



D3.1 Consolidated Scenarios Report

Due date of deliverable: June 30th 2008

Actual submission date: July 28th 2008

Deliverable dissemination level: PU

Grant no.: FP7-IST-2007- 215291
Project acronym: PHS2020
Project full title: Roadmapping Personal Health Systems: Scenarios and Research Themes for Framework Programme 7th and beyond
Instrument: Support Action- SA
Start date of project: January 1st 2008 Duration: 12 months
Funding Scheme: Support Action- SA
Organisation name of lead contractor for this deliverable: MIP

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1 Introduction

This is deliverable D3.1 “Consolidated Scenarios Report” produced at the end of the consultation process briefly recalled below.

First, the very preliminary draft of the State of play was delivered and discussed on April 4 2008 during the 2nd ESC meeting and was revised following the input received.

Second, in parallel to the revision of the State of Play, the scenarios cycle of drafting, consultation and revision was launched (using the scenarios building implementation methodology and related instruments described in § 2.3). From the State of Play a first draft of the scenarios was produced as a result of brainstorming within the PHS2020 research team and with the input of Gartner’s analysts. At the 3rd ESC meeting held on May 16 in Milan the new version of the State of Play was finally validated by the ESC members and closed as Deliverable D2.1. The State of play has been subsequently distributed as a baseline for the following consultation events. During the 3rd ESC meeting the very first and preliminary version of the scenarios was also discussed and the input of the discussion led to the production of a second intermediate draft.

Third, this second draft of the scenarios report was presented and discussed on June 19 2008 at PHS2020 1st Consultation Workshop held in Sheffield and hosted by Sheffield Hallam University¹. As a result of the input of the workshop a third draft was produced.

Fourth, this third draft was discussed with Gartner’s analysts, whose input have been used by the project team to produce the fourth draft that was discussed and validated during the 4th ESC Meeting and the 2nd PHS2020 Consultation Workshop held in Pisa and hosted by the Istituto Fisiologia Clinica (IFC, Institute of Clinical Physiology) of the Italian CNR (Research Area of S. Cataldo)², respectively on July 14 and July 15 2008.

The input of these two consultation events have been integrated into this *Consolidate Scenarios Report*, representing the fifth draft in the scenarios cycle.

It must be stressed that the Pisa step in PHS2020 consultation process, not only contributed to the final consolidation of the scenarios, but also represented the first step in the gap analysis and toward the roadmapping. In the original plan PHS2020 2nd Consultation Workshop was supposed to focus solely on the scenarios for final validation, whereas the 4th ESC meeting had the objective also to validate the scenario but especially to brainstorm collectively and extract the gap in existing research and developments in PHS by comparing the State of Play and the Scenarios along some selected dimensions and related issues.

¹ We must thank Professor Babak Akhgar and Dr. Sally Atkinson of Sheffield Hallam University for the support they provided to realize the workshop, even in difficult logistic conditions.

² We must thank Professor Oberdan Parodi of CNR IFC for hosting the two events and for the perfect organisation of the consultation workshop.

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In order to speed up the process the project team decided to start extracting already some very preliminary gaps and related research themes that have been used as the baseline for discussion and brainstorming both during the 4th ESC meeting and the 2nd Consultation workshop. Such preliminary gaps analysis and related research themes extraction and discussion will be included in Deliverable D4.1 “Gap Analysis Report” to be produced by the end of August 2008.

The production of the current document and the successful achievement of the foreseen consultation events mark the midterm milestone in the timeline of PHS2020 and, together with the mentioned Gap Analysis Report, set the grounds for the following consultations foreseen for the production of the final PHS2020 roadmap:

- The 3rd Consultation Workshop to take place in Barcelona on September 26, 2008;
- The 5th and final ESC meeting to take place in Milan on October 10, 2008;
- The 4th Consultation Workshop to take place in Brussels on November 20, 2008;
- The final international conference on PHS2020 vision and roadmap to take place in Brussels on November 21, 2008;

In **Section 2** we illustrate the underlying theoretical basis of our scenarios development approach (§ 2.1), then clarify the nature and purpose of scenarios within our overall methodology (§ 2.2), and describe the implementation procedure followed to extract the four scenarios (§ 2.3). In **Section 3** we present our overall descriptive framework used for the identification of relevant trends (§ 3.1), discuss the trends identified for each of the dimensions of the framework (§§ 3.2, 3.3, 3.4), and finally report a summary snapshot of trends (§ 3.5). **Section 4** starts by reporting how trends have been assessed and organised in terms of impact and uncertainty and present the four scenarios thus extracted (§ 4.1), it then moves to present each of the four scenarios in details (§ 4.2 through § 4.5), and finally presents cross-cutting trends and common element (§ 4.6). The concluding **Section 5** provides a synthetic view of the steps that will follow the scenarios development.

2 PHS2020 scenarios approach and implementation

2.1 Scenarios within technology roadmapping

Technology Roadmapping (TRM) is a strategic planning approach to identify future technology research and innovations. It provides a mean of depicting the link between the current, emerging and potential technologies that governments may choose to exploit, and the long term situational opportunities to which it could apply them (Probert & Shehabuddeen, 1999). Road mapping has become a widely referred effective approach for both individual companies, entire industries and governmental policy makers in the past decades (McCarthy, 2003; Phaal, Farrukh, & Probert, 2004). The term ‘road map’ conveys the main purpose of this approach, namely to chart an overall direction for

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technology development or usage (Grossman, 2004), although a uniform agreement on definition does not exist (Phaal, Farrukh, & Probert, 2004).

Within this field, however, a distinction applies that is important in order to understand the role of scenarios within the roadmapping process. The distinction is between TRM, assuming a single view of the future and TRM based instead of possible alternative and contrasting views of the future.

The first approach that we can call Traditional TRM (TTRM) rest on three elements: a) the characterisation of the state of play (baseline or 'As Is'); b) a normative and, to some extent, deterministic view of the future to be achieved ('To Be'); and c) a structured set of actions to achieve the desired future state derived in a simple and straightforward comparison between the 'As Is' and the 'To Be'. The main pillar of such approach, worth stressing again, is a normative view of the future assuming a straight-line projection from the current situation to only one possible scenario.

Since the mid-1990s, roadmapping has been increasingly applied to policy relevant and/or funded technological developments and research (Braun et al 2003; Cahill and Scapolo 1999; Codagnone and Wimmer 2007; Da Costa et al 2003; Da Costa et al 2004; Friedewald and Da Costa 2003; Osimo et al 2007). While in different ways, such policy oriented efforts aimed at providing the strategic intelligence needed by policy-makers to identify current and future challenges and, accordingly, optimise policy-making, investments decision, as well as research funding. In doing so, while focussing on a well defined domain, these roadmapping exercises needed to extend their focus and consider the many possible and highly uncertain interactions between different domains, going from the macro down to the micro level and ranging from politics, institutional settings and change, economy, society (demographic, cultures, social position) and technology. In this respect such roadmapping exercises are radically different from a TTRM, whose aim is simply to define the strategy for research in support of one specific product given a normatively and uniquely depicted future state. In fact, this second strand of roadmapping actually deals with what can be defined as a more complex socio-technical system³, where:

- to some extent the factors within each dimension affect one another, resulting in different directions for development or different areas of emphasis within the larger idea they represent.
- More important, perhaps, each cluster represents a set of trends, developments, actions, preferences, and choices that are at least moderately independent of the other clusters.
- At the same time, the main effects of each cluster interact with the other clusters in both predictable and unexpected ways.

³ On the concept of socio-technical systems see classical analysis such as Forrester (1961), Thompson, (1967) and Trist, 1981.

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- The social elements and the technical aspects are continually evolving on their own while continuously interacting with each other in ways that cannot be overtly controlled.

It is evident that, when taking by necessity a more holistic view at all possible important factors, we cannot pretend to predict and depict exactly one single desired future for the interplay of all these dimensions and related issues. Under these circumstances we can at most imagine various possible combinations of different factors and of their interactions. The solution then is an approach where scenarios development is introduced into an integrated scenario-building and road-mapping methodology (Lizaso & Reger, 2004). This is the approach we adopted in PHS2020 and it is probably pleonastic to stress how the future development of technology driven Personal Health System it is exactly embedded into a complex socio-technical system.

There are many different methods of scenario development (Bouwman & Duin, 2003; Duin, 2006; Glenn, 1999; May, 1996). Scenario building methodologies received a significant boost when organizations, such as Shell and RAND Corporation, turned the simple 'what if' exercises performed by national armies into fully-fledged future research methods (Duin, 2006). Gibson (1996) found that in the 1960s and 1970s a general sense of certainty existed about where we were going and how to get there. The lesson learned is that the future is inherently unpredictable and may be different than expected. During the twentieth century, more and more orientation on scenarios analysis as part of technology roadmapping (TRM) has emerged (Janssen et al., 2007; Lizaso & Reger, 2004; Wimmer, Codagnone, & Janssen, 2008). Scenarios are an integral description of various information aspects of a context in non-formal, narrative fashion, thus enabling communication and sharing (Carroll, 1995). Scenarios are being used in various situations and have different purposes, form, content and lifecycle (Kurokawa & Meyer, 2003; Phaal, Farrukh, & Probert, 2004). It is important to remark that in our context scenarios is radically different from forecasting. When looking at how future and yet not mature technologies can improve the supply of PHS solutions and their adoptions by healthcare players and by consumers/patients, we will depict different - sometimes contradictory or paradoxical - perspectives or images on the future (Handy, 1995). The basic idea is that the real future will be somewhere between those extremes, which are used to sketch an uncharted landscape of the future. Handy (1995) argued that if we understand the contradictory and paradoxical perspectives or images on the future we will eventually be able to find roadmaps to deal with desirable and undesirable outcomes. To develop valuable future scenarios, the implementation process is strategic.

2.2 Nature and purpose of scenarios

Having provided the more theoretical background, here we further clarify what scenarios are and what they are not, so that they are correctly read and interpreted by the reader and we recall which is their role within the overall architecture of PHS2020, stressing that scenarios are not an end in itself.

It is important to clearly state that developing scenarios is different from forecasting, as visually suggested in Figure 1 below. One can probably attempt to forecast developments from now until 2010, but when looking far ahead the potential changes in different dimensions and their interaction effects produce too much uncertainty for forecasting and call for the development of alternative future scenarios.

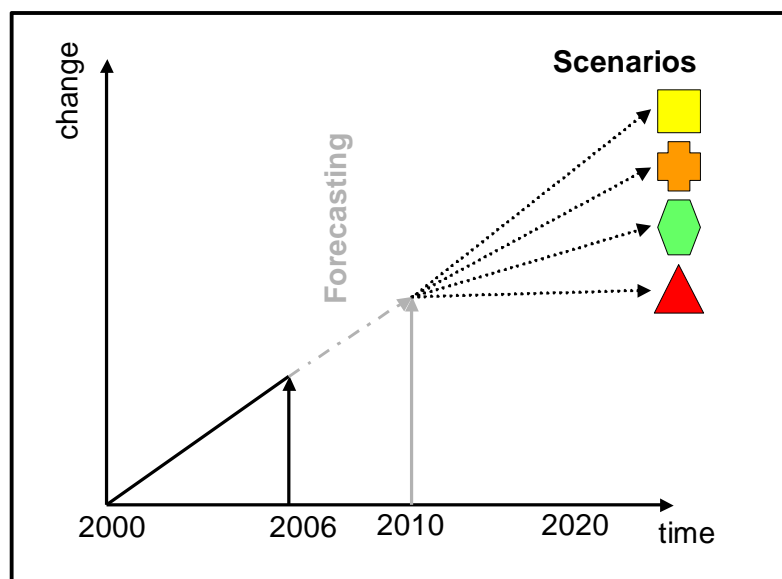
In fact, scenarios are defined by certain characteristics, which make of them:

- Archetypal images / pictures of the future;
- Interpretations of the current reality;
- Internally consistent stories about a path from now into the future;
- Plausible, mutually different stories about possible futures.

On the other side, scenarios are not:

- Predictions;
- Extrapolations of existing developments;
- Good and/or bad futures (in fact they can contain both);
- Strategies.

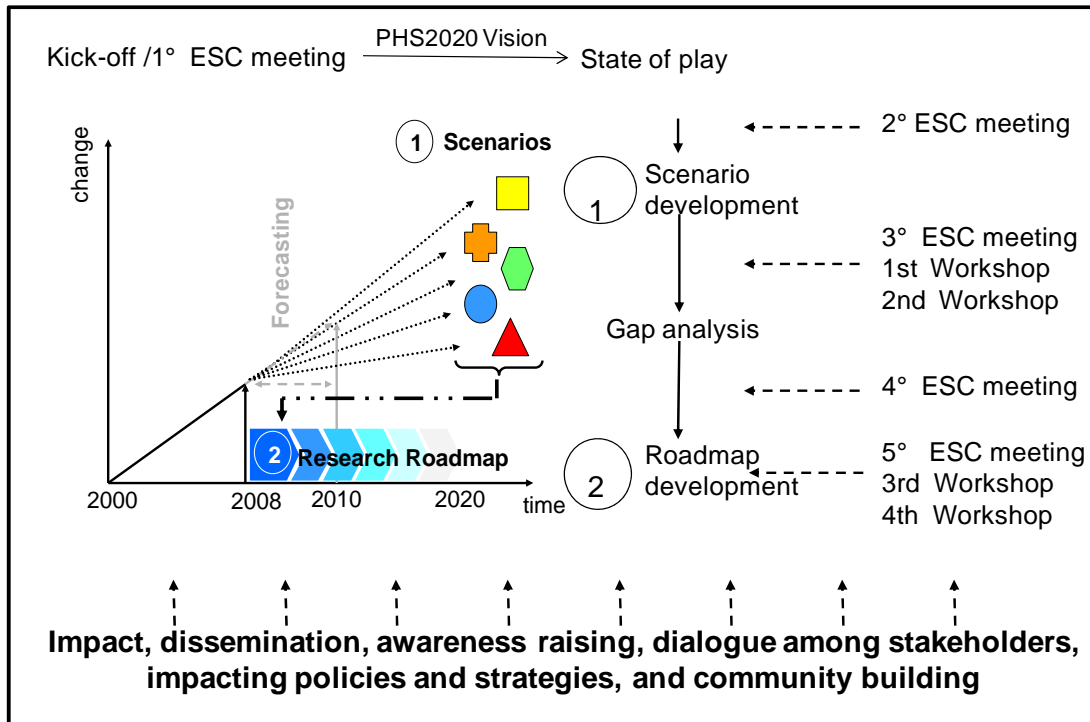
Figure 1 Scenarios development is not forecasting



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As illustrated in Figure 2 below, Scenarios development represents the second step in PHS2020 methodology.

Figure 2 Methodology snapshot



Let us briefly recall the four steps of PHS2020 approach

1. Establish the baseline through a state of play study;
2. Developing scenarios by extracting possible future trends from the state of play and then selecting the most impactful and uncertain ones to identify the two key axes of the scenarios matrix (see § 2.3 for the illustration of the implementation methodology);
3. Compare the state of play with the four scenarios to identify current gaps that need to be filled in order to favour the desirable elements of the scenarios and to counter and/or contain the undesirable elements;
4. Assess and prioritise the gaps in terms of relevance and link them to actions needed in terms of research themes to be financed in the future and of other kind of policy initiatives to be turned in the final roadmap for PHS in 2020 (with various actions phased across time)

So the scenarios we present in this document are one step in a process that, is worth recalling, has one key goal: proposing a comprehensive and exhaustive list of research needs to be structured into a roadmap of future research proposed for funding in FP7 and beyond in the field of PHS.

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Scenarios are not an end in itself, rather they are both a communication and practical tool, and as such they need to simplify a large amount of information into stories that are easy to communicate and share in order to collectively produce an exhaustive list of elements, from which gaps and subsequently proposal for research themes to be funded in the future are derived. This premise is important to understand their purpose and to anticipate possible concerns and/or misunderstanding.

First, as it will be clearer at the end of illustration of the scenarios development implementation methodology in next paragraph, the process leading to the scenarios is a progressive simplification of complexity and could be seen as a loss of information. From the many complexities of the state of play only a synthetic list of trends is extracted. Then such list of trends is reduced to include only a smaller sub-set of those trends deemed at the same time as having high impact and high uncertainty. Finally, from this sub-set of trends only two dimension of uncertainty representing the axes of the 2*2 scenarios matrix are extracted. The need of limiting the key uncertainty variables to only two is that a 2*2 matrix is much easier to communicate and discuss. Scenarios have also the objective of providing a message that is simple and can come across in terms of communication. Moreover, the information simplified to gradually reach the four scenarios is not entirely lost. The other possible dimensions of uncertainties as well as many of the trends will then reappear in the description of the four scenarios, or will be treated as issues cross-cutting all of the identified scenarios.

