize **effectiveness and patient safety**;

▶ tools for delivering **remote monitoring** and **self-management;**

▶ online consultations and interventions, supporting upstream **models of health care**, away from the hospital;

▶ wearable and implantable devices, providing **new ways to capture** and **monitor physiological parameters**.
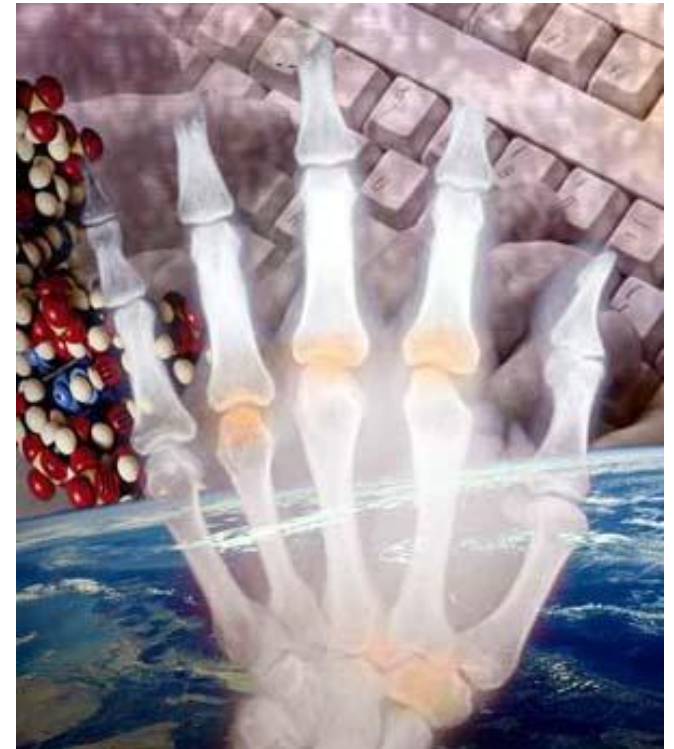
Smart Cities and Digital Healthcare: Exemplars

Example I: C3-Cloud

- **C3-Cloud:** A Federated Collaborative Care Cure Cloud Architecture for Addressing the Needs of Multi-morbidity and Managing Poly-pharmacy

- ICT infrastructure enabling a collaborative care and cure cloud to enable continuous coordination of patient-centred care activities

- Digitally-enabled integrated care – both smart city and rural community environments.

