SHIFT-HUB

D5.1

STAKEHOLDER MAPPING AND NEEDS

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Abstract

This deliverable includes a comprehensive analysis of the EU healthcare stakeholders' needs in the context of Non-Communicable Diseases (NCDs), including cardiovascular diseases, diabetes, cancer, mental health and prevention & management, that pose a significant global health challenge. Recognizing the diverse range of stakeholders involved, a needs assessment survey was conducted utilising a mixed-methods approach, both quantitative and qualitative data being collected to provide a nuanced understanding of the multifaceted needs within the NCD landscape.

The survey targeted a broad spectrum of healthcare stakeholders, including clinicians, policymakers, patients, researchers, and healthcare administrators.

The Deliverable also includes a description on the approach taken for stakeholders needs study and provides examples of the approach taken and that was applied in the cases of Porto, Cologne and Thessaloniki, each by respective partners UPORTO, UKOELN and AUTH. Relation to the project service offer that is part of WP3 is also covered as well as examples for three distinct cases namely A first level analysis and an example for stakeholders of Cardiovascular Innovation Ecosystems in Germany, and identification of medical ecosystems in the field of mental health diseases with Cologne as a central location and, following the same methodology as for the previous, an identification of medical ecosystems of cardiovascular diseases at the Cologne site.

The survey's outcomes underscored the interconnected nature of stakeholders' needs, emphasising the importance of a holistic and collaborative approach to address NCDs comprehensively. The findings from this study are instrumental in informing targeted interventions, policy development, and resource allocation strategies to meet the diverse and evolving needs within the healthcare landscape focused on NCD prevention and management.

Keywords

Prevention strategies; Health promotion; Lifestyle modification; Public awareness; Early screening; Cancer care; Early diagnosis; Treatment access; Health disparities; Patient-centric care; Hypertension; High cholesterol; Risk factors; Primary care; Early detection; Cardiac rehabilitation; Medication access; Continuous monitoring; Psychological support; Mental health awareness; Behavioural health; Destigmatization

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Interactions with other WPs	WP3 – SHIFT-HUB service offer; WP5/T5.2: Scouting EU digital health tech solutions and providers; WP5/ T5.3: Setting up a network of EU Partners; WP5/ T5.4: Creating focus groups.

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Abbreviations and Acronyms

Abbreviation, Acronym	Description
CDSS	Clinical Decision Support System
ECDC	European Centre for Disease Prevention and Control
EFSI	European Fund for Strategic Investments
EHDS	European Health Data Space
EHRs	Electronic Health Records
EIB	European Investment Bank
EIC	European Innovation Council
EIP on AHA	European Innovation Partnership on Active and Healthy Ageing
EIT	European Institute of Innovation and Technology
EMA	European Medicines Agency
ERC	European Research Council
ERN	European Reference Networks
ESF	European Social Fund
ESIF	European Structural and Investment Funds
EU	European Union
GBD	Global Burden of Disease Study
GDP	Gross Domestic Product
HADEA	European Health and Digital Executive Agency
HCWF	Health Care Work Force
IHME	The Institute for Health Metrics and Evaluation
IP	Intellectual Property
LMICs	Low- and middle-income countries
NCD	Non-Communicable Diseases

RPM	Remote Patient Monitoring
RTOs	Research and Technology Organizations
SME	Small and Medium-sized Enterprises
WHO	World Health Organisation
WP	Work Package

1 Introduction

Background

In recent years, the European Union (EU) has recognized the growing significance of addressing non-communicable diseases (NCDs) as a major public health challenge. Among the various NCDs, four prominent categories stand out as substantial contributors to the overall disease burden and healthcare costs in the EU: prevention, cancer, cardiovascular diseases, diabetes, and mental health. These health areas pose significant challenges that require comprehensive and nuanced responses, especially in the context of the diverse and dynamic EU member states.

The prevalence of these health conditions, along with the associated costs, has been steadily increasing in the EU. With ageing populations, urbanisation, and changing lifestyles, the region is confronted with higher incidences of NCDs, leading to a considerable societal and economic burden. It is against this backdrop that the EU, its member states, healthcare providers, and stakeholders have recognized the pressing need for a more proactive, targeted, and evidence-based approach to prevention and management.

Digital Health relevance

Digital health plays a pivotal role in mitigating the rising burden of non-communicable diseases (NCDs). Through digital health technologies such as apps and wearables that enable individuals to monitor their health status in real time and receive appropriate, personalised recommendations, solutions are provided that empower individuals to take control of their health, provide healthcare professionals with better tools for diagnosis and treatment, and enable proactive measures to prevent and treat NCDs.

Examples are:

- Remote patient monitoring (RPM), which enables healthcare providers to remotely monitor patients' vital signs and health data, which is valuable for the management of chronic conditions such as hypertension, diabetes and heart disease and ensures timely interventions when needed.
- Digital platforms that provide educational content on NCD risk factors, symptoms, prevention and management; personalised medicine and targeted interventions.
- Support for healthcare professionals through electronic health records (EHR) or clinical decision support systems (CDSS).
- Community and peer support in the form of online support groups using digital platforms that allow people with NCDs to connect with peers and share experiences to provide emotional and informational support.

By leveraging technology, significant strides are made in reducing the NCD burden and improving public health outcomes under various aspects, including bridging the gap between urban and rural regarding real-time access to health services as well as reducing socio-economic inequality.

In this context SHIFT-HUB aims to establish a pan-European Smart Health Innovation Hub bringing together a rich network of multidisciplinary stakeholders across the dimensions of the quadruple helix, with the mission to facilitate the development, promotion and fostering the uptake of Smart Health technologies and services as well as equitable access to health services.

Stakeholder Engagement

To address the multifaceted challenges posed by these health conditions, it is imperative to actively engage with relevant stakeholders. These stakeholders included are shown in the table 1, as below:

Stakeholder	Description
Patients/Citizens organisations	This includes organisations of patients, citizens (interested in digital/smart health developments)
Practitioners & Health Organisations	Health practitioners, public and private health organisations
Technology providers	Health Tech start-ups, SMEs, midcaps
Knowledge and infrastructure providers	RTOs, competence centres, technology parks, etc.
Innovation Intermediaries	This includes business support organisations like clusters, networks, incubators, accelerators, commerce chambers, (E)DIHs
Financial Intermediaries	This includes private investors (Business Angels, VCs, banks); institutional investors, regional development agencies
Public authorities	This includes public authorities like regional and national innovation/development agencies, ministries, governmental agencies/companies

Table 1: SHIFT-HUB's stakeholder table

Understanding and addressing the needs, concerns, and expectations of these stakeholders are fundamental to designing effective policies and interventions. In the same context, the new information acquired will help to shape and personalize the SHIFT-HUB service offers to promote and support EU healthcare stakeholders, through various services:

- "SHIFT-HUB provides easy access to high-quality information about Smart Health Solutions, helping patients and citizens to be aware of existing and upcoming Smart Health Solutions and to learn how to use them to their best personal needs."
- "SHIFT-HUB supports practitioners and Smart Health organisations to enhance the efficiency of their health systems. By providing insights into new and upcoming Smart Health solutions, we empower them to leverage cutting-edge technologies like Process Digitalization and Artificial Intelligence."
- "SHIFT-HUB will provide valuable resources to innovators, SMEs, and health enterprises including guidance on investors and financing sources, market insights, matchmaking and proof of concept."

- "By participating in the SHIFT-HUB community, knowledge and infrastructure providers can collaborate, exchange knowledge and expand their network. They have the possibility to showcase their expertise, gain visibility and have access to funding opportunities."
- "With the help of SHIFT-HUB innovation intermediaries have the chance to expand their network, incorporate value-added services to their overall support offerings, enhance expertise and knowledge and learn about new funding opportunities."
- "Financial intermediaries have the chance to contribute to the growth and development of innovative businesses, fostering economic growth within the community and capitalising on the potential returns."

  "Public authorities profit from SHIFT-HUB by being able to unlock the full potential of healthcare systems, adapt policies, and foster collaboration for responsible and efficient integration of innovative technologies and drive regional/national economic growth."

Purpose of the Report

The purpose of this report is to elucidate the needs, priorities, and recommendations expressed by EU stakeholders in the context of prevention, cancer, cardiovascular diseases, diabetes, and mental health. By systematically capturing and analysing their input, the report aims to provide valuable insights and recommendations that can inform evidence-based policies and practices.

It serves as a comprehensive resource for policymakers, healthcare professionals, digital technology providers to foster collaborative, demand-driven development and uptake of Smart Health solutions and all those involved in shaping the future of healthcare in the EU.

Scope of the Report

This report explores the key concerns, expectations, and needs of stakeholders in the mentioned health areas. It covers prevention strategies, early diagnosis, treatment access, health disparities, equitable care, lifestyle modification, destigmatization, access to mental health services, and other critical aspects. The report identifies common themes and cross-cutting issues that can guide more holistic and effective strategies for addressing NCDs in the EU.

Conclusion

This report is designed to contribute to a more informed and inclusive approach to tackling NCDs in the EU. By understanding and addressing the needs of stakeholders, new policies, systems and interventions can be developed that are more responsive, equitable, and ultimately more successful in preventing and managing these pressing health challenges.

2   Chapter 1: EU Health Stakeholders: General Historical Data

Historical data plays a crucial role in the current stakeholder needs analysis in the healthcare industry by providing a wealth of information that can be used for decision-making, strategic planning, and the development of effective interventions.

The European Commission launched in December 2021 the Healthier together – EU non-communicable diseases (NCD) initiative to support EU countries in identifying and implementing effective policies and actions to reduce the burden of major NCDs and improve citizens' health and well-being. The initiative covers the 2022-2027 period and includes 5 strands:

Figure 1: Healthier Together: five strands [4]

The five stands are:

- cardiovascular diseases;
- diabetes;
- chronic respiratory diseases;
- mental health and neurological disorders;
- health determinants /prevention.

All strands include a health equity dimension, thus supporting the reduction of health inequalities.
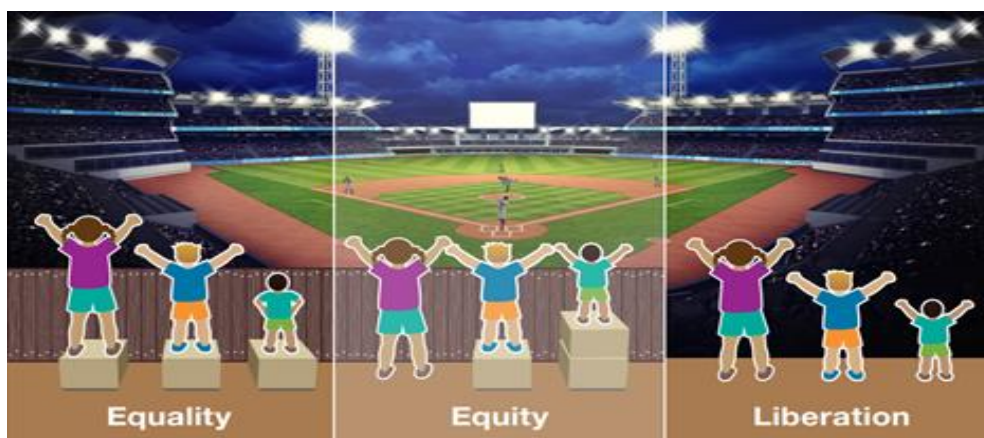
Figure 2: Healthier Together: Equality Equity Liberation [4]

Actions on cancer, which is also a major NCD, are covered in Europe's Beating Cancer Plan.

While the strands enable addressing particular challenges of each disease group, the initiative as such promotes a holistic and coordinated approach to prevention and care. It also supports better knowledge and data, screening and early detection, diagnosis and treatment management, and the improvement of quality of life for patients.

Collaboration and ongoing dialogue among healthcare stakeholders are key to advancing initiatives that positively impact public health.

2.1 Patients & Citizens organisations

NCD are caused by a combination of genetic, environmental and behavioural factors. NCDs are the leading cause of death and disability in the EU, accounting for nearly 90% of all deaths and 67% of premature deaths.
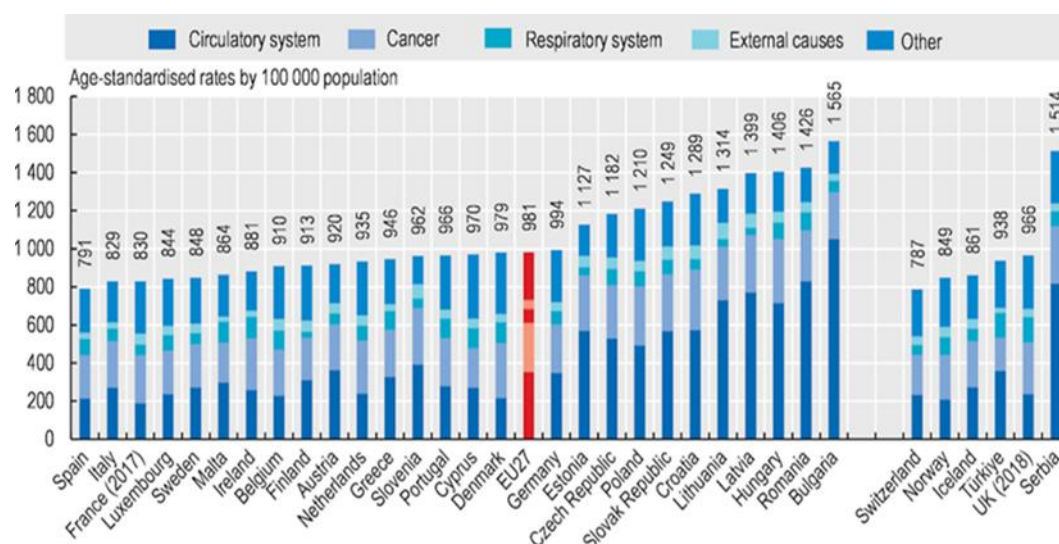
Note: External causes of death include accidents, suicides, homicides and other causes. The EU average is weighted (using 2017 data for France).

Figure 3: Main causes of mortality by country, 2019 (or nearest year). Source: Eurostat Database [4]

Patients of NCDs in the EU have various needs and expectations related to their health and well-being. Some of these needs are:

Access to timely, accurate, and affordable healthcare services regardless of their location, income, or social status;

Access to reliable, comprehensive, and user-friendly information and education on their conditions, prevention, management;

Access to innovative and effective digital health technologies and medicines;

Access to integrated and coordinated health and social care services, that take into account their individual needs, preferences, and co-morbidities, and that involve them in decision-making and self-management;

Access to supportive and inclusive environments, such as workplaces, schools, and communities, that respect their rights, dignity, and diversity, and that promote their participation and empowerment;

Access to meaningful and effective participation and representation in the design, implementation, and evaluation of health policies and programmes that affect them, and to have their voice heard and respected by health authorities and stakeholders.

Title	Description
The eHealth Stakeholder Group, relaunched in 2020, still ongoing	Group of experts providing advice and expertise to the Commission on the digital transformation of health and care in the EU.
Digital Health Europe, start date: 1 January 2019, end date: 30 September 2021	Project that provides comprehensive support to the Digital Health and Care Innovation initiative in the context of the Digital Single Market Strategy.
The map of the European digital health ecosystem Start date: 15 June 2022, End date, 14 June 2024, still ongoing	Platform that maps different types of European actors active in the eHealth sector.
The WHO European non-communicable disease dashboard, Start date: January 2022, still ongoing	Tool that provides data and indicators on the burden, risk factors, and policies of NCDs in the WHO European Region.

Table 2: EU initiatives regarding the needs of patients with NCDs

2.2   Practitioners & Health Organisations

The findings from the Global Burden of Disease Study (GBD) [5], published in The Lancet in October 15, 2020, reveal that Health systems are ill-prepared for rapid rise in non-communicable diseases and disabilities.

The top ten contributors to increasing health loss worldwide over the past 30 years, measured as the largest absolute increases in number of DALYs, include six causes that largely affect older adults—ischaemic heart disease (with numbers of related DALYs increasing by 50% between 1990 and 2019), diabetes (up 148%), stroke (32%), chronic kidney disease (93%), lung cancer (69%), and age-related hearing loss (83%). In addition, four causes are common from teenage years into old age—HIV/AIDS (128%), musculoskeletal disorders (129%), low back pain (47%), and depressive disorders (61%).

The country profiles according with The Institute for Health Metrics and Evaluation (IHME) show:
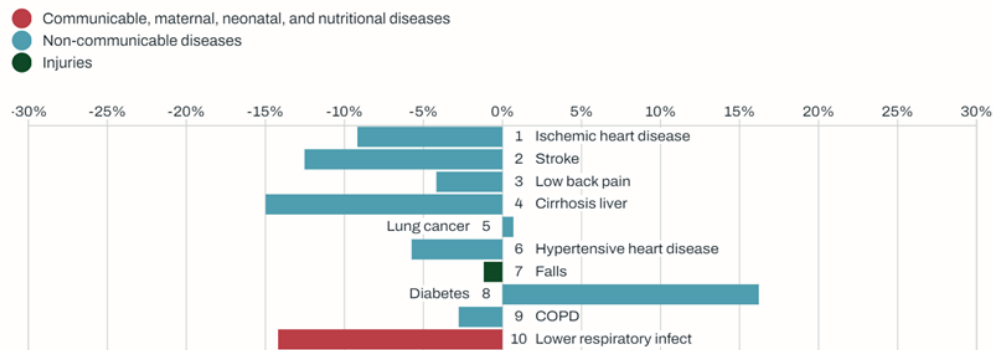
Figure 4: Romania: What causes the most death and disability combined? Top 10 causes of death and disability (DALYs) in 2019 and percent change 2009–2019, all ages combined [5]
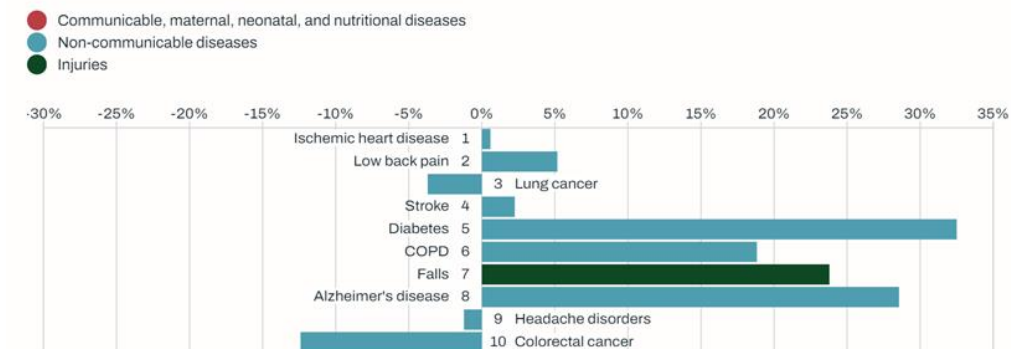
Figure 5: Germany: What causes the most death and disability combined? Top 10 causes of death and disability (DALYs) in 2019 and percent change 2009–2019, all ages combined [5]
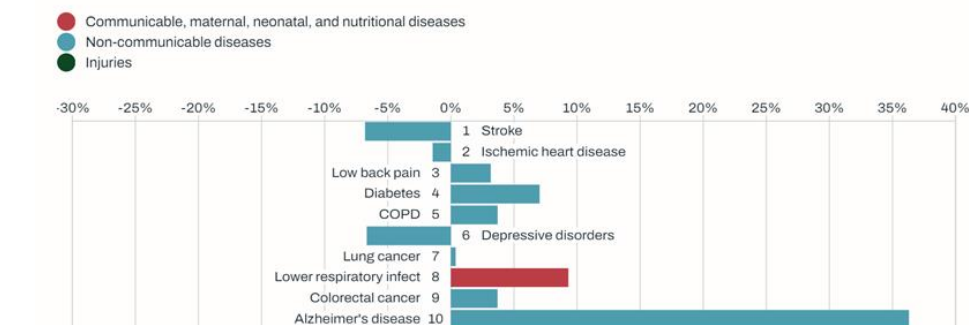
Figure 6: Portugal: What causes the most death and disability combined? Top 10 causes of death and disability (DALYs) in 2019 and percent change 2009–2019, all ages combined [5]

Profile of the HCWF (Health Care Work Force) in the WHO European Region according with the WHO European Region Report "Health and care workforce in Europe: time to act", September 2022:
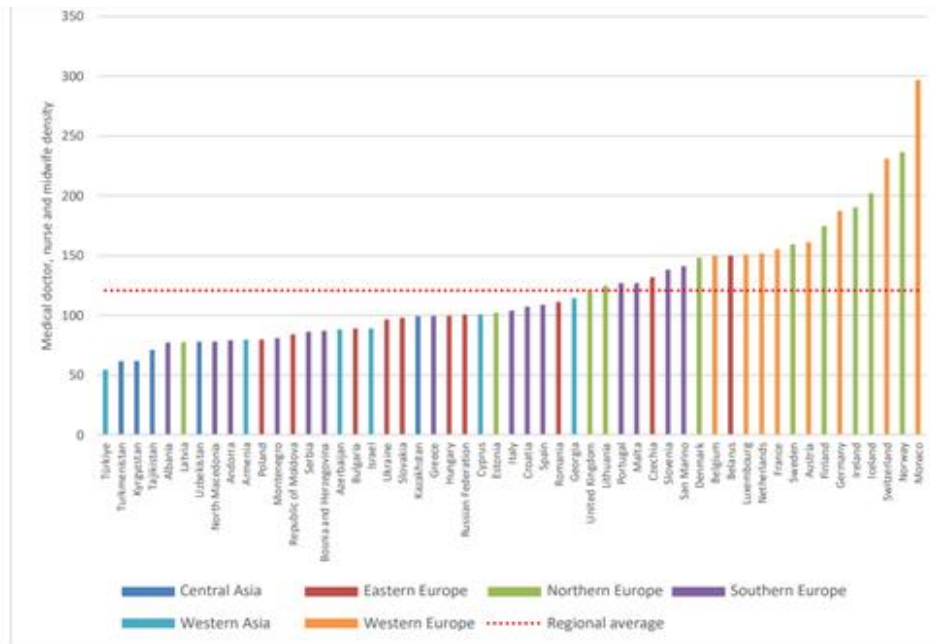
Figure 7: Health professional densities compared to regional averages, 2020 or latest year. Medical doctor, nurse and midwife total density compared to regional average of 121 per 10 000 population [5]

Overall, between 2010-2020, the HCWF of doctors, nurses and midwives decreased in Eastern Europe by 6%, while it grew in Western Europe by 26%, Southern Europe by 15% and Northern Europe with 12%.

Health practitioners and healthcare organisations in the European Union (EU) have diverse needs to deliver quality healthcare services, advance medical research, and address public health challenges. Main areas of focus and needs for practitioners and health organisations in the EU:

Healthcare Technology Integration: Practitioners and organisations need support in adopting and implementing health information systems, electronic health records (EHRs), telemedicine, and other digital health solutions.

Interoperability Standards: Establishing interoperability standards for health information systems.

Continuing Education and Training to healthcare professionals to stay updated on the latest medical advancements and best practices.

Patient-Centred Care Initiatives: Promoting patient-centred care requires a focus on patient engagement, shared decision-making, and communication. Organizations need resources to implement initiatives that enhance the patient experience and involve patients in their healthcare journey.

