



Home Care 2041: Signals from the Future

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Abstract. Technological evolution has made available tools capable of connecting the patient to treating doctors and health facilities for ordinary activities and carrying out medical investigations directly at the patient's home, thanks to increasingly sophisticated devices.

The restrictions on the movement of people due to the COVID-19 pandemic have encouraged the use of tools already available to doctors and patients but have also accelerated the development of ongoing projects. The Italian Society of Ergonomics and Human Factors SIE has created a multidisciplinary working group that has tried to imagine the shape of home care in the next twenty years. The study is based on integrating the "Human-Centered Design" and "Strategic Foresight" processes. According to their skills, the eight researchers have tried to identify the trends that will most influence the future, designing the possible scenarios in which home care will take place.

Keywords: Ergonomics · Human factors · Human-Centered Design · Strategic Foresight · Home care

1 Introduction

1.1 International Background

Traditionally, when we talk about "care" within the welfare system, we mainly refer to the pursuit of reducing and/or eliminating the state of the malaise of a population through the implementation of a complex system of services and interventions toward

the people themselves. In recent decades, however, we witnessed a shift in focus towards promoting healthy conditions rather than focusing exclusively on eradicating the causes of illness.

This change of focus takes place in a global context in which we are witnessing the development of various factors such as the change in demographic dynamics [1, 2] and in the health care needs of the population with an increasing number of older adults and/or people with chronic pathologies [3].

The experience of the restrictions resulting from the pandemic situation that society has had to face makes it clear that the network of personal services needs to be reorganized in order to strengthen the possibilities of territorial care. In this sense, technological innovations (both in the health and non-health sectors) are fundamental for developing a personal support and care network.

Therefore, we are dealing with “emerging technologies that cause disruptions to the current operating models of governments and enable innovative solutions, both for public policies and for the provision of goods and services, as well as for the socio-economic context in general” [4].

Technological development has a substantial impact on both the social and economic spheres, especially on health organization policies. The recent pandemic has favoured the proliferation of new digital tools, implementing both the knowledge and the use of them by health service operators and users in the various stages of treatment. We refer to the development and diffusion of Telemedicine practices [5–7], defined according to the guidelines of the World Health Organization as “the provision of care and assistance services, in situations where distance is a critical factor, by any health worker through the use of information and communication technologies for the exchange of information useful for the diagnosis, treatment and prevention of disease and trauma, for research and evaluation and for the continuous training of health personnel, in the interest of the health of the individual and the community” [8].

This method of access to care, therefore, offers, as far as the users of the service are concerned, the possibility of keeping their medical parameters under control by accessing their online health records, thus allowing the constant monitoring of their state of health and encouraging active participation in prevention and health implementation. On the other hand, as far as the provision of health care by doctors and health care personnel is concerned, this method offers the possibility of accessing more advanced equipment that favours a multidisciplinary approach tailored to the individual characteristics of the patient/user, from diagnosis to treatment and subsequent follow-up. However, it should be specified that these services should not be regarded as a replacement for the doctor-patient relationship but as an improvement and streamlining of that process. The risk, in this sense, is a shift of focus from the person’s centrality to digital and technological development.

It follows that it is necessary to bear in mind that when we talk about “care”, we are mainly referring to a “care relationship” in which the main actors are the doctor and the patient, who actively collaborate in the development of the psycho-physical wellbeing of the subject in the totality of the elements that constitute and promote it. From this point of view, it is essential to analyze the social, environmental, technological, political and economic elements that determine the evolution of healthcare organizations. This

process aims to hypothesize the possible and future scenarios of the care services and initiate beneficial choices and actions to implement and apply in the care process.

Therefore, the main objective of the research project is to create a transdisciplinary synergy, from healthcare professionals to researchers and developers of new technologies, to anticipate the risks, possibilities, and impact of technological development in the field of care. The overarching goal is to favour the cultural development towards innovation, keeping the people at the center, and promote the development of technologies capable of positively impacting the future of care.

In this paper, we describe the methodology used and the objectives achieved during the research programme promoted by the Italian Society of Ergonomics and Human Factors (SIE) and the World Usability Day (WUD), whose objective was the definition of a preferred scenario for home care in the next 20 years, through the integration of Human Centered Design and Strategic Foresight.

2 Material and Methods

2.1 Human-Centered Foresight Project

The Human Centered Foresight Project (HCFP) started between July and September 2021, with the establishment of the research team (8 experts on different drivers and two experts in Human Factors and Ergonomics).