- To demonstrate feasibility, pilot studies will focus on diabetes, heart failure, renal failure, depression in different comorbidity combinations. (3 European regions)
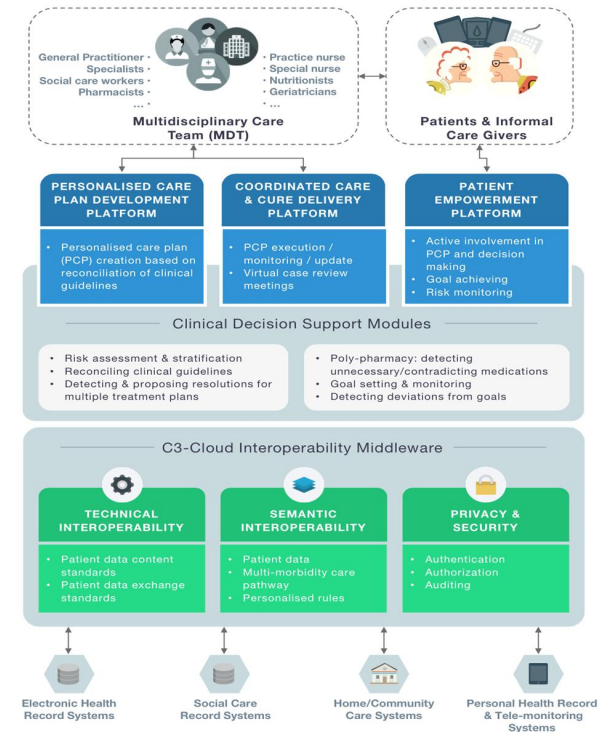
Horizon 2020. Research and Innovation Action
Project budget: 4,995,000 EUR
May 2016 – April 2020
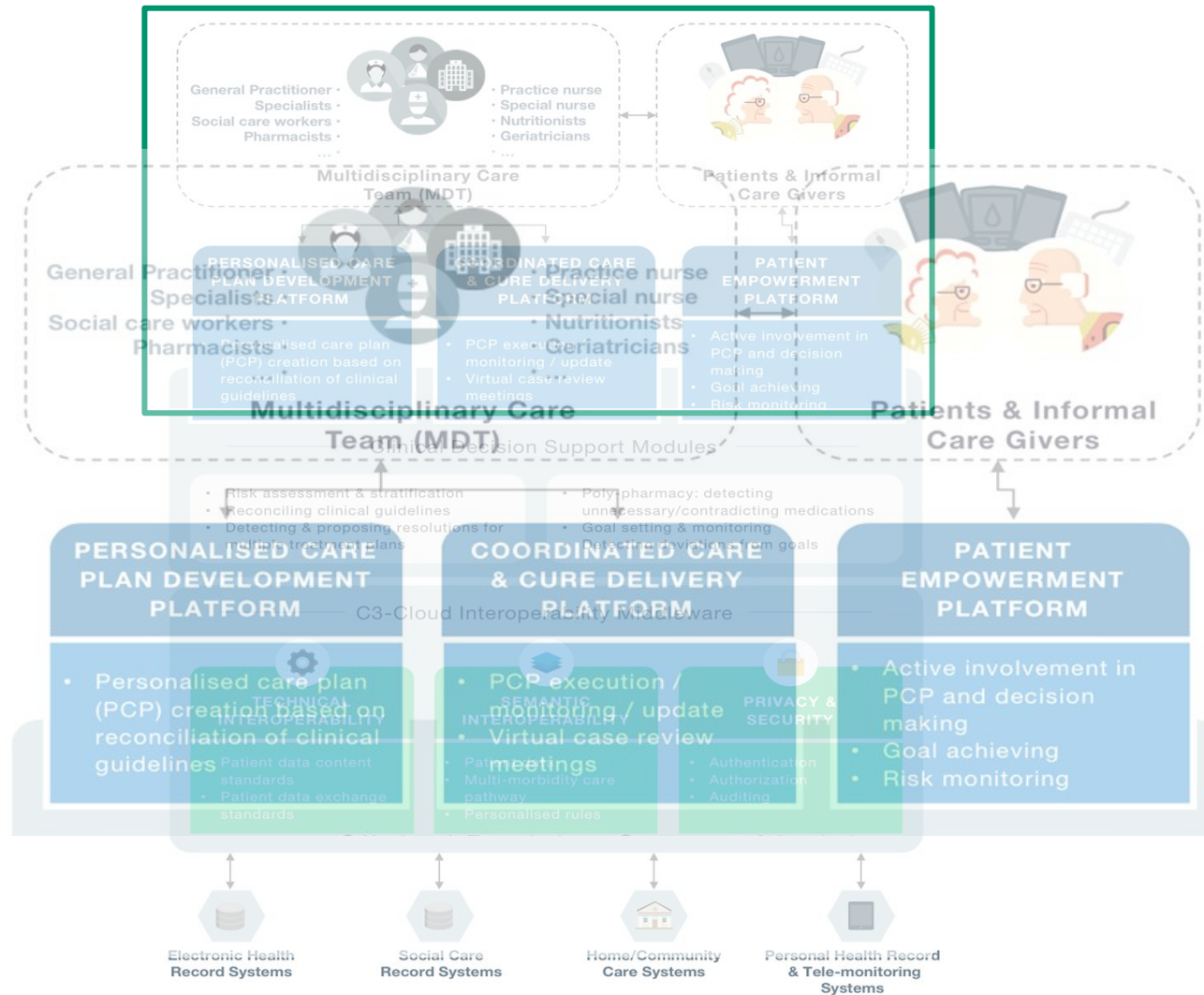
C3-Cloud: Overall Architecture I