Data Privacy and Security Measures: With the increasing use of health data and digital health solutions, ensuring robust data privacy and security measures is critical.

Research Funding and Collaboration: Facilitating collaboration between healthcare providers, research institutions, and industry partners is essential to drive innovation and improve medical knowledge.

Access to Innovative Therapies and Treatments: Organizations need support in navigating regulatory processes, reimbursement mechanisms, and collaboration with pharmaceutical and medical device companies.

Mental Health Services Expansion: Healthcare organisations and practitioners require resources to increase mental health awareness, provide accessible services, and address the mental health challenges of the population.

Health Workforce Planning and Support: Organisations need support in workforce planning, creating a positive work environment, and implementing measures to support the well-being of healthcare professionals.

Chronic Disease Management Programs: This includes preventive measures, early detection, and comprehensive care for patients with chronic conditions.

Health Equity Initiatives: Organisations require support in developing and implementing initiatives that reduce inequalities in healthcare access and outcomes.

Innovative Funding Models: Exploring and implementing innovative funding models, such as value-based care, can help organisations align financial incentives with improved patient outcomes. Support is needed to transition from traditional fee-for-service models.

Public Health Campaigns: Organisations need resources for public health campaigns that focus on preventive measures, health promotion, and awareness. These campaigns contribute to community well-being and disease prevention.

Title	Description
Horizon Europe, 2021 - 2027, still ongoing	The EU's flagship research and innovation program for 2021-2027
European Reference Networks (ERNs), Start date: March 2017, still ongoing	Virtual networks that connect healthcare practitioners and experts across Europe to share knowledge and expertise on rare and complex diseases.
European Innovation Partnership on Active and Healthy Ageing (EIP on AHA), Start date: 2011, still ongoing	Brings together stakeholders, including healthcare practitioners and organisations, to promote innovative solutions for active and healthy ageing. It focuses on improving the quality of life for the ageing population through technological and organisational innovations
European Centre for Disease Prevention and Control (ECDC), Start date: 2005, still ongoing	ECDC supports the EU member states in the prevention and control of infectious diseases. It provides evidence-based guidance, facilitates collaboration, and strengthens the capacity of healthcare organisations and practitioners to respond to health threats.
EU4Health Program, 2021 - 2027, still ongoing	EU initiative focusing on strengthening health systems, improving the resilience of healthcare systems and addressing cross-border health threats. It

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	supports healthcare practitioners and organisations in enhancing public health preparedness and response.
Cross-Border Healthcare Directive, Start date: April 2011, and was transposed into the national legislation of the Member States by October 2013. The Directive has no expiry date as its aim is to improve patients' access to quality healthcare, to increase cooperation between EU health systems and to promote patient mobility within Europe	Facilitates patients' access to healthcare services in other EU member states. This initiative supports healthcare organisations and practitioners in providing cross-border healthcare and promotes collaboration between healthcare systems.
Joint Action on Health Workforce Planning and Forecasting, The project started in October 2012 and ended in June 2016	This joint action aims to improve health workforce planning and forecasting across EU member states. It supports healthcare organizations and practitioners in addressing workforce challenges, such as shortages and skills gaps.
EU Health Policy Platform, Start date: 2015, still ongoing	A collaborative forum for stakeholders, including healthcare practitioners and organisations. It facilitates the exchange of information, best practices, and collaboration to improve health outcomes and healthcare delivery.
European Medicines Agency (EMA), Start date: 2005, still ongoing	Agency for the authorization and supervision of medicines within the EU. It provides regulatory support to healthcare practitioners and organisations, ensuring the safety, efficacy, and quality of medicines.
European Observatory on Health Systems and Policies, Start date: 1998	Provides evidence and policy insights to support health systems across the EU. It offers resources and analyses that can inform decision-making for healthcare practitioners and organizations.

Table 3: The EU initiatives aimed at supporting healthcare practitioners and organisations

These initiatives contribute to creating a collaborative and innovative environment for healthcare practitioners and organisations in the EU. They focus on research, technology adoption, cross-border collaboration, and policy development to enhance the overall effectiveness and resilience of healthcare systems.

2.3 Technology Providers

According to a report by MedTech Europe, there are more than 35,000 medical technology companies in Europe, with the highest number of them based in Germany, followed by Italy, the UK, France, and Switzerland. Small and medium-sized companies (SMEs) make up around 95% of the medical technology industry, the majority of which employ less than 50 people.
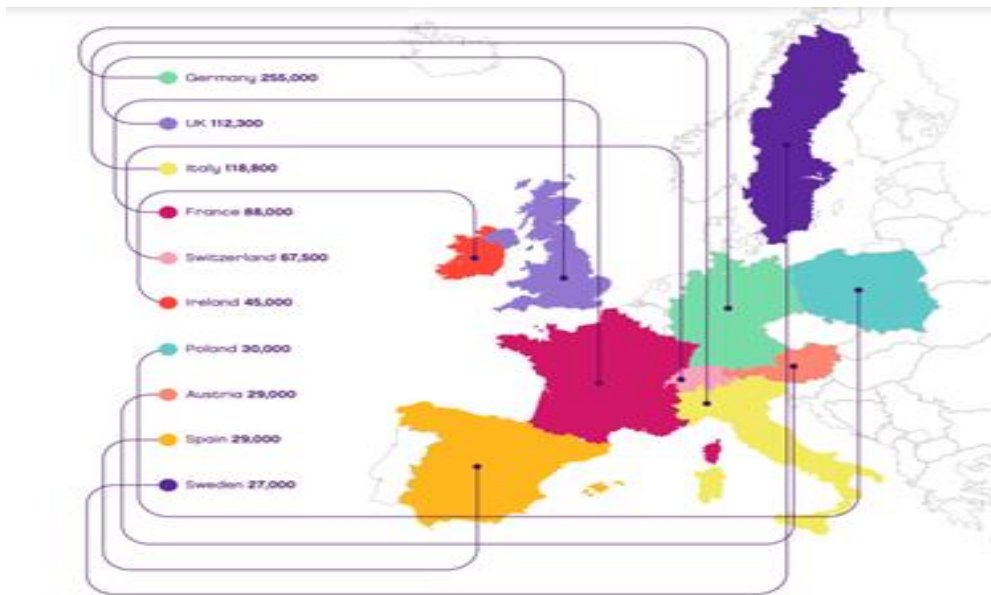
Figure 8: Top 10 countries in Europe with highest direct employment in the medical technology industry [6]

The SMEs in the EU tech sector, particularly those in the health industry, face several barriers that can impact their growth, innovation, and competitiveness. Here are some key barriers:

Regulatory Compliance Costs: The costs associated with obtaining certifications and meeting regulatory standards can be prohibitive.

Fragmented Regulatory Landscape: challenging for SMEs, particularly when seeking market access across multiple countries.

Access to Funding and Capital: Limited access to venture capital and challenges in obtaining loans or grants may hinder their ability to innovate and expand.

Limited Resources for Clinical Trials: Limited budgets and expertise can be obstacles for SMEs seeking to generate the evidence necessary for market acceptance.

Interoperability Challenges: Lack of standardised interoperability frameworks and data formats in healthcare systems can hinder the integration of tech solutions developed by SMEs.

Shortage of Skilled Workforce: Recruiting and retaining a skilled workforce with expertise in both technology and healthcare can be challenging for SMEs.
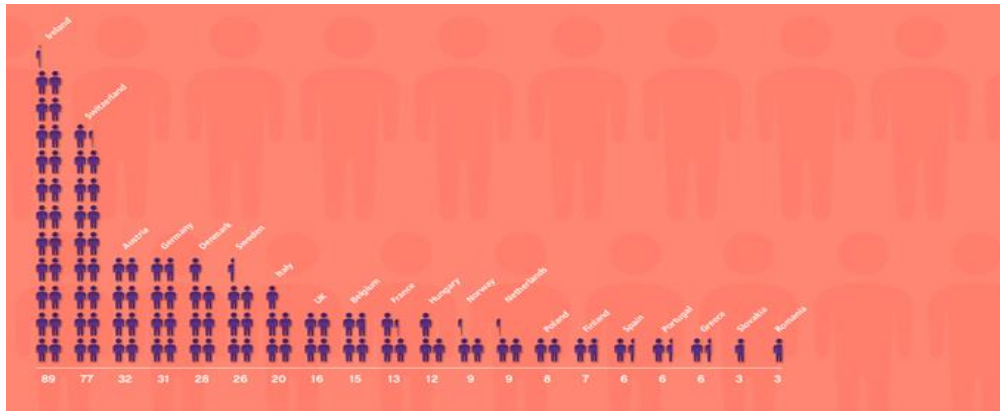
Figure 9: Number of people directly employed in the medical technology industry per 10,000 inhabitants [6]

Slow Adoption by Healthcare Providers: Healthcare providers may be slow to adopt new technologies, especially from smaller and less-established companies. Resistance to change and concerns about reliability and support may impede market penetration.

Data Privacy and Security Concerns such as GDPR, require robust security measures for health technologies. Ensuring compliance while maintaining cost-effectiveness can be challenging for SMEs.

Intellectual Property Protection: Protecting intellectual property is crucial for SMEs, but the cost and complexity of obtaining and defending patents can be prohibitive. This challenge may limit their ability to safeguard their innovations.

Figure 10: Evolution of European patent applications and granted patents by technical field 2022 [6]

Limited Marketing and Visibility: SMEs may struggle to establish a market presence and gain visibility among potential customers and investors. Limited marketing budgets and competition with larger enterprises can hinder brand recognition.

Risk Aversion and Lack of Awareness: Healthcare systems and professionals may be risk-averse when considering new technologies. SMEs may face challenges in raising awareness about their solutions and demonstrating their value.

To overcome these barriers, collaboration between policymakers, industry stakeholders, and SMEs is essential. Streamlining regulatory processes, providing targeted funding and support, and fostering a more innovation-friendly ecosystem can help promote the growth and success of tech SMEs in the EU health industry.

Title	Description
EU Helpdesk, Start date: 2004, still ongoing as "Access2Markets Platform"	Provides information on regulatory requirements, intellectual property rights, and market access for SMEs in the health sector Access2Markets Platform which provides SMEs with information on tariffs, taxes, and rules of origin for exporting to countries outside the EU.
Access2Markets Platform, Start date: October 2020, still ongoing	Platform that provides SMEs with information on tariffs, taxes, and rules of origin for exporting to countries outside the EU.
SETA Entrepreneurship Development Programmes, Start date: 12 June 2023, still ongoing	Provides training to individuals to start or grow their businesses
The SME Strategy for a Sustainable and Digital Europe, Start date: March 2020, still ongoing	Aims to reduce regulatory burden and improve market access for SMEs.

Table 4: The EU initiatives to support and promote small and medium-sized enterprises (SMEs)

Finally, the European Parliament has published a report that discusses the actions that the EU could take to properly tackle the challenges that SMEs are currently facing.

2.4 Knowledge and Infrastructure Providers

Research and Technology Organizations (RTOs), competence centres, and technology parks in the European Union (EU) face various barriers that can impact their mission to advance research, innovation, and technology transfer [8]. Here are some key barriers experienced by these entities in the EU:

Funding Challenges: Limited funding can hinder the ability of RTOs, competence centres, and technology parks to conduct research and provide necessary support to businesses and startups.

Bureaucratic Processes: lengthy administrative processes for obtaining grants and project approvals can slow down the pace of innovation.

Intellectual Property (IP) Management: RTOs and technology parks often need to navigate intricate legal frameworks and negotiate agreements with multiple stakeholders.

Collaboration and Coordination Challenges: Fostering collaboration among RTOs, competence centres, industry partners, and other stakeholders can be challenging. Aligning interests, sharing resources, and coordinating efforts require effective communication and collaboration mechanisms.

Access to Skilled Talent: A shortage of specialised talent, particularly in emerging fields, may limit the ability of RTOs and technology parks to fulfil their objectives.

Technology Transfer Barriers: Bridging the gap between research outcomes and commercialization can be challenging. It requires dedicated efforts and supportive ecosystems.

Regulatory Compliance: Compliance with regulations, particularly in fields like biotechnology and healthcare, can pose challenges.

Market Access for Startups & Sustainability and Scalability require connections with industry players and financial support.
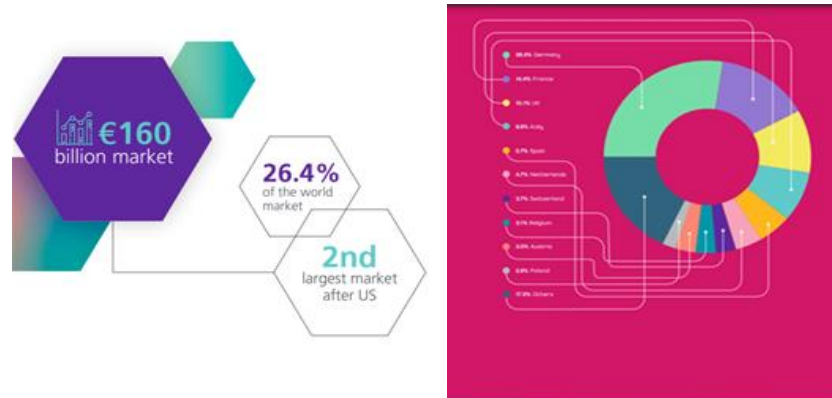
Figure 11: The 2022 European Medical Technology Industry Market in 2022 by country: The top five biggest markets are Germany, France, the United Kingdom, Italy, and Spain [9]

Infrastructure Limitations: Technology parks may face limitations in terms of infrastructure and facilities. Adequate spaces, laboratories, and equipment are essential for facilitating research and innovation activities.

Risk Aversion in Funding: Funding organisations and investors may exhibit risk aversion, particularly in supporting high-risk, high-reward projects. Encouraging a more risk-tolerant funding environment can foster innovation.

Title	Description
Horizon Europe, 2021 - 2027, still ongoing	It provides substantial funding for RTOs, competence centres, and technology parks, fostering collaborative research and innovation projects across member states.
European Institute of Innovation and Technology (EIT), Start date: 2008, still ongoing	It supports and funds the integration of higher education, research and business in innovation communities called Knowledge and Innovation Communities (KICs).
European Structural and Investment Funds (ESIF), 2021-2027, still ongoing	Includes various funds, such as the European Regional Development Fund (ERDF) and the Cohesion Fund, which aim to reduce regional disparities and promote innovation. These funds can be channelled to support RTOs and technology parks, especially in less developed regions.

Digital Europe Programme, Start date: May 2021, still ongoing	It focuses on accelerating the digital transformation of societies and economies. It supports projects related to artificial intelligence, high-performance computing, and digital skills, areas in which RTOs and technology parks play a crucial role.
European Innovation Council (EIC), Start date: March 2021, still ongoing	It supports high-risk, high-reward innovation projects, including those led by small and medium-sized enterprises (SMEs) and startups associated with technology parks. It provides funding, coaching, and networking opportunities.
European Research Council (ERC), Start date: 2007, still ongoing	RTOs and competence centres often benefit from ERC grants, contributing to the advancement of knowledge and innovation
COSME Program (Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises), It started in 2014 and was originally planned to end in 2020, but it has been extended until the end of 2023	Supports the competitiveness of SMEs, which are often involved in technology parks. Funding and support are provided for innovation and internationalisation efforts.
European Structural and Investment Funds (ESIF) - Thematic Objective 1: Research and Innovation, The implementation of the ESIF for the period 2014-2020 is still ongoing until the end of 2023	The objective is dedicated to research and innovation, supporting investments in RTOs, competence centres, and technology parks to enhance their research infrastructure and capabilities
European Structural and Investment Funds (ESIF) - Thematic Objective 2: Information and Communication Technologies (ICT) The implementation of the ESIF for the period 2014-2020 is still ongoing until the end of 2023	The objective focuses on investments in ICT infrastructure and technologies. RTOs and technology parks engaged in ICT research and development can benefit from funding under this objective.
EIT Digital, started in 2010 and is still ongoing	It focuses on digital innovation and supports activities that involve RTOs, competence centres, and technology parks to drive digital transformation

Table 5: The EU has implemented initiatives and programs to support Research and Technology Organizations (RTOs), competence centres, and technology parks

2.5 Innovation Intermediaries

In the context of healthcare innovation within the European Union (EU), innovation intermediaries play a vital role in facilitating the development and adoption of new technologies, processes, and solutions. These intermediaries bridge the gap between research, industry, and healthcare providers.
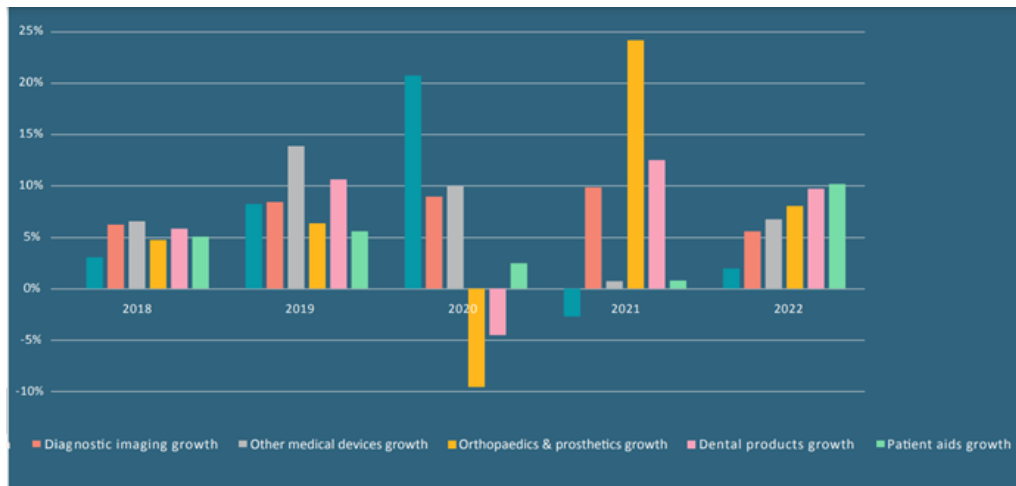
Figure 12: European medical technology growth rates by sectors 2018-2022 [9]

In addition to the typical challenges associated with the innovation process, key areas of focus and needs for innovation intermediaries in the EU healthcare sector:

Technology Transfer Support: This involves identifying promising technologies, supporting patenting processes, and connecting inventors with potential commercialization partners.

Collaboration and Networking Platforms to foster relationship among diverse stakeholders, including researchers, entrepreneurs, healthcare professionals, and industry players.

Clinical Validation Support: Supporting innovators in conducting clinical trials and obtaining relevant certifications by providing expertise, connections with clinical partners and guidance on regulatory compliance.

User-Centric Design and Patient Involvement: Encouraging user-centric design and involving patients in the innovation process is increasingly important. Innovation intermediaries should promote methodologies that prioritize the needs and experiences of end-users, including patients and healthcare professionals.

Investor Relations and Pitch Support: Assisting innovators in preparing for and engaging with investors is essential for securing funding. Innovation intermediaries can offer pitch support, investor matchmaking, and guidance on creating compelling business cases.

Ecosystem Coordination: Coordinating with other innovation ecosystem stakeholders, including research institutions, industry associations, and government agencies, is essential. Innovation intermediaries should act as connectors and facilitators within the broader innovation landscape.

Title	Description
Knowledge and Innovation Communities (KICs) of EIT, The first EIT-funded KICs were announced in 2009 and started their work in 2010, still under the 7th EU Research Framework Programme.	Each KIC under the EIT focuses on a specific thematic area, promoting collaboration among innovation intermediaries, businesses, and academic institutions. EIT Health, EIT Digital and other KICs contribute to fostering innovation ecosystems
European Network of Living Labs (ENoLL),	ENoLL is an international association that promotes the concept of Living Labs, real-world test and experimentation environments for co-creating

|	
It was founded in November 2006 under the Finnish Presidency of the Council of the European Union (EU) and is still ongoing.	innovative solutions. Living Labs can serve as intermediaries between research, industry, and end-users.
Horizon Europe, 2021 - 2027, still ongoing	It provides substantial funding for RTOs, competence centres, and technology parks, fostering collaborative research and innovation projects across member states
European Institute of Innovation and Technology (EIT), Start date: 2008, still ongoing	It supports and funds the integration of higher education, research and business in innovation communities called Knowledge and Innovation Communities (KICs).
European Structural and Investment Funds (ESIF) , The implementation of the ESIF for the period 2014-2020 is still ongoing until the end of 2023	Includes various funds, such as the European Regional Development Fund (ERDF) and the Cohesion Fund, which aim to reduce regional disparities and promote innovation. These funds can be channelled to support RTOs and technology parks, especially in less developed regions.
European Innovation Council (EIC), Start date: March 2021, still ongoing	It supports high-risk, high-reward innovation projects, including those led by small and medium-sized enterprises (SMEs) and startups associated with technology parks. It provides funding, coaching, and networking opportunities.
COSME Program (Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises), It started in 2014 and was originally planned to end in 2020, but it has been extended until the end of 2023	Supports the competitiveness of SMEs, which are often involved in technology parks. Funding and support are provided for innovation and internationalisation efforts.
European Structural and Investment Funds (ESIF) - Thematic Objective 1: Research and Innovation, The implementation of the ESIF for the period 2014-2020 is still ongoing until the end of 2023	The objective is dedicated to research and innovation, supporting investments in RTOs, competence centres, and technology parks to enhance their research infrastructure and capabilities
European Structural and Investment Funds (ESIF) - Thematic Objective 2: Information and Communication Technologies (ICT), The implementation of the ESIF for the period 2014-2020 is still ongoing until the end of 2023	The objective focuses on investments in ICT infrastructure and technologies. RTOs and technology parks engaged in ICT research and development can benefit from funding under this objective.
EIT Digital, started in 2010 and is still ongoing	It focuses on digital innovation and supports activities that involve RTOs, competence centres, and technology parks to drive digital transformation

Table 6: The EU initiatives aimed at supporting innovation intermediaries

These initiatives collectively contribute to creating a supportive ecosystem for innovation intermediaries, fostering collaboration, funding opportunities, and the development of innovative solutions in various sectors, including healthcare. Intermediaries can leverage these programs to enhance their capabilities and support the successful translation of research and innovation into tangible outcomes.

