



Health and Well-being

Healthcare is one of the most pronounced societal areas facing large challenges, involving patients, citizens, government, healthcare institutions and companies. ICT is considered an important enabling technology. Health and wellbeing is a broad domain. It is often broken down into:

- **Cure.** This is the domain of hospitals: diagnosis, surgery and care are the main processes. From the IIPIIC point of view there are challenges in the management of patient records, person-to-person communication, and wireless communication in surgery rooms. Treatment in hospitals is, in the Netherlands, funded by health-insurance companies on the basis of a well-defined treatment (status 2011).
- **Care centers** ('verzorgingstehuizen'). This is the domain of elderly and people that require a high level of care. These are financed by the government by means of the AWBZ (status: 2011). In 2012 the AWBZ funding will be rerouted through the health-insurance companies. The core business of care centers is to organize (personalized) 24x7 care services for their clients. There is a move towards decentralized care: smaller care-centers in neighborhoods, often requiring remote observation of inhabitants during out-of-office hours.
- **Telecare service providers.** These organizations provide services like vital-sign monitoring of individuals, connected either synchronously or asynchronously with a telecare center or hospital. Other variants involve smart homes; the in-home technology is connected to a telecare center and/or a general purpose alarm-centre. The business models for telecare are not really established yet. Telecare service providers are not always associated with a care-center; they can also be an intermediary between multiple care providers. Services are often tied together with specific hardware solutions, resulting in minimal interoperability between in-home solutions.
- **The care-chain.** Professional health and care centers have to cooperate: patient-centered care requires the combination of workflows across organizations, in combination with the exchange of the relevant medical data records. Concerns are process optimization, information security and privacy, efficient exchange of high-resolution images, and cost efficient operation.
- **Lifestyle, Prevention, and Well-being.** Prevention is both primary and secondary prevention. Ultimately, this is the domain that is driven (and paid for) by the consumer. Example services are support for fitness, cycling, or running. Assistance for cooking. Stop Smoking. Lifestyle coaching. Etcetera. Although some of these services are (co-)funded by employers, often they are paid for by consumers (e.g. via downloaded apps on smartphones in combination with a service-subscription).

Introduction

Health and Well-being visions are widespread. We quote a few of them:

IIP Health Support: "Care migrates from an isolated system (19th century), through (linear) healthcare chains (20th century), to networked care (21st century). There is continuous shift from cure to care".



European Foresight Network: "We depict the care that will be provided in a networked system and on an individual basis as personalized networked healthcare. The vision of **personalized networked healthcare** is to improve the quality of life and quality of care, provide individually tailored care at any location and support human persons in self management, and health professionals and voluntary care givers in better organized networked teams. Furthermore, personalized networked healthcare focuses both on healthy and disabled persons, supporting active ways of life, where cure and care are mixed with leisure and pleasure. Thus personalized care meets needs that arise from developments as sketched above in both society and care provisioning."



Domain challenges

In the table below we give the prominent domain challenges.

Domain challenge	Description
<i>Waiting lists</i>	Societal most pronounced and commonly known challenge: the need to wait before treatment can occur in hospitals, health centers or at medical professionals. This leads to the emergence of private hospitals for specific treatments.
<i>Lack of personnel</i>	Especially in care: nursing professions and informal care. We have an ageing society, which leads to a higher demand for care in combination with a reduction of the work-force.
<i>Lack of resources (e.g. expensive MRI scanners)</i>	Cost of procurement, duplication of equipment, non-optimal scheduling, waiting lists

<i>Dealing with increased availability of new (costly) treatments</i>	Due to scientific developments, the number of possible treatments increases. Potentially a multitude of patient-centric and disease-specific applications, services and solutions is needed.
<i>Fragmentation of care organization</i>	Market is difficult to penetrate for newcomers, also due to regulatory issues; high entry costs Economies of scale difficult to achieve due to fragmentation. No clear problem owner; inhibiting the uptake of innovations. Hard to keep track of overall 'patient' process.
<i>Financing structure</i>	No clear problem owner; inhibiting the uptake of innovations.

In addition, the special character of the health and wellbeing domain puts special constraints on innovations and technical solutions. Boundary conditions to solutions are:

Ease of use. Care puts heavy demands on ease-of-use, because of

- users of technology vary a lot in skills, and
- technology is being deployed in critical circumstances, e.g. in operation rooms or in emergency situations, and should therefore be very intuitive

Robustness. System failure is not acceptable because it might lead to loss of life or loss of quality of life.

IIPIC Challenge for the Health and Well-being domain

The Health and Well-being challenge is meant to *stimulate* the explicitation of research challenges for the Health and Wellbeing domain, but also to provide *focus* and *scope*.

Developing a national ICT platform for telemedicine: A platform that supports both mobile coaching, telemonitoring and teletreatment, and that is compatible with hospital systems on the one hand, and private (home) and semi-private (domestic cooperation's or nursing homes) on the other; and it should also allow for third party services.

In the SRA workshop it was identified that the platform should support use cases that pertain to

- Integration with the personal home environment (e.g. home entertainment and domotics)

- Integration with the regular cure processes and systems (i.e. hospital systems); with related Quality of Service requirements.
- Integration with social media application & community services.