C3-Cloud: Overall Architecture II
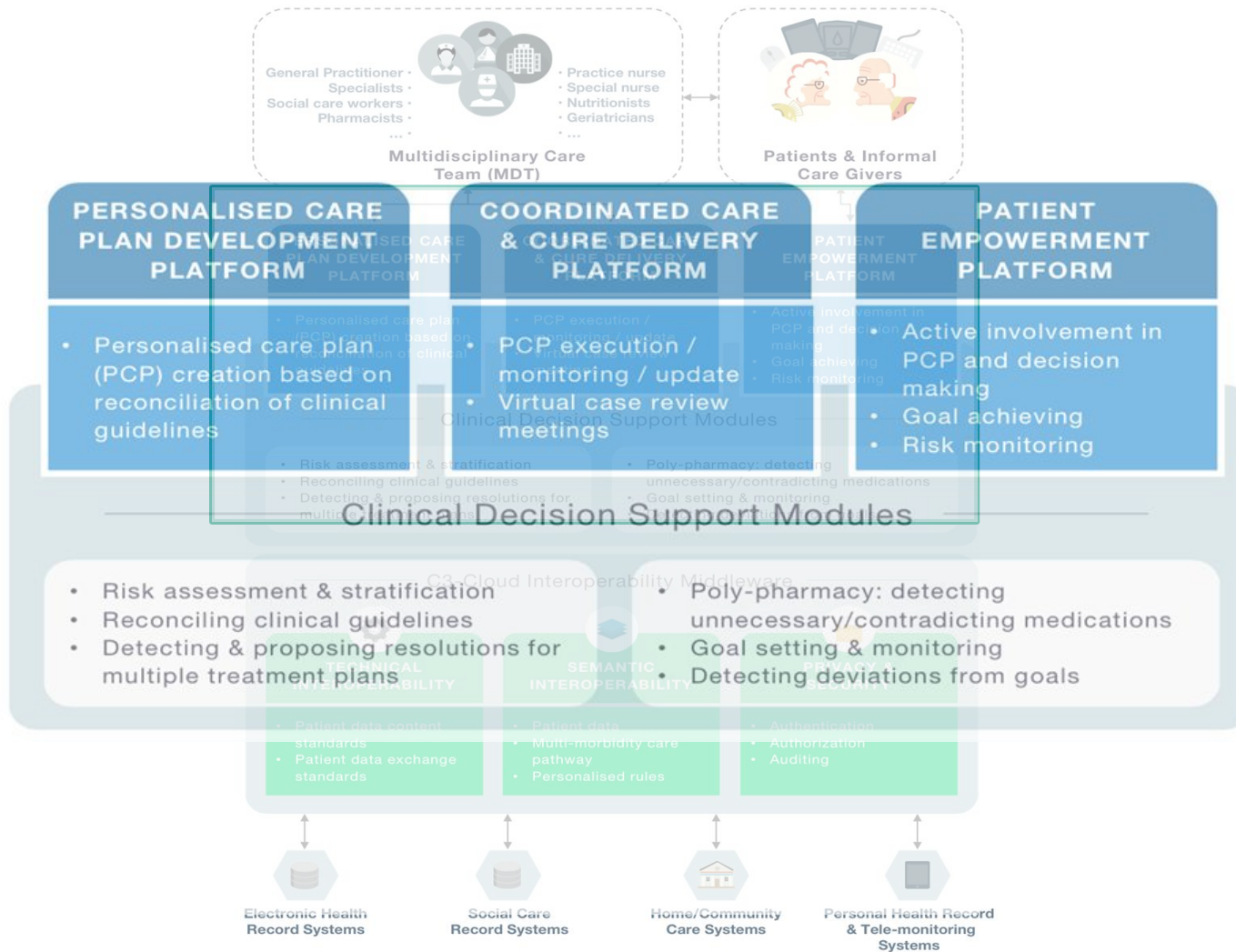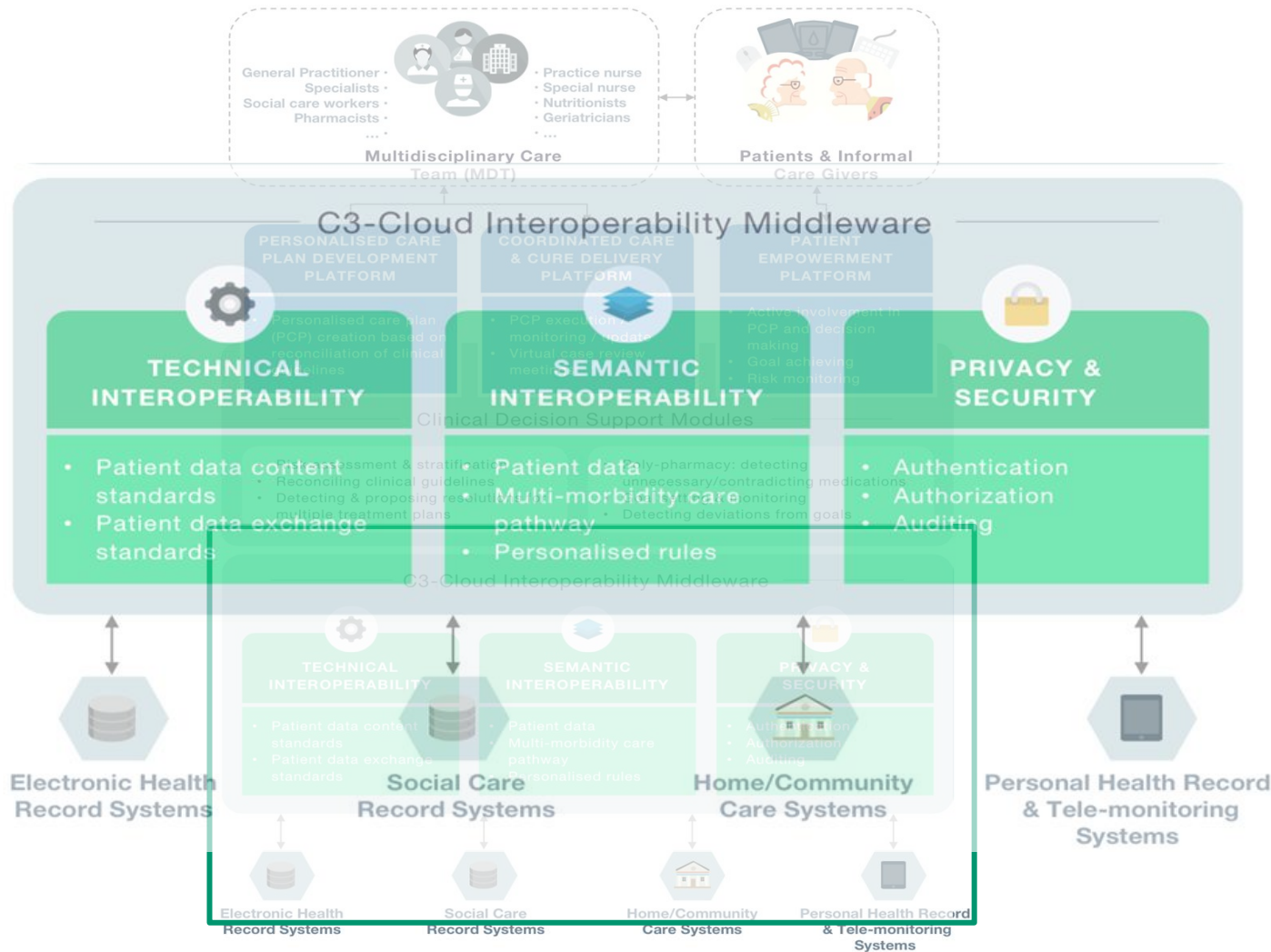
C3-Cloud: Overall Architecture III