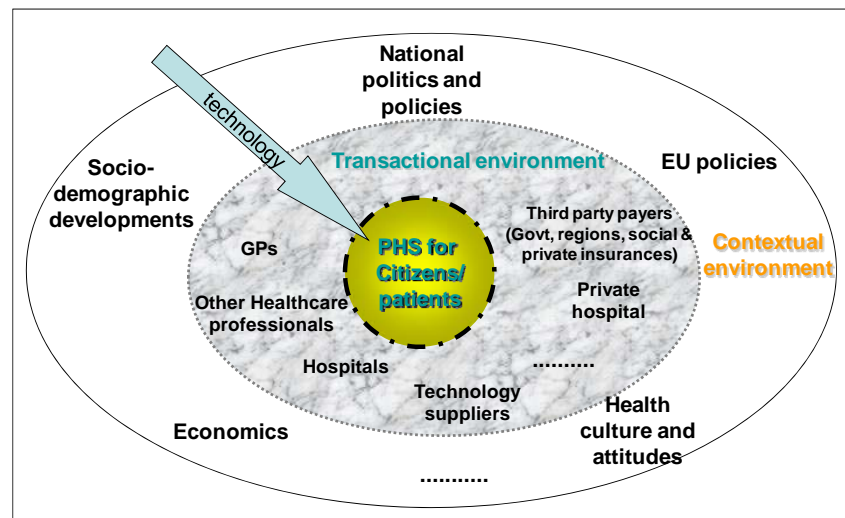
Second, scenarios through the interpretation of current reality propose archetypal images / pictures of the future in the form of different internally consistent and plausible but mutually contrasting stories. In order to do so uncertainties variables with high impact are combined to produce axes that can take extreme values and the scenarios are exactly positioned at such extremes, ***yet the underlying assumption is that the real future will be somewhere in the middle.*** Then why the need of polarisation? Because it can help effective communication and inclusion within each scenarios of all the possible elements that might end up characterising and defining the really occurring future. In this way gaps between the existing situation and scenarios can be extracted and lead to define a roadmap including topics that can then be adapted to the actual middle ground developments that will occur. Again this means that scenarios are not to be judged singularly but by the list of issues and dimensions they collectively brings to our attention.

Third, and directly related to the previous point, with their contrast scenarios should give rise to different gaps and related challenges calling for certain policy action, but it is also likely that certain gaps and challenges could cut across different scenarios. In this respect it is relevant the initial reminder that scenarios are not an end in itself: they are not elaborated so that each one of them produce a self contained and distinct roadmap. ***The scenarios taken together will produce an exhaustive list of elements, which will then be considered in the gap analysis and roadmapping phase in aggregate without reference to the scenarios from which they originated.***

2.3 Implementation methodology

Since the future is all encompassing and we aim to imagine possible different directions for what we deemed as a complex socio-technical system , a structuring framework is needed, a sketchy and exemplificative version of which is presented in Figure 3 below.

Figure 3 Scenario descriptive framework



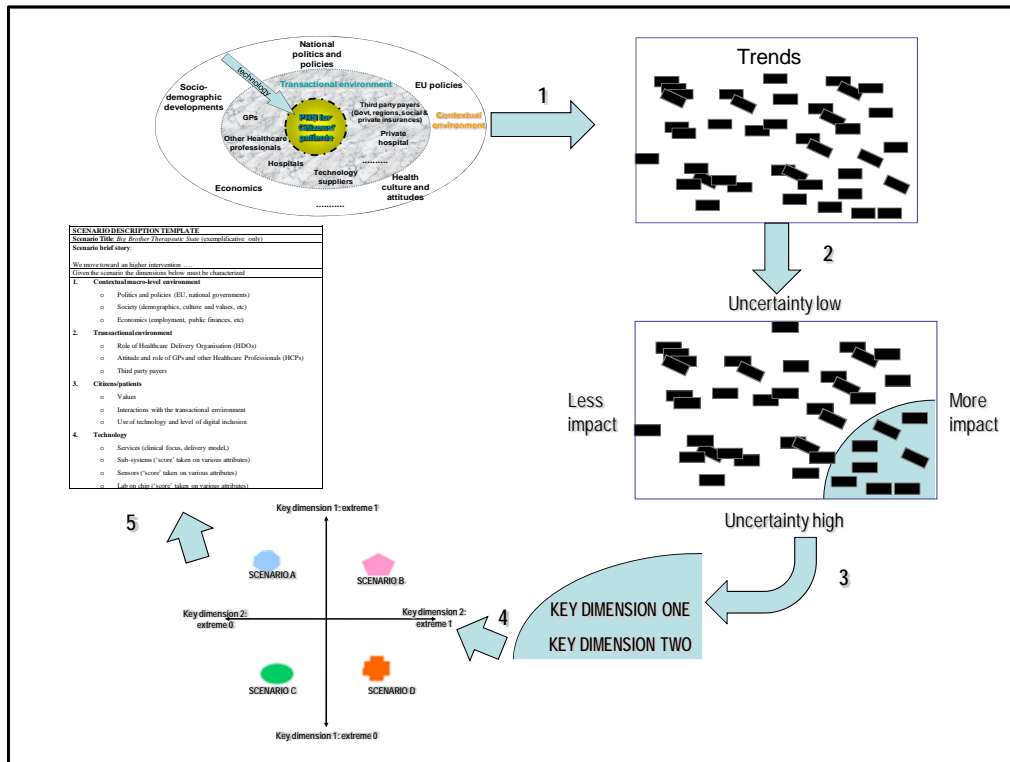
There is an higher macro level representing the overall context (society, state, economics), then a meso-micro level concerned with the actual transactions between the players directly involved in the provision of health care and supporting technological production (healthcare organisations and professionals, payers, technology suppliers). Our specific focus, that is technology supported PHS and the specific users attitudes/behaviours are embedded within these two tiers. We will come back on this issue at the beginning of next section, for the consultation process has led us to slightly modify our descriptive framework that, thus, need to be discussed separately.

Our approach to develop scenarios started, using the descriptive framework as a basic guiding and structuring tool, by extracting trends from the **State of Play**. The trajectories that the State of Play Model pointed out, as well as the analysis of barriers (to interpreted in terms of how they can evolve in terms of trends) have all already started and in place and can, therefore, be identified (Bouwman & Duin, 2003). The scenarios, thereby, investigate the type(s) of future(s) to which these trends may lead following the various steps illustrated graphically in Figure 4 overleaf and explained in the following. It must be added, however, that the State of Play and related trends should not be seen as a limiting constraining factor. For how extensive the work could be elaborating a state of play in any domain, it would never be 100% exhaustive. Accordingly, the consultation activities being a pillar of any foresight exercise serve also the purpose of extending the reach of analysis beyond the limit of the core team in charge of the exercise. Therefore, trends besides being extracted from the state of play were also added as a result of the

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consultation process. At each stage in the iteration between scenarios drafting and consultation the extracted trends were integrated and modified.

Figure 4 Scenarios development framework



Accordingly the trend analysis and the subsequent development of the final four scenarios presented in § Errore. L'origine riferimento non è stata trovata. was iteratively conducted by performing the following five steps illustrated in the figure above:

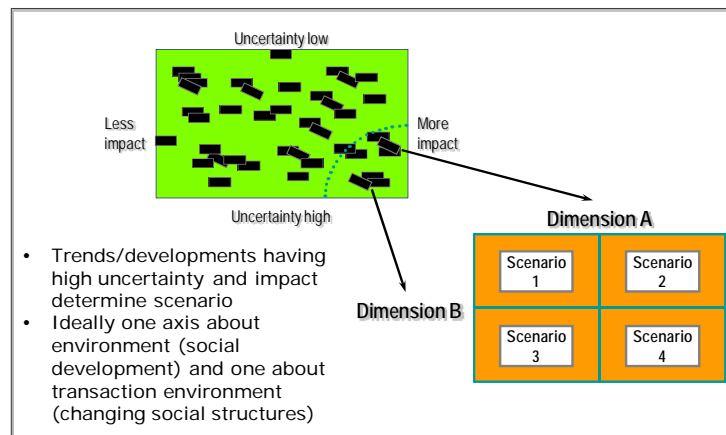
1. Trends identification.

- a. The trends were first derived from the State of Play through a clustering and voting process carried out in a brainstorming fashion within PHS2020 project team , using the general description framework and attempting to unleash a divergent thinking, where trends are not necessarily in concert with the truthfulness, coherence or verifiability. In this first phase the project team also discussed the trends with Gartner’s analysts. This produced a first list of trends;
- b. The preliminary list of trends thus produced was included in the first draft of the *Scenarios Report* and discussed in the same fashion during the 3rd ESC meeting (May 16 2008, Milan). As a result, some trends were discarded, many new added, some merged, others rephrased and clarified, thus producing a second list of trends;
- c. This second list of trend was then included in the second draft of the *Scenarios Report* that went through the PHS2020 1st Consultation Workshop

(June 19 2008, Sheffield), as a result of which a few but important trends were added. This produced a third list;

- d. As a result of a third draft of the *Scenario report* was drafted, discussed with Gartner’s analysts, thus introducing few minor changes leading to a fourth draft of the *Scenario report* with a slightly revised fourth version of the list of trends;
 - e. Finally the fourth draft of the *Scenario report* and the corresponding fourth list of trends were validated during the 4th ESC Meeting and PHS2020 2nd Consultation Workshop (14 and 15 July 2008, Pisa). As a result we produced this fifth and final version of the *Scenario report* ;
2. **Trends assessment.** This step required that the identified trends were clustered using an uncertainty - impact matrix such as the one below.

Figure 5 From trends to scenarios



The rationale is that trends having a high uncertainty and high impact may result in contradictory and alternative futures, shape key uncertainty variables, which in turn will define the different scenarios. ***On the contrary trends having a high impact and low uncertainty should result in one type of future that can be forecasted and will most likely characterise all of four different scenarios*** (i.e. ageing of the population and its consequence in terms of disease prevalence). Trends with expected low impact are irrelevant and should not be considered. The assessment was carried out using a standard template listing all the trends and providing a space for assessing the impact and uncertainty of each trend on a scale of 0-10 (10= maximum impact and/or uncertainty).

- a. The assessment was initially carried out by the project team on the first list of trends;
- b. ESC members also assessed the first list of trends;
- c. Participants of PHS2020 1st Consultation workshop assessed the second list of trends;
- d. The scores obtained were re-elaborated and averaged by the project team;

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- e. The assessment produced in this way was discussed and finally validated during the consultation events of 14-15 July 2008 in Pisa;
 - f. The final assessment presented in this document has been elaborated using the results of averaging the scores and also integrating it with qualitative assessment and judgement by the project team.
3. **Organization of trends.** The trends classified as having a high uncertainty and high impact must then be organized and clustered into a limited number of key uncertainties that should define two key dimensions to produce a 2*2 matrix with four scenarios. In doing so, trends related to each other are merged into key uncertainties having a high impact;
- a. The project team initially produced as key dimensions of the scenarios axes the following: a) technology convergence (extremes: all inclusive technology vs. componentisation); b) service control (extreme state vs. Empowerment)
 - b. The dimensions were discussed during both the 3 ESC meeting and PHS2020 1st consultation workshop, producing some agreement and disagreement, as well as several alternative dimensions;
 - c. The dimensions were also discussed with Gartner's analysts;
 - d. On the basis of the final assessment of the trends (see f) of step 3) and in light of the discussion and alternatives mentioned above the project team elaborated the two new dimensions illustrated later in § Errore. L'origine riferimento non è stata trovata.. These were validated during the consultation events of 14-15 July 2008 in Pisa
4. **Extraction of concerted scenarios.** By combining the two key dimensions of uncertainty (each one taking an extreme value) a 2*2 matrix is derived that will define four scenarios. Each scenario will be given a typical, easy-to-recognize, and understandable name.
- a. The project team initially derived and named four scenarios;
 - b. These were discussed during both the 3 ESC meeting and PHS2020 1st Consultation Workshop, producing some agreement and disagreement. Participants at the two evenst were asked to develop alternative scenarios and describe them with respect to the dimension of the framework (see below);
 - c. The preliminary scenarios elaborated by the project team were also discussed with Gartner's analysts;
 - d. Scenarios name and stories were further discussed during the consultation events of 14-15 July 2008 in Pisa where important input as to the name and stories were added. In light of the above the project team extracted the four scenarios presented in § Errore. L'origine riferimento non è stata trovata.Errore. L'origine riferimento non è stata trovata.;

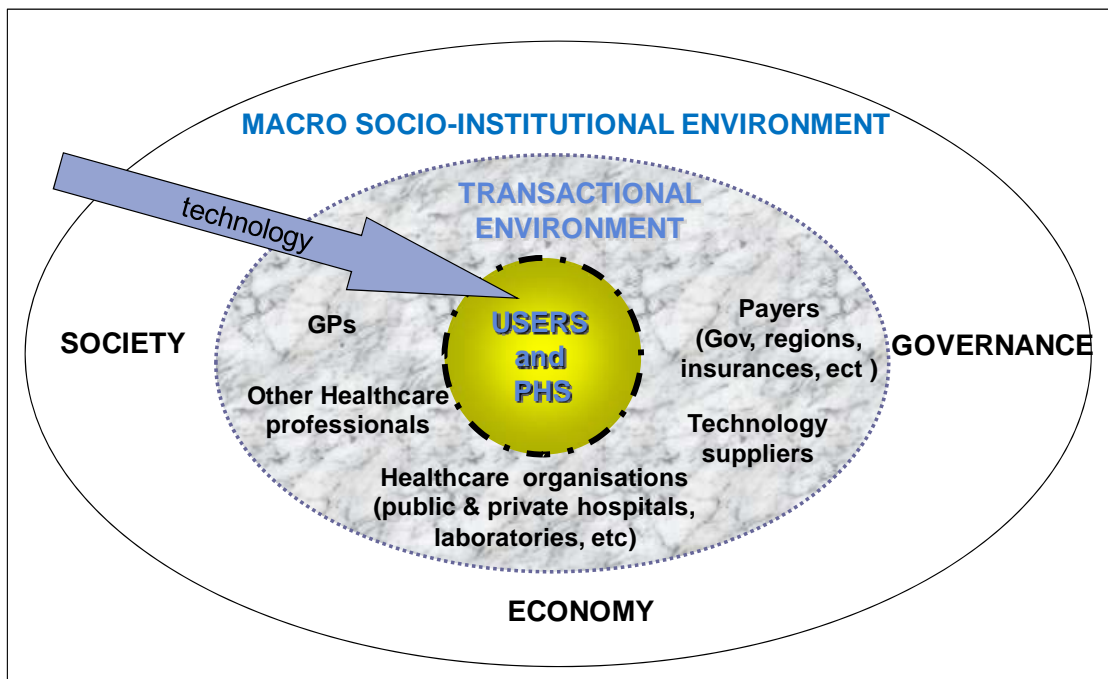
5. *Scenario stories and description.* The last step aims at enabling communication of the scenarios to non-involved and non-experts. An easy to read and understandable story is made of each scenario. The story is followed by the more detailed description of how the various dimension of the general framework will evolve. Participants to the consultation events were asked to develop scenarios and describe them. This step, however, was mostly fleshed out by the project team using the input from the consultation, but also through a re-reading of the trends and of the actual sentences and specific discussion occurred.

3 Descriptive framework and key trends

3.1 The descriptive framework

As illustrated earlier, trends leading to the definition of scenarios must be identified with respect to a general descriptive framework as a structuring tool. Figure 6 below describes the framework we used for the identification of the trends discussed in the following paragraphs of this section

Figure 6 PHS2020 scenarios descriptive framework



Before illustrating the various dimensions of the framework a premises is in order with respect to the overall perspective of PHS2020 and to some of the insights and results of the consultation processes, which had an impact in the definition of this framework and, subsequently, in the extraction of the scenarios.

The proposal and DoW of PHS2020 were eminently inspired by the view that PHS are complex socio-technical system and, thus, placed great emphasis on broader social, economic, and political-institutional dimensions alongside technology. During the kick-off meeting, however, it was decided that the state of play was to be overwhelmingly on technological and R&D trends, the rationale being that this support action is to produce themes of technological R&D, whereas the broader dimensions and their implications in terms of implementation issue are addressed by the Commission through other instruments (CIP pilots and tendered studies). Indeed the State of Play deliverable (D2.1) is mostly structured around a model assessing the development of technology

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(applications, sub-systems, components) and treats the other broader dimensions only synthetically in terms of current barriers to the full blown adoption of PHS. Following this same approach, we initially focussed scenarios development mainly on technology and we run the consultation process with this goal.

Re-phrasing a comment from one of the ESC member the general descriptive framework can be seen as a 'landscape' made up of three layers: a) at the bottom are the technologies (e.g. sensors, devices, systems, repositories, etc) that are being integrated into a health IT semantically interoperable support and enabling infrastructure; b) the second layer is that of the actual players involved in service provision, that is complex care processes involving various interactions, based on the presence of technologies as enablers of the processes; c) the third topmost layer is that of macro level structures. The three layers and their interactions form an ecosystem. The usual supply side view is that the push has been and will be from technology to service provision, and from services to structures. Yet, during the 3rd ESC meeting a consensus emerged that: *“90% of failure in PHS application are due to factors other than technology. Most needed technology already exist out there. The issue is how technology can help the transition to integrated care”*. Along the same line, a comment from one of the ESC members was that in the preliminary scenarios the interaction among the three layers was missing and suggested that we actually needed three separate scenarios and road mapping for each of these three layers.

The re-elaboration of all the scores assessing trends impact and uncertainty obtained during the consultation process showed an uncontroversial fact: most technological trends received high scores in terms of impact, but very low scores in terms of uncertainty. This means that experts overwhelmingly believed that process of technological development will not stop, but rather it will consolidate the existing development and go beyond them. On the other hand, societal, institutional and economic elements were the sources of sharp uncertainties according to the experts. It was evident, then, that our scenarios could not be shaped around a technological axis as was done in the first version (one of the axes being “technological convergence” with the two extremes of “all inclusive technology” and “componentised technology”).

