

TERRITORIAL MAPPING REPORT CYPRUS WP2 - Deliverable 2.2

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Constructing Healthcare Environments Through Responsible Research Innovation and Entrepreneurship Strategies, CHERRIES project will support Responsible, Research and Innovation (RRI) policy experiments in the healthcare sector in three European territories: Murcia (ES), Örebro (SE) and the Republic of Cyprus (CY).

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EXECUTIVE SUMMARY

CHERRIES engages ecosystems in South-West Europe (**Murcia ES**), Northern Europe (**Örebro SE**) and South-East Europe (**Republic of Cyprus CY**). The territorial preconditions and development paths are varying. While the size and population of the territories are similar, the administrative, economic, and innovation systems have major differences. What is the influence of these differences on the capacity of the regions to develop demand-driven health innovations; what are drivers and barriers, and what is the policy mix that supports territorial responsible research and innovation in healthcare?

Based on the mapping guidelines (D2.1), the three territorial ecosystems have been mapped. The mappings scrutinised the central **actors** in the territorial healthcare systems, their innovation behaviour and **capabilities, priorities, needs and observable trends**. Further, the policy instruments determining the innovation policy mix, were analysed. The methodology builds upon a mixed-method ranging from desk research, expert interviews to bibliometrics indicators and networks. The European Commission (EC) describes its policy for **responsible research and innovation (RRI)** as diverse sets of societal actors (researchers, citizens, policymakers, business, third sector organizations, etc.) that "*work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs, and expectations of society*". The major mechanism for bringing actors together is public engagement, one of the EC's six RRI 'keys' along with ethics, gender equality, governance, open science, and science education. The capacity to support territorial health innovations in an engaging and responsible way is central to the experimentation phase in CHERRIES.

The executive summary brings together the main findings from mapping the actors and stakeholders (section 1), the policy context (section 2), and mapping of context and content in relation to smart specialisation (section 3). The extended mapping results are available in these sections; the methodology is provided in each section and also referring to further documentation for details. The report comprises an understanding of the specificities of a territory, including the peculiarities of its economic structure, the idiosyncrasies of its institutions, the character of its political culture and policy-mix and its relational connections as well as the status for RRI implementation. These territorial development paths serve a baseline for further interventions (WP3 and WP4) into these systems, and subsequent monitoring (WP6).

Innovation from a responsible territorial perspective

'Smart Specialisation' is an innovation policy concept intended to promote the efficient and effective use of public investment in research. Its goal is to boost regional (territorial) science and innovation in order to achieve economic growth and prosperity, by enabling regions to focus on their strengths. This approach understands that spreading investment too thinly across several frontier fields risks limiting the impact in any one area.

The complementarities between both Responsible Research and Innovation (RRI) and Smart Specialisation (RIS3) approaches rely on some of the characteristics that differ between them. The RIS3 policy is primarily oriented towards regional competitiveness and therefore does not fully incorporate local institutions and notions of social value or choice. On the other hand, neither the theory, policy nor practice of RRI pays attention to the spatial dimension of innovation processes, which is central in RIS3 approaches. In that sense, RRI ignores the various ways in which regional context affects not only the development of innovation



but also the perception of what is responsible and socially desirable, understanding that knowledge and resources which are necessary for innovation - labor mobility, R&D collaboration- are all regional. Thus, from the innovation studies literature, we know that innovation processes are socially and spatially embedded, as the regional context creates conditions for knowledge acquisition and learning. Overall, these two approaches share their origins as a policy concept rather than a theoretically motivated framework that argues for broad stakeholder involvement in the development of research and innovation policy and the need for R&I to be oriented towards solving grand societal challenges SGC.

Actors and stakeholders supporting healthcare & innovation

Up until recently, health services in the **Republic of Cyprus** were delivered through a publicly funded health system, which entitled three-quarters of the population to access care free at the point of use and a private health sector that was unregulated and contributed to high out-of-pocket payments. A new General Healthcare System was voted in 2017. The long-anticipated General Health System (GHS) has been developed under the governance of the Health Insurance Organisation (HIO) - established by virtue of the Law No 89(I) 2001 as a legal entity governed by public law in the Republic. The HIO's mission is to implement the GHS, a people-centered system reflexive of modern thinking and practices, which is based on the principles of social solidarity, justice, and universality, both regarding contributions and coverage. The calibre of health care is improving in leaps and bounds with new specialized medical services and research, as well as the long-anticipated implementation of a comprehensive national health care system. Most medical professionals in Cyprus are educated at universities in the UK, Greece, Western Europe, the US, and Russia – an influential factor in the strong development of the country's private sector with 75 private hospitals and clinics. Cyprus is considered an ideal destination for both medical research and new venture development due to accessibility - in the cross-sector of three continents, the low tax and IPR incentives as well as the top-tier medical centres. Health improvements in ischaemic heart disease, stroke, and diabetes ensure that Cyprus has one of the highest life expectancies in Europe.

Generally, Cyprus is regarded as a moderate innovator in the European landscape, as indicated by the European innovation index. These indications suggest that Cyprus should not be looking to realise very advanced high-tech innovations since there is not much experience with this type of activities. Cyprus should rather focus on mid-tier innovations with potential for regional gains to ensure high chances of effectiveness for the pilots. The CYPRUS research & innovation STRATEGY framework 2019-2023, published by Innovate Cyprus, presents the vision: "Cyprus to become a dynamic and competitive economy, driven by research, scientific excellence, innovation, technological development and entrepreneurship, and a regional hub in these fundamental areas". The strategy framework is based on three pillars: research excellence, knowledge transfer & commercial exploitation and innovative entrepreneurship. However, Cyprus has not developed a specific strategy for Knowledge Transfer yet. Recently the government has appointed a Chief Scientist who will be the Executive authority for managing all activities including Policies, Incentives and Funding to Research, Innovation and Entrepreneurship. The R&I system is also governed by The National Research and Innovation Council (NRIC), the political, decision-making body of the R&I System while the NRIC is entrusted with the responsibility of formulating long term R&I strategic priorities.

As a result of the stakeholders'mapping exercise, the most prominent actors registered in Cyprus are the Hospitals (21) and Higher Education Institutions (HEI, 12). The majority of the health institutions work on a national/regional scale, but from the HEI's the majority operates internationally. According to the 4P model there are two CSOs belonging to the **Patients'** category, whereas the **Policymakers'** group constitutes of



a mixed group of Public Administration, Civil Society Organizations, Universities and Research Funding Organizations. In the **Providers** category, the regions identified mostly Hospitals and private sector, including two startups. Actors corresponding to the "payors" group were not identified by the region. In Cyprus, the *Aretaeio Hospital* and The *Research Promotion Foundation* are considered as the most relevant actors. Also in the core group are the privately-owned R&D centre CyRIC, which is a territorial support actor of the business and innovation ecosystem, and 3 specific patient organisations (CSO), focusing on cardiology, muscle disease, and physiotherapy.

Policies in RRI

There is no overarching RRI-policy in Cyprus. The only R&I specific policy document for Cyprus is the national policy for the European Research Area 2016-202 (ERA)¹, published in 2017 by the Cyprus Directorate General for European Programmes, Coordination, and Development (DG EPCD). This is the translation of the European ERA policy with 6 priorities into the Cypriotic context. Of these priorities, number 4 (Gender Equality and Gender Mainstreaming in Research) and 5 (Optimal Circulation, Access to and Transfer of Scientific Knowledge, including open access to scientific publications) refer directly to RRI keys. These are translated into specific national gender and open access policies. Priorities 1 (Effective National Research Systems) and 2 (Jointly Addressing Grand Challenges & Make Optimal Use of Public Investment in Research Infrastructures) indirectly refer to responsibility in R&I, as they represent R&I governance. Also the ethics and integrity dimensions is covered.

Smart Specialisation

The economic specialization areas for Cyprus show that Oil and Gas Production and Transportation are scoring the highest value on the <u>regional ecosystem scoreboard (EU)</u>. The previous Smart specialization strategy developed for Cyprus (2015), considers priorities that encompass the following areas: Tourism, Energy production and use, renewables and hydrocarbons, structured environment and construction, Transport, logistics and shipping, agriculture and nutrition, Environment, ICT, and **Health, ICTs and biomedical applications**. In the latter category, the emphasis will be on digitalisation of medical records, quality and safety management, early warning, diagnosis, and early medical care provision, molecular biology, genetics, diagnosis and targeted drugs, public health and quality-of-life issues, medical tourism.

In order to specify a place-based approach to smart specialisation in times of Grand societal challenges, locally and historically situated discourses and practices need to be taken into account for aligning research and society. The mapping of the regional capacity in science and technology shows that:

 Based on the publication data (2018), Cyprus has shown Medium Scientific diversity and Medium Scientific Complexity indicators values. Diversity matters because regions are more likely to expand and diversify into new topics and fields that are closely related to their existing activities.

¹ ERA, a central element of the Europe 2020 strategy for a smart, sustainable and inclusive economy, aims to achieve a "unified research area open to the world, based on the Internal Market, in which researchers, scientific knowledge and technology circulate freely and through which the Union and its Member States strengthen their scientific and technological bases, their competitiveness and their capacity to collectively address grand challenges". See European Research Area Roadmap presented on 20 April 2015.



Complexity of knowledge matters because it allows regions to produce idiosyncratic knowledge that few other regions can make.

