

**White paper - Innovation Think Tank at University of Evora**

# **Co-creation on Active Aging Challenges in Portugal**

**Trends, disease pathways, technologies & innovation best practices**

**July 2022**

# Co-creation on Active Aging Challenges in Portugal

Sultan Haider<sup>1</sup>, Lino Patricio<sup>2</sup>, Ana Costa Freitas<sup>2</sup>, Filipe Ribeiro<sup>2</sup>, Ana Telles<sup>2</sup>, Carlos Silva<sup>2</sup>, António Guerreiro<sup>2</sup>, David Neves<sup>3</sup>, Ivan Franca<sup>4</sup>, Carlos Parente<sup>4</sup>, Filipa Baptista<sup>4</sup>, Apoorva Goenka<sup>5</sup>, Niharika N<sup>5</sup>, Mohd Ibney Ali<sup>6</sup>, Jayati Vasavada<sup>6</sup>

Innovation Think Tank, Siemens Healthineers, <sup>1</sup>Erlangen, <sup>5</sup>Bengaluru, <sup>6</sup>Gurgaon

<sup>2</sup>University of Évora

<sup>3</sup>Espirito Santo Hospital

<sup>4</sup>Siemens Healthineers Portugal

## Abstract

With a rapid increase in aging population worldwide, there is a need to ensure good health and wellbeing for the elderly. Healthcare system in Portugal supports opportunities and addresses challenges of its aging population by well-maintained associations between its government and private institutes. In order to stimulate an innovation ecosystem in the region, Innovation Think Tank (ITT), a part of Siemens Healthineers (SHS), has been actively engaging in various interdisciplinary projects by collaborating with local healthcare institutions. Following an invitation from the University of Evora and SHS Portugal, ITT at Evora was institutionalized. As a part of this association, a certification program was organized at Evora University, in association with Espirito Santo Hospital, Portugal. The goal of this program was to 1) train the participants on the ITT methodology 2) capture and validate healthcare trends and solutions concerning aging challenges in Portugal 3) deep dive and tackle the most prominent healthcare and aging challenges in Portugal with a focus on five key areas of Lifespan and Health, Lifespan and Demographics, Lifespan and Arts, Lifespan and Ethics & Citizenship, Lifespan and Economy.

Over 30 multidisciplinary participants comprising of researchers, students, professors, industry leaders, and entrepreneurs, representing over 20 hospitals, universities, and consultancies worldwide participated in this two-week hybrid program where they learnt to apply the innovative thinking approach by working on real life problems and proposed solutions with a focus on the aging challenges and future of healthcare in Portugal. The consolidated results were presented at the outcome exhibition which included a feedback session and panel discussion with healthcare experts from Portugal and other locations worldwide. The overall outcomes of the program comprised for the definition of some of

the research areas for the Lifespan Chair, academic training proposals and community intervention proposals. With its global network and infrastructure, ITT envisions to boost future research at the university, and hospital by collaborating in projects that impact the future of healthcare in Portugal and globally, as well as identifying grants and partners for implementation.

**Keywords: Innovation Think Tank, University of Evora, Portugal, Hospital Espirito Santo, Siemens Healthineers, Healthcare System Framework, Aging Challenges, Lifespan**

## Introduction

Along with technological transformation and climate change, population aging will be one of the primary forces that will alter our civilizations in the next decades [1]. Over the last five decades, Europe's life expectancy has increased by around ten years. The age pyramid in many European countries has reversed because of this increase in life expectancy combined with a decrease in birth rate. Portugal has the fourth highest percentage of elderly citizens among the 28 European Union (EU) countries [2]. Both the government (national, regional and local) and the private sectors engage in care of the elderly in Portugal [3].

Healthcare system of Portugal incorporates three main systems, the private, voluntary health insurance and public, national health service (Serviço Nacional de Saúde, SNS), and the special social programmes of health insurance for certain professions (subsystems of the state). Universal coverage is offered by the national health service. Additionally, healthcare subsystems, private health insurance and mutual funds cover 25%, 10% and 7% of the population, respectively [4].

Even though the Portuguese population is aging, the current old population lives longer and in better conditions than previous generations [3]. World

Health Organization (WHO) defines healthy aging as “the process of developing and maintaining the functional ability that enables wellbeing in older age” [5]. Portugal has embraced the values and policy frameworks of the WHO and the EU in relation to active and healthy aging, which has resulted in improvements in the social protection and health of the elderly population [2, 3]. It has made significant reforms to its pension systems in response to changing demographics and labor markets, creating optimized circumstances for active and healthy aging [3].

Aging issues are transversal to the intervention areas of many Ministries of Portugal, and they are integrated into various action programmes and policies in a synchronized approach. Subsequently, the Portuguese government is becoming more aware of the need to address the issues raised by aging societies to build a sustainable environment where older people can enjoy a healthier and better life [3]. It is crucial to consider and address major areas impacting the healthy lifespan of humans which include health, demographics, arts, ethics and citizenship, as well as economy due to the growing necessity for quality care for the aging population.

The 20<sup>th</sup> century witnessed population growth whereas the 21<sup>st</sup> century is witnessing population aging. In recent years, fertility rate has been declining and mortality shift to older ages is evident. From a demographic perspective, it is essential that we take measures to prevent mortality in the elderly and improve their quality of life. Improvements in healthcare and prosperity has resulted in increased life expectancy and longevity.

It is essential for us to understand the difference between biological and chronological age and the biomarkers of healthy aging. Due to an increased number of elderly patients, it sometimes gets difficult for the healthcare providers to define the expectations when diagnosing and treating the elderly. Moreover, due to multiple comorbidities and propensity to drug interactions, it is important to be precise in the care of the elderly and optimizing potential on medical contribution for them, especially with respect to clinical interventions. At older age, the population is also more prone to suffer from chronic diseases or falls, thereby necessitating their prevention, rehabilitation care, and integrated community care.

Health is a part of life, and one cannot question the value of life. With the extensive technologies available today, we are conditioning the relationship between lifespan, life cycle and life extension, to prolong life. But a major ethical dilemma that arises

is whether it is worthwhile to invest in extending life beyond biological limits, and if yes, should it be made available to everyone or only to the individuals who can afford it? There are certain issues from a citizenship standpoint as well, such as the rise in socioeconomic inequality, dependency, and medicalization of life.

Longer lifespans have also shown to present opportunities for elderly people, their families, societies, and governments as a whole [6]. Arts and creativity have a positive influence on the healthy aging process. As people approach and go through the retirement and aging phases, creativity can improve overall mental health and help the elderly find meaning and purpose [7]. Additionally, arts and creativity also improve cognitive function, self-esteem, and memory, thus resulting in reduced stress, more intergenerational interactions, less solidarity, improved quality of life and well-being [8].

Economy, business, and firm activities are influenced by longevity. An increase in life expectancy, educational systems that focus on life processes, the need to encourage both financial and digital literacy among all citizens, sustainability of the NHS system, public pensions, social security systems and new policies all have an impact on today's global labor market. Moreover, the economy also has an impact on new strategies, new markets, products, and services, the expansion of the private healthcare sector, the bank and insurance industry, and financial services.

Considering all dimensions mentioned above, it is imperative that we investigate aging challenges and opportunities from a variety of perspectives. University of Evora and the Espirito Santo Hospital, have active and healthy aging as one of their core initiatives in its healthcare innovation roadmap, supported by the Lifespan Research Chair and the Evora Academic Clinical Center.

The University of Évora is the second oldest university in the country of Portugal, established in 1559. The aim of the university also includes the sharing of knowledge with the community, the promotion of innovation and commercial competitiveness, the transformation of public services, as well as the social and cultural development of the broader community [9].

To support innovation culture and enable establishment of self-sustaining innovation infrastructures, Innovation Think Tank (ITT), a part of Siemens Healthineers (SHS) has been actively engaging with healthcare institutions in the region

[10]. Following an invitation from the University of Evora and SHS Portugal, ITT at Evora was institutionalized. Furthermore, a certification program was organized at the University of Evora, in association with the Espirito Santo Hospital, Portugal from March 28 to April 7, 2022. The program's objectives were to familiarize participants with the ITT methodology and to collect and assess healthcare trends and solutions relating to Portugal's aging concerns, while delving into major healthcare and aging challenges focusing on five key areas: Lifespan and Health, Lifespan and Demographics, Lifespan and Arts, Lifespan and Ethics & Citizenship, and Lifespan and Economy.

A collaboration between the University of Evora and ITT will help to lay down a strong foundation for building local innovation infrastructure within the University and enhance research opportunities through global co-creation activities.

## Material and methods

University of Evora and ITT collaboratively organized a certification programme focused on active aging challenges and the future of healthcare in Portugal [Figure 1]. The participants were chosen based on their multidisciplinary backgrounds, skills, and qualifications. Medicine, nursing, medical science and technology, molecular biology, economics, engineering, architecture, management, and entrepreneurship were among the backgrounds represented by the selected participants. Over 20

institutions from around the world were represented by the participants (University of Evora, Imperial College London, RWTH Aachen University, University of Aveiro, INESC TEC, Technische Universität München, Indian Institute of Technology Hyderabad, American University of Sharjah, Espirito Santo Hospital, Pedro Nunes Institute, AAEUM, Ansbach University of Applied Sciences, ECAM LASALLE LYON, Cergy Paris University, Instituto Superior Técnico, German Jordanian University, Jashore University of Science and Technology, , Barcelona University, Instituto Superior Técnico, FIAP, National University of San Marcos, , and University of Lisbon).

The program was held in a hybrid format i.e., both onsite and online. During this certification program, the participants received training on the ITT methodology and learnt about problem solving through working on real life challenges, especially with regards to active aging. To further motivate the participants and highlight the importance of healthy aging and active aging challenges from various perspectives, subject matter experts delivered impulse speeches in the five focus areas of lifespan. All this encouraged the participants to develop a creative mindset and enabled them to gain a deeper understanding of the core topic. As a part of this training, 6 teams comprising of 30 participants researched, ideated, created visualizations, identified pain points, and developed solution proposals to tackle the challenges in the five focus areas mentioned.