2.6   Financial Intermediaries

In Europe, an average of approximately 11% of gross domestic product (GDP) is spent on healthcare. Of this figure, around 7.6% is attributed to medical technologies, i.e. less than 1% of GDP. The spending on medical technology is estimated to vary significantly across European

countries, ranging from around 5% to 12% of the total healthcare expenditure. Expenditure on medical technology per capita in Europe is at around €312.
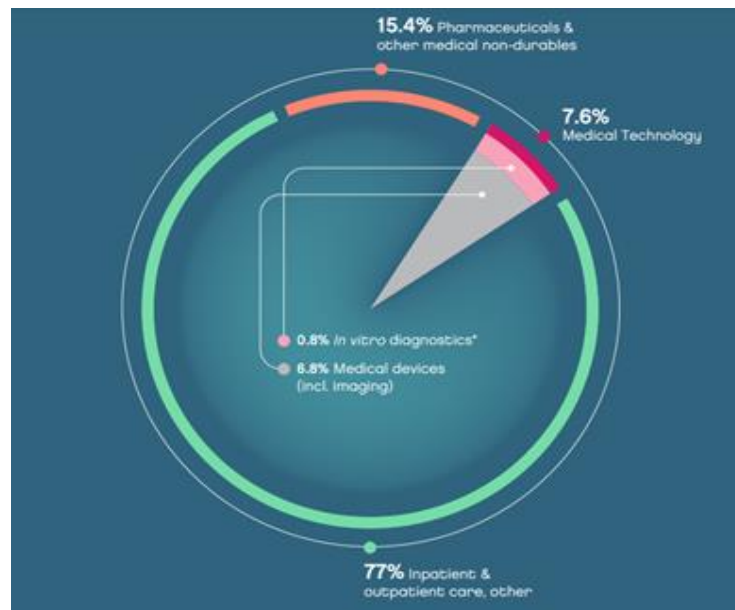
Figure 13: Expenditure on Medical Technology-2023 [10]

Total revenue for MedTech, as growth fell from a post-pandemic high, reached in 2022 the lowest level since 2015. This slowing trend continued into the first half of 2023. This continuation of 2022's pattern suggests that the industry's strong performance in 2021 could be an outlier; a one-time post-COVID-19 correction rather than a return to the trajectory of the period from 2000 to 2007, when MedTech averaged 15% annual revenue growth rather than the 5% average seen from 2008 to 2020.

Financial intermediaries in the digital healthcare industry within the European Union (EU) face several barriers and have specific needs that impact their role in supporting innovation and development.

Barriers: Regulatory Complexity; Risk and Uncertainty regarding the adoption and scalability of innovative technologies; Data Privacy Concerns.

Long Development Cycles, including research, testing, and regulatory approval; Fragmented Digital Health Ecosystem with a multitude of stakeholders; Technological Innovation Pace characterised by rapid advancements in technology that requires continuous updates on emerging trends and innovations; Market Fragmentation with different healthcare systems and regulations across member states.

Needs: Specialized Expertise in various fields; Risk Mitigation Strategies; Collaborative Ecosystem Building in creating networks, connecting startups with healthcare providers and fostering partnerships that enhance innovation; Flexible Funding Models that align with the unique development cycles of digital health innovation; Governance and Compliance Support.

Financial intermediaries should actively support innovation in digital health infrastructure, including telemedicine platforms, health information exchanges, and data interoperability solutions. Investing in foundational digital health infrastructure is crucial for the industry's advancement.

EU initiatives that have a significant impact on financial intermediaries operating in the healthcare field:

- Horizon Europe;

- European Structural and Investment Funds (ESIF);

- European Innovation Council (EIC);

- Digital Europe Programme;

- European Investment Bank (EIB): Financial intermediaries can collaborate with the EIB to access funding for healthcare infrastructure, research, and innovation;

- European Fund for Strategic Investments (EFSI);

- European Social Fund (ESF);

- European Health Data Space (EHDS);

- EU Green Deal is a comprehensive initiative addressing environmental sustainability.

While these initiatives may not explicitly target financial intermediaries, they create an enabling environment for financial support and collaboration in the healthcare sector. Financial intermediaries can explore collaboration opportunities, funding mechanisms, and partnerships within the frameworks established by these EU initiatives.

2.7 Public Authorities

The findings from the Global Burden of Disease Study (GBD), published in The Lancet in October 15, 2020, reveal that over the past decade, global progress on health has been uneven. Low- and middle-income countries (LMICs) have made impressive gains in health, largely as a result of successful efforts against infectious, maternal, and neonatal diseases. In contrast, improvements in health have started to stagnate in most higher-income countries, and have even reversed in several countries, particularly the USA.
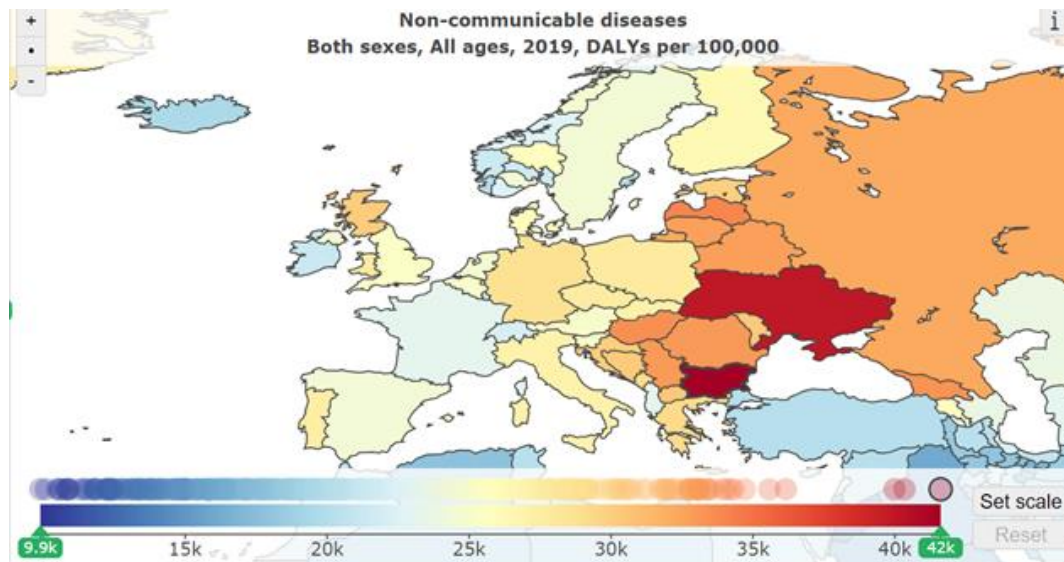
Figure 14: NCD status in Europe in 2019 [35]

With the rapid ageing global population, demands on health services to deal with disabling outcomes and chronic conditions, which increase with age, request greater levels of funding, strong political commitment, accountability supported by better data, and a coordinated global effort that prioritises the most vulnerable.
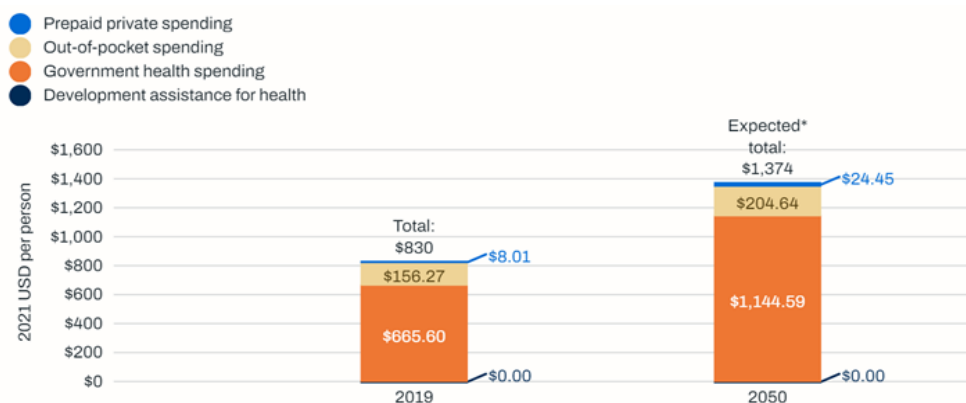
Figure 15: Romania: How much is spent on health – now, and in the future – and from which sources? [35]
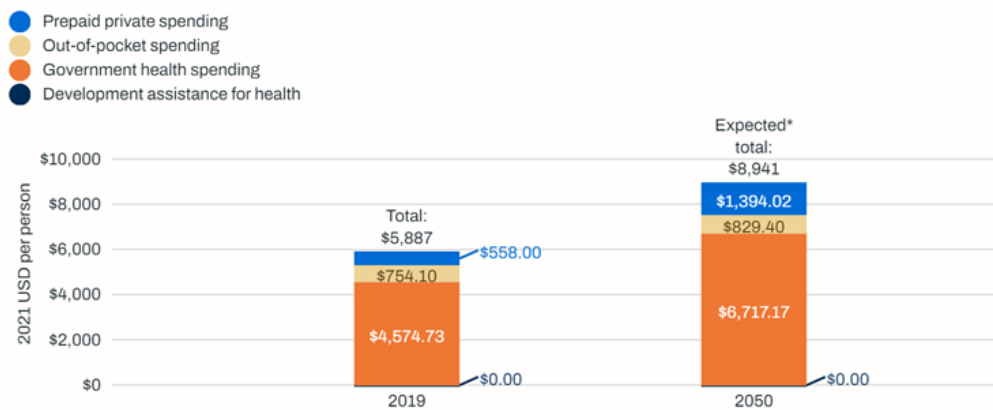
Figure 16: Germany: How much is spent on health – now, and in the future – and from which sources? [35]

Figure 17: Portugal: How much is spent on health – now, and in the future – and from which sources? [35]

Public authorities in the European Union (EU) play a vital role in shaping and regulating the healthcare sector to ensure the delivery of high-quality, accessible, and efficient healthcare services. Main areas of focus and needs for EU public authorities in healthcare [37]:

Healthcare Infrastructure Investment: Public authorities need to invest in and maintain robust healthcare infrastructure, including hospitals, clinics, and healthcare facilities.

Healthcare Workforce Planning to address issues such as workforce shortages, training programs, and creating a supportive work environment to ensure the delivery of quality care.

Health Information Systems and Digital Health: Public authorities need to invest in health information systems and digital health technologies to enhance healthcare delivery, improve patient outcomes, and facilitate data-driven decision-making, interoperability and data security.

Preventive Health Programs that focus on preventive health measures to reduce the burden of diseases.

Healthcare Innovation and Research: Public authorities can fund research initiatives, promote collaboration between research institutions and the industry, and facilitate the translation of research into practical applications.

Healthcare Accessibility and Equity to address disparities in healthcare access, taking into account geographical, socioeconomic, and demographic factors.

Regulatory Frameworks: Public authorities must adapt regulations to technological advancements, while safeguarding patient rights and data privacy.

Emergency Preparedness and Response to develop and implement effective emergency preparedness and response plans. This includes strategies for managing public health crises, natural disasters, and pandemics, as demonstrated by the COVID-19 pandemic.

Mental Health Services: Public authorities should invest in mental health services, reduce stigma, and integrate mental health support into overall healthcare strategies.

Patient Empowerment and Engagement to promote patient-centred care by empowering patients to actively participate in their healthcare decisions. This involves improving health literacy, providing accessible information, and fostering shared decision-making.

E-health and Telemedicine: Promoting the adoption of e-health and telemedicine solutions to improve healthcare accessibility, particularly in remote areas.

Data Governance and Interoperability: Establishing clear data governance frameworks and ensuring interoperability of health data systems. Public authorities need to balance the sharing of health data for improved care with privacy and security concerns.

Public Health Education and Awareness: Public authorities should invest in public health education and awareness campaigns to promote healthy behaviours, preventive measures, and awareness of available healthcare services.

Addressing these needs requires a collaborative approach involving public health officials, policymakers, healthcare professionals, researchers, and the broader community. Effective governance, strategic planning, and ongoing adaptation to emerging challenges are key elements in meeting the diverse needs of public authorities in the EU healthcare sector.

Title	Description
European Medicines Agency (EMA), Start date: 2005, still ongoing	The EMA is responsible for the scientific evaluation, supervision, and safety monitoring of medicines in the EU. It provides essential information to policymakers and administrators, guiding regulatory decisions related to the approval and monitoring of pharmaceuticals.
European Health Data Space (EHDS), The EHDS was launched by the European Commission on 3 May 2022, as part of the European Health Union	The EHDS is an initiative aimed at creating a single market for health data within the EU. It focuses on improving access to and sharing of health data, which can be valuable for policymakers and administrators in making informed decisions, shaping health policies, and addressing public health challenges.
European Reference Networks (ERNs), Start date: March 2017, still ongoing	ERNs are virtual networks that connect healthcare professionals and centres of expertise across EU member states.
Digital Health Initiatives, Some examples of Digital Health Initiatives are: The Global Strategy on Digital Health 2020-2025, The Global Initiative on Digital Health, which is a new programme	The EU has been actively promoting digital health initiatives to harness the potential of technology in healthcare. This includes efforts to facilitate the exchange of electronic health records, promote

launched by the WHO in 2023, The Digital Health Programme - It is part of the Digital Europe Programme, which was launched in 2021 and is still ongoing. The eHealth Network, which is a voluntary network of national authorities responsible for eHealth in the EU - It was established in 2011 and is still ongoing.	telemedicine, and enhance interoperability of digital health solutions. These initiatives aim to support administrators in adopting and implementing digital tools for better healthcare delivery.

Table 7: The EU initiative to support public authorities

3   Chapter 2: Identification and characteristics of Smart Health Ecosystems in Europe

3.1   Methodology

In addition to attempting to establish institutional collaborations from within the SHIFT-HUB modalities namely the project network, the project community and the project platform, we shall seek to and continue to engage with key stakeholders such as health service providers, research organisations, patients, regulators, SMEs, etc. More specifically, in the context of WP5 a taxonomy of stakeholders has been developed which includes the entities presented in Table 1 the project stakeholders.

It is easy to see the role and importance for coming up with a good roadmap of stakeholders from all the aforementioned categories that will be applied for all the five pathologies we support throughout the project lifetime, namely (1) Chronic diseases (in general), (2) Cancer, (3) Disease Prevention, (4) Cardiovascular diseases, and (5) Mental disorders.

To this aim, one may see that the service offer from our side as a consortium is to 'translate' health research and innovation that comes from the 'supply side' namely clinical researchers, healthcare professionals and medical experts into tangible benefits for the 'demand side' namely patients by enabling the faster development of people-centred, safe, effective, cost-effective and affordable smart health solutions that respond to currently unmet health needs. And it is again to this aim that it is essential to involve all stakeholders including patients in the co-design, co-development and co-implementation of those innovative solutions.

The modalities we shall be deploying in the project in terms of Open Innovation Workshops, Demo Days, Living Labs are to guarantee that such a needs-driven and patient-centric approach will be promoted and that we shall especially encourage different stakeholders to work in partnership with patients wherever possible.

Patients play an important role when designing and implementing smart health solutions, as demonstrated by partner COPAC who is representing their needs and perspective in the SHIFT-HUB consortium, alongside researchers from the public and private sectors such as partners AUTH, PORTO and UKOELN. It is for this reason that we strive to embed both the supply and the demand side perspectives at all levels, from agenda setting for research in medical innovation and funding opportunities assessment and application / proposal preparation processes.

The role of companies to this, with an emphasis to SMEs and / or start-ups is important as they can help bring the latest innovations to the market, leading to tangible benefits for patients as well as the society at large. Though not necessarily part of our mission in the project, a side effect from the implementation of SHIFT-HUB will be to enhance the innovation capabilities and performance of SMEs by promoting their involvement in future multi-stakeholder projects and ventures.

All collected stakeholders are presented in the Annex part of this Deliverable.

Furthermore, in the SHIFT-HUB project we have committed to focus not on innovation ecosystems in general but paying attention and with a specialisation to what we decided internally within the consortium and clustered as the five aforementioned pathologies.

However, in practice there is no such thing as a e.g. 'cardiovascular diseases' ecosystem or 'cardiovascular pathologies ecosystem' *as a discrete entity*. In its place, one may instead of a single tree see a dense 'forest' of innovations, some of which may have led to successful deployments and applications, while some other offerings seem like reaching a kind of dead-end or still waiting to find a successful match with a need that has yet not been identified or discovered. An example will help us understand the point here.

Transcatheter aortic valve implantation (hereafter referred to as TAVI) is considered nowadays as a common procedure for the replacement of the aortic valve of the heart through the blood vessels. It is considered as an alternative option to the widely used valve replacement by open heart surgery.

However, as an option it is recommended to patients who are seen as rather high risk for open heart surgery, where there is, as expected in medical procedures, a quite more complex path that leads to the decision which option to go for, and one of the important factors to take into account is the patient themselves. It is worth to notice that until about 2017 it was *not* routinely recommended for low-risk patients in favour of surgical aortic valve replacement (i.e. open heart surgery), however this has been increasingly offered to intermediate risk patients, based on studies finding that it is not inferior to surgical aortic valve replacement (Reardon, 2017).

What one may miss is to see the bigger picture (or the 'forest' we mentioned above): to come to TAVI, there have been an unimaginable rich amount of advancements and numerous innovations, all of them grounded on thorough clinical research and studies undergone, in cardiac catheterization that have, eventually, permitted replacement of heart valves by means of blood vessels, to allow valve replacement without open heart surgery. And especially in regard to the TAVI procedure, the valve delivery system which we can regard as a 'device' is now implanted without open heart surgery by being inserted into the body using a catheter-based delivery system (Ruparelia, 2016).

The key message to take is that innovation ecosystems are more complex than one might like to think and they need to allow for a multifaceted approach to represent the various stakeholders involved – both the ones that are already part of such an ecosystem as well as the ones that will need to be invited or involved in the future. The temporal aspect and the inherent need to reflect evolutions in their structure and organisation are also a prerequisite. To this aim we promote the idea of adopting lean schemas for the service offer that shall take place in such innovation ecosystems, as the ones we described in the paper.

Future work in the project shall provide us with specific use cases which we shall then have the opportunity to validate in terms of reality checks with the acquired data from each different stakeholders' community and pathology studied.

3.2 Identifying expectations and views of stakeholders regarding the SHIFT-HUB service offer

As part of the SHIFT-HUB consortium meeting held in Stuttgart on 30 and 31 March 2023, we have organised during the second day a workshop to identify and explore issues related to the nature of the project offerings and innovations with respect to our aim of building and operating a smart health innovation and technologies Hub - in the following we refer only to the 'Hub'.

Below we present some background information about the project context and then we present the results.

Dating back to its origins in 1980s of the corporate stakeholder theory [Freeman, 2010], it is now widely used to refer to 'stakeholders' in a variety of contexts and application fields, as it provides expressive power and the means to:

1. Identify and describe all interested and affected parties in the deployment of a technology;
2. Acknowledge stakeholders have legitimate interests in technology;
3. Affirm that all stakeholders have intrinsic value, even if their concerns do not align with the concerns of the technology producers;
4. Identify the responsibilities of parties with relation to a given process [Donaldson, 1995].

3.2.1 Why narratives?

Market and stakeholder needs analysis is crucial for the successful project implementation and achievement of our objectives. For this reason, we preferred to avoid building it based on the results of desk research and supported a more hands-on approach that gave emphasis to acquire narratives directly from the field and practitioners and conveying all acquired information in suitable epics and user stories.

The aim of SHIFT-HUB is to establish a pan-European Smart Health Innovation Hub bringing together a rich network of multidisciplinary stakeholders across the dimensions of the quadruple helix [Farinha, 2012], with the mission to facilitate the development, ensure the promotion and foster the uptake of Smart Health technologies and services.
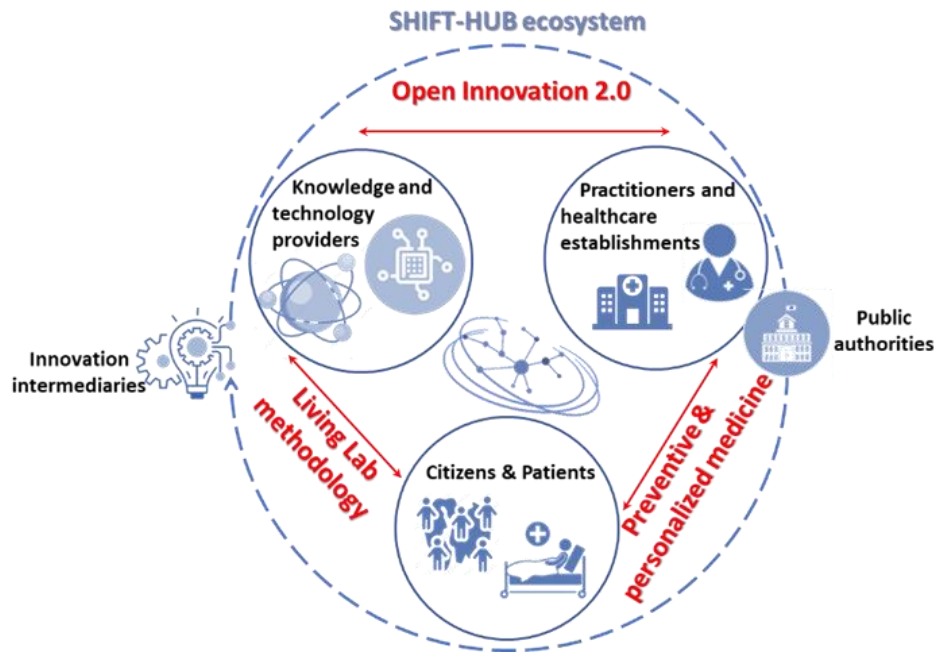
Figure 18: The SHIFT-HUB ecosystem with the quadruple helix interactions

As Donaldson and Preston identified in their seminal paper, '[T]he stakeholder theory has been advanced and justified in the management literature on the basis of its descriptive accuracy, instrumental power, and normative validity. These three aspects of the theory, although interrelated, are quite distinct; they involve different types of evidence and argument and have different implications [Donaldson, 1995]. It is exactly for this reason that we promoted the case of posing importance to the notion of stories.

The above is coherent also with the aims of the SHIFT-HUB project, according to which by putting a strong community of emerging digital technologies providers, and with the support of practitioners and the healthcare institutions they represent, at the service of patients and citizens, SHIFT-HUB may contribute to better coordination and stronger cooperation among the various public and private stakeholders of the Health and Care ecosystems, not only in each member country but also at the pan-European level as a whole.

We consider that the approach we promote is very close to the core first thesis of the aforementioned paper of Donaldson and Preston according to which '[t]he stakeholder theory is unarguably descriptive' and presents abstractions and models that can be 'tested for descriptive accuracy' and which can 'also serve as a framework for testing any empirical claims'.

With respect to SHIFT-HUB the central underlying element relates to ecosystems that address technology development and experimentation that will result in patient-centric and community-driven pilots, offering secure access to anonymized data for application development and paving the way toward the future federated European Health Data Space.

3.2.2 The relevance of new business models in the emerging European Health Data Space

Developing new and innovative business models will become important to achieve growth and sustainability in the European Health Data Space (EHDS).

The European Commission's proposal for a regulation on a European Health Data Space aims to improve individuals' access to and control of their electronic personal data (primary use), while facilitating data re-use for societal good across the EU (secondary use). Grounded in the EU data strategy, which mentions health as one of the nine European common data spaces, it cuts across several other EU policy priorities, such as the health union and the digital single market.

The proposal establishes a set of rules, infrastructure and governance mechanisms to promote both primary and secondary uses of electronic health data, while ensuring data protection and strengthening cybersecurity.

From an infrastructures' perspective, to link and explore fragmented data of different types, disease areas and provenance which are scattered in repositories and databases across Europe requires, apart from a solid governance, also clear and non-conventional business models for data ingestion and exploitation by public and private organizations.

3.2.3 Stories shall lead to novel model business blueprints

In the light of the above a major challenge for the SHIFT-HUB project will be to develop business model blueprints that we discuss and validate as part of workshop series at the mid and before the end of the project.

At the first phase members of the consortium will participate only in these workshops; at a second phase external actors and stakeholders will be included.

Again, strategic design and market research methods like Kano modelling for user acceptance may be used in order to come up with optimal business models. Ethical, Legal, Social Implications (ELSI) aspects, as well as future and emerging trends at social, business and policy level need to be taken into account. Especially for the ethical use of the system this is expected to play a central role in defining the business model blueprints. Results will be presented as part of the 'Stakeholders mapping and needs' in Deliverable 5.1 and situated with existing healthcare and health tech research and innovation ecosystems.