- Publication data further indicate Disease prevention, which relates to the WHO priority connected to "Health prevention" as most occurring category concerning knowledge production. As an example, this includes Oncology in connection to Nursing as an important topic; HIV, and Adolescent research. In relation to the category Active Ageing, Dementia in the context of Psychogeriatrics and the Nursing fields appeared.
- The relatedness indicator measures the main strength and capabilities already present in the region from the scientific perspective, as shown by the Revealed comparative advantage (RCA). Cyprus has a strong representation of *Engineering* and *Life and Earth Science fields* and some *Biomedical and Health Science* subfields, with a low relative advantage in the *Social science and humanities*. Fields in the *Biomedical and Health Science* with a high RCA compared to European partners are: Genetics & Heredity, Audiology & Speech -language, Pediatrics. Some of these fields are at the interface of Social Science: Rehabilitation, Biomedical Social Science, Psychology (Clinical and Applied).
- Further breakdown in microfields reveals that in the top 10 the following fields stand out: Mathematics and Computer Science, Physics, Particles within the engineering cluster. Microfields emerging from Biomedical and Health Science are Nephrology, Cardiology, Pediatrics, Radiology Nuclear Medicine. Also, Plant Science in relation to Agriculture and Nutrition is shown as relevant.
- Patent analysis in Cyprus indicated a total of 4.462 patents (1980 2019) across technological fields, where two of the categories related to the Health sector are within the top 10 positions. Computer technology, Pharmaceuticals and Medical technology are the sectors with the highest number of registered inventions. The high number of patents (compared to the other two regions), however, reflects the beneficial tax environment which is why many international companies deposit their patents in Cyprus. These patents do not reflect the innovative activities in Cyprus. In this way, the analysis of topics related to the patents needs to be taken carefully. For the Medical Technology sector, several inventions are associated with surgery instruments and the method and devices for optimizing the vision. Likewise, we found a few patents dealing with respiratory devices, mostly inhalers. The patents from the pharmaceutical sector and biotechnology appeared to be related to the diagnosis and treatment of Alzheimer's disease and cancer. The former sector also registered patents concerning Diabetes, atherosclerosis and cardiovascular disorders, and herbal therapy for the treatment of skin conditions.

Priorities informed by the regional actors indicate another range of demand-driven priorities: these are related to **Ambient Assisted Living (AAL)**, which is a sub-area of the Ambient Intelligence. This concerns the use of ambient intelligent techniques to enable elderly people to live independently for as long as possible. If analyzed the knowledge production on this topic for the country, it was possible to find related content in the fields of **Geriatrics and Gerontology** and **Neuroscience & Robotics.** From the author affiliations, we found the majority were published by the company **CITARD Services Ltd**. (Nicosia, Cyprus) together with the **Department of Computer Science – University of Cyprus** (Nicosia, Cyprus).

 When analyzed the AAL priority in terms of the EU projects we distinguished four initiatives funded by the (AAL) programme of the European Commission, and three from Horizon 2020 projects. The projects involve topics such as Dementia and the improvement of communication among healthcare providers, businesses, entrepreneurs, and elderly citizens. Almost all of the participant



organizations pertain to the private sector with only one Higher Education Institution (HEI), the University of Nicosia Research Foundation.

Our approach may assist policymakers in designing and implementing RIS3 strategies that not only promote smart (i.e. competitive) but also inclusive and sustainable regional economic development. By combining information on the relative strength of regional knowledge production activities (e.g. science and technology that is linked to global developments) with information about regional stakeholders, local needs and policies, we can thus specify priorities that can help to maximise the regional development potentials.

It further shows that scientific capacities that could be useful for regional development, do not necessarily align with the demand-driven regional needs. Demand-driven research priority setting for funding schemes is very much in sync with RRI, but the Smart specialisation paradigm doesn't seem to include regional needs.

Reflection process on RRI implementation

Based on the initial mapping results, a discussion with territorial stakeholders about benefits, barriers and strategies for the implementation of RRI based measures started. The reflection process began during the last quarter of the year 2020 (Q4) and also in connection to CHERRIE'S WP3. Training activities were performed based on Task T3.2 "Training key stakeholder and need identification processes" in the three regions involved in Cherries experimentations, whose general aim was to establish the territorial experimentation process, prepare the stakeholders' system (territorial multipliers and key stakeholders) for the RRI based demand articulation, facilitating bottom-up RRI and need articulation processes, experimentation and to the co-creation process.

The training supported a learning process aimed at helping healthcare and R&I stakeholders to reflect about how to identify potential for RRI principles and approaches within the institutions that aim at increasing the service delivery quality for patients as well as to identify innovation needs and how to articulate them within and between organisations for the territorial network. This process served as an entry point for the embeddedness of RRI at the institutional level and for triggering a more open and reflexive behaviour in a broad set of relevant territorial actors. The implementation of these activities resulted in one training workshop in each of the three regions involved in the CHERRIES experimentations and through the delivering of online resources.

Besides the training workshops, the preparation stage was developed based upon bilateral meetings. The training activities were supported by K&I and conducted in coordination with the establishment of the territorial experimentation process and the finalisation of the experiment design (T3.3) and with the preparation and the publication of the Call for needs (T4.1). Task T3.2 builds on the Stakeholders Mapping exercise started in the first stage of the project (WP2) and on the development of the CHERRIES Toolbox (T3.1).

The outcomes of these activities produced relevant up-to-date information about RRI oriented actors engaged in projects, in keys areas or initiatives identified during informal meetings and through the training workshops. The reports of these activities are at this time in local language and a further translation of the content will be integrated into the Synthesis report (task 2.2 & 2.4). However, the final round of consultation with the territorial teams to update any further information concerning to actors or initiative RRI-related identified during the preparation stage and the dissemination of the Call for needs and call for solution in the territory will be addressed during the reflection workshop to be conducted on March 2021, where an interregional and regional discussion will take place.



1. MAPPING STAKEHOLDERS IN THE HEALTH AND INNOVATION SECTOR – Cyprus

The European Commission (EC) conception of RRI emerged from its science with and for society (SwafS) policies and R&D work programmes. The EC describes RRI as diverse sets of societal actors (researchers, citizens, policymakers, business, third sector organizations, etc.) that "*work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs, and expectations of society*". The major mechanism for bringing actors together is public engagement, one of the EC's six RRI 'keys' along with ethics, gender equality, governance, open science, and science education. In that regard, CHERRIES project considers the bottom-up involvement of all kind of citizens, irrespective of their age, gender, ethnicity, and socio-economic background as one of its pillars (European Commission, 2018²).

The development of the Territorial mapping activities for CHERRIES project encompassed the mapping of relevant actors in the Health and Innovation landscape as one of the central activities during the first year of the project (2020). The engagement process has been also developed considering the adverse circumstances of the current pandemic of Covid-19. The regional partners have faced difficulties due to the physical distance restrictions that do not allow gatherings and events dedicated to the involvement process. In addition, one of the most important actors such as Hospitals and Health-related institutions (Providers), need to attend issues of higher priority for public health during the pandemic contention. That means the engagement process has been delayed and disrupted by this unexpected scenario. However, and despite the obstacles, the regional partners have conducted a substantial effort to follow the mapping exercise.

The following results are framed in task 2.2, "*Mapping Health and Innovation sector in the pilot territories*", and were steered by the territorial actors supported by Leiden University. This Work Package is conducted in collaboration with WP6 responsible for the Monitoring, evaluation, and impact assessment to secure the projects' overall impact.

1.1 Identification and assessment of territorial actors

The mapping exercise follows the methodological approach recommended in the document "GUIDELINE FOR TERRITORIAL MAPPING WP2 - Deliverable 2.1", part of WP2. The process involved the following 4 steps: 1) *Identification of stakeholders from current regional network* 2) *Addition of potential new partners from datasets* 3) *Selection criteria for stakeholders* 4) *Categorize stakeholders regarding their degree of involvement in the project.* The results of steps 1 and 2 provide an overview of the distribution and representation of the different types of organizations identified by the region. Figure 1 displays the number of Institutions classified by each category and the geographical scope or territorial scale in which the institutions develop their activities.

² European Commission (2018) Science with and for Society. Work Programme 2018-2020.





Figure 1. The number of institutions per each organization type and the territorial scale they perform.

In regards to the territorial scale, we observe that the main institutions operating at the regional level are Hospitals and Health care centres in Cyprus. A more international profile of the institutions can be seen in Higher Education Institutions, Research Funding Organizations, and Startups. We observe that Institutions with a governmental profile such as Public Administration or Public Research Organizations perform at the National/Regional level. The private sector, constituted by firms, business, SME's and startups are less represented in the local landscape.

The following Figure displays the results of all the regional actors recognized in the local ecosystem by implementing the aforementioned steps 1 to 4. It covers information regarding the categorization of the groups of actors and stakeholders concerning their level of importance. This is based on a set of criteria that led to values ranging from 1-3, where 1 = Less relevant; 2 = Important and 3 = Extremely important. As a result of the assessment, and applying the regional perspective each one of the actors was classified by their (potential) degree of involvement in the project, creating operative groups of stakeholders according to their interest and role in the project.



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Level of importance

Degree of involvement

Coordination team

Working team

Rep. key groups stakeholders

Figure 2. Identification of stakeholders in Cyprus, classified by their type of organization, the Level of importance and their Degree of Involvement.



One can notice from Figure 2 that Hospitals and Higher Education Institutions are the categories with a larger number of institutions registered. The assessed Level of Importance distinguished *Aretaeio Hospital* and The *Research Promotion Foundation* as the most relevant actors. The majority of the institutions were categorized as Representatives of Key groups of Stakeholders.