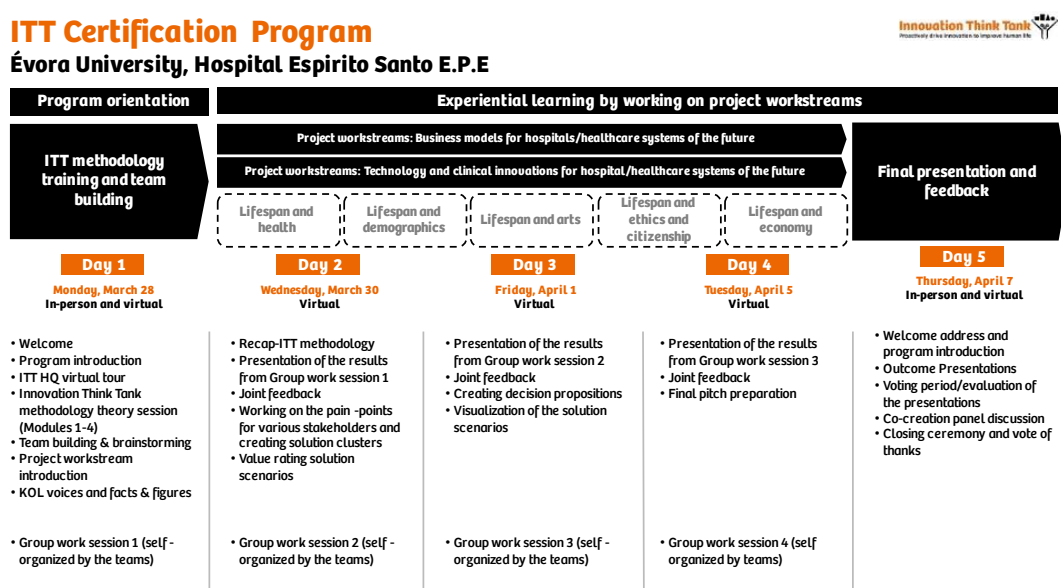


Figure 1: Roadmap for ITT CP at EVORA

The Innovation Think Tank Healthcare System Framework (ITT HSF) was used to collect, analyze, and validate trends and challenges. ITT HSF combines 1) Need analysis by capturing stakeholder’s workflow, 2) Co-ideation by trans-disciplinary global ITT teams and 3) Co-implementation with healthcare system stakeholders by local ITT programs [11] [Figure 2].

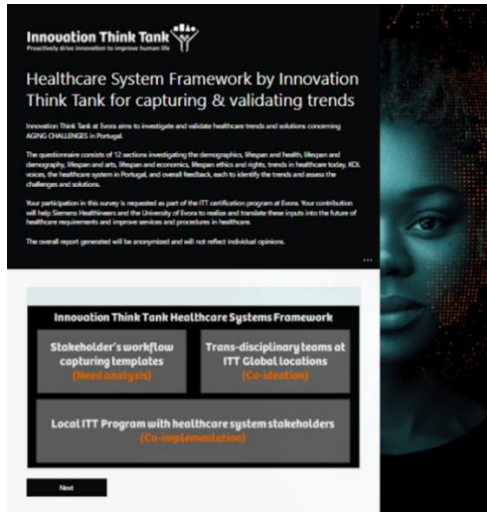


Figure 2: Innovation Think Tank Healthcare System Framework for capturing and validating trends

Incorporating feedback from previous surveys, the ITT HSF survey was altered and tailored to meet the unique requirements for capturing and validating

healthcare trends and challenges in Portugal with respect to the future of healthcare. The five focus areas for aging were also integrated into the survey.

The survey consisted of 12 sections: 7 sections investigated the demographics, trends (healthcare, technology, clinical, business model), key opinion leader (KOL) voices, healthcare system of Portugal, and the remaining 5 sections focused on validating information from the five key areas.

On the final day, outcomes from the program were presented to the jury and experts, followed by a brief discussion with researchers, industry experts, and executives on these challenges in Portugal.

## Results

### Program outcomes

The ITTCP at the University of Evora was successfully completed on April 7, 2022. The program outcomes consisted of over 60 healthcare trends, 78 KOL voices, 94 stakeholders, 312 pain points, 306 solutions and 18 solution clusters identified and compiled by the participants, in the five project workstreams of **Lifespan and Health, Lifespan and Demographics, Lifespan and Arts, Lifespan and Ethics & Citizenship, Lifespan and Economy**. Following illustrations depict example visualizations for each focus area [Figure 3-7] [12-28].

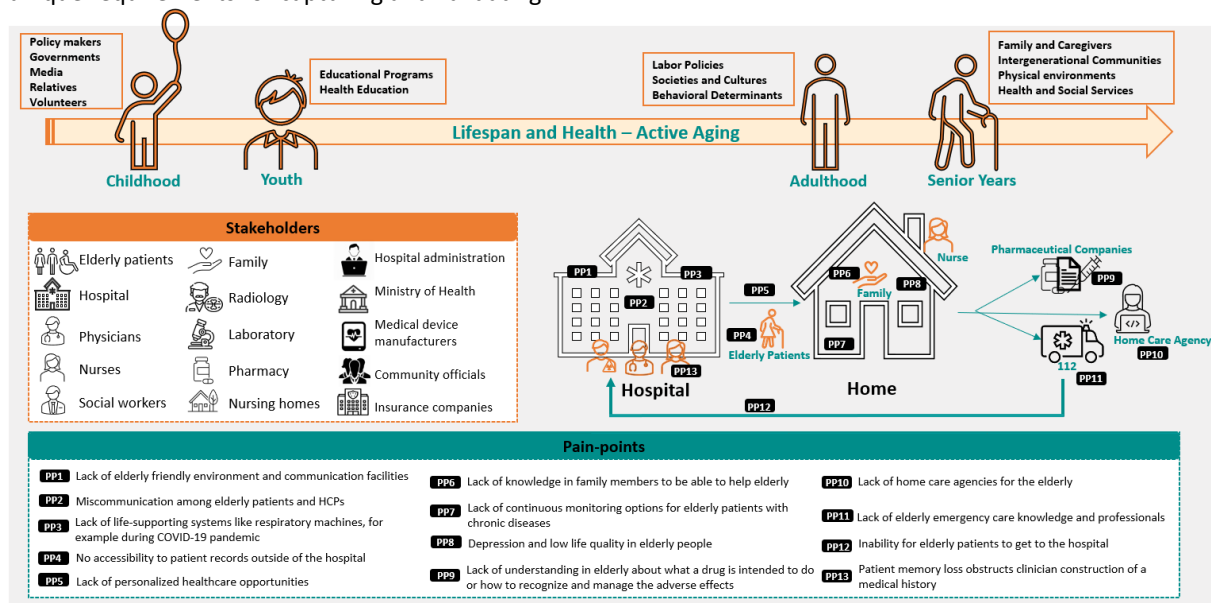


Figure 3: Example visualization illustrating the connection between active aging and the focus area of Lifespan and Health. It depicts the pathway that elderly patients potentially follow from receiving hospital care to availing home services. Stakeholders and pain points were also analyzed along the pathway, addressing health in the aging population.

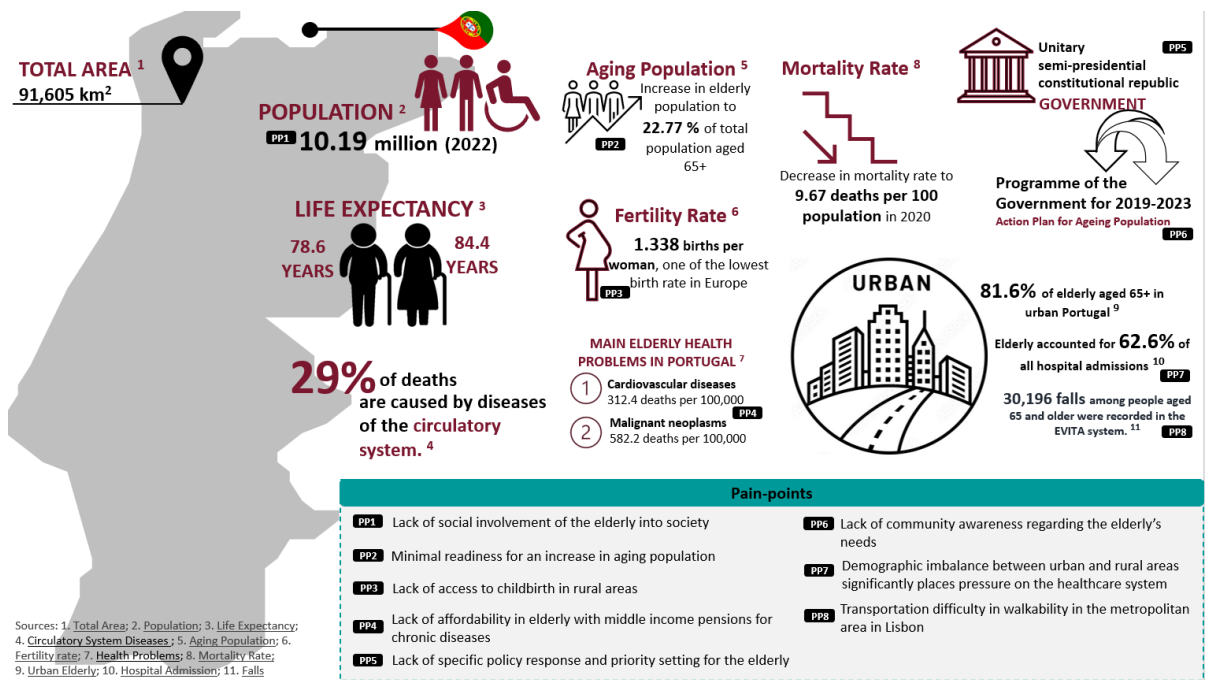


Figure 4: Example visualization of the pain-points found in the focus area of Lifespan and Demographics where topics like life expectancy, fertility, mortality, and falls were explored to understand the connection between demographics and aging population.

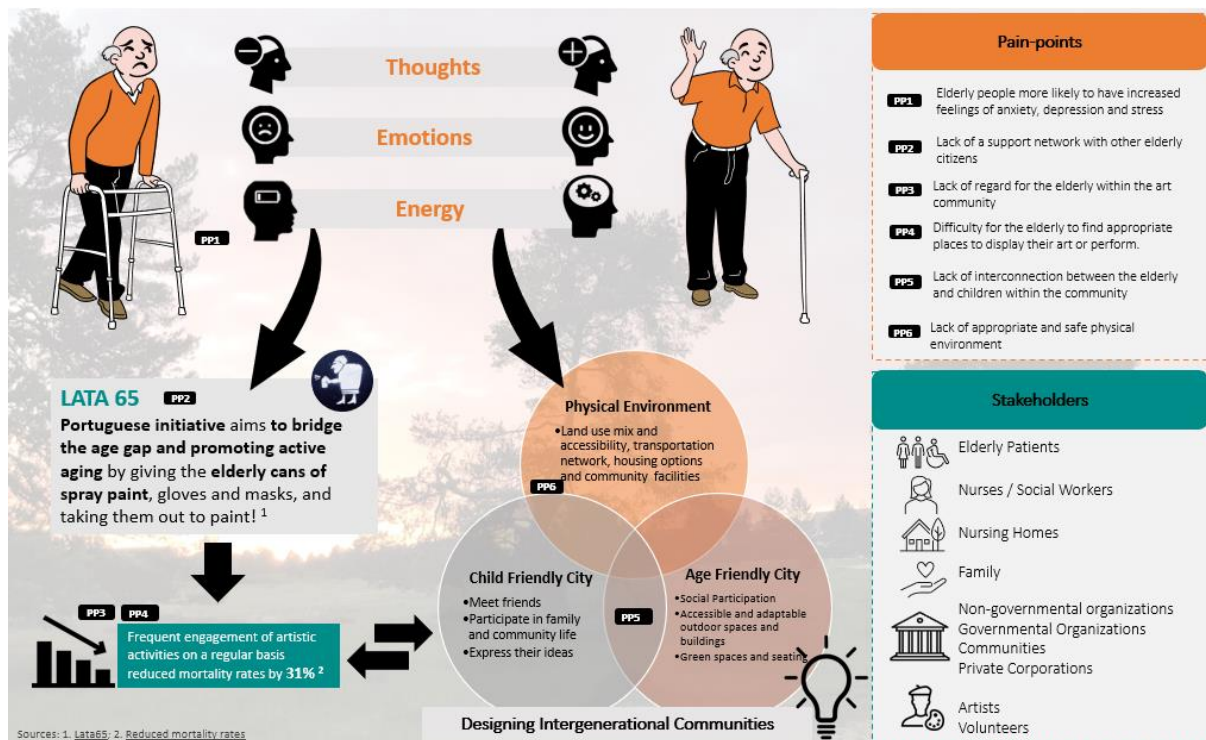


Figure 5: Example visualization of the Lifespan and Arts focus area highlighting the pain-points and stakeholders in the domain of arts and aging, which aims to shape the identity and place of the elderly in society via creativity and positive participation.