This was also strongly the position of Gartner’s analysts, who criticised the “technology convergence” axis, since in history technology has always shown cycles of convergence and then new fragmentation. Gartner’s analysts also affirmed that the most uncertain and differentiating factors are institutional (i.e. financing) and societal (users attitudes to healthcare and technology). In Gartner’s view the two key axes for scenarios building in the more broadly defined field of eHealth should be about: a) Financing; and b) users attitudes to using technology in taking care for their health.

Certainly, these input have not led us to abandon the goal of eventually producing research themes mostly, if not only, focussed on the technology layer of PHS and we will come back to this at end of this document when discussing the future steps of PHS2020. Nor have they pushed us to develop three separate roadmaps, for clear reasons of time and resource constraints. They have, instead, contributed to shape a middle ground, which we briefly explain here.

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First, the fact that according to the experts the main sources of uncertainties are non technological but rather springing from broader dimensions (societal and related to institutional and organisational elements) led us to focus and discuss the non technological dimensions more sharply and in details than it was done in the state of play. Second, we played down the role of technology in differentiating the scenarios axes and the scenarios description. *Technological issues then will come back in the gaps analysis where we will attempt to show how technology can contribute to tackle some of the issues emerged from the scenarios, even if such issues are not technological.*

Having clarified the above, we can now proceed to briefly and generally characterise the various layers presented in Figure 6 and some of their components, before each is then discussed in terms of relevant trends in the following paragraphs.

The **Macro socio-institutional environment** refers to higher level and aggregate trends that apply to **society, economy and governance** as a whole. The **Meso transactional environment** concerns the actual players involved in healthcare service provision and financing, that is complex care processes involving various interactions. Finally, we have the **micro-level domain of users** (patients / citizens) of the healthcare system and their attitude to technology supported PHS services. As any conceptual tool, the purpose of our descriptive framework is that of providing an intelligible structure and organise the complex underlying empirical material, as such it presents the usual limits of simplification, of possible overlapping, and of discretionary positioning of elements in one or another of the three levels. The aggregate macro-trends forms the context for the actual transactions between the relevant players, the latter in turn influence the attitudes/behaviours of the final users, which should also reflect the aggregate trends. Yet actual transactions can also take different and peculiar paths not perfectly matching the aggregate trends, but they are influenced by them. For instance, the issue of public funding of healthcare systems taken as a whole it falls within the macro dimensions, yet in our framework the payers are placed in the transactional environment. This could be seen as a duplication and source of overlapping, and to some extent it is, but it also reflects the complexities of healthcare, where broad decisions taken at the central level must then be implemented at a lower level of regions, local government, healthcare organisations and not necessarily and perfectly match the aggregate trends: they will be influence by them but can also take some variations. In the same way societal trends and users attitudes/behaviours could be possibly seen as coinciding, but this is not always the case.

While the components/players of the transactional and micro dimensions are self-explanatory, those of the macro level dimensions are so wide that need to be delimited and further illustrated.

First, we will not discuss **society, economy and governance** as a whole, as this would be beyond the scope of our work and so we must specify in what way we treat them. Second, we need to explain the choice of the term “**Governance**” to refer to the broadly defined institutional and political components.

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When discussing **society** we consider those elements more directly important for healthcare systems in general and for PHS in particular, that is: a) socio-demographic trends and their implications for healthcare; b) socio-cultural attitudes toward healthcare in general and toward technology.

When considering the **economic** component we limit our analysis to the overall cost of healthcare and their future sustainability and to the way resources are allocated, although we also consider one possible source of rupture and change with impact on both healthcare in general and on technology supported PHS.

We use “**Governance**” as a broader umbrella term and concept to refer to both institutional and political developments. We could have used government and politics, since the management of healthcare is always the object of debate and different executives may have different approaches. Yet here we consider the long term past trends and possible future ones in general, assuming that these can be discussed regardless of the different political orientation of each different government. So in alternative to government and politics, we could have used the expression “The State”, as this would convey the more structural institutional settings defining healthcare, regardless of political contingencies. We preferred, however, “Governance” as it is broader and more neutral especially with respect to future scenarios. Today talking about the macro level “**Governance**” of healthcare in EU27 is synonymous with talking about the State/government, given the dominant role of the public player. In the future, however, the macro governance structure may be one where the public player is only one among various others. In brief then **Governance** captures the different attitudes that governments have had, have and will take vis-à-vis the broadly defined issue of regulating and managing healthcare systems, that is having a lighter or heavier touch of intervention. A light touch would entail more spaces for existing and new players, whereas an heavier touch would restrict such spaces, and also a stronger or weaker dependence of the citizen upon the government. For example, government role could range from being only a regulator and monitor of services provision, to being a payer for those services (assuming they are delivered by more independent lower level public bodies and also by private players), to being a direct provider of services (through a re-centralisation of currently relatively autonomous public providers).

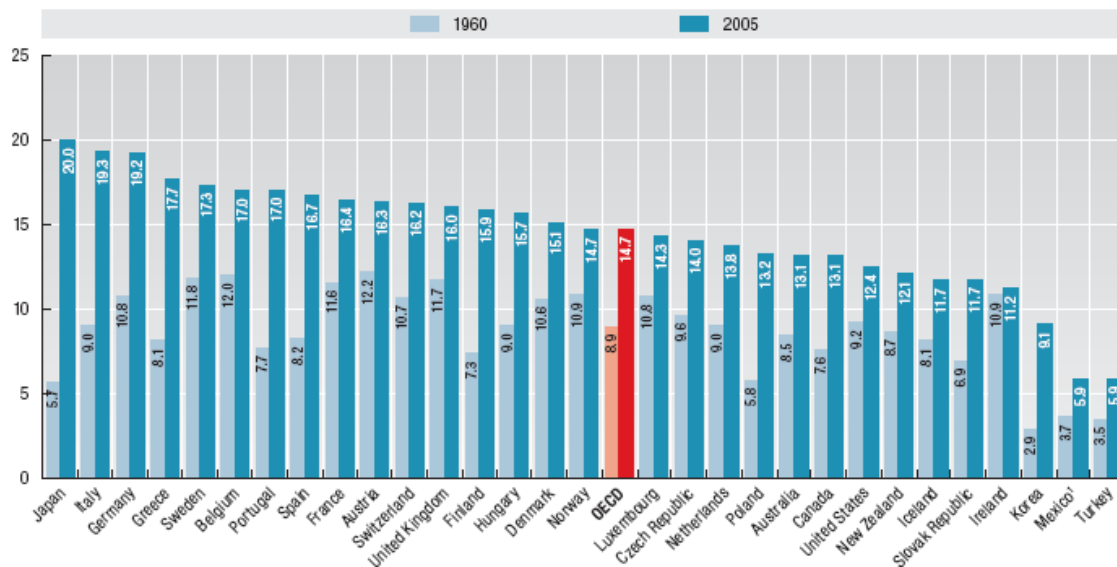
When we discuss “Governance” we refer to the higher level decision making and structures, which should be distinguished by the meso level of public and private players involvement and transactions that characterise the complex processes of healthcare provision.

3.2 Macro social and institutional environment

3.2.1 Society

Socio- demographic trends and related implications. From 1960 until 2008 in OECD countries the percentages of population over 65 on average doubled.

Figure 7 Share of population aged 65 and over, 1960 and 2005



Source: OECD Health Data 2008, June 2008

The ageing of the population and its continuation in the future is, from the perspective of healthcare, **The Trend**, and brings with it the following related trends:

- Simply as a result of larger shares of 65 and older a **rise in chronic disease prevalence**;
- Already now and possibly in a more marked way in the future **chronic disease co-morbidity** (patients suffering from multiple chronic diseases) will also increase. This, by the way, it is a fact that not always the healthcare systems tackle effectively due to fragmentation of processes and information flows;
- Longer life span will entails larger numbers of elderly people in need of **long term care and assistance**, even when no acute chronic disease are present (due to minor disease and conditions, however, compounded with reduced physical and cognitive abilities).
- Related to the above, a trend showing increasing **problems of compliance to medication and lifestyle guidance** is emerging for elderly with chronic conditions. The elderly, in fact have to take several drugs and/or follow multiple

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treatments⁴, with a clear risk low compliance with the medical prescriptions (e.g., people forget to take their drugs, or take them at different hours, etc.), resulting in adverse events and further need of treatment and hospitalisation⁵. Poor adherence to medication and lifestyle guidance is a major challenge facing the healthcare community in industrialized countries (Kausnik *et al* 2008).

Not necessarily related to the ageing population and influenced by other factors (socio-economic growth, changing work style, increasing social uncertainty, weakening of social ties, etc) other two trends are worth pointing out:

- **Obesity** is an increasing pervading trend and can compound other conditions and become a cause of early chronicisation of initially non acute conditions. It must be stressed that obesity includes not only abnormal conditions with deeper physiological and/or neuro-psychiatric causes, but also various degree of overweight in apparently healthy individuals mostly due to sedentary work and bad nutrition (life-style);
- **Rising token taken by neuropsychiatric disorders.** If one broadens the perspective from prevalence strictly defined to that of burden (measured by Disability Adjusted Life Years, DALY) an emerging trends under-recognised until recently is the increasing **incidence of neuropsychiatric disorders**. According to the analysis conducted by Murray and Lopez (1997) worldwide, neuropsychiatric disorders accounted for 10.5% of DALYs, but their contribution was much greater in developed regions, where they accounted for 22% of total DALYs (respiratory accounted for 4,8%, and for cardiovascular 20,4%; malignant neoplasm 13%) as compared to only 9% in developing regions. In particular, when considering individual disorder singularly, the fourth largest disorder appeared to be unipolar major depression (In accordance with ICD-9 conventions, suicides, many of which were due to major depression, were not included in the primary tabulations of unipolar major depression. With the addition of suicide, the burden of unipolar major depression increased by nearly 40%). Other neuropsychiatric conditions in the 30 leading causes of burden included alcohol use, schizophrenia, and bipolar disorder.

All of the above trends will continue in the future and cannot be reversed within the time span of our roadmap. While they are fairly certain and do not shape the dimension of uncertainties upon which scenarios are derived, **they must be considered horizontal to all the scenarios. Accordingly their implication will be considered in the gaps analysis and in the final roadmapping, regardless of the fact that they do not intervene to characterise and differentiate the four scenarios.**

⁴ It has been estimated that patients over 70 take an average of seven prescription medicines and three over-the-counter drugs per day (Fleming *et al* 1993).

⁵ In the U.S. alone, the annual direct and indirect cost of non compliance is estimated to be over \$177 billion.

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Finally, it is worth stressing that the trends identified above are compounded by changes in the social fabric of society with the increasing predominance of **nuclear families, work force feminization, and mobility**. The demise of the extended family, the increased participation of women to the work force, and the increasing mobility of the work force, are all factors making the care of the chronically ill and of the elderly in general even more difficult. This aspect, for instance, has been captured in one of the scenarios elaborated during the consultations process: *in society with fewer young individuals even the “healthy” 70-80 years old friends would have to be “on-call” together with grandchildren/nieces and nephews to assist those in needs*. Gartner analyst Handler (2008) refers to this trend as the rise of the new role of the “consumer care manager”(it can include professionals nurses and social workers, but also friends and relatives and), who will be together with the actual patients the customer/consumer of changing healthcare delivery and will demand more time and location efficient and effective services.

Socio-cultural trends: compliance and inclusion dilemmas

Many attempted and realised changes and reforms in healthcare and particularly all the patient-centric initiatives in the field of eHealth in general and of some directions of PHS in particular have found inspiration in the narrative of healthcare being increasingly characterised by:

- a more proactive consumerist culture,
- a drive toward more empowerment and autonomy that breaks the traditional information asymmetry *vis-à-vis* The Doctor,
- increasing and pervading health consciousness and demand for prevention and life-style management.

Summarising various strands of Gartner research, Handler (2008) without hesitation predicts that these are the clearly dominant emerging trends and characterises the health consumer of the future with the following four demand:

- **know who I am.** Expectation that the various players within the healthcare system have as much information as possible before he or she shows up for a visit or treatment;
- **know why I am here.** Savvy consumers expect healthcare to know even more and constantly update data such as for instance family history, recent treatment and tests, biomarkers, etc, and thus anticipate needs and intervene timely;
- **return me to health quickly.** Recognize that patients' time is valuable — and get them back to daily life as quickly as possible and/or provide alternatives for encounters that do not involve taking an entire day off from work. This entails also, moving away from the paternalistic approach, to provide the patient with alternative scenarios treatment and predictions of different outcomes: For example, the patient with coronary artery disease may have the choice of a coronary artery bypass graft (CABG) or stent placement. The latter allows the

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patient to return to a normal routine within days; the former involves open-heart surgery, and recovery can take weeks but with less risk of needing a repeat procedure. This will require a careful balancing act between the "desires" of the healthcare system (for example, shorter lengths of stay or even no hospitalization compared to reimbursement) and the desires/needs of the individual. This negotiated evidence based approach was also mentioned by one of the participants to Sheffield workshop as an emerging trend in the UK NHS;

- **help me to stay healthy.** The most desirable state is to not require any medical care and the savvy health consumer increasingly demands prevention and life-style guidance.

So the trends one can extract from such alleged emerging new and pervasive health awareness and consumerist culture are, among others, the following:

- Interest in **prevention and on keeping fit and healthy** (awareness of lifestyle impact to avoid diseases and increase the quality of life possible);
- High **compliance** with medication and lifestyle guidance;
- **“Self-initiative”** in the interaction with doctors;
- Desire of more **“empowerment”** and **self-care**;
- **Search and use of information** to make decisions and compare options;

On the other hand, the consultation process provided us with an apparently paradoxical results, for participants rated also as high impact and low uncertainty (so developments that will happen) trends representing the exact opposite of the previous ones such as:

- **“Fatalistic” attitudes:** “I will die anyway, so I don’t care”;
- **“Opportunistic”** behaviour: “They will save me at the end, so I do whatever I want”;
- **Unhealthy behaviours** (e.g., bad eating habits, little or no physical activity, smoking, alcoholism and substance abuse);

Another dimension, which was highly stressed and discussed during the 3rd ESC meeting and the Sheffield Consultation workshop and led also to apparently contradictory assessment of trends, concerns access and use of digital technologies, digital literacy and technology confidence. One could object that for PHS systems, which are much beyond simple use of web-enabled technology, this issue would not be highly relevant. We would argue instead that this dimension is relevant for two reasons. First, for instance, the diffusion of digital TV could become an important channels of providing personalised home services to the elderly in a more usable way through innovative technological solutions (Angius *et al* 2008). Second, and most importantly, the familiarity with digital technologies is the best proxy of attitudes toward remoteness as opposed to proximity in the fruition of services. In Sheffield, for instance, when discussing the possibility of remote monitoring with little or no intervention by healthcare professionals, several participants stressed that those currently very engaged in most innovative digital technologies (i.e. virtual reality) would be very likely to adopt and even prefer remote

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services. In this respect it worth noting that an analysis of ICT based preventive systems indicate as major risk that of widening of technology and health gap as a result of failure to achieve universal information and technology literacy and access to Internet, thus leading to tiered systems (Kopp *et al*, 2002). In the assessment exercise the following trend was deemed as having an high impact and low uncertainty (they will happen):

- Move toward **digital literacy** and **technology confidence**

On the other hand the discussion also pointed to the possibility that even if such trends advance it will also increase the gap with those who will remain digitally excluded and probably technology reluctant. Accordingly also the following trend was assessed as high impact and low uncertainty:

- Increasing **digital literacy** and **technology confidence** gaps;

Apart from the fact that contradictory stories can be a good element in scenarios building, such contrasting trends assessment reflect the complexity of healthcare and of its interaction with societal attitudes and behaviours.

This complexity can be appreciated, for instance, by briefly looking at the most updated and exhaustive survey of healthcare consumers attitude published in June 2008 by Deloitte (2008). Although it focuses on the US consumers⁶, it provide insights interesting with respect to the above.

First, after examining a vast array of answers on behaviours, attitudes and unmet needs or desires, it concludes that the health consumer market is not homogeneous, ma complex and demanding comprised in the U.S. of at least six unique segments. While consumerist and innovative attitudes and desires are widespread, when considering them together with actual behaviours, the finding is that two segments are still rooted in the status quo and represent 53% of the population, whereas only other three segments accounting together for 19% of the population can be firmly positioned toward consumerism and innovation (seek information, want to co-decide, would like tools for self-care), with the remaining 28% not using the healthcare system and not showing any marked and clear position.

Second, it shows that attitudes and behaviours (especially for what concern innovative approaches) varies widely across the different generations conventionally labelled and divided as follows:

- Senior (born before 1945);
- Baby boomers (born between 1946 and 1964);
- Generation X (born between 1965 and 1981);
- Generation Y (born between 1982 and 1989).

⁶ No survey similarly update and extensive is available for EU27 and to look of country specific studies was beyond the scope and resources available for this project.

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While it is beyond the scope and space here to speculate in depth on each of these generation, it suffices to say that the future trajectories of such different cohorts will to a large degree shapes the actual direction that the trends listed above will take and that their potential differentiation is a main source of future uncertainty.

Third, some example of concrete data from the survey can be used to show many contradictory attitudes or gap between attitudes/ desires (unmet needs) and actual behaviours, thus further underscoring the complexity of this domain. The respondents, for instance, overwhelmingly showed that the healthcare professionals are still the most important source of information, yet we find also that significant percentages of consumers modified a treatment recommendation, used alternative and non-conventional modes of care, and sought information to assist in decision-making in the last 24 months before the survey was taken: 14% delayed a recommended treatment; 13% decided not to pursue a course of care altogether; 30% questioned their physician about a treatment recommendation; 38% expressed a brand preference for a medication to their physician. It worth stressing that such data brings us back to the issue of compliance discussed earlier for the elderly. While for the elderly non compliance might not be intentional, health consumerism and self-care are also source of non compliance and, hence, potential risks. Taking care of one's health requires some level of human capital and we can hazard that self-care and non compliance can produce very different outcomes (positive and/or negative) depending on the socio-cultural assets of the individuals, in other word it is dependent on educational level, social class and status, as well as on access to quality social capital (network of relationship with knowledgeable individuals).