From the results of the 4P model articulation, we notice two CSOs belonging to the **Patients'** category, whereas the **Policymakers'** group is constituted of Public Administration, Civil Society Organizations, Universities and Research Funding Organizations. Among the institutions performing as **Providers**, the regions identified mostly Hospitals and the private sector, including two startups. Actors corresponding to the "payors" group were not identified by the region.

To visualize the composition of the Coordination and Working Team, Figure 3 depicts the main organizations representing these groups.



Figure 3. Diagram representing the results of the "Degree of Involvement" of the regional actors from the Health and Innovation sector in Cyprus.

Figure 3 illustrates the core working team from Cyprus, which is formed by 1 Provider, 1 Policymaker, and an Organization from the private sector. Patients are represented by 3 organizations acting as part of the Coordination team. In the case of Cyprus, the country maintains permanent contact with Aretaieio hospital through one of the Cyprus partners, collecting directly the needs and demands raised by the Health



institution. Other stakeholders that the region has open a communication channel is UCLan Cyprus (University of Central Lancashire – Cyprus), especially with professionals working on Responsible Research and Innovation.

We acknowledge that in the successive stages of the project, the current list of stakeholders may experience changes due to the engagement process being currently developed in the reflection and experimentation phase of CHERRIES project WP2 and WP3. These activities entail the implementation of workshops, meetings, and interviews that could potentially show new partners to be involved in the project, and likewise the operational groups categorization may undergo adjustments following the level of interest and participation shown during the engagement activities.

2. POLICY MAPPING ON TERRITORIAL R&I HEALTHCARE ECOSYSTEMS

2.1 International policy instruments

The analysis of the policy instruments at international level enabled us to comprehend the connection between international-umbrella policies and guidelines, and their National or regional policies adapted to the local context. Most of the documents are elaborated by the World Health Organization and the European Commission. This task addressed 4 policy domains; Responsible Research and Innovation, Smart Specialization Strategies, Healthcare & Innovation, and its results are presented below, where main documents are highlighted.

2.1.1 Responsible Research and Innovation

For almost a decade, the RRI approach to research and innovation policy has gathered traction and it is now a cross-cutting issue in the **European Union's Framework Programme for Research and Innovation in the European Research Area** (Horizon 2020) as well as a part of **Science with and for Society Work Programme** (SWAFS). RRI and its approach seek to focus on research and the products of innovation to achieve benefits in the social and environmental realms.

The **SWAFS (Science with and for Society) Work Programme 2018-2020 (WP18-20)** from latest Horizon 2020 has been developed to reflect and support the evolution of science and society and the increased emphasis on their interplay at national and EU levels. There is recognition that co-design with citizens, stakeholders and end-users needs to be promoted in all policy instruments, including in Horizon 2020.

From this Funding programme several initiatives have been developed towards the incorporation of RRI in the European and International arena. The projects funded by Horizon 2020 have widely created tools to put the RRI concept in practice. These tools consider the development of training materials, strategies, guidelines, methodologies, and databases to enable the discussion at different territorial levels (European Commission, 2014).

2.1.2 RIS3 - Research and Innovation Strategies for Smart Specialisation

Europe 2020 is the EU's growth strategy for the coming decade. The EU aims to become a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion. Concretely, the Union



has set five ambitious objectives – on employment, **innovation**, education, social inclusion and climate/energy – to be reached by 2020. Each Member State has adopted its own national targets in each of these areas. Concrete actions at EU and national levels underpin the strategy. National and regional authorities across Europe shall design smart specialisation strategies in entrepreneurial discovery process, so that the European Structural Investment Funds (ESIF) can be used more efficiently and synergies between different EU, national and regional policies, as well as public and private investments can be increased.

The **Regulation (EU) 1301/2013 of the European Parliament and of the Council of 17 December 2013** is a legal base which defines 'smart specialisation strategy'. The existence of a national or regional smart specialisation strategy in line with the National Reform Program, to leverage private research and innovation expenditure, which complies with the features of well-performing national or regional R&I systems is a prerequisite for the effective and efficient achievement of a specific objective for all investment priorities under thematic objective no 1: Strengthening research, technological development and innovation. More specific guidance for regions and Member States on how to develop and implement regional innovation strategies for smart specialisation is available in the form of a methodological and <u>practical guide</u> (European Commission, 2014a).

2.1.3 Healthcare policies

World Health Organisation

WHO has a long track record developing normative work and high-level international policy frameworks. The organisation identifies achieving universal coverage as a strategic priority, with the goal of 1 billion more people benefitting from universal health coverage by 2023. This work is supported by normative guidance and agreements; data, research and innovation; and leadership in the realms of diplomacy, advocacy, gender equality, health equity and human rights, multisectoral action, and finance. WHO's work is aligned with SDG target 3.8, which focuses on achieving universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all. The essence of Universal health coverage (UHC) is the access to a strong and resilient people-centred health system with primary care as its foundation. Community-based services, health promotion and disease prevention are key components as well as immunization, which constitutes a strong platform for primary care upon which UHC needs to be built. One of the core documents in this regard is the *Global strategy on human resources for health: Workforce 2030.* The main priorities established by WHO for the Universal health coverage and key policy instruments are detailed as followed

a) **Prevention:** In the European Region, preventable diseases continue to impose a high burden of premature mortality, and unfortunately, simple and cost-effective preventive and curative interventions are underused. WHO/Europe aims to strengthen public health programmes to prevent communicable and noncommunicable diseases, and address risk factors. The organisation has implemented a complete set of policy instruments in topics such as Alcohol use, Antimicrobial resistance, Food safety, Illicit drugs, Nutrition, Oral health, Physical activity, Tobacco, Vaccines and immunization, Violence and injuries. A key document at European level is the *European strategic action plan on antibiotic resistance (2011-2020)*



b) **Health promotion** is the process of empowering people to increase control over their health and its determinants through health literacy efforts and multisectoral action to increase healthy behaviours (e.g. lifestyle advise). In this context a relevant international instruments is: *Promoting health: guide to national implementation of the Shanghai Declaration (2018)*. There is also a series of Resolutions that contribute to reducing health inequities.

c) **Therapeutic or palliative care** is related to the treatment of disease or disorders by remedial agents or methods for cure having a beneficial effect on the body or mind (e.g. treatments, products, technologies or services). Palliative care is recognized in key global mandates and strategies on universal health coverage, non-communicable diseases, and people-centred and integrated health services. Some of the fundamental instruments link to this priority are: *Integrating palliative care and symptom relief into primary health care: a WHO guide for planners, implementers and managers (2018), and <u>Strengthening of palliative care as a component of comprehensive care throughout the life course (2014)</u>. Additionally, a set of documents on integrating palliative care and symptom relief into responses to humanitarian emergencies and crises are among the Guidelines presented by WHO. At the European level, we highlight the document: <i>Palliative care for older people: better practices* (2011).

d) **Rehabilitation or assistive care** enables and promotes inclusion and participation, especially of persons with disability, ageing populations, and people with non-communicable diseases, e.g. through hearing aids, wheelchairs, prostheses, and devices. A key document in this topic is <u>Rehabilitation in health systems</u> (2017). Other relevant documents provide guidelines on community-based rehabilitation (CBR), the provision of manual wheelchairs in less-resourced settings, and for training personnel in developing countries for prosthetics and orthotics services

European Commission

The European Commission's Directorate for Health and Food Safety (DG SANTE) is the Commission department responsible for EU policy on food safety and health, and for monitoring the implementation of related laws. **The Strategic plan 2016-2020 – Health and Food Safety** sets out the department's vision for a five-year period, up until 2020. EU action in the public health area is mainly linked to incentives and cooperation measures and the actions focus on the following challenges:

- Achieving greater cost-effectiveness
- Competitiveness together with safety
- Tackling emerging global threats such as antimicrobial resistance
- Evidence-based policymaking
- Addressing the risk factors of non-communicable diseases
- Promoting vaccination.

The EU can adopt health legislation under the **Treaty on the Functioning of the European Union: Article 168** (protection of public health), **Article 114** (approximation of laws), and **Article 153** (social policy). Areas where the EU has adopted legislation include Patients' rights in cross-border healthcare, Pharmaceuticals and medical devices (pharmacovigilance, falsified medicines, clinical trials), Serious cross border health threats, Tobacco, Organs, blood, tissues, and cells.



The Council of the EU can also address recommendations³ on public health to EU countries. These recommendations address topics concerning the Prevention of drinking of alcohol and drug dependence, Cancer screening, prevention of injury, and the promotion of patient safety, including the prevention and control of healthcare-associated infections. It also covers actions in the field of rare diseases, Smoke-free environments, and Seasonal influenza vaccination.

The main funding schemes or instruments for co-financing are the **Third Health Programme (2014-2020)** – where the Regulation (EU) 282/2014 is the legal basis for the current Health Programme and provides funding to projects on health promotion, health security, and health information. Also, **The Horizon 2020 research programme** supports projects in areas such as biotechnology and medical technologies. EU cohesion policy supports investments in health in EU countries and regions. The European Fund for Strategic Investments. Moreover, and specifically in relation to Healthcare systems, in 2014 appeared the *Communication from The Commission On effective, accessible, and resilient health systems.* This Communication focuses on effectiveness, or the health systems' ability to produce positive health to improve the health of the population (European Commission, 2014b).