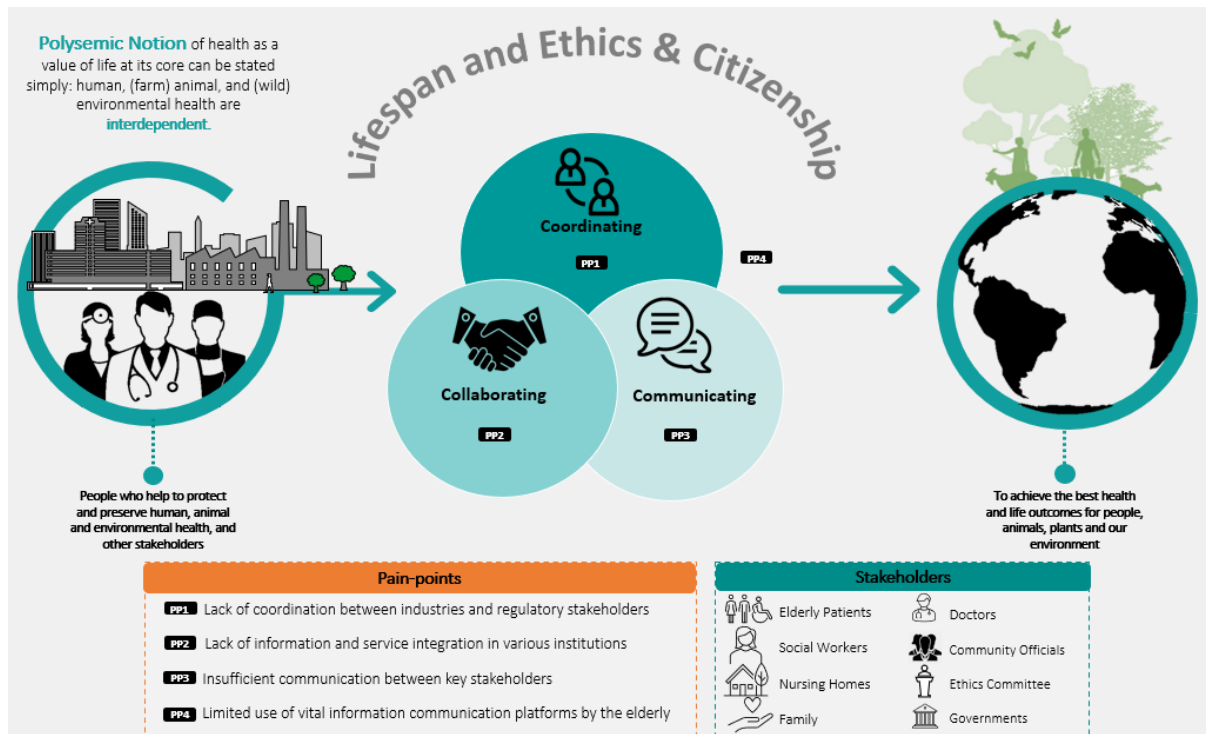
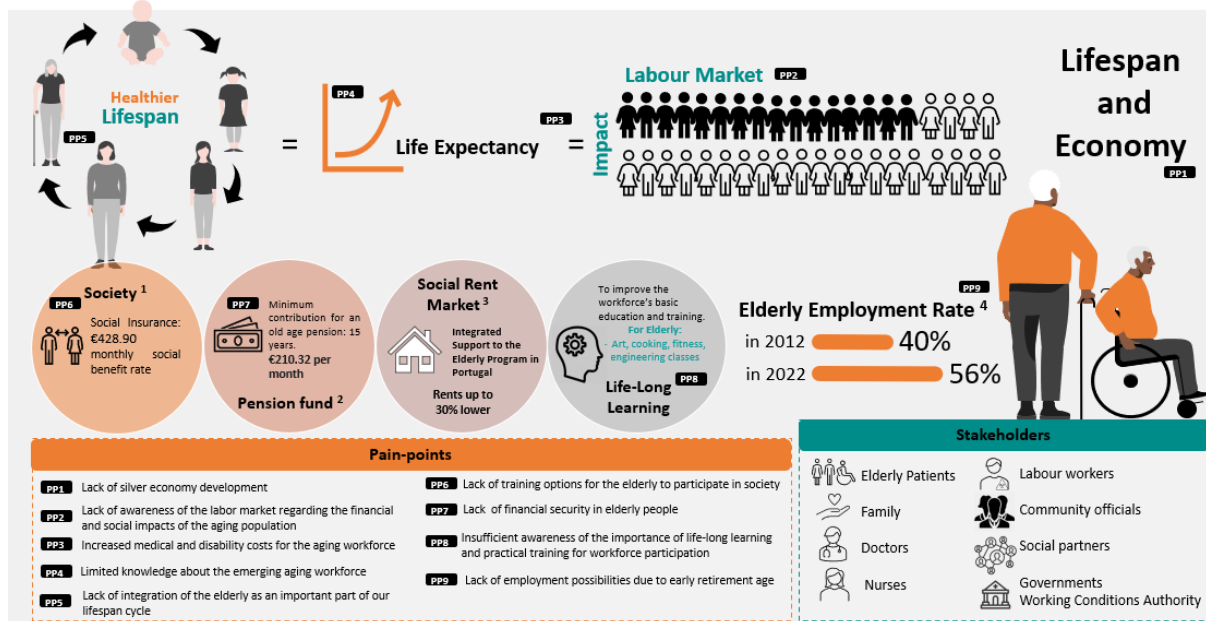


Figure 6: The focus area Lifespan and Ethics & Citizenship encompasses the polysemic notion of health as a value of life, which is visualized above, while also highlighting some of the stakeholders and pain points in this area.



Sources: 1. Society; 2. Pension Fund; 3. Social Rent Market; 4. Employment Rate

Figure 7: Example visualization for the focus area of Lifespan and Economy including the related stakeholders and pain points. It tries to show the idea that while the elderly population keeps increasing, living longer and being healthier have a positive impact on Portugal's labour markets.

*Survey findings*

The participants responded to the survey on the healthcare system in Portugal. The consolidated findings are presented in the following categories:

**Category 1:** *The key current trends that will transform healthcare delivery in Portugal and the degree of their impact on the healthcare system in Portugal*

**Healthcare trends**

The trends in healthcare system in Portugal were rated by the participants as per their observation and perspectives [Figure 8]. 81% of participants have

rated data driven health innovation as having a high impact. High impact was also attributed by 74% of participants for fully integrated care solutions. Participants also rated Individualization of diagnosis and treatment (73%), population health management (72%) and decentralization of healthcare to be highly impactful. 25.9% participants responded for medical tourism as having a low impact for the trends in healthcare. Moreover, digital health, preventive care, access to clinical trials, telehealth, healthcare training programs, and focus on education for disease prevention were identified as additional healthcare trends from participants.

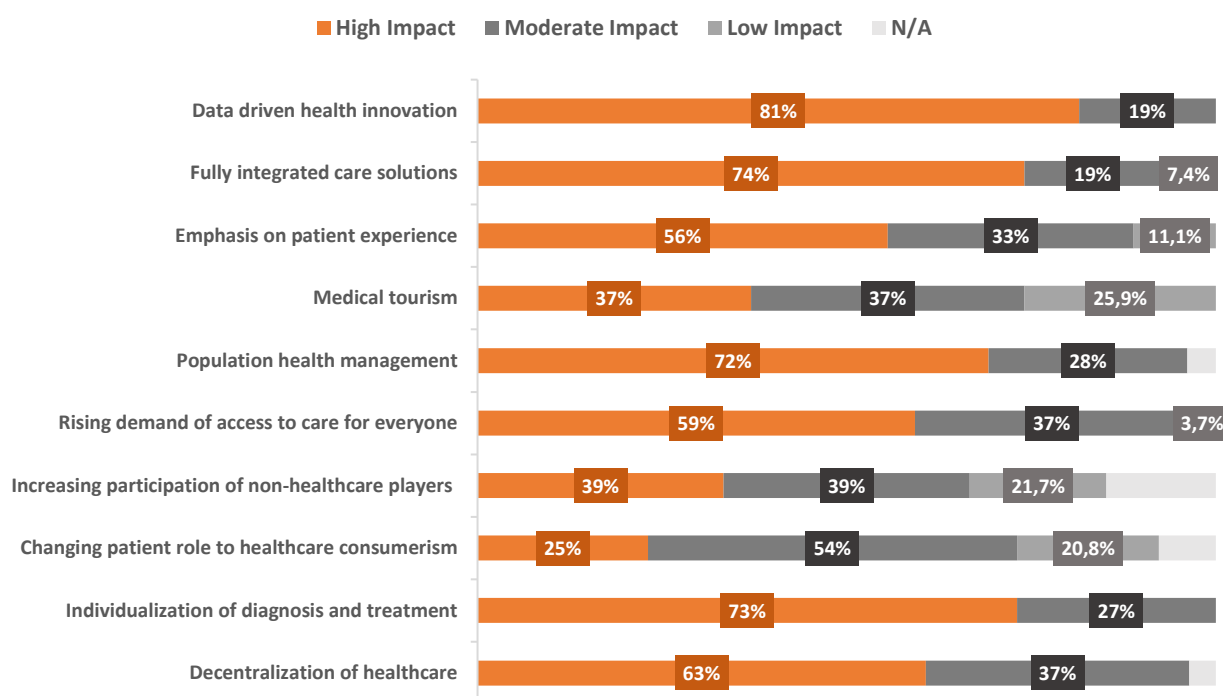


Figure 8: Healthcare trends outcome analysis

**Technology trends**

Key areas in technological advancement were given to participants for validation with respect to their degree of impact in healthcare [Figure 9]. With 85.7% of votes from participants, digitalization in healthcare was identified as highly impactful technology trend, followed by optimizing healthcare operations through big data analytics (77.8%), automation in healthcare operations (74.1%) and nanotechnology in healthcare (70.4%). Increased use of healthcare applications (51.9%) and quantum computing (50%) were voted as having moderate impact. 5G and connectivity was voted as having low impact by 19.2% participants. Along with this, under skin sensing and noninvasive procedures were also mentioned as technology trends by the participants.

**Clinical trends**

Key clinical trends were identified to check its degree of impact on overall healthcare system as illustrated in Figure 10. 85.2% participants voted for prediction of disease based on patient health data, precision medicine and shift from treatment of diseases to preventive care as highly impactful clinical trends. 81.5% participants also voted for intelligent cancer care as having high impact. 48.1% voted for worksite clinics as having moderate impact whereas 25.9% voted for self-testing kits as having low impact. In addition to this, participants identified redesigning clinical pathways, noninvasive diagnosis, and treatment as other clinical trends.