The complexity also emerge in the gap between desire and willingness to pay:

- 2 in 3 respondents are interested in participating in a wellness program to improve their health but only 1 in 4 is willing to pay more for this;
- 61% of consumers want tools that would provide **personalized recommendations** to improve their health, and 55% of consumers are interested in **tools** that would help them **assess, monitor or manage their health**, but only 12% would pay extra money to their insurances for these tools.

On the gap between desires/unmet needs and willingness to pay we will come back later when discussing the issue of business and cost models.

Going back to the apparently contradictory assessment of cultural trends during our consultation process, we can then conclude that they actually reflect the complexity and fragmentation also illustrated by the data of the Deloitte survey briefly discussed. Since these trends taken singularly were all assessed with high impact but low uncertainty, according to our methodology would not be useful for the definition of the scenarios axes. On the other hand, if we consider them jointly (each one of one sign with its exact opposite) they actually point out to a main source of uncertainty. They could actually be one of the axes presenting the opposition, for instance, between an “health aware society” and an “health passive society”. In other words if the trends are intended as pervading the entire society in an homogeneous way then their uncertainty would be very high. So

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we can take the license to reformulate the various singular trends listed earlier in the following aggregate fashion:

- Homogeneous health aware and consumerist societies;
- Homogenous health passive and traditionalist societies;
- Digitally equal and technology confident societies

Framed in this way, the trends remain high impact but in our view become highly uncertain and point out to major dilemmas for the provision of healthcare in terms of compliance and more generally of inclusion.

In general and specifically within the European space healthcare cannot be considered as any other service and, though to different degrees, is provided in a universalistic fashion with little scope for market differentiation strategies. First, the problems of compliance that can emerge as part of self care may vary depending on the socio-cultural asset of different segments of the population, that is self-care based on various PHS system may be fairly acceptable for highly educated individuals. Yet it is unlikely that, at least as far as the publicly provided healthcare is concerned, authorities could decide to provide such services only to individuals meeting some educational requirements. Here the challenge, that technology may help solve, is to envisage systems preserving autonomy and empowerment while at the same time reducing the risks of non compliance. Second, inequalities in access and use of technologies, could exclude large segment of societies from the benefits of better monitoring and management of disease and health conditions based only on technologically supported services. Here, however, one could envisage the possibility that technology together organisational change could introduce disruptive innovation realising somehow forms of the 20/80 rule: 80% of the demand addressed in more effective and cost-effective way through PHS applications, thus releasing resources for treating in more traditional way the 20% of demand originating from individuals with very acute problems and/or not capable to benefit from technology supported services.

3.2.2 Economy

As shown by the data below, healthcare expenditure as a percentage of GDP has grown substantially in all OECD countries between 1980 and 2005 and this is a result of the by now structural trend seeing healthcare expenditure growing more than GDP during period of economic growth and not decreasing during economic recessions (healthcare showing an asymmetric elasticity to GDP).

Figure 8 Total expenditure on health, percentage of GDP, 1980 to 2005

	1980	1990	2000	2001	2002	2003	2004	2005
Australia	6.8	7.5	8.8	8.9	9.1	9.2	9.5	9.5 2004-05
Austria	7.5	7.0	10.0	10.0	10.1	10.2	10.3	10.2
Belgium	6.3	7.2	8.6	8.7	9.0	10.1	10.2e	10.3e
Canada	7.0	8.9	8.8	9.3	9.6	9.8	9.8	9.8
Czech Republic	..	4.7	6.5	6.7	7.1	7.4	7.3	7.2
Denmark	8.9	8.3	8.3	8.6	8.8	9.1	9.2e	9.1e
Finland	6.3	7.7	6.6	6.7	7.0	7.3	7.4	7.5
France	7.0	8.4	9.6	9.7	10.0	10.9	11.0	11.1
Germany	8.4	9.6 1992	10.3	10.4	10.6	10.8	10.6	10.7
Greece	5.1	5.8	9.3	9.8	9.7	10.0	9.6	10.1
Hungary	..	7.0 1991	6.9	7.2	7.6	8.3e	8.1e	8.1 2004e
Iceland	6.3	7.8	9.3	9.2	10.0	10.3	10.0	9.5
Ireland	8.3	6.1	6.3	7.0	7.2	7.3	7.5	7.5
Italy	..	7.7	8.1	8.2	8.3	8.3	8.7	8.9
Japan	6.5	6.0	7.7	7.9	8.0	8.1e	8.0e	8.0 2004e
Korea	4.1 1983	4.3	4.8	5.4	5.3	5.4	5.5	6.0
Luxembourg	5.2	5.4	5.8	6.4	6.8	7.8	8.3e	8.3 2004e
Mexico	..	4.8	5.6	6.0	6.2	6.3	6.5	6.4
Netherlands	7.5	8.0	8.0	8.3	8.9	9.1e	9.2e	9.2 2004e
New Zealand	5.9	6.9	7.7	7.8	8.2	8.0	8.6e	9.0e
Norway	7.0	7.6	8.4	8.8	9.8	10.0	9.7	9.1
Poland	..	4.8	5.5	5.9	6.3	6.2	6.2	6.2e
Portugal	5.3	5.9	8.8	8.8	9.0	9.7e	9.8e	10.2e
Slovak Republic	..	..	5.5	5.5	5.6	5.9	7.2	7.1
Spain	5.3	6.5	7.2	7.2	7.3	7.9	8.1e	8.2e
Sweden	9.0	8.3	8.4	8.7	9.1	9.3	9.1	9.1
Switzerland	7.4	8.3	10.4	10.9	11.1	11.5	11.5	11.6
Turkey	3.3	3.6	6.6	7.5	7.4	7.6	7.7	7.6
United Kingdom	5.6	6.0	7.3	7.5	7.7	7.8	8.1	8.3
United States	8.8	11.9	13.2	13.9	14.7	15.2	15.2	15.3
Latest average ^a	..	..	..	..	..	..	..	9.0
Consistent average (24) ^b	6.6	7.2	8.3	8.6	8.9	9.3	9.3	9.4

Source: OECD Health Data 2008, June 2008

Currently the cost of healthcare in the EU is around 9% of GDP and costs are projected to reach 16% of GDP by 2020, representing a much higher rate of increase than that of average GDP (European Commission, 2008: 2). Coupled with Europe's ageing population, the situation is clearly unsustainable, with fewer and fewer economic "producers" to support the social and health costs related to Europe's population of retirees.

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So the key trend identified is:

- Healthcare **rising costs**.

This was naturally assessed as a high impact and low uncertainty trend, for it is unlikely that it can be reversed by 2020.

The main structural sources of rising costs are:

- 1) **Ageing of the population** and related implication in terms of disease prevalence;
- 2) **Increasing income**. The steady increase in aggregate income in advanced country is indissolubly linked to increased demand and expenditure on health, a straightforward economic structural relation proven and at work since more than half a century;

In addition source of rising cost include:

- 3) **Increasing capacity to cure** (new costly medical technologies and/or pharmaceutical products).
- 4) **Overshooting/mismatch in resource allocation**⁷. Health systems show a tendency at overshooting/mismatch in resource allocation to deal with the most demanding and complex segment (i.e. elderly with multiple acute problems) of patients, and a corresponding incapacity to introduce innovations (mostly not requiring costly sophisticated medical technologies, but rather organisational change supported by information and communication technology) that simplify the way the health system deals with the least demanding segment (i.e. prevention of single well known diseases at early stage to delay the moment when they will become seriously chronic problem).
- 5) **Fragmentation and overspecialisation (duplications, lack of integrate information management and use, errors)**. Fragmentation and overspecialisation has led to silos approach and focus on disease rather than on patient resulting in duplication of efforts, errors and sub-optimal treatment as, for instance, in cases where co-morbidity of chronic conditions is not considered.
- 6) **Inflation through unnecessary cost**. This can be due to intentionally opportunistic behaviours (moral hazard and adverse selection) or can simply be the unintended consequences of the structure of incentives determined by existing reimbursement and financing models (see *infra*)

Evidently causes 2 and 4 cannot be contained, but the other trends can be either contained or reversed through institutional/organisational change supported by technological applications such as PHS (reducing costs of chronic disease management, delay or avoidance of risk factors and incipient conditions turn into chronic disease through

⁷ For a specific analysis of this phenomenon Christensen et al (2000) .

lifestyle management and prevention, release of resources from least demanding segments, holistic approach overcoming fragmentation).

While the issue of how healthcare expenditure is distributed could be included under different heading (not necessarily under economics), nonetheless we discuss here as it entails a discussion of how the cost structure (economics) could change in the future.

Figure 9 Current health expenditure by function of health care, 2005

	Personal medical services	<i>of which:</i>			Medical goods	Collective health	<i>of which:</i>	
		Curative-rehabilitative	Long-term care	Ancillary services			Prevention and public health	Health administration and insurance
Australia (2004-05)	77	64	7	5	18	4	2	3
Austria	78	63	13	2	16	6	2	4
Belgium	72	53	15	4	19	8	2	6
Canada ^a	68	47	14	6	21	11	6	4
Czech Republic	65	49	3	12	30	5	2	3
Denmark	82	57	22	3	14	4	2	2
Finland ^b	72	65	6	0	20	6	4	2
France	69	57	9	4	22	9	2	7
Germany	71	54	12	5	20	9	3	6
Greece	..	..	..	..	..	..	..	..
Hungary (2004)	58	50	4	4	35	7	5	1
Iceland	82	65	17	0	16	2	1	2
Ireland	..	..	..	..	..	..	..	..
Italy	78	..	..	..	21	1	1	0
Japan (2004)	75	57	18	1	21	4	2	2
Korea	63	63	1	0	31	6	2	4
Luxembourg (2004)	79	56	17	6	12	10	1	9
Mexico ^a	62	..	..	..	22	14	3	11
Netherlands	73	57	14	2	18	9	5	5
New Zealand	77	55	15	7	13	10	6	4
Norway	83	50	26	7	14	3	2	1
Poland	64	53	7	4	32	4	2	2
Portugal	72	61	1	10	25	3	2	1
Slovak Republic	52	46	1	6	41	6	2	4
Spain	69	58	7	4	26	5	2	3
Sweden	83	..	..	..	15	1	..	1
Switzerland	80	57	20	3	13	7	2	5
Turkey	..	..	..	..	..	..	..	..
United Kingdom	..	..	..	..	..	..	..	..
United States	75	68	7	0	14	11	4	8
Consistent average (23) ^c	72	57	11	4	21	7	3	4

Source: OECD Health Data 2008, June 2008

As it is visible the overwhelming share of costs in most OECD countries goes to curative-rehabilitative services (on average 57% and up to 68% in the U.S.), while expenditure for collective health (7% on average) and particularly for prevention and public health is extremely marginal (3% on average). Interesting and paradoxical is also in countries with healthcare resting mostly on social and/or private insurance, the cost of administering such systems is way higher than the resources devoted to prevention. Accordingly an important very impactful and highly uncertain trend is the following:

- Substantial increase in spending for **public health and prevention**.

One additional and important trend that can be inscribed in the economic realm emerged during the final discussion of scenarios during PHS2020 2nd Consultation Workshop and concern the impact that a serious energy and/or environmental crisis might have also on healthcare and PHS.

The signs of a serious energetic crisis already emerging at the time of writing in the form of rising prices of oil matched with the increasing awareness about environmental problems and the need of sustainable economic development could lead in the future to a sharp rupture and discontinuity. This, until new innovative solutions emerge (less expensive and more environmentally compatible), could force hard energy saving measures in all sphere of economy and society, including the healthcare system. This would mean attempt to use more energy efficient treatment both within institutional care and within remote care at home, which for PHS would mean data gathering and processing and communications systems minimising energy consumption. Accordingly the identified trend is:

- Worsening energy crisis forces **energy efficient treatment** in healthcare.

3.2.3 Governance

It would lead us to far if we were to discuss in detail the overall macro-level governance arrangements even only in a few of the EU27 member states. For the sake of simplicity and brevity we will use as a proxy indicator for the discussion the aggregate share of healthcare expenditure by source of funding.

As can be seen in Figure 10 below, the main European countries members of the OECD have healthcare system overwhelmingly financed directly through general government (so called Beveridge model based on a unitary National Health System, NHS⁸) or through social insurances assimilated to public financing (so called Bismarck model⁹).

Figure 10 Health expenditure by type of financing, 2005

	Total public	<i>of which:</i>		Total private	<i>of which:</i>		
		General government	Social insurance		Private insurance	Out-of-pocket payments	All other funds ^d
Australia (2004-05)	67	67	0	33	7	20	6
Austria	76	30	46	24	5	16	3
Belgium ^a	71	4	66	29	5	22	1
Canada	70	69	1	30	13	15	2
Czech Republic	89	9	80	11	0	11	0
Denmark	84	84	0	16	2	14	0
Finland	78	61	17	22	2	18	2
France	80	5	75	20	13	7	1
Germany	77	10	67	23	9	13	1
Greece ^b	43	43	0	57		57	0
Hungary (2004)	71	11	60	29	1	24	4
Iceland ^b	83	49	34	17		17	0
Ireland	78	77	1	22	7	13	2
Italy	77	76	0	23	1	20	2
Japan (2004) ^b	82	16	66	18		17	1
Korea	53	12	41	47	3	38	6
Luxembourg ^c (2004)	91	17	73	9	1	7	1
Mexico	45	17	28	55	3	51	0
Netherlands ^a	66	3	63	34	20	8	6
New Zealand	78	78	0	22	5	17	1
Norway	84	69	15	16	0	16	1
Poland	69	11	58	31	1	26	4
Portugal	73	72	1	27	4	22	1
Slovak Republic	74	9	65	26	0	23	3
Spain	71	66	5	29	6	22	1
Sweden	85	85	0	15	0	15	0
Switzerland	60	17	43	40	9	31	1
Turkey	71	34	38	29	0	20	9
United Kingdom ^b	87	87	0	13		13	0
United States	45	32	13	55	37	13	5
OECD average	73	41	32	27	6	20	2

⁸ Key examples: United Kingdom, Sweden, Italy (though with an emerging regionalization having important impacts)

⁹ Key examples: France, Germany, Belgium

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Source: OECD Health Data 2008, June 2008

On average in the EU countries members of OECD public funding amount to 76% of health expenditure, private insurance to 3.7% and individuals private out of pocket disbursement to 18.3% (the remaining 1.9 goes to other private funds). With respect to this situation, the Dutch model stands out as a variation on the social insurance model with only 66% of public spending, 20% expenditure in private insurance and 8% out of pocket.

Next table, showing the historical trend from 1970 till 2005 in terms population coverage by publicly funded healthcare, is very telling in terms of the legacy of the past and of what can happen in the future.

Figure 11 Total public coverage, percentage of total population, 1970 to 2005

	1970	1980	1990	2000	2005
Australia	85.0	100.0	100.0	100.0	100.0
Austria	91.0	99.0	99.0	99.0	98.0
Belgium	97.8	99.0	97.3	99.0	99.0
Canada	100.0	100.0	100.0	100.0	100.0
Czech Republic	100.0	100.0	100.0	100.0	100.0
Denmark	100.0	100.0	100.0	100.0	100.0
Finland	100.0	100.0	100.0	100.0	100.0
France	95.6	99.1	99.4	99.9	99.9
Germany	89.2	92.3	88.8	90.7	89.6
Greece	55.0	88.0	100.0	100.0	100.0 2004
Hungary	..	100.0	100.0	100.0	100.0
Iceland	100.0	100.0	100.0	100.0	100.0
Ireland	85.0	100.0	100.0	100.0	100.0
Italy	93.0	100.0	100.0	100.0	100.0
Japan	100.0	100.0	100.0	100.0	100.0
Korea	..	29.8	100.0	100.0	100.0
Luxembourg	99.6	99.8	98.8 1993	98.2	99.7 2004
Mexico	..	..	..	51.0 2002	50.4
Netherlands	69.0	68.3	61.4	64.5	62.1
New Zealand	100.0	100.0	100.0	100.0	100.0
Norway	100.0	100.0	100.0	100.0	100.0
Poland	..	..	..	..	97.3
Portugal	40.0	100.0	100.0	100.0	100.0
Slovak Republic	..	..	..	98.8	97.6
Spain	61.0	83.0	98.1 1991	98.9 2001	99.5 2003
Sweden	100.0	100.0	100.0	100.0	100.0
Switzerland	89.0	96.5	99.5	100.0	100.0
Turkey	26.9	38.4	55.1	66.0 1997	67.2 2003
United Kingdom	100.0	100.0	100.0	100.0	100.0
United States	24.5	24.7	27.3
Latest average^a	92.9
Consistent average (27)^b	93.4	94.1	94.2

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Source: OECD Health Data 2008, June 2008

We can notice that:

- With few exceptions (i.e. especially U.S. but to different degrees The Netherlands) most countries are above 88% public coverage of the population with many providing 100% coverage;
- Those providing 100% public coverage already in 1970 have maintained it in 2005;
- Several countries increased public coverage from 1970 till 2005;
- There is only one noteworthy case of decreasing public coverage from 1970 till 2005: The Netherlands going from 69% to 62%

These data have been presented to support the fact that in the consultation process the most important trend identified in this domain, rated both as high impact but also with high uncertainty has been the following:

- Substantial increase of **private financing and expenditure substituting public financing;**

Again this trend can also be seen as a proxy for a broader possible trend of disengagement and lighter touch intervention of the government in the healthcare.