2.1.4 Health & Innovation policies

Transformation of Health and Care in the Digital Single Market

The European Commission is working to provide its citizens access to safe and top quality digital services in health and care. In line with the Commission's Digital Single Market (DSM) strategy and after analysing the results of an Open Public Consultation, the European Commission published a Staff Working Document and a <u>Communication on Digital Transformation of Health and Care in the Digital Single Market, empowering citizens and building a healthier society</u>. These policy documents give direction to EU activities in this field for the coming years.

As part of its Digital Single Market strategy, the European Commission has proposed political measures for ageing well in the Communication on Health and Care. This, acknowledging that Digital technology can help older people to stay healthy, independent, and active at work or in their community for longer and it helps to improve our quality of life.

Also in line with the Ageing well with ICT framework, European policymakers, civil society, professional organisations and the industry have developed a European blueprint to address the challenges in innovating better health and care provisions for the ageing society. A key document is: <u>Blueprint for a digital transformation of health and care in an ageing society</u>

2.2 Governance of the Cyprus R&I System

The R&I system in Cyprus is relatively young (from the mid-1990s) but is evolving over time with the aim to increase efficiency and foster cooperation between the research community and the productive sector (business and industry). The current governance system was established in 2007. The National Research and Innovation Council (NRIC) is the political, decision-making body of the R&I System. It is composed by a cabinet of six members/ministers and it is chaired by the President of the Republic. The NRIC is entrusted with the responsibility of formulating long term R&I strategic priorities. The Cyprus Scientific Council (CSC) is an advisory scientific body comprising of 19 high-esteemed scientists. All three Public Universities, as

³ <u>https://ec.europa.eu/health/policies/implementation/recommendations_en</u>



well as Private Universities and Public Research Institutions, are represented in the CSC. This Council is responsible for advising NRIC on strategy and policy R&I matters. The Research Promotion Foundation (RPF) is a national research funding agency. The existing Governance system has proven to be rather inflexible and has been inactive for the past few years. The gap is currently filled, to some extent, by the Council of Ministers. The main barriers of the R&I system relate to the inflexible governance structure, the weak coordination between the various actors involved, and the absence of an explicit long-term strategy for R&I. Besides, the development of the R&I system is hindered by the weak cooperation between the research and academic community with the business world, the low involvement and investments of the private sector in R&I activities and the limited extroversion of the Cyprus R&I system.

2.2.1 Policy Level

The responsibility for the design of the national R&I policy is carried out by the DG EPCD, an independent governmental body. The latest major policy initiative undertaken by DG EPCD was the preparation of the Smart Specialisation Strategy of Cyprus (S3Cy). This strategy is implemented through an Action Plan that is a "dynamic" document reflecting the national Framework Programmes for R&I over the period 2016-2020. The DG EPCD defines the multi-annual financial support for R&I through the Government budget (except funding to higher education institutions) and it provides funding to the main RFO in Cyprus, the RPF. The Ministry of Energy, Commerce, Industry, and Tourism (MECIT) is responsible for the design of the Business Innovation Policy, including entrepreneurship. The three Public Universities of Cyprus formulate their own R&I policy and goals based on their interests and research capacities, which, to an extent, align with the national policy priorities of the S3Cy.

The CYPRUS research & innovation STRATEGY framework 2019-2023, published by Innovate Cyprus, presents the following vision: "Cyprus to become a dynamic and competitive economy, driven by research, scientific excellence, innovation, technological development and entrepreneurship, and a regional hub in these fundamental areas". The strategy framework adopts an integrated, coherent and operational governance system that will facilitate effective and timely implementation of R&I strategy. It will implement a national strategy for the technological, social, and economic development of Cyprus, based on research and innovative entrepreneurship that is based on three pillars: research excellence, knowledge transfer & commercial exploitation and innovative entrepreneurship. This strategy is based upon cultural change to more entrepreneurial creativity, digital transformation, international level on the benefits and impact of R&I. Communicate the reform of the R&I governance system, R&I strategy, as well as defined policies, actions, measures and results, so communication is a matter of branding and marketing rather than engagement. There is no explicit public engagement or science communication strategies described to increase responsibility and engagement.

2.2.2 Knowledge transfer

Cyprus has not developed a specific strategy for Knowledge Transfer yet. The lack of a mechanism for the support of technology transfer is a major challenge for the R&I system in Cyprus and the need for the development of a Technology Transfer Office (TTO) has been identified as a major priority in the Smart Specialization Strategy of Cyprus (S3Cy). One of the national ERA priority actions is the enhancement of the links between research, business and education and promote the exploitation of Research and Innovation. In order to address this issue, the Action Plan of S3Cy foresees the creation of a TTO that will provide support to the RPOs in Cyprus in relation to the exploitation of their research results and the



protection of Intellectual Property Rights. Since 2010, a University-Industry Liaison Offices Network was established in all major public and private universities in Cyprus, with co-financing from the European Social Fund 2007-2013. The main priorities of the network was to ensure benefits to business and industry through academic research results and vice versa which proved extremely successful. Therefore, the Action Plan for the implementation of the S3Cy includes a similar scheme aiming to boost the academia-business cooperation by encouraging communication and collaboration of universities with the business world on issues such as Knowledge Transfer, applied research in response to specific problems of the industry, participation in research projects and student placements in enterprises.

2.2.3 RRI policies

There is no overarching RRI-policy. The only R&I specific policy document for Cyprus is the national policy for the European Research Area 2016-202 (ERA)⁴, published in 2017 by the Cyprus Directorate General for European Programmes, Coordination and Development (DG EPCD). This is the translation of the European ERA policy with 6 priorities into the Cypriotic context. Of these priorities, number 4 (Gender Equality and Gender Mainstreaming in Research) and 5 (Optimal Circulation, Access to and Transfer of Scientific Knowledge, including open access to scientific publications) refer directly to RRI keys, whereas number 1 (Effective National Research Systems) and 2 (Jointly Addressing Grand Challenges & Make Optimal Use of Public Investment in Research Infrastructures) indirectly refer to responsibility in R&I, as they represent R&I governance.

2.3 Policy mapping exercise in Cyprus

In the CHERRIES project and as pointed out in the Guideline for Territorial mapping report (section 3.2), this step entails the revision of sectoral policies, strategies, and innovation support, based on the theoretical interface of innovation policy, RIS3, RRI, and the healthcare sector and with a focus on mission-oriented policymaking.

The exercise focuses on existing National policy frameworks for territorial innovation, a selection of research and innovation strategies; and health innovation strategies, as well as other policy mixes at national and regional scale.

The actions conducted through this policy mapping exercise consisted of the collection of policy documents by each policy domain at the institutional level and the selection of relevant policy instruments and strategies. The type of documents collected consisted of executive or administrative policies to Technical/operational instruments, and development plans and strategies. The search effort involved the screening of documents from institutional websites and also reaching key stakeholders, requiring feedback on essential policy tools, particularly regulatory and legal as well as information and suasory instruments. Moreover, the procedure encompassed the "Snowball Research Strategies" method aiming to map networks of relations between

⁴ ERA, a central element of the Europe 2020 strategy for a smart, sustainable and inclusive economy, aims to achieve a "unified research area open to the world, based on the Internal Market, in which researchers, scientific knowledge and technology circulate freely and through which the Union and its Member States strengthen their scientific and technological bases, their competitiveness and their capacity to collectively address grand challenges". See European Research Area Roadmap presented on 20 April 2015.



policy actors and policy instruments. The approach begins by analyzing the documents of a single organization and follows a chain of references from this point. This is based on the assumption that a significant majority of actors in a policy network are known to each other.

As a result of the exercise the regional actors, together with Leiden University gathered the most representative documents from each policy domain. The main results are shown below in Figure 4.

Policy domain 1	Policy domain 2	Organisation			
Responsible Research & Innovation	RRI	DG EPCD. Direct. General European Programmes,			
	Open Science	DG EPCD. Direct. General European Programmes,			
		Sparc Europe			
	Gender	AIPFE Cyprus-Women of Europe			
		Governemnt of Cyprus			
		Ministry of Justice and Public Order			
		NMWR. Nat. Machinery for Women's Rights - Min			
		RPF. The Research Promotion Foundation			
		Statistical Service of Cyprus. Ministry of Finance			
		United Nations			
	Ethics& Integrity	CNBC. The Cyprus National Bioethics Committee			
		Cyprus Integrity Forum			
		Office of the Law Commissioner, Republic of Cyprus			
	Governance	Research and Innovation Foundation			
	Public Engagement	No documents found			
	Science literacy & Science Education- Citizen sc.	. No documents found			
Healthcare	Health workforce policy (Provider- nurses)	Ministry of Health			
policies	Health workforce policy (Provider- physicians)	Ministry of Health			
	Healthcare -Insurance policies (Payor)	Ministry of Health			
	Healthcare in Medical Tourism	Ministry of Health			
	Hospital policies and procedures (Provider)	Ministry of Health			
	Public Healt policies (Policymaker)	Ministry of Health			
Innovation	Innovative Entrepreneurship	Office of the Chief Scientist			
policies -	Knowledge transfer and comercial exploitation	Office of the Chief Scientist			
Entrepreneurship	National Research and Innovation	Office of the Chief Scientist			
Smart	Priorities in science & innovation	No document <mark>s</mark> found			
specialization	Regional policies innovation	Res. & Innovation Foundation + EPSA			
			0 1	8	2

Nº of doc.

