SHAPES

Smart and Healthy Ageing through People Engaging in supportive Systems

D3.1 – Ecological Organisational Models of Health and Care Systems for Ageing

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Table of Acronyms and Abbreviations

Table 3 Acronyms and Abbreviations

Acronym	Full Term
ASL	*Aziende Sanitarie Locali*/ Local health authorities
CISNS	*Consejo Interterritorial del Sistema Nacional de Salud*/ Inter-Territorial Council for the National Health System (ES)
CONOPS	Concept of operations
EOPYY	*Εθνικός Οργανισμός Παροχής Υπηρεσιών Υγείας*/ National Organisation for Healthcare Provision (EL)
ESY	*Εθνικό Σύστημα Υγείας*/ National Health System (EL)
G-BA/ FJC	*Gemeinsamer Bundesausschuss*/ Federal Joint Committee
GeSY	*Γενικό Σύστημα Υγείας*/ General Healthcare System
GP	General practitioner

HPRA	Health Products Regulatory Authority (IE)
HSE	Health Service Executive (IE)
IEEE	Institute of Electrical and Electronics Engineers
INGESA	*Instituto Nacional de Gestión Sanitaria*/ National Institute of Health Management (ES)
KPI	Key performance indicator
NHS	National Health Service (UK)
NMBI	Nursing and Midwifery Board of Ireland
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
OOP	Out-of-pocket
PEDY	National Primary Healthcare Networks (EL)
RHA	regional health administration
SNS	*Serviço Nacional de Saúde*/ National Health Service (PT)
SSN	*Servizio Sanitario Nazionale*/ Department of Planning and Organization of the National Health Service (IT)
SÚKL	*Státní ústav pro kontrolu léčiv*/ State Institute for Drug Control (CZ)
YPE	Regional Health Authorities (EL)
WHO	World Health Organization

Keywords

CONOPS, activity systems, healthcare system, care system, integrated care, sociotechnical systems, innovation, homecare services, informal care, long-term care provision, health, SHAPES.

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Table of Contents

List of Figures

List of Tables

Executive Summary

This deliverable presents an analysis of the current ecological organizational models of health and care systems in Europe and identifies opportunities for SHAPES to disrupt current care paths, employing digital solutions to improve health and wellbeing and achieve socioeconomic changes at scale. Particular emphasis is put on the human factors that shape the provision of health and care services, on the interactions of healthcare professionals and informal caregivers - enabled by innovative technologies - and on the changes necessary to improve health and care provision in the EU.

The current deliverable outlines the current 'as is' situation pertaining to health and care systems providing a concept of operations (CONOPS) document. Understanding the complex 'as is' situation in the CONOPS format is valuable as it provides a framework which both reveals the gaps in the current system and provides a guide for development of the SHAPES Platform, taking account of existing processes and structures. The CONOPS seeks to ensure that all components of the proposed system will work together holistically in an integrated manner, rather than in isolated silos, and that the new system is calibrated to meet the requirements of as many end-users as possible.

Section One introduces the rationale and purpose of D3.1, i.e., to provide an analysis of existing systems towards the development of a CONOPS to support the development of the SHAPES Platform. This is done in two ways: a) by identifying and modelling the organisational, structural and systemic factors, including human factors, with reference to the legislative and ethical frameworks pertaining to EU health and care systems for the SHAPES sociotechnical ecosystem and b) by validating the ecological models of the sociotechnical health and care systems associated with active and healthy ageing and independent living to support the platform development.

Section Two outlines the theoretical and methodological approach of the task based on the IEEE (Institute for Electrical and Electronics Engineers, 2007) CONOPS standard and informed by the activity system framework based on Engeström (1987). This section also outlines the method applied in gathering data for analysis through a combination of literature review and empirical research activities involving interviews with consortium partners and questionnaires.

In Section Three we describe the elements (i.e., structures, processes and resources) pertaining to health and care systems In the EU based on which the future CONOPS will be developed. These elements include descriptions of the pilot sites which will contribute to a better understanding of the diversity and complexity of care provision across the EU (Section 3.1). In Section 3.2, we illustrate the health contexts of the pilot site countries on the basis of life expectancy at age 65, remaining healthy life years but also individual and socio-economic contributors to ill-health. In Section 3.3 we provide a detailed overview of European health and care systems. We are looking at the organisation and governance of health and care systems - illustrated by graphics, situated within the legislative and ethical frameworks that regulate health and care provision. Moreover, we are describing the factors that facilitate or hinder access to healthcare, such as healthcare funding and spending, cost, distance and waiting times that may contribute to unmet needs and catastrophic household spending, as well as the availability of health and care professionals. We are also introducing the actors that are involved in health and care provision, both formally and informally. In Section 3.4, we take a closer look at the care pathways into and out of institutional care placing particular emphasis on the criteria for and the barriers to leaving institutional care. A swimlane graphic helps the reader to get a better

understanding of the processes involved in health and care provision, the interactions between various actors and, crucially, the shortcomings. Swimlanes are an optimal tool helping to identify opportunities for SHAPES as it shows where the gaps are and how the processes would change if different elements of the Platform were implemented. In Section 3.5, we list the wide range of innovative but disparate technologies and tools currently in use at the reference site. This repository is a reference point for SHAPES, an opportunity to showcase the originality of the project by figuring out the applicability and scalability of these technologies across a wide variety of care contexts. Following on from this, in Section 3.6 we outline partners' views of the limitations and constraints of the current systems and the changes that they deemed necessary to improve health and care provision.

In Section Four (Conclusion) we provide a summary of the deliverable including the key insights and recommendations from the research. This section also details how the future CONOPS will form an integral part of the overall SHAPES project and how its application will aid the development of the SHAPES Platform and serve as a valuable "blueprint" that can be applied to a Member State's current health and care system context or adapted to guide the evolution of future health systems enabled by technological innovation.

1 Introduction

In the current deliverable D3.1 we are reporting on the findings from activities associated with the objectives of task T3.1. D3.1 presents the findings from research activities including a review of relevant reports and research studies, interviews and questionnaires seeking to gather information about health and care systems in the European Union (EU). This data will guide the development of a concept of operations (CONOPS) which provides a "blueprint" of the future, proposed system. The current deliverable provides an overview of the organisational structures, systems and processes of the health and care systems to aid the SHAPES Platform development. The CONOPS describes the current 'as is' state of health and care systems in the EU which includes a description of the pilot sites on which the CONOPS descriptions are based, an overview of the health and care systems in the respective pilot site countries, This deliverable presents an analysis of the current ecological organizational models of health and care systems in Europe and identifies opportunities for SHAPES to disrupt current care paths, employing digital solutions to improve health and wellbeing and achieve socioeconomic changes at scale. Particular emphasis is put on the human factors that shape the provision of health and care services, on the interactions of healthcare professionals and informal caregivers - enabled by innovative technologies - and on the changes necessary to improve health and care provision in the EU.

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1.1 Rationale and purpose of the deliverable

This deliverable (D3.1 "SHAPES Ecological Organisational Models") is the result of the activities associated with Task 3.1 "Ecological Organisational Models of Health and Care Systems for Ageing". T3.1 sought to identify and model the organisational, structural, and systemic factors, including human factors, for the SHAPES sociotechnical ecosystem. Based on a combination of process and structural models, a series of concepts of operations (CONOPS) will be developed to be analysed and validated by users. The task's results will be subject to analysis and validation for the identification of requirements and recommendations for the SHAPES Platform's development, use and associated policy.

1.1.1 Deliverable objectives

The core objective of D3.1 is to identify and model the organisational, structural, and systemic factors, including human factors, for the SHAPES sociotechnical ecosystem. A combination of process and structural models will be used to support the development of a series of concepts of operations (CONOPS) to be analysed and validated by users which will take place in WP6.

1.1.2 Key inputs and outputs

This deliverable is intended to support the further development of the piloting activities of work package (WP6). The outputs from D3.1 are feeding into the following WP3 tasks: T3.2, T3.4 and T3.5. D3.1, together with the deliverables associated with T3.5, is providing the foundation for the SHAPES Platform both in terms of requirements and the CONOPS. The CONOPS framework is also participatory in nature as it allows stakeholders to see themselves within the proposed system and provide feedback.

1.2 Structure of the document

Section One introduces the rationale and purpose of D3.1, i.e., to provide an analysis of existing systems towards the development of a CONOPS to support the development of the SHAPES Platform. This is done in two ways: a) by identifying and modelling the organisational, structural, and systemic factors, including human factors, with reference to the legislative and ethical frameworks pertaining to EU health and care systems for the SHAPES sociotechnical ecosystem and b) by validating the ecological models of the sociotechnical health and care systems associated with active and healthy ageing and independent living to support the platform development.

Section Two outlines the theoretical and methodological approach of the task based on the IEEE (Institute for Electrical and Electronics Engineers, 2007) CONOPS standard and informed by the activity system framework based on Engeström (1987). This section also outlines the method applied in gathering data for analysis through a combination of literature review and empirical research activities involving interviews with consortium partners and questionnaires.

In Section Three we describe the elements (i.e., structures, processes, and resources) pertaining to health and care systems In the EU based on which the future CONOPS will be developed. These elements include descriptions of the pilot sites which will contribute to a better understanding of the diversity and complexity of care provision across the EU (Section 3.1). In Section 3.2, we illustrate the health contexts of the pilot site countries on the basis of life expectancy at age 65, remaining healthy life years but also individual and socio-economic contributors to ill-health. In Section 3.3 we provide a detailed overview of European health and care systems. We are looking at the organisation and governance of health and care systems - illustrated by graphics, situated within the legislative and ethical frameworks that regulate health and care provision. Moreover, we are describing the factors that facilitate or hinder access to healthcare, such as healthcare funding and spending, cost, distance and waiting times that may contribute to unmet needs and catastrophic household spending, as well as the availability of health and care professionals. We are also introducing the actors that are involved in health and care provision, both formally and informally. In Section 3.4, we take a closer look at the care pathways into and out of institutional care placing particular emphasis on the criteria for and the barriers to leaving institutional care. A swimlane graphic helps the reader to get a better understanding of the processes involved in health and care provision, the interactions between various actors and, crucially, the shortcomings. Swimlanes are an optimal tool helping to identify opportunities for SHAPES as it shows where the gaps are and how the processes would change if different elements of the Platform were implemented. In Section 3.5, we list the wide range of innovative but disparate technologies and tools currently in use at the reference site. This repository is a reference point for SHAPES, an opportunity to showcase the originality of the project by figuring out the applicability and scalability of these technologies across a wide variety of care contexts. Following on from this, in Section 3.6 we outline partners' views of the limitations and constraints of

the current systems and the changes that they deemed necessary to improve health and care provision.

In Section Four (Conclusion) we provide a summary of the deliverable including the key insights and recommendations from the research. This section also details how the future CONOPS will form an integral part of the overall SHAPES project and how its application will aid the development of the SHAPES Platform and serve as a valuable "blueprint" that can be applied to a Member State's current health and care system context or adapted to guide the evolution of future health systems enabled by technological innovation.

2   Methodology

In this section (Section 2), we are briefly describing the activity system framework (Section 2.1) that underpins the concept of operations (CONOPS) method (Section 2.2) that we used to analyse health and care provision in Europe. In Section 2.3, we describe the research design, i.e., data collection and participants who contributed to this deliverable.

2.1 Activity system framework

Our research is underpinned by an activity system framework. Activity systems can help us understand how people and groups of people interact with each other within their particular contexts which includes their historical, sociocultural and economic backgrounds and circumstances. Engeström's (1987) activity system (Figure 1) below illustrates the different nodes - subject, object, outcome, community, instruments, division of labour and rules - within a system, and how they interact with one another.

- Subject refers to the person who is acting towards an object, or goal. In the context of SHAPES, this may be healthcare providers, healthcare receivers and their relatives, care facilities such as nursing homes or rehab facilities, health administrators, policy makers and so forth.

- Object refers to the subject's goal which may vary depending on the perspective of the individual actor. Healthcare receivers may seek to increase their participation in life whereas healthcare providers, policy makers and health administrators may seek to reduce accidents or to detect early onset dementia.

- The outcome measures whether the goals have been achieved. In the context of health and active ageing, key performance indicators (KPIs), such as a subject's ability to remain outside of institutional facilities and to maintain and independent, good quality life, or a country's ability to provide sustainable services. Aside from the subject, the achievability of the desired outcome depends on several interdependent nodes, as described below.

- The community, a subject's socio-cultural and economic context, plays an important role in mediating independent living at home. Community refers to local communities, the health system as well as the market.

- Instruments are the tools and technologies that facilitate the achievement of the **goal** and include the SHAPES Platform, robotics, trackers and monitors, computers facilitating access to electronic medical records and telemedicine, screening tools, etc.

- Division of labour means to recognize that human activities are dependent on one another and in SHAPES, the assessment, treatment, and management of a person's medical condition is dependent on the activities of the setup of the health system and the availability of relatives and friends.

- Rules are the constraints that govern activity which includes legislative and regulative frameworks, ethical considerations, procedures, and culture.

SHAPES

The nodes and relationships between them, i.e., the arrows in Figure 1, make up the activity system.
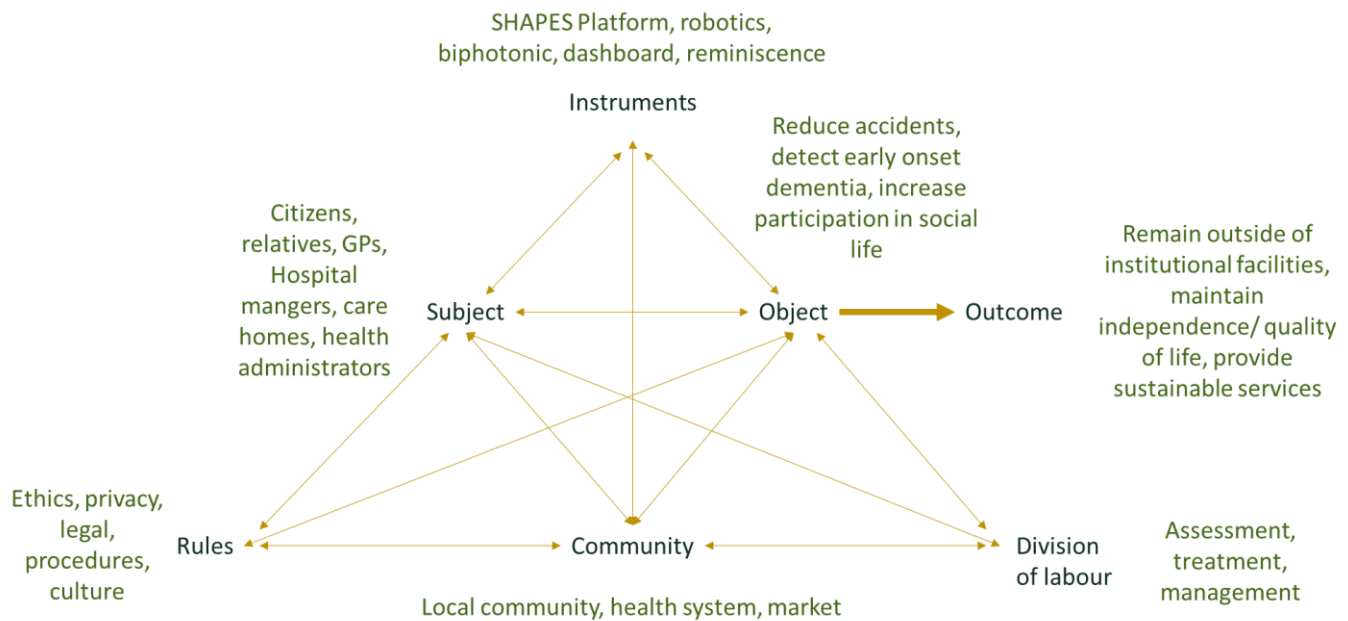
Figure 1: Own figure based on Engeström's (1987) Activity System.

2.2 Concept of Operations

SHAPES seeks to develop a platform to facilitate active and healthy ageing. D3.1 contributes to the platform development by mapping models of health systems in terms of their organisational structures, systems, and processes in different EU Member States (MS) that are involved in the SHAPES piloting activities. In order to achieve this, we are developing a Concept of Operations (CONOPS) framework and D3.1 takes the first steps of doing this by analysing how health and care is currently provided. CONOPS refers to a document which bridges the gap between users and developers by communicating the characteristics of the proposed system from the perspective of its users (Institute for Electrical and Electronics Engineers, 2007). Based on the perspectives of SHAPES partners that are involved in health and care provision, supplemented with information gathered through a review of relevant literature (see Section 2.3 for more detail), D3.1 maps existing health and care systems in the EU MS where the pilot activities will take place. This includes descriptions of the existing system, gaps and opportunities for the SHAPES Platform placing particular emphasis on the requirements and desires of the end-users. The CONOPS framework is not a static document; instead, it evolves alongside the platform development which involves several phases of review and revision in collaboration with the pilot task leaders in WP6 following the submission of D3.1, as described in more detail in Section 4 (Conclusions). The purpose of these additional iterative phases of review and revision is to identify and describe necessary changes and conflicts that may emerge during the piloting phases, and that were overlooked during the early stages of the CONOPS development (Fairley et al., 1994). Cycles of adaptation of the CONOPS are necessary to develop a holistic platform that meets the needs of all users and to avoid fragmentation. The findings based on which the CONOPS is being developed feed into other tasks (T3.2, T3.4, T3.5) and work packages (WP4, WP5, WP6) and ultimately, the final CONOPS will provide a validated description of the proposed system.

Part of the CONOPS development is the analysis of an existing system - or concept - to understand how the system operates as a whole, its current characteristics and associated challenges. This is to

ensure that all components of the proposed system will work together in an integrated manner, rather than in isolation, and meet the requirements of all end-users (Fairley et al., 1994). We are referring to the IEEE template (Institute for Electrical and Electronics Engineers, 2007) for guidance on the CONOPS development, which offers a detailed step-by-step description of the CONOPS development process. However, our approach is underpinned by the activity system framework (see Section 2.1) which addresses some of the shortcomings of the IEEE template which lacks important aspects such as agency, values, and motives. Moreover, the IEEE template is too linear. Activity system theory adds context, values, conflict (e.g., different goals and values) and conflict resolution through dialogue.

We are placing particular emphasis on the human factors of health and care systems, as well as the requirements and changes deemed necessary or desirable by the end-users. Although the CONOPS framework analysis does not focus on requirements for the SHAPES Platform *per se*, the information gathered during the concept analysis phase facilitates the formulation of Platform requirements as described in D3.7 and D3.8.

Concept analysis does not follow a linear pattern but rather, involves an iterative process of validation (Fairley et al., 1994). In D3.1, this was done through additional, clarifying conversations with SHAPES partners as well as a process of review and validation of the swimlanes graphic (Figure 47) which illustrates the pathways into and out of institutional care.

The CONOPS has several functions:

- It guides the development of the SHAPES Platform.
- It helps to identify the range of contextual factors that compose the organisational ecosystem of healthcare provision.
- It helps to capture the range of organisational models, and to identify where SHAPES may fit in.
- It helps to imagine the future operational situation with the platform to support evaluation.
- It provides a set of heuristics to not lose sight of the overall purpose of the platform in operational practice.
- As a human-activity centred concept, the CONOPS is constructed based on consultations with stakeholder involved in healthcare provision.

Figure 2 below provides an overview of the nine core categories and associated subcategories of the SHAPES CONOPS graphic which was informed by both the activity system framework described in Section 2.1 and the IEEE (2007) CONOPS template (Annex II) which outlines the basic structure of a CONOPS. For the purpose of SHAPES, this template was adapted to facilitate the analysis of European health and care systems.
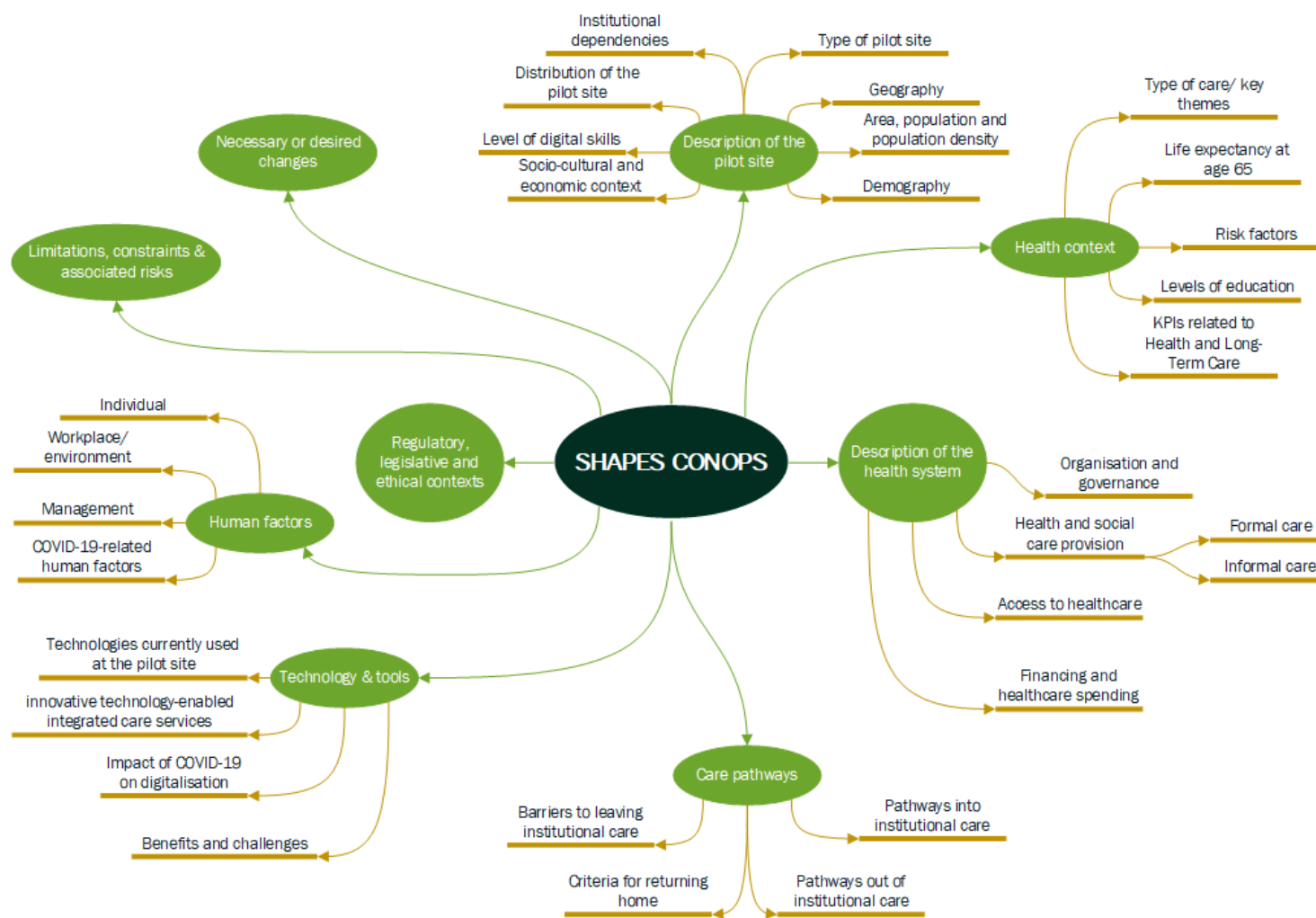
Figure 2: SHAPES CONOPS health system categories. Source: Own figure.

2.3 Research design

2.3.1 Data collection

Between February 2020 and June 2020, we gathered data through a series of video calls with SHAPES partners involved in healthcare. We had planned to visit the pilot sites in person and to interview the SHAPES partners on site but as a result of the COVID-19 pandemic, we needed to change our research strategy. Thus instead, we opted for video calls with the partners to interview them about their knowledge on and experiences with health and care provision in Europe. Several of the pilot sites were severely impacted by the pandemic and were under severe time pressure. Hence, we asked them to complete a questionnaire (Annex I) instead which also served as our interview guide. The interview calls and questionnaires allowed us to understand how care is provided within partners' local contexts. This information was supplemented by information obtained through a review of relevant studies and reports, particularly the OECD and European Health Observatory's 2019 *Country Health Profiles* series, the WHO's *Health Systems in Transition* series and the European Commission's *ESPN Challenges in Long-Term Care* series. In addition, statistics were obtained from official databases by the European Commission (Eurostat), the OECD and the WHO.

2.3.1.1 Explanation on how statistical data were used

As stated, this deliverable is based on both context-specific information gathered through interviews and official sources (see above). The tables and graphics throughout this deliverable refer to both national and regional statistics (i.e., NUTS2 and NUTS3 regions). It was not always possible to obtain statistical data pertaining to the specific regions and cities of the pilot sites and hence, we used the statistic closest to the respective pilot site. For example, although the pilot site in Cyprus is located in its capital city Nicosia, data specific to the catchment area was not available on the databases.

2.3.2 Ethical considerations

We did not collect any personally identifying data. Prior to data collection, informed consent was obtained from each interview partner. All participants were informed that no personally identifiable data was going to be used in the deliverable, that their participation was voluntary and that they were free to leave at any time.

2.3.3 Participants: An overview of the SHAPES pilot sites

Participants were recruited from SHAPES consortium partners involved in the piloting activities. Moreover, an additional informant – USIDEC - was recruited from outside the consortium with the help of the University of Aveiro. An additional informant, a nursing home in Aveiro, had agreed to participate in principle but due to time pressures as a result of the on-going COVID-19 pandemic, the interview did not materialise. Participants (listed in Table 4) were interviewed for their expertise on health and care provision in Europe. The respective pilot sites were selected for the interviews because they are diverse in terms of geographical location, geographical, socio-economic and demographic characteristics, healthcare models and governance as well as key/ care themes. As stated, the interviews enabled us to better understand how care provision takes place within localised contexts and the specific, localised challenges encountered by the pilot sites. This allowed us to identify trends in health and care provision in those EU countries in which the pilot sites are located. In the following section (Section 3), we describe the health and care systems reviewed for D3.1.

Name of pilot site	Country	Name of associated SHAPES partner organisation
University of Nicosia Research Foundation (UNRF) and University of Nicosia Medical School (UNIC)	Cyprus	University of Nicosia Research Foundation (UNRF)
University Hospital Olomouc	Czech Republic	UP/FNOL
Health Region Cologne Bonn (HRCB) (reference site since 2019, before reference site Oberbergischer Kreis (2016-2019), now included in HRCB-reference site)	Germany	GEWI- Institut für Gesundheitswirtschaft e.V.
Saxon State Ministry of Social Affairs and Consumer Protection (SMS)	Germany	Carus Consilium Sachsen (CCS)
LLM Care Ecosystem	Greece	AUTH
5th Regional Health Authority (5th YPE) – Local HealthCare Centres	Greece	5th Regional Health Authority (5th YPE)
Centre of Gerontology & Rehabilitation	Ireland	UCC
Northern Health & Social Care Trust (NHSCT)	Northern Ireland	Medicines Optimisation Innovation Centre (MOIC)
Porto4Ageing – Competence Centre on Active and Healthy Ageing of University of Porto	Portugal	University of Porto
Clinica Humana	Spain	CH
Asociación Benéfico Social "El Salvador"	Spain	Asociación Benéfico Social "El Salvador" (SAL)
WeCareMore Centre for Research and Innovation of AIAS Bologna onlus	Italy	AIAS Bologna onlus
USIDEC – Universidade Sénior de Cacia	Portugal	IDEC – Instituto para o Desenvolvimento e Estudos de Cacia

Table 4: Pilot sites that participated in the research

3 Health and care systems in selected EU countries: An overview

In this section (Section 3) we describe the health systems in selected EU countries. The information is based on 13 pilot sites in nine countries including Cyprus, Czech Republic, Germany, Greece, Ireland, Italy, Portugal, Spain and the UK (Northern Ireland). The reference sites were diverse in terms of geography, socio-cultural and economic context, institutional dependencies and roles. We unpack each point in the following sections.

3.1 Description of the pilot sites

In this section (Section 3.1) we provide a summary overview of the characteristics of the pilot sites on which we based our exploration of the healthcare systems in the European Union (EU). A fuller description of the pilot sites is available in Annex III.

3.1.1 Type of Pilot sites

Figure 3, as well as Table 5 and Table 6, provide an overview of the SHAPES pilot sites which include regional areas, hospitals, nursing homes, specialised service providers, one residential care facility, universities and research centres, and multi-agency partnerships.

Figure 3: Countries which participated in the research for D3.1. Own graphic created with mapchart.net

Types of pilot sites			
Country	Name of pilot site	Type of pilot site	Type of care/ key themes
Cyprus	University of Nicosia Research Foundation (UNRF); University of Nicosia Medical School (UNIC)	Research organization	Challenges to modern life from a wide range of perspectives, including technological and scientific advances, modern culture and thought
Czechia	University Hospital Olomouc (UHO)	Teaching hospital	Chronically ill patients with heart diseases, palliative care, anticoagulation treatment General healthcare to older people, people with chronic and cardiovascular illnesses general complex and specialised medical care
Czechia	Czech National eHealth Centre	Health centre associated with UHO	Innovations in healthcare in the region development and scaling up of eHealth infrastructure, services and applications
Germany	Health Region Cologne Bonn (HRCB); Oberbergischer Kreis	Regional area District	Resource for regional development digital health / health development corporate health management medicine technology care in rural areas healthy ageing regional development
Germany	Federal State of Saxony (Sachsen)	Federal State	General medical care provision
Greece	5th YPE	Regional health authority	Active Ageing and Independent Living Safe and secure traveling despite existing health problems Prevention/ Screening Empowering older people who are socially isolated
Greece	LLM Care (Long Lasting Memories Care) Health and Social	Multi-agency partnership comprised of academic/ research organisations, health/tech providers, regional policymakers,	Care and rehabilitation services for older people

		and civil society organizations	
Ireland	Centre of Gerontology and Rehabilitation at St. Finbarr's Hospital	Hospital	Rehabilitation following a stroke Rehabilitation for people aged 65+ years old Physiotherapy Occupational therapy and physiotherapy for people who are 65+, who have had a fall or are at risk of falling
Italy	WeCareMore Centre for Research and Innovation of AIAS Bologna onlus	Regional Centre for Assistive Technology	consultancy services and partnerships to bodies in the public and private sectors focussing on "the use of digital technologies in the health and social care sector" (AIAS)
Portugal	Porto4Ageing	Multi-agency partnership comprised of academic/ research organisations, health/tech providers, regional policymakers, and civil society organizations	Active ageing and Independent Living Care and Cure Prevention, screening and Early Diagnosis Focus on driving structural change regarding health and care provision in the Porto Metropolitan Area
Portugal	USIDEC	University for adults aged 55 years or older	Provision of education to older adults Attempts to tackle loneliness among older adults
Spain	El Salvador	Residential care facility	care for older people who are retired often people with dementia
Spain	Clinica Humana	Private clinic	Care for people with chronic illnesses, degenerative diseases such as dementia and Parkinson's Disease, cancer Often people with multiple co-morbidities Physical rehabilitation Palliative care
Northern Ireland/ United Kingdom	Northern Health and Social Care Trust	Health and social care trust	Provision of health and social care Acute services Psychiatric inpatient care (Holywell Hospital) Acute mental healthcare (Ross Thompson Unit in Causeway Hospital)

Table 5: Types of pilot sites

Most pilot sites are situated in mixed (i.e., urban-rural) geographical settings and include districts (CZ, DE), regional areas (EL, IE, PT), autonomous communities (ES), one federal state (DE) and one country (Northern Ireland, UK). Two pilot sites are located in cities: UNRF/UNIC (Nicosia, CY) and the WeCareMore Centre for Research and Innovation (Bologna, IT), and one pilot site is situated in the small village of Pedroche in the autonomous community of Andalucía in the South of Spain. Consequently, geographical characteristics and population density vary vastly as illustrated in Figure 4 which has implications for access to care, as described, for example, in Section 3.3.3.4 Unmet needs
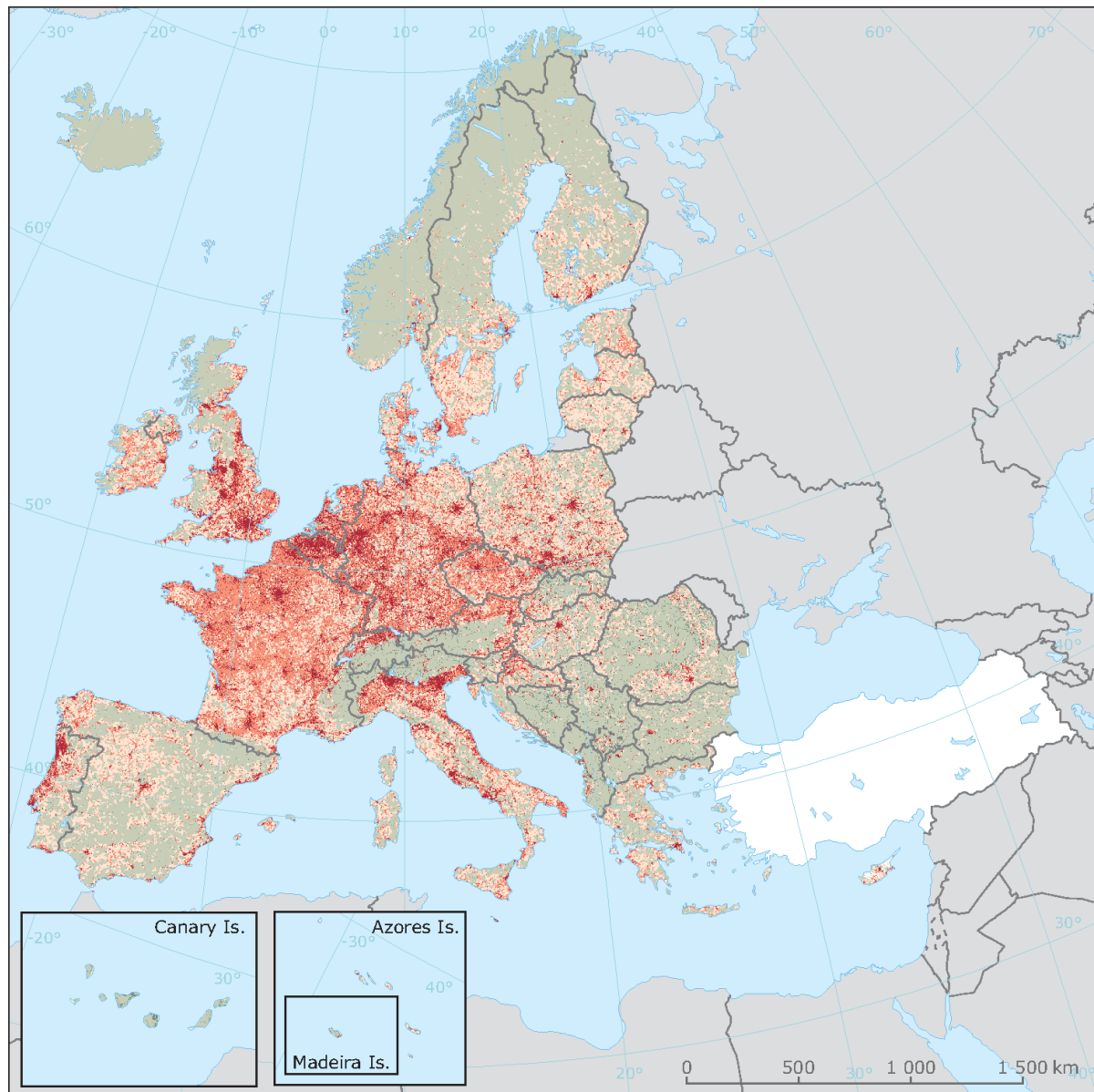
Fragmentation pressure and population density in EEA member countries

		Population density (Number of residents per 1km²)	
		< 100	**> 100**
Fragmentation pressure class	Very low	Low fragmentation over sparsely populated areas	Low fragmentation over densely populated areas
	Low		
	Medium	Average fragmentation over sparsely populated areas	Average fragmentation over densely populated areas
	High	High fragmentation over sparsely populated areas	High fragmentation over densely populated areas
	Very high		

No data

Outside coverage

Figure 4. European Environment Agency, 2018. Fragmentation pressure and population density in EEA member countries. https://www.eea.europa.eu/data-and-maps/figures/fragmentation-pressure-and-population-density.

and catastrophic household spending, particularly for older adults who live in rural areas. This presents an opportunity for SHAPES to utilise innovative technologies, such as telemedicine and teleconsultations, to provide care for older people who live remotely.