Given the current situation and the historical trajectory dominantly toward full public coverage, this trend is objectively very uncertain. On the other hand, the substantial share of out of pocket private expenditure in many European countries makes this trend not totally unrealistic.

Two other key issues leading to the identification of relevant trends concern the role of the state in healthcare, both of which have less or not necessarily to do with financing, but rather with other dimension of state intervention or withdrawal.

The first has to do with the fact that the state and more broadly defined public institutions (so not only at the level of central government), as has been debated and to some extent happening in other domain of state intervention, move away from 'rowing' and focus mostly on 'steering'. In general ever since the 1980s the political science and public management literature have debated the two opposite choice for government, one of rowing and being fully engaged in the production and delivery of public services in various domains (including healthcare), the other of steering and taking more distance with full blown application of horizontal subsidiarity, meaning that services can be produced by private players (even if publicly financed). We provide here only brief discussion to ICT supported healthcare services. On the one hand, for a number of reasons, the state may want to keep providing (through its various institutions, including regional and local ones) PHS service. Alternatively, they could outsource the provision of such services to private players, being they private healthcare providers (engaging in the provision of technology enabled services, but even technology suppliers and other third parties (call centres, media companies such as Google) managing the final delivery of such services

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(but naturally relying on healthcare players). This would entail the public institutions at all level would focus more on policy-making, standard setting, regulating, monitoring and evaluating outcomes. Accordingly the possible trend was phrased as:

- Increasing role of broadly defined **private players** in the production and/or delivery healthcare services;

The second issue emerged out of the discussion of the preliminary and sketchy scenarios presented in the second draft of the scenario report prepared as a background document for the consultation process. One of the axes of these scenarios was service controls: who takes the lead and is responsible for ensuring a good life style, keeping fit, problem diagnoses and solving. How far will public health care organisations and professionals will be involved this PHS process under strict rules and standards imposed by higher overseeing bodies and how much is in the control and responsibility of better empowered individuals. For the sake of synthesis and conveying the key message the dichotomy was framed as state control versus individual empowerment.

Several participants, however, pointed out that there can be an ambivalent and contradictory relations between the issue of state control and individual empowerment, where the latter instead of being seen in opposition to the former, could actually be the result of state intervention. Anticipating the articulation of the reasoning it could be said that a Caring State and (willingly or unwillingly) Empowered individuals taking responsibility could go hand in hand.

Recently in several countries healthcare planned reforms and policy documents show the desire and goal of governments to increase consumer responsibility for clinical and financial decisions related to health care for themselves and their family members. While the rhetoric is one of empowerment, the meta-goals is that of stimulating and possibly enforcing more health aware and compliant behaviours that could reduce utilization and costs of healthcare. All consulted experts agreed that for governments would be favourable to impose consumers and patients to change lifestyle and increase compliance and healthy behaviours. In other words in a sort of communitarian and possibly authoritarian approach (as opposed to the more liberal and *laissez faire* status quo) governments could attempt to make healthy lifestyle and compliance becomes a social responsibility instead of being an individual choice and even enforce this in compelling ways: exclusion from publicly reimbursed treatment or need of some payment for individuals showing unhealthy behaviours or non compliance with medication and lifestyle guidance. This could be done regardless of the fact that the service is controlled and delivered directly by public institutions or by private third parties . Accordingly the trend identified and its counter-part are:

- **Communitarian/Authoritarian** governments, pushing **responsibility onto consumers** and **enforcing healthy behaviours and compliance**;
- **Liberal laissez faire** governments, leaving matters of **healthy behaviours and compliance** entirely to individuals **free choice**.

3.3 Transactional environment

The discussion of the transactional environment will start from the barriers and bottleneck identified with respect to its various dimensions and players in the State of Play report (§ 3)¹⁰, from which the possible key trends are extracted. The transactional environment, as the expression indicates, refer to the various transaction inter-linking the various players involved in the healthcare system. As such, such transactions and players are very entwined with overlapping relations difficult to be captured in a clear-cut conceptual scheme. Accordingly the allocation of trends to the various categories below must be taken simply as a way of organising the contents, although some overlaps are evident.

3.3.1 Healthcare professionals and organisations

There are a number of different factors pertaining to the healthcare core players, some more related to the attitudes of the professionals involved, other of an organisational nature.

Professional attitudes.

Healthcare professionals are key for the future of PHS systems providing preventive services and management of disease. They currently show lack of awareness and acceptance of such system, and also open resistance due to the perceived threat to professional autonomy and authority. GPs in particular (but to a lesser extent also clinicians), have been shown to have clear attitudinal resistance to preventive/predictive systems, and particularly on the effectiveness of guidance they can provide (the corollary being the belief that is a waste of time). It must be stressed that behind this attitudes, there is also the genuine concerns and preoccupation for the patients health and the fear of damaging the relationship with them. Studies based on interviews with GPs and clinicians on monitoring, preventive and predictive systems showed that they are concerned about false positives causing unwarranted patient concerns and additional demands on their time, about the fact that inaccurate/inappropriate information may confound or complicate treatment decisions and delay care, and about the possibility that inappropriate use of applications or information obtained may undermine trust and prompt conflicts and motivate consumers to seek care from alternative and questionable providers.

Organisation: fragmentation.

The resistance and concerns of professionals are both the effect and cause of the lack of integration in processes and information flow between different tiers of healthcare system (primary, secondary tertiary) and between different specialties, in a sort of self-defeating system. If tiers and specialties were more integrated and exchanged information, preventive and monitoring systems would work better and produce better outcomes. But for this they would need more awareness and acceptance on the side of professionals, who withdraw it given the current

¹⁰ Such discussion is here reported in a compact way and for the articles sustaining some of the considerations and statement the reader can see the references quoted in the State of Play.

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situation, so contributing to blocking the development. During the consultations processes various participants stressed that in general and in particular for PHS system the importance of **primary care and integration between the various tiers of the healthcare system**. This is particularly relevant for the various organisational model of service provision presented in the State of Play. A participant affirmed that **90% of failure and delay are due to factor other than technology**: most needed technology already exist out there.

An additional source of fragmentation affecting services such as PHS is the lack of accepted standards and protocols of application, as well as explicit guidelines for seamless integration, communication, and interoperability. One of the greatest organisational obstacle to long-term integration has been the piecemeal development of the telecommunications infrastructure in health care which promotes the adoption of health information technologies that cannot “speak” to one another. According to Gartner analysis, for instance, home health monitoring is the application with the greatest potential for financial and clinical impact, but its market penetration is because most care delivery organizations do not have an electronic patient record capable of accepting data from home health monitoring applications.

It is evident that standard, procedural and technical inter-operability would be enhanced by a centralised management and decision system, which is not present in many healthcare systems.

Organisation: workloads, costs, resources

As a result of ageing population and increasing prevalence of chronic diseases and need of long term care healthcare organisations are increasing under pressure and experiencing shortage of professionals. If PHS and other preventive/monitoring services complement rather than fully substitute for traditional staff activities workloads and costs increase rather than decreasing, at least in the short to medium term. Major benefits in terms of reduced workload as a result of the remote treatment of demand would only occur after a threshold critical mass is reached, which in turn is highly contingent on users adoption and acceptance. Under these conditions, public healthcare organisation may decide to outsource at least the non core activities of PHS to third parties such as technology suppliers, call centre and media companies, although also this possibility is contingent upon inter-operability matters and legal-institutional issues.

From the above discussion we extract the following trend mostly framed as a positive move away from the barriers and bottleneck:

- Increasing **acceptance** by professionals of preventive and monitoring systems and willingness to relinquish power and control (favouring PHS service model fully led by patients);
- Increasing **acceptance** by professionals of preventive and monitoring systems but unwillingness to relinquish power and control (favouring PHS service model controlled by healthcare organisations/professional)
- **Centralisation** of broadly defined **inter-operability** decisions (standard, guidelines, procedures, technological) favouring integration
- Increase in **integrated-care provision** (diagnosis, treatment, monitoring and prevention). To further explain what is meant is worth reporting in full the little scenario envisaged by Professor Roca:

Mr Smith is 50 years old, former smoker and family history of COPD and cardiac diseases. He is sedentary and over-weight. After a lung function testing the diagnosis of a moderate COPD is

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made. In a PHS integrated care and modelling scenario Mr. Smith would start with a health professional in primary care who, through non invasive tools, would assess the levels of biomarkers in exhaled breath and in saliva with prognostic value. If he has high risk of accelerated developments in COPD+ cardiac disease + other (proven and evaluated by a simulation modelling tool) he would then go for: a) remote monitoring for compliance with pharmaceutical and non pharmaceutical treatment; b) point of care assessment of biomarkers level at home and likely treatment with appropriate pharmaceutical

- Growing **shortage of professional resources** and increasing workloads;
- **PHS** and other **ICT supported integrated care** delivery model failure leads to renewed resistance from healthcare organisations and professionals;
- Healthcare organisations **outsource PHS** and other system to third parties, and depending on professional attitudes:
 - PHS model provided by third party but fully led by patient;
 - PHS model provided by third party but controlled by healthcare organisations/professional;
- **PHS** and other **ICT supported integrated care** delivery model failure leads to renewed resistance from healthcare organisations and professionals.

Before moving to the next dimension of the transactional environment, it is worth stressing that a question treated in more details as a matter of payers and financing has a high impact on healthcare organisations and professionals, namely the issue of the structure of incentive. As framed by Handler (2008) in his discussion of the health consumers of the futures and of their likely demand for ICT supported prevention and monitoring, while providing such services from the perspective of consumers or society is the correct course of action, the problem is that in many countries health care organisations do not have the proper financial incentives and may, in fact, be penalized for doing the right thing monetarily on in term of increased work without a corresponding reimbursement.

3.3.2 Payers (financing systems)

Here we deal with the more micro level dimension of financing and payers for healthcare, for besides the general characteristic of financing considered at the macro-level earlier, in practices there can be particular differences.

All of the literature reviewed and the insights from Gartner premium research we have had access list the lack of clear economic incentive and appropriate reimbursement schemes, in a word of cost and business models, as one of the key barriers for telemedicine, tele-homecare and PHS. The “who, how and for what pays” question is critical to provide the corrective incentives to reward innovative services that improve health and disease management outside institutional care. In the field of preventive care, for instance, in system based on private and social insurance GPs needs to know if technology based preventive services are reimbursed otherwise they would not provide them. GPs in NHS are paid a fixed amount per patients and are assigned a fixed pool of patients, preventive activity may mean an increase in the amount of workload without a corresponding incentive and/or support. In both cases currently the result is non adoption. The same reasoning applies to secondary and tertiary care players.

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The importance of the lack of clear incentives and business models is testified by the fact that the European Commission is currently tendering a strategic study on business models for eHealth where, given the challenges European healthcare systems are facing, it stresses the following (2008: 2):

*... Member States have shown that they are keen to take an eHealth Action Plan forward that draws on best practices and experiences from across the Union. This Action Plan is the culmination of the work that enables a move towards a “European eHealth Area”; a framework built on a wide range of European policies and initiatives. This Action Plan for a European eHealth Area is comprehensively described in the Communication of the Commission COM (2004) 356 “eHealth - making healthcare better for European citizens: An action plan for a European eHealth Area”, in particular pages 24-26. A specific objective was defined in the Action Plan regarding ‘supporting and boosting investment in eHealth’. (p. 1). Despite their availability, **e-Health systems and services are not yet widely used in real-life medical or health situations. One of the reasons is the lack of awareness of successful business models for existing and future eHealth systems and services***

In view of the increasing share of individuals out of pocket expenditure for health care in most European countries suggesting a certain degree of willingness to pay, the over-the-counter **consumer electronics approach** can play a role. In such approach one could envisage that third parties from outside the healthcare system proper take the lead in delivering PHS services directly to citizens/patients and charge price (probably a subscription based model for more steady services, and pay per use for more punctual interventions). They rely on the expertise of established healthcare institutions (public or private) that they compensate, or they directly higher healthcare professionals. This solution presents, however, some limits. First, without strong initiatives in public funded schemes overall adoption of PHS and other eHealth applications is bound to be **small** and raise issues of social divide. Second, as long as it remains a niche market the supporting technological products and services will still have high prices (not being mass market) and thus will further reduce the pool of individuals using them (willing and able to pay). Third, for as much as these third party delivered service have to inter-operate with healthcare organisation and access patients health records and other data, lack of inter-operability standards will make it difficult, not to mention privacy and legal issues.

One of the potentially most relevant achievement that eHealth could bring about would be the wide adoption of ‘hospital at home’ solutions for dealing with chronic patients without acute conditions for assisting the elderly with reduced abilities. This would tremendously reduce the workload and cost pressure on healthcare, however, only if it went beyond the niche market paid for directly by the consumers. Wide adoption and critical mass cannot occur outside of public funding.

Where social and private insurance prevail, GPs concerns are about whether or not preventive activity are reimbursed. In National Health Systems where GPs are paid a fixed amount per patients and are assigned a fixed pool of patients, preventive activity may mean an increase in the amount of workload without a corresponding incentive and/or support.

The problem with current reimbursement and financing schemes is that they pay for the actual output. In some case, for instance, reimbursement is related to days of

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hospitalisation in other with actual treatment. In both cases they favour opportunistic behaviours inflating the stay in hospital or provided not strictly needed treatment, while they would penalise an hypothetical healthcare organisation that by providing a fully functional hospital at home solution and effective preventive monitoring, reduced its hospitalisation and treatments for chronic patients: it foregoes the reimbursement for hospitalisation and treatment, without being at least partially reimbursed for the remotely delivered service that, while may decrease workloads, it still needs the application of resourced and requires setting up and maintenance costs.

A possible solution for the further adoption of preventive, monitoring and management eHealth and PHS services would be **outcome-based** (i.e. number of chronically ill patients maintaining good conditions and not require hospitalisation and treatment for acute conditions) rather than **output-based** reimbursement (i.e. instead of number of treatments delivered within institutional care or number of hospital-days). Such radical and possibly disruptive institutional innovation entails, however, as a corollary the need for controlling the difference prevalence and socio-economic conditions in the population of reference of each healthcare organisations reimbursed by the public payers in such outcome based way and, above all, precise and solid measurement systems. This would probably require integration and continuous feed-back between PHS applications, patient health records, and public health databases (epidemiological and prevalence data, biological data, environmental data, etc).

On the other hand, the lack of measurement and evidence on the efficiency and effectiveness of broadly defined eHealth system is, alongside the lack of business model, another key barrier and bottleneck, a fact on which in the literature there is a broad consensus. Even in telemedicine, which presents some similarities with PHS but with a much longer history, evidence as to its costs and benefits is at best inconclusive, if not controversial. The case of telemedicine is very telling, for such applications have been available for decades but their take up is still very limited. Despite the maturity of technical solutions available for telemedicine applications, it is noted that telemedicine is still not as widely deployed as it could be. The lack of significant and systematically reviewed evidence on the clinical effectiveness and economic efficiency of telemedicine applications and their contribution of quality of care, are considered key factors which slow the uptake of telemedicine. Lack of acceptable evidence leads to a limited confidence in the new solutions, and thus low take up by healthcare providers caused by the reluctance of public or private insurance payers of healthcare.

In absence of cost-effectiveness data especially public payers may remain reluctant to support such application for fear of wasting resources and delaying innovation in other areas with better supporting evidence on impact.

From the above discussion two key trends strictly related to the payers side are extracted:

- Over the counter **consumer electronics** model paid from **out of pocket private expenditure** consolidates;
- Move to **outcome based** public reimbursement of **PHS** and other **eHealth** applications

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In addition we can add two trends, the first a pre-requisite of the move to outcome based reimbursement and the second its corollary:

- Emergence of empirically robust **measurement systems** to assess **PHS**;
- Wide adoption of hospital at home solutions;

3.3.3 Technology suppliers and other non healthcare players

Microsoft and Google as new players of healthcare? The best way to illustrate what the role of technology suppliers and/or media companies could be is to look at what happening in the fields of Personal Health Records (PHRs) as a result of the strategy of two giants such as Microsoft and Google (Rishel 2008a and 2008b). While PHRs is a different field from PHS, the trend is exemplificative and the potential entry of third party in healthcare and, moreover, has also implications for PHS.