The researchers were selected among the Italian Society of Ergonomics and Human Factors (SIE) members and external professionals in the field of home care. The requisites for participating in the project were two: i) having work experience in the social, economic, technological, environmental and political sectors as driving forces behind all change; ii) having work experience in health and personal care.

The project aims to answer the question: How will technology change people's home care in the next twenty years?

With the aid of the researchers involved, the project aspires to question and lay the foundations for a people-centered culture of innovation capable of driving the design of technologies that will positively impact the future of home care.

The researchers developed a new methodological process, hybridizing "Human-Centered Design" and "Strategic Foresight", to codify it in an effective and efficient methodological specification.

The project was developed through 7 workshops, each with the duration of eight hours:

1. *Future Literacy and Past Analysis*: presentation of the Strategic Foresight methodology, key concepts, historical drivers and new forces for change;
2. *Trend Analysis*: Horizon Scanning phase, identification of current relevant trends, counter-trends, weak signals and stability factors;
3. *Cross-Impact Analysis & Scenarios Development*: weighting the cross-impact of the identified trends, counter-trends, weak signals and stability factors and development of future scenarios considering the cross-impacts of trends, counter-trends, weak-signals and stability factors;

4. *Objectives and Critical Factors*: identification of 4 possible scenarios, identification of the preferred scenario and the objectives to be achieved, development of a road map using the “three horizons” method;
 - WudSIE2022: involvement of experts;
5. *Follow Up and Validation*: revision of the scenario and road map based on the experts’ findings, identification of a defined scenario and road map as the output of the table;
6. *Conclusion*: examination of the concepts, comparison of possible new “inspirations”, final validation of the results, fixing the modalities of production and communication of the results (report).

The process included an intermediate step for checking the results elaborated in the first half of the project. This was done during the WudSIE2021 event, presenting the future scenario to 2041. In this phase, a team of 8 experts on the different drivers (society, economics, technology, environment and politics) plus two experts in Human Centered Design were added to support the project, who provided feedback regarding the desirability and feasibility of the identified future scenario.

The experts’ feedback was used in the last two workshops for developing the final scenarios as the conclusive output of the project.

3 Results

This section outlines the results of the HCFP process.

The first workshop focused on introducing the methodology to the project researchers. A practical retrospective activity was carried out to analyze the historical drivers and forces of change over the past twenty years. The researchers were able to familiarise themselves with the Strategic Foresight methodology, analyzing the events that have shaped the world as we know it, namely the historical events that occurred in the last twenty years and how they have changed the way we live. In this phase, the focus was on society at large and not only the domain of home care.

The second workshop focused on the Horizon Scanning phase. The researchers carried out individual investigations and analyses between the first and second workshops. Elements that could impact the world of home care over the next twenty years were identified. Results of individual investigations were then shared during the workshop itself. The identified elements were systematized into a diagram to identify rising and downwards trends (Table 1). The researchers identified potential counterforces for each trend. In addition, researchers also identified “weak signals” (i.e. new ideas, issues, or technologies that are currently “under the radar” but could develop into relevant drivers of change) and “stability factors” (i.e. elements of the current society that will slow or prevent changes).

The third workshop started with the so-called cross-impact analysis phase. Firstly, the researchers reached an agreement on which elements collected in the Horizon Scanning phase had to be included to build the preferred future scenarios. The researchers then analyzed if and with what magnitude these factors could impact each other. The identified trends, counter-trends, weak signals and stability factors were then entered into a matrix table, and each crossing was assigned an impact value ranging between -3 and +3. This

Table 1. Trends analysis: horizon scanning

	Drivers of change	Counter-trends
Rising trends	BlockChain Robotics and Exoskeletons AI New migratory flows Energy: photovoltaic - wind - electricity Smart home - Smart cities -5G Health policies New foods Search for solutions to climate change Request for self-determination at the end of life Ageing Gamification	Bitcoin rejection (El Salvador, China) Rejection (fear) of workers / trade unions Taxation of robots Closing the borders Environmental movements - land availability Absence of public incentives - deductions Vegans - vegetarians - slow food Denial of the climate problem Legal limits EU push for regulations and bans
Downward trends	“Physical” Iteration - Appointments in presence.“ Energies: methane / LPG Traditional family Use of cash Physical stores Landline phones Quality/accessibility to water Paper books	Physical iteration requests increase Electricity cost increase Limits to “rainbow” families Limits to access to means of payment Game stop

Table 2. Clusters resulting from the cross-impact analysis

	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Factors included in the cluster	Gamification Circular Economy Smart Homes Alternative energies Environmental policies	Religious/cultural extremism Poverty Transport drones New pandemic viruses New economics concepts	Transhumanism Circular Economy Intelligent Robotics Alternative energies New economics concepts	Religious/cultural extremism Circular Economy Intelligent Robotics Alternative energies New economics concepts

analysis resulted in four clusters of factors. Each cluster composes a possible scenario to be developed. Figure 1 illustrates the selected factors and the cross-impact weightings assigned by the researchers, while Fig. 2 shows the resulting clusters.