Pilot sites: Geographical characteristics				
Pilot site	Geographical area	Population density	Geographical characteristics	Challenges caused by geographical makeup
Cyprus (CY)	Urban (Capital City of Nicosia)	94.4 p/km²[1]	Island country. Mountainous. Geo-political divide (Republic of Cyprus and Turkish Republic of Northern Cyprus)	None identified
Region of Olomouc (CZ)	Urban and rural (district)	121.4 p/km²	Region with approx. 640,000	None identified
Health Region Cologne Bonn (DE)	Urban and rural (district)	299.7 p/km²	3 cities and 7 regional districts including Oberbergischer Kreis. Very hilly area with many dams	Parts of the area impassable in the winter Barriers to accessing healthcare
Sachsen (DE)	Urban and rural (federal state)	224.5 p/km²	Cities and regional districts. Cities much more densely populated than the regions	Fewer GPs in rural areas Barrier to accessing healthcare
Thessalia/ Sterea Ellada (EL)	Urban and rural (regional areas)	51.7/ 36.0 p/km²	Greece general: Peninsula; mountainous and fragmented (many islands)	Imbalances in access to health care services, especially for residents of remote areas, small and isolated islands. Major issues regarding access to specialist consultants and laboratories Health care recipients may be forced to move to urban centres in order to receive efficient and appropriate services
Region of Central Macedonia (EL)	Urban and rural (regional area)	100.0 p/km²		
Pedroche (ES)	Rural (village in autonomous community of Andalucía)	12.5 p/km²	Village of Pedroche, located in the province of Cordoba. Cordoba is one of six provinces of the Autonomous Community of Andalucia in the South of Spain. One city (Cork) and nine towns, including Tralee in Co. Kerry.	None identified
Mallorca (Balearic Islands, ES)	Urban and rural (island and autonomous community)	252.0 p/km²	Island country, part of an archipelago off the Spanish mainland	None identified

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[1] Data on population density only available for the whole country of Cyprus.

South-West of Ireland (IE)	Urban and rural (regional area)	57.8 p/km^2	Catchment area of the pilot site covers the counties of Cork and Kerry.	None identified
Bologna (IT)	Urban-rural (city of Bologna, region of Emilia-Romagna)	Bologna: 275.5 p/km^2 Emilia-Romagna: 201.7 p/km^2	Bologna is the capital city of the Emilia-Romagna region in the North of Italy. The region comprises of nine provinces	None identified
Porto Metropolitan Area (PT)	Urban and rural (metropolitan area)	849.1 p/km^2	City located in a metropolitan area in the north of Portugal. Densely populated area.	None identified
Region of Aveiro (PT)	Urban and rural (regional area)	221.0 p/km^2	City and municipality in northern Portugal. Part of 11 municipalities, forming the intermunicipal community of the Region of Aveiro	None identified
NHSCT Area (UK)	Urban and rural (country/ region of Northern Ireland)	572 p/km^2	1.8 million people in the catchment area living in urban, rural and semi-urban communities	None identified

Table 6: Population density by NUTS 3 Region. Source: Eurostat, 2020. DEMO_R_D3DENS. Data are from 2018.

3.1.2 Gender, age and socio-economic characteristics of the pilot sites/ countries

This section provides contextual data relating to demographics (gender and age) and socio-economic aspects of the pilot site countries. Where possible, we show information pertaining to the pilot sites, or to the regions in which the pilot sites are located to demonstrate how varied the age profiles and socio-economic factors are. Where this was not possible, we provided national data.

Approximately one fifth of Europeans are 65 years old or over and the OECD predicts that this share will rise to one third (29.3%) by 2060. However, the age profiles in the different countries and regions were far from homogeneous in 2019 and the proportion of adults aged 65 years old or older ranged from 14 percent in Ireland to 23 percent in Italy. There is also some variation within countries. For example, Germany's population aged 65 and over was 22 percent yet in Saxony, this share was as high as 26 percent. Similarly, in Italy 20 percent were 65 years old or older but in the Region Emilia-Romagna (the region where Bologna is located), this was 24 percent (Figure 5).

There were also differences in sex. As women tend to live longer than their male counterparts, the share of women aged 65 or over is four percent higher than the share of men. However, as addressed in Section 3.2.1 (Trends in life expectancy), a longer life span does not equal healthy life years. As illustrated in Section 3.4.1, older people are more likely to experience health limitations and comorbidities and hence, will require more care. Yet, as described in Section 3.3.3 and Section 3.6.1, shortages of care professionals and care facilities are already posing difficulties for the adequate provision of care.
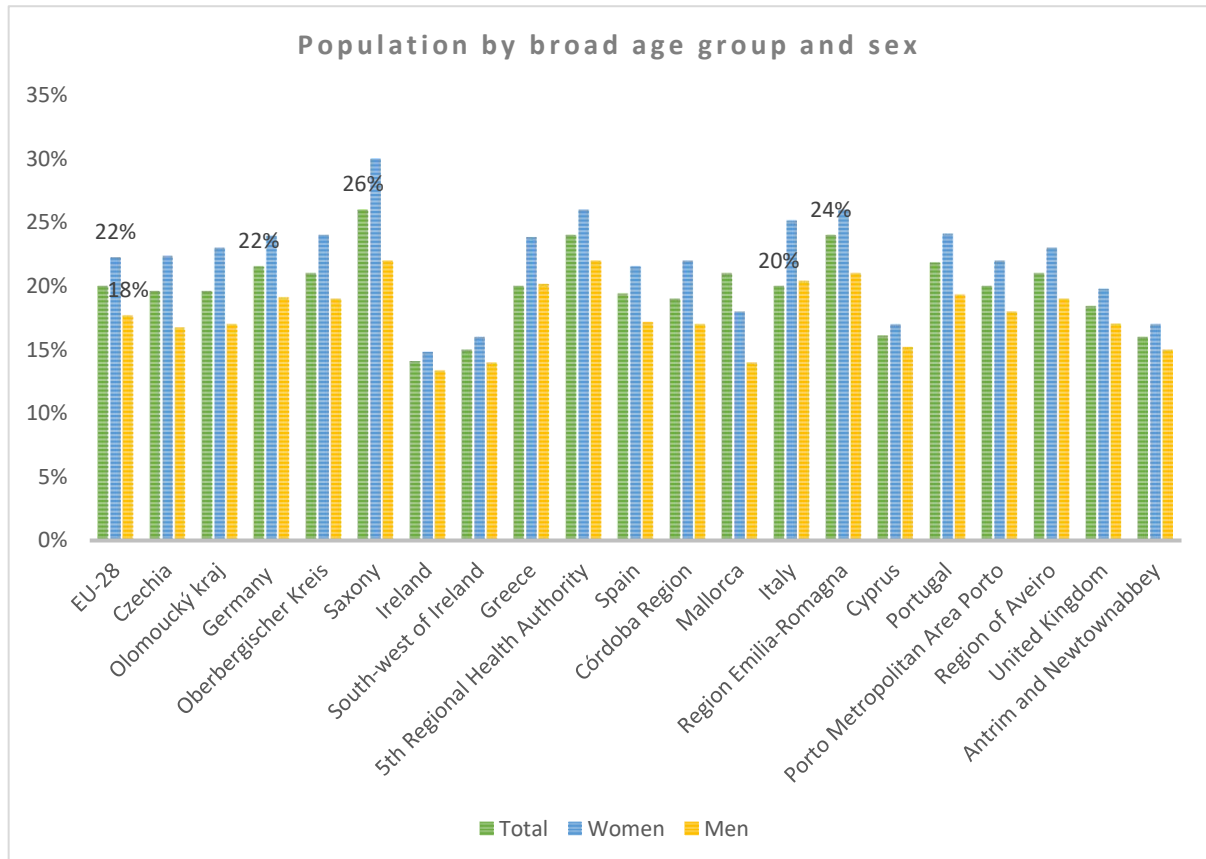
Figure 5: Population on 1 January by broad age group and sex. [demo_pjanbroad]. Eurostat, 2020. Population on 1 January by age group, sex and NUTS 3 region. Eurostat, 2020. [DEMO_R_PJANGRP3]. Figures are from 2019.

Real GDP per capita (Figure 7), unemployment rates[2] (Figure 6) and poverty rates (Figure 8) are also presented in this section. This is important for the development of the SHAPES Platform because as described throughout the deliverable, notably in Section 3.3.3, healthcare financing, household income and out-of-pocket household expenditure is linked to health outcomes and access to care, and particularly those in the lowest income group. The data presented here is intended to provide context that illustrates the vast differences that exist between countries. Particularly the comparatively high unemployment rates in some countries (e.g.,EL, ES, IT) (Figure 6) and their vulnerability to poverty (Figure 8) impacts on their citizens' ability to access care. This needs to be taken into account by both policy makers and by the developers of the SHAPES Platform as its success is dependent on both affordability and sustainability.
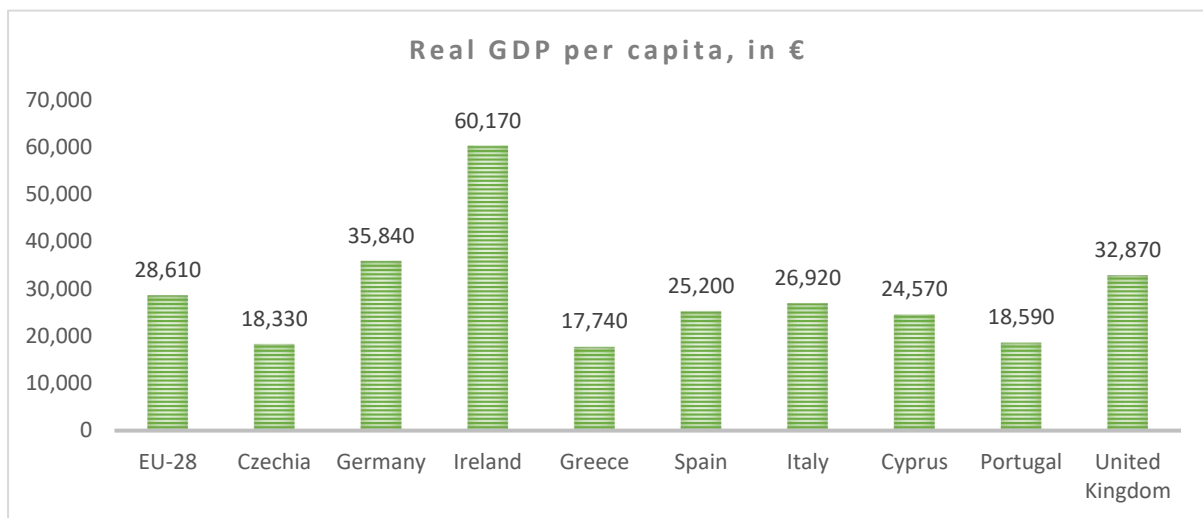
Figure 7: Real GDP per capita. Eurostat, 2020. [SDG_08_10]. Figures are from 2019.
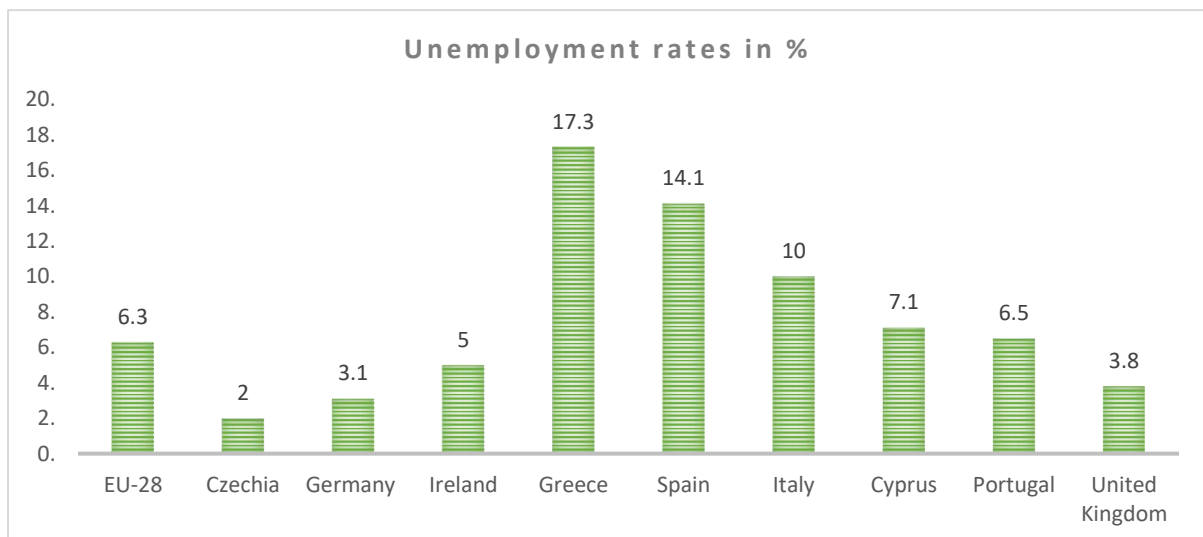
Figure 6: Unemployment rates in percent. Eurostat, 2020. [une_rt_a]. Figures are from 2019.

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[2] These figures were not adjusted for unemployment as a consequence of the COVID-19 pandemic.
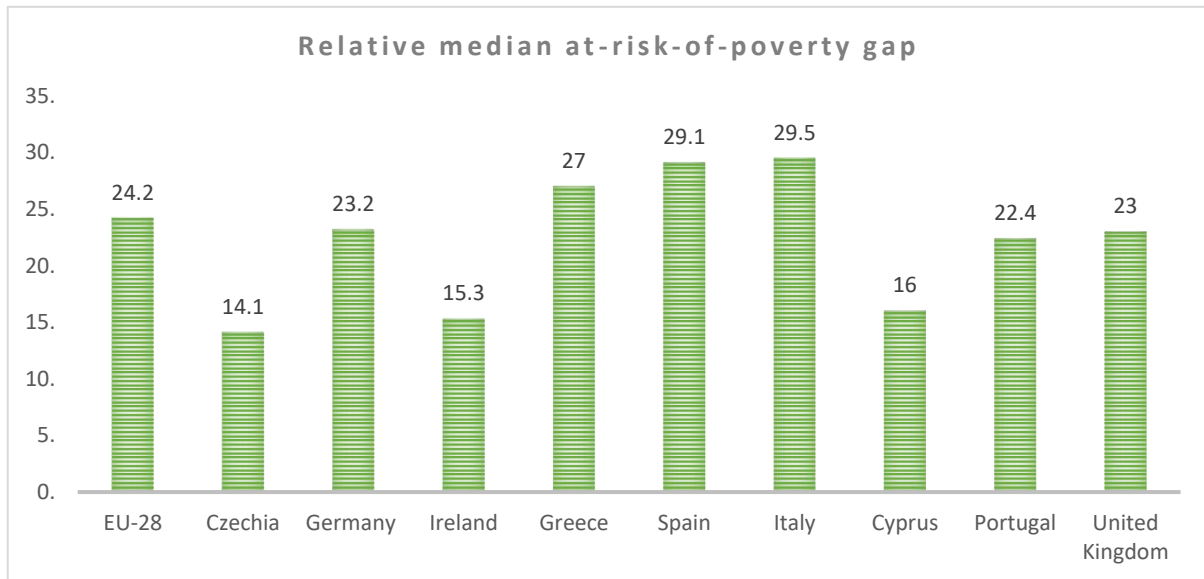
Figure 8: Relative median at-risk-of-poverty gap. Eurostat, 2020. [SDG_10_30]. Figures refer to 2019 or latest available. Data for Ireland, Italy and the UK are from 2018.

3.1.3 Digital skills and ICT usage

Digitalisation and ICT usage play an important role in the development of the SHAPES platform and hence, this deliverable takes into account digital skills and ICT usage among older people. Digital skills refer to a person's ability to navigate digital environments using digital technologies, such as mobile devices, internet platforms and social media.

Figure 9 shows the level of digital skills among the age group 65 to 74 years old in 2019 demonstrating that most people in this age group have some digital skills: only two percent overall have no digital skills. In the EU-28 MS, 19 percent had basic overall digital skills, and eight percent had above basic overall digital skills. However, about one third had low overall digital skills and this share was highest in Ireland (43%) and in the UK and Spain (both 39%), compared with Portugal and Greece (both 19%) and Italy (24%).
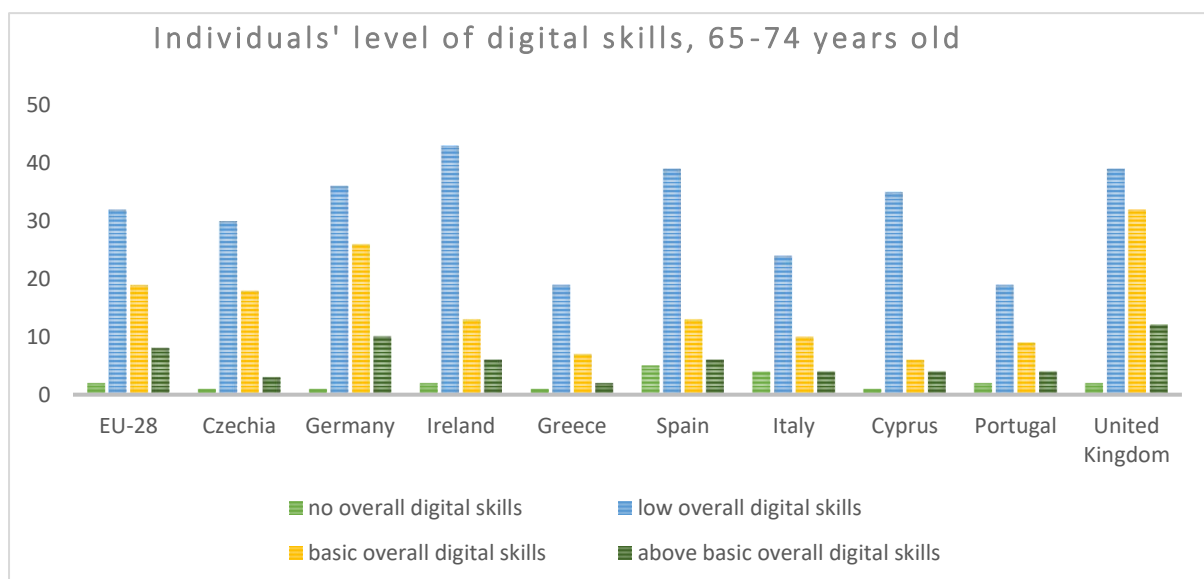
Figure 9: Individuals' level of digital skills. Eurostat, 2020. [isoc_sk_dskl_i]. Figures are from 2019.

Digital skills also varied considerably across the other pilot site countries. Although the UK had one of the highest percentages of low overall digital skills, the country also had the highest share of both basic digital skills (32%) and above basic digital skills (12%). The situation was comparable in Germany. By contrast, Cyprus (6%) and Greece (7%) had the lowest levels of basic overall digital skills, and Greece (2%) and Czechia (3%) had the lowest levels of above basic digital skills.

Figure 10 shows that approximately three quarters of the overall EU-28 population had accessed the internet using a desktop computer, laptop, netbook, or tablet, and approximately half of the 65 to 74-year olds used such ICT devices. Data for the age group 75 years old or older was only available for Spain (12%) and Italy (7%). However, these percentages varied considerably from country to country. The share of the overall population using such devices was highest in Germany (88%) and in the UK (87%) and lowest in Italy (51%) and in Cyprus (60%). Among the age group 65-74 years old, this share was highest in the UK (79%) and in Germany (67%) and lowest in Greece (20%) and in Italy (25%).
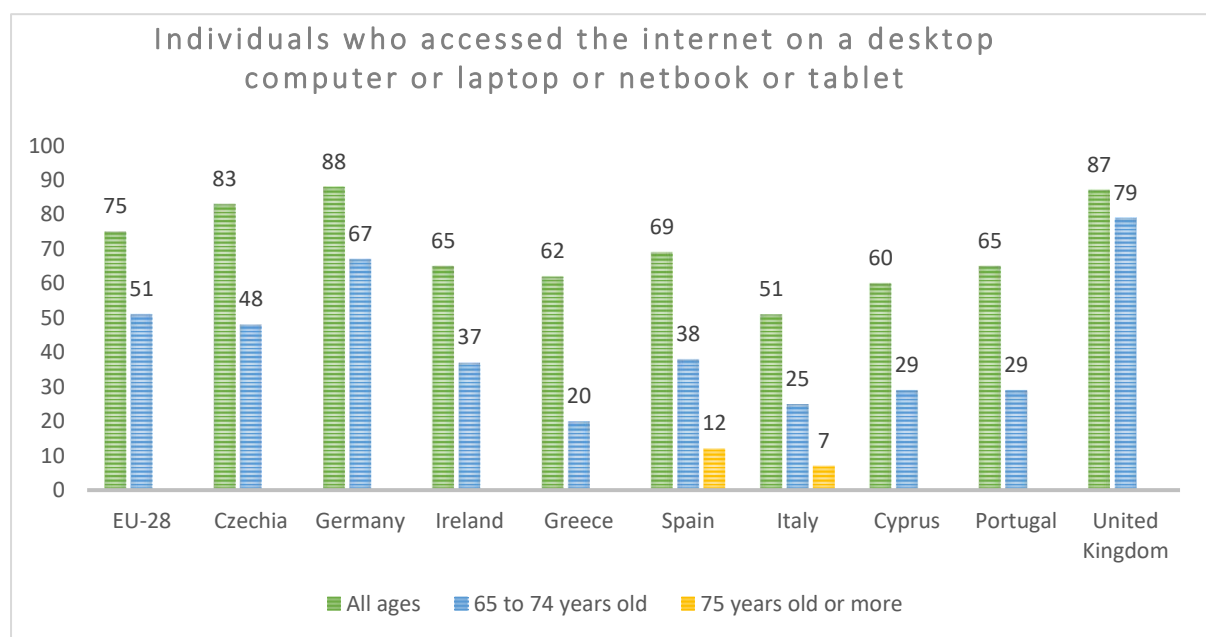
Figure 10: Individuals - devices used to access the internet. Eurostat, 2020. [ISOC_CI_DEV_I]. Figures are from 2018.

Figure 11 illustrates the percentage of individuals who accessed the internet via mobile phone or smart phone. Although approximately three quarters of the overall EU-28 population used such phones, only about 34 percent of the age group 65-74 years old used these. Again, data relating to the 75 years plus age group was only available for Spain (11%) and Italy (6%). Mobile or smart phone usage varied greatly across the reviewed countries. Mobile/smart phone use was highest among the overall population in the UK (84%) and Spain (83%) and lowest in Greece (59%) and Czechia (64%). Similarly, the highest proportion of mobile/smart phone users among the 65 to 74-year olds was in the UK and in Germany (both 48%), compared with Greece (12%) and Czechia (15%).
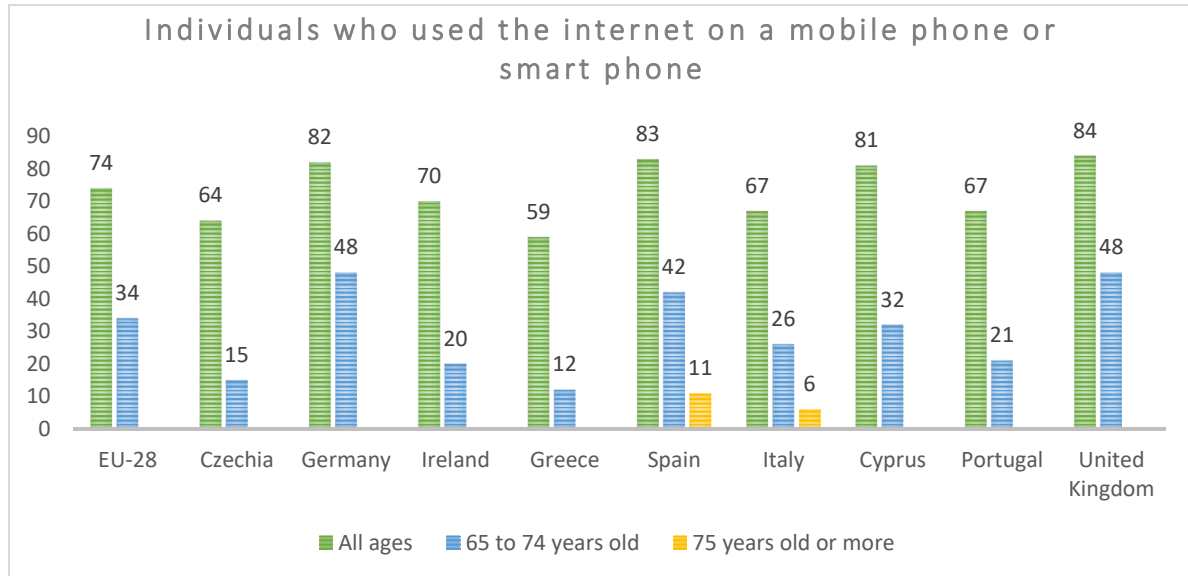
Figure 11: Individuals - devices used to access the internet. Eurostat, 2020 [ISOC_CI_DEV_I]. Figures are from 2018.

3.2 Health contexts in EU countries

In this section (Section 3.2), we describe the health context in the EU. In this section, we look at trends in life expectancy and at contributors to ill-health. As there are vast differences with regards to life expectancy and contributors to ill-health, we present the data pertaining to all 28 EU countries. These national health contexts set the scene for the illustration of the care pathways in Section 3.4 and for the health limitations which impact on the lives of some older adults (Section 3.4.1).

3.2.1 Trends in life expectancy

3.2.1.1 Life expectancy at age 65 years

Across the EU, people are living longer. As illustrated in Figure 12, in 2018, a 65-year-old person could, on average, expect to live another 20 years with women's life expectancy being slightly higher at 21.5 years than men's (18.2 years). Yet, much variation in life expectancy exists across EU countries. In 2018, in sixteen countries life expectancy was equal to the EU average (NL, Sl), slightly above average (AT, UK, BE, PT, IE, FI, SE) or above average (CY, LU, EL, MT, IT, ES, FR). Spain and France were the countries with the highest number of remaining years at age 65 with 21.9 years and 21.6 years, respectively. By contrast, in the remaining 12 countries, life expectancy was slightly below the EU average (DE, DK, EE), below average (PL, CZ, HR, SK, LT, LV, HU, RO, BG) with the shortest span of remaining years in Romania (16.7) and Bulgaria (16.2). In all countries, women tend to live between 2.2 and 5.2 years longer. The UK (2.2), the Netherlands (2.4) and Sweden (2.4) are the countries with the smallest age gap, whereas Latvia (4.9), Estonia (4.9) and Lithuania (5.2) are the countries with the widest age gap. A recent report by the OECD and EU (2018) attributed the gender gap in longevity to diseases (e.g.,heart diseases, cancer) linked to behavioural risk factors in men, including greater levels of alcohol and tobacco consumption and unhealthy diets.
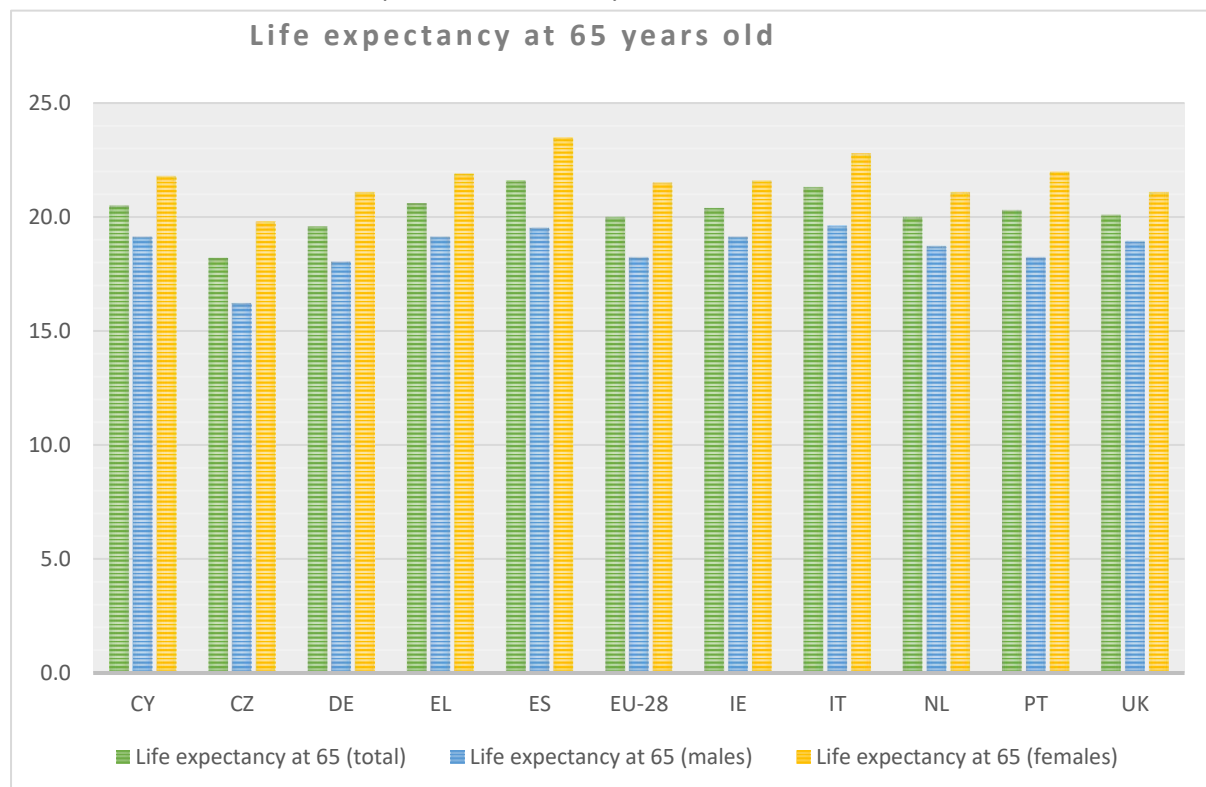
Figure 12: Life expectancy at age 65, by sex Eurostat, 2020.[tps00026]. Data are from 2018.