Digitally-Enhanced Tools in C3-Cloud: example of self-empowerment platform

Example II: NHS digital infrastructure empowering the citizen

Taking the hassle out of healthcare

1. Accessing your GP record online will give you more control over your care

2. Booking appointments will be quicker when you can do it online

3. You'll need fewer phone calls when you can communicate with professional teams electronically

4. You'll have less paperwork in your life when your healthcare letters are available online

5. You'll know where to go for health and care information when there is one trusted website

6. Services will do more to offer you support you use and understand information if and when you need it.

7. You won't have to repeat yourself when your information is shared between health and care professionals

8. You'll be confident that your feedback is being listened to and helping to improve services

9. You will have more information to help you choose the best services and treatments for you

Source DOH, Digital Strategy Report, 2012

PatientView

Source https://www.patientview.org/

PHRs: open access to quality data

Records of all current and historical medication records held by the hospital are displayed. The patient can also add their own medication, or notify QEHB of any changes.

Lab results held by the hospital are displayed.

The patient can submit their own external blood and other test results (e.g. blood pressure). BP measurements entered by the patient are presented in a graph

Recent and historical inpatient history is displayed.

Relevant Web links (e.g. BNF) are listed here.

Hospital appointments are listed and patients can add other events (such as appointments).

Patients can add GP details, QEHB and other hospital contacts.

Patients can choose to upload health documents to their portal and keep them private or share them with QEHB.