	A. SOCIETY					B. ECONOMICS					C. TECHNOLOGY					D. ENVIRONMENT				E. POLITICS								
	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6	D1	D2	D3	D4	E1	E2	E3	E4	E5	
A. SOCIETY																												
- A1 Population decline						0	2	2	-1	0	1	0	1	0	0	1	0	-2	-2	-2	0	0	2	0	0	1		
- A2 Transhumanism						1	0	2	0	3	0	1	2	2	2	1	3	-1	0	0	1	1	1	0	1	2		
- A3 Body positivity						0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	2		
- A4 Gamification						0	0	1	0	2	0	0	1	1	1	0	1	0	0	0	0	3	0	2	0	0		
- A5 Religious/cultural extremisms						0	-2	-2	-2	-2	3	-3	-3	-3	-3	-2	0	0	0	-2	-3	-3	-2	2	-3			
- A6 social differences						-2	3	3	0	3	3	0	0	0	0	0	0	2	0	0	0	-2	2	-2	2	2		
B. ECONOMICS																												
- B1 Microenterprise System	0	0	0	1	0	-2						1	1	1	1	1	1	0	0	0	1	1	2	0	0	-1		
- B2 Universal Basic Income	0	0	0	0	-2	-2						0	0	0	0	0	0	0	0	0	0	0	-2	0	2	-2		
- B3 Circular Economy	0	0	0	0	0	-1						1	1	1	0	1	0	0	-2	-1	3	0	0	2	2	0		
- B4 New natural resources	0	0	0	0	0	0						1	1	1	0	1	0	3	0	2	-1	0	0	-1	0	0		
- B5 Power of corporations	0	2	1	2	2	3						2	3	2	2	3	1	0	2	2	3	-2	1	-2	-3	1		
- B6 Poverty	2	0	2	0	3	3						0	0	-2	0	0	0	3	0	0	0	-2	3	-2	1	2		
C. TECHNOLOGY																												
- C1 Quantum computing	0	2	0	1	0	0	0	0	0	0	2	0						0	0	0	0	0	0	0	0	0		
- C2 Smart Robotics	0	2	0	2	2	2	2	2	2	0	3	2						0	0	0	2	0	0	1	2	0		
- C3 Smart Home	0	1	0	2	0	0	2	0	2	0	1	0						0	0	0	0	0	1	0	0	0		
- C4 Domotics Blockchain	0	1	0	0	0	0	0	0	0	0	2	0						0	0	0	0	0	0	0	0	0		
- C5 Unmanned Transport	0	0	0	0	0	0	2	0	0	0	0	0						0	0	0	0	0	0	0	0	0		
- C6 Deepfake	0	0	0	1	0	0	1	0	0	0	0	0						0	0	0	0	0	0	0	0	0		
D. ENVIRONMENT																												
- D1 New pandemic viruses	2	0	0	0	3	3	-1	3	0	0	2	3	0	1	2	1	3	0					1	1	1	2	2	
- D2 Water shortage	3	0	0	0	3	2	-1	0	3	0	1	3	-2	-2	-2	-2	-2					0	0	3	3	1		
- D3 Increase in negative natural phenomena	3	1	0	0	3	3	-1	1	2	1	1	3	0	2	0	0	2	0					0	1	3	2	1	
- D4 Alternative energy resources	0	0	0	0	1	0	2	0	3	0	1	0	2	2	2	2	2	0					0	0	2	1	1	
E. POLITICS																												
- E1 Health literacy	-1	0	1	0	0	0	1	0	0	0	-1	0	0	0	1	0	0	0	-1	0	1	0	0	0	0	0	0	
- E2 Increased services to families	-1	0	0	-2	-2		-1	-1	0	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
- E3 Environmental policies	-1	0	0	0	1	0	0	0	2	0	-1	1	1	2	2	1	2	0	-1	-1	-2	3	0	0	0	0	0	
- E4 New models of economics/ownerships	-1	0	0	0	-1	-2	1	2	2	0	-2	-3	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	
- E5 Health related associations	-1	0	1	0	0	-1	1	0	1	0	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Fig. 1. Weightings of the Cross-impact Analysis

After the cross-impact analysis, the third workshop saw the development of possible future scenarios. Each researcher was asked to choose one of the four clusters identified in the third workshop. Then, based on the selected cluster, each researcher had to develop a preferred scenario using a storytelling methodology. The developed scenario had to show and clarify the interactions between the various cluster elements for each identified driver. Simultaneously, a survey for experts was developed. The survey aimed to check the result of the second and third workshops against the judgments of a pool of experts belonging to the WUD group. The results of the qualitative questionnaire were later used to complement the researchers' work.