3.2.1.2 Healthy remaining life years at age 65 years

Although Europeans are living longer, this does not necessarily mean that they will also live healthily, i.e., free of disability (OECD & European Union, 2018). According to Eurostat (2018) figures, only about fifty percent of remaining life years were spent free from disability (Figure 13). However, there was wide variation between countries. The highest share of healthy life years was in Sweden (77%), Malta (69%) and Ireland (63%), whereas the countries with the lowest proportion of healthy life years were Slovakia (25%) Latvia (26%) and Croatia (28%). Only nine countries (BE, BG, DE, DK, ES, IE, MT, SE, UK) had higher than average shares of healthy remaining life years.
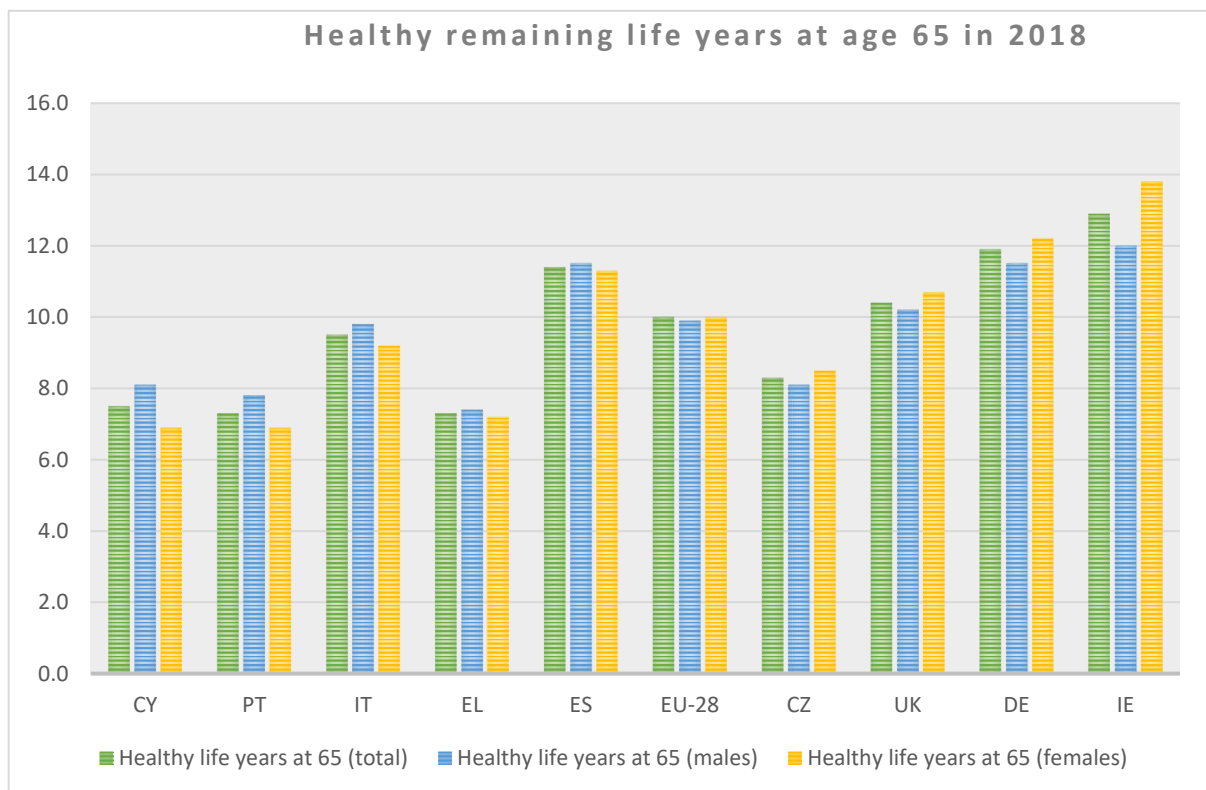
Figure 13: Healthy remaining life years by sex (from 2004 onwards). Eurostat, 2020. [hlth_hlye]. Data are from 2018.

Although women tend to live longer than men, this does not necessarily healthy years. In 2018, the average proportion of healthy life years was lower for women (47%) than for men (53%). In five countries (CY, EL, ES, IT, PT) the number of healthy life years was below average. By contrast, the number of healthy life years was above average in the remaining four countries (CZ, DE, IE, UK) (Statistical Office of the European Union, 2018). According to the OECD and EU (2018), the proportion of healthy life years is greater in men than in women, for two reasons: women live longer than men, and women tend to "report more activity limitations due to health problems at any given age" (p. 86). In 2018, the number of healthy life years was greater for men than women in sixteen EU/UK countries.

In eleven countries, the number of remaining healthy life years was slightly higher for women than for men.

3.2.2 Contributors to ill-health: Individual risk factors and socio-economic disparities

A range of factors may contribute to ill-health later in life, such as genetic predispositions and accidents, but also individual behaviour and socio-economic inequalities which, to some extent, is related to access to healthcare. This section (Section 3.2.2) compares and contrasts individual risk factors and socio-economic inequalities. 'Access to healthcare' will be described more fully in Section 3.3.3. Individual risk factors contributing to preventable mortality include poor diets and low levels of physical activity which may also contribute to obesity, as well as the consumption of tobacco and alcohol. Although risk behaviours appear to play a role in gender differences in life expectancy, socio-economic inequalities has also been linked to adverse health outcomes (OECD & European Union, 2018). Eurostat figures demonstrate a clear association between income and diet, as well as income and levels of physical activity.

3.2.2.1 Diet: Daily consumption of fruit and vegetables

The World Health Organization recommends a daily fruit and vegetable intake of 400 grams, or five portions which tends to be a measure of a healthy diet. According to Eurostat figures for 2014 pertaining to the EU-28 MS, only fourteen percent ate five portions or more, compared to 34 percent who consumed zero portions per day. Generally, people in the lower income brackets also ate fewer portions of fruit and vegetables per day than people in the higher income brackets. As illustrated in Figure 14, 41 percent in the first quintile did not eat any fruit and vegetables, compared with 30 percent in the highest (5th) quintile. The proportion of fruit and vegetables consumed per day increases across all five income brackets. Although not even one fifth of EU-28 citizens come close to the recommended fruit and vegetable intake (i.e., five portions per day), this is generally higher among higher income earners. As shown in Figure 14, only 12 percent in the lowest income bracket (1st quintile) ate the recommended portions per day, compared to 17 percent in the highest income
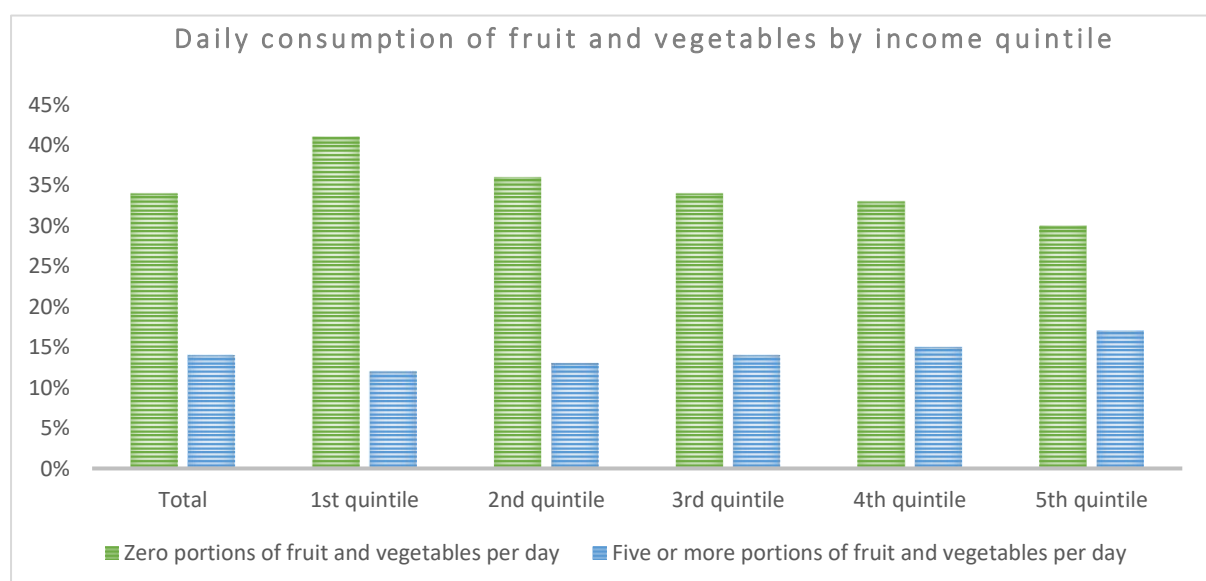
Figure 14: Daily consumption of fruit and vegetables by income quintile. Eurostat, 2020. [hlth_ehis_fv3i]. Data are from 2014.

bracket (5th quintile). Again, the higher people's income, the higher the recommended intake of fruit and vegetables. However, there is significant variation across the EU-28 MS. The proportion of people who consumed zero portions of fruit and vegetables per day was much higher in low-income countries (RO: 65%, BG: 59%, 55%) than in high-income countries. Yet, there was also a significant proportion of high-income countries where fruit and vegetable consumption is low, such as Germany.

3.2.2.2 Exercise

The association between health indicators and income can also be observed with regards to non-work-related exercise. In 2014, people in the lowest income group (1st quintile) reported that they did not exercise at all, i.e., zero minutes per week. Among the EU-28 MS, 49 percent did not engage in any exercise per week, compared to 57 percent in the lowest income group and 39 percent in the highest income group (5th quintile) (Figure 15). Likewise, people in higher income groups were more likely to exercise for 1 to 149 minutes per week than people in lower income groups. On average (EU-28), twenty percent exercise between 1 and 149 minutes per week, compared to 18 percent in the lowest income group and 23 percent in the highest income group. When compared across all income group, there appears to be a clear trend: the higher the income, the more people seem to exercise.
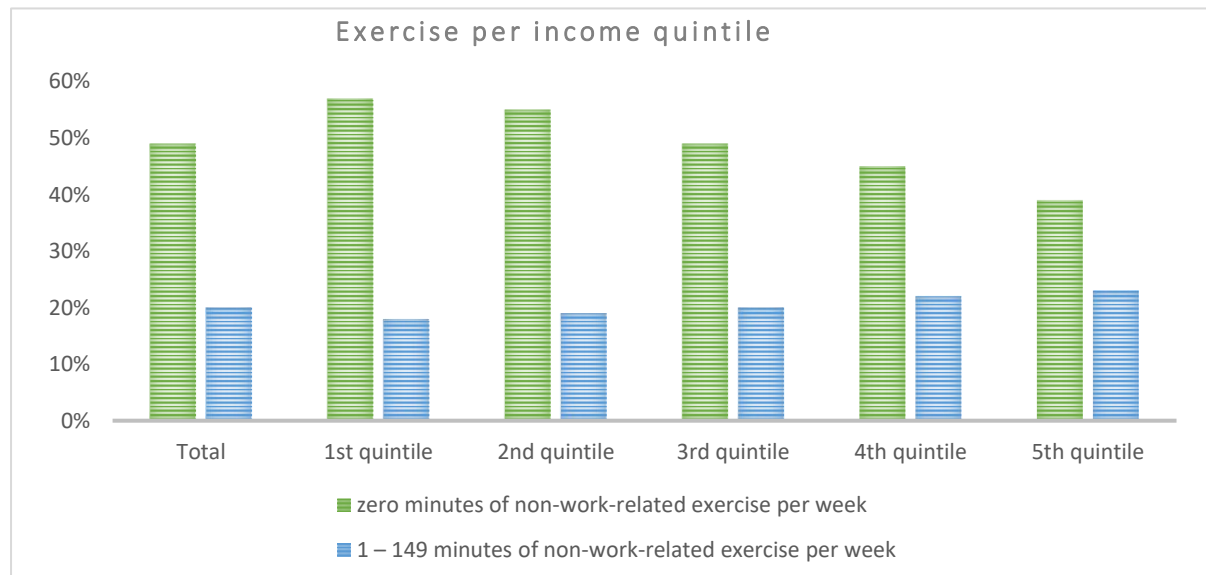
Figure 15: Time spent on health-enhancing (non-work-related) aerobic physical activity by income quintile. Eurostat, 2020. [hlth_ehis_pe2i]. Data are from 2014.

Another interesting finding was that the countries with the lowest real GDP per capita – Romania and Bulgaria (not represented in the figure which only refers to the EU average) - also had the highest proportion of people who do not exercise at all or engage in moderate-duration exercise (i.e., one to 149 minutes per week). In Romania and Bulgaria, 84 percent and 83 percent respectively did not exercise at all, compared with the EU-28 average of 49 percent. In both countries, only seven percent said that they engaged in moderate-duration exercise, compared with the EU-28 average of 20 percent. In 2014, Romania's GDP was €7,020 and Bulgaria's was €5,530 compared with an EU average GDP of 26,140. The GDP per capita in all countries with the lowest levels of exercise (i.e., zero minutes) was lower than the EU-28 average (€26,140). This list also includes some Eastern European countries, i.e., the Baltic States and Poland. In 2014, the exception was Ireland (53%), the country with the fourth-highest GDP per capita (€39,920). By contrast, higher-income countries (AT, DE, DK, FI, LU, SE) had the lowest proportion of people who never exercised ranging from 19 percent in Denmark to 37 percent in Luxembourg.

However, the association between GDP and levels of weekly exercise is not as straightforward as the within-country comparison. Many of the countries with the lowest levels of exercise (i.e., zero minutes) are also southern EU countries (CY, EL, ES, FR, HU, IT, PT). The situation also changes when moderate levels of exercise are concerned. Although higher-income countries (except Ireland) still engage in above-EU average levels of exercise, the list also includes all of the Eastern EU MS except Bulgaria and Romania, and two of the Southern EU MS – France and Croatia. Hungary, Denmark and France were the countries with the highest levels of moderate exercise (HU: 28%, DK: 27% and FR: 26%).

3.2.2.3 Obesity

Nutritional state and hence, obesity, is assessed through the so-called Body Mass Index (BMI). Adults whose BMI is below 18.5 are underweight. According to the WHO, a BMI of between 18.5 and 24.9 is deemed normal, 25.0 to 29.9 is classed as overweight or pre-obese, and anything above 30.0 falls into three obesity classes (World Health Organization Regional Office for Europe, n.d.). As shown in Figure 16, lower income earners tend to have a higher BMI than higher-income earners. In 2014, overall 47 percent had a normal BMI compared to 15 percent in the obese category. However, while 50 percent in the highest income group had a normal BMI, only 44 percent in the 2nd quintile, 46 percent in the 3rd quintile and 47 percent in the 1st and 4th quintile had a normal BMI. This discrepancy was even more pronounced among people with an obese BMI. While 18 percent in the two lowest income groups were classed as obese, it was only 12 percent in the highest income group. As shown in Figure 16, the higher the income group, the lower the levels of obesity which is related to "premature death, cardiovascular diseases, high blood pressure, osteoarthritis, some cancers and diabetes" (World Health Organization Regional Office for Europe, n.d.).
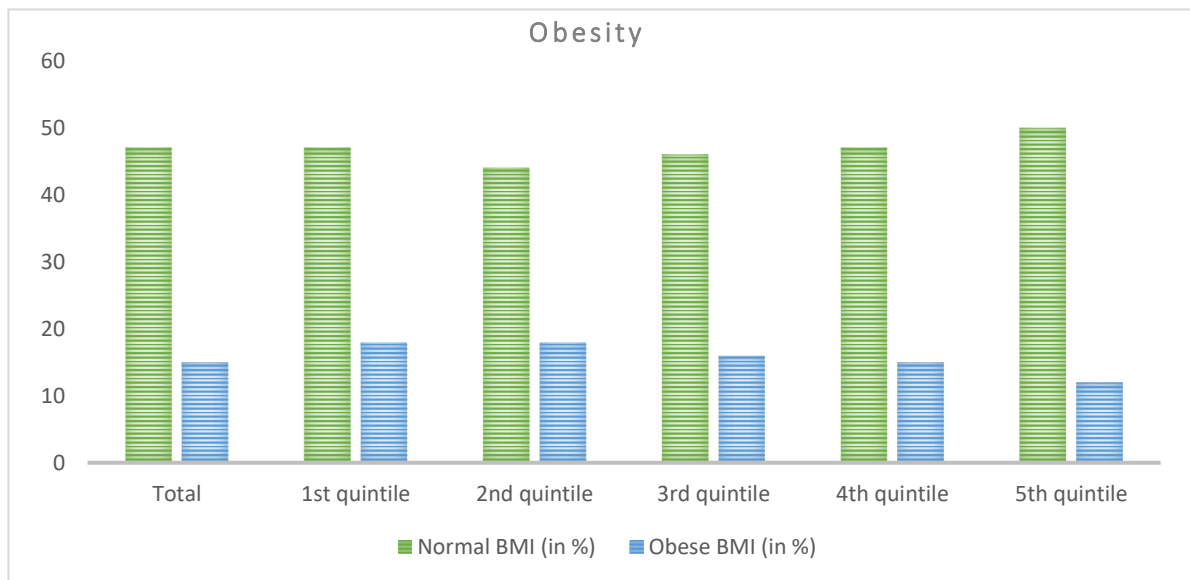
Figure 16: Body mass index (BMI) by income quintile. Eurostat, 2020. [hlth_ehis_bm1i]. Data are from 2014.

3.2.2.4 Tobacco use

Tobacco use follows the same trends as quality of diet, exercise levels and obesity: the higher the income, the lower the use of tobacco. In 2014, the highest proportion of daily smokers (23%) were in the lowest income group, compared to 15 percent in the highest income group. Like obesity, Figure 17 indicates a steady decline in tobacco use as income increases.
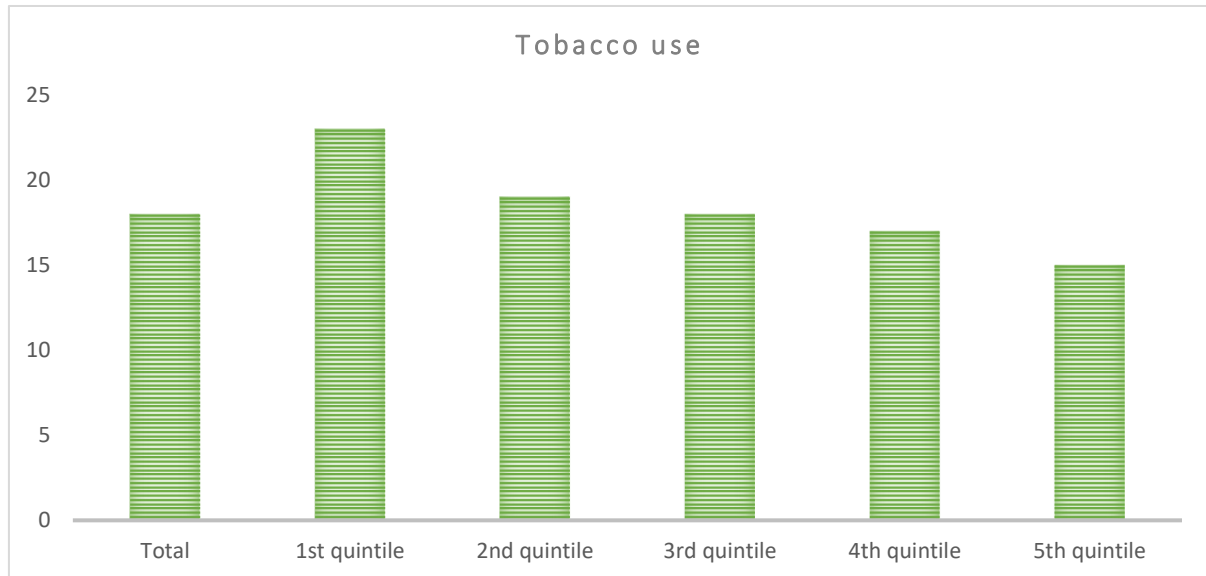
Figure 17: Daily smokers of cigarettes by income quintile. Eurostat, 2020. [hlth_ehis_sk3i]. Data are from 2014.

3.2.2.5 Alcohol use

The only category of risk behaviours where lower income was not associated with an increase in risk behaviours was alcohol consumption (Figure 18). Here, the trend was reversed. On average nine percent of Europeans drink every day. However, only eight percent in the lowest income group consume alcohol every day compared to 11 percent in the highest income group. Likewise, 24 percent of Europeans reported to never drink, or not in the past 12 months. This percentage is highest in the lowest income group (32%) and lowest in the highest income group (15%).

The data presented in this section suggests that risk behaviours/ indicators are likely to contribute to ill-health and fewer healthy remaining life years at the age of 65. However, the data also demonstrates the association between income and risk behaviours/ indicators. With the exception of alcohol consumption, all risk behaviours/ indicators were more prevalent among low-income groups and this trend is revisited in Subsection 3.3.3.4: Unmet needs and catastrophic household spending. As stated previously, the association between income and health outcomes is crucial for the SHAPES Platform and for policy makers alike to improve people's health and wellbeing. In the following section (Section 3.3) we provide an overview of European health and care systems.

Figure 18: Frequency of alcohol consumption. Eurostat, 2020. [hlth_ehis_al1i]. Data are from 2014.

SHAPES

3.3 Overview of European health and care systems

In this section, we provide an overview of European health and care systems. Here, we describe different healthcare models through the lens of governance. We then situate healthcare within the legislative and regulatory frameworks of the EU as well as the SHAPES Ethical Framework. This is because legislation, regulation and ethical considerations specify the rules that govern health and care provision and will also shape the SHAPES Platform. We then describe the factors that facilitate or hinder access to care, including financing, cost, distance and waiting times, as well as resources. We then describe how care is currently provided formally and informally, including the challenges pertaining to long-term care provision.

3.3.1 Description of different healthcare models

3.3.1.1 Organisation and governance of the healthcare system

Healthcare models within Europe are as diverse as the political systems that govern healthcare. For the purpose of this deliverable (D3.1), we borrow the World Bank's definition of governance as "the process and institutions through which decisions are made and authority in a country is exercised" (S. L. Greer et al., 2016, p. 28). European healthcare models are embedded within the governmental structures of each country. States tend to be classified as either unitary or federal, and can be located on a centralisation/ decentralisation continuum (Dardanelli, 2019). Table 7 provides an overview of the institutions and their responsibilities regarding the provision of healthcare at different governmental levels (i.e., national, regional, local).

3.3.1.2 Degrees of de/centralisation: Healthcare governance at the national, regional and local level

Both governance and the effectiveness of healthcare systems are directly linked. Within countries, there are varying degrees of decentralisation, which is also known as devolution. Decentralisation refers to the degree to which responsibilities of the central government have been assigned to regional governments (Costa-Font & Turati, 2016).

Cyprus and Portugal both are countries with high degrees of centralisation. Cyprus is currently in the process of transforming the healthcare system into a General Healthcare System (*Γενικό Σύστημα Υγείας*: GeSY) to address the divide between a public sector that was controlled by the central government, and a private sector that was largely unregulated. The transformation of the Cypriot health system is marked by a greater division of responsibilities from the Ministry of Health to the newly established State Health Services Organisation and the Health Insurance Organisation. The State Health Services Organisation will be responsible for "the development, management, control and supervision of autonomous public hospitals and health centres" (OECD & European Observatory on Health Systems and Policies, 2019a, p. 7). Moreover, the purchasing of healthcare services from both the public and private sectors will fall within the remit of Health Insurance Organisation. Previously, this had been the responsibility of the Ministry of Health. It is currently unclear what the current status of this transformation is, which was supposed to be complete by 2020.

Portugal is another country with a highly centralised healthcare system which comprises of three cooperating and overlapping systems. In Portugal, the responsibility for planning and regulation lies with the Ministry of Health. Five regional health administrations (RHAs) are responsible for the local

management of the National Health Service (*Serviço Nacional de Saúde*: SNS). In addition to the universal NHS there are three so-called health subsystems, i.e., a range of insurance schemes, both private and public, that are particular to specific professions or companies. Moreover, healthcare receivers can also opt for private voluntary health insurance. Santinha (2016) described the Portuguese health system as one that "is based on a centralised control and decentralised management" (p. 149). According to Santinha, the process of administrative decentralization was partially reversed as a consequence of the economic downturn, and the recentralisation was both costly and negatively impacted the provision of care. Although still highly centralised, Portugal is taking steps towards assigning authority from central to regional or local government to improve the allocation of resources where they are needed (Santinha, 2016; Simões et al., 2017).

Czechia, Greece and Ireland are countries with some degree of decentralisation. In Czechia, the Ministry of Health drafts the healthcare policies and legislation, oversees the health system and runs healthcare services. In addition, the Ministry is responsible for the supervision of several healthcare institutions (e.g., the public health network and the State Institute for Drug Control (*Státní ústav pro kontrolu léčiv*: SÚKL). Healthcare providers are registered by the regional authorities (*kraje*) and contracted by health insurance funds (Alexa et al., 2015; OECD & European Observatory on Health Systems and Policies, 2019b).

In Greece, healthcare planning and policy development, decision-making, and regulation of both the National Health System (*Εθνικό Σύστημα Υγείας*: ESY) and the National Organization for the Provision of Health Services (*Εθνικός Οργανισμός Παροχής Υπηρεσιών Υγείας*: EOPYY) is predominantly concentrated in the central government, namely the Ministry of Health. The Greek NHS is responsible for the provision of certain types of care e.g., primary and outpatient care including emergency care through rural surgeries and health centres, as well as inpatient care via public hospitals (Economou et al., 2017). Since 2014, the National Primary Healthcare Networks (PEDYs), organised by the Regional Health Authorities (YPEs) have been responsible for the provision of primary and outpatient care. Like in Cyprus, both public and private healthcare services are purchased by a single, autonomous entity, the EOPYY, which also outlines the prerequisites which need to be fulfilled by healthcare providers. Although regional and local governments were intended to take on a greater role in healthcare planning, coordination and provision, lack of power and funding has hindered their abilities to implement regional health policies.

In Ireland, like in most other European countries, the overarching body is the Department of Health which takes a leadership role in the areas of policy direction and governance and moreover, supervises the performance of the health sector. The Health Service Executive (HSE), a government agency answerable to the Department of Health, is tasked with the coordination and provision of both health and social care services. Although the HSE often has the dual role of purchasing and providing healthcare services, sometimes healthcare services in the public sector are purchased from private GPs or private hospitals (McDaid et al., 2012; OECD & European Observatory on Health Systems and Policies, 2019d). The Nursing and Midwifery Board of Ireland (NMBI) is the independent, statutory organisation which regulates the nursing and midwifery professions in Ireland. The Medical Council (*Comhairle na nDochtuirí Leighis*) regulates medical doctors in Ireland and promotes high standards of professional conduct and professional education, training, and competence among doctors.

The Pharmaceutical Society of Ireland has legislative responsibility under the [Pharmacy Act 2007](#) for the registration of pharmacists, pharmaceutical assistants, and pharmacies. It is responsible for setting standards for pharmacy education and training, assessing compliance, and promoting good professional practice. The Mental Health Commission is the independent body responsible for the

promotion of high standards in the delivery of mental health services. The Commission's functions are set out in the [Mental Health Act 2001](#). Finally, the Health Products Regulatory Authority (HPRA) is the independent regulator of health products in Ireland. Ireland is in the process of changing its health system from a two-tier system which has been harshly criticised for creating inequities in access to hospital care (Burke et al., 2016) to a system that provides universal health and social care to ensure equal access to services based on need, and 'not ability to pay' (Sláintecare Report, 2017).

Germany, Italy, Spain, and the UK are countries with high degrees of decentralisation. Among the countries reviewed for the present deliverable (D3.1), Germany is the only federal state. Self-governance is at the centre of the health system and underpins the division of responsibilities at federal level, state level (*Länder*) and among self-governing bodies. Policymaking falls within the remit of the Federal Ministry which includes the development of laws and the formulation of administrative guidelines. The federal *Länder* are responsible for decisions pertaining to hospital planning and allocation of funding for hospital investments, such as medical devices. Self-governance bodies include associations of sickness funds, healthcare providers and the German Hospital Federation. These stakeholders, as well as neutral members, form the Federal Joint Committee (FJC). The FJC turns statutory goals pertaining to most healthcare sectors into specific regulations. Unless the Federal Ministry of Health objects, these regulations become legally binding directives issued to all actors within the public healthcare system, such as healthcare providers, purchasers of healthcare, patients and manufacturers (Busse & Blümel, 2014; OECD & European Observatory on Health Systems and Policies, 2019c).

Unlike Germany, Italy, Spain and the United Kingdom (UK) are all decentralised unitary states which means that regional authority is granted at central state level (Costa-Font & Turati, 2016). Italy is highly decentralised, and responsibilities are divided at the national, regional, and local level. At national level, the Ministry of Health is composed of three autonomous departments with different foci including Department of Public Health and Innovation, the Department of Planning and Organization of the National Health Service (*Servizio Sanitario Nazionale*: SSN), and the Department of Veterinary Care, Food Safety and Collegial Organs for Health Protection. The Ministry of Health assumes responsibility for the following key areas: definition of core principles and objectives of the NHS, supervision of the NHS as well as healthcare planning, financing, and the allocation of national funding to its regions. Regional health departments are responsible for the management and delivery of healthcare (Ferré et al., 2014). Local health authorities (*Aziende Sanitarie Locali:* ASL) depend on regional governments for funding. They are involved in the coordination and direct delivery of public and community health services, as well as the direct provision of primary, secondary and specialist healthcare (Ferré et al., 2014; OECD & European Observatory on Health Systems and Policies, 2019e).

In Spain, the Inter-Territorial Council for the National Health System (*Consejo Interterritorial del Sistema Nacional de Salud*: CISNS) holds the central authority for healthcare provision. The CISNS consists of the National Ministry of Health, 17 regional ministers, and two autonomous cities (Ceuta and Melilla). Via the CISNS, the 17 autonomous regions, together with the National Institute of Health Management (INGESA), make decisions on the organisation and management of public health services, whilst retaining a high level of regional autonomy and influence. Within the autonomous communities, regulation, planning and budgeting falls within the remit of the regional Departments of Health. Primary and specialised healthcare is provided by regional agencies either via primary care centres and teams (mostly GPs and staff nurses) or hospitals, which also includes outpatient care. The cities are responsible for the health promotion and collaboration in healthcare management (Bernal-Delgado et al., 2018; OECD & European Observatory on Health Systems and Policies, 2019f).

The United Kingdom (UK) includes four countries, England, Scotland, Wales and Northern Ireland. Similar to Italy and Spain, decisions pertaining to the organisation of healthcare provision, as well as the drafting of healthcare policies, are made autonomously by each country. In England, health policies are set by the UK government whereas in the other three countries this is the responsibility of the devolved administrations. Furthermore, the UK government is responsible for the allocation of funding for healthcare to each country. In England, these funds are allocated as part of a healthcare budget; by contrast, Scotland, Wales and Northern Ireland receive block grants. In Scotland, Wales and Northern Ireland, responsibility for public health and healthcare services fall within the remit of the health ministry. Healthcare services are arranged by regional healthcare agencies which are funded by the Departments of Health. In Scotland and Wales, healthcare is purchased and provided by a single actor, whereas in England and Northern Ireland, these responsibilities are divided (Cylus et al., 2015; OECD & European Observatory on Health Systems and Policies, 2019g).

Governance of European healthcare systems			
Countries	**National government**	**Regional government**	**Local government**
Cyprus	**Ministry of Health** Oversight function **State Health Services Organisation** Development, management, control and supervision of autonomous public hospitals and health centres **Health Insurance Organisation** purchasing of healthcare services from both the public and private sectors	n/a	n/a
Czechia	**Ministry of Health** Healthcare policies Legislation Supervision of the health system Running of healthcare services	**Regional authorities (*kraje*)** Registering of healthcare providers **Health insurance funds** Contracting of healthcare providers	n/a
Germany	**Federal Ministry of Health** Development of laws, healthcare policies and administrative guidelines	Federal states (*Bundesländer*) Hospital planning Allocation of funding for hospital investments **Self-governance bodies** e.g.,associations of sickness funds, healthcare providers and the German Hospital Federation form the **Federal Joint Committee (FJC)** Formulating specific regulations based on statutory goals Unless the Federal Ministry of Health objects, these regulations become legally binding directives issued to all actors within the public healthcare system, such as healthcare providers, purchasers of healthcare, patients and manufacturers (Busse & Blümel, 2014; OECD & European	n/a

		Observatory on Health Systems and Policies, 2019c).	
Greece	**Ministry of Health** Healthcare planning Policy development Decision-making Regulation of National Health System (ESY) & National Organization for the Provision of Health Services (EOPYY) **National Health Service** Provision of primary and outpatient care	**Regional Health Authorities (YPEs)** Organisation of the National Primary Healthcare Networks (PEDYs) **PEDYs** Provision of primary and outpatient care **EOPYY** Purchaser of public and private healthcare	n/a
Ireland	**Ministry for Health** Provision of health services Policy development **Governance and Performance Division** Supervision of performance of the HSE **HSE** Health and social care planning Purchasing and delivery of health and social care services	**6 HSE Administrative Health Regions** Planning and delivery of health and social care at the regional level	n/a
Italy	**Ministry of Health** composed of three autonomous departments: Department of Public Health and Innovation, Department of Planning and Organization of the National Health Service (SSN), and the Department of Veterinary Care, Food Safety and Collegial Organs for Health Protection responsible for the definition of core principles and objectives of the NHS supervision of the NHS healthcare planning, financing, and the allocation of national funding to its regions	**Regional health departments** responsible for the management and delivery of healthcare (Ferré et al., 2014).	**Local health authorities (*Aziende Sanitarie Locali*)** Funded by regional governments Coordination and direct delivery of public and community health services Direct provision of primary, secondary and specialist healthcare (Ferré et al., 2014; OECD & European Observatory on Health Systems and Policies, 2019e).

Portugal	**Ministry of Health** Planning Regulation Resource allocation National Health Service (SNS) Provider of healthcare **Health subsystems** Purchaser of healthcare for specific population groups	**Regional Health Administrations** Local management of the National Health Service (SNS) Planning Resource allocation	n/a
Spain	**Inter-Territorial Council for the National Health System (CISNS)** Central authority for healthcare provision CISNS: National Ministry of Health, 17 regional ministers, and two autonomous cities (Ceuta and Melilla). Via the CISNS, the 17 autonomous regions, together with the National Institute of Health Management (INGESA), make decisions on the organisation and management of public health services, whilst retaining a high level of regional autonomy and influence.	Within the autonomous regions, regulation, planning and budgeting falls within the remit of the regional Departments of Health. Primary and specialised healthcare is provided by regional agencies either via primary care centres and teams (mostly GPs and staff nurses) or hospitals, which also includes outpatient care.	n/a
United Kingdom	**UK government/ devolved administrations** decisions on the organisation of healthcare provision drafting of healthcare policies **UK government** allocation of funding - England: part of the healthcare budget - Scotland, Wales and Northern Ireland receive block grants **Health ministry** responsibility for public health and healthcare services	Healthcare services are arranged by regional healthcare agencies which are funded by the Departments of Health In Scotland and Wales, healthcare is purchased and provided by a single actor, whereas in England and Northern Ireland, these responsibilities are divided	n/a

Table 7: Governance of European healthcare systems.

3.3.2 Legislation, regulation and ethical considerations for the SHAPES Platform

The development of the SHAPES platform takes place within the legislative, regulative and ethical contexts that govern health and care provision within the EU. The following two sections provide summary tables of the a) legislative and regulatory frameworks of the EU and b) of the *SHAPES Ethical Framework*.

3.3.2.1 Legislative and regulatory frameworks of the EU

Notably, although there is no EU health system, there is an EU health policy (J. Greer, 2019). This means that the responsibility for the regulation, organization and delivery of healthcare falls to the EU MS who are guided by a "Union health law and policy", which refers to "a body of legal rules and policy provisions which mandate, incentivise or otherwise regulate certain actions, or the refraining from certain actions, in the provision of human health care and the protection of public health" (Ruijter, 2019). A brief overview of these legal rules and policies is provided in Table 8 which is based on a document drafted by the legal experts in WP8.