University Hospitals Birmingham **NHS**
NHS Foundation Trust

Delivering the best in care

# Quality service improvement: smart data to knowledge

Source, Dr Anne Talbot, GP & Urgent Care Clinical Lead, Bolton CCG
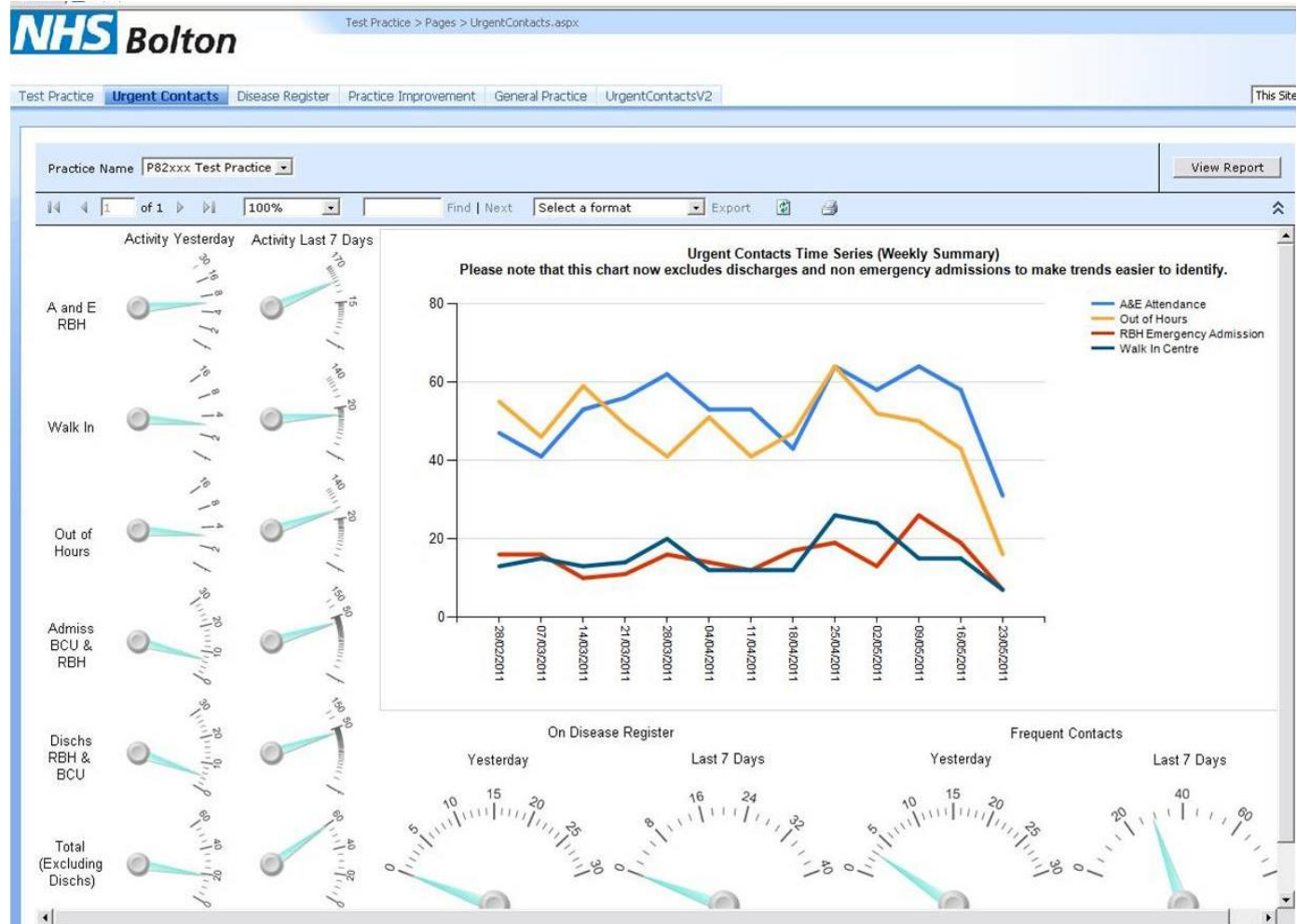
Example III: Quantified Self