3.2.4 Questions set to facilitate the narratives collection

[Kavvadia 2022] states that '[t]o understand the organization as a functioning whole, in interac-tion with its context, at the specific points in time corresponding to the crafted business models. In other words, what were the primary objectives and resources, and how have they been used to achieve the organizational objectives and assess the de-gree to and ways in which the objectives have been achieved? Further, who were the primary actors and stakeholders, and what was their role? What was the interaction with the organization with its con-text, and how did the context shape organizational agency? In the event that the research question concerns a specific organizational activity, the busi-ness model can alternatively allow the focus to be on the relevant aspects of the particular organizational activity through refinement to increase the level of detail to the desired level, matching the research needs.' (p. 105)

We have below identified a set of (open answer) questions that come from the literature and which we used as part of our preparation for the first workshop within the consortium to identify some primary patterns:

Nr.	Question	Sources
1.	Which factors determine the business models of organizations operating in a smart health data ecosystem?	[D'Hauwers, 2022]
2.	How are the business model of real-world data ecosystems constructed?	[D'Hauwers, 2022]
3.	How do organizations retain control over their data and design governance in in-ter-organizational relationships while deconstruct-ing data silos?	[Abraham, 2019]
4.	How are value and trust created in data collaborations?	[Abraham, 2019]
5.	How can companies propose, create, deliver, and capture value while protecting privacy in a sustainable way?	[Rezac, 2022]
6.	Based on the proposition that pri-vacy can be only protected when a business model is economically feasible, how can start-ups and entrepreneurs that put pri-vacy protection and social values as a keystone of their existence become financially stable?	[Rezac, 2022]
7.	What are the drivers and challenges of their efforts?	[Rezac, 2022]
8.	What are the characteristics of their ecosystems and their relationship with "oligopo-lies" and centralized mega-corporations?	[Rezac, 2022]
9.	How do they interact with incumbents when entering established ecosystems?	[Rezac, 2022]

Table 8: Open questions from the literature

While all questions presented above are important and relevant, they are of rather academic nature and thus would be not helpful to acquire opinions and views regarding the project offer. For this reason, we have transformed them into questions that might better fit into an interactive workshop, which we present in [47].

3.3 Lean schemas for the Shift-Hub service offer in innovation ecosystems

In this chapter we come up with a first approach to identify synergies amongst Tasks 5.1 'Market and stakeholder needs analysis' (Leader: UKOLN) and WP3 (Leader: KINNO) and all its encompassing Tasks. The most critical issue relates to the definition of basic needs of the different Tasks that shall guide the development of synergies amongst them and the corresponding Deliverables namely the catalogue of the Shift-Hub services (Deliverable 3.1, related mainly to Task 3.2), the catalogue of educational resources (Deliverable 3.2, related to Task 3.4) and the planning of all Shift-Hub workshops (Deliverable 3.3, related mainly to Task 3.6 but also to the others of WP3).

Our aim is to design a lean scheme for the Service Offer, that its value will be demonstrated with a respective 'storylines' that will help build the regional ecosystems. To this we make a start in the document by providing insights of the ecosystems in Porto and Cologne. In the next version we shall include also information on the Thessaloniki ecosystem and elaborate for the other two ecosystems as well.

3.3.1 Ecosystems, business models and value generation

Business models are expected to answer question related to how benefits driven by the adoption of innovations as in our case for the area of Smart Health technologies and services, 'flow back' into a particular actor or stakeholder like e.g. a company that has developed the core technology for the particular innovation or an actor who takes part in its promotion to a market sector or a customer base. Success of a business model is primarily measured or judged in the form of revenues. To this, the recent study of (Schlecht et.al., 2021) in the field of Blockchain provides an adequate comparison in terms of the authors building their postulates on all three constituents namely (i) a number of interviews with experts, (ii) results from the conduct of interactive workshop, and last but not least 9iii) prior literature, upon which they developed their set of projections of implications for business models.

In our case the aim is to explore the most appropriate format for a Service Offer that will possess all necessary expressive power to describe both demand- and supply-side scenarios for which the SHIFT-HUB Service Offer may foster the uptake of innovations in smart health technologies and services. The latter will take place either in existing and operational ecosystems, or demand the creation of new ones that will be developed as part of the project lifetime and shall, following the definition of (Chesbrough, 2007) set up and configure suitable business models that shall create and capture the respective value of the innovations promoted.

The most important aspect in the innovation ecosystem approach we take in the project, apart from the network effects created, is that all actors maintain their roles in the ecosystem and their informal interconnection to each other. This aspect is important to capture in the Service Offer: it is not a weakness or a risk if the actors are chance-oriented. Testing and experimentation are important properties and there is no need to stick to 'formal structures' that might contribute with little or no potential for success. To this, both formal structures as well as the track record of an actor is of little or even no significance, and as long as they contribute to the successful realisation of a particular Service Offer, their role is considered as positive and should be encouraged to participate. We expect this to enrich the Shift-Hub ecosystems with new possibilities and shall help both demand- and supply-driven innovators to reflect upon their innovations and get the chance of action-oriented reflection.

The field of digital business Ecosystems has facilitated the characterization of innovation ecosystems in terms also of detecting commonalities with properties of general ecosystems [Briscoe, 2010]. And it is in the latest years with an increasing prevalence supported by the proliferation of technologies and increased competition due to globalisation that importance of value co-creation is given more significance as a success factor within ecosystems and other similar constellations. As a consequence, many approaches have emerged to model and analyse business ecosystems; we mention here few that span between 2010 and 2020 namely [Al-Debei-Mutaz, 2010], [Adner, 2013], [Basole, 2015 & 2016], [Aldea, 2018], [Faber, 2020].

For the needs of the project we shall study Service Offers that can be mainly related to one of the following two 'basic' reference cases, as will be further approached in section 3.2:

1. Supply-side driven innovation: from the researcher and scientist to the market

2. Demand-driven innovation: from the patients and customers back to the researcher

However, as will be evident from our work, the Service Offer format shall allow also several other hybrid forms of Service Offers to get realized and instantiated.

As supported by (Iansiti and Levien, 2004), our Service Offer will be conceptualized for a network of interacting actors where the large number of interconnected partners and competition to allow for their survival form the most important properties of the ecosystem. This aspect is welcome as it may incentivise innovations and help the expansion of the various ecosystems. It is to this that the role of start-ups may act as a catalyst due to their dynamism and their willingness for experimentation and risk-taking.

In the following three subsections we present, in order of appearance, information of three ecosystems that are sustained in the project namely those of Porto, Portugal (partner UPORTO), Cologne in Germany (partner UKOELN) and Thessaloniki, Greece (partner AUTH). The rationale for this is that we shall engage them also as part of other project activities such as the DemoDays to take place as part of WP3 and Task 3.5 in particular.

An important aspect of innovation ecosystems that we also mentioned in Section 3.1 is that these 'are more complex than one might like to think' as well as that 'the temporal aspect and the inherent need to reflect evolutions in their structure and organisation are also a prerequisite'. In this respect. The presentation of these three ecosystems in Porto, Cologne and Thessaloniki will be used as indicators of the diverse nature of innovation ecosystems.

3.3.2 The Porto Ecosystem

For the Porto ecosystem we present two supply-side innovation scenarios that relate to two respective innovations being developed in the region. Some additional information on the Porto4ageing ecosystem and the reference site as a whole are also provided at the end, as these relate to the described innovations.

DialGames: Co-creation development of therapeutic digital games for patients under haemodialysis treatment

Hemodialysis, a renal function replacement technique used in end-stage renal disease (ESRD), is associated with an accentuated loss of cognitive function (even when compared to other ESRD treatment options), that is up to three times more common than in the general population and may manifest at younger ages [1]. There may be underlying mechanisms related

to uremia, stress fluctuations during dialysis therapy with cerebral hypoperfusion, depression, social isolation, among others[2].

Cognitive intervention mediated by therapeutic serious games (TSG) may bring benefits to hemodialysis patients through systematized assessments and subsequently customized interventions with physical and cognitive stimulation that may result in an improvement in decision-making, reduction of depressive symptoms, and therapy-related stress, and, consequently, improve quality of life during and after hemodialysis therapy[3]

Although there are numerous studies on cognitive interventions in these populations, results are still inconsistent, with limited evidence supporting treatments to mitigate the degree of cognitive impairment observed. Despite insufficient tailoring to patient needs [4], some show promising results.

In Portugal the long waiting list for renal transplantation leads to a median waiting time on list that can be greater than 10 years and many patients are not candidates for this treatment due to their age and comorbidities [5]. Therefore, long waiting time leads to greater depression levels and cognitive impairment levels, and it is needed to devise systems and develop a longitudinal and transdisciplinary program to understand the needs of this population and develop solutions for them to prevent their cognitive decline.

Protecting their brain, it is also assuring their future, assuring a long-term active life, active aging, providing a lifelong education and their quality of life, during and after the hemodialysis treatments.

To archive these goals, this developing innovation (part of a 2023 PhD research) intents to assess to the levels of depression and cognitive impairment on patients under the hemodialytic treatments at Hospital de Braga. After assessing to this data, patients, and health professionals, will be part of a co-design program to develop a mobile application (m-health app) with a collection of digital TSG, accessible, focused on cognitive stimulation. The m-health app,. intends to assess the influence of TSG on cognitive skills and depressive symptomatology in adults/elderly patients undergoing hemodialysis therapy, during their treatment at the Hospital de Braga. At the same time, the intervention using TSG provide an occupation and promote a social interaction, digital inclusion by using the games during the long hemodialytic treatment sessions.

With this study it is also expected to produce and validate a new approach of applying Montreal Cognitive Assessment (MoCA), Mini-Mental State Examination (MMSE) using mobile information and communications technology (ICT).

MASK-air: an App dedicated to those who are bothered by allergic rhinitis

MASK-air is an App dedicated to those who are bothered by allergic rhinitis. Its goal is to provide the opportunity to regularly record all symptoms, to facilitate optimal management of allergic rhinitis condition and to improve the quality of life of patients. It invites users to record their symptoms for at least 7 days in a row (answering a questionnaire), to record their current treatment and to monitor the consequences on their quality of life. This data enables their healthcare providers to better advise users on the most appropriate strategy and optimal treatment for their allergic rhinitis throughout the year and across different seasons.

The innovation is currently hosted under the Website: https://www.mask-air.com/ (in google play: https://play.google.com/store/apps/details?id=nl.peercode.allergydiary&pli=1)

Mask Air, developed under the scope of the former EIP-AHA (European partnership on active and healthy ageing) has been developed in France, but widely transferred to many European ecosystems, including Porto4Ageing. This wide cooperation can be seen by examining examples from published scientific papers developed based on Mask Air's data. See, for example:

1. Digitally-enabled, patient-centred care in rhinitis and asthma multimorbidity: The ARIA-MASK-air approach (http://www.scopus.com/inward/record.url?eid=2-s2.0-85147105865&partnerID=MN8TOARS)

2. Allergen immunotherapy in MASK-air users in real-life: Results of a Bayesian mixed-effects model (http://www.scopus.com/inward/record.url?eid=2-s2.0-85127220768&partnerID=MN8TOARS)

3. Assessment of the Control of Allergic Rhinitis and Asthma Test (CARAT) using MASK-air (http://www.scopus.com/inward/record.url?eid=2-s2.0-85116774862&partnerID=MN8TOARS)

4. Behavioural patterns in allergic rhinitis medication in Europe: A study using MASK-air real-world data (http://www.scopus.com/inward/record.url?eid=2-s2.0-85126344447&partnerID=MN8TOARS) ,

5. Comparison of rhinitis treatments using MASK-air® data and considering the minimal important difference (http://www.scopus.com/inward/record.url?eid=2-s2.0-85131752144&partnerID=MN8TOARS)

6. Consistent trajectories of rhinitis control and treatment in 16,177 weeks: The MASK-air® longitudinal study (http://www.scopus.com/inward/record.url?eid=2-s2.0-85143420123&partnerID=MN8TOARS)

7. Correlation between work impairment, scores of rhinitis severity and asthma using the MASK-air App (http://www.scopus.com/inward/record.url?eid=2-s2.0-85081893884&partnerID=MN8TOARS)

In addition, Mask air has been fully translated to Portuguese, and made available to national patients with chronic rhinitis. The app is used by over 1000 individuals and joined the Portuguese Health Care System's selection of Health apps (https://mysns.min-saude.pt/mysns-seleccao-processo-de-avaliacao-diario-da-alergia-macvia-aria/)

Frail Survey

This innovation practice was developed within the national and regional objectives of increase the integrated healthcare solutions that are available to elderly. One of the goals was to use the gathered data and obtained results to advise certain intervention strategies for the elderly, thus reducing the risk of frailty and providing for active and healthy ageing. FRAILSURVEY, is a mobile phone application for (self)-assessment of frailty, which has been developed in the context of the 2016 Call for Twinnings of Scale AHA of EIP-AHA. This mobile app has been developed in Portuguese language and has been used during one year in our region to self-assessment of frailty and in some organizations has been used by health and social care

professionals to access frailty. FRAILSURVEY was consider as a GP in the Ageing Summit 2018 and 2017 UNECE ministerial conference on ageing (www.unece.org/fileadmin/DAM/pau/age/Ministerial_Conference_Lisbon/Posters/Poster_Exhibition.pdf). Moreover, this app has been included in the selection of NHS of app on health (https://mysns.min-saude.pt/mysns-seleccao-processo-de-avaliacao/frailsurvey/ .

Frail Survey is a mobile phone application for self-assessment of frailty status among the elderly in the community. This application is free and is available for operating systems.

IOS and Android. The frailty status screening is based on the frailty indicator from Groningen frailty indicator. The app assesses various aspects of life such as mobility, physical fitness, vision, hearing vision, hearing, nutrition, as well as cognitive and psychosocial aspects.

Information on the Porto4Ageing regional Ecosystem (Reference site)

The Competences Centre on Active and Heathy Ageing of University of Porto (Porto4Ageing, https://www.porto4ageing.up.pt) competency centre is a four-starred Reference Site and Partner Plus of the former European Innovation Partnership and Healthy Ageing of the European Commission, bringing together over 90 organisations, the large majority of them established within the Porto Metropolitan Area, in the Northern Region of Portugal. The partnership is built upon the quadruple helix approach involving different stakeholders (regional governments and health and care providers, academia and research, industry and civil society), which are in good position to drive structural changes far beyond the scope any organization could achieve on its own, aiming to innovate and experiment in real world settings. Despite the different backgrounds, goals and actions, Porto4Ageing revolves around a shared vision and common targets, where each organisation actively contributes in a specific way to the overall goal of responding to the citizens' needs, specifically in matters related to active and health ageing in the Porto Region. The Porto4Ageing alliance is committed to promoting local convergence and improving the health innovation ecosystem, while reducing and overcoming existing bottlenecks. It is doing so by promoting joint work for high impact, thus bridging the gap between public and private actions and instruments and, ultimately, facilitating knowledge exchanges and scaling up of results. The Porto4Ageing consortium stems from the UPORTO Ageing Network, established in 2013, as UPORTO considered that it could play a vital role in the improvement of health and quality of life of European citizens, and particularly relating to elderly population, by contributing through research and development in this particular field. In this context, the top management of UPORTO had decided that a network composed of experts in the field of ageing should be created within the university, to bring together, not only different stakeholders to join up forces and expertise, but also different visions and contributions (health and social services, social, cultural, behavioural determinants, etc.). Adoption of European good practices (GP) by our region is a priority for Porto4Ageing. Furthermore, Porto4Ageing is setting up a regional Living Lab, dedicated to the study and development of technological solutions to treat dementia, is being developed by Santa Casa da Misericórdia de Riba d'ave (SCMRA). SCMRA via the Centre for Research, Diagnostic, Training and Tracking of Dementias (CIFAD - https://www.scmribadeave.pt/CIDIFAD/CIDIFAD) is a partner of Porto4Ageing and has participated in a twinning activity (organized by IN-4-AHA) with LABSAUD, a Galician Living Lab, in order to learn from their example.

Porto4Ageing has also been a part of other EU funded projects such as the "Smart and Healthy Ageing through People Engaging in Supportive Systems (SHAPES)". The Smart & Healthy Ageing through People Engaging in Supportive Systems (SHAPES) Innovation Action intends to build, pilot and deploy a large-scale, EU-standardised open platform. The integration of a broad range of technological, organisational, clinical, educational and societal solutions seeks to facilitate long-term healthy and active ageing and the maintenance of a high-quality standard of life. Porto4Ageing has also participated in the "Encouraging the reuse of research data generated by publicly funded research projects (Fair4Health)", and "Scaling-up innovation in active and healthy ageing (IN-4-AHA)". Fair4Health supported the FAIRification of data, stressing on data quality (certification), their interoperability and reproducibility of research, and IN-4-AHA developed a new scaling-up model for active and healthy ageing and managing the EIP-AHA community for the 2021-2022 period. Most of these projects relate not only to the topic of ageing, but mostly to digital health as a whole. Finally, Porto4Ageing also engages in supporting health innovation and entrepreneurship by managing the regional EIT Health RIS Hub. From the many activities developed by EIT Health RIS Hub Porto, we can refer:

- EIT Health's "Morning Health Talks" event: a bi-yearly roundtable to which regional and local decision-makers that are invited to participate and discuss a contemporary topic. This year's theme is "Rethinking the future of health care", with the introduction of digital health solutions in the system (https://drive.google.com/file/d/1doKk6Vmafsw6pt3u3eKt6c1OTslACUVo/view)

- EIT Health's "iDays/ INNOVATION DAYS", a 2-day design thinking and entrepreneurship competition, targeting university students and researchers (https://www.up.pt/eithealth/events/idays2021/)

- EIT Health's Acceleration program for start-ups focused on providing training, mentoring and the opportunity to validate their technology (https://www.up.pt/eithealth/events/pa-ppa/)

In short, Porto4Ageing is a regional ecosystem that aims to support innovation by leveraging local infrastructure such as the University itself, other related research and development talent, and EU funds to provide students, innovators and citizens with the tools for their own success.

[1] Crowe K, et. al (2021) "Is It Removed During Dialysis?"—Cognitive Dysfunction in Advanced Kidney Failure—A Review Article. Front Neurol. https://doi.org/10.3389/fneur.2021.787370

[2] Mosleh H, *et. al* (2020) Prevalence and Factors of Anxiety and Depression in Chronic Kidney Disease Patients Undergoing Hemodialysis: A Cross-sectional Single-Center Study in Saudi Arabia. Cureus. https://doi.org/10.7759/cureus.6668

[3] Bento SR, *et. al* (2018) Use of digital game therapy among elderly persons undergoing dialytic treatment: cognitive aspects and depressive symptoms. Rev Brasil Geriatr Geront 21:447–55

[4] Patel M, et. al (2016) Cognitive impairment in hemodialysis patients: What can slow this decline? Hong Kong J Nephrol 18:4–10

[5] Sampaio S (2018) The Portuguese kidney transplant allocation system – a change is needed. Port J Nephrol Hypert 32:365–66

3.3.3 The Cologne Ecosystem

For the Cologne ecosystem we present two supply side innovations scenarios that relate with innovations that have been either co-developed by the active participation of the SHIFT-HUB partner University Hospital Cologne and in particular the Biomedical Informatics Institute, or have been identified as part of the Institute's MedTech Entrepreneurship research and teaching activities.

PADME – a platform for Analytics and Distributed Machine Learning for Enterprises

For the needs of the project and in order to scale up the intervention potential of medical and health information provision into several settings and communities in Europe, there is need for a federated analysis infrastructure. This can be achieved by the deployment of PADME, that is a 'Platform for Analytics and Distributed Machine Learning for Enterprises'. PADME enables secure and privacy preserving analysis of patient data with federated and incremental learning shall be used and deployed within the project. PADME is a distributed analytics platform that will be provided and customised for data driven healthcare and medical service provision, spanning from applications in clinical research to 'routine' sharing and exchange of medical and health data as part of adopted interventions. Secure federated learning methods will enable partners to conduct multi-cohort analysis, develop and test their AI/ML learning models without sharing their data. PADME has been deployed and validated in several research data infrastructures, such as German Medical Informatics initiative (MII) and National Research Data Infrastructures (NFDI). It offers a secure platform to transfer algorithms and analytics tasks, an isolated environment to run tasks with data, and tools to prevent data leakage. Clinical partners will be able to control who can access their data and preserve the privacy of the patient. PADME deploys the Personal Health Train (PHT) concept for performing distributed data analytics tasks to address the federated learning. Data will remain in its original location, and analytical tasks will be sent to all participating intervention nodes. This guarantees the highest data protection standards.
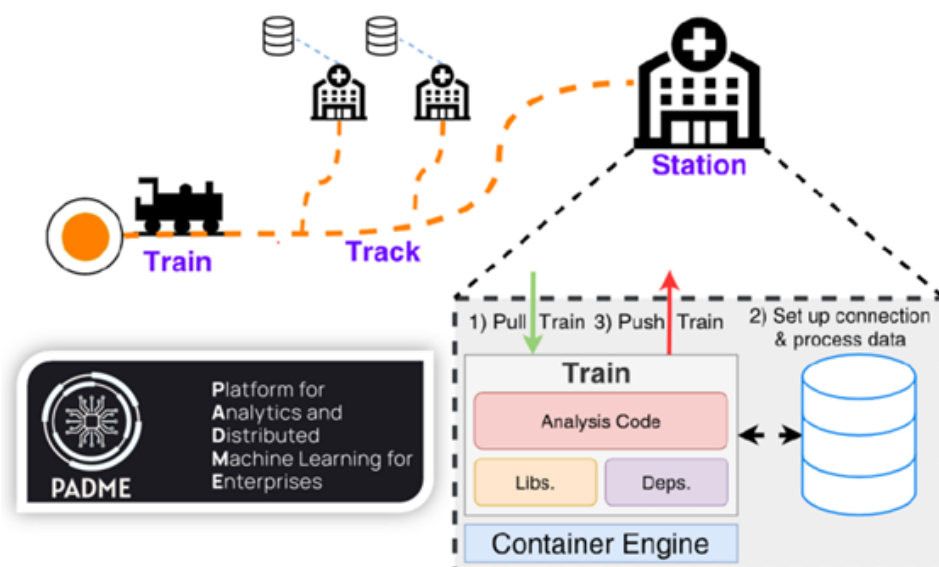
Figure 19: Main notions of PADME implementation of Personal Health Train

The PHT approach comprises three core components, as also shown in the Figure, namely: *Train, Station*, and *Track (Handler)*. The *Train* created by a data consumer, e.g., a researcher, is a data analysis algorithm encapsulated in a lightweight application container. The purpose of the *Train* is to access privacy-sensitive data from multiple institutions and then execute the algorithm to reveal valuable insights about the data. The *Station*, on the other hand, is an institution that contains privacy-sensitive and confidential data. The unique value that PADME offers to any adopters as a federated learning platform, relates to privacy preservation: a large part of the patient data cannot be shared amongst the six nephrology clinical research centres as there is no patient consent and this cannot be acquired retrospectively. To this, the use of PADME offers an optimal solution, due to the ability to train models at scale across the different sites and without moving the data. Distributed federated learning boosts patient numbers and algorithm quality. PADME is already completely developed, evaluated in various projects such as CORD[1] and NFDI4Health[2] and will be only deployed and executed to the different sites.