**Business model trends**

To understand the factors for growth of healthcare market and their degree of impact, business trends in healthcare were identified [Figure 11]. With votes from 81.5% of participants, cross institutional collaboration has been identified as having high impact for business trends. Interconnecting

healthcare providers (76.9%) and value-based healthcare (71.4%) were also identified as having high impact. 53.8% participants voted for mergers and acquisitions as having moderate impact. On the other hand, 23.1% participants voted for subscription licensing of devices as having low impact. Additionally, service-based models were mentioned as a business trend by participants

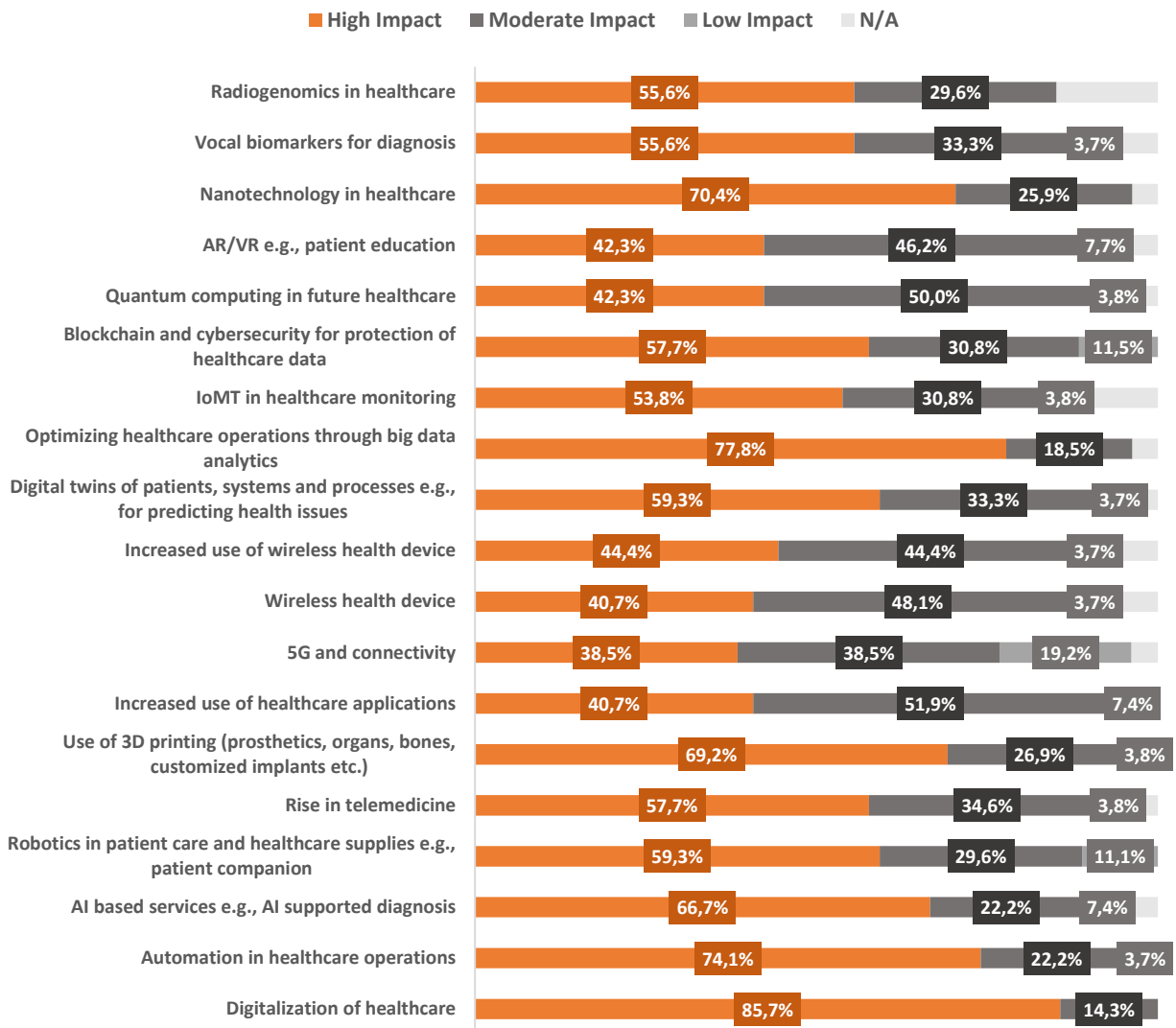


Figure 9: Technology trends outcome analysis

**Category 2: Key opinion leaders, institutional challenges and goals of hospitals, healthcare system in Portugal and their degrees of importance**

**KOL voices**

Participants in the survey were given the challenges and opportunities indicated by prominent key opinion leaders to validate their degree of impact on the healthcare system. [Figure 12]. Healthcare for all

with votes from 92.3% participants was considered as having high impact, followed by quality of care (88.5%), operational efficiency (80.8%) and increasing aging population (76.9%). 66.7% and 56% participants voted for institutional occupancy rate and regulatory clearances as having moderate impact, respectively. Additionally, cost increase and targeted acquisition of talent were some KOL voices identified by the participants.