EU Health Law and Policy		
Article	**Description**	**Challenges**
Protection of human health		
Article 3(1) TEU	Aims to protect human health and to promote well-being	
Article 9 TFEU	Cross-cutting provision that requires that the EU in defining and implementing its policies and actions, "shall take into account requirements linked to the […] protection of human health." Aims to ensure a high level of human health protection Underlying principle: The right to preventive and curative care as a universal right	No clear EU competence to act which hinders the protection and promotion of health as a constitutional objective
Article 6 TFEU	states that the Union has the competence to carry out actions "to support, coordinate or supplement the actions of the Member States" with regard to the "protection and improvement of human health".	
Article 4(2)(k) TFEU	provides that the EU shares competence with the MS with regard to "common safety concerns in public health matters",	considered a narrow exception to the otherwise limited competence of the EU
Article 168 TFEU	confirms that subject to certain exceptions related to "common safety concerns in public health matters", the EU's role is to support, coordinate and supplement the measures of Member States with regard to public health, and that the competence to regulate healthcare lies with the MS.	
Quality and safety for medicinal products and devices for medical use		
Article 168 TFEU	entrusts the EU with the power to legislate with a view of "high standards of quality and safety for medicinal products and devices for medical use".	"weak legal basis" that allows the Union to spend "small sums of money to promote European networks that connect people and organizations, put items on the agenda for the future, and

	The EU can also "adopt incentive measures designed to protect and improve human health and in particular to combat the major cross-border health scourges, measures concerning monitoring, early warning of and combating serious cross-border threats to health, and measures which have as their direct objective the protection of public health regarding tobacco and the abuse of alcohol, excluding any harmonisation of the laws and regulations of the Member States".	sometimes produce research" (Greer, 2014).
Article 168(7) TFEU	makes clear that "Union action shall **respect the responsibilities of the Member States for the definition of their health policy and for the organisation and delivery of health services and medical care**. The responsibilities of the Member States shall include the management of health services and medical care and the allocation of the resources assigned to them".	n/a
Essential functions of the health service		
Article 114 TFEU (Directive 2011/24/EU)	**Patient's Rights Directive** concerns the rights of patients who receive medical treatment in a Member State other than the one where they reside or are insured directive aims to ensure a high quality of healthcare throughout the EU.	n/a
Regulations on Community procedures on the marketing and monitoring of pharmaceuticals and medical devices		
Council Directive 2001/83/EC[3] & Regulation (EC) No 726/2004[4]	regulates Community procedures on the marketing and monitoring of pharmaceuticals and medical devices	n/a
Council Directive 90/385/EEC[5] Council Directive 93/42/EEC[6] Directive 98/79/EC of the European Parliament and of the Council[7]	regulatory framework to ensure the safety and efficacy of medical devices and facilitating patients' access to devices in the European market since 1990	outdated and fails to accurately protect current medical device developments
Regulation (EU) 2017/745 Regulation (EU) 2017/746	Updated regulations on medical devices seeking to modernize and strengthen the legislative framework to improve protection of public health and patient safety	n/a

[3] Council Directive 2001/83/EC on the Community code relating to medicinal products for human use.
[4] Regulation (EC) No 726/2004 laying down Community procedures for the authorisation and supervision of medicinal products for human and veterinary use and establishing a European Medicines Agency.
[5] Active Implantable Medical Devices (AIMDD) (1990).
[6] Council Directive 93/42/EEC on Medical Devices (MDD) (1993).
[7] Directive 98/79/EC of the European Parliament and of the Council on in vitro Diagnostic Medical Devices (IVDMD).

Competition law and State aid		
Articles 101- 109 TFEU	set out the Competition law and State aid provisions prohibits anti-competitive agreements, cartels, and outlines permissible use of mergers and state aid provisions and sets rules for the purchases of public services of general interest Public bodies must adhere to public procurement, competition and in certain circumstances State aid rules, when purchasing health related supplies or services	n/a
Data processing		
EU 'General Data Protection Regulation' ('GDPR') Regulation (EU) 2016/679	regulates the processing by an individual, a company or an organisation of personal data relating to living individuals in the EU sets out two categories of data[8]: i) **'personal data'**: information which can identify a person or can together with other information identify a person ii) **'special category personal data'**: information which is considered sensitive to a person Not permissible to process such data unless the 'data subject' (the person to whom the data belongs) gives permission to do so[9].	n/a
Regulation (EU) No 536/2014	On clinical trial on medical products for human use requires that the subject of the trials give informed consent in accordance with specified rules. Where the subject is not able to give informed consent, his or her legally designated representative is required to do so. Article 31 of the Regulation addresses clinical trials on "incapacitated subjects" and sets certain conditions on the participation of such individuals in trials.	n/a

Table 8: EU Health Law and Policy. Sources: See left-hand column.

3.3.2.2 SHAPES Ethical Framework

In addition to the legislative and regulatory frameworks, the SHAPES Platform will be guided by the SHAPES Ethical Framework as set out in detail in D8.4. The following table (Table 9) summarises the ethical requirements which are essential for the SHAPES Platform.

Ethical requirements related to the SHAPES Governance Model			
No.	Requirement	Importance	Responsibility	More information in D8.4 sections:
GE8	Note that the participation of older persons in the development of	Essential	WP2, WP3, WP4, WP5	Capabilities 3.4

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[8] E.g. racial or ethnic origin; Political opinions; Religious or philosophical beliefs; Trade union membership; Genetic data; and Biometric data (Articles 4 Regulation (EU) 2016/679).
[9] Art 5 Regulation (EU) 2016/679

				Division of Labour 7.2
	SHAPES can in itself be seen as a service that supports a person's human capabilities. Ensure that end-users have real power and impact in service development as part of the SHAPES ecosystem.			
GE10	Consider sustainable development goals in order to optimise the value SHAPES can bring to society. Work towards both the economic, social and environmental sustainability of the SHAPES Integrated Care Platform.	Essential	WP3, WP7, WP9	Sustainable development 4.1
GE11	Consider that the public sector, as part of the SHAPES ecosystem, plays a role as a bearer of political responsibility for ensuring the wellbeing of older persons.	Essential	WP3, WP9	Sustainable development 4.1 Rights 3.1 Capabilities 3.4
GE51	Design and implement a Security Management Plan for SHAPES.	Essential	WP4, WP3?	Cybersecurity 6
GE55	Design and implement a Resilience Management Plan that covers all four event management cycles (plan/prepare, absorb, recovery, adapt) and interdependencies with other systems.	Essential	WP3, WP4	Cybersecurity 6

Table 9: General ethical requirements. Source: D8.4: SHAPES Ethical Framework.

The legislative and regulatory frameworks, as well as the ethical framework will be discussed in more detail in the deliverables related to the SHAPES Governance Model (D3.5: Initial SHAPES Collaborative Governance Model and D3.6: SHAPES Collaborative Governance Model).

3.3.3 Access to healthcare

3.3.3.1 Categories of different healthcare funding models

Health system models can be categorised based on the predominant approach to financing. Broadly speaking, EU health systems are either financed through general taxation or social health insurance with varying levels of private, out-of-pocket (OOP) expenses. National health service (NHS) systems are funded through general taxation whereas social health insurance (SHI) are financed through salary-based contributions (Wren & Connolly, 2016). Figure 19 illustrates the four basic healthcare systems in terms of their predominant funding models: Beveridge model (general taxation), Bismarck model (social health insurance), national health insurance (elements of both Beveridge and Bismarck models) and out-of-pocket payment model. As demonstrated in Figure 8, the pilot site countries reviewed operate either versions of the Beveridge Model or Bismarck Model with varying degrees of out-of-pocket payments which is further illustrated in Table 11. All funding models can occur independent of the degree of centralization and levels of public/ private funding.

3.3.3.2 The four basic health system models

Each health system model comes with various advantages and challenges. The Beveridge model (Figure 20), which is funded through general taxation and operates on the principle of health as a right, provides universal coverage, the government as a single payer keeps prices for healthcare services low and healthcare is affordable for healthcare receivers as there are no OOP payments. However, since healthcare is provided free of charge, there is a risk of overutilisation for non-urgent treatments, which may lead to higher costs and taxes and of long waiting lists which is the case
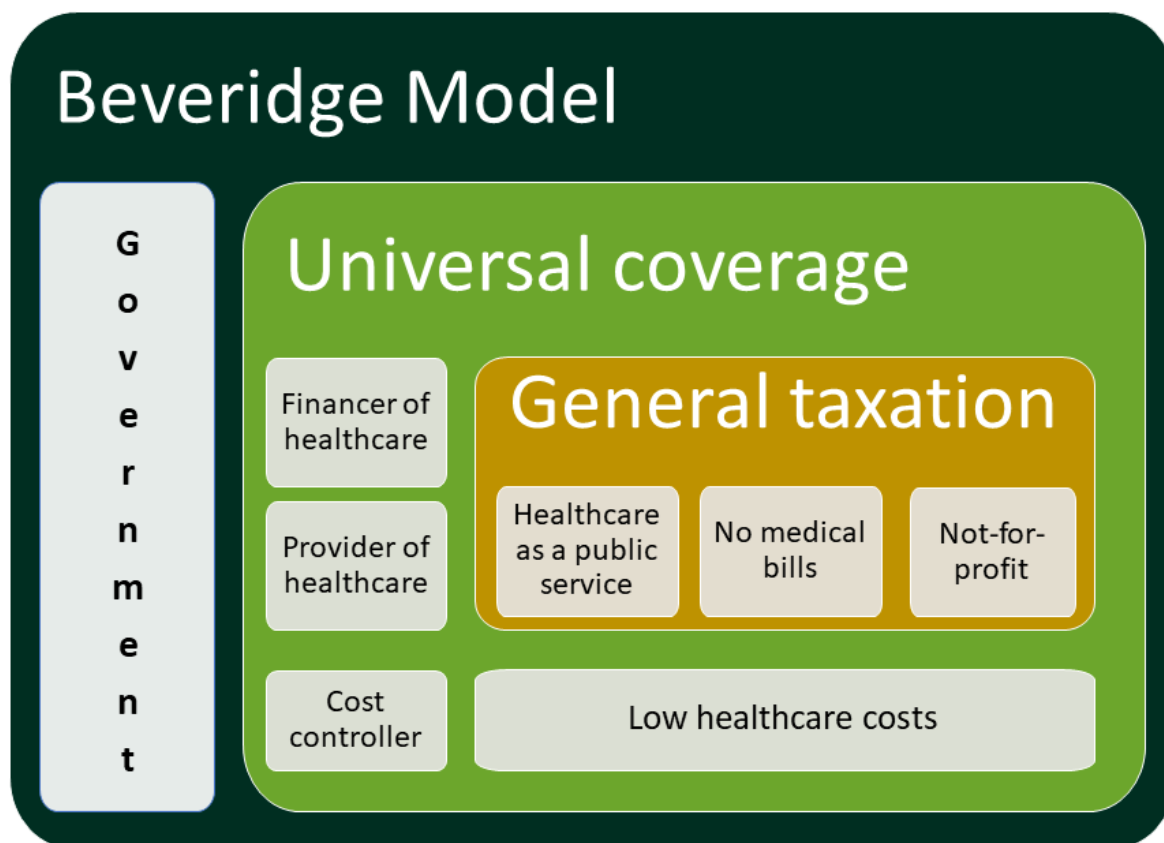
Figure 20: Beveridge Model. Own figure based on Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016.

particularly in Ireland (OECD & European Observatory on Health Systems and Policies, 2019d). Moreover, there are concerns that the government may not be able to provide adequate healthcare in a state of emergency (Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016).

The Bismarck model (Figure 21) is funded through social health insurance (SHI) contributions and is underpinned by the principle of health as a privilege. SHI models allow healthcare receivers to choose between multiple, self-governing, quasi-public insurance providers. Healthcare is affordable since health insurance contributions are based on income and the practice of risk equalisation, which refers to the transfer of funds between provides to avoid penalisation of people with higher healthcare needs, keeps costs down whilst also supporting vulnerable groups. Moreover, funds that are set aside for healthcare facilitates transparency pertaining to insurance payments and healthcare spending. However, as employment is a requirement, the Bismarck model does not necessarily provide universal access to healthcare which presents challenges pertaining to the care of the unemployed and ageing populations (Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016).
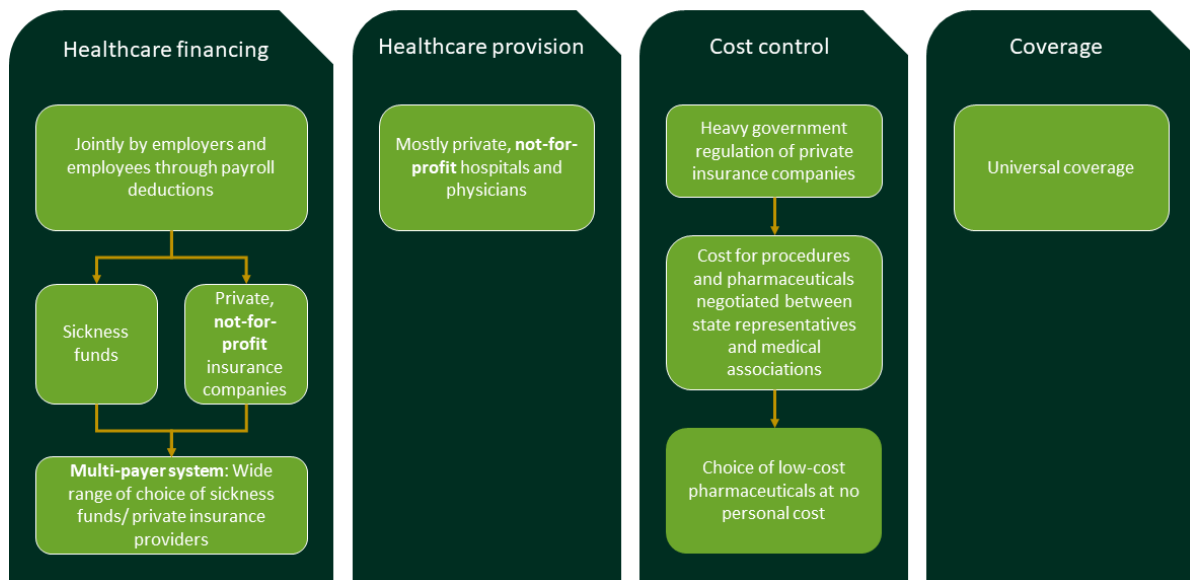
The Bismarck Model

Figure 21: Bismarck Model. Own figure based on Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016.

The national health insurance model (Figure 22) mixes aspects from both the Beveridge and Bismarck models, i.e., healthcare is funded through general taxation (Beveridge) but is provided by private insurers (Bismarck). As a result, there are few financial barriers to treatment ensuring universal access, healthcare receivers may choose their healthcare provider and hospitals can operate independently. However, there are challenges pertaining to overutilisation of health resources in non-urgent situations, long waiting times, delay of treatments and continuity of care due to ageing populations (Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016).

The National Health Insurance Model
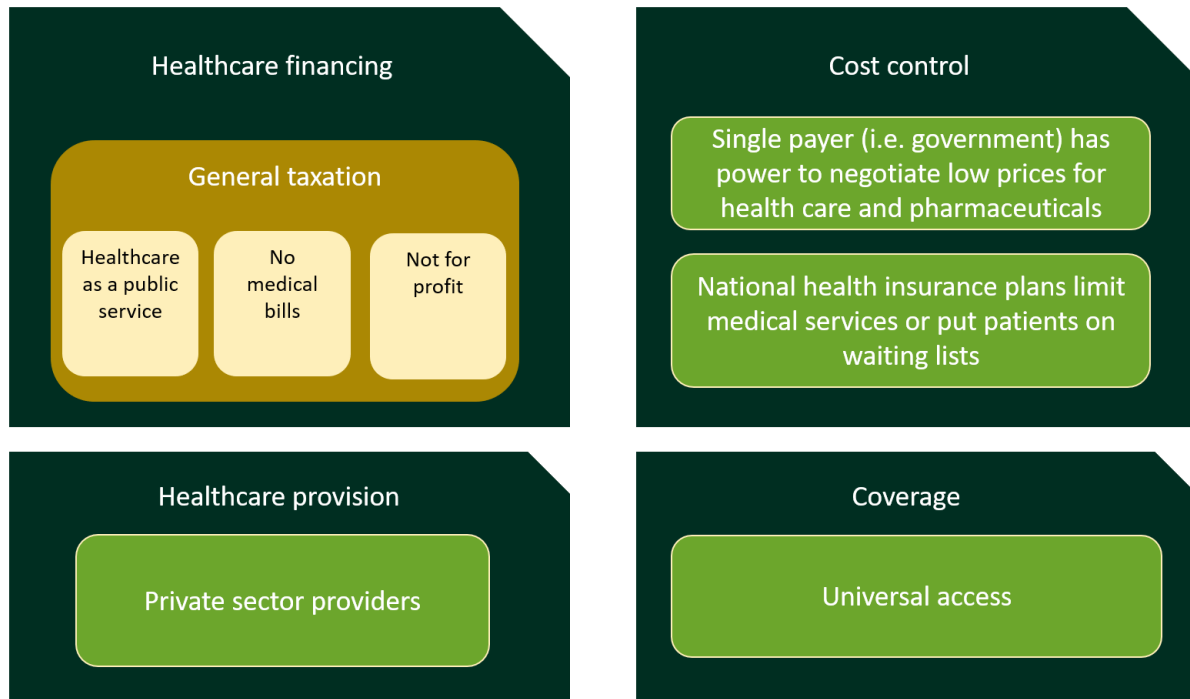
Figure 22: The National Health Insurance Model. Own figure based on Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016.

 Lastly, the OOP payment model (Figure 23) is funded through private health insurance and pay-per-service payments. Access to healthcare is based on income levels, i.e.,, ability to pay for healthcare. Proponents of this model claim that it is more efficient and innovative, and that it provides better quality care. However, people on low incomes may not be able to afford healthcare which leads to higher levels of untreated conditions and hence, disparities in health outcomes. Moreover, there is a risk of over-prescription which is paid for by insurance providers entailing unequal cost distribution for purchasers of PHI (Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016).

The Out-of-Pocket Model
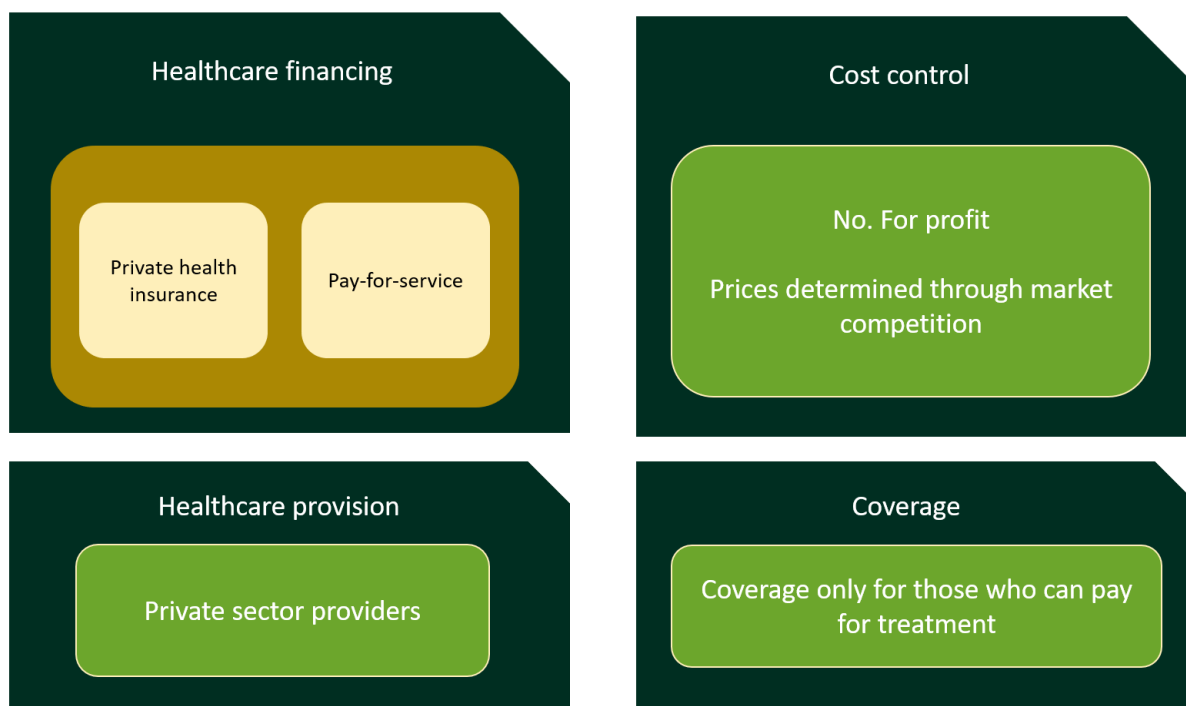
Figure 23: The Out-of-Pocket Model. Own figure based on Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016.

Table 10 provides an overview of the characteristics of the four health system models:

Characteristics of different health system models				
	Funding	**Access to healthcare**	**Advantages**	**Challenges, risks, concerns**
Beveridge system National health Service (NHS) models	General taxation Single-payer system no market competition	Health as a right Universal access managed by one organisation but can be provided by several organisations	Universal coverage Government single payer = low prices Affordable for healthcare receivers: no out-of-pocket expenses	Risk of overutilisation Potentially leading to higher costs and taxes Government ability to provide healthcare in state of emergency (e.g.,war or public health crisis) Long waiting lists
Bismarck system Social health insurance (SHI) models	Regular salary-based contributions Not-for-profit	Health as a privilege Access through range of self-governing, quasi-public insurance providers (e.g.,sickness funds)	Choice between multiple insurance providers Risk equalization: (e.g.,transfer of funds between provides to avoid penalisation of people with higher needs) Income-based ceilings to contribution funding of vulnerable groups	Does not necessarily provide universal access Employment as a requirement for health insurance Challenges pertaining to the care of the unemployed and ageing population

			earmarking of funds for healthcare transparency regarding insurance payments and healthcare spending	
National health insurance model (mixed, Beveridge & Bismarck)	Single-payer system (Beveridge) Private insurers (Bismarck) Not-for profit	Universal access through range of self-governing, quasi-public insurance providers (e.g.,sickness funds)	Few financial barriers to treatment Choice of healthcare providers Allows hospitals to maintain independence	Long waiting times Delay of treatments Challenges due ageing populations Overutilisation of health resources in non-urgent situations
Out-of-pocket payments	Private health insurance Per-service payments For profit	Access based on income levels, i.e., ability to pay for healthcare	Potentially more efficient Potentially more innovative Potential for better quality care	Access barriers to healthcare for people on low incomes Higher levels of untreated conditions Disparities in health outcomes Risk of over-prescription Unequal cost distribution for purchasers of PHI

Table 10: Characteristics of health system models. (Chung, 2017; Cummiskey, 2008; Reid, 2010; Wren & Connolly, 2016).

3.3.3.3 Financing and healthcare spending

As shown in Table 11, all health systems (CY, CZ, EL, ES, IE, IT, PT, UK) - except Germany - reviewed for this deliverable are funded predominantly through general taxation. By contrast, Germany's health system is funded through social health insurance (SHI). However, while general taxation or SHI are the predominant funding model, there are varying degrees of additional out-of-pocket payments (OOP).

Predominant funding models and healthcare spending										
	EU	CY	CZ	DE	EL	ES	IE	IT	PT	UK
Healthcare model	n/a	NHS	NHS	SHI	NHS	NHS	NHS	NHS	NHS	NHS
Public healthcare spending (%)	79	43	83	85	61	71	73	74	66	79
OOP total (%)	21	45	13	13	35	24	12	24	28	16

Table 11: Predominant funding models and healthcare spending. Measure: Share of current expenditure on health. Unit: percentage. Source: OECD, 2020. Joint OECD, EUROSTAT and WHO Health Accounts SHA Questionnaires (JHAQ).European Health Observatory and Eurostat Country Health Profile Reports for CY, CZ, DE, EL, ES, IE, IT, PT, UK.

Around one fifth of all healthcare spending is shouldered by private households and contributes to inpatient and outpatient care, pharmaceuticals, home-based long-term care, therapeutic appliances, amongst others (Figure 24). which makes access to healthcare considerably more difficult for low-income households as described in the following section (Section 3.3.3.4).
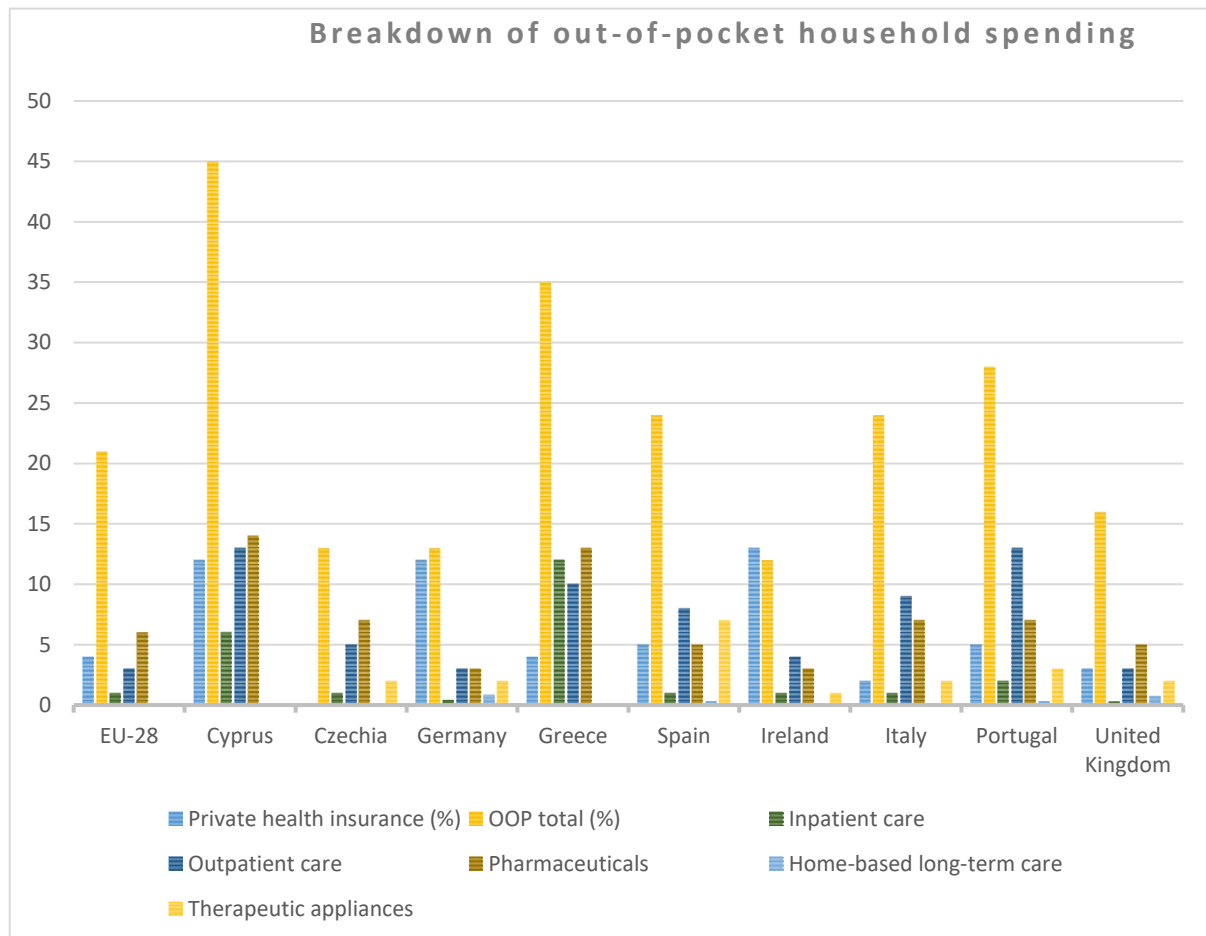
Figure 24: Health expenditure. Measure: Share of current expenditure on health. Unit: percentage. Source: OECD, 2020. Joint OECD, EUROSTAT and WHO Health Accounts SHA Questionnaires (JHAQ).

3.3.3.4 *Unmet needs and catastrophic household spending*

Cost, distance and waiting times can be a barrier to healthcare. In the EU, approximately two percent of the population reported unmet needs due to cost, distance and waiting times. In the following sections, we compare self-reported unmet needs distinguishing between urban and rural residents, as well as age. As shown in Figure 25, cost may act as an obstacle to accessing care. Although unmet needs due to cost are relatively low on average, the data indicates that older people find it more difficult to afford care - particularly older people who live in rural areas. However, as the graphic illustrates, the level of unmet needs due to cost varies considerably across the countries that were reviewed.
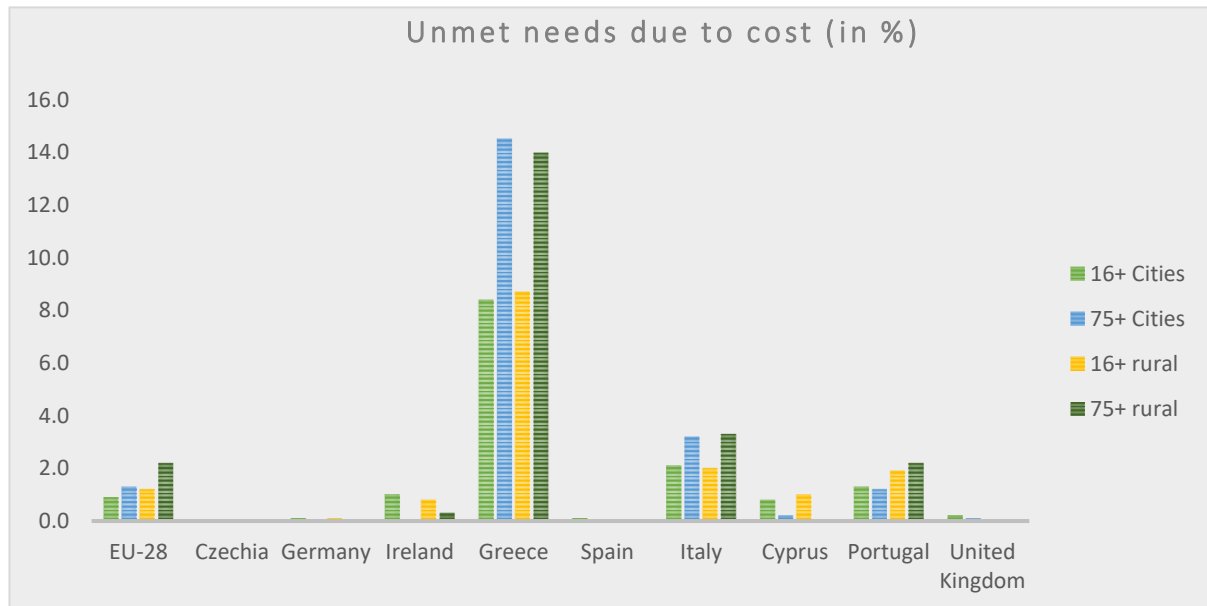
Figure 25: Self-reported unmet needs for medical examination by sex, age, main reason declared and degree of urbanisation [hlth_silc_21].

Levels of unmet needs in most countries are linked to socio-economic status and vary according to income group. Those in the lowest income group (1st quintile) tend to have higher proportions of unmet needs than those in the highest income group (5th quintile). As shown in Figure 26, Czechia, Germany and Spain have the smallest gap between income groups, whereas Greece has by far the widest gap: while a total of 8.8 percent reported unmet medical needs in 2018, this proportion was largest among those in the lowest income group (20.6%) and smallest among those in the highest income group (0.8%).
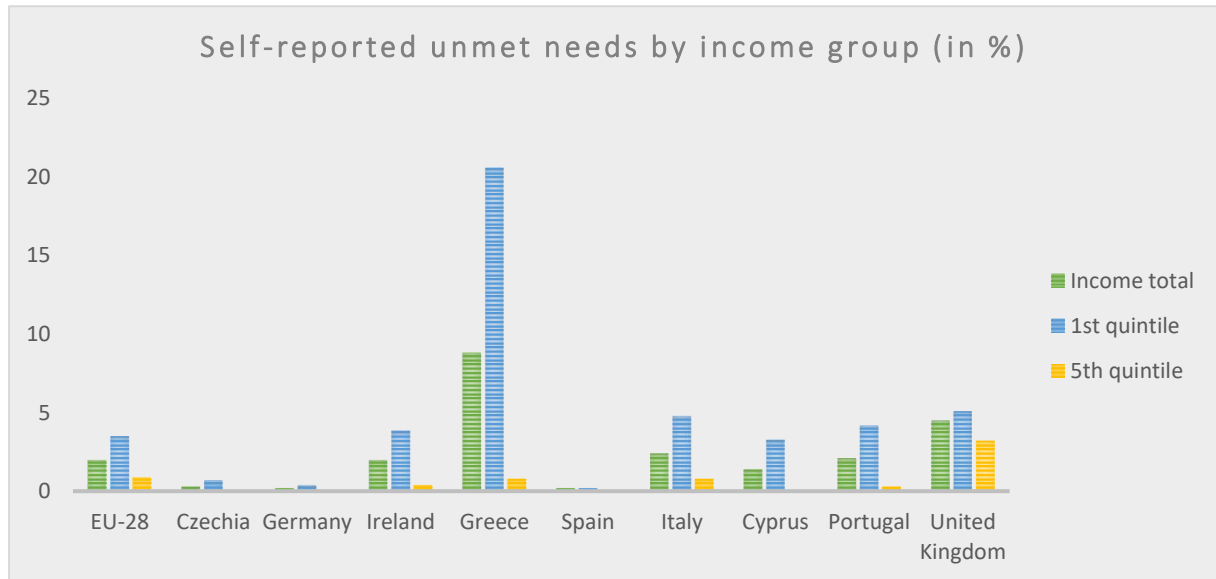
Figure 26: Eurostat, 2020. Self-reported unmet needs for medical examination due to cost, distance and waiting time and income quintile [hlth_silc_08]. Data are from 2019 or latest available. Data for Italy, Ireland and the UK are from 2018.