Figure 4. Results of the policy mapping activity showing the representation of the collected documents by their general policy domain (1), the specific domain (2), and the policymaker organization responsible for the elaboration of the policies.



All the policy documents identified have a national scope of governance, except for one document elaborated by the United Nations. From the previous figure we notice that for RRI policies, Gender has the highest number of documents, together with Ethics and Integrity. On the other hand, for the Public engagement, Science literacy, and Science education keys, no documents were found. It should be noted that policy instruments are inherently difficult to track throughout the institutional structure of a nation or at the regional level, and therefore the fact that we were not able to find the documents for some of the policy domains or RRI keys, does not mean that they do not exist.

For Healthcare policies the main policymaker institution is the Ministry of Health. In the case of policy regulations concerning innovation and entrepreneurship, the Chief Scientist of Research and Innovation institution is the political and executive owner for Research and Innovation within the R&I Governance System of Cyprus. One of its responsibilities is to contribute to the formulation of the government's R&I Policy and coordinate and supervise the formulation and implementation of the national R&I Policy, ensuring that the national strategy is implemented through coherent and comprehensive policy measures, funding instruments, and initiatives. For complete detail of the policy instruments and regulations compiled in this exercise see Appendix A (excel sheet).

The following table describes the status and level of development of the analyzed policy domains, highlighting key policy documents, and likewise the current gaps we have for the RRI keys.

Table 1.Description of national policies in Cyprus by domain.

Policy domain	Policy description
Responsible Rese	earch & Innovation
Gender	 One National R&I report (ERA), 3 priorities 1.Empowerment of the women's role by encouraging their equitable representation in decision-making bodies and in high-level appointments 2.Facilitation of the reconciliation of family and professional life (better work-life balance). 3.Promotion of gender dimension in research proposals and projects and equal participation opportunities in the evaluation panels. Other gender policies have a broad scope and are not particularly related to R&I:
	 - 1 National Action plan on Gender Equality. - 2 documents equal payment, treatment in employment. - 1 informal report / Woman in Science, Cyprus.
Open Science	 - 1 National Policy for Open Access to Scientific Information Cyprus adopted a National Policy for Open Access on the 25th February 2016. The National Policy promotes the "Green Route" (self-archiving) of Open Access. Priority and Actions to be promoted is the implementation of the National Open Access Policy to Scientific Information.



	The Policy for Open Access to Scientific Information of the Republic of
	2020.
	- 1 National Open Science policy.
	- There are not any Institutional OA Policies yet in place, but several
	Universities are in the process of formulating such policies and are expected to be adopted soon.
	- Cyprus National Bioethics Committee (this is on research)
Ethics &	- Patients rights law (2004) Cyprus Integrity Forum (CIF 2010) was established in 2010 and is today the
integrity	leading institution in Cyprus for the fight against corruption and promotion of
	transparency in our everyday lives, enhance the content and quality of public
	and corporate governance. It is an independent, non-governmental, non-
	politically partisan, and non-profit organization.
Public	none
Engagement	
Governance	There is nothing to govern responsible research and innovation
Science literacy	none
and Science	
Education-	
Citizen sciences	
Healthcare	One of the key Healthcare policies refers to the "Strategic Plan of the Ministry
policies	Health System Insurance Law 2001 (80(1)/2001)" which seeks universal
	healthcare coverage and equal access to healthcare services
Innovation	- 1 Research and Innovation Strategy Framework 2019-2023 – Innovate
policies	Cyprus
Smart	- 1 Smart Specialization Strategy for Cyprus 2015.
Specialization	
policies	

2.3.1 RRI relevant actors

- **National Machinery for the Advancement of Women (NMWR)** under the Ministry of Justice and Public Order, is the main coordinating body for the promotion of gender equality in Cyprus.
- The University of Cyprus Library has been acting as a National Open Access Desk (NOAD) of the project OpenAIRE since 2009 (European project supporting Open Science). In the framework of the European Programmes OpenAIRE and OpenAIREplus, the Library of the University of Cyprus (UCY) has been appointed as the National Office for Support of Open Access since 2009, assisting researchers in the process of article submission and in promoting their research. At an institutional level, there are currently three repositories operating in Cyprus: (a) LEKYTHOS



repository of the UCY, (b) KTISIS repository of the Cyprus University of Technology (CUT) and (c) KYPSELI repository of the Open University of Cyprus.

- Office of the Chief Scientist. New research and innovation (R&I) governance system adopted by the Government of Cyprus.
- **Cyprus University of technology** was involved in the EU project PARRISE (2014-2017) about students' active citizenship (inquiry-based science education-IBSE) and learning based on socio-scientific issues. This integrated approach is called Socio-Scientific Inquiry-Based Learning (SSIBL). The SSIBL approach introduces the challenges of Responsible Research and Innovation in education.

3. CONTENT AND CONTEXT SMART SPECIALIZATION STRATEGY

3.1 Introduction

The definition of 'Smart Specialisation' – as an innovation policy concept is intended to promote the efficient and effective use of public investment in research. Its goal is to boost regional science and innovation as a means to achieve economic growth and prosperity, by enabling regions to focus on their strengths. This approach understands that spreading investment too thinly across several frontier fields risks limiting the impact in any one area.

The complementarities between both Responsible Research and Innovation (RRI) and Smart Specialisation (RIS3) approaches rely on some of the characteristics that differentiate them. The RIS3 policy is primarily oriented towards regional competitiveness and therefore does not fully incorporate local institutions and notions of social value or choice. On the other hand, neither the theory, policy nor practice of RRI pays attention to the spatial dimension of innovation processes, which is central in RIS3 approaches. In that line, RRI ignores the various ways in which regional context affects not only the development of innovation but also the perception of what is responsible and socially desirable, understanding that knowledge and resources which are necessary for innovation - labor mobility, R&D collaboration- are all regional. Thus, from the innovation studies literature, we know that innovation processes are socially and spatially embedded, as the regional context creates conditions for knowledge acquisition and learning.

Overall, these two approaches share their origins as a policy concept rather than a theoretically motivated framework that argues for broad stakeholder involvement in the development of research and innovation policy and the need for R&I to be oriented towards solving grand societal challenges SGC.

In that sense, we develop an approach that may assist policymakers in designing and implementing RIS3 strategies that not only promote smart (i.e. competitive) but also inclusive and sustainable regional economic development.

The Territorial mapping exercise enclosed as one of the main steps the definition of the Territorial priorities of the regions. In order to achieve this goal, the methodological approach follows the Research and Innovation Strategies for Smart Specialisation method (RIS3 Guide) from the European Commission (2012). The process entailed the adaptation of the steps and actions considered in the original document, to provide a more specific input required in the context of the CHERRIES project. The actions considered in this approach contemplate: *Step 1*) *Analysis of the regional context and potential for innovation, Step 2*)



Governance: Ensuring participation and ownership, Step 3) Elaboration of an overall vision for the future of the region, Step 4) Identification of priorities, Step 5) Definition of coherent policy mix, roadmaps and action plan. This version of the strategy established a special focus on Healthcare and Innovation sector and uses more recent data and information available, if compared with the previous Regional Smart Specialization Strategies.

3.2 Previous regional smart specialization strategy Cyprus

The Smart specialization strategy developed for Cyprus, considered priorities that encompass the following areas: Tourism, Energy production and use, renewables and hydrocarbons, structured environment and construction, Transport, logistics and shipping, agriculture and nutrition, Environment, ICT, and **Health, ICTs and biomedical applications.** In the latter category, emphasis will be placed on digitalisation of medical records, quality and safety management, early warning, diagnosis, and early medical care provision, molecular biology, genetics, diagnosis and targeted drugs, public health and quality-of-life issues, medical tourism.

In the context of the CHERRIES project, the strategy will establish a special focus on Healthcare and Innovation sector or activities, obtaining a deeper understanding and detail for those fields. Additionally, the methodology considers using more recent data and information available and likewise performing analyses not previously incorporated in the strategies. The prioritization proposed in this section should therefore be seen as an updated and more specified complementarity to the existing RIS3 strategies.

It is worth noting that the Research and Innovation Strategy for Smart Specialisation we propose, recognizes the previously constructed RIS3 strategies initiated by the European Commission⁵, which set smart specialisation priorities defined for Cyprus in 2014.

3.3. Territorial context of the region

3.3.1 Economic specialization

This section aims to describe the regional context and potential for innovation in Cyprus. We measured this variable using the cluster mapping tool, which shows the analysis of the **regional ecosystem scoreboard**. The regional eco-system scoreboard for clusters and industrial change illustrates conditions for successful cluster development and industrial change by region in Europe. It displays sectoral, cross-sectoral, and regional indicators of cluster specialisation and size, business performance, regional context and other statistical information. It can be visualised the relative cluster strength and cluster development over time, cluster and regional strength across sectors and emerging industries, and linkages between clusters, industrial change, innovation, entrepreneurship, and economic development. The information was extracted using the Mapping tool from the European Observatory for Clusters and Industrial Change (2019).

By using this indicator, we selected the top 10 economic specialization areas for Cyprus where Oil and Gas Production and Transportation lead the activities, scoring the highest value for the economic specialization. The categories "Biopharmaceuticals" and "Medical Devices", both part of the Life Sciences industry are not present among the highest scores. The national values are displayed in Figure 5.