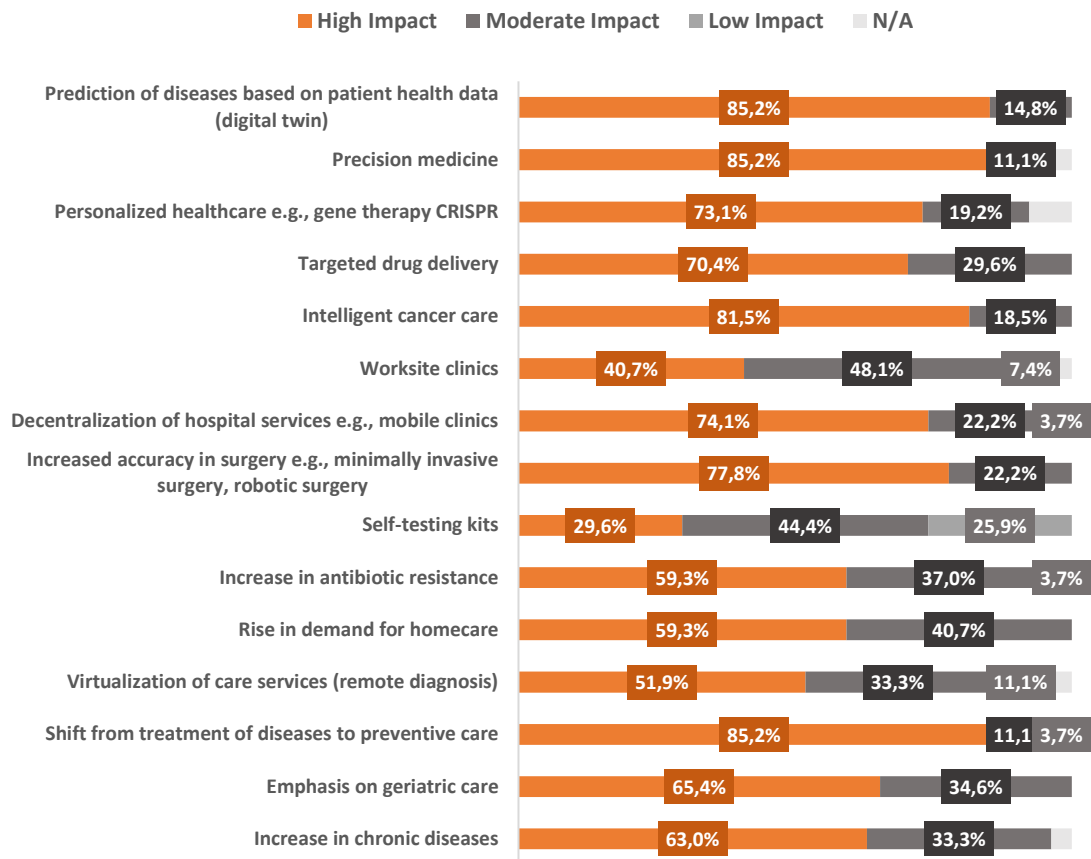


Figure 10: Clinical trends outcome analysis

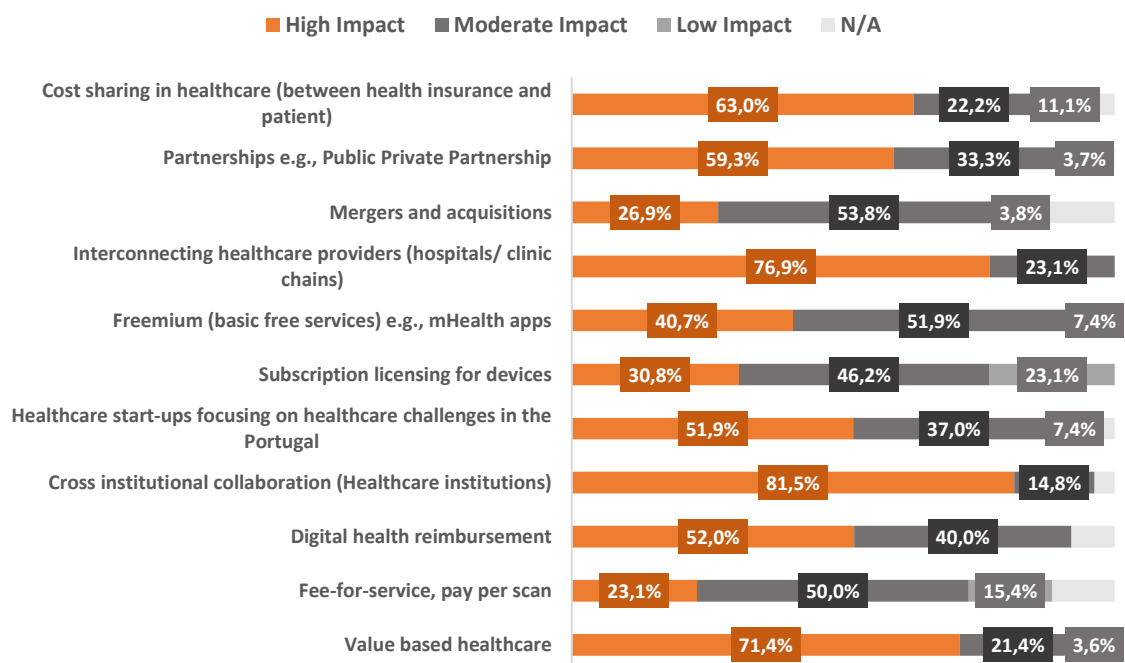


Figure 11: Business model trends outcome analysis

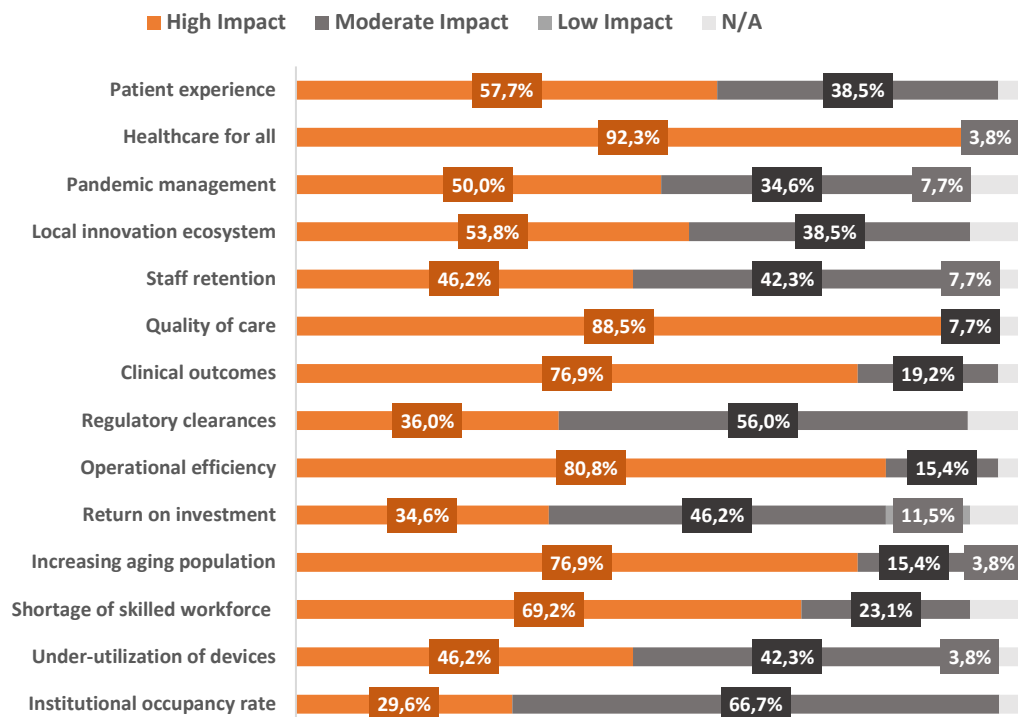


Figure 12: KOL voices outcome analysis

**Category 3: Portugal Healthcare System**

Participants were provided with a visualization of the Healthcare System in Portugal [Figure 13] which illustrates the patient pathway in Portugal, patient population statistics, physicians, hospitals and other healthcare establishments, healthcare expenditure and insurances in Portugal, and inter-dependencies between the various stakeholders in the healthcare system. Participants provided their feedback based on their observations and research on the Portugal healthcare system, some of which are mentioned below.

- All aspects like health, demography, arts, ethics & citizenship, and economy should be included in the healthcare system.
- Other stakeholders like local health centers, diagnostic centers, informal caregivers, universities, and corporates can be included in the visualization.
- Optimization of costs for outpatients, inpatients and pharmacies with prevention and education for a better lifespan and healthcare system.
- Access to care problems due to lack of hospitals and doctors in certain areas.

- Digitalization of healthcare, telehealth system, medical automation, robotic surgery, and robotic assistive smart devices play an important role.

**Category 4: Investigating into the most eminent healthcare and aging challenges in Portugal and the impressions on them in five key areas of Lifespan and Health, Lifespan and Demography, Lifespan and Arts, Lifespan and Ethics & Citizenship, Lifespan and Economy.**

**Lifespan and Health - The potential of medical contribution**

Participants have stated their impressions on various key statements on healthcare and aging challenges in Portugal in lifespan & health – the potential of medical contribution. 77% of participants consider aging to be a degenerative process rather than a disease [Figure 14-A] and that the biological age is, nowadays, shifting positively further from chronological age (61% agree and 18% strongly agree) [Figure 14-B]. 53% of participants defined “senescence” as decline in physiological condition with age [Figure 14-C] and that it is an unavoidable process during the lifetime of an individual (43%)

**[Figure 14-D].** Most of the participants agree (55% agree and 21% strongly agree) that medicine is the key driver for increasing life expectancy **[Figure 14-E].** Economic balance (62.1%), preventive behavior (58.6%) and work or school (50%) are the factors that over 50% of participants agreed to as contributors towards a better quality of life **[Figure 14-F].** Additionally, maintaining an active lifestyle (41.4%), not having any diseases (50%), and controlling aging-

related diseases (58.6%) were all found to be important contributors to a better quality of life in later life. **[Figure 14-G].** According to the survey, more than half of the participants said that they would like to live up to 100 years or more, provided they are in good physical and cognitive health. This would give them more time to spend with their loved ones and allow them to witness the advancement of science and technology.

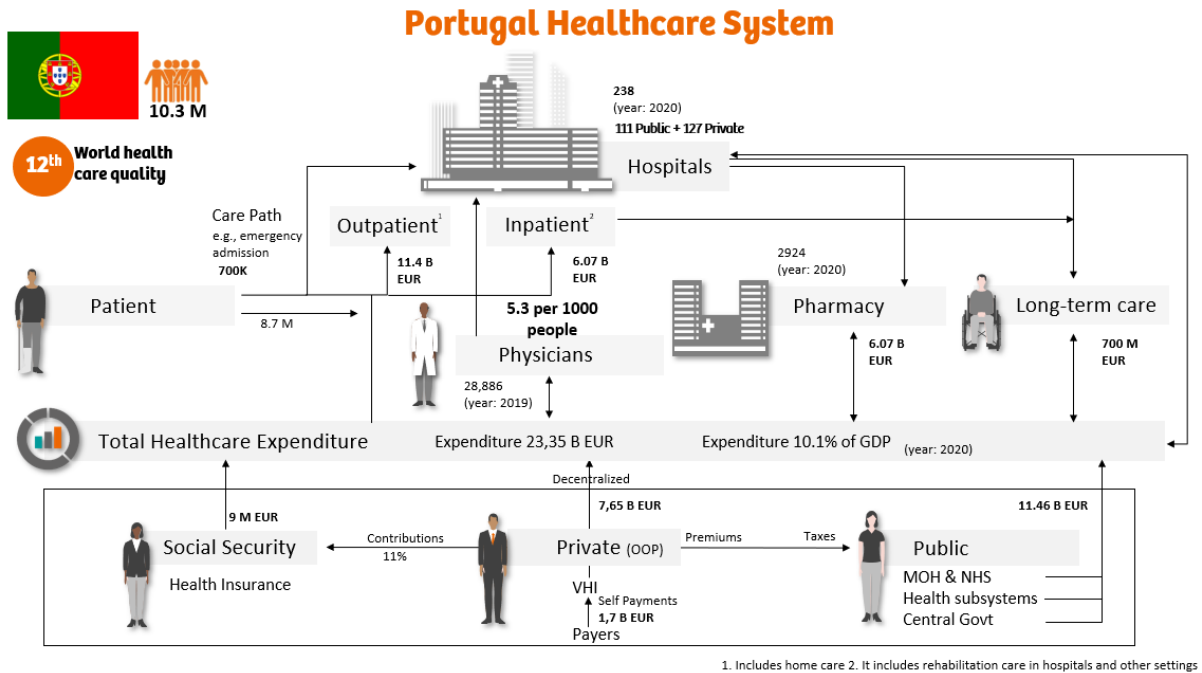
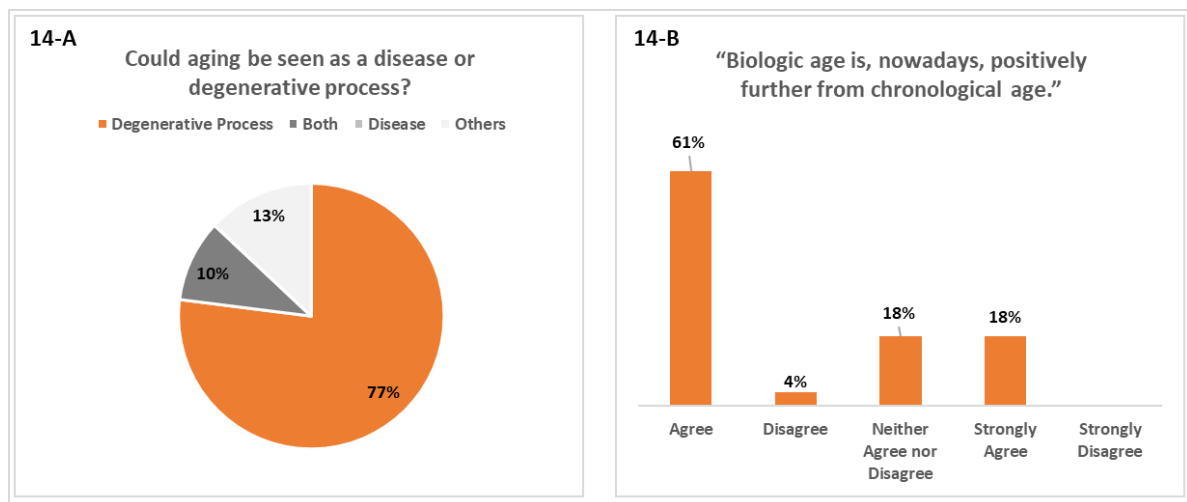
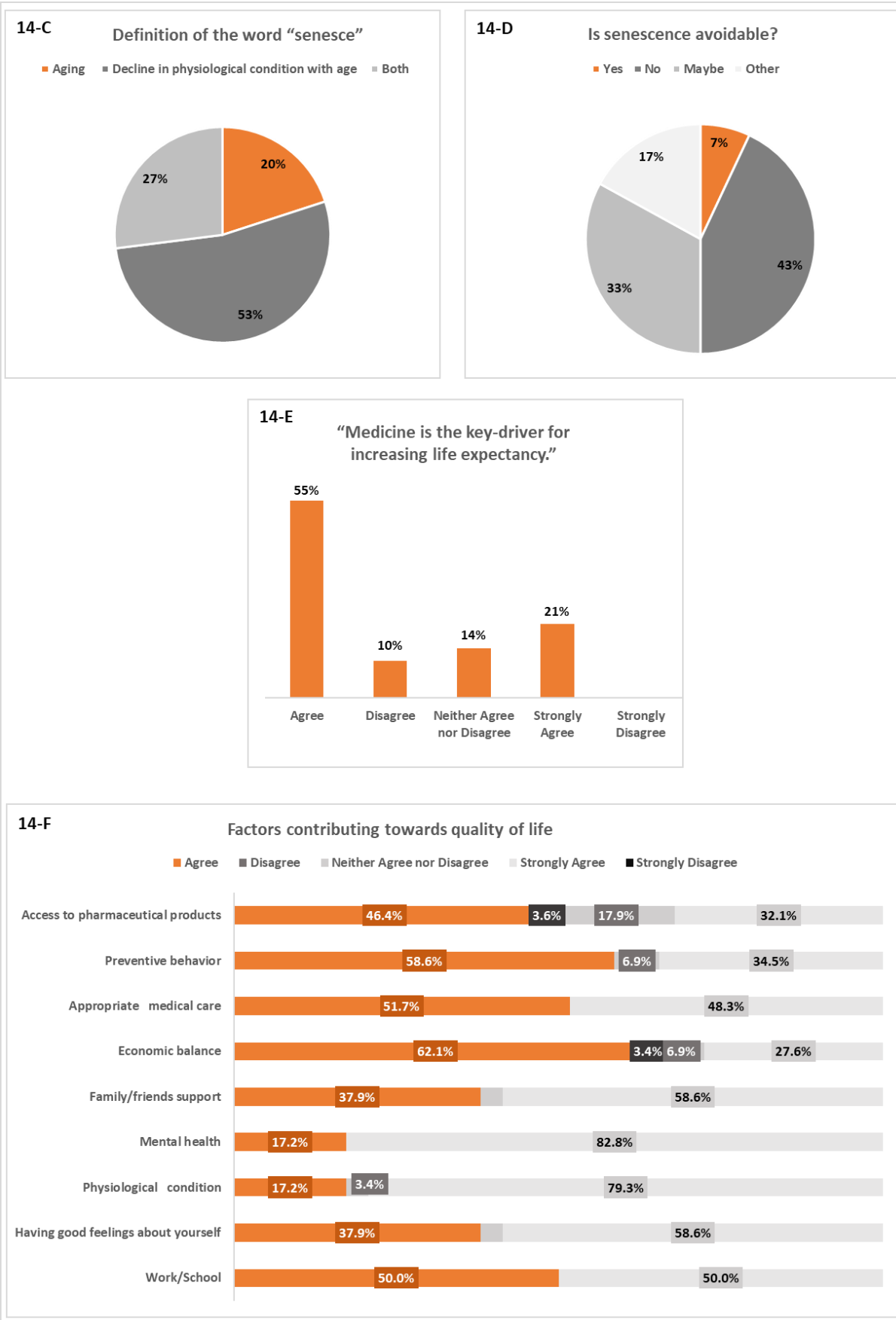