Google Health and Microsoft HealthVault offer personal health records (PHRs) that are free and controlled by the consumer and could achieve a high degree of interoperability with clinical systems operated by healthcare providers and other third parties. They are very similar and have the potential to achieve several important benefits:

- 1) Lifetime health records that is free to consumers and healthcare payers: both players have very low costs through their cloud computing facilities, today can monetise PHRs by drawing consumers to their other online products, in the future may sell value added health services (see point 6);
- 2) They can scale up to cover the expansion in healthcare data driven by increased use of diagnostic imaging, genomics and proteomics;
- 3) Given sheer size and brand , their initiatives could set the pace and lead healthcare organizations to provide PHRs data and in the future support for other third party players.
- 4) They could expedite achieving interoperability among healthcare IT systems by their market presence and vendor-oriented marketing/partnering.
- 5) They offer Internet-savvy approaches to the two most vexing issues in sharing electronic information in many jurisdictions: consumer authorization and consumer identification. Given their trusted brand they could increase users confidence in providing data and overcome concern with privacy and use of their health data;
- 6) Their cloud-computing approach, offering data access as a software service, can help to create a new market of consumer-oriented healthcare applications such as also to some extent PHS, enabling better consumer lifestyle choices and more active consumer participation in choosing a course of treatment for serious health problems. The goals of Microsoft and Google are not simply to provide a repository of data or to provide the single application that consumers use to derive value from their PHR. They are actively recruiting many vendors to provide third-party applications that add specific value to the repository, all operating under consumer control

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- 7) The cloud-computing approach is synergistic with the underlying philosophy of these products, which is to engage consumers in managing their own data. This consumer engagement is another reason that better consumer choices could stem from their use

A linchpin assumption of the Google and Microsoft products is that the consumers/patients (or their “consumer healthcare manager”) is able to access the PHR and authorize specific interfaces that will add data on an ongoing basis. For example, once the authorization is in place for a practice, the practice would routinely send summaries to the PHR after visits. The consumer can authorize sharing of data in the PHR in three ways: 1) sending a report to a clinician or other person on a one-time request; 2) establishing an ongoing interface to forward information; or 3) authorizing a Web-based application to access the data as required for its purposes. For example, a diabetes disease management Web application may access glycosylated hemoglobin and lipid data sent to the PHR from a lab, medication data sent by drug stores and serum glucose data from the patient's own glucometer to provide recommendations on diet and exercise.

One concern is that such solution could divert public support to ongoing PHRs and PHS initiatives leading to a waste of resources, which were deployed to ensure PHRs and PHS also to consumers/patients who may not have regular access to the Web, who may not afford to pay value added services when technology suppliers and media companies will start charging a prices, who may have language and other impairments.

As stated this is only an exemplificative way of how third parties could enter the healthcare domain, and is limited to PHS services that can be provided through web based applications, which is not always the case and for certain very sophisticated applications not appropriate.

A more general issue related to technology suppliers and other third party players is whether they will remain in an ancillary position or will become active players in the actual delivery of PHS services, and in the latter case who and how many will do so. Though in a way different from that seen for healthcare organisation, here also the uncertainties is about integration versus fragmentation. One could envisage a large scale process of merger and acquisition across related but separate industries (strictly define IT providers, Telecommunications, media companies, call centres, providers of sensors, wearable, nano-technology and other PHS related technologies), or at least the emergence of a few end providers (integrating the other players of the value chain through partnership or simply supply chain transactions), thus bringing about standardisation, inter-operability and economy of scale. On the contrary, the current fragmentation could continue and actually increase. It beyond our goal to enter into the factors that could push one or the other of these trends, what it is important for us to stress is that an integration process could contribute (if matched by adoption and other changes) to make many innovative technology products, currently still too expensive, reach a mass market dimension and become more affordable, which would be more unlikely with a fragments industry. PHS devices can be bought in every shop and persons are able to use the devices themselves.

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From the above discussion the following trends are extracted

- **Third party** provision of integrated **PHRs** and **PHS** services;
- Industry **integration** and emergence of **few large players** leading to increased standardisation and inter-operability
- **innovative technology** products reach a **mass market** dimension and become more **affordable**;

As for previous trends, the opposite of these trends are considered indirectly by way of assessing their uncertainty.

Finally, technology suppliers and especially media companies can also play a role by providing information and comparison website and web 2.0 application and mashups based networks supporting communities of interest among consumers/patients empowering them in their interactions with healthcare professionals. These trends were, however, rated as having low uncertainty but also limited impact.

3.4 Users and technology

3.4.1 Users

For users, the trends are extracted from the discussion of the specification of some of the more macro trends considered for the society as a whole and also from additional elements not considered within the discussion on society.

Barriers and bottlenecks related to consumers/patients, beside that in usability problems, are rooted in very complex socio-psychological and cultural factors, which we cannot go into details here. First, there is the typical fear of social labelling to diagnosis. Second, and directly related to the first, there are concerns about privacy invasion and use of confidential health data by third parties. Third, cognitive dissonance between individuals' holistic, integrated view of health and the constraints of most self-monitoring systems, as well as difficulty relating to traditional clinical health metrics and language. Fourth, there is the fear of unintended errors. Fifth, consumers/patients may be reluctant to adopt invasive and/or uncomfortable data gathering devices. Finally, there is the issue of confidence or lack of it with remotely provided services with no direct intervention on the side of healthcare professionals.

With respect to some of the above factors during the consultation workshop some interesting considerations emerged. First, some participants stressed that the privacy and confidentiality concerns may be overcome as increasing number of people get used to provide personally sensitive data in other domains without encountering main problems. Second, other stressed that with respect to the invasiveness and/or comfort of data gathering device is likely that individuals with chronic conditions would accept them anyway, whereas they would be rejected by health individuals demanding preventive and lifestyle management services. Third, other suggested that both privacy and invasiveness/comfort concern could disappear if in the face of a crisis situation they become a necessity or if enforced by an interventionist state.

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In addition to these socio-psychological and cultural dimension we must consider the issue of affordability if PHS services will be provided upon out of pocket payment.

The trends identified and related to the above discussion are:

- Move toward **remote interaction** and **less healthcare professional intervention**;
- Continuous **reliance on healthcare professionals** and preference for **face2face** interactions;
- Distrust due to failures and errors and/or misuse of personal data
- Acceptance of invasive / uncomfortable data gathering devices
- Social divide between those able and not able to pay healthcare

3.4.2 Technology

As anticipated, most of the technological trends in the first list we elaborated (containing more than 40 different trends) were deemed with low uncertainty, that is all participants assumed that technological progress would make them happen. Accordingly below we list only a few of them, the most relevant and in most cases those that were deemed to be uncertain at least to some extent (full discussion can be consulted in the State of Play report). Given the detailed analysis of technological solution provided in the state of play, below we simply list them without additional discussion, except in a few cases.

- Convergence of ICT, nano-technologies and bio-technology;
- Improvement in sensors technology (multiple signs, local data processing, integration with communication sub-systems, organic sensors high miniaturization. low-cost, low-power, multifunctional sensors etc);
- Lab on chip and early diagnosis (PoC);
- Multi-disease platforms
- Platforms for new diseases (i.e. neuro-psychological)
- Multiple data integration across all tiers of the healthcare system (including social support and primary care). This is currently already in place only in fourth tier care (i.e. bio-markers for a certain disease and tailoring of prevention)
- Simulation and modelling tools used from primary care up to policy-making and high level monitoring (Decision Support Systems);
- High level of invasiveness of data gathering devices
- Improvement in smart clothes, wearable (nano-integrated into textiles and textile fibres)
- Inter-operable open Personal Health Records integrated across healthcare and between healthcare and third parties players
- Clouds and grid computing;
- New and more sophisticate Digital TV and related protocols;

3.5 Summary

By way of summarising the discussion above we list in the table below all the identified key trends. They substantially different from those included in the original list, as a result of improvements (in terms of discarding overlapping and/or unclear and/or totally irrelevant trend and including new ones) produced by the consultation and revision iteration process

Table 1 Synoptic table of key identified trends

MACRO SOCIO-INSTITUTIONAL ENVIRONMENT
Society
<ul style="list-style-type: none"> • Population ageing • Rise of chronic diseases prevalence • Rise of chronic diseases co-morbidity • Increasing need of long term care assistance • Increasing problems of compliance to medication and lifestyle guidance (elderly) • Increasing obesity • increasing incidence of neuropsychiatric disorders • Time starved “consumer health care managers” • Homogeneous health aware and consumerist societies; • Homogenous health passive and traditionalist societies; • Digitally equal and technology confident societies
Economics
<ul style="list-style-type: none"> • Rising healthcare costs and spending; • Substantial increase in spending for public health and prevention • Worsening energy crisis forces energy efficient treatment in healthcare
The State
<ul style="list-style-type: none"> • Substantial increase of private financing and expenditure substituting public financing • Increasing role of broadly defined private players in the production and/or delivery healthcare services • Communitarian/Authoritarian state approach, pushing responsibility onto consumers and enforcing healthy behaviours and compliance; • Liberal laissez faire state approach, leaving matters of healthy behaviours and compliance entirely to individuals free choice.
<i>Continued</i>

Table 1 Continued

TRANSACTIONAL ENVIRONMENT
Healthcare professionals and organisations
<ul style="list-style-type: none"> • Increasing acceptance by professionals of preventive and monitoring systems and willingness to relinquish power and control (favouring PHS service model fully led by patients);
<ul style="list-style-type: none"> • Increasing acceptance by professionals of preventive and monitoring systems but unwillingness to relinquish power and control (favouring PHS service model controlled by healthcare organisations/professional)
<ul style="list-style-type: none"> • Centralisation of broadly defined inter-operability decisions (standard, guidelines, procedures, technological) favouring integration
<ul style="list-style-type: none"> • healthcare integrated and joined-up across tiers (primary, secondary, etc)/ specialties and functions (diagnosis, treatment, monitoring and prevention)
<ul style="list-style-type: none"> • Further fragmentation of healthcare
<ul style="list-style-type: none"> • Growing shortage of professional resources and increasing workloads
<ul style="list-style-type: none"> • PHS and other ICT supported integrated care delivery model failure leads to renewed resistance from healthcare organisations and professionals
<ul style="list-style-type: none"> • Healthcare organisations partially outsource PHS and other systems to third parties
<ul style="list-style-type: none"> • PHS and other ICT supported integrated care delivery model failure leads to renewed resistance from healthcare organisations and professionals
Payers (financing system)
<ul style="list-style-type: none"> • Over the counter consumer electronics model paid from out of pocket private expenditure consolidates;
<ul style="list-style-type: none"> • Move to outcome based public reimbursement of PHS and other eHealth applications
<ul style="list-style-type: none"> • Emergence of empirically robust measurement systems to assess PHS
<ul style="list-style-type: none"> • Wide adoption of hospital at home solutions
Technology suppliers and other third party players
<ul style="list-style-type: none"> • Third party provision of integrated PHRs and PHS services;
<ul style="list-style-type: none"> • Industry integration and emergence of few large players leading to increased standardisation and inter-operability
<ul style="list-style-type: none"> • innovative technology products reach a mass market dimension and become more affordable;
<i>Continued</i>

Table 1 Continued

USERS AND TECHNOLOGY
Users
<ul style="list-style-type: none"> • Acceptance of remote interaction and less healthcare professional intervention; • Continuous reliance on healthcare professionals and preference for face2face interactions; • Distrust due to failures and errors and/or misuse of personal data • Acceptance of invasive / uncomfortable data gathering devices • Increased self-diagnosis and potential for non compliance (beyond elderly) • Widening social divide between those able and not able to pay healthcare
Technology
<ul style="list-style-type: none"> • Convergence of ICT, nano-technologies and bio-technology; • Improvement in sensors technology (multiple signs, local data processing, integration with communication sub-systems, organic sensors high miniaturization. low-cost, low-power, multifunctional sensors etc); • Lab on chip and early diagnosis (PoC); • Multi-disease platforms • Platforms for new diseases (i.e. neuro-psychological) • Multiple data integration across all tiers of the healthcare system (including social support and primary care). This is currently already in place only in fourth tier care (i.e. bio-markers for a certain disease and tailoring of prevention) • Simulation and modelling tools used from primary care up to policy-making and high level monitoring (Decision Support Systems); • High level of invasiveness of data gathering devices • Improvement in smart clothes, wearable (nano-integrated into textiles and textile fibres) • Inter-operable open Personal Health Records integrated across healthcare and between healthcare and third parties players • Clouds and grid computing; • New and more sophisticate Digital TV and related protocols • Convergence of ICT, nano-technologies and bio-technology;

4 From trends to scenarios

4.1 Assessing and organising the trends: the four scenarios

4.1.1 Trends assessment

The identified trends have been assessed in the impact/uncertainty matrix below through the consultation and iteration process illustrated earlier. The two tables below reflect our final re-elaboration of the various assessment made during the consultation. The first table includes also trends not having a high degree of uncertainty but at least a medium or medium low one. It has been included to show that technological trends have all been rated at high impact but in terms of uncertainty, apart from two exceptions, they reach only a medium-low level¹¹. The second is instead the final one including only high impact and high uncertainty trends.

Table 2 Trend assessment: wider listed

MACRO SOCIO-INSTITUTIONAL ENVIRONMENT	Impact	Uncertainty
Society		
• Homogeneous health aware and consumerist societies;	High	High
• Homogenous health passive and traditionalist societies;	High	High
• Digitally equal and technology confident societies	High	High
Economics		
• Substantial increase in spending for public health and prevention	High	High
• Worsening energy crisis forces energy efficient treatment in healthcare	High	High
Governance		
• Substantial increase of private financing and expenditure substituting public financing	High	High
• Increasing role of broadly defined private players in the production and/or delivery healthcare services	High	High
• Communitarian/Authoritarian state approach	High	High
• Liberal laissez faire state approach,	High	High
<i>Continued</i>		

¹¹ In the trends assessment exercised we asked all expert to assess the trends on a scale from 1 to 10 (with 10 representing maximum impact or uncertainties). Have deemed high scores of 7 and above, medium score between 5 and 7, and low all those below 4.

Table 2 Continued

TRANSACTIONAL ENVIRONMENT	Impact	Uncertainty
Healthcare professionals and organisations		
<ul style="list-style-type: none"> Increasing acceptance by professionals of preventive and monitoring systems and willingness to relinquish power and control (favouring PHS service model fully led by patients); 	High	High
<ul style="list-style-type: none"> Increasing acceptance by professionals of preventive and monitoring systems but unwillingness to relinquish power and control (favouring PHS service model controlled by healthcare organisations/professional) 	High	High
<ul style="list-style-type: none"> Centralisation of broadly defined inter-operability decisions (standard, guidelines, procedures, technological) favouring integration 	High	High
<ul style="list-style-type: none"> healthcare integrated and joined-up across tiers (primary, secondary, etc)/ specialties and functions (diagnosis, treatment, monitoring and prevention) 	High	High
<ul style="list-style-type: none"> Further fragmentation of healthcare 	High	High
Payers (financing system)		
<ul style="list-style-type: none"> Over the counter consumer electronics model paid from out of pocket private expenditure consolidates 	High	High
<ul style="list-style-type: none"> Move to outcome based public reimbursement of PHS and other eHealth applications 	High	High
<ul style="list-style-type: none"> Emergence of empirically robust measurement systems to assess PHS 	High	Medium
<ul style="list-style-type: none"> Wide adoption of hospital at home solutions 	High	Medium
Technology suppliers and other third party players		
<ul style="list-style-type: none"> Industry integration and emergence of few large players leading to increased standardisation and inter-operability 	High	High

Continued

Table 2 Continued

USERS AND TECHNOLOGY	Impact	Uncertainty
Users		
<ul style="list-style-type: none"> • Acceptance of remote interaction and less healthcare professional intervention; 	High	High
<ul style="list-style-type: none"> • Continuous reliance on healthcare professionals and preference for face2face interactions; 	High	High
<ul style="list-style-type: none"> • Increased self-diagnosis and potential for non compliance (beyond elderly) 	High	High
<ul style="list-style-type: none"> • Widening social divide between those able and not able to pay healthcare 	High	High
Technology		
<ul style="list-style-type: none"> • Convergence of ICT, nano-technologies and bio-technology; 	High	Medium-low
<ul style="list-style-type: none"> • Multiple data integration across all tiers of the healthcare system (including social support and primary care). This is currently already in place only in fourth tier care (i.e. biomarkers for a certain disease and tailoring of prevention) 	High	High
<ul style="list-style-type: none"> • Local data processing by sensors 	High	Medium-low
<ul style="list-style-type: none"> • High level of invasiveness of data gathering devices 	High	Medium-low
<ul style="list-style-type: none"> • Simulation and modelling tools used from primary care up to policy-making and high level monitoring (Decision Support Systems); 	High	High

Table 3 Trend assessment: final restricted list

MACRO SOCIO-INSTITUTIONAL ENVIRONMENT	Impact	Uncertainty
Society		
• Homogeneous health aware and consumerist societies;	High	High
• Homogenous health passive and traditionalist societies;	High	High
Economics		
• Substantial increase in spending for public health and prevention	High	High
• Worsening energy crisis forces energy efficient treatment in healthcare	High	High
Governance		
• Substantial increase of private financing and expenditure substituting public financing	High	High
• Increasing role of broadly defined private players in the production and/or delivery healthcare services	High	High
• Communitarian/Authoritarian state approach, pushing responsibility onto consumers and enforcing healthy behaviours and compliance;	High	High
• Liberal laissez faire state approach, leaving matters of healthy behaviours and compliance entirely to individuals free choice.	High	High
<i>Continues</i>		
TRANSACTIONAL ENVIRONMENT	Impact	Uncertainty
Healthcare professionals and organisations		
• Increasing acceptance by professionals of preventive and monitoring systems and willingness to relinquish power and control (favouring PHS service model fully led by patients);	High	High
• Increasing acceptance by professionals of preventive and monitoring systems but unwillingness to relinquish power and control (favouring PHS service model controlled by healthcare organisations/professional)	High	High
• Centralisation of broadly defined inter-operability decisions (standard, guidelines, procedures, technological) favouring integration	High	High
• healthcare integrated and joined-up across tiers (primary, secondary, etc)/ specialties and functions (diagnosis, treatment, monitoring and prevention)	High	High
<i>Continued</i>		

Table 3 continued

Payers (financing system)		
<ul style="list-style-type: none"> • Move to outcome based public reimbursement of PHS and other eHealth applications 	High	High
<ul style="list-style-type: none"> • Over the counter consumer electronics model paid from out of pocket private expenditure consolidates 	High	High
Technology suppliers and other third party players		
<ul style="list-style-type: none"> • Industry integration and emergence of few large players leading to increased standardisation and inter-operability 	High	High
USERS AND TECHNOLOGY	Impact	Uncertainty
Users		
<ul style="list-style-type: none"> • Move toward remote interaction and less healthcare professional intervention; 	High	High
<ul style="list-style-type: none"> • Continuous reliance on healthcare professionals and preference for face2face interactions; 	High	High
<ul style="list-style-type: none"> • Widening social divide between those able and not able to pay healthcare 	High	High
<ul style="list-style-type: none"> • Increased self-diagnosis and potential for non compliance (beyond elderly) 	High	High
Technology		
<ul style="list-style-type: none"> • Multiple data integration across all tiers of the healthcare system (including social support and primary care). This is currently already in place only in fourth tier care (i.e. bio-markers for a certain disease and tailoring of prevention) 	High	High
<ul style="list-style-type: none"> • Simulation and modelling tools used from primary care up to policy-making and high level monitoring (Decision Support Systems); 	High	High

So the table above contains all the trend to be used to derive the key dimension of uncertainty to be used to extract the axes of the scenarios.