Link: https://padme-analytics.de/

Related publications:

Mehrshad Jaberansary, Macedo Maia, Yeliz Ucer Yediel, Oya Beyan, and Toralf Kirsten (2023) Analyzing Distributed Medical Data in FAIR Data Spaces. In Companion Proceedings of the ACM Web Conference 2023 (WWW '23 Companion). Association for Computing Machinery, New York, NY, USA, 1480–1484. https://doi.org/10.1145/3543873.3587663

Welten S, Mou Y, Neumann L, Jaberansary M, Ucer Yediel Y, Kirsten T, Decker S, **Beyan O.** (2022). A Privacy-Preserving Distributed Analytics Platform for Health Care Data. *Methods of Information in Medicine.* doi: 10.1055/s-0041-1740564.

Welten S, Hempel L, Abedi M, Mou Y, Jaberansary M, Neumann L, Weber S, Tahar K, Ucer Yediel Y, Löbe M, Decker S, **Beyan O,** Kirsten T. Multi-Institutional Breast Cancer Detection Using a Secure On-Boarding Service for Distributed Analytics. *Applied Science.* 2022, 12, 4336. doi: 10.3390/app12094336.

Welten S, Neumann L, Ucer Yediel Y, da Silva Santos LOB, Decker S, **Beyan O**. DAMS: A Distributed Analytics Metadata Schema. *Data Intelligence* 1–17. May 12 2021. https://doi.org/10.1162/dint_a_00100.

Mou Y, Geng J, Welten S, Rong C, Decker S, **Beyan O.** Optimized Federated Learning on Class-Biased Distributed Data Sources. *International Workshops of ECML PKDD 2021 (Virtual Event).* September 13-17, 2021. In: *Machine Learning and Principles and Practice of Knowledge Discovery in Databases.* Proceedings, Part I / edited by Michael Kamp, Irena Koprinska, Adrien Bibal [u.a.] Page(s)/Article-Nr.: 146-158.

Puraite

Puraite is an innovative startup from Paderborn, Germany, that aims to support daily work to medical and health researchers, clinicians and life sciences professionals by providing up-to-date medical research results in a reliable and user-friendly way. Whether one work in research, care, treatment or management, they all know how important it is to be informed about the latest advances in their field. Unfortunately, the ever-increasing number and complexity of scientific publications can mean that this task takes up more and more of someone's time, which could instead be used much more effectively for other core tasks.

Puraite was developed to meet this challenge; the vision is to make it easier for everyone to access the latest scientific knowledge. By developing an intelligent knowledge base, supported by advanced Artificial Intelligence (AI) technologies, the company aims to save the time and effort that is sometimes required to find and use the information one needs. The offered knowledge database is completely free of advertising and provides users with exactly the information they need 'in a nutshell'. Care is taken to offer the product in a personalised way, as the needs of a practising doctor are certainly different from those of a clinical researcher e.g. in the pharmaceutical industry.

Information on what exactly Puraite is, how it works and how far the state of developments are is briefly given below.

What exactly is Puraite? Puraite is an interactive web platform that serves as a configurable dashboard. It consists of different modules that can be selected and configured according to individual needs. These modules are designed to facilitate the search for information and the understanding of current research results. A central module is the innovative, AI-based search, which is more efficient and convenient than traditional search engines such as PubMed or Google Scholar due to a constantly growing knowledge base, the consideration of semantic factors and the possibility of natural language communication. However, Puraite offers even more, because even if one finds the publications they want quickly, they still need time to get to grips with them. To help users achieve this, Puraite offers additional modules that extract relevant information from the publications one finds and presents it in a convenient format. There is a wide range of options here, from a textual abstract of the publication in question to automated trend detection and visualisation of causal relationships. The ultimate goal is to maximise end user's convenience and efficiency, regardless of which modules they want to use.

How does Puraite work? Puraite is a knowledge system that automatically processes existing and newly published medical publications by using modern AI technologies such as machine learning. By linking the knowledge gained with the knowledge already available in the system, not only is the state of knowledge kept up to date, but new opportunities to acquire more knowledge are also opened up. The use of computer technology makes it possible to process and link larger amounts of information faster than a human could, which makes Puraite a valuable tool for research, especially in the field of medical meta-analysis.

How far along is development? The development of Puraite is still in its early stages. After a market analysis and feasibility study, an initial system prototype (MVP) is currently being developed. The goal is to bring this to market as soon as possible in order to collect feedback from customers in the early stages and incorporate it into further development. The team is currently looking at a market launch in Q1 2024, but individual modules may be tested earlier.

What does the team look like? The team currently consists of three people: Karlson Pfannschmidt, Shahin Baki and Vitalik Melnikov. Karlson and Vitalik are PhD students in computer science at the University of Paderborn and are doing their doctorates in machine learning. They are responsible for the AI know-how of the team. Schahin has solid business skills in addition to his in-depth computer science knowledge, so he can not only support the software development but also take care of the entrepreneurial side of the startup. Puraite also has several external mentors who support the core team with their unique expertise. Through

the expert mentoring of Prof. Dr. Axel Ngonga from the University of Paderborn, the development of AI technology at Puraite is ensured.

What is the vision for the future? Unlike many modern AI technology developments such as PubMedGPT or ChatGPT, which are essentially a closed system (black box), Puraite aims to build a knowledge system based on principles of transparency and quality control. Fully respecting the intellectual property rights of research results and ensuring that all information published on Puraite actually corresponds to the current state of research and can be verified down to the last detail if necessary belong to the guiding ethical principles and commitments. *The aim is to be perceived as a reliable and fair source of up-to-date research results and not like a company that profits from the openness of science at the expense of society.*

How much may Puraite cost? As the final pricing model is still under development and depends on several external factors, this question cannot be answered conclusively at the moment. Currently, there is the expectation to offer a flexible licensing or subscription model (Software as a Service) that takes into account factors such as the number of users or the required functionalities. As the Puraite team places a high value on inclusion and social justice, it is also planned to provide free (or profit-free) licences for educational institutions or institutions from developing countries.

Links: https://puraite.com/

SRDC

SRDC is a high-performance SME that originates from a successful academic spin-out from the Middle Easter Technical University in Turkey. The company has been one of the early stage innovators in the field of digital health technologies and solutions, with contributions both to scientific and research excellence as well as innovative industry applications and successful commercial deployments.

OnFhir.io service ecosystem by SRDC

As part of the Cologne ecosystem SRDC promotes their OnFhir.io service ecosystem briefly described below.

OnFhir.io Ecosystem

onFHIR (https://github.com/srdc/onfhir), is a secure and high-performance health data repository, which is used as the cloud-based clinical data repository in currently running three H2020 projects, C3-Cloud and Power2DM , FAIR4Health , and Chronic Disease Management Platform of Turkey.

The open-source initiative, onFHIR.io provides a secure HL7 FHIR based EHR repository to handle records of millions of patients without compromising for write or query performance. It provides mechanisms for secure data exchange, fine-grained access control, backups, audit logs.

onFHIR uses MongoDB as a persistency mechanism and uses its sharding mechanism for horizontal scalability of the system. It supports subscription mechanisms, enabling SmartHT components to be immediately informed about EHR, PHR updates in the Patient Data Store

What onFHIR.io Offers:

- Interoperability: A common, standardized, HL7 FHIR® compliant way for data access and storage for your health data

- Data Security: Mechanisms to secure health data for secure data exchange, fine-grained access control, backups, audit logs, etc.

- Scalability and Performance: Flexibility to handle records of millions of patients without compromising for write or query performance

- Compliance with EU Privacy Regulations: Support for easily complying with the current and forthcoming EU privacy regulations and member states' data protection laws, and security standards for healthcare

Where can onFHIR be used for?

- Large Healthcare Facilities: As a secure central health data repository to enable interoperable health data exchange among different medical systems running in your organization while conforming privacy policies and access control rules.

- Health Information Systems: As your secure PHR repository where your mobile or web based self-management or homecare applications can easily access to patient's data via FHIR compliant REST services.

- Clinical Studies or Research Projects: As data integration platform among different data collecting systems or multi partner research projects and serve the data to your researchers or value added services with a common standardized model.

References

onFHIR is used as the cloud-based clinical data repository in 3 H2020 projects which have been successfully completed: C3-Cloud, Power2DM and FAIR4Health.

It is currently being used in 4 of our active EU projects, namely: ADLIFE, CAREPATH, AICCELERATE and DataTools4Heart.

onFHIR is also utilized as the backbone of the national Chronic Disease Management Platform of Turkey, which is currently being used daily by more than 25,000 Family Medicine practitioners for the screening and monitoring of Turkish citizens for several chronic diseases, including hypertension, diabetes, obesity, and cardiovascular disease risk. onFHIR setup for the national Chronic Disease Management Platform currently maintains ~15 terabytes of FHIR resources for more than 70 million Turkish citizens, and millions of new resources are added every day. The daily number of handled FHIR interactions is above 100 million, and the average response time is around 30 ms, with read and search performance being around 4-5 ms. At peak times of the day, the system can easily handle 5,000 FHIR interactions per second.

toFHIR Suite

In the onFHIR ecosystem, we have been building a health data interoperability pipeline where toFHIR is a major component. toFHIR (https://github.com/srdc/tofhir) is a data mapping and high-performant data transformation suite to convert existing health datasets from various types of sources to HL7 FHIR. It provides a graphical user interface to configure mappings from source data to FHIR resource types and a powerful distributed data processing engine to execute those mappings.

On top of toFHIR we have also developed a *REDCap - FHIR Integration Service* which includes the provision, demonstration, testing and deployment of a data transformation route using the open-source toFHIR Engine (https://github.com/srdc/tofhir) for REDCap form instruments. In collaboration with the service requester, mappings are developed from REDCap form fields to different FHIR resources (e.g., Patient, Condition, Observation etc.) conforming to required FHIR profiles (e.g., German MII FHIR profiles). With the deployment of this service, any data entry/update on REDCap is automatically reflected to the configured FHIR server endpoint.

References:

toFHIR is currently being used in 2 of our Horizon Europe projects for enabling standardization of heterogenous data sources for secondary use for clinical research in order to train AI models: AICCELERATE and DataTools4Heart.

Together with the Medical Data Integration Center (MeDIC) of the University Hospital of Cologne (Universitätsklinikum Köln – UKK) we have collaborated for the co-shaping and provision of the following services:

- We added REDCap integration capability to toFHIR and developed mappings from REDCap forms to FHIR resource types. We are deploying it to automatically catch any data entry/update on REDCap and reflect that to their FHIR server according to the developed toFHIR mappings.

- We provided a FHIR data transformation service to map UKK's lab result data to corresponding FHIR observation resources in line with the German Medical Informatics Initiative (MII) FHIR profiles.

Links: https://www.srdc.com.tr

KronIQ Integrated Care Platform by SRDC

KronIQ is an Integrated Care Platform supporting intelligent decision support services for diagnosis, monitoring and management of chronic diseases.

What KronIQ Offers:

Screening and Risk Assessment

- Intelligent decision support services for patient-specific risk classification

- Decision support services enabling the identification of individual preventive actions

- Ensuring early diagnosis of diseases

Regular Monitoring of Chronic Disease Patients

- Automation of evidence-based medical guidelines

- Following the diagnosis, the clinical decision support wizard ensures that periodic follow-up is carried out in accordance with the recommendations of the evidence-based medical guidelines

- Clinical decision support services offering patient-specific treatment plan recommendations

  o Personalized clinical goals

- o Personalized examination requests, additional diagnostic recommendations

- o Personalized drug treatment recommendations

- o Customized contro0l visits, referral recommendations

- o Lifestyle suggestions

- Co-ordination and collaboration between multi-disciplinary treatment teams

Population Tracking and Monitoring of Clinical Quality Metrics

- Dashboards for monitoring of the latest status of disease-based clinical indicators (eg proportion of patients achieving the Blood Sugar target)

- Patient population follow-up (Upcoming / delayed monitoring, actual monitoring and screening numbers)

Who are the potential users of the platform?

Regional/national health authorities, public/ private hospitals, clinics

References

Kroniq is used as the chronic disease management solution automating clinical guidelines and serving decision support services for personalized care planning in 3 of our H2020 projects:

- C3-Cloud: A Federated Collaborative Care & Cure Cloud Architecture for Addressing the Needs of Multi-morbidity and Managing Polypharmacy

- ADLIFE: Integrated Personalized Care for Patients with Advanced Chronic Diseases to Improve Health and Quality of Life

- CAREPATH: An Integrated Solution for Sustainable Care for Multimorbid Elderly Patients with Dementia

Deployment in Turkey by Ministry of Health Turkey as a Disease Management Solution

Chronic diseases are the most common cause of death and disability in most of the countries including Turkey. These diseases consume a significant portion of our country's health resources. With the increasing rate of elderly population, chronic diseases and mortality and disability / incapacity rates related to these diseases are also increasing. Negative effects on the health system are constantly increasing and threatening socio-economic development. The Disease Management Platform, developed (https://hyp.saglik.gov.tr/), aims to ensure that primary health care services play a more active role in the early diagnosis, treatment and process management of chronic diseases. With the platform provided, it is aimed to ensure that the screening and treatment process is carried out in accordance with the evidence-based clinical practice guidelines and to control the symptoms and signs of the diseases through periodic follow-up, and to prevent the loss of function and become disabled of individuals by monitoring the complications.

 The system has been built for Ministry of Health Turkey to be used by more than 25.000 Family Medicine Practitioners for management of the screening and monitoring of whole Turkish population (around 80 million patients).

Currently the following screening and monitoring of the following conditions:

- Hypertension

- Type 2 Diabetes

- Cardiovascular Risk

- Obesity

- Coronary Artery Diseases

- Renal Failure

- Stroke

- Geriatric Screening

- Asthma

- COPD

As of February 18th, 2023, the DMP has been used by 23,617 users (22,575 FMPs and 942 FMP nurses) to perform 49,006,906 screening and follow-up encounters for 12,287,655 unique citizens. As a result, 113,288 people were diagnosed via DMP with hypertension during screening and moved to monitoring list; 359,006 people with diabetes; 384,077 people with high cardiovascular risk; and 2,654,178 people with obesity.

Links: https://www.srdc.com.tr, https://www.srdc.com.tr/chronic/

[1] The Use Case "Collaboration on Rare Diseases" (CORD-MI) is a project involving the four consortia of the Medical Informatics Initiative and involving numerous German university hospitals and partner institutions. The aim is to improve care and research in the field of rare diseases.

[2] NFDI4Health is part of the German national research data infrastructures initiative and aims to create a comprehensive inventory of German epidemiological, public health and clinical trial data to date. To this aim it builds, amongst others, a data analysis toolbox, while respecting stringent requirements for privacy concerning personal health data. Standardization services will ensure a high degree of interoperability.

3.3.4 The Thessaloniki Ecosystem

The Thessaloniki Innovation Ecosystem comprises both demand- and supply- driven initiatives and strives to blend academia and business acumen. For this reason, it encompasses Academic Institutions (Universities, Colleges) Incubators, Co-Working Spaces, Institutions and Organizations, Research Institutes, as well as pre-incubators.

As is the case with the *Alexander Innovation Zone* (https://www.thessinnozone.gr/en), Thessaloniki is in the process of making a trend out of bringing startups to life, promoting R&D, facilitating educative initiatives and supporting innovative projects via its increasingly rich network.

For the present document, we present 2 cases from the local ecosystem.

CAPTAIN COACH: Digital solutions for healthy ageing and independent living

CAPTAIN introduces a revolutionary user interface designed to empower and motivate individuals seeking guidance and care. It assists in setting goals and offers feedback throughout the journey toward achieving these goals within the four well-being domains.

CAPTAIN Coach P.C. has its origins in the Aristotle University of Thessaloniki (spin-off), stemming from the CAPTAIN project, which received funding from the European Union's Horizon 2020 program. CAPTAIN collaborates with established day care centres and nursing homes to further its research on promoting healthy aging and independent living.

CAPTAIN's primary objective is to provide digital solutions to facilitate healthy aging and independent living, featuring AI components such as:

- Movement Analysis,

- Emotion Analysis,

- Speech Analysis,

- User Modeling,

- Environmental Monitoring and

- Behavior Prediction.

CAPTAIN has already identified the value of living labs in health as it was designed through a co-creation methodology where older adults and experts participated from the ideation to the prototyping and testing. In one of its projects, CAPTAIN got access to patients of the university hospital (ecosystem of Medical Physics and Digital Innovation's living lab) in order to recruit COVID-19 patients for at home monitoring.

Links: https://captaincoach.gr

EMMA Triage: Emergency Clinical Support

Improving Patient Triage for Reduced Emergency Room Wait Times

EMMA Triage is a newly established company from Thessaloniki. It offers medical and nursing staff in emergency departments a digital assistant that contributes to optimal patient management, reduces their waiting times, and consequently impacts the cost of care for hospitals. Moreover, it has submitted the relevant patent to the European Patent Office. EMMA (Emergency Medical Assistance) was created through the collaboration of the Laboratory of Medical Physics and Digital Innovation of the Medical School of Aristotle University of Thessaloniki (AUTh) and Vidavo to provide a medical decision support system for emergency care.

The issue of overcrowded emergency rooms in European hospitals, exacerbated by the COVID-19 pandemic, necessitated a response. This situation has led to prolonged patient waiting times, and data indicates that the National Health Service (NHS) has experienced a five-fold decrease in efficiency compared to 2010, with each additional hour of waiting resulting in approximately a 30% increase in care costs. Leveraging machine learning on real-world data, researchers developed EMMA, a Clinical Decision Support System that enhances the effectiveness of triaging incoming patients in the emergency room. EMMA's primary objective is to minimize patient waiting times, thereby positively impacting healthcare services and mitigating the associated economic burden.

EMMA's values is based on Autonomous Prioritization, Notification System, Probabilistic Framework, Medical Wearables compatibility and Data Visualization. EMMA got access to patients of the university hospital (ecosystem of Medical Physics and Digital Innovation's living lab) in the past in order to support COVID-19 patient triage at the emergency department of the hospital.

Links: https://www.emmatriage.com

3.4 Stakeholders of Cardiovascular Innovation Ecosystems in Germany: A first level analysis and an example

We aimed to provide a first attempt towards an analysis innovation ecosystems for cardiovascular pathologies in Germany through the use of a stakeholder model. We present essential stakeholders for the development and deployment of innovations in the field of cardiovascular research and medicine, and the primary functions they fulfil in the context of these innovation ecosystems. The adopted approach consists of the implementation of a multilevel system model for analysing stakeholders in this particular field. Data acquisition transpired through systematic literature review of multiple articles and studies. Data analysis phases were executed until reaching a point at which the considerable amount of data was discovered, ensuring consistency across various sources. We demonstrate that innovation ecosystems in cardiovascular medicine involve interconnected networks of stakeholders across different fields. Moreover, through an investigation of innovation ecosystems of cardiovascular pathologies particularly in Germany, we present the functions undertaken by each stakeholder which are essential for the participation in the innovation ecosystems. The findings presented in this paper hold the potential to bring better understanding of cardiovascular pathology innovation ecosystems in Germany. This assertion is substantiated through a comprehensive examination of relevant scientific literature.

Cardiovascular disease takes a central place in German healthcare. It is the most common cause of death in Germany and was responsible for 43.9% of all deaths in women and 36.1% in men in 2012 [1]. Similar high are the numbers for Europe accounting for 45% of all deaths [2]. Furthermore, they dramatically impact the health of individuals and, therefore, cause high healthcare costs for the government. Due to steadily increasing incidence of cardiovascular diseases they have become one of the primary reasons for hospital admissions and readmissions and in this respect preventing readmission of patients with cardiovascular pathologies is one of the main priorities for clinicians, researchers, and other stakeholders [3].

Cardiovascular diseases have great relevance to modern healthcare in Germany and worldwide because of their prevalence rates. The major factors that influence the manifestation of these diseases, such as obesity, diabetes mellitus and high blood pressure can be moderated through lifestyle changes, including healthy diet, weight loss and improvement of fitness [4]. Innovations in the sphere of prevention, diagnosis and therapy of cardiovascular pathologies have enabled a substantial reduction in the age-adjusted cardiac mortality rates since the 1950s [5]. These innovations can be directly related to integration of various tools and techniques. Noteworthy examples involve introduction of the intra-aortic balloon pumps introduced by Kantrowitz [6], promotion of defibrillators by Zoll and others [7], development of coronary angiography by

Sones [8], advancements of right heart catheterization techniques by Ganz and Swan [9], innovation of percutaneous intervention by Grüntzig [10], and the introduction of transcutaneous aortic valve insertion by Cribier [11] among other breakthroughs. The development and integration of these novel tools highlight how the innovation allowed to significantly contribute to outcomes advancement in patient care outcomes [12].

Although these innovations have indeed brought about a revolutionary transformation in cardiovascular clinical practice, barriers continue to exist. The optimal approach to advance requires the concerted involvement of a diverse array of stakeholders united by a shared vision. It is this aspect that one may expect to be the unique value proposition of the various innovation ecosystems. Bolstering collaborations within the field of cardiovascular therapy is the key, necessitating partnerships spanning technology enterprises, both large, small and medium sized or start-ups, different industrial sectors, academic institutions, and other private actors, with an emphasis on various forms of innovation. The objective lies in establishing connections between patients, clinical researchers and technology developers, in order to push advancements in a field of cardiovascular disease therapy.

3.4.1 Methodology

For the conducted literature review stakeholder analysis was used to identify the relevant stakeholders of cardiovascular innovation ecosystems in Germany. The search of relevant literature for this review was performed through the PubMed database (https://pubmed.ncbi.nlm.nih.gov/).

The higher order search terms were 'cardiovascular disease', 'innovation' and 'stakeholder'. This led to discovery of a journal article with a headline 'Innovation in cardiovascular disease in Europe with focus on arrhythmias: current status, opportunities, roadblocks, and the role of multiple stakeholders' [13].

Based on this article, stakeholder categories of this particular field were identified. Research was identified as the most important part of innovation and the subsequent search through the PubMed database with keywords 'cardiovascular', 'research' and 'Germany' took place. A journal article titled 'Cardiovascular Research in Germany' was identified as highly relevant [14]. It helped in getting a more in-depth analysis of the research facilities in Germany such as universities, research institutions and various scientific societies.

The data of specific the research institutions, scientific societies and governing bodies was acquired through the annual reports of the respective institutions and for the period between 2013 to 2022, which are, publicly accessible on the official websites of each of them, such as the German Research Foundation (DFG.de), the German Centre for Cardiovascular Research (DZHK.de), the Max Planck Institute for Heart and Lung Research (MPI-HLR.de) and the Institute for Quality and Efficiency in Health Care (IQWIG.de). For the acquisition of data concerning specific investors and private companies, the annual reports of these companies were used.

The specific example of Topaz tricuspid heart valve that we present in Section 5 as an empirical example took place during the investigation of TRiCares as a private company that operates in Germany. Data concerning this innovation has been acquired through the PubMed database, utilizing 'Topaz' and 'transcatheter' keywords.