sweatcoin

- Sweatcoin: currency 2.0
- Engages the user and creates a sustainable uplift in physical activity
- Facilitates the exchange of economic value created by physical activity through Sweatcoin Marketplace and user-to-user transactions
- Tackling obesity:
  - Indoor step verification
  - Verification of other activities
  - Predictors of physical activity behaviour change
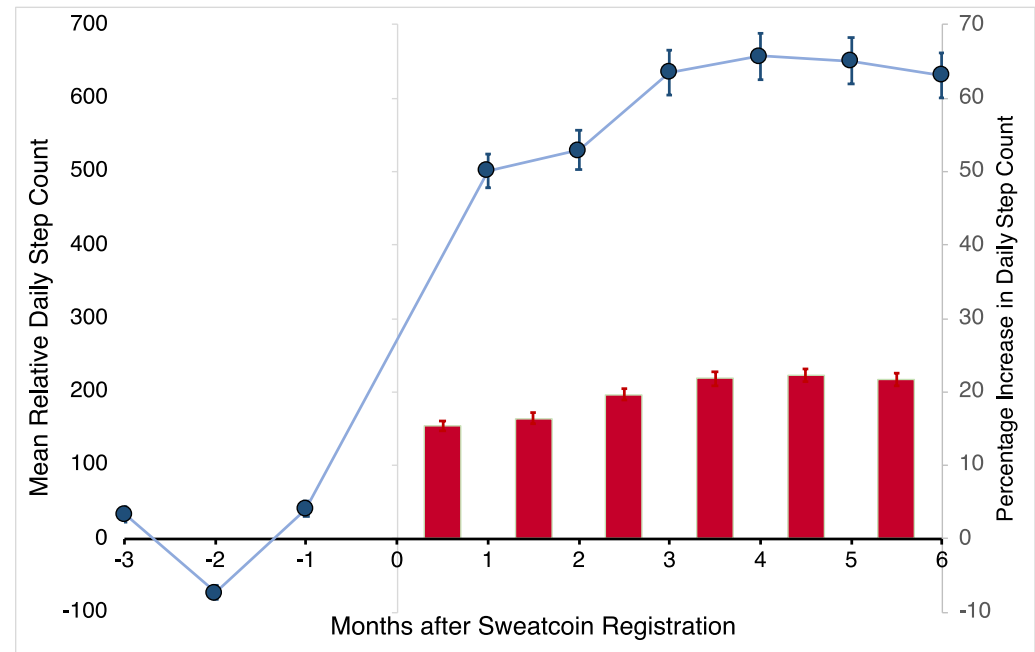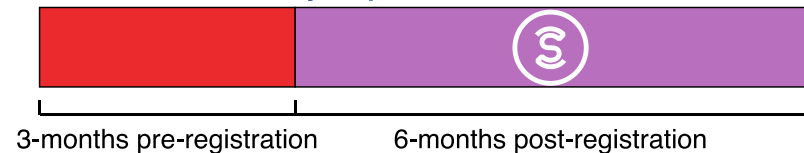
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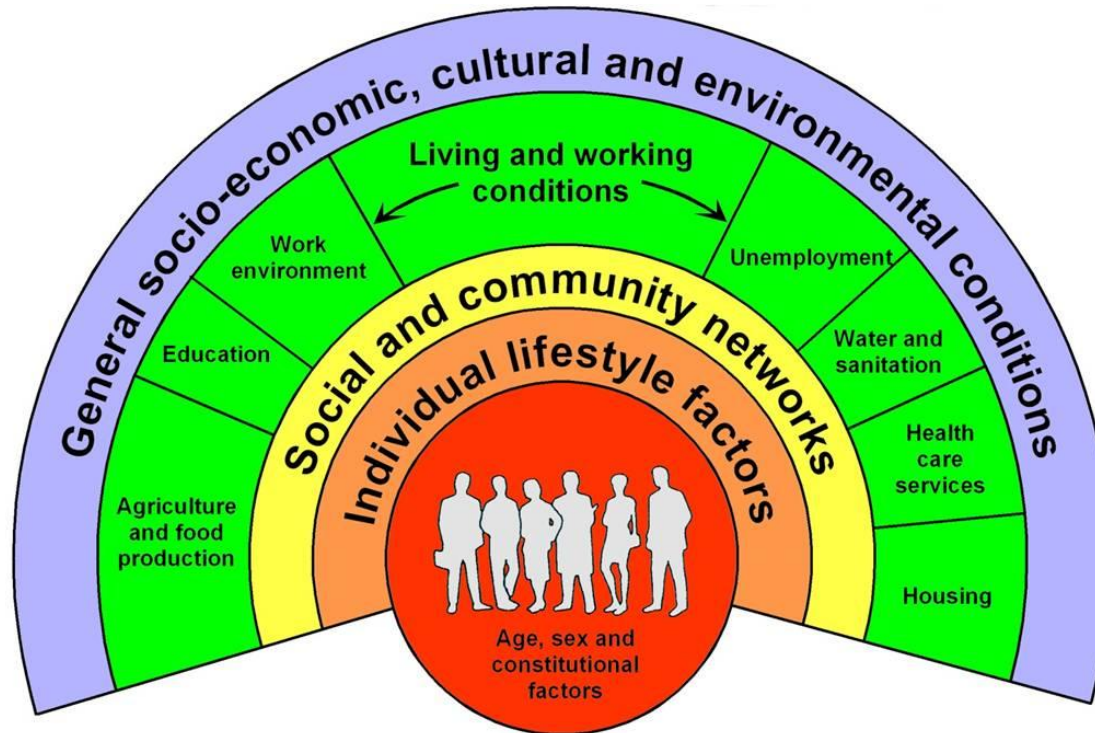
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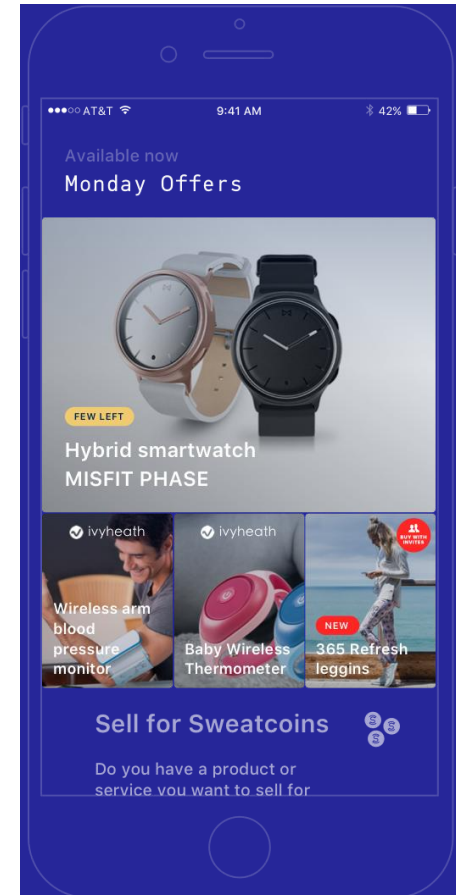
Example III