4.1.2 Trends organisation

The developments depicted in the grey-coloured cell above (high uncertainty and high impact) were clustered into categories to identify the main uncertainty variables.

Table 4 Organising trends along key uncertainties dimensions

Uncertainty variable	Trends shaping uncertainty variable
<p>Governance</p>	<ul style="list-style-type: none"> • Substantial increase of private financing and expenditure substituting public financing • Over the counter consumer electronics model paid from out of pocket private expenditure consolidates • Increasing role of broadly defined private players in the production and/or delivery healthcare services; • Move to outcome based public reimbursement of PHS and other eHealth applications • Communitarian/Authoritarian state approach, pushing responsibility onto consumers and enforcing healthy behaviours and compliance; • Liberal laissez faire state approach, leaving matters of healthy behaviours and compliance entirely to individuals free choice; • Healthcare organisations and professional relinquish control over service provision • Increasing acceptance by professionals of preventive and monitoring systems and willingness to relinquish power and control (favouring PHS service model fully led by patients); • Healthcare organisations and professional maintain control • Centralisation of broadly defined interoperability decisions (standard, guidelines, procedures, technological) favouring integration <p style="text-align: right;"><i>Continued</i></p>

Table 4 Continued

Uncertainty variable	Trends shaping uncertainty variable
Society and health and technology: degree of differentiation	<ul style="list-style-type: none"> • Homogeneous health aware and consumerist societies; • Homogenous health passive and traditionalist societies; • Digitally equal and technology confident societies • Move toward remote interaction and less healthcare professional intervention; • Continuous reliance on healthcare professionals and preference for face2face interaction • Widening social divide between those able and not able to pay healthcare • Increased self-diagnosis and potential for non compliance (beyond elderly);
Not contributing to any of the two key uncertainty variables	<ul style="list-style-type: none"> • Industry integration and emergence of few large players leading to increased standardisation and inter-operability • Multiple data integration across all tiers of the healthcare system (including social support and primary care). This is currently already in place only in fourth tier care (i.e. bio-markers for a certain disease and tailoring of prevention); • Simulation and modelling tools used from primary care up to policy-making and high level monitoring (Decision Support Systems); • Worsening energy crisis forces energy efficient treatment in healthcare

So in the end are two key uncertainty variables are:

- **Governance** : will government opt for a lighter touch the state and substantially withdraw from both production, control and financing of services (opening to new players) and also from shaping consumers/patients attitudes, or will retain a strong involvement in many ways (financing, enforcement of healthy behaviours and compliance, retaining full control of both production and delivery of services) and seal the healthcare to new players?
- **Societal differentiation**: will we live in fairly homogeneous society where individual attitudes, behaviours and capabilities in relevant domains (attitudes to health, to technology, willingness/capabilities to pay) will tend to converge or will

we witness and increasing differentiation even more marked than the one visible today?

4.1.3 The four scenarios

As we had anticipated (see § 2.2), in moving from the full discussion of trends to the selection of the two key dimensions we have progressively reduced complexity. From the long illustration of the state of play we then moved to the more synthetic discussion of trends. Then the over 50 trends identified were reduced to the 20 deemed at the same time as having high impact and high uncertainties. Finally, from these 20 trends it was clearly possible to extract even four different dimensions of uncertainties (about governance, about society, about healthcare organisations and professionals' orientation, about technology), but we extracted only two dimensions. In the same paragraph mentioned above, however, we explained and anticipated that this does not entail that all the information progressively eliminated to identify the two axes for the identification of the scenarios will be lost.

In light of this possible concern about the loss of information we must recall that scenarios have also the objective of providing a message that is simple and can come across in terms of communication and that the information are actually not lost. We briefly exemplify below, why this is the case.

Financing and reimbursements scheme (varying for instance from status quo to outcome-based), for instance, has been subsumed into the **governance** axis, but could reasonably be a separate axis in itself. Yet it will not be lost for it in the characterisation of scenarios. In the same way preference/acceptance of remote versus face2face healthcare delivery could also be a dimension distinct from the broader one about societal differentiation in attitudes and behaviours, but will also figure in scenarios description. A different case is that of trends more strictly related to healthcare organisations and professionals, which have been subsumed into the overall governance dimension. Here the idea is when considering governance we are talking about all the public institutions dealing with healthcare and, thus, the higher level elements permeates also the more micro level ones.

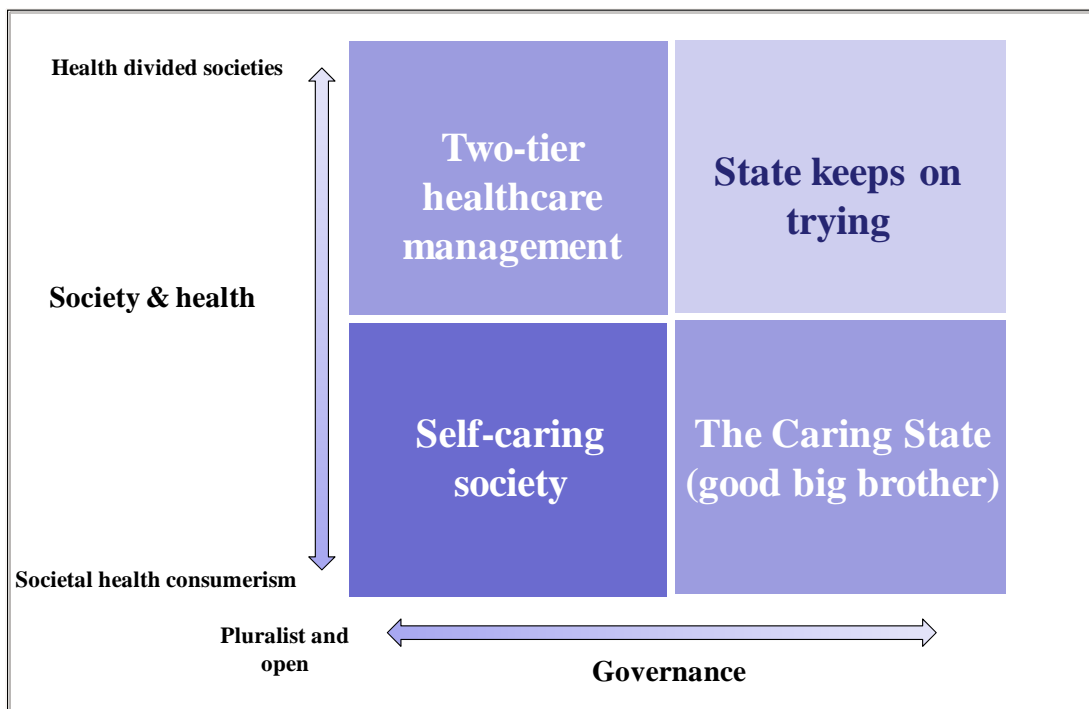
Next we have trends deemed having high impact and high uncertainties not contributing to any of the two key dimensions of uncertainties and also very impactful but low uncertainty trends that were discarded even before the identification of the scenarios axes. Some of these come back in the scenarios descriptions, others are cross-cutting and horizontal to all the four scenarios and, thus, are not mentioned in such descriptions. Nonetheless they are discussed in the final paragraph of this section and they will be considered in the gap analysis and roadmapping. The same applies for technological trends that, as anticipated, will not be included in the scenarios descriptions, for its role will be considered in more details in the gap analysis and especially in the roadmap, regardless of the scenarios to which they are more relevant.

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Figure 12 below reports the four scenarios extracted with some adaptation and liberty from the two key dimensions of uncertainties. It is worth stressing that in using one dimension related to the institutional domain (government and governance) and one dimension related to societal attitudes and behaviours, our approach is fully in line with other recent scenarios exercise focussed more broadly on the future of government (van der Veer 2005; Di Maio *et al* 2005; Codagnone and Wimmer 2007). Despite differences in some methodological aspects, these three scenarios exercise share the fact that one key dimension concerns society and the other concerns the state. In all three of them for what concerns society the dimension of uncertainty focus on broad socio-cultural attitudes, whereas the other uncertainty related to the state, though in different way, focus on the issue of control/intervention.

While following a different and independent methodological and consultation process and focussing on a different topic, we also focussed on society and government and on issues of attitudes, cultures, control and intervention.

Figure 12 Scenarios snapshot



For the sake of brevity and simplicity in communication we termed the axis related to the social dimension as “Society & Health”, although the careful reading of the previous parts of this document should suffice to understand that we mean a broader set of issues, including both health as such and the role of technology, and the attitudes and behaviours related to both. Within this dimension the two possible extremes are: a) societies where health consumerism, confidence in technology and remote treatment with little health professional intervention have permeated 95% of society thus much reducing social exclusion potential problems; b) on the contrary the differentiation existing today has

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persisted and has possibly been exacerbated thus leading to health divided society and raising serious social exclusion problems.

In the institutional dimension the uncertainty is about the extent to which the government will want to maintain and increase intervention and control continuing to be the main payer and provider (through the public institutions and professionals operating at various level), or conversely will open to other players and reduce its involvement and direct control. The two extreme are represented by: a) a pluralist and open governance and delivery with new spaces for third party players, where the government will focus mostly on policy making and monitoring of healthcare outcomes, will reduce its direct financing role, will introduce regulations and measures leading to new financing and business models, will stimulate public healthcare organisations and professional to relinquish their full control on service provision; b) a government dominated governance where the government and its network of healthcare organisations and professional remain the dominant players, where public financing will continue to be the main source of funding along already existing output based models and with closure to third party players confined to very limited niche markets.

The stories and description of the four scenarios depicted in Figure 12 are provided in the following four paragraphs, before of which we add here a synthetic illustration of how the four scenarios differ among each other, starting from the two being on the same side of the governance extreme (pluralist and open) and then going to the two positioned on the other extreme (government dominated).

In “**Self-caring Society**” government withdrawal and an open and pluralist governance is mutually reinforcing with an health consumerist society posing few, if any, social exclusion challenges. In the “**Two-tiers Healthcare Management**” the difference is that a lighter touch government faces a split society and makes the conscious choice of a two-tiers management with a plurality of delivery players and models for the health consumerist segment of society and with government intervention where social inclusion issues persists that cannot be addressed otherwise than through government funded traditional delivery. Note then that healthcare is tiered, but as a result of conscious political choice.

On the opposite site of the governance spectrum, even in the face of an homogenous and cohesive health consumerist society, in “**The Caring State (Good Big Brother)**” for reasons of various nature government retains full control and leverage social conditions to fully develop and use selected technology driven remote PHS. The diffusion of such technologies and strong enforcement of compliance and lifestyle guidance help containing the rising of healthcare costs and, though at the expense of full free choice, can produce benevolent outcome for citizens/patients. On the contrary, in “**State Keeps on Trying**”, which is to some extent a straight line projection of the current situation with worsening elements, the impossibility of leveraging technologies and shape attitudes and behaviours results steeply rising costs and to de facto tiered healthcare in that the quality of publicly provided healthcare worsened and a social gap emerged among those who can or cannot pay for better and more sophisticated services, including remote PHS. It is important to stress the difference between the tiered nature of healthcare under in “**Two-**

tiers Healthcare Management” and in **“State Keeps on Trying”**. In the former it is a conscious choice to cope with social exclusion issues, in the latter is a *de facto* results exacerbating such issues rather than addressing them.

4.2 Self-caring Society

Scenario story

With pervasive health consumerist attitudes and behaviours in a society where digital inclusion is almost complete and confidence in technology high, the government has moved to a steering role (oversees outcomes and stimulate compliances through soft methods) reducing the direct intervention and financing of healthcare except for acute problems and has opened up to a variety of players, who compete for public but decentralised reimbursements provided through an outcome-based model and/or for consumer out of pocket expenditure and thus provide integrated PHS services at competitive prices to consumers/patients taking most health matter in their own hand and at ease with remote technology driven services entailing little intervention from healthcare professionals.

Macro environment

- While the implications of ageing society have become fully visible with increase in chronic diseases and in their co-morbidity patterns and large pool of elderly requiring assistance with neuro-psychological disorders are also on the rise, improvement in prevention and the widely PHS tools available to individuals in their double role of consumer/patients and ‘care consumer managers’ for friends and relatives, together with full digital inclusion and technology confidence, are maintaining the equilibrium of the system and reducing compliance problems among the elderly;
- The government has moved from ‘rowing’ to simply ‘steering’ in a new pluralist and open Networked Governance model where the principle of horizontal subsidiarity is fully implemented. With the exception of acute medicine, other functions are exercised also by private health organisations and by other non health care players especially for the delivery of PHS services, competing with public health care organisations. Government is engaged in strategic policy making, facilitating the processes (privacy, data sharing, standards, interoperability) monitoring and measuring of outcomes, devising indirect control and soft incentives to compliance, all of which has been largely centralised with lower roles for regional and local governments except for the allocation of outcome based reimbursement. As a result the public funding share of healthcare expenditure has decreased, but affordable coverage of the population is maintained through cooperation and competition between public and private players;
- Government, however, will be directly involved in decision, investments and realisation of basic infrastructures favouring the development of innovative technology based PHS and other eHealth applications

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- Healthcare costs are still high after years of rising trends but the trends is stabilised and being gradually reversed, and new public resources have been realised for spending on public health and prevention.

Transactional environment

- Public funding has become decentralised and competitive. Regardless of the different institutional model (NHS or social insurance) the higher level bodies provide fixed budget to lower tier bodies who are free to allocate them according to various scheme and particularly using outcome based competitive reimbursement to public and private healthcare organisations and to third parties. Also public healthcare organisations in turns can outsource some of their tasks and enter into various deals with private players. Willingness to pay and actual out of pocket outlay are increasing for most sophisticated services. Outcome based financing is also used by private insurances signing schemes directly with healthcare providers;
- Public healthcare organisations and their professionals, as well as General Practitioners, have embraced PHS services providing full empowerment to consumers/patients directly or through the intervention of third parties. The new top down standards and inter-operability requirements and the need to open to external private provider and/or compete with them has favoured integration of data systems, which in turn are fostering integrated care solutions at the local level. Benefits are being felt and large public healthcare organisations show a 80/20 patterns, where 80% of less complex matters are taken care by PHS directly entrusted on the citizens/patients or provided by third parties, whereas resources and expertise (naturally with diminished budget) will concentrate on the 20% most critical and difficult cases and on new research;
- Advancement in technological solutions and the new state approach have enabled the emergence of a few large technology suppliers and media companies that, aggregating the services of the many providers populating the value chain, have achieved standardisation, inter-operability and economy of scale. This has mainstreamed earlier niche innovative and very expensive products/services into mass market ones provided at affordable prices.

Users

- They are fully confident in technology, digitally included, and technology-users interaction, if need be, is facilitated bottom up by social intermediaries (family and friends);
- They want to take full part in deciding about their treatment in a symmetric and negotiated relationship with healthcare professionals;
- While increasingly aware and informed, some still represent risks in terms of compliance;
- Are comfortable with remote interaction and willing to proceed with little intervention on the side of healthcare professionals;

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- They are reluctant, except that in most acute conditions, to use invasive and uncomfortable data gathering devices;
- Outcome based competitive public reimbursement reduce exclusion from PHS for the socio-economic disadvantaged;
- Recently retired wealthy baby boomers pays for more sophisticated and advanced PHS services

4.3 Two-tiers Healthcare Management

Scenario story

While social gaps with respect to health consumerism and access to, and confidence in, technologies persist, nonetheless the government has moved to a steering role (oversees outcomes and stimulate compliances through soft methods) reducing the direct intervention and financing of healthcare except for acute problems, and opened to a variety of players competing for public but decentralised reimbursements provided through an outcome-based model and/or for consumer out of pocket expenditure thus providing integrated PHS services at competitive prices to consumers/patients, who take most health matter in their own hand and are at ease with little intervention from healthcare professionals. The gains and savings derived from the approach to the most advanced health consumers, are used to subsidise the other segment of consumers/patients and provide them traditional treatment and specific PHS services with sophisticated inter-face and with the support of professional intermediaries.

Under this scenarios the macro and transactional environment resemble the description provided for the “Self-caring Society” with some variations and additional characterisation. Below for the sake of brevity we only discuss the more peculiar elements.