3.4.2 Results

Innovation in the field of cardiovascular pathologies, same as in other fields, requires a combination of various contributing factors and resources. Innovation ecosystems, defined as complex networks of organizations, individuals, and institutions collaborating to drive innovation, are recognized for their role in initiating advancements across various sectors, including healthcare. Understanding the dynamics of stakeholders within cardiovascular innovation ecosystems is essential to enable effective collaboration and support the rapid translation of research findings into impactful clinical solutions. For Germany there are several contributing stakeholders deeply interconnected with each other, as illustrated in Figure below, that can facilitate innovation which we briefly present in the next subsections.
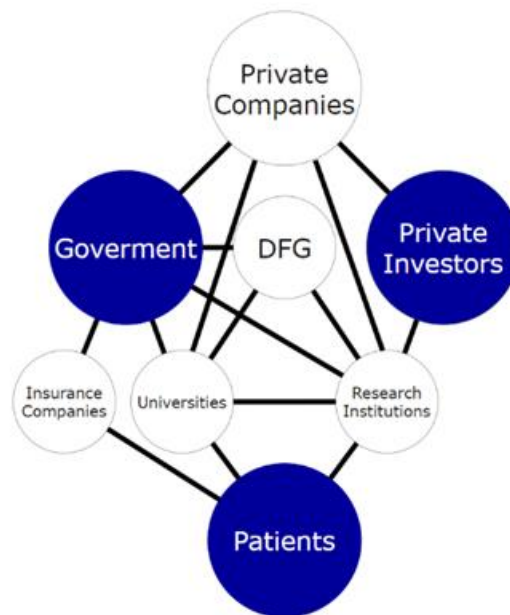
Figure 1.

Figure 20: Contributing stakeholders for the German medical and in particular cardiovascular pathologies ecosystem

Government

The German government takes up a central place in the cardiovascular innovation ecosystem in Germany. One of the most significant ways the German government supports cardiovascular innovation is through research funding. The government allocates funds to support research in cardiovascular health through various channels, including federal and state research agencies, as well as collaborative initiatives. Organizations such as the German Research Foundation (DFG) and the German Centre for Cardiovascular Research (DZHK), which derive their funding exclusively from the government, distribute considerable resources to support projects in cardiovascular research.

The government plays a crucial role in shaping policies that influence cardiovascular innovation. It can further strengthen primary care to deliver prevention, early diagnosis and management of cardiovascular diseases by introducing innovative elements such as benchmarking and monitoring of patients. Government synchronizes policies with innovation objectives and by that means creates an ecosystem suitable for growth and development of modern cardiovascular technologies [15]. The German government has shown a keen interest in promoting the integration of digital solutions into healthcare delivery. Initiatives like the "Digital Health Applications" program support the development and implementation of digital tools for

cardiovascular risk assessment, remote patient monitoring, and telemedicine consultations [16].

The Federal Ministry of Health (Bundesministerium für Gesundheit, BMG) establishes policies to provide guidance at the federal level. It develops laws and provides guidelines for the autonomous activities inside the healthcare system. It is responsible for the administration of multiple institutions and other entities that handle diverse challenges faced by German healthcare. One of these institutions is Federal Institute for Drugs and Medical (Bundesinstitut für Arzneimittel und Medizinprodukte, BfArM). It is responsible for making decisions regarding the approval of innovative medications and medical devices. The Federal Joint Committee (Gemeinsamer Bundesausschuss, G-BA) is tasked with making decisions regarding which medical services will be included in coverage provided by statutory health insurance (Gesetzliche Krankenversicherung, GKV) and the form of this coverage [17].

Quality assessment of health care is another responsibility of the Government. The Institute for Quality and Efficiency in Health Care (Institut für Qualität und Wirtschaftlichkeit im Gesundheitswesen, IQWiG) is responsible for carrying out this function. It is a public entity independent of insurance companies and healthcare providers. IQWiG evaluates advantages and risks associated with new therapies and diagnostic procedures, by collecting and analyzing the available research data about these therapies and procedures. The outcomes of their analysis are then to be taken into account when making a decision regarding health care [17]. For instance, this institution receives all the preoperative, intraoperative and postoperative data about every patient with statutory health insurance undergoing any type of heart valve replacement. Afterwards, this data will be anonymized, carefully examined, presented annually [18].

Collaboration and partnership between the government and private sector, including medical device companies, is essential to advance cardiovascular innovation. These collaborations *provide a translation of research discoveries into practical applications* ranging from advanced medical devices to new treatment methodologies. The German government encourages such collaborations through initiatives like tax incentives for research and development activities in exchange for novel technologies and knowledge [19]. It supports patient advocacy organizations and, by involving patients in discussions about research priorities and treatment options, ensures that innovative solutions are aligned with patient needs [20].

Academic and Research Institutions

Academic and Research Institutions within the cardiovascular innovation ecosystem includes a diverse range of organizations dedicated to advancing scientific knowledge, training the next generation of cardiovascular researchers and healthcare professionals, conducting cutting-edge research, exploring innovative technologies, and investigating the molecular and physiological basis of cardiovascular diseases. These institutions include universities and other research institutions.

Universities

Renowned universities with medical and life sciences faculties represent a key stakeholder group in a field of cardiovascular innovation. They contribute to research, education, and collaboration that drive advancements in the field.

Cardiovascular academic medicine in Germany was traditionally separated into clinical cardiology and basic science departments, such as physiology, pharmacology, and pathology. Over the past three decades, this model has experienced gradual evolution [21]. The majority of university cardiology clinics now not only engage in clinical cardiology, but also perform basic science studies. Basic cardiovascular science used to be limited to traditional university departments such as physiology, pharmacology, and pathology. Nowadays there are numerous university chairs (Lehrstühle) dedicated to experimental cardiovascular medicine, operating under diverse titles and designations, have been established. Consequently, there is growing pressure to secure competitive external funding to sustain operations and research projects [14].

Research Institutions

Research Institutions are playing a very important role as a stakeholder in cardiovascular innovation ecosystems in Germany. Examples of notable German research organizations are the German Centre for Cardiovascular Research (DZHK), the Max Planck Society, the Leibniz Association, Fraunhofer Society and Helmholtz Centres. These research organizations have their own research institutes dedicated to cardiovascular research [21].

The German Centre for Cardiovascular Research (DZHK) consists of a network of 31 notable research institutions allocated across seven partner sites, including centres of the Helmholtz Association, Max Planck and Leibniz Institutes in addition to 14 university hospitals [22]. 90 percent of its funds come from the Federal Government (Bundesrepublik Deutschland) and 10 percent from State Governments (Bundesland) in which these institutions are located [23]. The main objective of the DZHK is to encourage comprehensive collaboration between outstanding scientists who specialize in cardiovascular research. These collaborations among scientists in the field of cardiovascular research should enhance the translation between scientific insights and clinical practice and advance the exchange of knowledge [24]. DZHK places a strong emphasis on turning research discoveries into real world benefits through strategic planning and targeted financial support. [25].

The Max Planck Society (MPS), maintains The Max Planck Institute for Heart and Lung Research (MPI-HLR) dedicated to cardiovascular research. It's funded by both the Federal Government and State Governments. About 18 years ago, the MPI-HLR was restructured, gaining its new focus on the cardiovascular and pulmonary systems. Since then, basic cardiopulmonary research has been a dominant theme at the MPI-HLR. This has led to numerous groundbreaking discoveries which had an enormous impact on the research community. Research in MPI-HLR laboratories is mainly funded by the Max Planck Society (MPS), the German Research Foundation (DFG) and the German Centre for Cardiovascular Research (DZHK) [26].

German Research Foundation

German Research Foundation (DFG) plays a prominent role as a stakeholder, advancing innovation in the field of cardiovascular pathologies in Germany. It is the most important funding organization in Germany. It is governed by scientists, who are nominated by the universities and elected by all active scientists including postdoctoral fellows. It independently selects research projects on a competitive basis and distributes money, which is contributed by the federal state (70%) and the individual states of Germany (30%), that is, tax payers' money.

The funding of individual research projects and scientists makes up to 45% of their annual budget. It is the largest research funding program in Germany, accessible to all fields of science [14]. To encourage commitment of universities to a certain field of research, DFG also supports networks of various sizes within universities and groups of universities and other entities. For example, research units support small consortia (around 6–9 projects) and Collaborative Research Centres support larger consortia (around 15–10 projects) [14].

A Research Unit (Forschergruppe, FOR) is formed by a team of researchers collaborating on a research project that goes beyond the funding available for individual grants. These types of projects have a medium-term duration, usually around 6 years, and involve aspects like topic focus, duration, and funding. Clinical Research Units (Klinische Forschungsgruppen, KFO) are specific medium-term research projects that require coordinated efforts because their expected outcomes cannot be achieved through individual grants alone. They offer similar opportunities for disease- or patient-centred clinical research [14].

More extensive networks are sustained by Collaborative Research Centres (Sonderforschungsbereiche, SFB), which operate within the defined structure of a 12-year funding trajectory. Transregional Collaborative Research Centers (Transregio, TRR) constitute networks including up to three universities. Among the existing 268 CRCs, a notable proportion, approximately 2.9%, are concentrated on cardiovascular research. Additionally, cardiovascular scientists are engaged in CRCs that cover a wider scope than just cardiovascular disease and include interdisciplinary collaboration [14].

Clusters of Excellence (Exzellenzcluster, EXC) are specialized research networks composed of universities and research institutions. These were launched in 2019 and aim to spark innovations in German universities. This meant to be achieved through the funding of project-based research at universities, the improvement of research profiles, and the facilitation of collaborative efforts within the research ecosystem [21].

DFG also provides specialized graduate training initiatives in cardiovascular research or fields closely associated with it. These initiatives, known as Research Training Groups (Graduiertenkollegs, GRK), are instituted within universities and receive backing from the DFG for a period of up to 9 years. Their objective is to furnish doctoral education within a well-defined research framework, coupled with a thoroughly designed training regimen. These programs serve to cultivate early scientific autonomy and encourage independent scholarly pursuits [21].

Pharmaceutical and medical device companies

Pharmaceutical and Medical device companies assume an exceptionally important role in the cardiovascular ecosystem innovation in Germany, as they are not only involved in research, development, and therapies for cardiovascular diseases but are assigned the role of bringing these innovations into practice and, as a consequence, to the market. Germany is an attractive market for medical device companies involved in cardiovascular technologies. They invest heavily in research and development and collaborate with various research facilities, such as universities and research institutions to create innovative cardiovascular devices and technologies and to conduct clinical trials to test the safety and efficacy of their devices and to gather data and demonstrate the effectiveness of their products. They continuously innovate to create new and improved cardiovascular devices such as pacemakers, stents, catheters, and

imaging equipment. Among these companies, are, for instance, JenaValve Technology with a focus on developing and manufacturing innovative heart valve replacement technologies ,such as transcatheter aortic valve replacement (TAVI) [27], Osypka Medical, who specializes in electrophysiology and interventional cardiology products, including catheters and diagnostic tools to diagnose and treat heart rhythm disorders [28], Medtronic, who offers a huge variety of cardiovascular devices, including cardiac rhythm management, structural heart, and coronary and peripheral intervention solutions [29] and numerous others.

The rising prevalence of cardiovascular diseases and a growing preference for minimally invasive medical procedures are influencing the expansion of the market. According to the statistics of the German Heart Surgery Report 2021 [30], there were a total of 161,261 cardiac procedures performed in Germany in year 2021. Among them 36,714 were heart valve procedures and 19,490 were pacemaker and cardiac implantable electronic device-related procedures. These numbers illustrate how high is the demand for cardiovascular devices in Germany [31].

Investors

The development of innovative medical technologies requires substantial to not say extreme amounts of financial resources in the form of direct investments. Investors support the research and development of these technologies, which greatly enhance the diagnosis and treatment of cardiovascular diseases. Investors provide essential financial support to startups, research institutions, and healthcare companies working on cardiovascular innovations. They also support various clinical trials by providing seed funding and investments to test the safety and efficacy of new therapies. For example, High-Tech Gründerfonds (HTGF) is one of Germany's largest venture capital firms, focusing on technology startups. They currently invest in healthcare companies working on innovative cardiovascular solutions, such as advanceCOR, a drug-developing biotech company which focuses on a cardiovascular diseases research, and Capical, a world leading company for contact-free ECG-measurement via capacitive electrodes [32], Wellington Partners, who provided a financial support to TRiCares during the development of minimally invasive tricuspid heart valve replacement system [33], Sunstone, who supported JenaValve Technology in development of trilogy heart valve system [34] to name only a few. These examples illustrate the diverse range of investors and organizations involved in cardiovascular innovation in Germany. They provide resources, helping to drive advancements in cardiovascular healthcare into innovative applications and product offerings.

Insurance companies

Insurance companies have an interest in promoting cardiovascular health to reduce the prevalence of costly claims related to cardiovascular diseases. It lies also in the sphere of their interests to promote a healthy lifestyle and offer preventive measures, such as regular check-ups, screenings, and wellness programs. They analyse large volumes of wealth to health-related data to identify high-risk groups, to detect potential issues and to develop targeted interventions. Insurance companies provide financial support for cardiovascular innovation through investments, partnerships, and funding mechanisms. They engage patients in their cardiovascular health by providing information about innovative treatments, lifestyle changes, and disease prevention.

Insurance companies seek the balance between the advantages of innovation and economic sustainability. Their priority is to improve procedures, end results and quality of life, but they must at the same time take economics of healthcare sector and operational effectiveness into consideration. It can be complicated to a certain degree to integrate an innovative treatment into standard healthcare because of extended assessment periods and the necessity, sometimes, for regulatory changes related to health insurance. Public health insurance companies in Germany for example take part in an innovation fund with an intention to stimulate and accelerate innovations to improve patients' outcomes [13].

Patients

Patients and their families serve as catalysts for cardiovascular innovation by demanding better treatments, diagnostics, and therapies. Their perspectives, needs, and experiences are central to the development, adoption, and success of innovative cardiovascular technologies and treatments. Patients are essential participants in clinical trials and research studies related to cardiovascular innovation. Their willingness to participate in these trials helps researchers evaluate the safety and efficacy of new treatments and technologies. Their feedback contributes to continuous quality improvement in healthcare institutions and influences healthcare policies and regulations. Patients' input addresses ethical concerns in cardiovascular research and care, such as privacy, consent, and transparency in sharing medical information, and helps to shape guidelines, reimbursement policies, and regulatory decisions related to cardiovascular therapies.

Patient advocacy groups, such as the German Heart Foundation (Die Deutsche Herzstiftung), play a significant role in representing the interests of cardiovascular patients. These groups collaborate with healthcare professionals, researchers, and other stakeholders to ensure that innovations align with patients' needs and preferences and contribute to better outcomes in cardiovascular care. To further advance medical progress, the German Heart Foundation also actively engages in research funding.

3.4.3 An Empirical Example

The validity of the proposed definition of innovation ecosystems can be illustrated through an empirical case of the development of the Topaz tricuspid heart valve replacement system. In the recent years innovative minimally invasive transcatheter therapies, such as transcatheter aortic valve implantation(TAVI) and transcatheter mitral valve implantation (TMVI) have induced a revolution in clinical practice, significantly contributing to a better patient treatment and reducing mortality among high-risk patients [35]. Nevertheless, there was no comparable treatment for patients with tricuspid regurgitation. Severe tricuspid regurgitation is a common condition affecting the tricuspid heart valve, often leading to poor outcomes. However, a substantial number of patients are ineligible for surgery due to the significant surgical risks [36]. The viable surgical procedures such as isolated tricuspid valve repair and tricuspid valve replacement are associated with a hospital mortality as high as 10 and 20% respectively [37]. Because of such high mortality during an open heart surgery, a minimally invasive transcatheter option of tricuspid valve implantation was being developed by TRiCares.
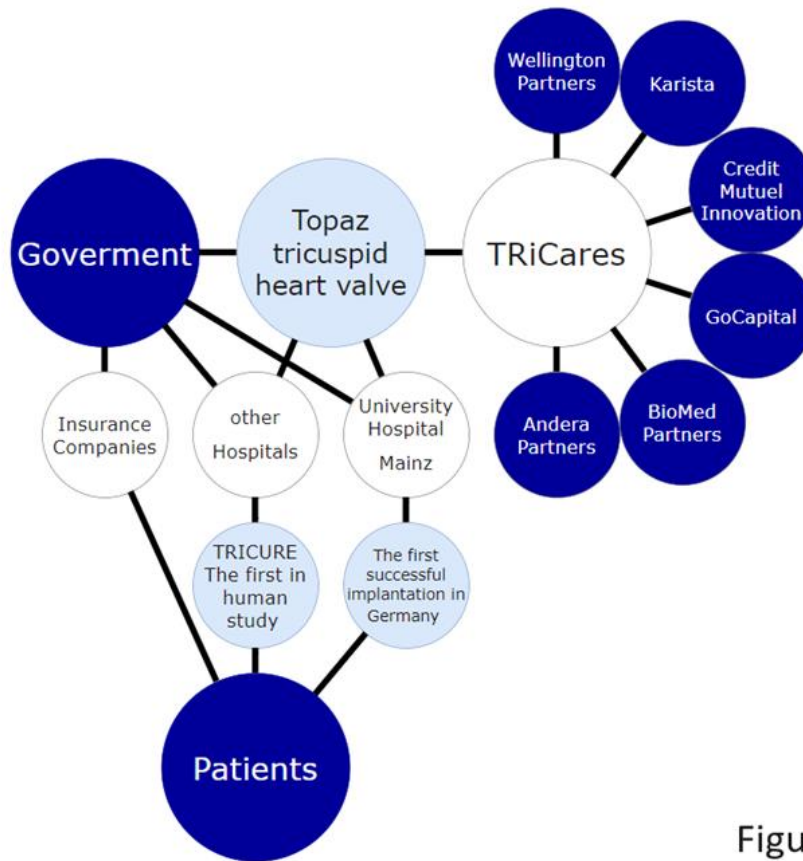
Figure 2.

Figure 21: Ecosystem for the case of the development of the minimally invasive Topaz tricuspid heart valve

TRiCares is a medical device startup organization that was established in 2013, with its headquarters located in Paris, France, and its operational base situated in Munich, Germany. Its main objective was to help people affected by severe tricuspid regurgitation by introducing a transfemoral tricuspid valve replacement system, replacing an open heart surgery that was associated with high mortality and offering them a better option. The company has garnered support from prominent European investment companies, including Andera Partners, Wellington Partners, BioMedPartners, Credit Mutuel Innovation, GoCapital and Karista [39]. Notably, the first successful implantation occurred at University Hospital Henri Mondor in Créteil, France, on June 7, 2021 and the first successful implantation in Germany took place at University Hospital Mainz, on 8 April 2022 [38]. The first-in-human study [39] started on 15 July 2022 and the primary completion is estimated to be on 15 October 2023. This clinical study is financed by TRiCares and takes place in numerous hospitals in Europe. This case of the development of the minimally invasive Topaz tricuspid heart valve illustrated in Figure 2. shows the interactions of various stakeholders in the field of cardiovascular pathology innovation ecosystems.

3.4.4 Discussion and conclusions

As identified in [40], 'orchestrating scientific work in educational research laboratories is demanding, especially when many interdisciplinary perspectives are involved'. This applies to the case of innovation ecosystems in medicine at large as well as in any specific case of tackling

with a disease or a pathology. Their role will be dramatically increasingly, as result also of the proliferation of artificial intelligence (AI) in healthcare, and as digital health start-ups are bringing new digital technologies and services to the market, allowing for cost savings and service improvements in the healthcare sector [41]. The importance that these may have on 'the growth of the respective demand and supply sides' and the resulting ecosystems has been examined in [42] with the use of a practical example.

The existing literature barely explains the complexity of ecosystems of cardiovascular innovation, regarding the range of stakeholders and their role within the ecosystem. In our report we tried to address this deficiency by means of identifying the relevant and demonstrating the complexity of cardiovascular innovation ecosystems which consist of multiple levels and each level comprises various stakeholders. Additionally, we elaborate the role of each stakeholder in the engagement within the ecosystem and follow the dynamics of cardiovascular research through the analysis of its catalysts. The outcomes reinforce the point of innovation ecosystems continuously advancing, rather than functioning at a certain level of development.

Germany's cardiovascular innovation ecosystems thrive due to the *active participation and collaboration of a diverse set of stakeholders*. From academic institutions and healthcare providers to government agencies and patient advocacy groups, each plays a unique and critical role in driving forward advancements in cardiovascular care. As innovation continues to evolve in response to the ever-changing landscape of cardiovascular diseases, these stakeholders will remain essential in shaping the future of German healthcare. The development of collaborations between key stakeholders in Germany has undeniably improved interactions within the ecosystem of cardiovascular innovation, supporting a conducive environment for the synergistic evolution of technologies and the equitable exchange of resources.

3.5   Identification of medical ecosystems in the field of mental health diseases with Cologne as a central location

As part of the network formation towards a Europe-wide smart health innovation hub under the leadership of the Horizon Europe SHIFT-HUB project, our work was on the identification of specific med-tech ecosystems in the field of mental illness with Cologne as the central location. To this aim, the websites of involved organisations were used for data research purposes and the members of the ecosystem or network were identified by acquiring information about their cooperation partners. A variety of selection criteria have been applied to filter out whether these partners were suitable to be considered as a further starting point for the research. The results indicate the existence of ecosystems in the field of mental illness with Cologne as the central location, in which various stakeholders, including healthcare institutions, healthcare providers, foundations, NGOs and the business community, work closely together. Larger institutions are usually networked at an international level, while smaller institutions increasingly depend on and foster regional partnerships. This promotes cooperation and the exchange of knowledge at the regional level and facilitates direct contact with the people affected. Research institutions in the field of mental illness often receive financial support from

commercial organisations, which highlights the importance of the business community's involvement in tackling mental illness and promoting research. The article highlights the complexity and interdisciplinarity of the ecosystem, with all the different categories of institutions occupying an indispensable position. It is likely that this interaction between stakeholders at international, regional and local levels can help to deploy resources more effectively and improve the quality of life of people with mental illness.

In the context of this network formation, work presented in this article deals with the search for specific medical ecosystems in the field of mental illness with Cologne as the central location. The aim is to examine whether cross-networks exist between stakeholders across different categories of institutions and whether these connections go beyond a regional context.

3.5.1 Methodology

To begin with, it should be noted that there are parallels in the method applied in [43], as both works pursued similar goals in different subject areas.

The data we employed were determined on the basis of an internet research with all information coming exclusively from the websites of the investigated partners, so that only long-term partners were noted and short-term collaborations have not been taken into account. The procedure can be seen graphically in Figure 1 below.

First, an Internet browser was used to search for possible facilities located in Cologne under the keyword of the disease category "mental illness". Starting from this "facility 1", a search was then carried out on their website for co-operation partners. These were noted on a list, sorted alphabetically and highlighted in colour depending on their location.

All partners with a Cologne location were highlighted in red, those with a Germany-wide location in blue and those with an international location in green. It is important to note that only cooperation partners that are directly related to the topic were listed. For example, cooperation partners that fall under orthopaedics are not included.

In the next step, the relevance of the partners was assessed as possible stakeholders that could be considered for further research. As this study is specifically concerned with the search for ecosystems located in Cologne, this assessment was only made for partners highlighted in red.