Figure 13: Portugal Healthcare system





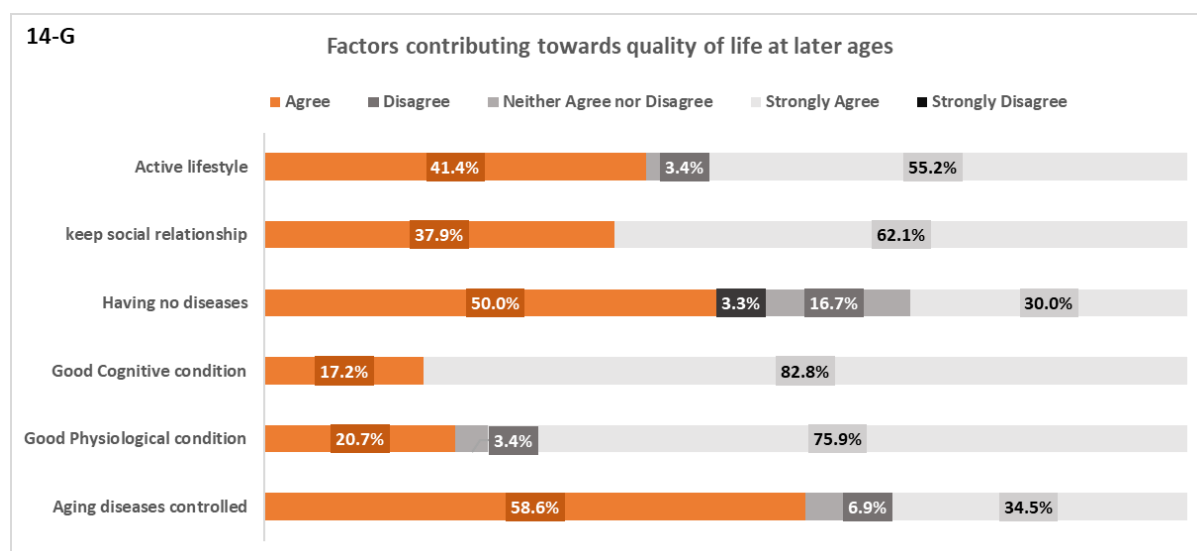


Figure 14 A-G: Outcome analysis for Lifespan and Health: The potential of medical contribution

### Lifespan and Demographics - A problem or an opportunity?

Participants shared their thoughts on a variety of critical statements related to healthcare and aging challenges in Portugal in lifespan and demographics – a problem or an opportunity. 66% of the participants have an opinion that a human must live for 100 years or more [Figure 15-A]. However, all the participants unanimously accepted that humans cannot be expected to live indefinitely, stating few reasons as mentioned below.

- The logic of population replacement would be compromised and life as we know would change drastically
- There should be a cycle of life
- We can only prevent the aging process to a certain point, not entirely
- It could lead to overpopulation and its problems
- There is a possibility to make cells immortal by avoiding the shortening of the telomeres. However, to make an entire organism immortal is uncertain.

While a certain group (31%), disagrees with the statement “COVID-19 pandemic will stop lifespan’s progression”, another set of participants (31%) are in dilemma of agreement or disagreement to it [Figure 15-B]. 61% of the participants stated that behavioral patterns are one of the main reasons for difference in life expectancy between different genders [Figure 15-C]. 51.7% of the participants consider population

decline to be a menace for modern society [Figure 15-D]. However, 41.4% of participants also agree to the fact that even though modern society is aging, the elderly share of population is still younger [Figure 15-E].

### Lifespan and Arts – A free view

Standpoints on various crucial statements in lifespan and arts – a free view, concerning healthcare and aging challenges in Portugal were analyzed. Almost 90% of the participants agree that the promotion of creative and artistic expression delays senescence [Figure 16-A]. However, 38% agree that creative abilities deteriorate over time, while 31% disagree on this [Figure 16-B].

### Lifespan and Ethics & Law - The citizenship of the elderly

Participants’ reflection on several key statements concerning healthcare and aging challenges in Portugal, referring to aspects on lifespan and ethics & law – the citizenship of the elderly, was studied. 53.6% participants consider old age as a new life stage, an opportunity, whereas 50% agree that being old means a loss of autonomy [Figure 17-A]. A group of participants (53.6%) disagree on societies being prepared to maintain their active elderly share of population until later ages [Figure 17-B].

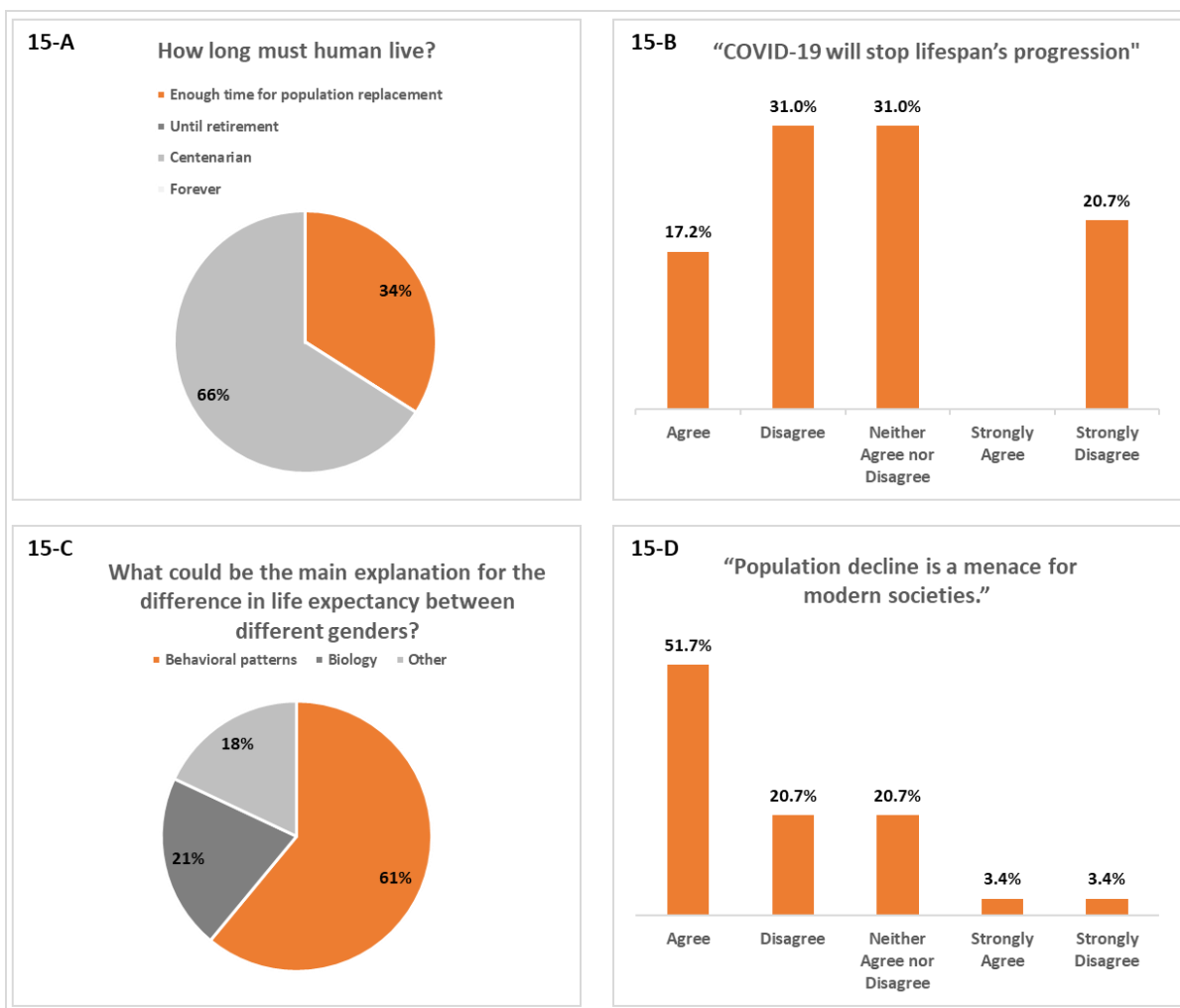
### Lifespan and Economy - The market expansion

The perspectives of participants on numerous critical statements on healthcare and aging difficulties in Portugal, focusing on lifespan and economy – the

market expansion, were investigated. More than 70% of participants consider aging population to be an opportunity for societies, rather than a burden (34.5%) [Figure 18-A & B]. Almost 80% of participants agree or strongly agree that societies, where longer lifespans are now common, benefit from lifecycle redefinitions [Figure 18-C]. There is a unanimous consensus (up to 80%) that aging societies can be seen as chances to promote new economic perspectives such as health tourism [Figure 18-D]. Aging populations are getting healthier and living longer in greater physical shape. However, more than 50% of participants said that retirement age should

not be greater than it is now, citing the following reasons.

- Quality of life would be compromised
- Retirement age should be an economical/social factor. The fact we live longer means we should live better and not bound by the government to do uncreative tasks
- The retirement age should be 65 years to offer seniors the chance to experience many aspects of life and give back to the community without suffering economic losses.



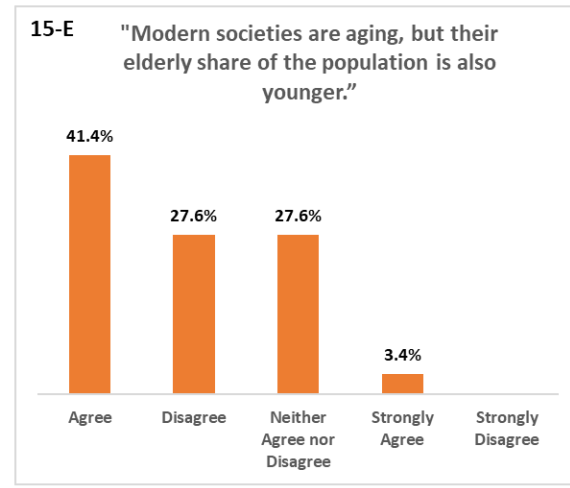


Figure 15 A-E: Outcome analysis for Lifespan and Demographics - A problem or an opportunity?