Macro environment

- With the implications of ageing society fully visible (see description provided earlier in § 4.2) the two-tiers management of healthcare and the related fairly large use of PHS services by the consumerist segment of society help addressing the traditionalist segment while containing the pressure on healthcare but cannot entirely restore the financial equilibrium of the healthcare system;
- The government has moved from ‘rowing’ to simply ‘steering’(see description provided earlier in § 4.2) but has preserved ad hoc funds and delivery mechanisms for intervention where social inclusion issues persists that cannot be addressed otherwise than through government funded traditional delivery;
- The rise in healthcare costs is contained and partially stabilised but no signs of reversing are visible.

Transactional environment

- Public funding has become decentralised and competitive for the delivery of services to the consumerist segment of users (see description provided earlier in §

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- 4.2), but central budget allocation are preserved for the treatment of the traditional segment of users;
- Besides full provision of PHS service by public and private and new players (see description provided earlier in § 4.2), especially public healthcare institutional use ad hoc government funding for delivering services to the traditionalist segment of users;
 - The provision of PHS services to the consumerist users by way of new financing mechanisms (see description provided earlier in § 4.2) has helped mainstreaming earlier niche innovative and very expensive products/services but not in such a way to turn all of them into mass market ones provided at affordable prices. Some remain niche services provided for out of pocket payment only by the most affluent among the consumerist users.

Users

Given the split of society between a segment of health consumerist digitally included and technology confident users and one presenting opposite characteristics the characterisation of users under this scenarios resemble that of “**Self-caring Society**” scenario with the following additional elements:

- The segment of health consumerist and technology confident users are strongly encouraged to use remote PHS services provided by several players and do use them with ease;
- In society there still is a considerable segment of users who have passive attitudes toward health and/or are digitally excluded, and/or are still not confident with technologies and continue to prefer face2face interaction with healthcare professionals. These users rely on traditional treatment provided by publicly funded public or private healthcare organisations;
- The conscious differential treatment of the two segments of society pursued by government attenuate social divides that, however, persist to some extent in relative terms (the consumerist segment having more opportunities than the traditionalist one and within the consumerist the more wealth having more choices).

4.4 The Caring State (Good Big Brother)

Scenario story

Although pervasive health consumerist attitudes and behaviours became dominant, the outbreak of acute crisis management have led the government to retain and increase control and direct financing and production of all healthcare services including PHS and reach high level of public financing of healthcare expenditure with little, if any, reliance on private players. Additionally the state enforce through hard incentives as a social responsibility healthy lifestyle and monitoring onto consumers/patients and aims to leverage and shape consumerist attitudes by fully controlling some prioritised PHS, placing high emphasis on compliance with treatment and lifestyles prescribed by healthcare professionals.

Macro environment

- With the implications of ageing society fully visible (see description provided earlier in § 4.2) government controlled and provided PHS services focussing mostly on ensuring compliance and in monitoring acute conditions help containing the pressure on healthcare but cannot entirely restore the financial equilibrium of the healthcare system;
- The government directly and through its various healthcare institutions takes the full responsibility for the health status of its citizens, at all levels. Healthcare is funded for above 80% by public money, gathered through the general tax system. Except for the case of the elderly with ability problems, strict rules sanction non compliance to treatment and lifestyle guidance, excluding the non compliant from public funding of certain treatment and requiring from them cost-sharing for others. Inter-operability, guidelines, and standards for the provision of PHS are strictly dictated from the centre that monopolise the management of PHRs, not inter-operable and open to third parties players such as technology suppliers and media companies;
- Centralised government control and direct intervention in many domains bring about positive outcomes in terms of inter-agency integration and also of integration across social support, primary, secondary, and tertiary care, with healthcare organisations and professionals resistance overcome leveraging against them the expectations and needs of citizens/patients for seamless and technology supported services. Inter-mediate government tiers such as regions and local governments loose power;
- The trend of rising healthcare costs is contained but not reversed, despite efforts to curb non compliance and to enforce healthy lifestyles;

Transactional environment

- Public funding remains centralised, with a limited role for private insurance and the out of pocket outlays remaining of the same level as in the past. The prioritised PHS services provided by public healthcare organisations are directly financed by central government;

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- Public healthcare organisations and their professionals, as well as General Practitioners retain full control of government funded PHS services, without any third party intervention and without relinquishing control in favour of consumers/patient empowerment. While some resistance still remain, government enforcement leads to integrated care solutions in limited areas, mostly aiming at early diagnosis compliance and enforcing healthy lifestyles;
- Despite top-down inter-operability and emphasis on some specific PHS applications, the PHS market taken in its entirety is not mainstreamed and remains fragmented into niche each dominated by few preferential providers of public institutions. In parallel a market develops based on PHRs voluntarily provided by consumers to large technology and media companies providing also PHS services , whose scale is such that prices remain high and cater wealthy individuals able to pay for them.

Users

Users present the same characteristics described in the “**Self-caring Society**” scenario with the following additional characterising elements:

- Most citizens/patients tolerate the benevolent but intrusive and limiting approach of government in exchange to the wide and affordable coverage it provides also in terms of PHS services. While reluctant, under certain conditions, they even accept PHS services based on invasive and/or uncomfortable data gathering devices;
- Those most independent an interested in taking health in their hand resort to advanced web tools for information and self-diagnosis provided by non public actors as well as to web 2.0 and community of interests;
- Affluent in the age group 45-55 and recently retired wealthy baby boomers pays for niche PHS services (different from those provide by the government) delivered by private players, while socio-economic disadvantaged individuals are fully excluded from PHS services other than those prioritised and provided by the government;

4.5 State keeps on trying

Scenario story

Social gaps with respect to key dimensions (health consumerism, access to, and confidence in, technologies) have persisted (constraining take up and mainstreaming of PHS and other eHealth innovations), the role of government related healthcare institutions and basic financing mechanisms have not changed but rising costs are de facto eroding the full public coverage of the population, with PHS services consolidated into a niche consumer electronics market and paid for by out of pocket outlays, thus sharpening social divide between those who can and those who afford them, although acute resources shortages have led to increasing deployment of a few PHS systems especially for long term care of the elderly being financed out of the public budget.

Macro environment

- With the implications of ageing society fully visible (see description provided earlier in § 4.2) and given little innovation and limited take up of PHS healthcare systems are under strong pressure;
- The government directly and through its various healthcare institutions remains the main player and funder of healthcare, although public budget crisis are slowly but gradually *de facto* eroding public coverage of the population, with quality of care varying widely across the system and increasing problems of access and waiting lists, forcing increased out of pocket expenditure and the adoption of private insurances. The government has difficulty to enforce issues of interoperability, guidelines, and standards for the provision of PHS, though pilot projects and some local specific developments consolidate for some specific applications;
- Fragmentation increases both in verticals terms (across tiers of governments) and within the different tiers of healthcare (GPs, primary, secondary, etc).
- Growth rates in healthcare cost are no longer sustainable and the government is forced to reduce overall amount of funding while still trying to preserve universal coverage, which leads in practice to rationing and high variability in quality of publicly funded/provided care;

Transactional environment

- With public funding *de facto* eroded and affecting average quality and access, besides out of pocket expenditure, regional bodies and/or large healthcare organisation are testing localised agreement with private insurances to cover some segment of their population of reference. Even public healthcare organisation increasingly provide special services and treatment for out of pocket payments;
- Public healthcare organisations and their professionals, as well as General Practitioners still show resistance to PHS and little signs of integrated care. On the other hand increased workloads and acute shortage especially of nurses and other staff needed to care for patients recovering from sever conditions and for severely

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impaired elderly in need of steady assistance pushes them to adopt some specific PHS solutions in cooperation and partnership with technology suppliers;

- The consumer electronic models directly paid by consumers/patients consolidate but is not enough for the mainstream of the market still characterised by niche players fragmentation and high prices affordable only by the more affluent segment of society.

Users

Users present the same characteristics described in the “**Two-Tiers Healthcare Management**” scenario with the following additional characterising elements:

- Within the segment of health consumerist and technology confident users the more affluent pay for the limited PHS services available in the consumer electronics market
- Within the segment of non consumerist and more traditionalist users, the wealthy pay for higher quality services provided by private organisation or by public organisation outside of publicly funded schemes, whereas the less affluent must relying only on the traditional services publicly funded, adapting to varying quality and waiting lists;
- The elderly and those in need of long term care are forced to accept technology based solution given lack of carers paid by public financing and of means to pay for private carers;
- Those presenting the characteristics of full health consumerism described in the “free choice self-care” scenarios and capable of paying use the limited services available in the consumer electronics market;
- Social divides are evidently increasing.

4.6 Cross-cutting trends, common elements, technology

First, we must recall very important and impactful trends that have not been used in the extraction of the key dimensions of uncertainties and have not been used in any one of the specific scenarios, for they cut across and are relevant to all of them.

These trends are emerging developments that most likely will continue in the future and, though they could not be used in the characterisations of the scenarios, they will be considered as sources of gaps and research themes and are listed here with some preliminary considerations on the kind of technological needs they call for: Some of the technology elements characterising the four scenarios addresses some of these trends, but two are left out and it is worth indicating the characterising technology here:

- Increased chronic disease prevalence calling for continuation and improvement of existing products and pre-competitive research in the chronic disease management application area;

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- Rising co-morbidity among chronic patients calling for early diagnosis and multiple diseases monitoring systems relying on advanced sensors and data processing and integrated across the healthcare tiers (primary, secondary, tertiary care);
- Increasing incidence of neuro-psychological disorders calling for new PHS systems capable of gathering and analysing through multiple signs sensors data going beyond physiological and physical parameters and capturing context, activity, emotional and social interaction data;
- Increasing need of long term care calling for robotics and ambient intelligence;
- Worsening energy crisis forces energy efficient treatment in healthcare, calling for PHS based on energy saving data gathering and communication systems

Second, except for the “**State Keeps on Trying**”, among the other three different scenarios, one can identify common elements, though depending on different purposes and characteristics of the system depicted within each envisaged scenario:

- A shift of power from regional and local tier of government back to the central level. In both “Self-caring Society” and “Two-Tiers Healthcare Management” this is due to the increasing importance of third party players and the need of government to better define policies, set rules and standards, monitor and measure. In “The Caring State” the driver comes from more efficient control through integration.
- Again for evidently different reasons, there is a trend toward integrated care delivery;
- Data analytics and intelligence and measurement and monitoring of health conditions and how they vary with delivery are key in all three scenarios.

Finally, we can provide a very preliminary list of differentiated technological needs by scenarios. This was elaborated by the project team prior to the Pisa consultations events and does not reflect the initial discussion of gaps conducted there, which will be the object of the Gap Analysis Report to be delivered at the end of August 2008. This preliminary list is reported below:

Self-caring Society

- Innovative measurement systems to support outcome based reimbursement based on integration between PHS generated data and larger public health data bases;
- Use of simulation and predictive technology (Decision Support Systems) both for policy making and for healthcare provision based on multi-data integration;
- Patient decision aids system to support self-diagnosis and negotiated decision and channel consumers/patients toward compliance;
- Fully inter-operable and integrated consumer controlled PHRs and PHS ensure that gathered and processed data , directly communicate with, and update the patients’ electronic files.

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Two-Tiers Healthcare Management

Same as above with, in addition, two development that can help users in the traditionalist segment move toward the attitudes/behaviors of the consumerist one:

- Use of sophisticated human interactions technology complement some PHS services;
- Digital TV based PHS services.

The Caring State

- Sophisticated all encompassing sensors (that are actuators of medication) are used to manage disease and ensure compliance;
- Strict software supported care pathways guide PHS services requiring integration of different health care tiers/specialty (software systems coordinate the activities of all the health professionals responsible for the treatment of a patient and aligning delivery to best practice guidelines)

State Keeps on Trying

Both of the two needs below respond to the shortages of professional resources envisaged under this scenarios, leading to the adoption of these PHS applications despite unfavourable conditions:

- Advanced robotics for rehabilitation after severe and acute conditions provided by public healthcare institutions to the less financially capable patients;
- Ambient intelligence for monitoring and independent living provided by public healthcare institutions to the less financially capable impaired elderly.

5 Next step: from scenarios to gaps

The next step consist of the gap analysis that, starting from the input provided during PHS2020 2nd Consultation Workshop of Pisa (July 15 2008), will perform a systematic comparison between the scenarios and the state of play and will:

- **Identify issues common to state of play and scenarios** where current research will not meet future needs or must be continued in order to meet them;
- **Identify lacking issues**, which are not mentioned in the state of play but emerged in the visionary scenarios for 2020. These are emerging issues not addressed at all in current research;
- **Formulate gap and provide a preliminary assessment**, the two types of issues identified are formulated as gaps and assessed according to their impact and relevance on the major factors shaping the successful spreading of PHS

Once this is accomplished, then the final cycle of consultation for the production of the roadmap will be launched and aims with the contributions of experts and stakeholders to:

1. **Assess and prioritise the identified gaps.** The participants will be provided with a very short and brief questionnaire to score the gaps while the brainstorming discussion on them is ongoing. As part of the discussion they can also add new gaps and also assess them. At the end of the various workshop a consolidated list of prioritised gaps all assessed as highly relevant will be produced.
2. **Identify and develop research themes and actions.** Group discussions in the workshops will be used to develop important themes for future research in PHS. Groups will be formed based on their interest and expertise and given the task of proposing research themes and related actions only on a limited set of gaps not all gaps . For the most important research themes, research actions and means of implementing the actions must be formulated.
3. **Phasing the proposed research themes and actions.** The proposed research actions will be phased into a time scale of short-term (2009-2010), medium term (2011-2015) and long term (2016-2020) implementation.

As stated, the goal is that of producing recommendations to the Commission on which research themes should be funded in the domain of PHS within FP7 from 2011 till 2013 and in FP8 from 2014 till 2020.

In this respect we close with a final considerations on the limits inherent in any foresight exercise and on the efforts needed on the side of the project team in drafting the Gap Analysis Report and in managing the next consultations events to partially overcome such limits.

The literature on foresights contains the disclaimer that there is always an inevitable bias which may prevent from capturing the future: every expert participating in a foresight

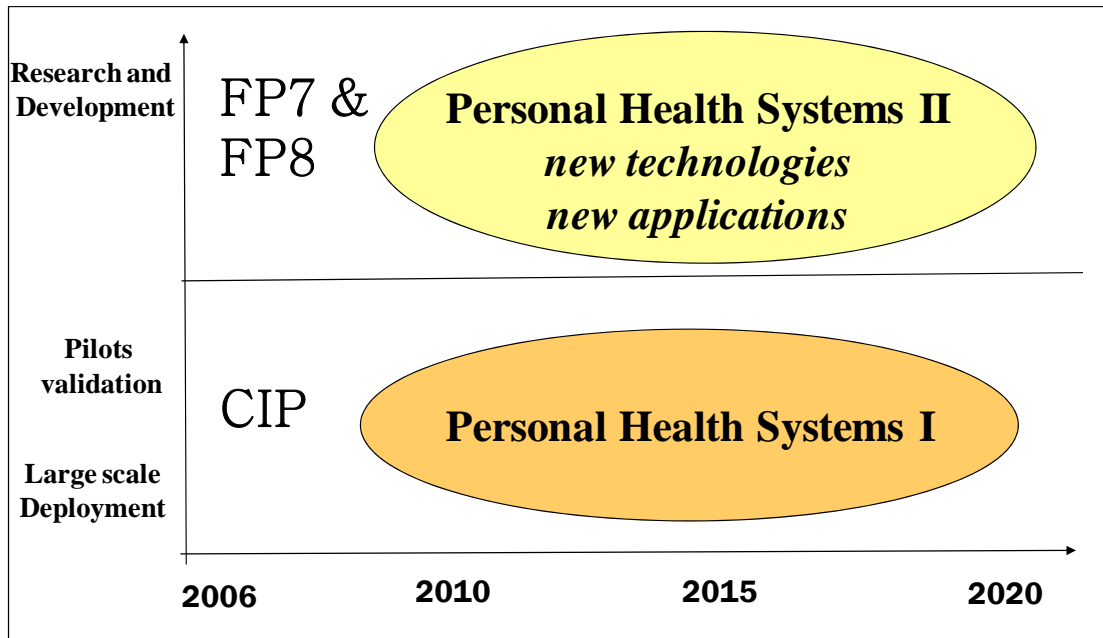
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exercise reflects on his or her past and current knowledge of actual developments and from there extrapolates his or her view on potential futures and needed actions.

We have seen an exemplification of such bias in the emphasis that experts participating to the consultation events have placed on socio-economic and socio-institutional and organisational factors, as these are the key challenges and barriers they experience and observe currently. This emphasis is also visible in the preliminary gap analysis discussion conducted during PHS2020 2nd Consultation Workshop.

Such tendency if left unchecked can prevent us from really thinking out of the box and providing input to the upper part of Figure 13 below.

Figure 13 PHS the way ahead



Source: Presentation delivered by Dr. Loukianos Gatzoulis at PHS2020 2nd Consultation Workshop, 15 July 2008, Pisa

Identifying gaps and needed actions in the socio-economic and institutional domains is also a side outcome of PHS2020 that can feed into the lower part of the figure, namely providing suggestions for pilot validation and large scale deployment of first generation PHS within the CIP activities. Yet the core outcome is providing suggestions for research that will support the development of second generations PHS, that is entirely new research on new technologies and new applications and/or refinement and continuation of existing research. In drafting the Gap Analysis Report and in managing the next round of consultation, while we are aware that the implicit bias of extrapolating current experiences into the futures can never be turned off fully, we will strive to relieve and neutralise our analysis and the consultations discussion from past and current states to think out of the box in terms of futuristic technologies, whose development FP funded research can support.

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