In some households, OOP payments may result in catastrophic healthcare spending. Catastrophic healthcare expenditure measures the level of financial protection and health coverage and is defined as "out-of-pocket payments that exceed a predefined percentage or threshold of a household's ability to pay for health care" (OECD & European Union, 2018, p. 172). According to Cylus, Thomson and Evetovits (2018), variances in definition of ability to pay will lead to different results. Figure 27 below, adapted from the *Health at a Glance* report (OECD & European Union, 2018), bases its results on the following definition of ability to pay: "household consumption spending minus a standard amount representing basic spending on food, rent and utilities (water, electricity, gas and other fuels); the threshold used to define households with catastrophic spending is 40%" (p. 172). The graphic shows that across all countries, those in the lowest income bracket are also the ones most affected by catastrophic household spending. Yet, as the report also stresses, incidences of catastrophic OOP expenditure is lower in countries with higher levels of public spending. At first glance, Cyprus seems to be the exception to the rule. As shown in Table 11, Cyprus had the highest proportion of OOP expenditure (45%) and the lowest proportion of public spending (43%). Yet, at five percent the share of catastrophic household spending was below the EU average (6%). However, like all other countries presented in Figure 27, those in the lowest income group in Cyprus also have the highest rate of catastrophic spending.
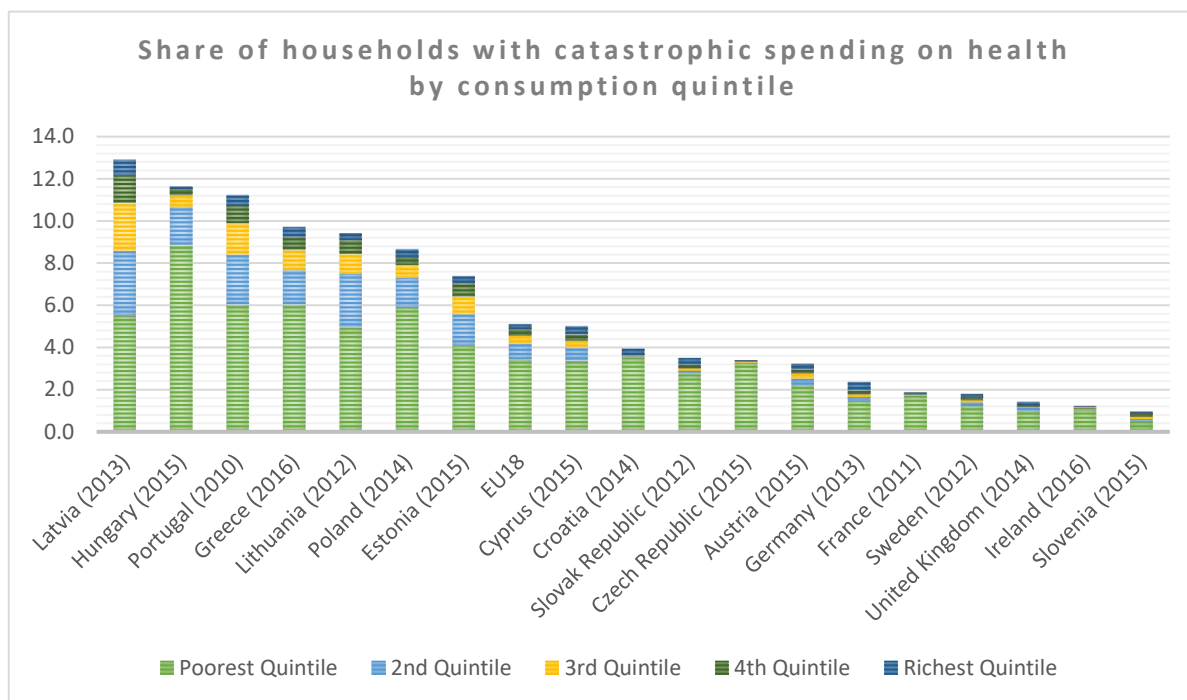
Figure 27: Eurostat and European Union, 2018. Health at a Glance. dx.doi.org/10.1787/888933836295.

Distance can also to be a barrier to healthcare in most EU countries, but particularly for older people living in rural areas. According to Eurostat data based on self-reported unmet needs (Figure 28), this was the case in Czechia, Ireland, Greece, Cyprus and Portugal but not reported in Germany, Spain, Italy and the UK. In Czechia, Greece, Italy, Portugal and the UK, older people (75 years or over) who are living in cities also reported unmet medical needs due to distance. In the UK, unmet needs were reported by people of all ages living in cities, and by people of all ages living in rural areas but not by older people living in rural areas. However, it is worth pointing out that generally, unmet needs due to distance were reported by less than one percent.
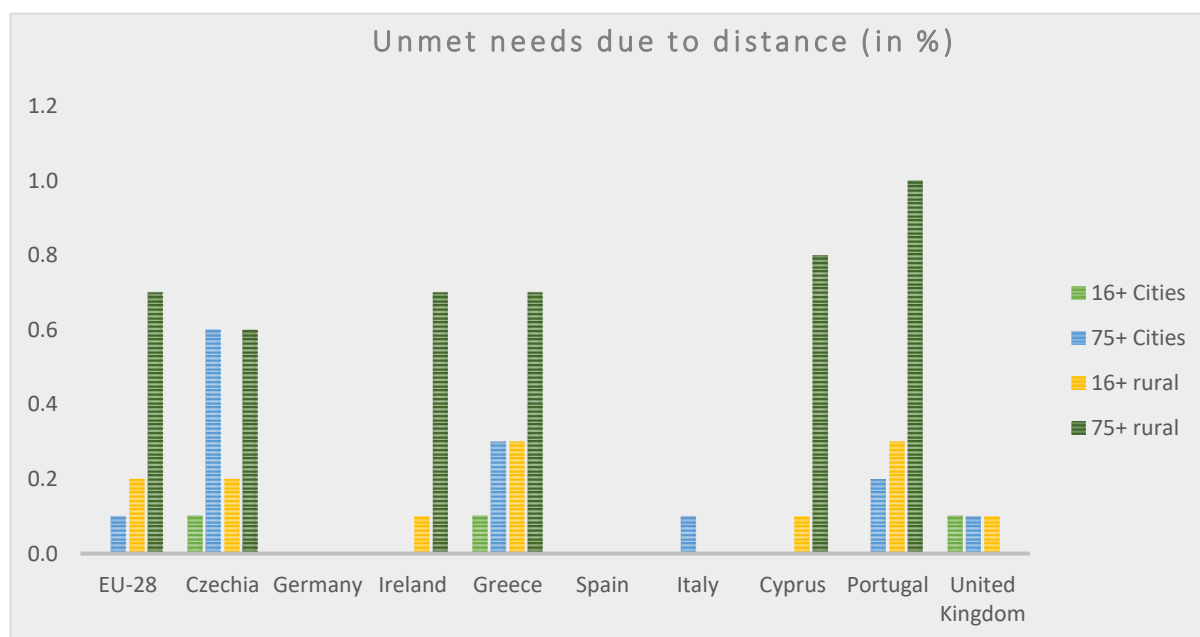
Figure 28: Self-reported unmet needs for medical examination by sex, age, main reason declared and degree of urbanisation. Eurostat, 2020. [hlth_silc_21]. Data are from 2019 or latest available. Data for Italy, Ireland and the UK are from 2018.

Long waiting times are another obstacle to accessing care (Figure 29). Although more pronounced in cities, it is an even greater hurdle for older people above the age of 75 years. Waiting time as a barrier to healthcare plays a particularly noticeable role in urban areas in the UK where 45 percent of the 16+ age group, and 5.3 percent of the 75+ age group reported unmet needs, which is significantly above the EU-28 average (16+ years: 1.1%; 75+ years: 1.4%). Interestingly, although still above the EU-28 average of 0.8 percent, older people in rural areas in the UK reported the lowest share of unmet needs (2.4%) due to waiting times. In Ireland, people in both urban and rural areas reported difficulties accessing healthcare, although rates were lowest for the urban 16+ age group and highest for the urban 75+ years age group. In Greece, particularly older urban residents reported unmet healthcare needs which equals the EU average (1.4%), whereas all other groups had reported below-average unmet needs. Cyprus, Czechia, Germany and Spain have the lowest levels rates of self-reported unmet needs due to waiting times, which in Cyprus was zero percent for all groups.
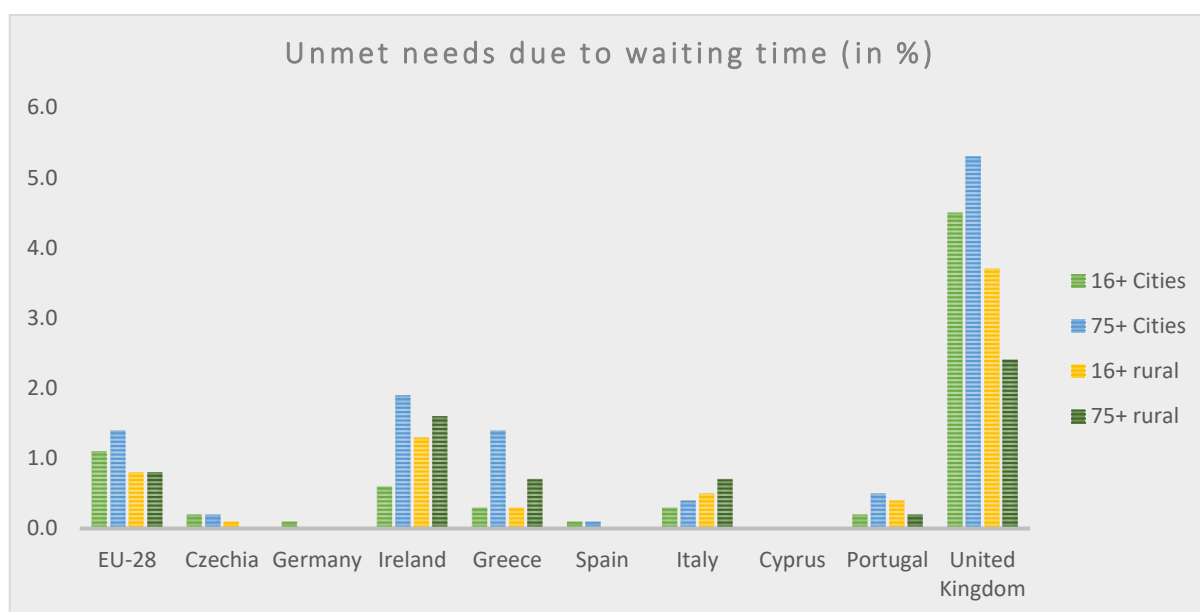
Figure 29: Self-reported unmet needs for medical examination by sex, age, main reason declared and degree of urbanisation [hlth_silc_21]. Data are from 2019 or latest available. Data for Italy, Ireland and the UK are from 2018.

3.3.3.5 Availability of caregivers

Access to care is also facilitated or hindered by the availability of healthcare professionals. In most EU countries, the rates of nurses per 100,000 inhabitants is greater than the rates of physicians. As illustrated in Figure 30[10] below, the EU-28 average is 680 nurses per 100,000 inhabitants but only 357 physicians per 100,000 inhabitants which means that there are roughly two nurses per doctor. However, the graphic also reveals stark variation across the pilot site countries. The nurse doctor ratio differential was greatest in Ireland, the country with the highest rate of nurses per 100,000 inhabitants, where there are four nurses per doctor and in Germany (2.5:1). Greece was the only country where there are fewer nurses than doctors: for every doctor, there were 0.6 nurses. As suggested by a recent report on the State of Health in the EU (OECD & European Union, 2018), nurses play an important role in the provision of healthcare. Although most nurses work in hospitals and long-

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[10] Physicians include generalist medical practitioners, specialist medical practitioners.

term care facilities, they are increasingly providing care in people's homes, together with nursing aids and homecare workers.
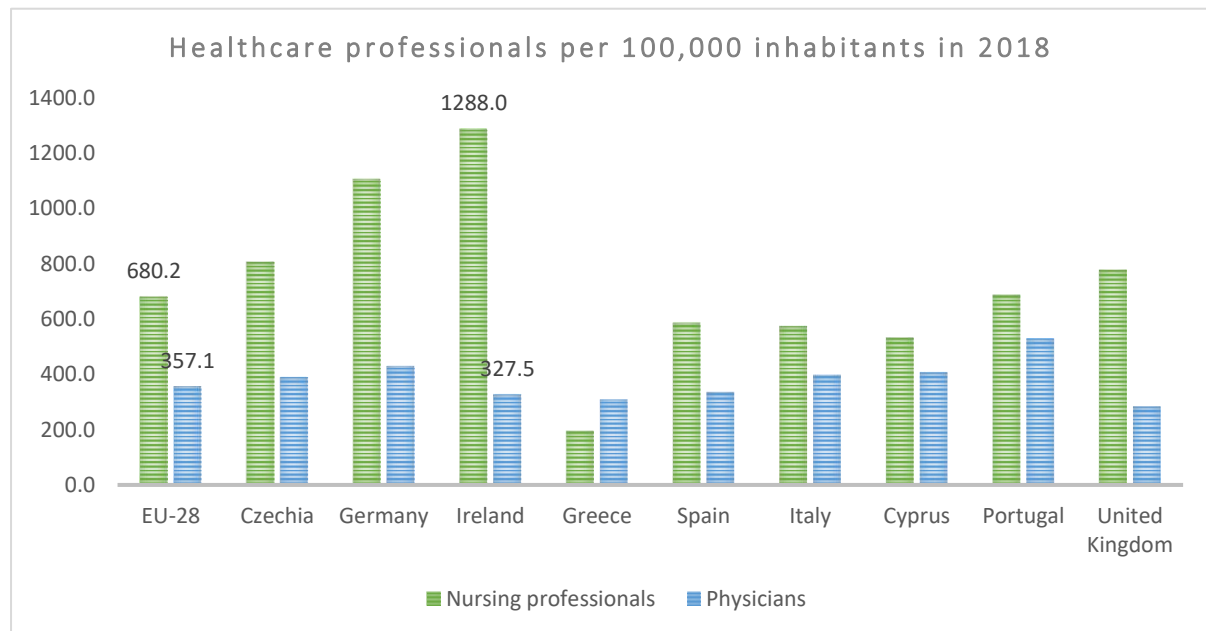
Figure 30: Rates of nurses and physicians per 100,000. Nursing and caring professionals. Eurostat, 2020. [HLTH_RS_PRSNS]. Physicians by medical specialty. Eurostat, 2020. [HLTH_RS_SPEC]. OECD, 2020. Health data.

The report argues that as EU populations age, countries are becoming increasingly concerned about possible shortages of nurses. As Figure 31 shows, many countries have been taking steps towards increasing the numbers of nurses.
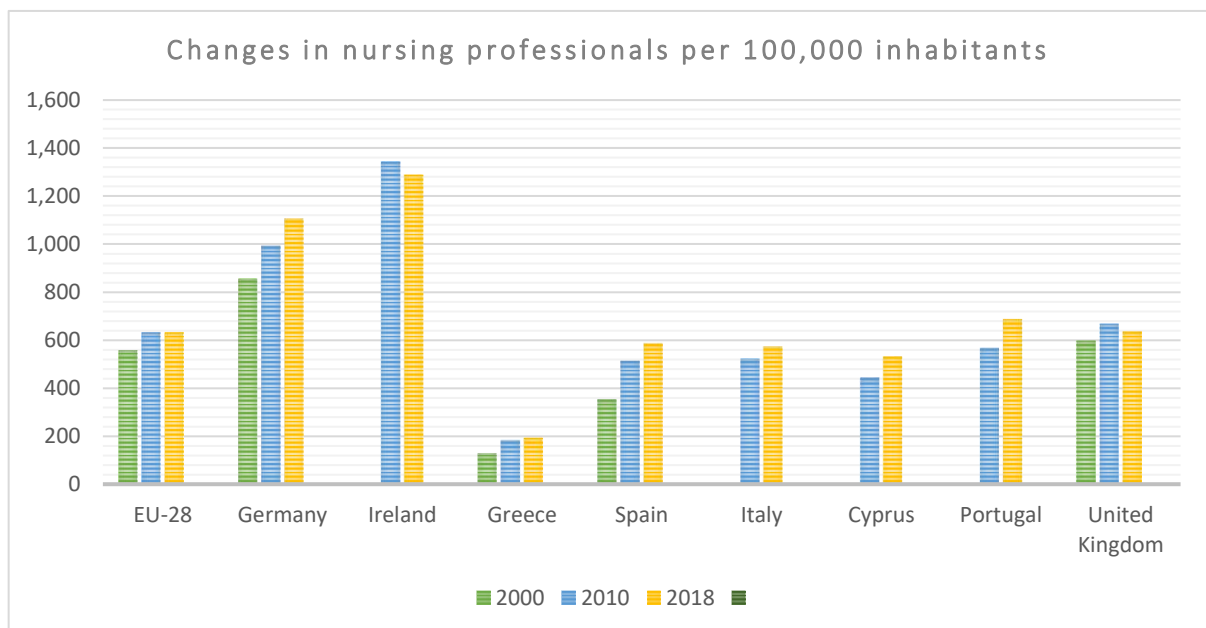
Figure 31: Changes in nursing professionals per 100,000. Eurostat, 2020. [HLTH_RS_PRSNS].

3.3.3.5.1   Age of healthcare workers

Some partners raised concerns with regards to the increasing age of the healthcare workforce, emphasizing the potential challenges to the continuity of care provision if GPs or pharmacists, particularly in rural areas, are unable to find a successor. Partners suggested that this may lead to a loss primary care provision or entail longer travel times which, as suggested in Section 3.3.3.4, may have negative consequences for people's ability to access care. As Figure 32shows, the share of physicians in the age band 55 - 64 years old is particularly large in Germany and Italy (both 38%), followed by Spain (28%) and Cyprus (26%), with Italy (17%) and Cyprus (16%) also having one of the largest proportion of physicians in the 65 to 74 years age group.
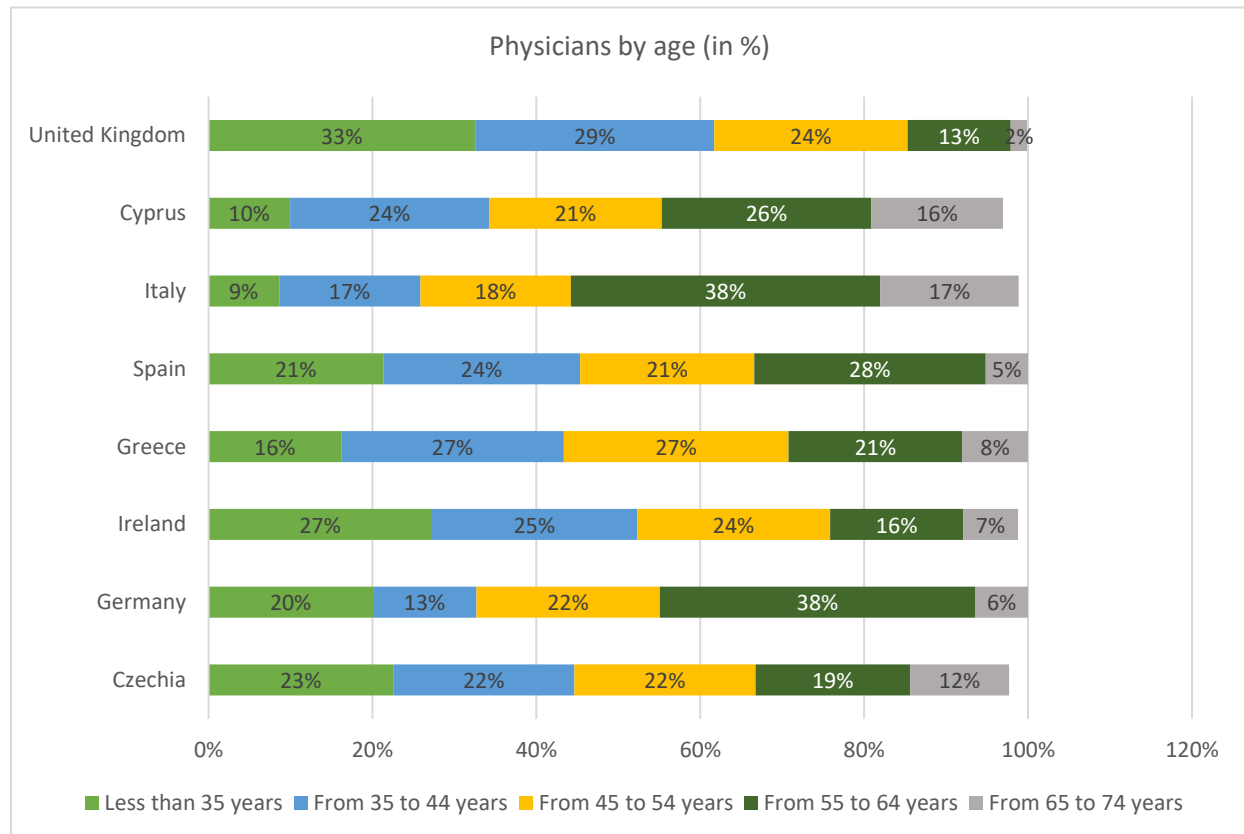
Figure 32: Physicians by age (in %). Eurostat [hlth_rs_phys]. No data available for Portugal.

This section outlined some of the barriers to accessing healthcare, particularly with regards to cost, distance and waiting times. As will become clearer in Section 4, addressing some of these challenges, particularly pertaining to unmet needs, will require policy changes to create more equal societies. However, Section 4 also outlines opportunities for the SHAPES Platform as an enabler utilising existing technologies (Section 3.5) in an innovative manner to disrupt current care paths and to improve health and wellbeing and achieve socioeconomic changes at scale.

3.3.4 Formal and informal long-term care provision

In Europe, care is provided both formally and informally, long-term or short-term, at home or in institutional facilities, such as hospitals, rehabilitative facilities or nursing homes. As SHAPES seeks to facilitate independent ageing at home, this deliverable (D3.1) focuses primarily on the provision of long-term care (LTC) at home. Long-term care (LTC) refers to

> *a range of services and assistance for people who, as a result of mental and/or physical frailty and/or disability over an extended period of time, depend on help with daily living activities and/or are in need of some permanent nursing care* (European Commission, 2014, p. 11).

In most countries, responsibilities for the provision of LTC are fragmented and divided between the health system and the social sector. In most countries, healthcare, which is provided by professional healthcare workers, is regulated and funded at the national level or regional level (e.g., (IT). By contrast, social care workers assist with daily routine tasks (e.g., household, eating, personal care). Depending on the jurisdiction, social care is funded and regulated at the national level (CY, EL, IE, IT) or regional/local level (UK) or a mix between all three levels (ES). Moreover, regions (ES, IT) and municipalities (EL, IT, CY, UK) have the responsibility for the organisation and coordination of social services. Unfortunately, the fragmentation of responsibilities in relation to LTC provision means that the health and social aspects of LTC provision are often poorly integrated (Figure 33) (Spasova et al., 2018).

Provision of professional long-term care
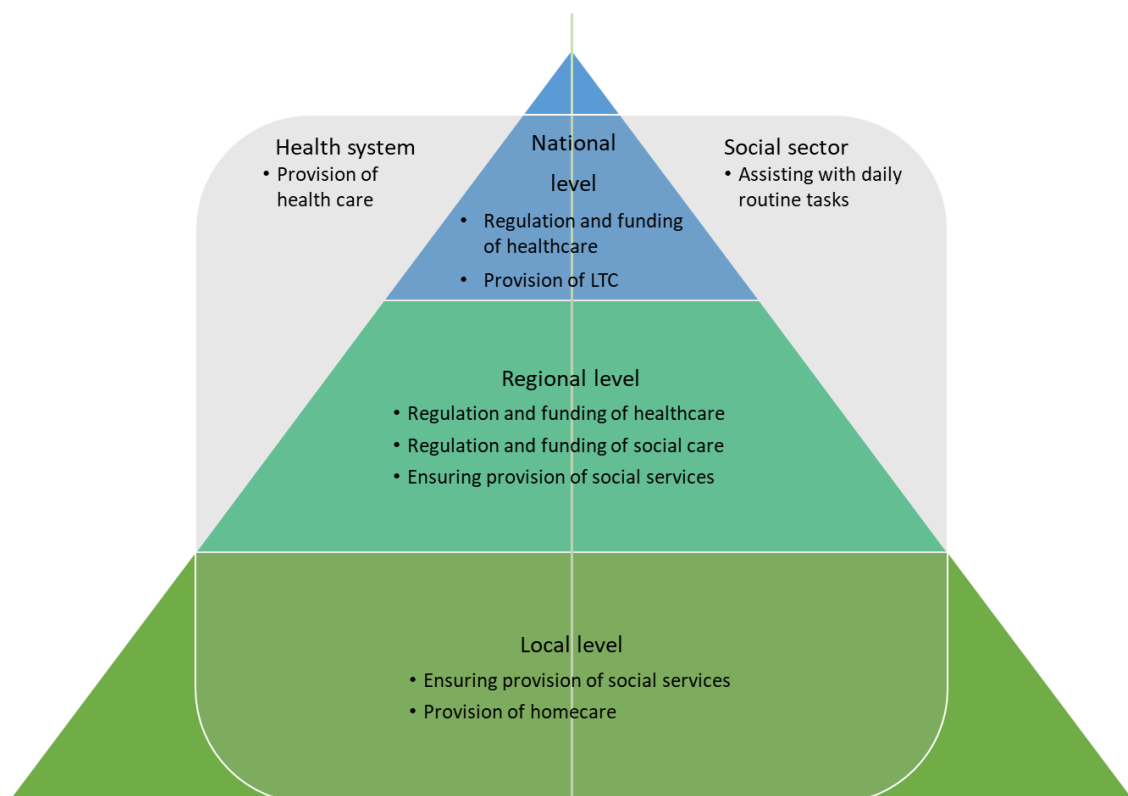
Figure 33: Professional LTC provision. Source: Own figure, based on Spasova et al., 2018.

3.3.5 Home care

The meaning of the term 'home' varies from country to country and can refer to, for example, someone's house or the wider environment, such as local neighbourhoods. Bearing this in mind, homecare in this deliverable (D3.1) refers to "any care provided behind someone's front door or, more generally, referring to services enabling people to stay living in their home environment" (Genet & European Observatory on Health Systems and Policies, 2012, p. 9). In Europe, LTC at home tends to be provided by both health and social care professionals, as well as informal carers (e.g., spouses, adult children and other family members, friends and volunteers) and non-professional carers who are hired privately and paid informally (Genet & European Observatory on Health Systems and Policies, 2012; Spasova et al., 2018; Zigante, 2018).

3.3.5.1 Homecare use and age

Homecare use increases with age. In the EU-28, approximately 11 percent of people aged 65 years old or older were in receipt of homecare in 2014, compared to 17 percent of people aged 75 years old or older. Homecare use differs by country; among the countries reviewed, Spain (12%), Italy and Ireland (both 11%) had the highest proportion of homecare use among the 65 years and over age group, compared to Germany (6%), Portugal (7%) and Czechia (8%). Among the 75 years and over age group, Spain (22%) and Ireland (21%) had the highest proportion of homecare use compared to Germany (11%) and Greece (11%) (Figure 34).

As women both live longer and report greater levels of health issues than men (see Section 3.2.1),
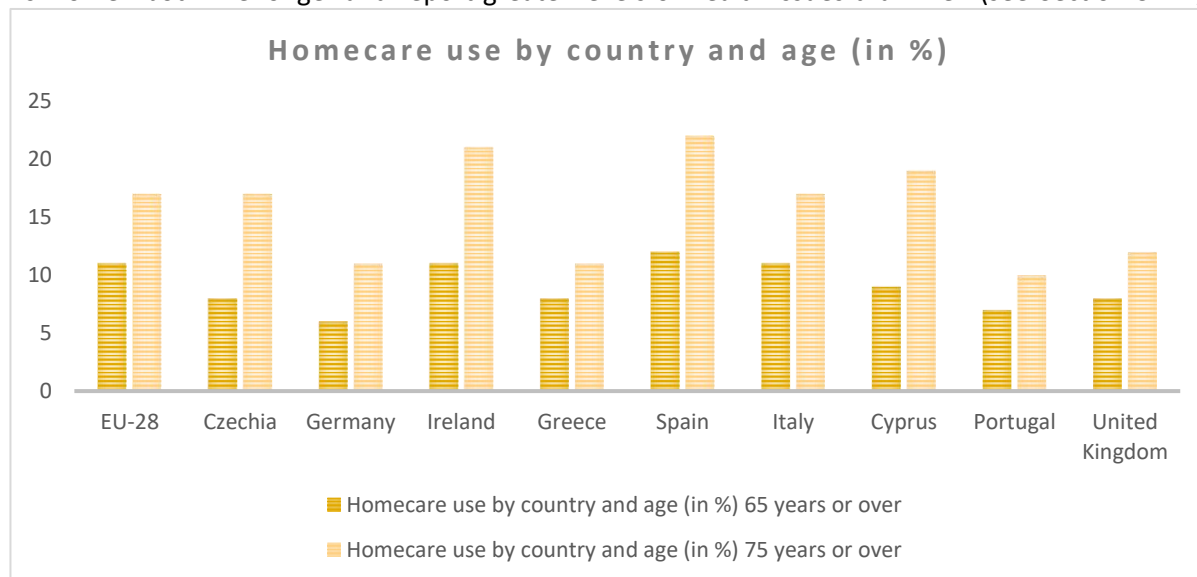
Figure 34: Homecare use by country and age group. Eurostat, 2020. [hlth_ehis_am7e]. Data are from 2014.

homecare use is also more common among women than men (Figure 35). For example, in 2014 (EU-28), among the 65+ age group, eight percent of men received homecare compared with 13 percent of women. Likewise, in the 75+ age group, 14 percent of men received homecare compared with 20 percent of women. Although levels of homecare use differed from country to country, more women received homecare in 2014 than men, with one exception: in Portugal, the proportion of men and women aged 75 years or over was the same (10%).

3.3.5.2 Homecare use and educational attainment

Homecare use by gender and age (in %)
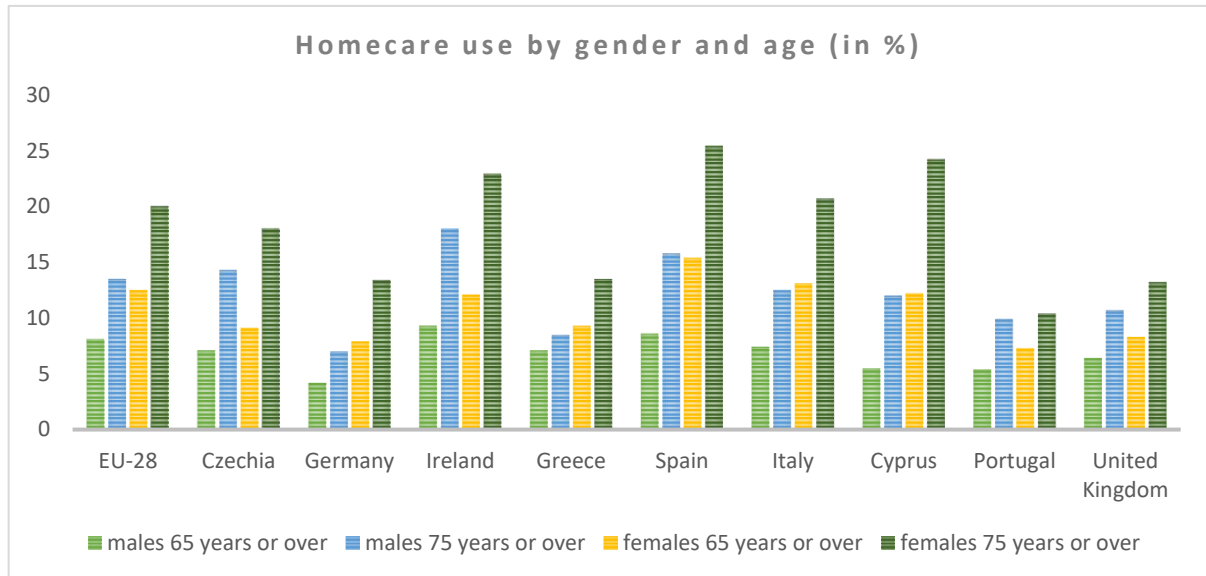
Figure 35: Homecare use by age and gender. Eurostat, 2020. [hlth_ehis_am7e]. Data are from 2014.

In addition to gender, homecare use also differs according to educational attainment which is categorised using the UNESCO International Standard Classification of Education 11 (ISCED 2011) (UNESCO Institute for Statistics, 2012). As shown in Figure 36 and Figure 37, people with lower levels of educational attainment will have greater needs for homecare. This is the same for both age bands, although homecare requirements increase with age. In the EU-28 MS, 13 percent of the 65+ years age band with lowest levels of education (Level 0-2) availed of homecare compared with eight percent with an upper secondary/post-secondary non-tertiary (second level) education and six percent of people with tertiary education. This was the same for all reviewed countries except Czechia and Cyprus. Although homecare use was also highest among the group with the lowest levels of education, it was slightly lower in the middle education group (Czechia: 6%; Cyprus: 5%) than in the tertiary education group (both countries 7%).