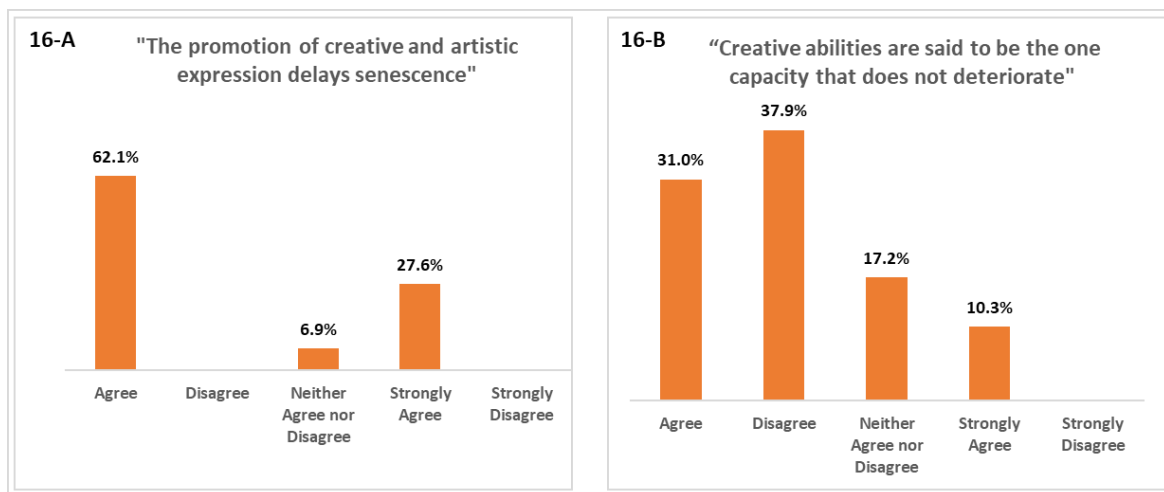
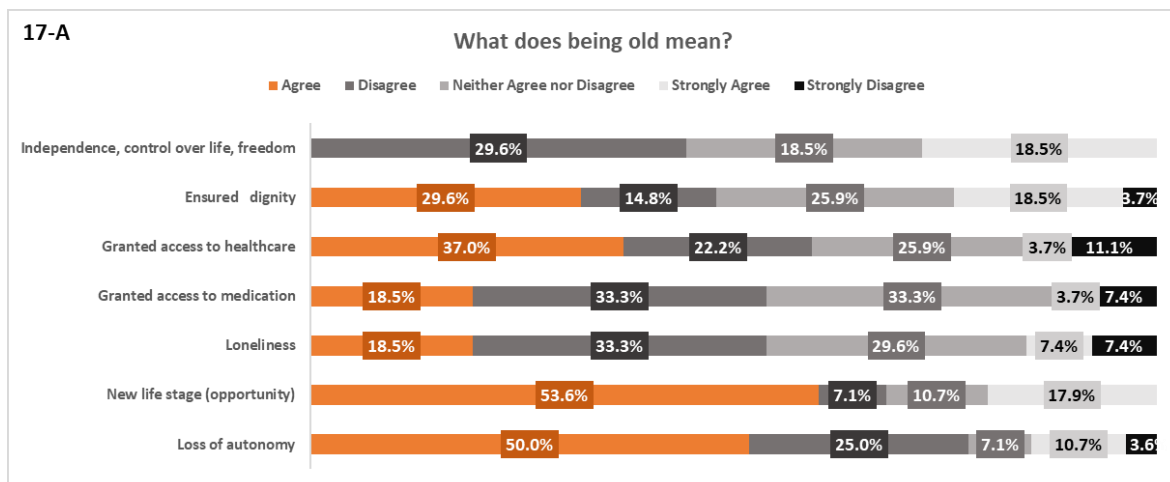


Figure 16 A-B: Outcome analysis for Lifespan and Arts – A free view





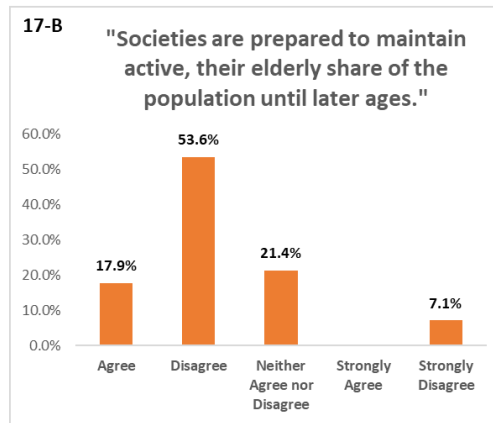


Figure 17 A-B: Outcome analysis for Lifespan and Ethics and Law - The citizenship of the elderly

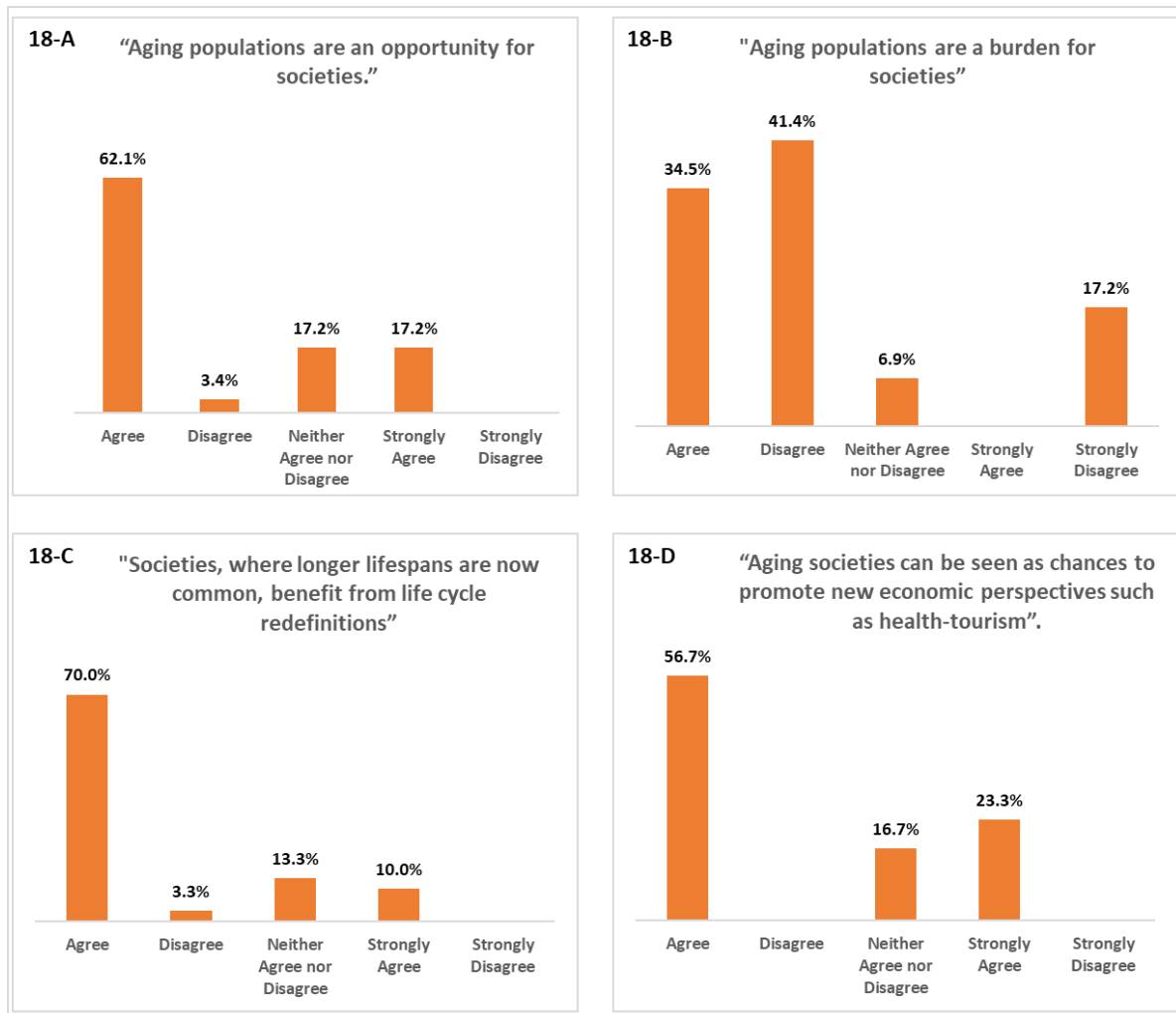


Figure 18 A-D: Outcome analysis for Lifespan and Economy - The market expansion

## Discussion

The world's population is aging, and alternative living arrangements are emerging. These demographic shifts have an impact on the health, quality of life, and life satisfaction, leading to new challenges and increased demands in terms of social care and connectivity that must be adapted to the needs of the growing elderly population. Portugal is situated in the world's oldest territory with a large aging population. It is crucial to address the country's challenges to continuously improve the living conditions of elderly.

ITT provides a robust healthcare system framework which considers not only the needs of key stakeholders but also investigates the big picture of current trends and site-specific challenges and identifies innovative strategies to bring valuable impact on the conventional way of healthcare delivery.

As a part of the certification program, ITT HSF was integrated, and insights were collected and analyzed to study the current trends and active aging challenges within the healthcare system of Portugal. Various KOL and institutional challenges within the local healthcare system were investigated where quality of care, optimizing operational efficiency and increasing aging population were rated by the respondents as having high impact. Data driven health innovation was rated as the topmost impactful healthcare trend within the healthcare system of Portugal. The European Union and the Portuguese government with their various initiatives are trying to increase digital inclusion in health framework for the elderly. ITT HSF's technology trend responses also indicate an increased digital presence with digitalization in healthcare identified as a highly impactful trend. Prediction of disease based on patient health data, precision medicine and shift from treatment of diseases to preventive care were identified as highly impactful clinical trends. While considering the technical and clinical aspect of healthcare systems, it also becomes important to consider the impact of emerging business model trends that influence the overall healthcare ecosystem. According to the responses, cross institutional collaborations have a high impact on local healthcare systems.