Partners were only categorised as relevant if their area of employment was directly or indirectly related to the topic of mental illness. However, this distinction is often not entirely clear-cut and, in cases of doubt, is a matter of subjective judgement, but it allows the relevant stakeholders to be narrowed down in the wider context and is therefore essential. For example, a company that provides financial support to a relevant stakeholder may be considered as a partner, but is not to be considered as a stakeholder itself due to its different focus. A clinic with a particular specialisation in the field of mental illness is therefore both a partner and a relevant stakeholder and is used for further research insofar as its (main) headquarters are located in Cologne.

For a better overview, the relevant partners were highlighted in bold. The search for further partners was continued using the approach described above, starting only from these partners, which are highlighted in red and in bold and are accordingly localised in Cologne and considered to be relevant stakeholders.
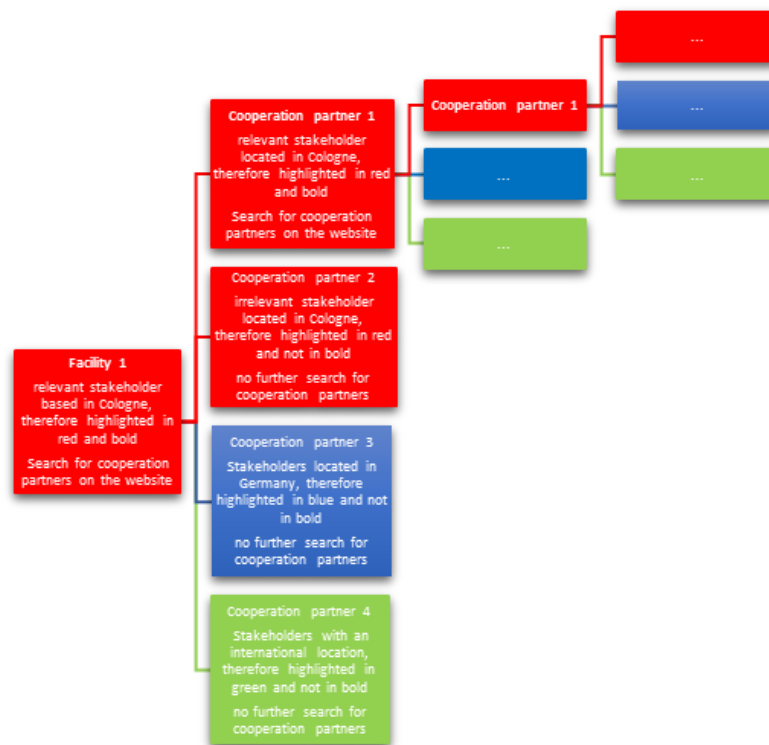
Figure 22: Example of data research

In order to filter the data somewhat and focus on larger organisations, smaller stakeholders such as GP practices were not included in the list.

In order to clearly present the stakeholders and partners noted on the list, the presentation of the results is divided into two different parts:

1. In the first part, the (colourless) Cologne stakeholders and the researched (coloured) partners following the colon are listed in alphabetical order.

2. The second part consists of the stakeholder list, which contains all previously mentioned stakeholders and partners.

In order to make the results clear and, if necessary, suitable for a proper visualisation, each stakeholder and each partner were assigned a specific code consisting of one or more letters and a number. This promptly provides information about the type of organisation. In addition, the codes have been highlighted in colour as described above to make the location of the facility clear. The letters provide a direct overview of which subgroup the stakeholder belongs to. The letter "B" stands for Business support organisations, "C" for Companies, "Gc" for Governmental agencies/companies, "Ga" for Governmental authorities, "Hcs" for health care schools, "H" stands for stakeholders from the subgroup Hospitals and Healthcare professionals, "O" for Organisations founded by healthcare professionals, "Pa" for Patient associations and patient advocacy groups and "R" for Research. The stakeholders were also sorted alphabetically and numbered in order in the list of stakeholders for the sake of clarity. Figure 2 shows only one possible graphical representation. The Alexianerkrankenhaus serves as an example facility from which researched partners are further listed according to the coded schemes. Due to the overview and size, not all partners were listed in detail, but the graphical representation could

be extended. The Alexianerkrankenhaus can be replaced by any stakeholder listed in the results list and a new chart can be created with the corresponding partners.

All the names in this paper are not translated to English to keep the alphabetic order of their original names.

Figure 23: Example of graphical representation

3.5.2   Results

For practical reasons and the limitations in space, this paper exclusively features the stakeholders and partners outlined in the provided example as this appears in Tables 1 and 2 below. Consequently, not every category is represented, and the codes might be intricate. For a comprehensive overview, readers may refer to the publicly shared Zenodo repository list [44].

The list of results illustrates the large number of institutions based in Cologne that deal with the topic of mental illness and maintain an effective network with each other.

The relevant organisations listed as stakeholders can be divided into five main categories. The category "Hospitals and healthcare professionals" comprises fourteen stakeholders, "Research" two, "Patient associations and patient advocacy groups" five, "Governmental agencies/companies" two, "Organisations founded by health care professionals" three and in the category "Companies" there are two stakeholders.

Each stakeholder that is relevant to the topic has a different number of partners listed. It is worth noticing that larger institutions such as the University Hospital of Cologne list a

considerable number of partners, among which there are regional, national and international connections. In addition, these partners cover significantly more of the listed categories than partners of smaller institutions. The list shows, for example, close cooperation between research institutions and commercial enterprises.

Smaller organisations such as the Alexian Hospital in Cologne have fewer partners and focus more on regional networking. Many non-profit organisations and foundations are strongly networked with each other. It is also worth noticing that there are organisations that serve as stakeholders and make a targeted contribution to networking, such as the PSAG (Psychiatrie-Sozial-Arbeits-Gesellschaft), which has set itself the goal of strengthening professional cooperation between the associations, societies and services active in the field of psychiatry by identifying deficits in psychiatric and psychosocial care in Cologne and developing solutions. (Psychosocial Working Group (PSAG) Cologne, undated).

Hospitals and healthcare professionals

Alexianer Krankenhaus Köln (H1):

(Alexianer Köln GmbH, undated; Psychosoziale Arbeitsgemeinschaft (PSAG) Köln, 2017)

- Psychosoziale Arbeitsgemeinschaft PSAG Köln (O8)

LVR Klinik Köln (H14):

(LVR Klinik Köln, undated; Psychosoziale Arbeitsgemeinschaft (PSAG) Köln, 2017)

- Deutsche Sporthochschule Köln (R7)
- Erfolgsfaktor Familie (Gc2)
- Hochschule Fresenius (R15)
- Psychosoziale Arbeitsgemeinschaft PSAG Köln (O8)
- Uniklinik Köln (H26)

Tagesklinik Alteburger Straße (H23):

(Klinik Alteburgerstraße gGmbH, undated; Psychosoziale Arbeitsgemeinschaft (PSAG) Köln, 2017)

- MVZ Alteburger Straße (H15)
- Psychosoziale Arbeitsgemeinschaft PSAG Köln (O8)

Organisations founded by Health Care Professionals

Psychosoziale Arbeitsgemeinschaft PSAG Köln (O8):

(Psychosoziale Arbeitsgemeinschaft (PSAG) Köln, 2017; Rat und Tat e.V., undated)

- Alexianer Krankenhaus Köln (H1)
- Alexianer Werkstätten GmbH (C2)
- ASB Alten- und Pflegeheime Köln GmbH (C7)
- AWO Kreisverband Köln e.V. (Pa4)
- BTZ Berufliche Bildung Köln GmbH (C9)
- Caritas Wertarbeit (C11)
- Caritasverband für die Stadt Köln e.V. (Gc1)
- Der Sommerberg AWO Betriebsges. mbH (C14)
- Diakonie Köln und Region (C15)
- DRK-Kreisverband e.V. (O6)
- Förderverein für psychische kranke Mitbürger im Stadtbezirk Köln-Kalk (Pa18)
- Förderverein für psychische kranke Mitbürger im Stadtbezirk Köln-Mühlheim (Pa19)
- LVR Klinik (H14)
- Rat und Tat e.V. – Hilfsgemeinschaft für Angehörige von psychisch Kranken (Pa31)
- SKM Köln e.V. (Pa33)

- Sozialdienst katholischer Frauen Köln e.V. (Pa34)
- Stadt Köln Gesundheitsamt (Ga5)
- Stiftung Leuchtfeuer (Pa35)
- Tagesklinik Alteburger Straße (H23)
- Uniklinik Köln (H26)

Table 9: Stakeholders and their partners (Part 1)

Companies:

C2: Alexianer Werkstätten GmbH

C7: ASB Alten- und Pflegeheime Köln GmbH

C9: BTZ Berufliche Bildung Köln GmbH

C11: Caritas Wertarbeit

C14: Der Sommerberg AWO Betriebsges. mbH

C15: Diakonie Köln und Region

Governmental agencies/companies:

Gc1: Caritasverband für die Stadt Köln e.V.

Gc2: Erfolgsfaktor Familie

Governmental authorities:

Ga5: Stadt Köln Gesundheitsamt

Hospitals and Healthcare Professionals:

H1: Alexianer Krankenhaus Köln

H14: LVR Klinik Köln

H15: MVZ Alteburger Straße

H23: Tagesklinik Alteburger Straße

H26: Uniklinik Köln

Organisations founded by Health Care Professionals:

O6: DRK-Kreisverband e.V.

O8: Psychosoziale Arbeitsgemeinschaft PSAG Köln

Patient associations and patient advocacy groups:

Pa4: AWO Kreisverband Köln e.V.

Pa18: : Förderverein für psychische kranke Mitbürger im Stadtbezirk Köln-Kalk

Pa19: : Förderverein für psychische kranke Mitbürger im Stadtbezirk Köln-Mühlheim

Pa31: Rat und Tat e.V. - Hilfsgemeinschaft für Angehörige von psychisch Kranken

Pa33: SKM Köln e.V.

Pa34: Sozialdienst katholischer Frauen Köln e.V.

Pa35: Stiftung Leuchtfeuer

Funded by the European Union

Research:
R7: Deutsche Sporthochschule Köln
R15: Hochschule Fresenius

Table 10: Stakeholders

3.5.3 Discussion

The results of our performed stakeholder analysis indicate the existence of a strong ecosystem for the field of mental illness that has Cologne as its central location. The results show that various actors from healthcare institutions, healthcare providers, foundations and NGOs work closely together to provide comprehensive support for people with mental illness.

The results also confirm the fact that large institutions such as the University Hospital of Cologne in particular play a central role as a value added mediator between different categories of stakeholders. One reason for this could be that such institutions have the necessary resources and expertise to act as an important interface between different stakeholder categories and at regional, national and international level due to their number of employees and size.

Research institutions also often have close links to industry, as research and development are closely linked in many sectors. This applies in particular to the pharmaceutical industry, as the development of drugs is heavily dependent on scientific research. For example, Novartis and Janssen Pharmaceutica NV are pharmaceutical companies that are partners of University Hospital Cologne.

Participation and support from industry in research institutions can help promote innovation. This emphasises the need for appropriate regulation and transparency regarding the relationships between industry and other players in the ecosystem.

Smaller stakeholders focussing on regional activities may be less visible but play an important role in regional networking. These smaller actors are often highly interconnected, suggesting that there is a dense network of organisations in the region that share common interests and goals. This can promote cooperation and the exchange of knowledge, which can be important for the development and implementation of projects. In addition, the smaller organisations in particular often work together with voluntary agencies and establish direct contact with the people affected. They therefore have a very relevant position in the individual ecosystems.

One example is Caritas Cologne, where many volunteers work. It is indirectly linked to Cologne hospitals such as the LVR Clinic or the Alexian Hospital via the PSAG as a partner. The high number of non-profit organisations indicates their important role in networking and care. This multiple networking, also with authorities and companies, emphasises this. The results of the PSAG clearly show that there are also partners who specifically serve to link facilities.

The present results offer certain insights, but the informative value of this data collection is limited to a certain extent. The chosen method of data collection aimed to gather a large amount of information in a relatively short period of time. Whilst this can be efficient, it does have certain limitations.

If we had opted for more in-depth research over a longer period of time and expanded the stakeholder categories, it would have been possible to collect more comprehensive and detailed data. One problem is that many stakeholders may not list all partnerships and collaborations online on their websites. This means that some important partnerships may not have been captured.

Furthermore, it can be difficult to make a clear distinction between overarching topics such as mental illness and other subject areas, as the information is not always sufficiently detailed.

To overcome these challenges, one could have considered engaging directly with stakeholders to obtain more comprehensive and accurate information. The ideal and almost flawless data collection would undoubtedly be the one based on active information from all stakeholders.

Nevertheless, it can be summarised that the results show that there are a large number of different stakeholders who deal with the topic of mental illness and who work together in a complex ecosystem with Cologne as the central location. The hypotheses stated in the introduction that cross-networking exists between stakeholders across different categories of organisations and that these connections go beyond a regional context could be confirmed on the basis of the results.

3.6 Medical ecosystems of cardiovascular diseases at the Cologne site

In our work we provide information on the networking of various institutions in Cologne that deal with the topic of cardiovascular diseases. The aim was to create an overview in order to get a basic picture of the networking that would later on help us build an understanding of the dynamics of the research and innovation ecosystem and to analyse special features. The respective websites of the institutions were used for the data research and members of the network were collected via the information on partners. A variety of selection criteria have been applied to filter whether the partners were suitable as starting points for the intended research. The results were sorted, labelled and given a code so that they could be easily displayed. The research revealed that many organisations are networked with partners from their own category as well as partners from other categories of organisations. In addition, larger institutions are usually internationally networked, while smaller institutions primarily rely on regional partnerships. In addition, there are some institutions that appear to be specifically involved in networking. Institutions that conduct research usually receive financial support from commercial organisations. Smaller institutions, on the other hand, usually receive support from volunteers.

Within the framework of this network formation, the present work is related to the search for existing ecosystems in the field of cardiovascular diseases with Cologne, Germany as its centre. The data collected serves as information on existing partnerships between the individual institutions. The institutions that are connected and considered as members of the ecosystem are referred to in the scope of the paper as stakeholders.

We used the acquired data in order to check whether large stakeholders in the network are also networked supra-regionally and whether there is any cross-networking that appears between the small(er) and large(er) stakeholders.

3.6.1 Methodology

We have undertaken our work jointly with the authors of [43], who focused on the mental health ecosystem, so it was desired and intended that there are parallels in the methodology that we applied.

All data collected have been based on internet research. The information comes exclusively from the websites of the researched partners as this appears cumulatively in the bibliography section at the end of the paper. This ensures that only long-term partners who are listed on the website receive an entry. Short-term collaborations have therefore not been taken into account. The basic procedure started with any organisation that was considered as *verifiably relevant* to the research question. To ensure the latter, this was followed by a visit to the website of the same organisation, where further partners were identified there, their data were collected, noted by name and transferred to the data collection in alphabetical order.

It is important to note that only partners relating to cardiovascular diseases were documented. It should also be noted that GP practices and other very small, potential stakeholders were excluded from the research in order to reduce the amount of the acquired data and focus on more significant organisations.

In order to find out whether the identified partners could be considered as stakeholders according to the research topic and therefore include the respective organisation in the data set of stakeholders and then consequently explore its connections to further stakeholders, six different categories have been used to divide our stakeholders population:

1. Firstly, the main, central location of the partner was determined.

2. Depending on the location, this was then colour-coded.

3. The colour red indicates an entity registered in Cologne,

4. blue was used to indicate an entity registered in Germany though outside Cologne, and

5. green has been used to indicate an entity registered elsewhere outside Germany.

One may regard the above as the core part of the algorithm that we have implemented that allows also others to validate the repeatability of our applied methodology.

Furthermore, and in order to clarify whether the partner could be considered a relevant stakeholder, an assessment has been made as to whether the particular partner's main focus is directly or indirectly related to the topic of cardiovascular diseases.

This distinction cannot be made accurately and with exactness and is a matter of personal judgment in cases of doubt, but it does allow the relevant stakeholders to be narrowed down in the wider context and has been considered in this respect as essential.

For example, a company that only financially supports a relevant stakeholder is a partner but is not itself a relevant stakeholder due to its fundamentally different orientation. A hospital with a department dealing with the overarching theme of cardiovascular diseases, on the other hand, is both a partner and a relevant stakeholder. Partners with stakeholder relevance located in Cologne are highlighted in **bold**, all others are not. An example for a relevant stakeholder is

the University Hospital of Cologne since its main focus is related to the topic and it is located in Cologne.

This results in six categories into which all identified partners were categorised, two for each localisation and in combination with or without stakeholder relevance.

There are only four different categories in the presentation, as partners outside Cologne cannot be visually differentiated in terms of their relevance. This visualisation option was chosen to focus specifically on the relevant stakeholders based in Cologne. The colour coding of the individual partners indicates their localisation and thus, in the case of partners based outside Cologne, the reason why they were not considered further.

As the stakeholder relevance for these partners is not relevant to the question, it is not shown visually. If a partner was identified as a relevant stakeholder from Cologne, this served as the new starting point for the research and the same methodology was applied to it. While it is outside the scope of the present paper, it is easy to identify the potential of reflecting lines of thought into an algorithm, which in our case relate to a finite sequence of instructions in order to perform a stakeholders' computation.

In the event that only one partner listed the other as such on its website, this was nevertheless added to the data list for the other partner, as it is assumed that the partnership is based on reciprocity and was only not documented by one partner.

In cases where several smaller institutions are part of a large institution, these were not listed separately, but were listed under the name of the larger institution and the researched partners were noted together (e.g. as in the case of the Heart Centre of the University Hospital of Cologne). Figure 24 below shows the process of information retrieval again visually.
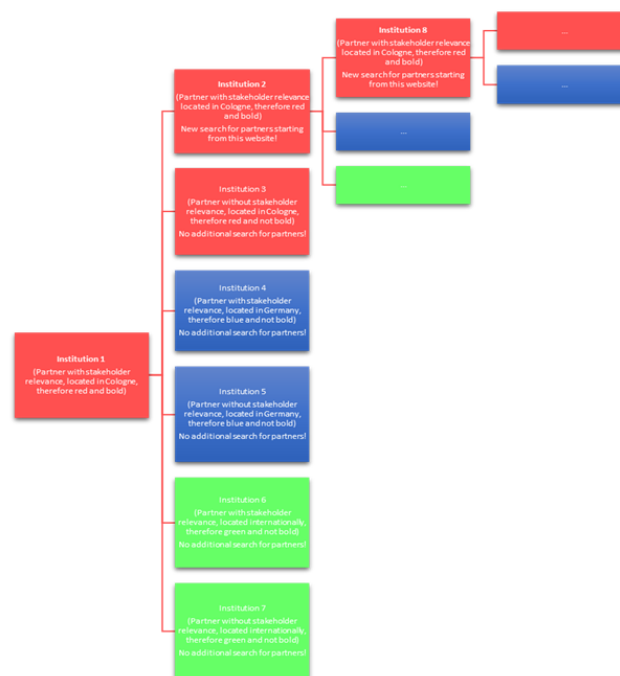
Figure 24: Example of data research

The documentation of the results consists of two parts. In the first part, the collected data was collated, and the stakeholders were assigned to their respective partners. The stakeholders and

their partners were assigned to an institution category; in the case of the stakeholders, these are the categories "Hospitals and healthcare professionals", "Organisations founded by healthcare professionals", "Patient associations and patient advocacy groups" and "Research".

One exception in this case is the University Hospital of Cologne, which could have been included to both the "Hospitals and healthcare professionals" and "Research" categories. We decided to include it to "Hospitals and healthcare professionals.

The stakeholders and their subordinate partners are then listed in alphabetical order. This provides a direct overview of the individual partnerships. Here, too, the familiar colour and formal means of presentation have been used.

For the sake of clarity, the higher-level stakeholders are not highlighted in colour. In addition, each stakeholder and or partner was assigned a code, which is derived from the second part of the results documentation and provides information on the type of organisation.

In this second part, all stakeholders and partners were listed, assigned to one of eight types of organisations and then sorted alphabetically. Each type of organisation has one or more specific letters that make up the first part of the code. For the institution type "Business support organisations", the letter code is "B" for "Companies" "C", for "Governmental agencies/companies" "Gc", for "Governmental authorities" "Ga", for "Healthcare Schools" "Hcs", for "Hospitals and healthcare professionals" "H", for "Organisation founded by healthcare professionals" "O" for " Patient associations and patient advocacy groups" "Pa", and for "Research" "R".

The different types are derived from the stakeholder organisation types. Here, too, it is not possible to allocate them with certainty. For example, a for-profit organisation is a "company", whereas a non-profit organisation is not.

The second part of the code consists of a one- to two-digit number, which is determined by the position of the organisation within the organisation category in alphabetical order. For example, the code for the hospital, which is in position 7 in the "Hospitals and healthcare professionals" category, is "H7".

This coding offers several advantages. Firstly, it allows the partner's facility category to be identified straight away, even outside the list sorted for this purpose. Secondly, because each facility can be clearly assigned to a code, the code can theoretically stand alone for its facility. Thus, in the case of a graphical representation, it would be possible to list only the code and still have direct information about the localisation, the type of institution, whether this institution is a stakeholder in relation to the question itself and, in the case of a look-up in the coding list, also about the exact name. In this way, a maximum amount of information can be obtained with a minimum of visualisation effort.

Overall, the results list serves as a basis for visualising the facts of individual stakeholders graphically, although all results could also be presented in one graphic in this way, this is unwieldy due to the lack of clarity and the total amount of data. Figure 2 below shows an example of a graphical representation, in this case with the names of the organisation, based on the stakeholder "AmKaRe". The size of the organisation also plays a role in evaluating the results. As this, in turn, is difficult to measure, obvious differences in size are used to support

the analysis. A hospital is counted as a larger facility, while a privately organised sports group, for example, counts as a small facility.

All the names in this paper are not translated to English to keep the alphabetic order of their original names.

Figure 25: Example of graphical representation

3.6.2   Results

For practical reasons and the limitations in space, this paper only features the stakeholders and partners which were listed in the example as this appears in Tables 1 and 2 below. Therefore, not every Category is shown, and the Codes can appear as confusing. For the complete results, readers may refer to the publicly shared Zenodo repository list [45].

The lists of results confirm that the institutions in the Cologne ecosystem that deal with the topic of "cardiovascular diseases" are strongly networked. Overall, the relevant stakeholders from Cologne can be divided into three categories. There are 24 relevant stakeholders in the category "Hospitals and healthcare professionals", one relevant stakeholder in the category "Organisations founded by healthcare professionals", eight relevant stakeholders in the category "Patient associations and patient advocacy groups" and three relevant stakeholders in the category "Research".

All institutions relevant to the research question have at least one, often several partners. Patterns can be recognised in this networking. Large institutions, such as the University Hospital of Cologne, have many different partners, while smaller institutions, such as the PAN-Klinik am Neumarkt, tend to list fewer partners.

Many stakeholders have partners from other institution categories (e.g. hospitals that work together with companies). It should be noted that research and large institutions sometimes work together with companies, while smaller institutions tend to receive support from voluntary organisations.

There are also differences between these two groups in terms of the localisation of the partners. Large organisations often have national and sometimes international partners, while smaller organisations tend to have regional networks. It is also noticeable that there appear to be several stakeholders that are specifically intended to promote networking. One such example is the case of the Kölner Infarkt Modell e.V. (Cologne Infarct Model), which, with the support of some companies, is a registered association that links all Cologne hospitals that provide internal medicine care to one another. It is also important to mention that state institutions are also part of the network and cooperate with private institutions.