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[11] ISCED 2011 Levels: Levels 0-2: Less than primary, primary and lower secondary education. Levels 3 and 4: Upper secondary and post-secondary non-tertiary education. Levels 5-8: Tertiary education (UNESCO Institute for Statistics, 2012).
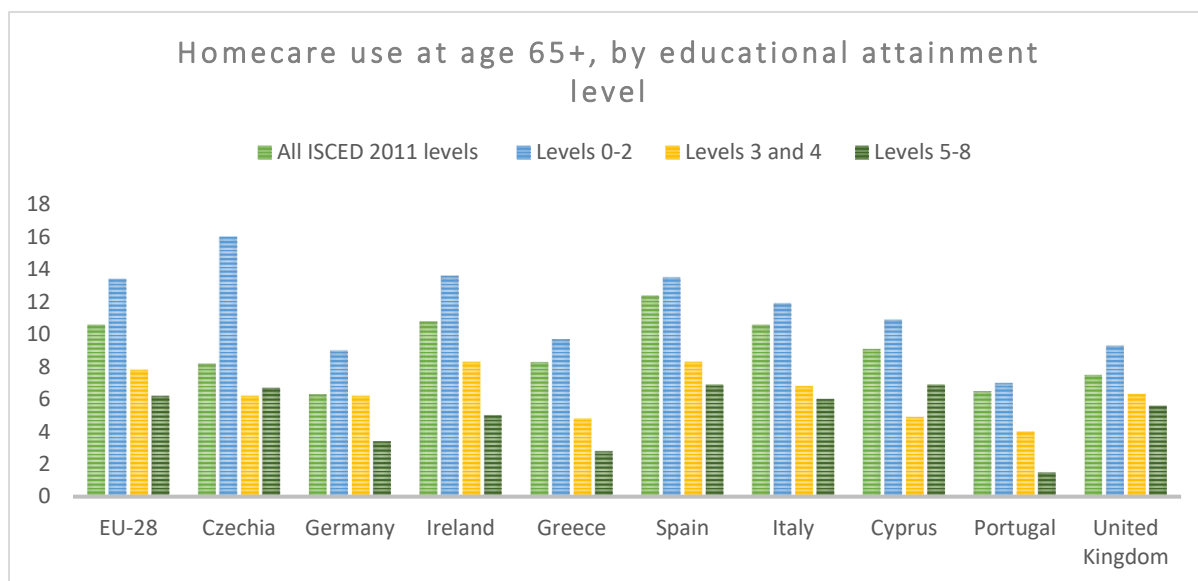
Figure 37: Homecare use by country and educational attainment, 65 years or over (in %). Eurostat, 2020 [hlth_ehis_am7e]. Data are from 2014.

Likewise, in the 75 years or over (75+) age band, homecare use in the EU-28 MS in 2014 was highest in the lowest education group (20%) and lowest in the tertiary education group (11%). Although homecare use was highest in the lowest education group in all countries, there were some differences between countries in the second and third level education groups. Although people with a tertiary education tend to avail of homecare less often than people with a second level education, this was not the case in some countries. In Czechia, Greece and Italy homecare use was somewhat higher among people with a tertiary education than those with a second level education. In Cyprus and Portugal, shares of homecare use was the same among second and third level-educated people.
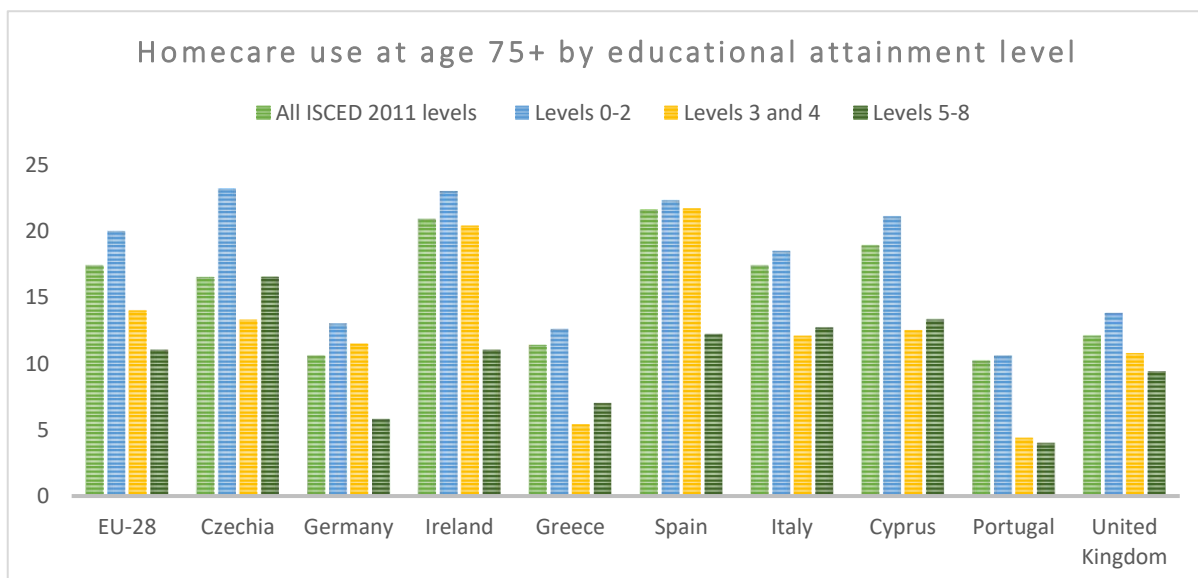
Figure 36: Homecare use by country and educational attainment, 75 years or over (in %). Eurostat, 2020. [hlth_ehis_am7e]. Data are from 2014.

3.3.6 Actors involved in long-term care provision

In this section, we provide a brief overview of the formal and informal actors involved in long-term care provision.

3.3.6.1 Professional, formal long-term care provision

Formal care services are provided by the health and social care sectors. Healthcare services are the domain of health professionals and social care is provided by social care professionals. Challenges for long-term care provision revolve around issues such as lack of care services, lack of integration between health and social care sectors and shortcomings pertaining to training (see Table 12).

Professional long-term care provision	
Type of carers	**Healthcare professionals** (e.g., GPs, nurses, physiotherapists, mental health professionals) / **Social care professionals** (professional care services or trained individuals)
Type of care	Nursing care, physiotherapy, rehabilitation / Assistance with daily routine tasks (bathing, clothing, eating, shopping, cooking)
Challenges for LTC provision	Underdeveloped homecare services and community based LTC Insufficient increase in more and affordable home care and community-care provision to match residential LTC Lack of integration between healthcare and social care sectors Insufficient training increasing the risk of unmet needs

Table 12: Professional long-term care provision. Sources: (Genet & European Observatory on Health Systems and Policies, 2012; Gruneir et al., 2011; Spasova et al., 2018).

3.3.6.2 Informal long-term care provision

Informal care plays an important role in the provision of LTC to older people. Informal care is defined as any care or help provided to older people, care provided to working age adults, young people and children with disabilities (Zigante, 2018). The reliance on informal caregivers entails a myriad of challenges related to policy, working conditions, social norms (i.e., expectation that female relatives will provide care) and ensuing consequences relating to income, mental and physical issues (Table 13).

Informal care tasks are often carried out by close family members of the care recipient, such as spouses, partners, or their adult children. Women are more likely to care for their relatives at least once a week more often than men, and the gender gap is more pronounced among people of school-leaving or working age (15-64 years old) (Figure 38).

Informal LTC provision		
Type of carers	**Informal carers** e.g., spouses, adult children and other family members, friends, and volunteers mostly women	**Privately hired carers**
Type of care	any care or help provided to older people (both relatives and others), including personal care or basic activities of daily living (ADL)	
Payments and benefit schemes	**Often unpaid work** **Cash benefits (e.g., i) carer's allowance or ii) care allowance paid to the care receiver)** to replace lost income / symbolic recognition of care work available in some countries (CH, FI, HU, IE, SK, UK) **Care leave schemes** to take time off work/ reduce working hours (AT, BE, FR, AT, HU, IE, IT, LU, NL, UK) • Limited compensation (e.g., AT, BE) • Full salary (IT, LU) • Unpaid leave (e.g., FR, HU, IE, HR) • part-time care leave (e.g., AT, FR) • time-limited leave (e.g., AT, BE, IT) Payments as part of social insurance	Privately paid, informal payment
Training/ Assistive technology (AT)	AT aimed at caregivers	

Challenges	**Policy challenges:**
	• Lack of formal care capacity leading to reliance on informal care provision
	Work conditions:
	• Insufficient wages or compensation
	• Lack of social security, precarious work particularly for migrant carers
	• Unfair working conditions
	• Caregiving incompatible with full-time/ inflexible employment
	  o Reduced/ loss of employment, particularly if caring for 10+ hours per week
	  o Risk of poverty
	• Lack of information regarding care provision/ adequate training
	• Lack of regulation
	Gender:
	• Traditional gender roles reduce opportunities to participate in the labour market
	• Increases risk of poverty for women
	Mental and physical health issues for caregivers:
	• Mental health difficulties and psychological distress increase with intensity of care (20+ hours) and if co-habiting
	• Mental and physical health implications post-care	

Necessary or desired changes	• Respite support for informal caregivers • Psychological support and counselling for informal caregivers • Training and employment support programmes • Flexible work conditions may prevent loss of employment	

Table 13: Non-professional long-term care provision. Sources: (Brimblecombe et al., 2018; Colombo et al., 2011; Genet & European Observatory on Health Systems and Policies, 2012; Spasova et al., 2018; Zigante, 2018); personal communication.

Provision of informal care, by gender (in %)
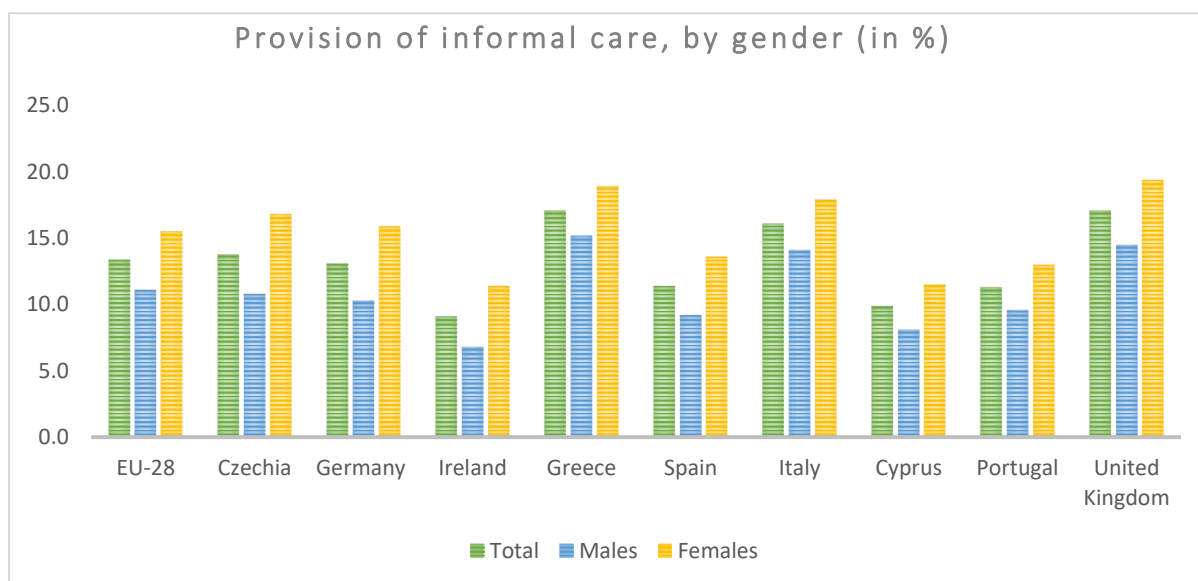
Figure 38: Persons providing informal care or assistance at least once a week by sex, age and educational attainment level. Eurostat, 2020 [hlth_ehis_ic1e]. Data are from 2014.

In most EU countries, the gender gap narrows or even reverses with age (Figure 39). Particularly in the age group 75 years or over, more men than women care for their relatives, except in Czechia, Ireland, Greece, and Spain, although the difference in Greece is negligible (males: 9.3%; females: 9.4%).

Provision of informal care by age and gender (in %)
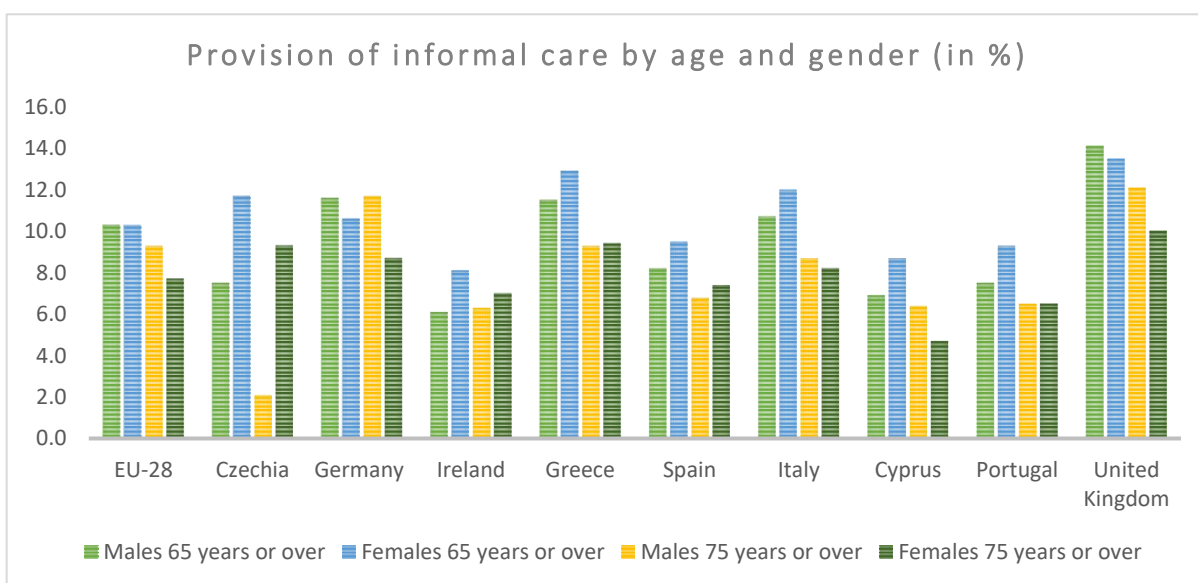
Figure 39: Persons providing informal care or assistance at least once a week by sex, age and educational attainment level. Eurostat, 2020 [hlth_ehis_ic1e]. Data are from 2014.

Apart from gender, informal care provision also has a socio-economic dimension. Both men and women with lower educational attainment (i.e., less than primary, primary and lower secondary education (levels 0-2) and upper secondary and post-secondary non-tertiary education (levels 3 and 4)) are more likely to care for their relatives than men and women with a tertiary education. There were some differences between countries. In Cyprus and Czechia, men and women with the lowest levels of education were also least likely to care for their relatives (Figure 40).
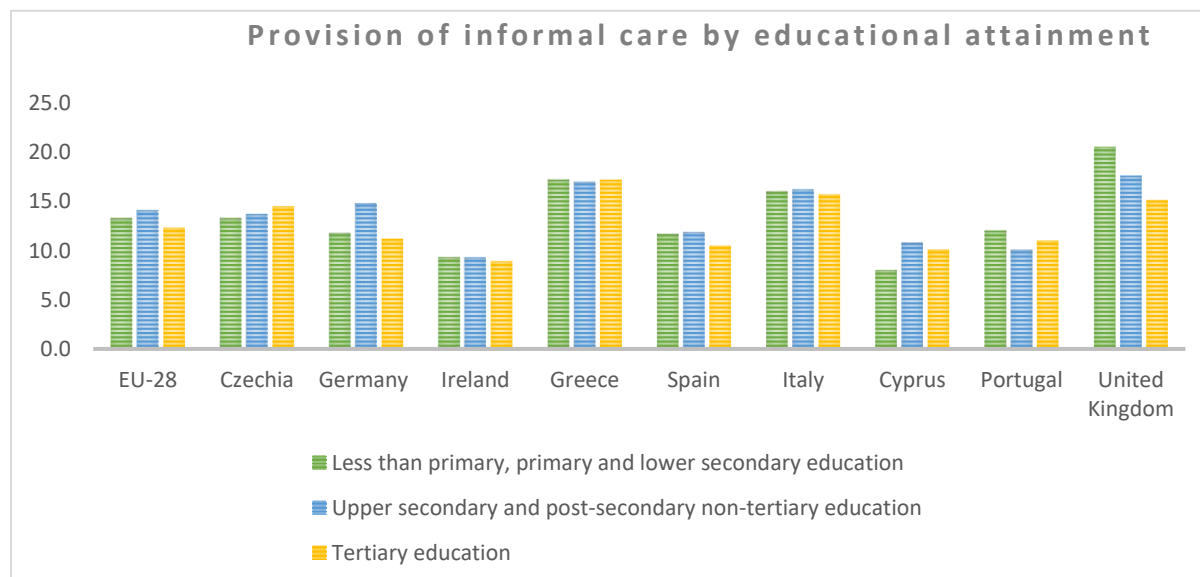
Figure 40: Persons providing informal care or assistance at least once a week by sex, age and educational attainment level. Eurostat, 2020 [hlth_ehis_ic1e]. Data are from 2014.

3.3.7 Challenges for long-term care provision

There are a range of challenges associated with the provision of LTC relating to access and adequacy, quality of care, employment and financial sustainability which are outlined in in Table 14.

Challenges to the provision of long-term care			
Access and adequacy	**Quality**	**Employment**	**Financial sustainability**
Fragmentation of provisions between health system and social sector **Associated challenges:** • poor coordination between entities • impact on waiting times and administrative procedures	Lack of standardised approach to measuring and monitoring quality of LTC provision	high levels of informal care due to: • insufficient availability of formal LTC services • poor quality of LTC • lack of residential and community services • high cost of formal LTC • societal expectations that family members will provide care	Increase in LTC expenditure puts pressure on public finances
Inequalities in LTC provision due to regional divisions of responsibilities	Shortage of professionals due to inadequate working conditions and lack of job security caused by low	Traditional gender roles leading to: • Gendered provision of care, i.e., women • Impairment of female participation in the	Fragmentation between health and social care sectors also problematic for financial sustainability • May lead to unpredictable spending

	income, insufficient training, high workload and high level of pressure	labour market due to reduced working hours/ loss of employment	on LTC services in the absence of a clear financial strategy or if certain type of LTC is favoured over another
Insufficient availability of home and community-based care services in some countries (e.g.,CZ, CY, EL, ES, PT, UK)		Reliance on migrant workers to provide LTC for family members • Lack of legal protection • Irregular, informal, oral contracts • Lack of qualifications • Poor and precarious working conditions • Often not registered	
Deinstitutionalisation of care, i.e., reduction of availability of residential care, without sufficient increase of affordable home and community care provision	n/a	n/a	n/a
Impact of economic and financial crisis in some countries (e.g.,EL, ES, IE, UK) **Associated challenges:** Cuts in public funds/ increasingly restrictive eligibility criteria for home care as barriers to access to home care	n/a	n/a	n/a

Table 14: Challenges for Long-term care provision. Spasova et al., 2018.

3.3.7.1   Impact of caregiving on informal carers

The quality of care and the impact of caring on informal caregivers are closely related as positive physical and mental health of informal carers ensure that LTC is both accessible and sustainable. However, as Zigante et al. (2018) have stated, the informal provision of care tends to be associated with a range of negative physical and mental health outcomes due to primary and secondary stress as summarised in Table 15.

Impact of caregiving on the mental and physical well-being of informal carers	
Primary stress	**Secondary stress**
Physical and psychological strain Distress and depression Greater susceptibility to illness Potentially reduced lifespan High levels of unpredictability and uncontrollability	Stress resulting from attempts to reconcile work and family relationships with caregiving duties Requirement to maintain high levels of continued alertness

Table 15: Physical and mental health outcomes of informal caregivers. Zigante et al., 2018.

3.4 Care pathways

In this section, we look at the most common health complaints among older people which may necessitate medical or social care. Some illnesses may require institutionalisation while others will be managed at home either independently or with assistance from formal or informal caregivers. As there is a trend towards prioritizing home care (Spasova et al., 2018), we are looking at the criteria for returning home after hospitalization, but also at the barriers that may prevent an older person from returning home. We are also illustrating different phases of the pathways into and out of institutional care through a swimlanes graphic (Figure 47) of both the current 'as is' process, and of the imagined future process altered through SHAPES.

3.4.1 Health limitations among older adults

There are many health reasons that may require care. As people are ageing, they are more likely to experience degrees of functional and sensory limitations as well as chronic diseases. Many older people are likely to find it increasingly difficult to see, hear and walk. As Figure 41 illustrates, 37 percent of adults over 75 years old (EU-28) experienced moderate auditory limitations, one third struggled with their eyesight, and just over one quarter experienced moderate difficulty walking. Moderate functional and sensory limitations varied across countries but overall, mirrored this trend.
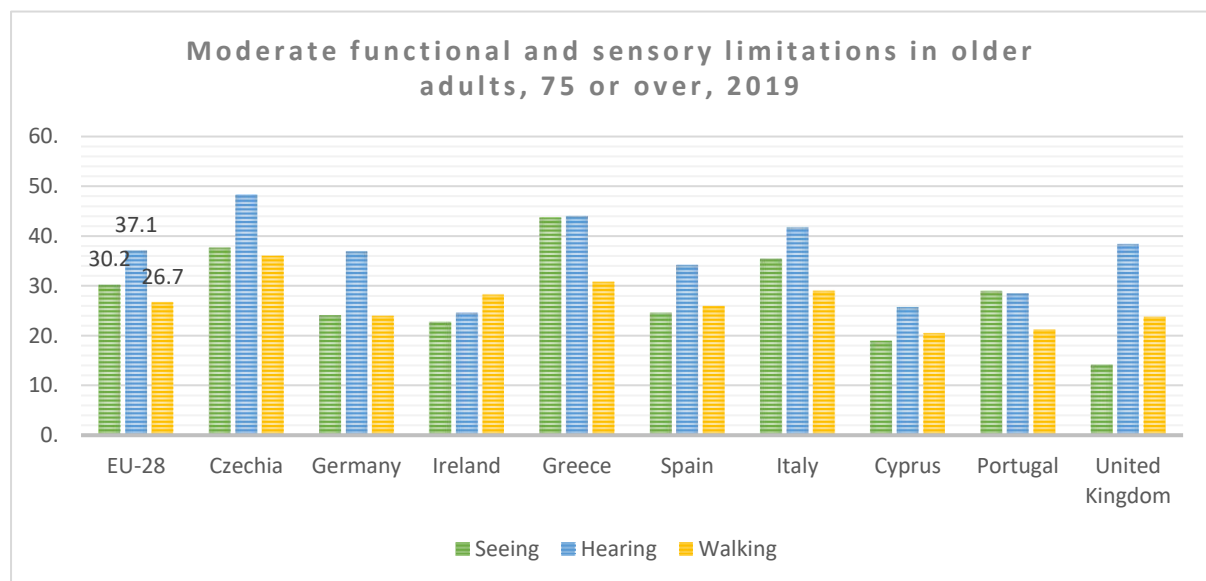
Figure 41: Physical and sensory functional limitations by sex, age and educational attainment level. Eurostat, 2020. [HLTH_EHIS_PL1E]. Data are from 2014.

Figure 42 illustrates severe functional and sensory limitations highlighting that roughly one third of adults aged 75 years old or older experienced serve difficulty walking, compared to hearing (18.2%) and seeing (8.2%). Functional and sensory limitations play an important role with regards to quality of life, independence and moreover, mortality as frailty has been associated with increased risk of falls (Kojima, 2015) and mortality (Cunha et al., 2019).

Severe functional and sensory limitations in older adults, 75 or over, 2019
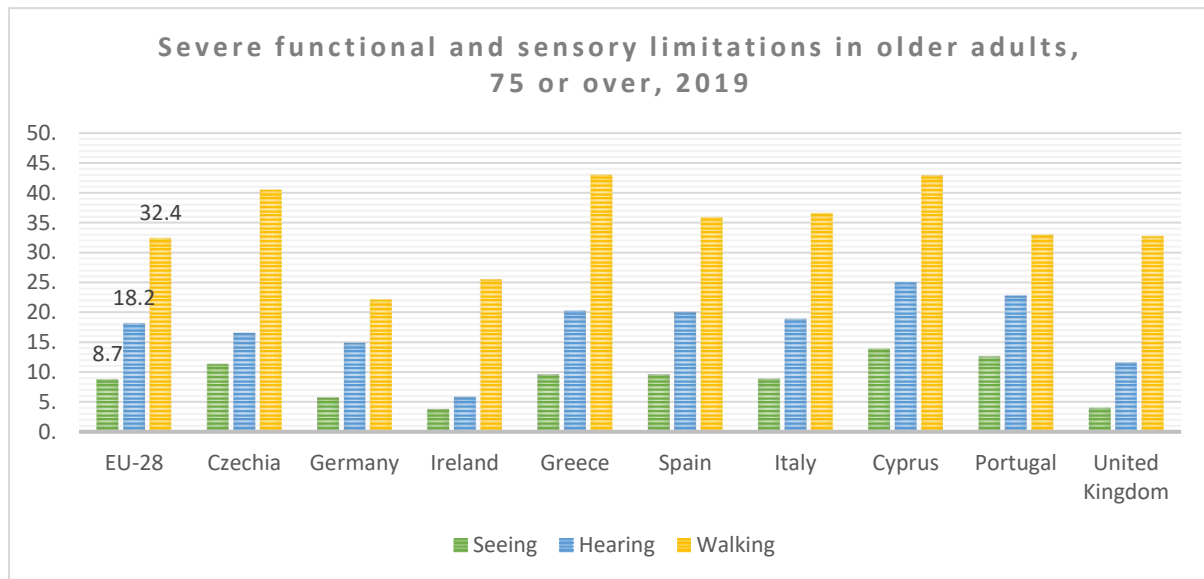
Figure 42: Physical and sensory functional limitations by sex, age and educational attainment level. Eurostat, 2020. [HLTH_EHIS_PL1E]. Data are from 2014.

Figure 43 looks at self-reported chronic diseases in the EU-28 MS in the population overall, and in older people. These illnesses do not necessarily require hospitalisation, but they necessitate continuous care which is illustrated in Phase One in the swimlanes graphic (Section 3.4.4). Overall, the top three chronic diseases are lower back issues, high blood pressure and allergies. In older people (65 years or over and 75 years or over), the top three chronic diseases are high blood pressure (65+

Self-reported chronic diseases
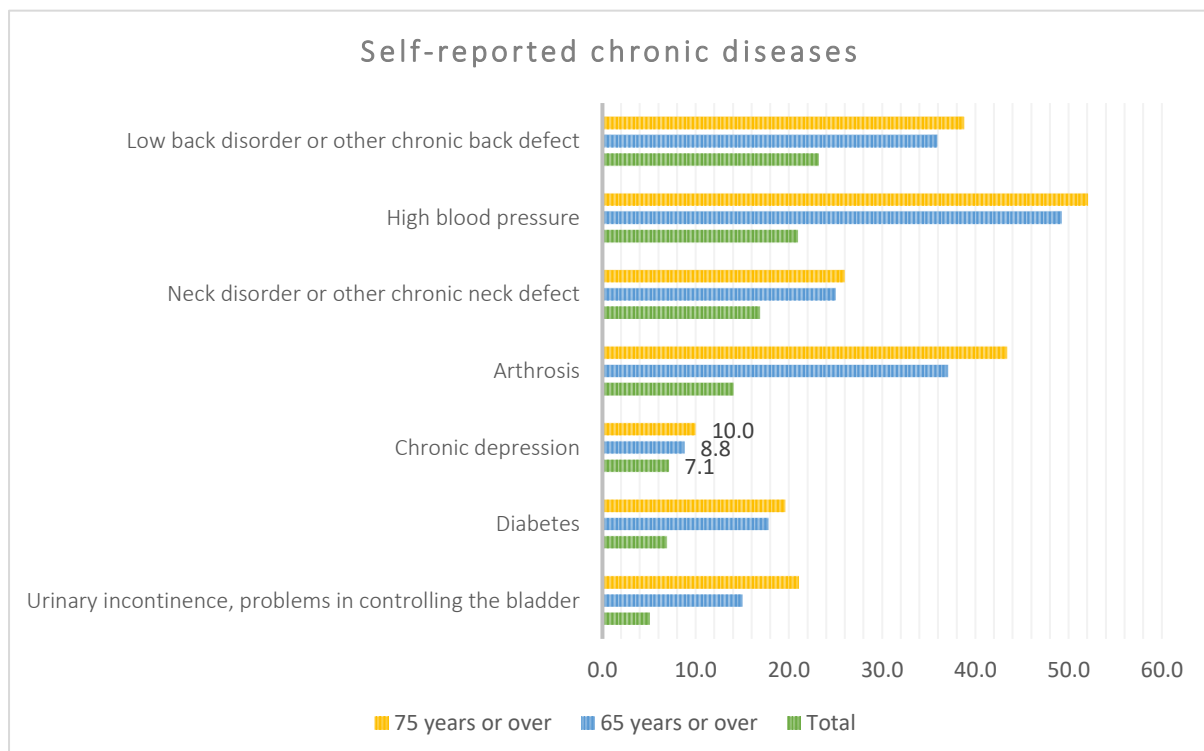
Figure 43: Persons reporting a chronic disease, by disease, sex, age and educational attainment level (in %), 2014. Source: Eurostat [hlth_ehis_cd1e]. Data are from 2014.

years: 49.2%; 75+ years: 52.1%), lower back issues (65+ years: 35.9%; 75+ years: 38.8%) and arthrosis (65+ years: 37.0%; 75+ years: 43.4%).

It is also worth pointing out the prevalence of chronic depression which appears to be increasing with age. As Figure 43 shows, ten percent of older adults (75+) suffer from self-reported chronic depression, compared to 8.9 percent at age 65 or over and 7.1 percent overall. Causes of depression in older adults vary and may include a combination of genetic susceptibilities, neurobiological, cognitive and psychological causes, age-related issues (e.g., frailty) as well as environmental factors, such as social isolation and loneliness (Fiske et al., 2009; Nicholson, 2012; Soysal et al., 2017). Apps can play a role to keep older adults more connected with their loved ones and communities which is illustrated in the swimlanes graphic at all stages of the care process.

These self-reported chronic diseases are not in themselves a predictor for acute unplanned hospitalisation. However, older people are more likely to develop multimorbidity which bears the risk of prescribing errors resulting in hospitalisation (Gallagher et al., 2011; Lavan et al., 2016; Rieckert et al., 2018)

Aside from prescribing errors, one review of the literature (Šteinmiller et al., 2015) revealed that unplanned visits to the emergency department (ED) were most commonly a result of:

- Cardiovascular issues;
- mental health difficulties;
- musculoskeletal and abdominal conditions;
- adverse drug reactions;
- dermatological conditions;
- neurological and respiratory conditions;
- poor general health status;
- accidents;
- influence of time factors such as time of day, week or season.

As illustrated in Figure 44, some of these conditions also account for the most common causes of death in older adults (65 or over), including diseases of the circulatory system (57%), malignant neoplasms (i.e., cancer) (26%), diseases of the respiratory system (10%), diseases of the digestive system (4%) and endocrine, nutritional and metabolic diseases (3%).
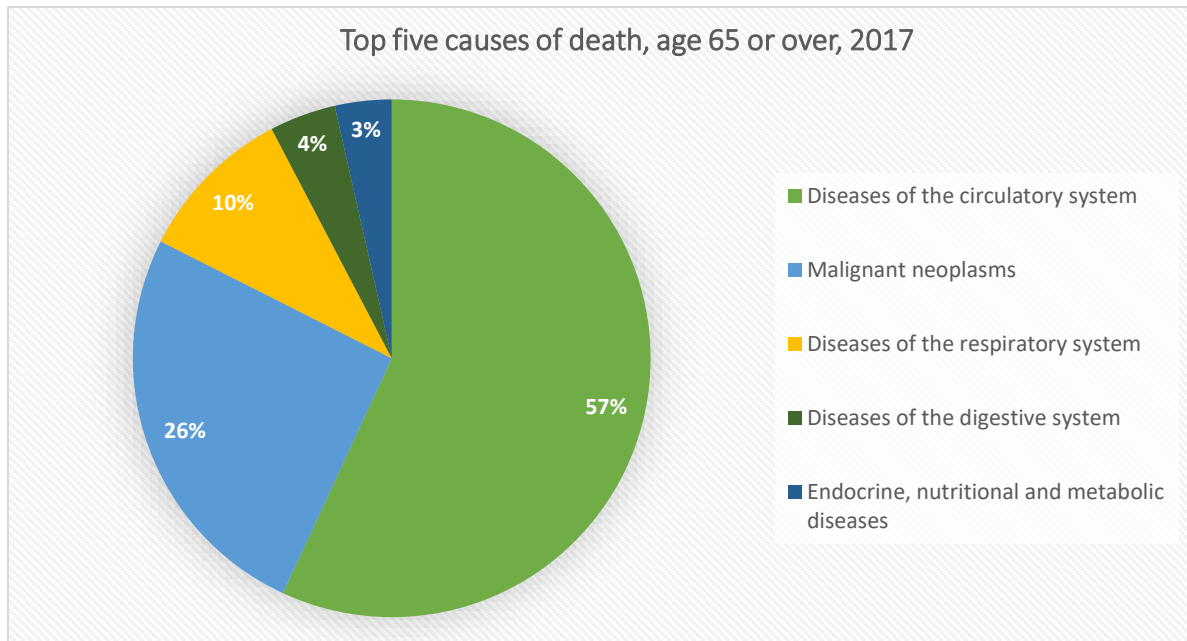
Figure 44: Causes of death - standardised death rate by residence. Eurostat, 2020. [hlth_cd_asdr2]. Data are from 2017.