sweatcoin

- 5406 users, 9 months daily step count (3-months prior to SWC registration and 6-months post registration).

- Demographics, self-report activity and Sweatcoin feedback

- Relative step count: average from 3-mth prior subtracted from all values to see change after registration.

- Sustained 15-20% increase in daily step count following registration.

N=5406

Sweatcoin user for minimum 6 months

Has opened the Sweatcoin app in the last week

iPhone owner

An equal split of US and UK users

Mean daily step count for each month

3-months pre-registration   6-months post-registration

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Smart Health: System View of Public Health

Source: Dahlgren and Whitehead, 1991

Determinants of Health: Relevance to Smart Cities Concept

Prof Theodoros N. Arvanitis, **6th Smart Cities Conference** , Boussias Conferences, Athens, 9th of March 2018

Summary

▶ The impact of digital technology and information can be transformative for healthcare.

▶ Digital Healthcare – Individuals & Communities: The benefits to individuals and society are multiple. People's health journeys are better understood and appropriate lifestyle choices can be better tailored and promoted to the individual.

▶ Digitally-enabled integrated care as a smart Healthcare way forward: In the case of chronic conditions, disease management can be more effectively supported and avoidable deaths can be prevented.

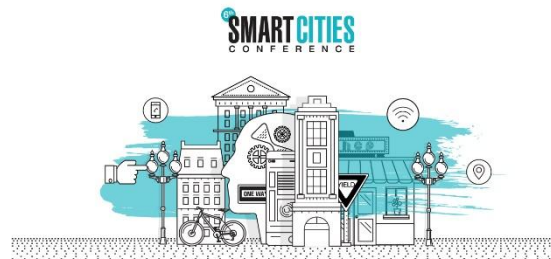▶ Digital Healthcare an important constituent to smart cities

Thank You

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