⁵ <u>https://s3platform.jrc.ec.europa.eu/</u>







3.3.2 Innovative behaviour

Generally, Cyprus is regarded as a **moderate innovator** (score: 97) in the European landscape, indicate by the European innovation index. This suggests that Cyprus should not be looking to realise very advanced high tech innovations, since there is not much experience with these type of activities. Cyprus should rather focus on mid-tier innovations with potential for regional gains to ensure high chances of effectiveness for the pilots.

3.3.3 Health care system

Health improvements in ischaemic heart disease, stroke and diabetes ensure that Cyprus has one of the highest life expectancies in Europe Overall. Up until recently, health services were delivered through a publicly funded health system, which entitled three-quarters of the population to access care free at the point of use and a private health sector that was unregulated and contributed to high out-of-pocket payments. A new General Healthcare System was voted for in 2017. The long-anticipated General Health System (GHS) has been developed under the governance of the Health Insurance Organisation (HIO) - established by virtue of the Law No 89(I) 2001 as a legal entity governed by public law in the Republic. The HIO's vision is, through the implementation of the GHS, for every Cypriot citizen to enjoy lifelong, equal, and unhindered access to high-quality healthcare services.

The HIO's mission is to implement the GHS, a people - centered system reflective of modern thinking and practices, which is based on the principles of social solidarity, justice, and universality, both in regard to contributions and coverage. The GHS is a comprehensive and financially sustainable healthcare system aiming at meeting the expectations of Cypriot citizens for equal access to treatment and provision of high – quality healthcare by using, in the best possible way, all available resources

The calibre of health care in the Republic of Cyprus is improving in leaps and bounds with new specialized medical services and research, as well as the long-anticipated implementation of a comprehensive general



healthcare system (GHS), which is set to make the sector more streamlined and cost-effective. Most medical professionals in Cyprus are educated at universities in Greece, Russia, the United Kingdom, the United States of America and Western Europe – an influential factor in the strong development of the country's private sector which boasts an impressive 75 private hospitals and clinics. Cyprus is considered as an ideal destination for both medical research and new venture development due to Mediterranean Climate conditions, accessibility – in the cross-sector of three continents, the low tax and IPR incentives as well as the top-tier medical centres.

Health status At 82.2 years, life expectancy at birth in Cyprus is among the highest in the EU. Decreases of more than 20 % in mortality rates from ischaemic heart disease, stroke and diabetes since 2004 have contributed to large life expectancy gains. However, the leading cause of preventable mortality is **deaths from lung cancer**, and **mortality from diabetes is the highest in the EU**. Overall, more than three-quarters of the Cypriot population report being in good health, but as in other EU countries, those on lower-income report a lower rate.

Risk factors More than one in four adults in Cyprus are **daily smokers**, which is among the highest in the EU. While **adult obesity** is consistent with EU levels, the overweight and obesity level among six- to nine-year-olds is extremely high, with about 43 % of children in this category. Adults consume around the same amount of alcohol as the EU average but binge drinking in Cyprus is the lowest in the EU. Behavioural risk factors are more prevalent among people with low income and education, resulting in worse health outcomes.

Health system Cyprus spent EUR 1 674 per person (or 6.7 % of GDP) on health in 2017 compared to the EU average of EUR 2 884 (9.8 % of GDP). At 43%, the public share of health expenditure is the lowest in the EU and contrasts with the EU-wide average of 79 %. Conversely, private health expenditure, which primarily consists of direct out-of-pocket payments, reached 56 % of total spending, the highest in the EU. Pharmaceuticals make up the largest component of out-of-pocket spending, followed by outpatient (or ambulatory) care, such as specialist visits and diagnostics.

Within the healthcare system doctors primarily work in the private sector and nurses in the public sector. Compared to the European landscape nurses are scarce, which could be explained by the relatively low amount of public spending. Unmet medical needs are low, however some low-income groups still struggle to attain to their medical needs.

Accessibility Overall, reported unmet needs for medical care, fuelled mainly by long waiting times, are low in Cyprus but are ten times higher for low-income groups than high-income groups.

Resilience The financial crisis highlighted the need for long-debated health system reforms. Apart from universal health coverage, the new General Healthcare System will reorganise the provision and financing of health services and grant greater autonomy to public hospitals.



4. DEFINITION OF TERRITORIAL PRIORITIES AT REGIONAL LEVEL

4.1 Knowledge production indicators and scientific production analysis by fields of Science

As part of step 1 from the Smart Specialisation Strategy methodology (*Guideline for Territorial Mapping WP2* - *Deliverable 2.1*), and regarding the analysis of the regional context and potential for innovation, this section entails the study of **Scientific and Technological specialisation** of the territory. The following analyses aim to build a profile of the current knowledge production in the regions using as a source of data, the scientific production in Cyprus, patents' creation, and the development of European projects.

Some of the requisites filled by the priorities defined in each territory are: 1) priority level should be smaller than whole sectors, but bigger than single activities for maximal effectiveness. 2) Priorities do not have to fit in one particular sector and can be connected to multiple sectors. This is important because often innovative concepts are formed from a diverse set of capabilities. 3) In respect to the importance of RRI and SDGs in today's society these priorities do not have to carry an economic value only 4) Stakeholders can formulate their societal visions for the future and collectively integrate these in their smart specialization priorities.

4.1.1 Scientific production in connection with Societal Grand Challenges (SGC) and World Health Organization (WHO) priorities

The chart below (Figure 6) depicts the average number of publications of each SGCs category associated to "Health" for the period 2012- 2016. The colours in the chart characterise the relation between Health categories from SGC and the World Health Organization (WHO) priorities. The data was obtained through KNOWMAK, a web-based tool, which provides interactive visualisations and indicators on knowledge co-creation in the European research area6. The analyzed period corresponds to publications from 2010 -2016.



Figure 6. Average number of publications (normalized by population) of each SGCs category associated to "Health" for the period 2012- 2016.

Considering the results of the Societal Grand Challenges with regard to knowledge production, the category with the major number of scientific articles is "**Disease prevention**". The results are aligned with the Health

⁶ <u>https://www.knowmak.eu/</u>



priorities established in the Smart Specialization report from 2014, where the emphasis was placed on early warning, diagnosis, and early medical care provision.

When analysing the publication content, was possible to identify **Oncology** in connection to **Nursing**, as an important topic developed in the publications and also with the highest scientific impact (number of citations). Additionally HIV, and Adolescent research appeared in the set of studied articles. In relation to the category Active Ageing, we found articles dealing with **Dementia** in the context of and Psychogeriatrics and the Nursing fields. The most cited article for this set is: *Caring for a relative with dementia: family caregiver burden*⁷.

4.1.2 Complexity and diversity indicators

Just as regions differ in size and wealth, they also vary in the diversity and complexity of their knowledge base. Especially large, metropolitan regions are capable of contributing to a wide range of fields (Nomaler *et al.*, 2014). Every region has its own, unique knowledge base. Regions specialize because of the cumulative and path-dependent character of scientific knowledge production (Heimeriks & Boschma, 2014). The opportunities to diversify into new fields are to a large extent dependent on the existing portfolio of related knowledge (i.e. the adjacent possible). From this perspective, it is clear that the **diversity of the knowledge base** can be considered an important indicator for further knowledge developments in regions. Diversity matters because regions are more likely to expand and diversify into new topics and fields that are closely related to their existing activities. Because the diversity of topics indicates a diversity of capabilities, the results confirm the idea that more diverse capabilities are important for producing complex knowledge.

The **complexity measure** looks to explain the knowledge produced in a region combining metrics of the diversity of regions and the **ubiquity** of the fields to create measures of the relative complexity of a region's scientific portfolio. Hausmann and Hidalgo (2009) developed a complexity measure based on the diversity of outputs within territories and the ubiquity (or range) of territories across which individual outputs can be produced. For further details of the methodology applied, please refer to Heimeriks, G., *et al.*, 2019.

The complexity of knowledge matters because it allows regions to produce idiosyncratic knowledge that few other regions can make. In analogy with the production of goods (Hausmann & Hidalgo, 2009; Hidalgo et al., 2007), it can be expected that sophisticated regions are capable of contributing to a large variety of 'exclusive' fields that few other regions can develop. The complexity of a region is embodied in the wide range of knowledge or capabilities that are combined to produce outputs: less ubiquitous outputs are more likely to require a greater variety of capabilities. We thus expect that these specialized (e.g. more complex) outputs tend to be produced at relatively few locations and often provide long-run competitive advantage.

Based on the data collected for publications (2018) and the measurement of the **Scientific diversity** and **Scientific Complexity** indicator, Cyprus shows values referring to the **Medium category**.

7

https://www.researchgate.net/publication/6386706 Caring for a relative with dementia Family caregiver burden



4.1.3 Definition of priorities using scientific relatedness analysis

In this section, we aim to communicate the main strength and capabilities already present in the region from the scientific perspective. The relatedness indicator measures the Revealed comparative advantage (RCA) by analysing the fields in which the region has an above-average concentration of publications. Likewise identify which scientific subfields are often found together in the same region, as a representation of the ability of the territory to diversify into related subfields.



Figure 7. Results of relatedness analysis depicting fields of science with a Revealed Comparative Advantage (RCA).

This analysis allows the formation of 2 Clusters and Cyprus has a scientific representation on **Engineering subfields and Life and Earth Science**, as can be seen by the dense area presented in the map below in red (Figure 7). The green cluster depicts fields from **Social Science and Humanities**. Also within the Biomedical and Health Science field, we recognize several scientific fields having a Revealed Comparative Advantage (RCA) such as: Genetics & Heredity, Audiology & Speech -language, Pediatrics, Psychology, Clinical and Applied, Biological. Some of these fields are at the interface of Social Science: Rehabilitation, Biomedical Social Science, Psychology (Clinical and Applied), Biological.