The duration of hospital stays varies between countries and increases with age. Within the EU-28 MS, the average duration is 6.8 days. Among the reviewed countries, Cyprus overall has the shortest duration of hospitalisation for all ages (3.3 days) compared to Portugal (9.1 days). Although the duration of hospitalisation rises with age in all countries, Czechia has the longest duration of hospitalisation for older people across all age groups (i.e., 70-74, 75-79, 80-84, 85-89) (Figure 45).
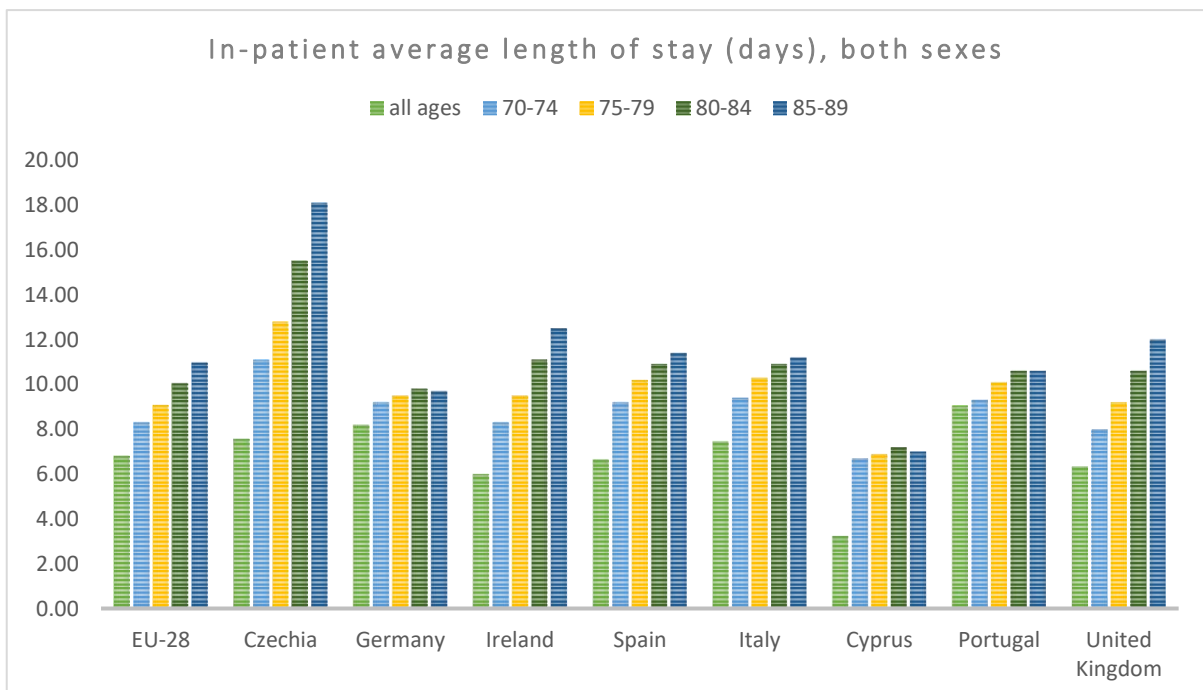
Figure 45: In-patient average length of stay (days). .Eurostat, 2020. [hlth_co_inpst]. Data are from 2018 or latest available. Greece: data from 2014.

Duration of hospitalisation also varies by sex. As shown in Figure 46, women in the age group 70-89 years tend to stay in hospital longer than men of the same age (men: 9.1 days; women: 10.0 days), expect in Portugal (9.2 days, both sexes). There was also virtually no difference in Ireland (m: 10.3 days; f: 10.4 days) and Cyprus (m: 6.9 days; f: 7.1 days). By contrast, the greatest gender discrepancy was in Czechia (m: 12.6 days; f: 15.7 days).
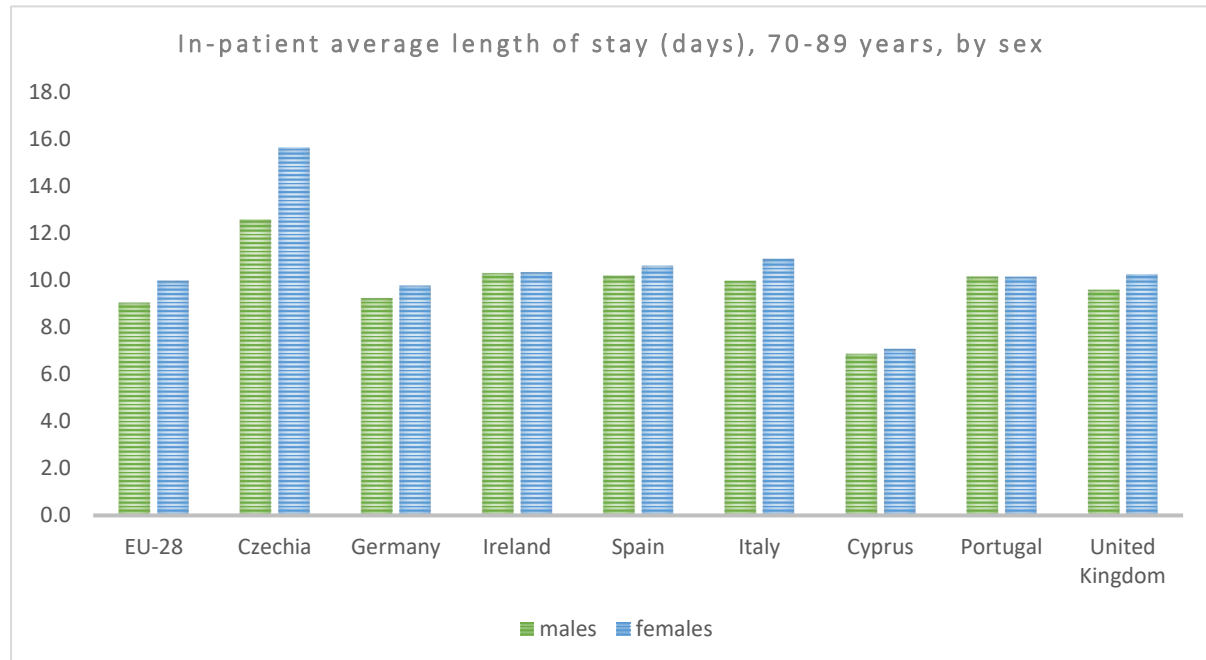
Figure 46: In-patient average length of stay (days). Eurostat, 2020. [hlth_co_inpst]. Data are from 2018 or latest available. Germany: 2017. Ireland: 2015. Portugal: 2015. UK: 2016. No data available: Greece.

While the duration of acute institutional care may increase because of age, some partners have also pointed out that hospitalisation may be extended if the care receiver requires a period of rehabilitation but cannot avail of a bed at the point of discharge. If this is the case, the care receiver may remain in hospital until a space becomes availabe.

3.4.2 Pathways out of institutional care

There has been a trend towards the prioritisation of homecare over residential care (e.g., nursing home) (Spasova et al., 2018). However, despite meeting the criteria for discharge from hospital, the care receiver may not be able to return home immediately. Reasons differ from case to case. As the swimlanes graphic illustrates, the care receiver may require additional rehabilitative treatment in an institutional facility. Moreover, the home may be deemed not adequate to meet the care receiver's post-discharge needs and require retrofitting before the person can return home. Another reason may relate to the availability of formal or informal home care. As Section 3.3.6 has outlined, there is a shortage of residential care facilities and a prioritisation of homecare; yet there is a lack of professional care providers and hence, countries rely heavily on informal caregivers, such as family members.

3.4.3 Criteria for and barriers to leaving institutional care

A range of criteria and barriers determine whether a care receiver may leave institutional care and return home. Broadly, there are four categories: level of care needs, availability of formal care services, availability of informal caregivers and cost/affordability.

Criteria for and barriers to leaving institutional care				
	Level of care needs	**Availability of formal care services**	**Availability of informal caregivers**	**Cost/ affordability**
Assessment by physician/ multidisciplinary care team	Medical needs, adherence to medical plans, complexity of pharmacological treatment Functional capabilities (e.g., mobility, ability to care for oneself) Cognitive and communicative abilities Social environment and network Proximity of care provider	Availability of homecare services	Possibility of staying with/ being cared by family	Income Ability to pay for homecare in countries/ areas where they require out-of-pocket payments
Assessment by social care professional	Adequacy of the home	n/a	n/a	n/a

Table 16: Criteria for leaving institutional care. Source: partner interviews. Spasova et al., 2018.

3.4.4 Swimlanes: Pathways into and out of institutional care

The swimlanes graphic (Figure 47) below illustrates current pathways into and out of institutional care. The graphic depicts the different actors that are involved in providing and receiving institutional care, and the processes (rectangular shapes) that take place and intersect at different phases, e.g., at decision points (diamond-shaped box). The main actors presented are the care receiver, professional healthcare providers, professional social care providers, informal caregivers, insurance providers and governments at national, regional and local level. The phases are as follows: Phase One: Living independently, potentially managing some health issues; Phase Two: Visiting A&E or out-of-hours medical services; Phase Three: Hospitalisation; Phase Four: rehabilitation and/or retrofitting the care receiver's home; Phase Five: Returning home and living independently. This may involve some post-discharge medical treatment, such as physiotherapy. Phase Six: Living at home with assistance (e.g., through home care services) and Phase Seven: Living in a residential care setting, such as a nursing home.

As stated, health and care service provision and governance vary across EU countries and the swimlanes are intended to accommodate these differences. This means that the phases and processes (shapes) and paths (arrows) may not apply to every context. These pathways allow the viewer (e.g., developers of the SHAPES platform, the leaders of the pilots or policy makers seeking to make changes to their current health and care systems) to take the perspective of different actors. For example, a Platform developer could follow the path of the health and care receiver and see where they interact with other parts of the health and care system. This will make it easier for them to identify gaps and opportunities for the SHAPES Platform.

We have also added elements of the proposed SHAPES Platform as an external actor to a separate swimlane and highlighted (in red). Currently, this supports the SHAPES technical partners and the pilot leaders in imagining how different phases of the care processes may be altered depending on the placement of different Platform components. We will be working closely together with the task leaders of the pilots in WP6 to further develop these swimlane graphics tailored to each pilot. These graphics, in conjunction with the CONOPS, will be a valuable tool to support the Platform development.
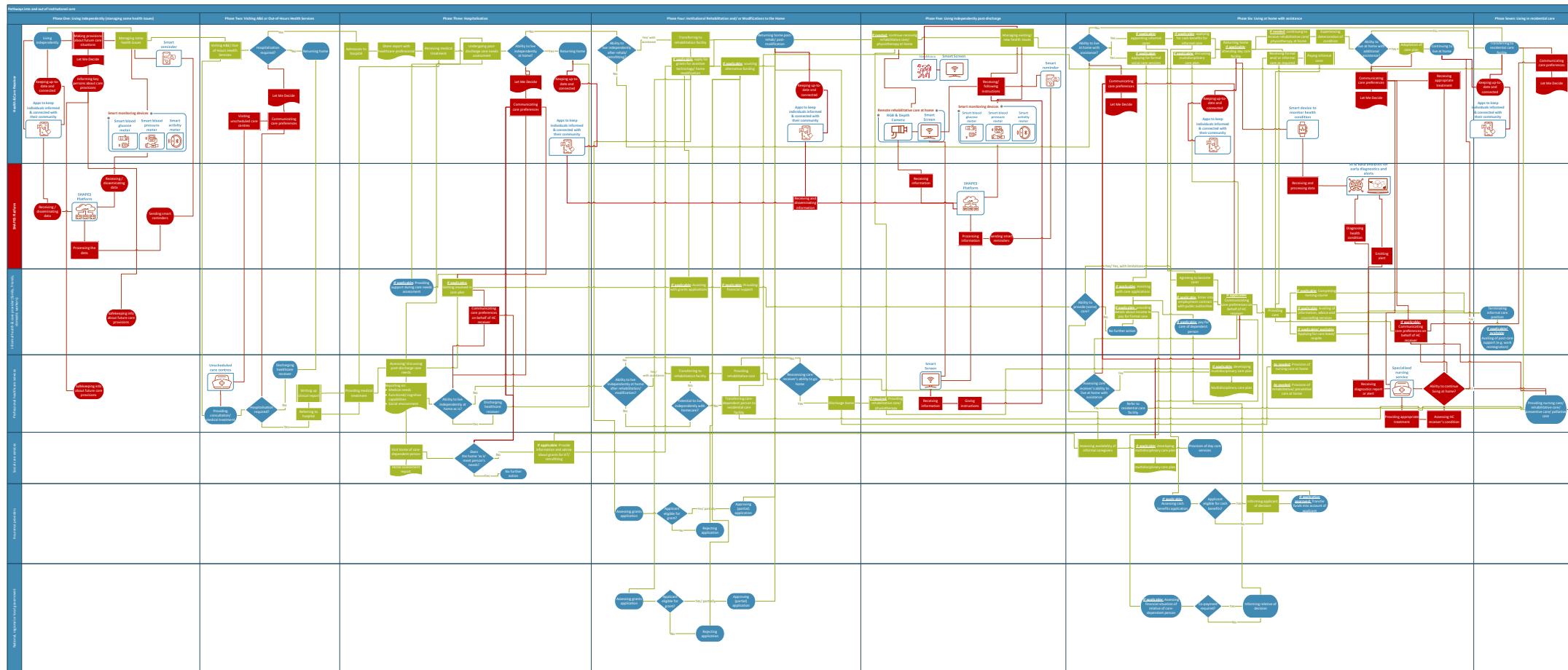
Figure 47: Swimlanes illustrating the pathways into and out of institutional care. Own graphic.

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67

3.5 Technology and tools currently used at the pilot sites

Partners identified a wide range of technologies and tools that are currently being used at the reference sites and include a laboratory, the Internet of Things, scanners, sensors, monitors and trackers, screening tools, computers and consoles, electronic medical records, video consultations and online chat functions, electronic prescriptions, self-monitoring devices, support lines and integrated management platforms. Some of these tools and technologies are legacy tools that have been used widely in healthcare settings (e.g., CT and EEG scanners) whereas others are innovative, locality-specific (e.g., chatbot "Rosa") and are being deployed on a trial basis (e.g., *Projekt Telearzt*). A list of broad categories of technologies and tools is provided in Table 17. A more detailed description of the specific tools and their purposes, benefits and challenges is provided in Table 22. This list is not meant to be exhaustive, but to give an overview of the range of possibilities for SHAPES and moreover, provided valuable data based on which some of the requirements in Deliverable D3.8 were formulated.

Technologies and tools used at the pilot sites			
Medical Physics Laboratory	The Internet of Things The Internet of Medical Things The Internet of Active Aging Things	Scanners	Sensors
Trackers and monitors	Screening tools	Computers, consoles, etc.	Electronic medical records
Video consultations and online chat	Robots, chatbots, virtual assistants	E-prescriptions	Tools for patient self-monitoring of medical condition
Support lines	Integrated management platform	n/a	n/a

Table 17: Technologies and tools used at the pilot sites. Information primarily based on partner interviews

3.6 Human factors: Limitations and opportunities for SHAPES

The following two sections (Section 3.6.1 and 3.6.2) outline the human factors associated with health and care provision in Europe. Human factors are those factors that shape and influence the provision of health and care and can be broken down into individual characteristics, aspects of the workplace/ environment as well as management. Section 3.6.1 deals with this in terms of the limitations, constraints and risks associated with current health and care provision while Section 3.6.2 outlines the changes necessary or desired to improve the present situation.

3.6.1 Limitations, constraints and risks associated with current health and care provision

Table 18 details the limitations, constraints and risks associated with current health and care provision. The information was primarily provided by the SHAPES partners. Broadly, issues identified related to access, quality of care provision, staffing challenges and working conditions, policy-related issues, low levels of investment, infrastructural issues, privacy and security issues, and challenges related to computer literacy. Some of the challenges universal whilst others are location specific. Specific issues are labelled with associated country codes in brackets.

Access to health and care services	Quality of care provision, staffing challenges and adequacy of working conditions	Policy-related challenges	Low levels of investment	Infrastructural challengers	Privacy and security risks associated with technology	Computer literacy
No universal coverage and equal access to healthcare services (CY, IE) Difficulty in accessing and receiving necessary healthcare services (CY, IE)	Issues related to the provision of quality care due to reliance on informal care providers and lack of trained and qualified health and care professionals	**Formal LTC provision**: • lack of a clearly defined comprehensive policy, regulation and legislation no recognition of formal LTC providers due to lack of opportunities for professional development, training or lifelong learning; lack of compliance with minimum quality requirements, appropriate standards of provision, quality	Lack of investment and low levels of collaboration between business and academia hinders research and innovation (CY)	**Issues caused by snow and ice**: Dams making parts of the area impassable in the winter Riskier for people to go outside and to see the GP or other healthcare professionals Transportation an issue and can be costly if dependent on cabs Increased response and transportation times for rescue services	Risk of hacking: risk of private and personal data being accessed by unauthorised persons	Lack of digital skills hindering adoption of digital technologies

		assurance, staff ratios, staff training.

lack of clearly defined working conditions

no specific types of employment contracts for those employed in the formal care sector | | Changes in drop-off and pick-up points (DE) | | |
| High percentage of out-of-pocket health expenditure paid by patients (CY) | Burnout syndrome and other health-related challenges

Demoralisation, stress and lack of incentives to go into solo practice, e.g.,lack of work-life balance, high workload, high responsibilities | **Informal LTC provision**:

• no clearly formulated policies that regulate informal (paid) caregivers, supports informal caregivers

• no benefits to compensate informal family caregivers such as cash, pension credits/rights or allowances | n/a | Fragmented islands are causing difficulties pertaining to accessing healthcare (EL) | n/a | Low levels of interactions between public authorities and citizens online (CY) |

		• reliance of informal carers as a resource but lack of regard for the needs of caregivers				
High demand for care, lack of capacity Long waiting lists or travel times (CY, DE, EL, IE, UK)	Poor communication between health and care staff	Limited evidence-based approach to care to inform policy and commissioning	n/a	n/a	n/a	n/a
Lack of co-ordination between public and private sectors resulting in duplication of infrastructure and waste of resources	Poor communication between health and care staff and health and care receivers	n/a	n/a	n/a	n/a	n/a
Lack of data and transparency (CY) Limited evidence-based approach to care to inform policy and commissioning	Age of healthcare staff and rural depopulation may lead to loss of primary care or obstacles to accessing care	n/a	n/a	n/a	n/a	n/a

Low healthcare provider/ receiver ratio (IE)	Lack of health and care professionals					
Lack of integrated long-term care provision, the majority of which is privately funded	Relatively limited allocated efficiency of resources more dependence on technical efficiency	n/a	n/a	n/a	n/a	n/a
Lack of integrated software	Low ICT literacy and resistance to using ICT solutions	n/a	n/a	n/a	n/a	n/a

Table 18: Limitations, constraints and risks. Source: Information provided by SHAPES partners.

3.6.2 Necessary or desired changes for improved pan-European health and care provision

Partners who contributed to this deliverable (D3.1) identified a range of changes deemed necessary for an improved health and care system which can be categorised as follows: technological changes, structural and procedural changes, training and support, policy changes and innovation, investment, and financing. This information was compiled in Table 19 and may assist in the in the continued formulation and weighting of user requirements, guide the development of the Platform and moreover, feed into the evolving CONOPS document.

Necessary or desired changes identified by SHAPES partners					
Proposed changes / Expected benefits	Technological changes	Structural and procedural changes	Training and support	Policy changes	Innovation, investment and financing
Improve work of healthcare professionals	Adoption of telemedicine/ teleconsultations	**Reallocation of responsibilities/ task-sharing among health care professionals** Training of community nurses to take on greater responsibilities usually performed by GPs – particularly regarding routine tasks Move away from a hospital-centred care model towards one where care is predominantly provided in the community	n/a	**Improved working conditions for GPs** different career options for GPs needed: progressing from locum work into a partnership; salaried posts and roles allowing GPs to develop more specialist knowledge in a particular field. GP Federations where a number of GP practices agree to work together, have the potential to help drive this change in the future. as well as the Health and Social Care Trusts stepping in to help run practices, when this is necessary (IE)	n/a
Increased capacity and better use of resources	**Adoption of telemedicine and robotics to:** support health and care professionals in their work increase time spent with health and care receivers	n/a	n/a	**Prevention** Prioritise healthy and active aging early on to reduce dependency on long-term care and find some way to fund appropriately	Co-design to ensure that resources are allocated appropriately **Prevention** Prioritise healthy and active aging early on to reduce dependency on long-term

	reduce cost reduce pressure on the healthcare system				care and find some way to fund appropriately
Improved conditions for informal care providers	Permanent helpline, technologies for tele-assistance and respite services should be created and/or developed	Carers should have a support plan. Professionals from the health sector and from social care should be involved in the definition of such plan, which should include easy access to specialist consultations.	Carers should have better access to information and capacity-building, through individual interventions and the establishment of self-help groups.	n/a	Consideration should be given to using social benefits to reduce the risk of poverty for carers, and/or financial support compensating them for the loss of earnings resulting from taking on caring duties, for example part-time employment
Adoption of telemedicine/ teleconsultations by healthcare professionals	n/a	n/a	On-going training for healthcare providers on the use of telemedicine and other health technologies Continuous adaptation of the system to become more user friendly and fulfil the expectations of the providers	Need to compensate GPs adequately to incentivize the adoption of telemedicine/ -consultations (DE) Prioritise digital technologies	Co-design of systems with input from care providers Maximise investment in digital technologies
Adoption of telemedicine/ teleconsultations by healthcare receivers	Personalised digital solutions to facilitate communication with older people	n/a	Continuous guidance on how to navigate health-supporting technologies Active listening and clear communication about perceived health risks of technologies. Facilitate tactile introductions to novel technologies	n/a	Personalised digital solutions to ensure user-friendliness and uptake

| Improved communication and record keeping | (Improved) interoperability of electronic medical record (EMR) systems

Ability to exchange information aligned with international standards for interoperability and clinically validated information structures to ensure consistent and more complete recording and sharing of data for various patient groups

ICT standardization for clearer communication

Better regional communication between healthcare providers and receivers through adoption of telemedicine or teleconsultations | n/a | n/a | n/a | n/a |
|---|---|---|---|---|---|
| Increased agency of healthcare receivers | GDPR compliance and ensuring that data is owned by healthcare receiver who decides what data they want to share and with whom | Integration of telemedicine enabling patients to take measurements, enter their health data into an individualised device, and to communicate with their GP | n/a | n/a | n/a |
| Improved quality of care and health outcomes | Telemedicine

Reduced need to visit GP surgery whilst ensuring continuation of care but reducing risk of infection | Better coordination and integration of currently fragmented health and care services

Coordination, cooperation and integration | n/a | remove private practice from public hospitals which reduces access to medical care for public patients

Prevention | Co-design to meet needs of care receivers

Prevention

Prioritise healthy and active aging early on to reduce dependency on long-term |

	Integrated (national) health and care systems to improve health outcomes and create better experiences for those receiving, using and delivering services.	Unifying public and private outpatient provision of drugs. Cooperation between professional associations Cooperation between insurance companies **Reallocation of responsibilities among health care professionals** Training of community nurses to take on greater responsibilities usually performed by GPs – particularly regarding routine tasks: Improved quality of care through early identification of deterioration in a patient's condition and referral to GP. Move away from a hospital-centred care model towards one where care is predominantly provided in the community		Prioritise healthy and active aging early on to reduce dependency on long-term care and find some way to fund appropriately More intergenerational care and improvements in built environments	care and find some way to fund appropriately
Improved well-being of health care receivers	Personalised digital solutions to facilitate communication with older people	n/a	n/a	n/a	n/a
Improved competitiveness	n/a	n/a	n/a	n/a	Improved competition through innovation, access to finance and investment

					in the areas of smart specialization (CY)

Table 19: Necessary or desired changes. Source: Information provided by SHAPES partners.

3.6.3 Key performance indicators related to health and social care

Although difficult to measure, health and care outcomes, or key performance indicators (KPIs) can be assessed according to the following categories: access and adequacy of care, quality, and financial sustainability. Table 20 below summarises the KPIs in relation to long-term care (LTC) identified by Spasova et al. (2018) in their summative review of the challenges to LTC.

Key performance indicators related to care			
Access and adequacy indicators	**Quality of care**		**Financial sustainability**
Number of beneficiaries of: • Inpatient care • Outpatient care • Day care services • Not specified Number of providers/ structures of: • Inpatient care • Outpatient care Number of unsuccessful applicants/ pending applications	Outcomes	Effectiveness of care and safety of care receiver • Clinical aspects, injuries, falls, … Person-centeredness & responsiveness: • Satisfaction and experience of healthcare receiver/ relatives Care coordination	LTC expenditure: • General • Inpatient LTC • Home-based LTC
Waiting lists Number of home help hours provided Ratio number of beds Number of inhabitants Capacity Cost of care Cost related to dependency	Structural factors	Workforce • Staff, ratio • Continuity of staff • Rate of sickness • Skills/level of education Care environment • Infrastructure ICT • Safety technologies	Public spending
	Other indicators	Complaints from care receivers/ relatives Timeliness of services Waiting time/ waiting lists Well-being of staff/ working conditions % of compliance with inspected outcomes	

Table 20: Key performance indicators related to care. Adapted from Spasova et al., 2018.

4 Conclusions

4.1 Summary

This deliverable (D3.1) is based on our analysis of health and care systems in the EU countries which are participating in the SHAPES piloting activities. Particular emphasis was placed on the human factors that shape the provision of health and care services, on the interactions of healthcare professionals and informal caregivers' interactions with technological and other resources, and on the changes necessary to improve health and care provision in the EU.

The present deliverable outlines the current 'as is' situation pertaining to health and care systems. Although the present document depicts primarily the 'as is' situation, D3.1 is nevertheless useful for the following reasons: D3.1 provides a description of the structures and processes that govern health and care service provision, it reveals the gaps in the current systems, and it provides a guide for the development of the SHAPES Platform based on the necessary and desired changes identified by the end-users. Current components comprise of contextual descriptions of the pilot sites on which are research is based (Section 3.1) and the health contexts of the pilot site countries (Section 3.2), and overview of health and care systems (Section 3.3), an outline of the care pathways into and out of institutional care (Section 3.4), a description of the human factors that shape health and care provision (Section 3.5), an overview of the technology and tools currently used at the pilot sites (Section 3.6), an outline of the of the limitations and constraints (Section 3.7) and of the necessary and desired changes (Section 3.8). The future CONOPS seeks to ensure that all components of the proposed system will work together in an integrated manner, rather than in isolation, and that the new system meets the requirements of all end-users.

4.2 Key observations and implications for the SHAPES Platform

4.2.1 Diversity of the pilot sites and respective countries

The pilot sites are diverse in terms of governance, geography, socio-economic context and demographic characteristics. In order to meet the needs of all users, this requires the platform to be agile enough work in both rural and urban areas with varying levels of population density. Moreover, the analysis has revealed vast differences in terms of GDP, employment and relative poverty rates meaning that the success of the Platform is directly linked to its affordability which will be explored in more detail in WP7. Lastly, the successful adoption of the Platform needs to take into consideration the age of the end-users. As outlined in Section 3.1.2, the population aged 65 years and over accounts for more than one fifth of the overall population and within this age group, levels of digital skills and ICT usage varies which may have implications for the adoption of the Platform. Although most in the age group 65 to 74 years old have some digital skills, approximately one third has low overall digital skills. However, the data suggests that approximately half of the 65 to 74-year olds uses ICT devices such as desktop computer, laptop, netbook or tablet to access the internet, and approximately one third uses smartphones.

4.2.2 Health context

The increase in life expectancy at age 65 is not synonymous with healthy ageing. On average, EU citizens can expect to live twenty more years at age 65 but only about ten of those will be spent healthily (Section 3.2.1). This presents challenges for health and care systems which, as the data

suggests, struggle with shortages in funding, health and care facilities (both institutional and homecare) and health and care personnel. Currently, care systems rely heavily on the support of an ageing population through informal caregivers. However, societal changes require innovative approaches to care provision.

Another aspect of the health context is the focus on the risk factors that contribute to ill health, such as low-quality diets, lower levels of exercise and higher rates of obesity. However, socio-economic disparities should also be taken into consideration, particularly in terms of prevention. This is because socio-economic disparities exacerbate individual risk factors (Section 3.2.2) and moreover, these factors are associated with higher rates of unmet needs and catastrophic household spending (Section 3.3.3.4). Consequently, individuals who are socially disadvantaged are more likely to have less favourable health outcomes and, as demonstrated in (Section 3.3.5.2), tend to have higher levels of homecare use.

4.2.3 Challenges pertaining to long-term care

In addition to the geographical challenges, health and care provision is further complicated by institutional fragmentation whereby the health system and social care sectors tend to operate in silos. This entails implications for the quality of long-term care and hence, for the quality of life of care receivers. Here, the SHAPES Platform might be ideally suited to facilitate communication between these sectors and hence, enhance the processes involved in the provision of care and consequently, improve the quality of care.

There has been a trend to prioritise home care and to reduce residential care. However, despite increased demand, home care and community care services remain underdeveloped in many countries which impedes access to non-institutional services. Moreover, privatisation and marketisation of care further hinders access to long-term care for those who cannot afford it. However, as stated, affordability is vital to the success of the SHAPES Platform and hence, the issue of private and public care provision needs to be taken into consideration.

As a consequence of the lack of home care services and high costs many EU countries tend to rely heavily on informal caregivers which are often female relatives or domestic migrant workers. The reliance on informal care provision negatively impacts women's ability to participate in the labour market as well as their mental and physical well-being even after their care commitment has finished. Beyond, informal domestic workers, who are also predominantly women, often find themselves in precarious situations caused by the absence of employment contracts and thus, legal protection, poor working conditions, lack of qualifications and insufficient training. Although, as Spasova et al. (2018) have argued, the challenges pertaining to informal care provision require policy responses, there may be opportunities for the SHAPES Platform to support informal caregivers in their routine tasks.

4.3 Opportunities for SHAPES

As Section 3.6.2 (Necessary or desired changes for improved pan-European health and care provision suggests, SHAPES has the potential to address some of the challenges described in the present deliverable pertaining to the working conditions of both health and care professionals and informal caregivers, lack of capacity and resources, quality of care and health outcomes, and agency of health and care receivers. A range of changes are necessary to improve health and care provision in the EU. Technological changes, such as the adoption of telemedicine and teleconsultations can help ease the workload of health and care professionals (e.g., by enabling healthcare receivers to monitor their

health indicators using digital solutions), increase capacity and facilitate the better use of existing resources, and improve the quality of care and hence, health outcomes. Technological changes may facilitate the integration of health and care services, improve the coordination of care and support communication. However, partners also emphasized the importance of providing training and support for both health and care providers and health and care receivers for the successful adoption and use of technological solutions.

Technological changes can bring about – or go hand in hand with - structural and procedural changes. The SHAPES Platform may facilitate structural and procedural changes to health and care provision, e.g., through changes to the ways in which information is being communicated between health and care professionals, and between health and care providers and receivers. Beyond that, SHAPES will also act as a knowledge base which can inform health and care policy and governance. The voices of care recipients are an important element to inform policy change and the Platform can enable them to have their say and have their voices recorded.

4.4 Next steps

Based on the concept analysis (see Section 2 – Methodology) of existing health and care systems, we have developed a swimlanes graphic which illustrates different phases of the pathways into and out of institutional care. In conjunction with the future CONOPS framework, swimlanes are a useful tool because they facilitate the identification of opportunities for SHAPES within the existing structures, processes, and systems. As the swimlanes graphic shows, we have already taken first steps towards situating the SHAPES Platform within the 'as is' situation.

Next steps will involve the expansion of the existing document using swimlanes graphics as a tool to identify how the pilots could fit into the existing systems. Together with outputs from other tasks (e.g., T3.5 "User Requirements") and work packages (e.g., T2.1 "Understanding Older People"), D3.1 will contribute to the development of the SHAPES Platform in close collaboration with the pilot task leaders. As described in Section 2.2 (Concept of Operations), this is an iterative and collaborative process which requires cycles of adaptation to ensure the development of a holistic platform that meets the needs of all users and to avoid fragmentation. This means that we will be observing closely the system architecture and the pilots which will allow us – in collaboration with the SHAPES partners – to evaluate and validate the CONOPS. As part of this evolution we will take a closer look at crucial aspects underpinning the development of the SHAPES Platform including governance (Section 3.3.1.1 and Section 3.3.1.2), legislation (Section 3.3.2.1) and ethics (Section 3.3.2.2) which have been touched on in the current CONOPS (D3.1). In partnership with GEWI and with input from the experts on legislation and ethical issues (WP8), we will, in subsequent deliverables (D3.5 and D3.6) develop the "SHAPES Collaborative Governance Model"). Moreover, we will also take into account the findings from Task 3.2 "Scaling-up Improved Integrated Care Service Delivery" and from WP7 "Market Shaping, Scale-up Business Models and Socio-Economic Impact". The final CONOPS document (D3.10 "SHAPES Change Management and Implementation Handbook") will provide a validated description of the proposed future system detailing the methodology for organisational implementation of the SHAPES Platform, addressing the operational, human- factors, cultural, performance and professional factors mediated by SHAPES. D3.10 emphasises the importance of sustainability and is intended as a valuable "blueprint" that can be applied to a country's current health system context or adapted to guide the evolution of future health systems mediated through, but not exclusively, through technological innovation.