In the fourth workshop, the researchers selected one scenario according to two criteria: highest preferability and presence of the highest number of trends analyzed in the previous workshops. The selected scenario was labelled as the "Preferred Scenario". Then, on the basis of the "Preferable Scenario", a set of requirements was identified for the five drivers. On the basis of the requirements, the steps for the realization of the scenario were identified, i.e., the objectives linked to the requirements and critical factors for the achievement of each objective.

The WudSIE2021 event was the last step of the first phase of the research. As mentioned in the method section, it helped gather feedback on the results and encouraged a discussion about the identified objectives.

In the fifth workshop, a follow-up and validation of the researchers' output were conducted. In particular, the Preferable Scenario, its requirements, and critical factors were adjusted according to the experts' comments and feedback gathered through the survey and during the WudSIE2022 event. This allowed progressing to another crucial step of the project, the development of a road map for reaching the Preferable Scenario. The road map consisted of a series of steps, distributed across the five drivers, that should

be achieved within the next 20 years to reach the Preferable Scenario. The roadmap was considered the basis for the definition of the system architecture.

Finally, the last step involved the definition of the system architecture, which, during the SIE Conference “Ergonomics and Nudging for Health, Safety and Happiness”, was helpful in the working group of designers to graph the preferred scenario proposed by the group of researchers.

Six system architectures were provided to the designers (see Fig. 3), divided in time: Scenario 2024, Scenario 2026, Scenario 2029, Scenario 2031, Scenario 2036 and Scenario 2041.

The realization of the objectives, identified with the letters T (technology), S (society), A (environment), E (economics) and P (politics), allowed the researchers to define

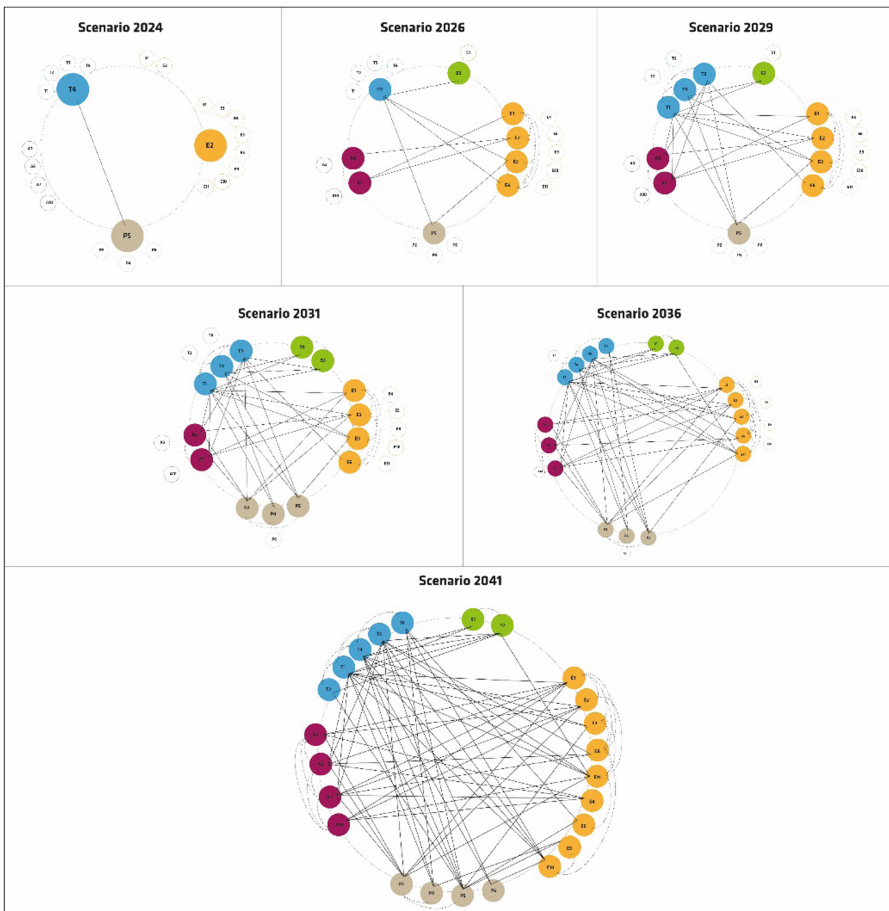


Fig. 2. System architecture, scenario 2041

time divisions. During the workshop phase, the researchers asked themselves two questions: i) How long does it take to realize each objective? ii) How do the objectives relate to each other?