During the 10-day ITT CP at University of Evora, participants from transdisciplinary areas were motivated to create innovative solution proposals

and ideations for the five focus areas given by experts that impact the lifespan of the aging population, through ITT methodology training and experiential learning. Additionally, ITT HSF was also used to analyze these five areas. The area of **Lifespan and Health** examined various key statements and factors associated with aging. Majority of the respondents recognized medicine as a key driver for increasing life expectancy, also evident from the existing literature that relates rising prosperity and advances in medicine with increased longevity. Economic balance and aging diseases controlled were attributed as the most agreed factors for quality of life overall and at later ages, respectively. For the area of **Lifespan and Demographics**, statements were analyzed for aging societies. Participants agreed that even though modern society is aging, the elderly share of population is still younger as also suggested by research, senescence is shifting to older ages with better physiological condition. Furthermore, there was a consensus that behavioral patterns contribute to the difference in life expectancy for different genders. By the analysis of the area, **Lifespan and Arts**, it was agreed that the promotion of creative and artistic expressions delay senescence, as they positively affect mental and physiological health indicators. However, there was a mixed response towards creative abilities and its deterioration with age. For the statements analyzed in the area of **Lifespan and Ethics & Citizenship**, majority of the respondents considered being old as a new life opportunity, but they did not consider societies as being prepared to maintain their active elderly share of population until later ages. From **Lifespan and Economy** section, respondents agreed that aging population is an opportunity for societies, aging societies are a chance to promote new economic perspectives and that these societies will benefit from life cycle redefinitions. The sample size of this study is limited and can be expanded to create deeper insights into the analyzed factors and key statements.

ITT has leveraged its global infrastructure to co-create and innovate for challenges and needs of the healthcare system in Portugal by collaborating with Evora university and SHS Portugal. ITT aims to further support Evora university to promote innovation and research within the local healthcare system. The collected inputs for trends, workflows, and related challenges will be used to co-create and co-implement translational and innovative solutions for improving the Portuguese healthcare system.

## Conclusion

The Portuguese healthcare system is committed to following WHO and EU policies on healthy and active aging. With new policies and increased social awareness, it aims to provide better lifespan support to its aging population. ITT as a part of SHS, has been co-creating with various institutions and stakeholders within the local healthcare systems, enabling them to act locally and think globally. The certification program highlighted in the paper was collaboratively conducted by SHS Portugal, University of Evora, Espirito Santo Hospital and ITT with the vision to boost innovation and research in the region with a focus on aging challenges and future of healthcare in Portugal. Along with the ITT innovation methodology training and experiential learning, insightful information by experts on lifespan and aging was utilized to propose innovative solutions by each team. Key trends, KOL statements and information on lifespan within areas of health, demographics, arts, economy, ethics & citizenship were captured and validated by incorporating ITT HSF during the certification program. The program's collated responses and solution proposals will aid in the implementation of future co-creation activities to leverage innovation and associations in the local healthcare system.

## Authors Statement

SHS has established and confirmed the paper's framework as well as guided and initiated the paper's context. LP and CP have provided crucial insights and aspirations for creation of the proposed healthcare system framework and its implementation for the active aging context. AG, NN, MA, and JV collected the data, analyzed the survey results, and added content to the whitepaper. All authors contributed to the paper's drafting and approved the final version. The authors do not state any competing interests.

## Acknowledgements

We are thankful to our ITT SHS and SHS Portugal colleagues for their support in organizing the program and compiling this publication. We are obliged to Evora university for hosting the certification program. We would like to express our gratitude to Professor Lino Patricio for his kind invitation and support to establish ITT at the esteemed institute, University of Evora. We are

thankful for the continuous support from Mr. Carlos Parente in organizing and hosting the event and for being an integral part of the interactions and engagements. We are also grateful to the subject matter experts for their impulse speeches: Prof. Lino Patricio and Dr. David Neves (Lifespan and Health), Prof. Filipe Ribeiro (Lifespan and Demographics), Prof. Ana Telles (Lifespan and Arts), Prof. Carlos Silva (Lifespan and Ethics & Citizenship), and Prof. António Guerreiro (Lifespan and Economy). Moreover, we would like to thank our jury members for providing their valuable insights during the program. Finally, we would like to acknowledge all the participants and respondents for their efforts and contributions during the certification program on aging challenges and future of healthcare in Portugal.

## References

1. Ageing in Spain and Portugal and its impact on economic growth: a regional approach. CaixaBank Research. (2020). <https://www.caixabankresearch.com/en/economics-markets/labour-market-demographics/ageing-spain-and-portugal-and-its-impact-economic>.
2. Costa, A., Câmara, G., Arriaga, M., Nogueira, P., & Miguel, J. (2021). Active and Healthy Aging After COVID-19 Pandemic in Portugal and Other European Countries: Time to Rethink Strategies and Foster Action. *Frontiers In Public Health*, 9. <https://doi.org/10.3389/fpubh.2021.700279>
3. Mainstreaming Ageing Portugal. unece.org. [https://unece.org/sites/default/files/2021-03/Portugal\\_CN\\_EN.pdf](https://unece.org/sites/default/files/2021-03/Portugal_CN_EN.pdf).
4. Management Articles, Journals, Events, Directory | HealthManagement.org. HealthManagement.org. <https://healthmanagement.org/c/hospital/issuearticle/the-portuguese-healthcare-system-1>.
5. Healthy ageing and functional ability. Who.int. <https://www.who.int/philippines/news/q-a-detail/healthy-ageing-and-functional-ability#:~:text=WHO%20defines%20healthy%20ageing%20as,they%20have%20reason%20to%20value>
6. Ageing And Health. Who.int. <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>.
7. T Dahlberg, S. (2007). Think and Be Heard: Creativity, Aging, and Community Engagement. The National Arts Forum Series. [https://www.academia.edu/11086899/Think\\_and\\_Be\\_Heard\\_Creativity\\_Aging\\_and\\_Community\\_Engagement](https://www.academia.edu/11086899/Think_and_Be_Heard_Creativity_Aging_and_Community_Engagement).
8. Participating in the arts creates paths to healthy aging. National Institute on Aging. (2019). <https://www.nia.nih.gov/news/participating-arts-creates-paths-healthy-aging#:~:text=Research%20on%20music%2C%20theater%2C%20dance,stress%20and%20increased%20social%20interaction>.

## Co-creation on Active Aging Challenges in Portugal 7-2022 – White Paper

9. Évora, U. Universidade de Évora / About / Mission. Uevora.pt.  
<https://www.uevora.pt/en/university/mission>.
10. Haider, Sultan. (2021). Addressing Healthcare Needs with Innovation Think Tank Global Infrastructure and Methodology. Innovation Think Tank.  
<https://www.siemens-healthineers.com/en-in/careers/innovation-think-tank>.
11. Haider, S., Vasavada, J., N, N., Goenka, A., Hassan, D., & Azem, G. (2022). Healthcare System Framework by Innovation Think Tank for understanding needs and defining solution requirements. Innovation Think Tank.  
<https://www.siemens-healthineers.com/en-in/careers/innovation-think-tank>
12. Land Area (Sq. Km) | Data. Data.Worldbank.Org,  
<https://data.worldbank.org/indicator/AG.LND.TOTL.K2?locations=PT>.
13. Portugal Population (2022) - Worldometer. Worldometers.Info. (2022).  
<https://www.worldometers.info/world-population/portugal-population/>.
14. Life Expectancy In Portugal. World Life Expectancy.  
<https://www.worldlifeexpectancy.com/portugal-life-expectancy>.
15. A morte para além da Covid-19: Em busca do que explica os picos de mortalidade em Portugal | UCP. Ucp.pt. (2022). <https://www.ucp.pt/pt-pt/press/morte-para-alem-da-covid-19-em-busca-do-que-explica-os-picos-de-mortalidade-em-portugal>.
16. Portugal - Population Ages 65 And Above (% Of Total) - 2022 Data 2023 Forecast 1960-2020 Historical. Tradingeconomics.com.  
<https://tradingeconomics.com/portugal/population-ages-65-and-above-percent-of-total-wb-data.html>.
17. Portugal Fertility Rate 1950-2022. Macrotrends.Net.  
<https://www.macrotrends.net/countries/PRT/portugal/fertility-rate>.
18. Falvo, R., Poscia, A., Magnavita, N., Ignazio La Milia, D., Collamati, A., & Moscato, U. et al. (2017). Health promotion for older people in Portugal. *Zdrowie Publiczne I Zarządzanie*, 15(1).  
<https://doi.org/10.4467/20842627oz.17.006.6232>
19. Portugal Adult Mortality Rate, 1950-2021. Knoema.  
<https://knoema.com/atlas/Portugal/topics/Demographics/Mortality/Adult-mortality-rate#:~:text=Adult%20mortality%20rate%20of%20Portugal,sank%20by%2047.24%20%25%20in%202020>.
20. Mota-Pinto, A., Rodrigues, V., Botelho, A., Veríssimo, M., Morais, A., & Alves, C. et al. (2011). A socio-demographic study of aging in the Portuguese population: The EPEPP study. *Archives Of Gerontology And Geriatrics*, 52(3), 304-308.  
<https://doi.org/10.1016/j.archger.2010.04.019>.
21. Doetsch, J., Pilot, E., Santana, P., & Krafft, T. (2017). Potential barriers in healthcare access of the elderly population influenced by the economic crisis and the troika agreement: a qualitative case study in Lisbon, Portugal. *International Journal for Equity In Health*, 16(1).  
<https://doi.org/10.1186/s12939-017-0679-7>
22. Sampaio, F., Nogueira, P., Ascensão, R., Henriques, A., & Costa, A. (2021). The epidemiology of falls in Portugal: An analysis of hospital admission data. *PLOS ONE*, 16(12), e0261456.  
<https://doi.org/10.1371/journal.pone.0261456>
23. Graffiti grandmas: street art for seniors | Atlas of the Future. Atlas of the Future.  
<https://atlasofthefuture.org/project/lata-65/>.
24. Fancourt, D., & Steptoe, A. (2019). The art of life and death: 14 year follow-up analyses of associations between arts engagement and mortality in the English Longitudinal Study of Ageing. *BMJ*, l6377.  
<https://doi.org/10.1136/bmj.l6377>
25. Social Security Programs Throughout The World: Europe, 2018 Portugal. Social Security Office Of Retirement And Disability Policy. (2018)  
<https://www.ssa.gov/policy/docs/progdesc/ssptw/2018-2019/europe/portugal.html>.
26. Pensions At A Glance 2019: Country Profiles - Portugal. Oecd.org. (2019)  
<https://www.oecd.org/els/public-pensions/PAG2019-country-profile-Portugal.pdf>.
27. Alves, S., & Andersen, H. (2015). Social housing in Portugal and Denmark: a comparative perspective. *Core.ac.uk*.  
[https://core.ac.uk/display/32333537?utm\\_source=pdf&utm\\_medium=banner&utm\\_campaign=pdf-decoration-v1](https://core.ac.uk/display/32333537?utm_source=pdf&utm_medium=banner&utm_campaign=pdf-decoration-v1).
28. Portugal Employment Rate - 2022 Data - 2023 Forecast - 1998-2021 Historical - Chart. Tradingeconomics.com.  
<https://tradingeconomics.com/portugal/employment-rate>.

---

### Siemens Healthineers Headquarters

Siemens Healthcare GmbH  
Henkestr. 127  
Erlangen 91052, Germany

### Published by

Siemens Healthcare GmbH  
Technology Excellence  
Technology and Innovation Management  
Innovation Think Tank Global Headquarters  
Henri-Dunant-Str. 50,91058 Erlangen, Germany  
Contact:[innovationthinktank.team@siemens-healthineers.com](mailto:innovationthinktank.team@siemens-healthineers.com)  
<https://www.siemens-healthineers.com/careers/innovation-think-tank>