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Tables

4.4.1 Physicians by sex and age [hlth_rs_phys]

GEO/Age	Less than 35 years	From 35 to 44 years	From 45 to 54 years	From 55 to 64 years	From 65 to 74 years
Belgium	11%	21%	23%	25%	16%
Bulgaria	13%	10%	26%	35%	14%
Czechia	23%	22%	22%	19%	12%
Denmark	23%	28%	19%	20%	10%
Germany	20%	13%	22%	38%	6%
Estonia	21%	14%	20%	26%	15%
Ireland	27%	25%	24%	16%	7%
Greece	16%	27%	27%	21%	8%
Spain	21%	24%	21%	28%	5%
France	15%	20%	21%	31%	13%
Croatia	26%	22%	23%	26%	3%
Italy	9%	17%	18%	38%	17%
Cyprus	10%	24%	21%	26%	16%
Latvia	21%	10%	22%	30%	13%
Lithuania	23%	15%	19%	26%	14%
Luxembourg	5%	23%	29%	31%	10%
Hungary	21%	17%	18%	24%	16%
Malta	44%	20%	15%	17%	4%
Netherlands	32%	24%	19%	19%	6%
Austria	19%	26%	23%	25%	5%
Romania	31%	24%	21%	18%	5%
Slovenia	25%	26%	20%	22%	8%
Slovakia	23%	19%	23%	21%	14%
Sweden	17%	27%	21%	20%	11%
United Kingdom	33%	29%	24%	13%	2%

4.4.2 Persons providing informal care or assistance

GEO	Less than primary, primary, lower secondary education (total)	Tertiary education (total)	Less than primary, primary, lower secondary education (males)	Tertiary education (males)	Less than primary, primary, lower secondary education (females)	Tertiary education (females)
EU-28	15.4	12.5	12.6	10.4	18.1	14.5
Belgium	9.7	7.1	8.2	4.2	11.3	9.4
Bulgaria	14.3	13.1	11.1	12.6	16.9	13.5
Czechia	15.0	14.9	13.5	10.5	15.8	18.5
Denmark	22.8	18.6	25.3	15.2	18.9	21.4
Germany	15.3	11.3	12.1	9.4	18.3	13.8
Estonia	9.0	14.2	7.8	9.1	11.2	17.2
Ireland	11.2	9.4	9.7	5.0	13.6	13.0
Greece	19.6	17.7	18.2	16.0	21.1	19.4
Spain	13.2	11.0	9.9	9.0	16.8	12.8
Croatia	18.0	15.6	19.6	12.6	16.9	18.0
Italy	18.3	16.1	15.7	14.1	20.9	17.5
Cyprus	10.8	10.6	7.4	9.9	13.6	11.2
Latvia	13.4	17.1	13.2	15.3	13.7	18.1
Lithuania	13.0	10.4	12.4	8.9	13.9	11.3
Luxembourg	13.7	11.2	7.9	10.1	19.3	12.3
Hungary	12.8	13.3	11.3	11.7	13.8	14.4
Malta	21.3	15.7	16.3	15.3	26.2	16.3
Netherlands	16.7	12.5	12.1	10.6	20.7	14.4
Austria	16.6	13.1	14.6	12.6	17.7	13.8

Poland	14.2	12.7	12.0	10.5	16.4	14.1
Portugal	12.6	11.3	10.8	9.3	14.4	12.7
Romania	6.3	4.8	4.3	3.7	7.8	5.9
Slovenia	13.1	14.6	10.6	11.6	15.0	16.8
Slovakia	9.6	10.9	9.0	7.0	10.0	14.3
Finland	17.2	11.0	14.2	9.2	21.6	12.3
Sweden	10.6	6.1	8.7	4.4	12.9	7.2
United Kingdom	21.4	15.1	17.2	12.9	24.4	17.0
Iceland	24.7	23.1	20.7	19.6	29.1	25.6
Norway	14.1	12.8	13.4	11.3	15.0	14.0
Turkey	9.6	6.9	7.8	6.5	11.3	7.6

Table 21: Persons providing informal care or assistance at least once a week by sex, age and educational attainment level [hlth_ehis_ic1e]

4.4.3 Technologies and tools used at the pilot sites

Technologies and tools used at the pilot sites			
Broad categories	**Specific tools and their purposes**	**Benefits**	**Challenges**
Medical Physics Laboratory (EL)	Facilitation of health monitoring Design and development of tailor-made healthcare solutions	Enhancement of the quality of health care Personalised prediction and decision in prevention, diagnosis or treatment.	Older adults may harbour sceptical attitudes towards the potential benefits of technology. Ethics and data management (obtaining, handling and storing data)
The Internet of Things **The Internet of Medical Things** **The Internet of Active Aging Things**	Experiential learning strategies in supporting and empowering care givers. Open data research protocols for disease management Non-pharmacological new therapies and interventions based on early risk detection and ideas for integrated care	Supporting and empowering care givers disease management early risk detection and ideas for integrated care	**Greece (in general):** Lack of reliable data regarding the HVCE (e.g.,Data on purchase price, annual maintenance costs, downtime, and actual use of devices). Uneven geographical distribution of HVCE in regional level. Rapid technological developments lead to the high-paced introduction of new or improved devices and require lifelong learning and continuous training for all professionals involved. [3] [3] World Health Organization. (2017). Rationalizing Distribution and Utilization of High Value Medical Equipment in Greece. Ethics and data management (obtaining, handling and storing data)
Scanners	Computer tomography (CT) scanners (CY) magnetic resonance imaging (MRI) scanners (CY) Electroencephalogram (EEG) (EL) Emotiv EPOC wireless EEG system (EL) bio-signal recording system (EL) Polhemus FASTRAK magnetic stylus localisation	n/a	n/a

	system with accompanied software (EL)		
Sensors	• Neurosky biosensor (EL) • in-house made trigger box for auditory and visual stimulus/ recording synchronisation (EL) • wearable physiological sensor systems with wireless connections (EL) • mobile wrist wearable units/sensors (EL) • skin conductance response (SCR) devices (2 of them specifically fabricated, equipped with fibre optics and capable of operating in magnetically shielded rooms) (EL) • 10-channel biofeedback system (EL)	n/a	Ethics and data management (obtaining, handling and storing data)
Trackers and monitors	**SAIDNT garment identification system (ES)** • All the garments of the users are marked with a chip • registers personal data of each garment (owner, room, type of garment, number of washes, etc...) via computer application • system identifies tray where each garment must be placed.	Enhancement of the quality of life of persons belonging to vulnerable and vulnerable social groups Facilitating independent living and moving Fostering the feeling of security in their daily lives for themselves and for their families	Ethics and data management (obtaining, handling and storing data) Informed consent
	VIDATRACK Service (CY) • emergency signal transmission and detection management system		Ethics and data management (obtaining, handling and storing data) Informed consent
	Hospital alert system (CZ) (COVID-19 related response) Monitors via cameras whether patients wear masks/ wear them incorrectly Cameras monitoring social distancing and coughs (via microphones)	Potential for	Ethics and data management (obtaining, handling and storing data) Informed consent
Screening tools	**Quick Mild Cognitive Impairment (QMCI) Screen (IE)** http://www.qmci.ie/ test to detect mild cognitive impairments using a score card including 6 questions	Short, efficient, simple to use and easy to score Multilingual Improved accuracy, superior sensitivity, specificity,	n/a

	pertaining to orientation, word registration, clock drawing, delayed recall, verbal fluency, logical memory	positive, and negative predictive values at detecting any form of cognitive impairment	
Computers, consoles, etc.	Touchscreen units for cognitive and physical training (EL) Wii Fit and Kinect consoles (motion sensing) (EL) Innovative system on smart rehabilitation and exergaming (EL) Computers, internet (PT) Tablets to enable residents to communicate with their family members (ES)	• enable older people to maintain interpersonal relationships ➢ during COVID, users of tablets or computers would have been able to see their loved ones face-to-face without them being physically present ➢ ameliorate experience of loneliness • usage of smart devices would faciliate **teleconsultations with GPs** ➢ during COVID, health centres are closed ➢ GPs only available via phone consultations	• low levels of tech. literacy • very few older people in the village have an internet connection in their home • older people tend to think that technology will not add any/much value to their lives • Fear that technology might harm their health prevents older people from using technology • older people tend to use older mobile phones cannot facilitate face-to-face conversations phone calls insufficient to maintain good interpersonal relationships • for many older people, internet connection in the home and gadgets like tablets, smartphones or computers are too costly • grants or donations tend to go school rather than to old people
Electronic medical records (CY, ES)	Clinical care history report tool (ES)	**Improved quality of care** • easier to read than handwritten notes ➢ reduced risk of errors and misinterpretations **Convenience and Efficiency:** • EMRs easier and quicker to access than paper files ➢ less time consuming **Space saving** • EMRs remove the need for filing cabinets ➢ more space for medical supplies and equipment **Patient Access** • Many EMR systems include a patient portal	Potential Privacy and Security Issues pertaining to EMR systems • risk of hacking ➢ risk of private and personal data being accessed by unauthorised persons • Inaccurate/ incomplete information if healthcare providers fail to update patient records promptly ➢ other healthcare providers work with inaccurate/ incomplete information which may affect the patient's treatment plan • Miscommunication with patients who may misunderstand doctor's notes

		➢ allows patients to view their medical history and information at any time **Financial benefits** • Installation of a certified EMR may be in line with the Meaningful Use requirements ➢ fulfils qualification for government subsidies	➢ may cause undue alarm, or even panic • Malpractice Liability Concerns associated with EMR implementation. ◦loss or destruction of medical data during the transition from a paper-based to a computerized EMR system ➢ potential for treatment errors ◦Since doctors have greater access to medical data via EMR, they can be held responsible if they do not access all the information at their disposal
Video consultations and online chat (CZ, DE, ES, IE)	video and teleconsultations systems (CZ) online symptom checker (CZ) • accessible via covid.fnol.cz • patients can check COVID-like symptoms • includes recommendations as to whom they should call Launch of Tele-care Psychological Care Service by Clinical Psychologists on 30 March 2020 (CY) Pilot project "Tele-Arzt" (DE) enhanced access to phone helplines and on-line assistance, 24/7 emergency call centre for primary care (ES) Consultations via telephone, video calls (IE)	Disease management of chronically ill patients. • Better adherence to treatment regimen • Better communication • Increased of quality of life • Decreased number of rehospitalization • Time savings • Lower patients indirect cost etc. less driving time for GPs and more time for the treatment of patients Greater agency among patients to monitor their own health Cost saving: Fewer emergency transports due to the early identification of a deterioration in their condition	• Ageing GP population ➢ some GPs are finding it challenging to learn how to use new telemedicine technology ➢ may result in absenteeism instead of spending time on learning how to use the equipment • Interoperability with old hospital information system • Sharing data with GPs and specialists from ambulatory sphere • Cooperation with social care providers • Cooperation with region • Lack of reimbursement for teleconsultations
Robots, chatbots, virtual assistants	Nurse 'Rosa' (automated chatbot) (ES) Allows patients to discuss their health conditions or concerns from home Assists in the diagnosis of health conditions	Facilitates better time management	Healthcare recipients' acceptance of communicating with a chatbot rather than a human being
E-prescriptions (ES, IE)	Automatic renewal for patients with chronic illnesses (ES)	Period of validity for prescriptions increased from 6 months to 9 months	

	Discretionary extension of prescriptions up to nine months (IE)	Allow continuity of care of patients through repeated prescriptions	
Tools for patient self-monitoring of medical condition (CZ)	Telemedicine System (CZ) Patient Set (DE) Allows patients to monitor their health on an ongoing basis Use of a "Patient Set" which allows patients to use an individualised device to measure e.g.,blood sugar or blood pressure themselves. Anonymised data are anonymised and transferred directly to the GPs practice via a device called "Vitaphone". GP can access the data at all times	Facilitates earlier detection of health risk indicators Facilitates faster responses to health risks Shorter driving time for GPs and more time for the treatment of patients Greater agency among patients to monitor their own health Cost saving: Fewer emergency transports due to the early identification of a deterioration in their condition	Trust: public hesitancy/ resistance to changes in healthcare delivery: patients are used to being visited by their GP instead of community nurses leading to lengthy conversations to explain why the nurse visits instead of the GP Infrastructure: lack of broadband coverage and mobile data in rural parts of the Oberbergische Kreis. Patients who live outside of the network cannot be connected to the teleconsultation service
Support lines (ES, IE, EL)	• Support for relatives of COVID patients (ES) • Community Call Initiative (IE) • Help at Home (EL)	More support for informal carers and relatives	n/a
Integrated management platform (CZ, ES)	**software service based on Video Analytics (CZ)** • supporting the management of the COVID emergency in a Healthcare environment • implements decision support system for security operators and healthcare professionals working in a public and private Healthcare setting • can automatically detect and report violations or risk situations in the environment	n/a	n/a
	Human Assist (ES) • Under development • Aims to integrate electronic medical files, chatbot Rosa, all doctors and nurses	• Improves communication between healthcare staff (including chatbot) • Facilitates better management of patients and their conditions • Facilitates better quality care provision	n/a

Table 22: Technologies and tools used at the pilot sites. Information primarily based on partner interviews.

5 Ethical Requirements Check

The focus of this compliance check is on the ethical requirements defined in D8.4 and having impact on the SHAPES solution (technology and related digital services, user processes and support, governance-, business- and ecosystem models). In the left column there are ethical issues identified and discussed in D8.4.(corresponding D8.4 subsection in parenthesis). For each deliverable, report on how these requirements have been taken into account. If the requirement is not relevant for the deliverable, enter N / A in the right-hand column.

Ethical issue (corresponding number of D8.4 subsection in parenthesis)	How we have taken this into account in this deliverable (if relevant)
Fundamental Rights (3.1)	n/a
Biomedical Ethics and Ethics of Care (3.2)	n/a
CRPD and supported decision-making (3.3)	n/a
Capabilities approach (3.4)	n/a
Sustainable Development and CSR (4.1)	3.4
Customer logic approach (4.2)	n/a
Artificial intelligence (4.3)	n/a
Digital transformation (4.4)	n/a
Privacy and data protection (5)	allows for these issues to become more visible
Cyber security and resilience (6)	allows for these issues to become more visible
Digital inclusion (7.1)	Swimlanes
The moral division of labor (7.2)	CONOPS approach allows for the moral division of labour to be addressed more explicitly in T3.4
Care givers and welfare technology (7.3)	CONOPS approach allows for the moral division of labour to be addressed more explicitly in T3.4
Movement of caregivers across Europe (7.4)	CONOPS approach allows for the moral division of labour to be addressed more explicitly in T3.4

Table 23: Ethical requirements check

Annex 1: Interview guide

T3.1 Ecological Organisational Models of Health and Care Systems for Ageing Description of the current situation

Brief profile of the reference site

Name of the reference site:	
Public or private:	
Type of care (e.g.,acute, rehabilitation, end of life etc.):	
Most common conditions:	
Age range of patients:	
Number of places/ beds:	
Average duration of stay:	

1. Description of the reference site

Please describe the reference site in terms of the subcategories below. Please bear in mind that some of the reference site include one organisation whereas others encompass entire regions. So, some questions are more applicable than others.

1. Geography (e.g.,rural, urban, suburban, other)

What does it look like? Where is it located? How accessible is it? What's its size (e.g.,in terms of population and area)?

2. Socio-cultural and economic context

What is the socio-cultural and economic background of the people that you care for/ that are part of your reference site? (think in terms of ethnicity, class, practices, behaviours or attitudes relating to health and healthcare, social supports, income (e.g.,are people generally affluent or disadvantaged).

3. Institutional dependencies

Healthcare provision does not occur in a vacuum. So, we are assuming that there are many factors that influence how the work is carried out. For example, it may not be possible to transfer a patient from an acute setting (e.g.,hospital) to a rehab facility due to availability of places, back home due to bureaucratic procedures (e.g.,assessment of grant application).

4. Distribution

Here we'd like to know, for example, how many hospitals/nursing homes are part of the reference site, how are they spread across the reference site, how accessible are they, etc. This question may not be applicable to everyone.

5. Roles

Roles may refer to both roles performed by the reference site (e.g.,care for older people with dementia) and the staff involved in healthcare provision.

2. What types of organisations are involved in current healthcare systems?

We want to understand how healthcare is provided and managed at different levels. Please describe, to the best of your knowledge, how healthcare is accessed and how this differs in terms of public/private healthcare. What kinds of NGOs (if any) are involved in healthcare provision and what do they do? What are the barriers to accessing healthcare?

1. Governmental level

2. Private/ corporate level

3.   NGOs
4.   Other

3.   What is the health context in terms of:
1.   Epidemiology

What kinds of illnesses/ diseases are most prevalent at your reference site?

2.   Health-related KPIs

What are the health-related outcomes your reference site tries to achieve?

3.   Other

4.   What are the pathways into, and out of, institutional care?

Please give an example of the process that is prompted if an older person has an accident or other incident that requires hospitalisation. We are particularly interested in the criteria that enables the person to return home from the medical, social and economic point of view.
Please describe what the challenges are pertaining to the process, and what works well.

1.   How do people end up in hospital and for how do they stay (on average)?
2.   What are the criteria for discharge from hospital?
3.   Where does the healthcare recipient (patient) go from here? (e.g.,rehab).
4.   What are the criteria/ minimum requirements that need to be met before the person can return to their own home? (e.g.,physical, psychological, home environment, etc.)
1.   How/ by whom is this assessed?
2.   What kind of help is available to them once they are back home? (e.g.,home help, nursing staff, family member, neighbour etc.)
1.   If there are any home visits, what are the tasks carried out by the support person, how often do the visits happen?
3.   What programmes/ schemes (if any) are available that may facilitate the person's return home? (e.g.,financial, governmental, community, etc).
5.   What are the challenges and opportunities that you have encountered?

5.   Who are the people involved in healthcare systems? What do they do?

Please describe how both formal and informal healthcare provision looks like at your reference site. We would like to understand what the challenges and opportunities are and how the SHAPES platform may either address the challenges or learn from the opportunities.

1.   Professionals
2.   Family
3.   Community
4.   Other?

6.   How are healthcare systems currently governed in terms of:
1.   Models of participation

E.g.,what level of decision-making powers do patients and their families have with regards to their care?

2.   How are healthcare systems financed and by whom?

We are trying to understand how healthcare systems are financed in terms of government payments, health insurance (both public and private), patient out of pocket expenses, co-payments, and the challenges related to any of those points.

3.   Resource distribution
4.   Other

7.   What is the regulatory, legislative and ethical context?

Depending on how your country/ reference site is governed (e.g.,centralised versus federal), some of these questions may not apply to your particular reference site.

1. EU level
2. National level
3. Regional/local/ management level
4. Ethical frameworks/ procedures/ implications

This is a very open question which can be answered in different ways. We are trying to understand what (if any) the ethical frameworks or procedures are that underly the work at your reference site. However, this may not apply to everyone. Another angle you could take are the ethical implications with regards to Question 8: technology/tools that are being used at your reference site/ in a person's home (e.g.,the use of cameras) or Question 10: human factors (e.g.,what are the ethical implications of the ways healthcare is currently managed).

8. Tools and technologies

1. What digital technologies are you currently using as a care provider?
2. Briefly describe the most important ones (maximum of 3).
3. When did you introduce them?
4. What are the advantages of using these technologies?
5. What are the disadvantages of using these technologies?
6. While using these technologies, what are/were the major concerns and obstacles (i.e., personal skills, organizational problems, technical issues/limitations)?
7. If more digital solutions were to be introduced in your unit, what additional elements would you require (e.g.,training for workers, more computers, high-speed internet access)?
8. Is there a way of linking any of these technologies?
9. With regard to the user experience of the platform, what information do you need to have in order to be able to use it?
10. Will the platform be used by every individual care giver?
11. How many users do you think will need to have access to the platform?
12. Will you have a single point of contact / main user of the platform or will there be multiple users (e.g.,all care providers)?

9. Are you aware of innovative technology-enabled integrated care services in your region (which support active and healthy ageing and independent living of older citizens)?

1. Describe the types of services.
2. Who delivers these services?
3. Can you briefly describe their scope and target group?
4. Can you provide further details (websites, links to reports, etc.)?

10. Human factors in current healthcare provision models: what are the challenges and opportunities?

Human factors refers to how humans behave physically and psychologically in relation to particular environments, products, or services.

1. People (individual factors)

including his/her competence, skills, personality, attitude, and risk perception. Individual characteristics influence behaviour in complex ways. Some characteristics such as personality are fixed; others such as skills and attitudes may be changed or enhanced.

2. Workplaces (workplace factors, equipment and design, work environment)

including work patterns, the culture of the workplace, resources, communications, leadership and so on. Such factors are often overlooked during the design of jobs but have a significant influence on individual and group behaviour.

3. Management (organisational/ systems factors, job design, information transfer)

including areas such as the nature of the task, workload, the working environment, the design of displays and controls, and the role of procedures. Tasks should be designed in accordance with ergonomic principles to take account of both human limitations and strengths. This includes matching the job to the physical and the mental strengths and limitations of people. Mental aspects would include perceptual, attentional and decision-making requirements.

11. What are the limitations, constraints and associated risks of current healthcare systems?

1. Cyber-security risks
2. Human factor risks
3. Financial risks
4. Other risks, limitations and constraints

This may refer to policy, human factors (e.g.,how do individual, workplace and management factors limit/constrain your work/ work processes).

12. What changes are needed/ desired?

What changes are necessary or desired to support the work at your organisation/reference site? This question may link back to all of the previous questions, especially in terms of the challenges encountered. This question may address technological solutions, but also desired changes in terms of policy (including financing), training, and other supporting factors you can think of.

Annex 2: IEEE CONOPS document outline

Title page
Revision chart
Preface
Table of contents
List of figures
List of tables
1. Scope
    1.1 Identification
    1.2 Document overview
    1.3 System overview
2. Referenced documents
3. Current system or situation
    3.1 Background, objectives, and scope
    3.2 Operational policies and constraints
    3.3 Description of the current system or situation
    3.4 Modes of operation for the current system or situation
    3.5 User classes and other involved personnel
    3.6 Support environment
4. Justification for and nature of changes
    4.1 Justication of changes
    4.2 Description of desired changes
    4.3 Priorities among changes
    4.4 Changes considered but not included
5. Concepts for the proposed system
    5.1 Background, objectives, and scope
    5.2 Operational policies and constraints
    5.3 Description of the proposed system
    5.4 Modes of operation
    5.5 User classes and other involved personnel
    5.6 Support environment
6. Operational scenarios
7. Summary of impacts
    7.1 Operational impacts
    7.2 Organizational impacts
    7.3 Impacts during development
8. Analysis of the proposed system
    8.1 Summary of improvements
    8.2 Disadvantages and limitations
    8.3 Alternatives and trade-offs considered
9. Notes
Appendices
Glossary

Figure 48: CONOPS document outline. IEEE, 2007.

Annex III: Brief description of the pilot sites

This section briefly describes the most important characteristics of the pilot sites that participated in the research for D3.1.

Cyprus

The Cypriot pilots will be carried out in both the University of Nicosia Research Foundation (UNRF) and the University of Nicosia Medical School, located in the capital city of Nicosia. Cyprus is a large island country in the Mediterranean Sea with an area of 9,253km² (Eurostat, 2020. [REG_AREA3]). In 2019, the population was 875,899 which makes it a rather sparsely populated country (94.4p/km²). Most people live in the urban centres of Nicosia, Limassol, Larnaca and Paphos. In 2019, approximately 16 percent were 65 years old or older.

Research at UNRF focuses on global and local issues including health, complex networks, social sciences, education, ICT, engineering, and environmental sustainability. Researchers at UNRF are interested in examining challenges to modern life from a wide range of perspectives, including technological and scientific advances, modern culture and thought, and apply their expertise derived from addressing local, regional and national issues to global challenges and develop teams to bring disciplinary strengths together to approach key issues with global impact.

Czechia

The Czech pilot site, the University Hospital Olomouc (UHO), is located in the Region of Olomouc. Olomouc is one of two self-governing NUTS III regions within the [Central Moravia Cohesion Region](#) which is located in the eastern part of Czechia. Most of the population lives in the urban areas. There are vast economic differences between the north and south of Olomouc Region. While the southern part is the political, economic and cultural centre of the region, the northern part is one of the poorest regions of Czechia which is a result of its geography and lack of transport links.

UHO is one of the largest and oldest state-owned teaching hospitals in Czechia, with 4,200 employees providing complex health care services. UHO effectively acts as Regional Hospital in the Olomouc Region with approx. 640 000 inhabitants. UHO is the driver of innovations in healthcare in the region. It develops and scales up eHealth infrastructure, services and applications. UHO is providing whole spectrum of health care. Prevail elderly and chronically ill people. As pilot site, UHO focusses on older people from all parts of the Olomouc region with cardiovascular health issues.

Germany

Two of the pilot sites are located in Germany. One is the *Oberbergische Kreis* (regional district) in the federal state of North Rhine-Westphalia (NRW) which, with 22% of the national population, is the most populous of the 16 federal states. NRW shares external borders with Belgium and the Netherlands, and internal borders with Lower-Saxony, Hesse and the Rhineland-Palatinate. The Oberbergische Kreis also belongs to the Health Region Cologne Bonn (HRCB) which is one of six official health regions within North Rhine-Westphalia and an EIP on AHA[12] reference site. The HRCB is a comprehensive network of 130 companies, institutions and associations from a variety of sectors (e.g., science, research, economy, supply) which seeks to improve both the cooperation and communication

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[12] European Innovation Partnership on Active and Healthy Ageing

between different actors within the healthcare industry and the structural conditions that govern healthcare provision in North Rhine-Westphalia (https://www.health-region.de/en/de-home/).

The Oberbergische Kreis is a mixed (rural-urban) area which includes cities and regional districts. It is quite hilly which has many dams which makes it impassable in winter which produces challenges for access to health and care, particularly for older people who may depend on public transportation (personal communication with partners).

The other pilot site is the Free State of Saxony (Saxony) in the south-east of Germany. Saxony shares external borders with Poland and Czechia, and internal borders with Brandenburg, Saxony-Anhalt, Thuringia and Bavaria. Saxony has three large cities: the capital city of Dresden, Leipzig and Chemnitz where about one third of its four million inhabitants live, and ten regional districts: Bautzen, Erzgebirgskreis, Görlitz, Leipzig, Meißen, Mittelsachsen, Nordsachsen, Sächsische Schweiz-Osterzgebirge, Vogtlandkreis, Zwickau. Due to a combination of emigration and low birth rates, the population of Saxony has declined by 700,000 since 1990 (Sächsische Staatskanzlei, 2019). Approximately 26 percent are 65 years old or older, with an average age of 48.8 years.

Saxony has 77 hospitals and approximately 25,000 beds. Hospitals are categorised according to three ascending levels of care: 1) Krankenhäuser der Regelversorgung (hospitals which provide general care) 2) Krankenhäuser der Schwerpunktversorgung (hospitals which provide general care but have a particular focus) and 3) Krankenhäuser der Maximalversorgung (hospitals which provide a maximum level of care). Our informants suggested that Saxony, due to the reunification of East and West Germany, has a comparatively low number of beds as old hospitals were either downsized or closed entirely. However, there appear to be a sufficient number of beds per inhabitants.

Greece

There are also two pilot sites in Greece. One is the LLM Care (Long Lasting Memories Care) Health and Social Care Ecosystem (llmcare.gr), which is a coalition scheme, comprised of academic/research organizations, health/tech providers, regional policymakers and civil society organizations, created to align user-driven research, innovation, education and training in the field of Active & Healthy Ageing. The Thessaloniki Active & Healthy Ageing Living Lab (Thess-AHALL), core and council member of the European Network of Living Labs (ENoLL) and part of the Medical Physics Laboratory of the Medical School of the Aristotle University of Thessaloniki (AUTH) (medphys.med.auth.gr), has been given the authority by partners to lead this initiative, under a multi-agency and constantly expandable partnership, which is active across Greece and Cyprus. There are more than 20 full-time employees and 30 part-time trainees in more than 30 Day Care centres, rehabilitation centres, residential homes, municipality centres for elderly people, across Greece and Cyprus. Many external partners or the origin organizations within the Ecosystem have their own staff and occupy them with internal contracts for servicing the activities of the LLM Care action plan. The Day Care, rehabilitation centres, residential homes etc. usually involve 5 Full-time employees from their staff (estimation: 30x5=150 employees).

The second Greek pilot site is the 5th Regional Health Authority (5th YPE) which covers the areas Thessaly and Central Greece and is the largest one of seven Decentralised Administrations in Greece. The region, which is a major agricultural area, is located on mainland Greece. Like other areas in Greece, the region has been adversely affected by the economic crisis. In 2018, the unemployment rate in Thessaly was 18.4%. However, this marks a stark improvement from 2015, when 27.1% were unemployed.

The 5th YPE, a National Organisation, is responsible for the management, coordination, supervision and control of the provision of health and social care services in the region. These include 13 Hospitals (1 of which is a University Hospital) in 10 major cities and 60 Primary Care - Health Centers (urban and rural areas), covering a population of 2 million people.

Ireland

The Irish pilot site, which is also an EIP on AHA reference site - St. Finnbarr's Hospital (SFH) - is located on the southside of Cork City in the south west of Ireland. SFH's catchment area is the south west of Ireland which includes the counties of Cork and Kerry. In 2018, the area was home to a population of 705,950 people and with 57.8p/km^2, it is not very densely populated. Cork is the only city in the region with 208,669 inhabitants. However, there are nine towns in the region, with Tralee being the only one in County Kerry.

SFH's focus is on the provision of care for older people over 65 years old via a rehabilitation unit and a day hospital. Following a stroke, patients receive specialist care through a needs-based rehabilitation programme to improve strength, balance and physical function. At the Day Hospital, patients receive treatment for between six to eight weeks. Moreover, people over 65 years old who either experienced a fall or are susceptible to falling, can avail of treatment through a falls and mobility group.

Italy

The Italian pilot site, the *WeCareMore* Centre for Research and Innovation of AIAS Bologna Onlus, is a Regional Centre for Assistive Technology located in Bologna. Bologna is the capital city of the Emilia-Romagna region in the North of Italy. The region comprises of nine provinces (Bologna, Ferrara, Forlì, Modena, Parma, Piacenza, Ravenna, Reggio nell'Emilia, and Rimini). Emilia-Romagna is one of the wealthiest and most developed regions in Italy.

WeCareMore is a research and innovation centre which provides consultancy services and partnerships to bodies in the public and private sectors focussing on "the use of digital technologies in the health and social care sector" (AIAS). The multidisciplinary team is composed of experts from AIAS Bologna Onlus. AIAS is an organisation which, in close collaboration with local health and social care services, provides assistance to people with disabilities in the home, day care centres and in residential care facilities.

Portugal

There are two pilot sites in Portugal which participated in the research. One is the Porto4Ageing – Competence Centre on Active and Healthy Ageing of University of Porto. Porto4Ageing is a partnership made up of over 100 organisations. Partners are regional governments, health and care providers, academia and research, and industry and civil society bodies. Most partners are located in the Porto Metropolitan Area (AMP), a metropolitan area in the north of Portugal. AMP comprises of 17 municipalities including the city of Porto which is the second largest city in Portugal. AMP, which covers an area of 2,028km^2, is one of the most densely populated metropolitan areas in Europe with about 849.1km^2. In 2019, it was home to approximately 1,7 million people. Porto4Ageing's work focusses on three key thematic areas: care and cure, active ageing and independent living, prevention, screening and early diagnosis, alongside with others. Detailed information about these key areas can be obtained from the Porto4Ageing's website.

The second Portuguese pilot site is a senior citizen's university called Universidade Sénior de Cacia é uma actividade do IDEC (USIDEC). The USIDEC branch that our informant represents is located in a

small village near Aveiro City. Aveiro is both a city and a municipality located in northern Portugal, about 90km south of Porto. Aveiro is part of an agglomerate of 11 municipalities which form the intermunicipal community of the Region of Aveiro. In 2018, the population of the Region of Aveiro was 362,100.

USIDEC is a university for adults older than 55 years. Our partner informed us that at their branch, there were only about 80 students, whereas in Aveiro City, there were about 2,000. The university is manned by volunteers who teach languages and psychology, IT, arts, gymnastics, music, they have a band of older people, maths, and yoga. Aside from adult education, USIDEC also seeks to counteract problems in the community, particularly loneliness. USIDEC has a support group and an institution that support older people in need of psychological support. However, at the time of the interview (June 2020), the support group was not operating due to the COVID-19 crisis.

Spain

The Retirement Home "El Salvador", is located in a rural area in the village of Pedroche, which is located in the province of Cordoba. Cordoba is one of six provinces of the Autonomous Community of Andalucia in the South of Spain. Pedroche is a small village of 1,516 inhabitants in a region which is sparsely populated (57.6 p/km^2, Eurostat, 2020. [DEMO_R_D3DENS]). Most people in Pedroche work in agriculture which means low income and low state pensions. In addition, women also tend to find work in the nursing home. According to participants, the area has one of the oldest populations in Spain and many of the older people will eventually live in El Salvador, which is predominantly funded through taxation, even though there are privately funded spaces also. Participants suggested that most people from the surrounding villages will also go to El Salvador for two reasons: affordability - cost which is much lower than in privately funded nursing homes and for the quality of care. Many of the 147 residents in El Salvador have dementia so they tend to live at the nursing home full time. However, they also have the option to stay with their families some of the time. Participants pointed out that El Salvador is well integrated into village life which means that full time residents still have the option to participate Depopulation is one of the core challenges facing rural Spain as younger people will go to the urban centres for work, and this also includes healthcare professionals. This also presents issues for the provision and access of long-term care.

The other pilot site is Clinica Humana (CH), a private clinic located in Mallorca, one of the Balearic Islands. The Balearic Islands are an archipelago of islands off the Spanish mainland, and the largest ones are Mallorca, Menorca, Ibiza, and Formentera. In 2019, the population was 1.2 million, and approximately 21 percent were 65 years old or over (Eurostat, 2020 [DEMO_R_PJANGRP3]). Founded ten years ago, CH is a relatively new clinic which specialises in the care management of patients with chronic illnesses. CH provides care to all residents of the Balearic Islands and focusses on the provision of individualised outpatient care services in people's homes. CH combines traditional care provision through qualified health and social care staff with the use of ICT devices to enhance the coordination and management of care. Participants informed us that most care provided on the Balearic Islands is privately funded which makes it a very different model of health and care provision even within the same country.

United Kingdom

The Health and Social Care system (HSC) in Northern Ireland serves a population of 1.8 million. People live in urban, semi-rural or rural communities. Responsibility for population health and wellbeing, and the provision of health and social care, is devolved to the Northern Ireland Assembly from the United

Kingdom (UK) government in Westminster. As in other parts of the UK, the Northern Ireland health service operates based on the founding principles of the National Health Service (NHS) - the provision of care according to need, free at the point of access and beyond, funded from taxation. However, since the advent of devolved government, England, Scotland, Wales and Northern Ireland have adopted their own strategies for: promoting and protecting health; preventing disease; reducing health inequalities and planning and providing health and social care services. The countries have developed different structures and functions within their systems to meet these responsibilities. Thus, they vary in features such as: arrangements for planning and contracting of care; levels of investment in public health, primary and community care versus hospital provision; funding models; incentives; use of the independent sector; managerial structures, and the role of the headquarters function. NI is an outwardly focussed region with a great number of active, international partnerships. Specifically, with regard to care services for Active and Healthy Ageing, NI has already developed valuable links with a growing number of regions that include the Basque Region, Catalonia, Finland, Malta, Republic of Ireland, Greece, Lithuania, Spain, France and the United States. These are in addition to the many linkages with other devolved administrations of the UK (Scotland and Wales) as well as England. Networks include health care and social care, academia, independent (i.e., private) and voluntary (i.e., charity) sector, as well as formal legislative agencies such as the Office of the Older People's Commissioner in Wales and the Welsh Local Government Association.