As shown in Fig. 2, the various time steps, and the various relationships between objectives, allow for the definition of a complete and accurate short- and long-term preferred scenario.

4 Discussion

Starting from the “Strategic Foresight” methodology, the global changes of the last 20 years were analyzed concerning the topic of investigation: technological progress, innovative ideas and values, behaviours and expectations, previously unpredictable changes, identifying the “historical” drivers that led to the current situation and identifying the “historical” drivers that are still current. Then we identified the new “forces” of change (e.g., new technologies, new potential policies, new ideas or concepts, etc.), considering the social, technological, economic, environmental, political context. In the so-called “Horizon Scanning”, we analyzed trends and counter-trends, hypothesizing their present and future impact and outlining the basis of the Preferable Scenario.

The process has allowed us to assume that, in order for the technological implementation to maintain people at the centre of the care system, understood as a bio-psycho-social system [9], it is necessary that, as of now, inter-professionalism, both health and technological, initiate solid and constant collaborations. In order for this to happen, it is necessary to initiate changes in organizational paradigms of social and economic policies. This implies a greater awareness of the influence that the areas analyzed can develop reciprocally. If, on the one hand, the political and economic class needs to initiate concrete organizational choices of wide-ranging development and actions to consolidate what already exists, on the other hand, it is necessary to implement new health and social culture among users and operators in the sector by developing training and information activities on all the aspects inherent to the implementation of the research project.

At the same time, it is necessary to develop innovative technologies that are easy, both economically and technically, accessible to the target group and specialists. Fostering greater awareness of the circularity of events, the so-called One Health, is based on recognizing that human health, animal health, and the ecosystem’s health are inextricably linked.

The holistic One Health vision [10], i.e., a health model integrating different disciplines, is ancient and current. It is an ideal approach to achieving global health because it addresses the needs of the most vulnerable populations based on the intimate relationship between their health, the health of their animals and the environment in which they live, considering the broad spectrum of determinants that emerges from this relationship. The Italian Ministry of Health officially recognizes it, the European Commission, and all international organizations as a relevant strategy in all areas that benefit from collaboration between disciplines (doctors, environmentalists, economists, sociologists, etc.).

5 Conclusions

The construction of future scenarios on the theme of home care is of broad interest also outside the health sector. It is linked to various aspects and categories of products and services, from the furnishing of the home, where data collection and monitoring technologies will have to be integrated, to the professionalism of health workers to be developed to bring the most appropriate skills into the home.

At the same time, transport and communication systems will also have to be aligned with the new modes of interaction. This requires the construction of comprehensive, accurate, feasible and desirable future scenarios using Strategic Foresight and Human Centered Design methodologies, which can be the basis for political and economic decision-making processes. As a result, companies can implement strategies in the short term and be ready for the envisaged future by providing services and products adapted to society's future needs and requirements.

The boundaries drawn by humans on maps lose their meaning in the face of modern global challenges posed by climate, health, and an increasingly interconnected world. Considering ourselves as extraneous elements of the ecosystem has meant that we significantly alter 75% of the earth's surface and 66% of the seas and oceans, often without respecting their balance [11]. We are elements of a single system, in which the health of each human, animal or environmental element is closely interdependent with that of the others: this is the heart of the One Health approach, which promotes integrated management in the field of public health, and which must become the overall vision to be developed at all levels of decision-making.

It is also necessary to renew education and training courses, which primarily operate in watertight compartments and have little dialogue, limiting the development of a circular culture where the "contamination" of skills becomes increasingly important.

Understanding how much the health of living beings on the planet increasingly requires an integrated approach is enough to observe the decrease in emissions in China and Italy, a direct consequence of the restriction on the free movement made in the two countries for the Coronavirus. Integration, the sharing of programmes, organizations, training and technologies, may be the only way forward so that there are no winners or losers, but only a more balanced ecosystem, capable of conserving valuable resources, with a greater capacity for social, political, health and economic inclusion, and able to provide adequate responses to the present and future needs of the population.

Finally, the added value of this research project is the involvement of companies and professionals already working in specific fields and who are developing innovative systems and solutions not yet available to the public or limited to small contexts but which is a desirable and not so distant future will become easily accessible and widespread.

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