4.1.4 Analysis and characterization of priorities at micro-field level

The outcomes from this analysis provide a more detailed characterization of the fields already prioritized in the Relatedness analysis and eventually will reveal new micro-level fields that are relevant in respect to the level of specialization and knowledge production in the territory. The micro-level analysis method considers the use of a computer algorithm, where each publication is assigned to one of the 4013 fields based on a large-scale analysis of hundreds of millions of citation relations between publications. These micro-level fields are embedded into the five main fields of science, namely: *Social Science and Humanities, Mathematics and Computer Science, Biomedical and Health Science, Physical science and Engineering.* For further details please refer (Waltman & Van Eck, 2012). The tool to represent the results is Vosviewer, a software tool for constructing and visualizing bibliometric networks.

That being said, the following image (Figure 8) portrays the most relevant subfields in Cyprus. The colours represent the main fields of science and each circle symbolize a micro-level field, where the bigger the circle (node), the higher the number of publications produced in that specific micro-field or topic. As we aim to define how specialized the region is within a specific field, we used the relative number of publications, which takes into account the total number of publications produced in this subfield in the world from the CWTS internal database - Web of Science's (WoS) produced by Clarivate Analytics. The period of the analysis considers the years 2014 to 2018. A total of 10.179 publications were considered in the analysis including articles, reviews, and conference proceedings.



Figure 8. Results of the micro-level scientific field analysis using the relative number of publications for Cyprus.

The science map above (Figure 8) presents an overview of the micro-level fields arising as relevant from each main field (Social Science, Engineering, Health Science, etc.). In line with the Relatedness analysis (Figure 7), the region exhibits strengths related to Mathematics and Computer Science as well as Physics



science and engineering. The field **Physics**, **Particles**, **and fields** appear as highly relevant either in terms of specialization as in absolute terms (blue cluster).

When analyzing at a finer scale the fields emerging from Biomedical and Health Science (green color), we can see that **Nephrology**, **Cardiology**, **Pediatrics**, **Radiology** - **Nuclear Medicine** appear as prominent. Similarly, **Plant Science** in relation to Agriculture and Nutrition is shown as relevant.

Characterization of the most relevant fields from Biomedical and Health Science

The following image (Figure 9) characterizes the key subjects developed in the Biomedical and Health Science field. The outcomes are based on the previous micro-level field analysis (Figure 8). In order to obtain an enhanced level of detail of each one of these fields and understand the core topics published by the region, we selected the top 10 fields as the most representative at the regional level. This threshold can be extended if the interest of the region is to explore a larger set of scientific areas or fields.

From the chart below, the columns indicating the number of publications show two sets of data. On one side the *Relative number of publications*, to specify the level of specialization in each field and also the absolute number of publications in the field, to depict a full counting of the publications, disregarding the measurement of specialization. It should be noted that a higher degree of specialization should be accompanied by a minimum amount of scientific production. For this reason, we set a minimum threshold of 5 publications per field during the analyzed period (2014-2018). Fields with less than that were not considered in the analysis.

In methodological terms, the description of the fields represented below in Figure 9, considers the name of the most representative Journals where the region publishes, and the content of the publications by using the titles of articles contained in each micro-level field. For the ones having a larger set of publications, we used text mining techniques or term maps (Vosviewer software) to detect the core topics in the abstracts of the publications.



Biomedical and Health Science

Field of science - micro-level	Field description		
Nephrology	Nephropathy -Alport syndrome - Familial kidney disease		
Cardiac & Cardiovascular Systems	Epidardial obesity bariatric - adipose tissue - bariatric surgery & diabetes melitus		
Rehabilitation	Disability and rehabilitation - physical medicine		
Cardiac & Cardiovascular Systems	Cardiovascular interventions - myocardial bridging		
Peripheral Vascular Disease	Vascular and endovascular surgery - stroke - coronary artery disease - atherosclerotic carotid		
Public, Environmental & Occupational Health	Environmental health - climate change - heat-related nortality		
Public, Environmental & Occupational Health	Primary health care - public health sector		
Nursing	Caring studies -Oncology nursing care - mental health nursing		
Sport Sciences	Strength and conditioning research - applied physiology		
Radiology, Nuclear Medicine & Medical Imaging	ultrasound in medicine and biology - ultrasound contrast agent		
		0.000 0.005	0 10 20 30 40
		Relative num pubs	Absolute num pubs

Figure 9. Top 10 micro-level fields within Biomedical and Health Science. Values refer to the relative and the absolute number of publications for Cyprus..

All the represented fields above from the Biomedical and Health Science present a high level of specialization in Cyprus. The most specialized one refers to **Nephrology** in connection to the study of Alport syndrome. An outstanding performance considering both measurements: the level of specialization and the total number of scientific publications can be found in the **Peripheral vascular diseases & Nursing fields.**

4.2 Addressing territorial priorities raised by the regions

During communication with regional partners in Cyprus, the areas of interest are related to the **Ambient Assisted Living**, which is a sub-area of the Ambient Intelligence. It is an emerging multi-disciplinary field aiming at providing an ecosystem of different types of sensors, computers, mobile devices, wireless networks, and software applications for personal healthcare monitoring and telehealth systems. This concerns the use of ambient intelligent techniques to enable elderly people live independently for as long as possible.

At European level the **European programme AAL**⁸ is a funding activity aiming to create better living conditions for older adults with the help of technology, as well as to strengthen the international industrial opportunities in the area of information and communication technology (ICT). It carries out its mandate through funding cross-national projects (at least three countries involved) that involve small and medium

⁸ <u>www.aal-europe</u>



enterprises (SMEs), research bodies and end-user organisations (representing seniors). AAL projects are financed by the European Commission and the 18 countries that constitute the partner states of this joint initiative: Austria, Belgium, Cyprus, Hungary, Ireland, Israel, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

AAL provides an effective IoT platform governed by artificial intelligence algorithms, thereby satisfying the reliability metric in monitoring patient's health in their place of living safely. The AAL system includes activity monitoring of patients which is important for the patient suffering from Alzheimer's disease, bedsore, diabetes, and osteoarthritis.

4.2.1 Relevant publications and actors involved

If analyzed the knowledge production on this topic for the country, it was possible to find related content in the field of **Geriatrics and Gerontology and Neuroscience & Robotics**. It follows a selection of publications on the topic:

Table 2.Description of selected scientific publications corresponding to the Ambient Assisted Living priority.

Publications on Elderly and assisted living		
Publication title	Content description	Link
An Age Simulated Virtual Environment for	Several age-related effects are simulated in a	Link
Improving Elderly Wellbeing	Virtual Reality (VR) environment in order to allow	
	users to virtually experience life as an older	
	person.	
ICT Systems and Services for Ageing Well:	Assistive technologies from ICT to support	<u>Link</u>
Identification and Assessment of an Important	seniors stay active and independent	
Set (Package) of ICT Services for Active Ageing		
and Independent Living		
	It provides a robotic cloud ecosystem, able to	<u>Link</u>
A Robotic Cloud Ecosystem for Elderly Care and	support, encourage and engage the older	
Ageing Well: The GrowMeUp Approach.	persons to stay socially involved and longer	
	active and independent, in carrying out their daily	
	life at home.	
SocialRobot: An interactive mobile robot for	a state of the art mobile robot platform has been	<u>Link</u>
elderly home care.	integrated with virtual social care technology to	
	meet the elderly individual needs and	
	requirements, following a human-centered	
	approach.	
	It presents an architecture that is able to meet	Link
Computation and communication challenges to	several ethical and clinical requirements and	
deploy robots in assisted living environments	investigates the technical challenges introduced	
	by the approach.	
Analysis of Elderly Users' Preferences and	Empirical study, conducted in the scope of an EU	Link
Expectations on Service Robot's Personality,	– Horizon 2020 project, in order to explore	
Appearance and Interaction.	people's perceptions, attitudes and requirements	



	towards the idea of a future service robot for the home.	
Verification Methodology of Ethical Compliance for Users, Researchers and Developers of	It presents a proposal for a Verification Methodology for Ethical Compliance in robotic	<u>Link</u>
Personal Care Robots.	platforms development.	

The area of Ambient Assisted Living in Cyprus, considers the use of diverse technologies to support seniors to stay active and independent. It ranges from physical training, to maintain them emotionally and socially involved when carrying their daily life. A human-centered approach stand-out from the analyzed publications, addressing ethical and clinical requirements.

From the author affiliations of each one of the scientific articles, the majority of them were published by the company **CITARD Services Ltd**. (Nicosia, Cyprus) together with the **Department of Computer Science – University of Cyprus** (Nicosia, Cyprus). Only the paper called: "*Computation and communication challenges to deploy robots in assisted living environments*" was authored by **AVN Innovative Technology Solutions**, Cyprus.



4.3 Patents analysis by technological field and in the Health sector

It was analyzed the number of patents registered in Cyprus according to the classification of technological fields. The source of information is PATSAT - Worldwide Patent Statistical Database - EPO database 2020 Autumn edition. Patent statistics and bibliometric analysis are used as indicators of the inventive activity of the regions. This analysis considers only companies registering patents and not individuals, between the years 1980 and 2019 (4.462 patents).