Possible constituting building blocks:

- Platform framework of standards and interface definitions
- Platform services
- Service/Application Development Kit
- Platform adoption strategies and roadmaps

Scenario Health and Well-being 2025

Around 2025, care is organized different from today. Because of the continuously increasing number of treatment methods (with expensive technology), the costs of healthcare have surpassed all boundaries of the collective affordability. Health and treatment has in fact become a scarce commodity, so that economic laws put a much stronger marker on the organization of care than in the past.

Specialized centers, public and private, play a major role in the daily care as well as health counseling. This is both a direct consequence of efficiency targets and market forces. On the other hand it also has a societal cause: people with health and wellbeing wishes and demands (formerly denoted as "patients") want optimal care, and are no longer satisfied with an average 'treatment; this trend is further supported by increased mobility of people. Therefore many people are turning to specialist health centers. These centers (large and small) are often the result of cooperation between traditional providers and private organizations: insurance companies, employers and care providers (e.g. fitness centers, gyms and housing associations) that other than strictly healthcare-related reasons, invest in health and wellness.

The strict line between sick and healthy has disappeared. It has been replaced by a continuum of life-long well-being, in which an individual and his next of kin are basically responsible for seeking and addressing the right care at the right time. The market offers numerous telemedicine or self care solutions that meet the wishes and necessities of people to monitor their own health, in the most pleasant way possible.

Use case scenario: Somewhere in the not so far away future...

Marijke loves to exercise. In her 47th year she still feels pretty fit, and spends considerable time at her work as a casting

consultant. Still, life has left some traces. As a result of thrombosis with pulmonary embolism a few years ago, her lung capacity is reduced, and she is forced to swallow anticoagulants. But especially for her an active lifestyle is recommended if she wants to stay as healthy as possible. But her condition has made Marijke a tad uncertain. She keeps a close look on her heart rate and blood pressure during exercise, even though that does not directly relate to her lung problem.

Her gym reacts to her situation through its own portal by offering several health services that visualize various health aspects. The data from the Nike App on her iWatch are directly visible on the portal (which is why she wears the watch all day, precisely because of this functionality), but also the details of her last workouts including the response of her body to the training efforts. She has set the alarm somewhat sensitively, so that there is timely warning if her heartbeat shows deviations. Given her past health issues, she has also arranged for a warning signal to telecare-center in case of a heartbeat disorder. Because she knows that the web-portal has been developed in conjunction with a medically-recognized consulting firm, she knows that the portal is more than just a few inaccurate graphs. What's particularly nice is that once a month, the doctor at the sports center performs an extra scan of her data, to see if there are any peculiarities to be noted. For which there is no extra charge by the way.

She grabs her racket and a squash ball which is still cold. Then the phone rings. She sees immediately that the ringer is one the informal caretakers of her single mother, but from the green color of the screen she already knows that there is no alarming situation ...

Research questions for the Health and Well-being domain

Requirements

- The home network should be extensible. This home network should be future proof in order to support new applications, including robotics, or health support at home.
- The platform should support personalized user interfaces. How to design personalized user interfaces for people/patients?
- A platform should interface to social network sites, Instant Messaging, and e-mail
- A unified integrated health log should be available to patients. This should support the addition of new types of information, coming from multiple sources, in various formats and through a variety of channels.
- Resilience against failures. If the network fails critical messages (alarms, medication reminders ...) should still be given. Fall-back scenarios (e.g. via public mobile networks) must be available.

Technical Challenges

- Standardized data formats and efficient lower layer transport protocols.
- Ensure that sufficient bandwidth is available
- Define standard programming interfaces for services, that can dynamically switch between lower layers, and that automatically discover the most optimal network.

Data Storage

- How to deal with scalability of 24/7 monitoring with respect to data storage - should all (raw or processed?) data be stored - if so, for how long? Discard raw data and keep only processed data or high level interpretations/abstractions derived from that data? Thus losing the audit trail...
- How to select appropriate data or decide which data to be discarded or not; whichever choices are made, legal and privacy implications, as well as potential medical consequences, can follow.
- How to identify and use patterns in large amounts of sensor data?

Solution directions

- Define a virtual care network as an overlay over existing infrastructure.
- Create a Care Exchange: an application layer switch between (smart) homes and care centers.
- Unobtrusive monitoring using various technologies: For use in the extramural case this is a must to get it broadly accepted. This means reliable (i.e. handling artifacts), small (i.e. integrated), easy to use (i.e. battery-less, hidden in textiles) and low cost (i.e. ready for the mass market).
- Can we use Service-oriented computing as a solution?

Business models and innovation

- How to orchestrate care around a particular patient? Can this be related to the care-exchange from the previous paragraph?
- What are usable go-to-market strategies for in-home care solution providers?
- How to design new healthcare processes that reflect the available and upcoming technological possibilities?

Authorization, authentication and privacy

- How to arrange multi stakeholder access to information?
- How to guarantee the privacy of health related data?

- Storage and retrieval services for medical (sensor) data. What are appropriate search algorithms? Data filtering and diagnostic recommendation

Proposed Actions and Opportunities

Proposed actions

- Develop a national program to take up the home-care platform challenge, and to actually build it.

Opportunities for getting connected to various HWB communities:

- Universaal Project on Open Source domotics:
- Health and Well-being program in EIT ICT Labs
- Topsector Lifesciences and Health ;
- Topsector High-Tech

References Health and Well-being

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