In the figure below we observe that two of the categories related to the Health sector are within the top 10 positions. Computer technology, Pharmaceuticals, and Medical technology are the sectors with the highest number of registered inventions.



Figure 10. Number of patents per technological field in Cyprus between 1980 and 2019.



The next Figure depicts the Pharmaceutical sector as being the one with the higher number of patents in the Health sector for Cyprus. The total number of patents analyzed was 1.742.



Figure 11. Percentage of patents belonging to the three major groups linked to the Health sector.

The topics related to the patents for the Medical Technology sector encompass several inventions associated to **surgery instruments**, mostly sterilisation and ligation clips, catheter systems and electrosurgical vein strippers. It also stands out the use of bioanalogic intraocular lens, glasses for amblyopia treatment, method and **devices for optimizing the vision**. Likewise, we found a few patents dealing with respiratory devices, mostly inhalers. The patents from the pharmaceutical sector and biotechnology appeared to be related to the diagnosis and treatment of **Alzheimer's disease** and **cancer**. The former sector also registered patents concerning **Diabetes**, **atherosclerosis** and **cardiovascular disorders** and herbal therapy for the treatment of **skin conditions**.

It is worth noting that the high number of patents in Cyprus (compared to the other two regions), reflects the beneficial tax environment which is why many international companies deposit their patents in Cyprus. Many of these patents do not reflect the innovative activities in Cyprus.

4.4 European projects and territorial priorities

The goal of selecting the following projects is twofold; to identify projects and initiatives developed in Cyprus which relate to the main priorities stressed by the country as a result of the stakeholder engagement process and, secondly to build a potential assortment of initiatives that could serve as an innovation story for task 2.3 (Study of innovation biographies of health pilots).



We analysed the Active and Assisted Living (AAL) programme, which is a funding scheme that aims to create better quality of life for older people and to strengthen industrial opportunities in the field of healthy ageing technology and innovation. This, together with the Horizon 2020 funding programme supported the selection of seven projects around the Active and Assisted Living (AAL) priority manifested by Cyprus. The following table characterizes the initiatives.

Table 3. List of selected European projects connected to the Active and Assisted Living priority.

EU projects (AAL programme)					
Project Name	Name	Description	Period/ Duration	Organisation in Cyprus	
MedGUIDE	It helps seniors with adherence through networking.	n dementia with their medication smart pillboxes and social	2017 -2019	Materia Group – AgeCare	
SUCCESS	SUccessful Caregive Situation Support in o the users' knowledg interact with someone	er Communication and Everyday dementia care. The tool increases ge about dementia and how to e suffering from this disease.	2017 -2019	Citard Services Ltd. University of Cyprus	
CARU cares	CARU is a device between elderly peop	e that facilitates communication le, relatives and caregivers.		GeoImaging Ltd. Agecare (Cyprus) Ltd.	
<u>vINCI</u>	Develops an integrat loT framework to de support for older adu caregiving.	ed and validated evidence-based liver non-intrusive monitoring and lts to augment professional health	2018 – 2020	University of Nicosia Research Foundation	

EU projects (Horizon 2020)

Acronym	Name	Description	Period	Organisation
<u>RADIO</u>	Robots in assisted living environments: Unobtrusive, efficient, reliable and modular solutions for independent ageing	develop an integrated smart home/assistant robot system, to pursue a novel approach to acceptance and unobtrusiveness.	2015 / 2018	AVN innovative technology solutions limited
GATEKEEPER	Smart living homes – whole interventions	It aims to ensure healthier independent lives for the ageing populations. It will connect	2019 / 2023	Stegi Evgirias Archaggelos



	demonstrator for people at health and social risks	healthcare providers, businesses, entrepreneurs, elderly citizens and the communities they live in.		Michael Kaimaklioy
<u>AgeingatWork</u>	Smart, Personalized and Adaptive ICT Solutions for Active, Healthy and Productive Ageing with enhanced Workability	It will develop a novel ICT-based, personalized system to support ageing workers (aged 50+) into designing fit-for-purpose work environments and managing flexibly their evolving needs.	2019 -2021	Hit Hypertech Innovations Ltd.

There are several initiatives from the AAL programme involving the Cypriot territory. Almost all of the participant organizations pertain to the private sector with only one Higher Education Institution (HEI), the University of Nicosia Research Foundation.

5. IDENTIFICATION OF FINAL PRIORITIES IN THE REGION

Shaping the territorial dimension of future policies for sustainable growth requires understanding the territorial diversity – key challenges and development perspectives – of different places as well as formulating policy approaches and implementation tools that can help to maximise their development potentials. Each region has a unique perspective on global developments. In order to specify a place-based approach to smart specialisation in times of Grand societal challenges, locally and historically situated discourses and practices need to be taken into account for aligning research and society.

Our approach may assist policymakers in designing and implementing RIS3 strategies that not only promote smart (i.e. competitive) but also inclusive and sustainable regional economic development. By combining information on the relative strength of regional knowledge production activities (e.g. science and technology that is linked to global developments) with information about regional stakeholders, local needs and policies, we can thus specify priorities that can help to maximise the regional development potentials. As a result of the analyses conducted, the territorial priorities identified for the region are summarized below.

Considering the results of the Societal Grand Challenges with regard to the knowledge production the category with the major number of scientific articles is associated to "**Disease prevention**". The results are aligned with the Health priorities established in the Smart Specialization report from 2014, where the emphasis was placed on early warning, diagnosis, and early medical care provision. In addition, when analysing the publication content under this category, we identified **Oncology** in connection to **Nursing**, as an important topic developed in the publications, and also with the highest scientific impact based on the number of citations. Additionally HIV, and Adolescent research appeared in the set of studied articles. In



relation to the category Active Ageing, we found articles dealing with **Dementia** in the context of Psychogeriatrics and the Nursing fields.

Outcomes in reference to the Relatedness indicator positioned Cyprus with a scientific representation on **Engineering subfields**. If we look into the Biomedical and Health Science field, we recognize several scientific fields having a Revealed Comparative Advantage (RCA). Among them are **Genetics & Heredity**, **Audiology & Speech -language**, **Pediatrics**, Biological. Some of these fields are at the interface of Social Science: **Rehabilitation, Biomedical Social Science, Psychology (Clinical and Applied).** A complete visualization of the prioritized fields is represented in figure 7, showing the strengths and capabilities of the country.

The micro-level analysis of the scientific fields shows Cyprus' strengths related to the Mathematics and Computer Science, as well as Physics science and engineering fields. The area of expertise **Physics**, **Particles and fields** appears as highly relevant either in terms of specialization as in absolute terms. This is in line with the priotities seen from the Relatedness analysis. The analysis of the fields emerging from Biomedical and Health Science, portray as the most specialized area **Nephrology** in connection to the study of Alport syndrome. An outstanding performance considering both measurements: the level of specialization and the total number of scientific publications can be found in the **Peripheral vascular diseases** field (vascular and endovascular surgery) and **Nursing** field (nursing care -oncology nursing and mental health care).

In connection with the priority raised by the region, based on **Ambient Assisted Living**, the capabilities of the country are developed from the Geriatrics and Gerontology and Neuroscience & Robotics fields. The use of diverse technologies to support seniors stay active and independent ranges from physical training to maintain them emotionally and socially involved when carrying their daily life. A human-centered approach stand-out from the analyzed publications, addressing ethical and clinical requirements. From the author affiliations of each one of the scientific articles, the majority of them were published by the company CITARD Services Ltd. (Nicosia, Cyprus) together with the Department of Computer Science – University of Cyprus (Nicosia, Cyprus). Only the paper called: "Computation and communication challenges to deploy robots in assisted living environments" was authored by AVN Innovative Technology Solutions, Cyprus.

Patent analysis in Cyprus revealed a total of 4.462 patents across technological fields, where two of the categories related to the Health sector are within the top 10 positions. Computer technology, Pharmaceuticals and Medical technology are the fields with the highest number of registered inventions. The high number of patents (compared to the other two regions), however, reflects the beneficial tax environment which is why many international companies deposit their patents in Cyprus. These patents do not reflect the innovative activities in Cyprus. In this way the analysis of topics related to the patents needs to be taken carefully. That being said, for the Medical Technology sector, several inventions are associated with **surgery instruments**, mostly sterilisation and ligation clips, catheter systems, and electrosurgical vein strippers. It also stands out the use of bioanalogic intraocular lens, glasses for amblyopia treatment and the method and **devices for optimizing the vision**. Likewise, we found a few patents dealing with respiratory devices, mostly inhalers. The patents from the pharmaceutical sector and biotechnology appeared to be related to diagnosis and treatment of **Alzheimer's disease** and **cancer**. The former sector also registered patents concerning **Diabetes**, **atherosclerosis** and **cardiovascular disorders**, and herbal therapy for the treatment of **skin conditions**.



Skills and capabilities coming from the Nursing, Psychology and Rehabilitation field, defined as priorities by the knowledge production analysis, are considered useful to develop the pilot innovation in the context of Ambient Assisted Living. When analyzed this priority in terms of the EU projects we distinguished four initiatives funded by the (AAL) funding programme of the European Commission and three from Horizon 2020 projects. The projects involve topics such as Dementia and the improvement of communication among healthcare providers, businesses, entrepreneurs and elderly citizens. Almost all of the participant organizations pertain to the private sector with only one Higher Education Institution (HEI), the University of Nicosia Research Foundation.

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