Category 1: Hospitals and healthcare professionals

AmKaRe (H1):

(Gesundes Herz, undated)

- Deutsche Sporthochschule Köln (R4)
- Helios Kliniken (H10)
- Kölner Herzzentrum (H16)
- Krankenhaus Porz am Rhein (H20)
- Netzwerk Diabetischer Fuß Köln und Umgebung (Pa3)
- St. Vinzenzhospital (H33)
- Uniklinik Bochum Herzzentrum (H35)
- Uniklinik Bonn (H36)
- Uniklinik Freiburg Herzzentrum (H38)
- Uniklinik Köln (H39)
- Uniklinik Leipzig Herzzentrum (H40)
- Universität Witten Herdecke (R14)

Kooperatives Kölner Herzzentrum (H16):

(Gesundes Herz, undated, Kooperatives Kölner Herzzentrum, undated)

- AmKaRe (H1)
- Helios Klinik Siegburg Herzzentrum (H9)
- Krankenhaus Porz am Rhein (H20)
- MVZ Porzer Herz und Gefäßzentrum (H22)
- Uniklinik Bochum Herzzentrum (H35)

Table 11: Stakeholders and their partners (Part 1)

Hospitals and Healthcare Professionals:

H1: AmKaRe

H9: Helios Klinik Siegburg Herzzentrum

H10: Helios Kliniken

H16: Kooperatives Kölner Herzzentrum

H20: Krankenhaus Porz am Rhein

H22: MVZ Porzer Herz und Gefäßzentrum

H33: St. Vinzenzhospital

H35: Uniklinik Bochum Herzzentrum

H36: Uniklinik Bonn

H38: Uniklinik Freiburg Herzzentrum

H39: Uniklinik Köln

H40: Uniklinik Leipzig Herzzentrum

Patient associations and patient advocacy groups:

Pa3: Netzwerk diabetischer Fuß Köln und Umgebung

Research:

R4: Deutsche Sporthochschule Köln

R14: Universität Witten Herdecke

Table 12: Stakeholders

3.6.3   Discussion

We are convinced that the developed method of obtaining information is in general suitable for the context of the analysis we have performed. The chosen approach enables quite straightforward and less time taking data research with a good level of granularity for the acquired data.

However, there are some limitations to this method. Inaccuracies already arise in the definition of "partner". As the research relies on the information provided by the individual stakeholders, the definition of the partnership also lies with the stakeholders. As there is also no standardised information from the partners, there is a high probability that the partner list is incomplete using this research method. For example, some partners, such as the Cologne Sports University, have not provided their own information on partners and have therefore only made a passive appearance by being listed as partners by other stakeholders.

It is also obvious that medical practices were not included in the research. This would have meant an enormous expenditure of time with little gain in knowledge, but now leads to an incomplete overview of the cardiovascular network in Cologne. The result therefore contains a part of the network. This certainly allows conclusions to be drawn on the topic but cannot be regarded as a complete overview.

In our presentation, the code system provides a direct overview of localisation, type of facility and relevance as a stakeholder, but not of the size of the facility. Although this can be researched on the websites, it cannot be precisely defined and is therefore only approximately reliable.

The topic of cardiovascular diseases can also only be vaguely defined, which makes data selection difficult in some cases. The results allow various conclusions to be drawn. First and foremost, it seems to be an advantage to be networked as a stakeholder, as the multiple networking indicates this. The hypotheses were also confirmed. The results also fit the picture in other respects. While small stakeholders are of little relevance to large companies and organisations from abroad, voluntary work in particular appears to support small stakeholders. This could be related to the fact that the smaller organisations work close to the private individual, the patient. They are often the first point of contact for patients, as they are more

familiar, local and personal to the patient than the large facilities. This means that these people are more likely to be involved in this area.

Against the background of patient proximity, some larger stakeholders such as hospitals also have an interest in working with smaller facilities. In this way, patients who do not necessarily need to be treated in large hospitals can be referred to smaller facilities, and patients who necessarily need treatment in a large hospital can be referred from the small facilities to the large ones.

Although this is common practice even without a partnership, it can be organised in a more targeted and coordinated way. The large companies, on the other hand, support the large stakeholders. These are often those that also conduct research, as the companies hope to gain a financial advantage in the long term. For example, pharmaceutical companies usually work together with research institutions to develop new drugs, which they can then offer for sale.

It is also not surprising that state institutions are part of the network, as they have regulatory oversight and an interest in expanding the network to improve healthcare provision. One indication that networking is beneficial for the stakeholders overall is the existence of certain organisations that appear to serve the sole purpose of networking. Apparently, a need for connection was seen in this context, which is why, for example, the registered association "Kölner Infarkt Modell e.V." was founded in the specific case, which serves the purpose of supporting hospitals in the care of the widespread disease "heart attack". Overall, it can therefore be said that the networking of individual stakeholders is often worthwhile for moral and financial reasons.

3.7   Open science practices note

In accordance to open science practices that we follow in the Shift-Hub project, content that appears in this Deliverable has been shared in repositories like Zenodo and / or has been subject of open access publications to which we explicitly mention, as required, the support and financing of the work that is taking place from the Shift-Hub project.

Working papers shared through Zenodo:

Heimann, J., Dannenberg, C., Koumpis, A., & Beyan, O. (2023). Complete list of identified stakeholders related to "Medical ecosystems of cardiovascular diseases at the Cologne site". Zenodo. https://doi.org/10.5281/zenodo.10257118	v.1, 4 December 2023
Dannenberg, C., Heimann, J., Koumpis, A., & Beyan, O. (2023). Complete list of identified stakeholders related to "Medical ecosystems in the field of mental health diseases with Cologne as a central location". Zenodo. https://doi.org/10.5281/zenodo.10257217	v.1, 4 December 2023
Adamantios Koumpis, Elísio Costa, Cláudia Campos, Yiannis Geragotellis, Efi Mpakogianni, Paul Stefanut, Odysseas Spyroglou, Bolieraki, E., & Konstantinidis, E. (2023). Lean schemas for service offer formats in innovation ecosystems. Zenodo. https://doi.org/10.5281/zenodo.10040493	v.2, 25 October 2023 v.1, 24 June 2023

Adamantios Koumpis, Paul Stefanut, & Odysseas Spyroglou. (2023, May 10). Task 5.1 Methodology for stakeholder analysis. Zenodo. https://doi.org/10.5281/zenodo.7922548	v.1 10 May 2023
Adamantios Koumpis, Paul Stefanut, & Odysseas Spyroglou. (2023). Identifying expectations and views of stakeholders regarding the SHIFT-HUB service offer. Zenodo. https://doi.org/10.5281/zenodo.7852323	v.1 21 April 2023

Publications:

Stanislav Kirichenko, Adamantios Koumpis, Oya Beyan (2023) Stakeholders of Cardiovascular Innovation Ecosystems in Germany: A first level analysis and an example, International Journal of Online and Biomedical Engineering (iJOE) Vol. 19 No. 18 (2023) [Open Access]	To appear in December 2023
Cara Dannenberg, Johannes Heimann, Adamantios Koumpis, Oya Beyan, Identification of medical ecosystems in the field of mental health and cardiovascular diseases at the Cologne site, accepted for publication and to appear in the issue 05 March 2024 of the International Journal of Online and Biomedical Engineering (iJOE) [Open Access]	Submitted December 2023

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Conclusion

Across various stakeholders in the healthcare sector, several common themes and needs emerge. These shared concerns and requirements reflect the interconnected nature of healthcare and the importance of a collaborative approach to address challenges. Some overarching themes and needs that cut across different healthcare stakeholders:

Digital Transformation

Stakeholders, including practitioners, organisations, and policymakers, share a common need for digital transformation in healthcare. This includes the adoption of electronic health records (EHRs), telemedicine, health information systems, and data analytics to enhance patient care, streamline processes, and improve overall efficiency.

The SHIFT-HUB project is a pan-European network for smart health solutions that aims to establish a patient-driven approach for creating and adopting smart health solutions. The project will create a network of healthcare organisations that will implement selected smart health applications after they have been tested by patients and online users . SHIFT-HUB will identify a pool of 100 high potential Smart Health apps, that will be assessed by at least 300 patients and citizens during 5 Living Lab events, 1500 users on-line and will be connected to at least 50 Healthcare organizations for further uptake.

Interoperability and Data Sharing

Ensuring interoperability and promoting secure data sharing among different healthcare systems is a shared need. Stakeholders recognize the importance of seamless communication to facilitate coordinated care, prevent duplication of efforts, and enhance the overall patient experience.

In order to increase the outreach and the impacts at the pan-European level, Shift-Hub offer also aims to establish a pan-European network of multidisciplinary partners representing stakeholders, across the dimensions of the quadruple helix, able to participate to the value co-creation process.

The service capitalizes on the current partnerships, collaborations and dense networks of the consortium members that cover extensively all the target groups. From the technological perspective, the network leverages:

1) A pool of 1000 Technology Transfer Centres worldwide integrated in the Steinbeis Foundation's ecosystem (https://www.steinbeis.de/en/network/searching-for-steinbeis-experts.html), further enriched by thematic communities established in the scope of projects conducted by S2i like the Enterprise Europe Network that allowed to establish public mappings bringing an important value to community members seeking cooperation;

2) 30 Networks members of the Digital SME Alliance (EDSA) weighing for 45.000 companies across Europe in the field of Digital Technologies;

3) The strong cooperation of Cleyrop with Gaia-X and some of its 333 members (https://www.gaia-x.eu/membership) working together for the development of sovereign European cloud offer, as well as with the IDSA (https://internationaldataspaces.org);

4) A pool of over 150+ active Living Labs across 5 continents members of ENoLL (among a network of 440+ Living Labs built over the last 14 years).

Patient-Centred Care

Prioritising patient-centred care is a common theme. Healthcare practitioners, organisations, and policymakers aim to involve patients in decision-making, enhance communication, and tailor healthcare services to meet individual needs and preferences.

The concept of a living lab aims to bridge the gap between research, patients, health professionals, etc., regarding practical applications by bringing them together to co-create, test, and validate innovative healthcare solutions and technologies in a controlled yet authentic setting. By creating an immersive and interactive process that allows citizens and patients to discover emerging Smart Health solutions and provide valuable feedback to the developers, Shift Hub Living Labs empowers patients and citizens by enabling them to tailor solutions to their needs and thereby match the supply and demand of the healthcare industry and drive the adoption of emerging digital solutions.

Shift-Hub will organise 5 Living Labs, one for each of the five pathologies with the highest health impact, where 20 Apps providers will be selected (for each) by a committee of experts to allow a pool of at least 100 patients and/or citizens to test their solutions in an immersive manner and provide feedback. Six serious play workshops (at least 2 per year) x at least 50 participants will be Involved.

Preventive Health and Wellness

Stakeholders are increasingly focused on preventive health measures to reduce the burden of diseases. This includes health promotion, disease prevention campaigns, and interventions aimed at addressing lifestyle-related factors contributing to health issues. The cornerstone of health prevention is health literacy and behavioural change. To address this issue SHIFT-HUB has collected educational materials ranging from simple videos to full courses to help its stakeholders navigate the world of smart health - SHIFT-HUB's catalogue of educational resources (D3.2). Among the courses provided, learners can find materials aimed at increasing health literacy for patients and general population, as well basic ICT skills to increase the uptake of technological solutions.

Health Equity and Access

Achieving health equity and ensuring access to quality healthcare for all is a universal goal. Stakeholders aim to address disparities in healthcare access, outcomes, and resource distribution, with a focus on vulnerable populations and underserved communities. Health literacy is also crucial to ensure health equity and access, hence, that citizens regardless of their socio-economic status are aware of self-management options to keep themselves healthy for longer. Once more, SHIFT-HUB's catalogue of educational resources provides accessible (generally free and with no educational levels as entrance barriers) for patients/citizens, but also for health care professionals, including courses on how to manage the health of more "at risk" populations, such as the elderly, people with neurological diseases, and migrant populations.

Development and Well-Being

Stakeholders emphasise continuous professional development, workforce planning, and measures to enhance the well-being of professionals to ensure sustainable and high-quality services. Reiterating the benefits of health literacy, once patients/citizens are aware of treatment options, beneficial behaviours and healthy lifestyles, their health outcomes are generally improved. SHIFT-HUB's catalogue of educational resources features, for example, some courses on diabetes management, that range from a scientific explanation of the disease to more practical healthy living guidelines, to help these patients not only deal with their chronic illness but thrive regardless of it.

Innovation and Research

This involves supporting initiatives that advance medical knowledge, develop new therapies, and promote the adoption of cutting-edge technologies to improve patient outcomes. The SHIFT-HUB consortium has deployed the 1st Open innovation Workshops in 2023 to engage with likeminded partners in order to develop competitive and relevant teams to work on EU relevant topics - such as obesity - design innovative to address them and apply for funding. Furthermore, research developed in relation to D3.2 was based around a web survey that reached over 300 individuals, whose main results are already featured in the respective deliverable, and may in the future, result in a scientific paper.

Public Health and Education

Stakeholders work towards raising awareness, promoting healthy behaviours, and addressing public health challenges through comprehensive education and outreach programs.

Collaboration and Partnership

This involves fostering partnerships between public and private sectors, academia, industry, and international organisations to leverage collective expertise and resources for healthcare improvement. SHIFT-HUB has also a plan on how to reach out and engage with its stakeholders. Individual stakeholders are invited to join the Community Platform, where they can sign up and receive news and updated from the project, and organisational partners are prompted to sign Shift-Hub Memorandum of Understanding, to establish an informal a mutually beneficial partnership were both organizations agree to participate in activities to boost bilateral synergies and the uptake of smart health solutions.

Value-Based Care

Stakeholders share an interest in transitioning towards value-based care models. This involves focusing on outcomes, patient satisfaction, and cost-effectiveness to drive improvements in the quality and efficiency of healthcare services.

Shift-Hub initiative for Stakeholder's promotion, cooperation and procurement opportunities service focuses on making the community members, their solutions and services visible and bridging the market gap. A particular emphasis will be put on creating procurement opportunities for Smart Health solutions and services providers. Through the demonstrations organised for the professionals in the community, along with the marketplace established and the involvement of patients and citizens through the network of Living Labs, Shift-Hub offer would be able to maximise the visibility of the community members, having at least 1000 matchmaking activities and generate on the overall 100 successful cooperation.

Addressing these common themes and needs requires a coordinated effort among stakeholders, including healthcare practitioners, organisations, policymakers, researchers, and the broader community. A holistic and collaborative approach is essential to drive positive change and enhance the overall effectiveness of healthcare systems.

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Annex

Innovation Intermediaries

This is a mapping of relevant Business Support Organisations and Innovation Intermediaries like clusters, networks, incubators, accelerators, commerce chambers.

Organization Name	Region	Type
GERMANY		
4C Accelerator	Baden-Württemberg	Accelerator
Bayern Innovativ	Bavaria	Business Support / EEN
Berlin Partner	Berlin	Business Support / EEN
BioLAGO	Baden-Württemberg	Cluster
BioPharma Cluster South Germany e. V.	Baden-Württemberg	Cluster
BioRegio Freiburg	Baden-Württemberg	Cluster
BioRegio STERN	Baden-Württemberg	Cluster
BioValley	Baden-Württemberg	Cluster
CODE_n SPACES	Baden-Württemberg	Incubator
Cubex One/Cubex 41	Baden-Württemberg	Incubator
CyberForum	Baden-Württemberg	Cluster
CyberLab	Baden-Württemberg	Accelerator
DIGIHUB Südbaden 2.0	Baden-Württemberg	Digital Hub
Digital Chemistry & Digital Health 5-HT	Baden-Württemberg	Digital Hub
Digital Hub Neckar-Alb und Sigmaringen	Baden-Württemberg	Digital Hub
Digital Hub Nordschwarzwald	Baden-Württemberg	Digital Hub
Digital Hub Oberschwaben	Baden-Württemberg	Digital Hub
Digital Hub Region Bruchsal Walldorf	Baden-Württemberg	Digital Hub

Digital Hub Schwarzwald-Baar-Heuberg	Baden-Württemberg	Digital Hub
Digital.FuturES	Baden-Württemberg	Digital Hub
Digitalisierungszentrum Ostwürttemberg	Baden-Württemberg	Digital Hub
Digitalisierungszentrum Ulm	Baden-Württemberg	Digital Hub
EDIH AICS	Baden-Württemberg	EDIH
EDIH Digicare	Bavaria	EDIH
EDIH Südwest	Baden-Württemberg	EDIH
Gesundheitsnetzwerk Schwarzwald-Baar	Baden-Württemberg	Cluster
Gesundheitsregion KölnBonn	North Rhine-Westphalia	Cluster
HealthRegion Freiburg e. V.	Baden-Württemberg	Cluster
heilbronn-franken: connected	Baden-Württemberg	Digital Hub
IHK Bodensee Oberschwaben	Baden-Württemberg	Commerce Chamber
IHK Heilbronn-Franken	Baden-Württemberg	Commerce Chamber
IHK Hochrhein-Bodensee	Baden-Württemberg	Commerce Chamber
IHK Karlsruhe	Baden-Württemberg	Commerce Chamber
IHK Nord-Schwarzwald	Baden-Württemberg	Commerce Chamber
IHK Ostwürttemberg	Baden-Württemberg	Commerce Chamber
IHK Reutlingen	Baden-Württemberg	Commerce Chamber
IHK Rhein-Neckar	Baden-Württemberg	Commerce Chamber
IHK Schwarzwald-Baar-Heuberg	Baden-Württemberg	Commerce Chamber
IHK Stuttgart	Baden-Württemberg	Commerce Chamber
IHK Südlicher Oberrhein	Baden-Württemberg	Commerce Chamber

IHK Ulm	Baden-Württemberg	Commerce Chamber
Innotec Pforzheim	Baden-Württemberg	Incubator
InnoWerft	Baden-Württemberg	Incubator
KIT Gründerschmiede	Baden-Württemberg	Accelerator
KIT Hightech Inkubator	Baden-Württemberg	Incubator
Life Science Accelerator	Baden-Württemberg	Accelerator
Mannheim Medical Technology Cluster	Baden Württemberg	Cluster
Medical Mountains	Baden-Württemberg	Cluster
ReDiKo – Digital Hub Region Rutesheim	Baden-Württemberg	Digital Hub
Start-Up Campus Germany	Berlin	Accelerator
Startup Mannheim	Baden-Württemberg	Incubator
TechnologyMountains e. V.	Baden-Württemberg	Cluster
Wirtschaftsförderung Brandenburg	Brandenburg	Business Support / EEN
ZENIT	North Rhine-Westphalia	Business Support / EEN
Zentrum Digitalisierung Region Stuttgart	Baden-Württemberg	Digital Hub
FRANCE		
21 l'Accélérateur d'innovation sociale de la Croix Rouge française	Île-de-France	Accelerator
Accélérateur BioMedTech	Île-de-France	Accelerator
Amiens Cluster	Hauts-de-France	Cluster
Biolabs Hôtel-Dieu	Île-de-France	Incubator
Biovalley France	Grand Est	Cluster
Cancer Campus Gustave Roussy	Île-de-France	Cluster

Connected Health Lab	Occitanie	Living Lab
EDIH Occitania	Occitanie	EDIH
Eurasanté	Hauts-de-France	Business Support
Eurasenior	Hauts-de-France	Incubator
Eurobiomed	Occitanie	Cluster
France Biotech	Île-de-France	Cluster
Future4care	Île-de-France	Accelerator
Future4care	Île-de-France	Cluster
Genopole	Île-de-France	Cluster
HCL Innovation Department	Auvergne-Rhône-Alpes	Innovation Platform
Innov'Pôle Santé (IPS)	Occitanie	Innovation Facilitator
iPEPS-ICM (Incubateur de Startups Santé Paris-Salpêtrière)	Île-de-France	Incubator
Medicen	Île-de-France	Cluster
Paris Biotech Sante	Île-de-France	Incubator
Paris Saclay Cancer Cluster	Île-de-France	Cluster
PariSanté Campus	Île-de-France	Cluster
Prevent2careLab	Île-de-France	Accelerator
Silver Valley	Île-de-France	Cluster
Spartners by Servier & BioLabs	Île-de-France	Accelerator
Springboard by Imagine	Île-de-France	Accelerator
Tech Care Paris (Paris & co)	Île-de-France	Incubator
Villejuif Biopark	Île-de-France	Cluster
VIVINNOV	Occitanie	Business Support
WILCO - HEALTHCARE	Île-de-France	Accelerator

GREECE		
Alexander Innovation Zone	Central Macedonia	Innovation Hub
Asklipieia Health Cluster	National	Cluster
Athens Chamber of Commerce & Industry	Attica	Chamber
AUTH Technology Transfer Office	Central Macedonia	Technology Transfer Office
EUKARDIA Cluster	National	Cluster
Health Hub	Thessaly	EDIH
Hellenic Digital Health Cluster	National	Cluster
HL7 Hellas	Attica	Standards Organisation
iED Health Hub	Thessaly	EDIH
JOIST Innovation Park	Thessaly	Innovation Park
OK Thess	Central Macedonia	Innovation Hub
PYTHeIA	Thessaly	Competence Center
smartHEALTH	Crete	EDIH
BELGIUM		
All Digital	Brussels	Network
EHTEL	Brussels	Network
EUREGHA	Brussels	Network
LiCalab	Antwerp	Living Lab
ROMANIA		
bioROne	Iasi	Cluster
Center for Innovation in Medicine	Bucharest	Innovation center
Cluj IT	Cluj	Cluster
Clusterul Medical Sănătate România	Bucharest	Cluster

Digital Innovation Zone	Iasi	EDIH
Imago Mol Cluster	Iasi	Cluster
ROHEALTH Cluster	Bucharest	Cluster
Romanian Association for Electronic Industry and Software (ARIES)	National	Network
Romanian Innovation Relay Center (RoIRC)	National	Network
Spherik Accelerator	Cluj	Accelerator
TechHub Bucharest	Bucharest	Digital Hub
Techsylvania	Cluj	Conference
PORTUGAL		
AEP - Associação Empresarial de Portugal	Norte	Chamber of Commerce
B.acis	Norte	Health Innovation Center
CoLAB TRIALS	Norte	
Health Cluster Portugal	Norte	Cluster
HealthTech Lisboa	Lisbon	Accelerator
Resolve Health	Norte	Accelerator
Startup Braga	Norte	Accelerator
Tecminho	Norte	Technology Transfer Office
UPTEC	Norte	Tech Hub
VOH.CoLAB	Lisboa	Collaborative Laboratory
ITALY		
INISME	Latium	Network
OTHER COUNTRIES		
Cluster Saúde de Galicia	Galicia, Spain	Cluster
ECHAlliance	Ireland	Network

EIT Digital	Europe	European Institute of Innovation & Technology
EIT Health	Europe	European Institute of Innovation & Technology
GAIA	Basque Country, Spain	Cluster
Slovenian Innovation Hub	Slovenia	Innovation Hub

Financial Intermediaries

This is a mapping of relevant Financial Intermediaries like private investors (Business Angels, VCs, banks), institutional investors and regional development agencies.

Organization Name	Region	Type
GERMANY		
Bundesverband Beteiligungskapital	Berlin	Equity Capital
Business Angels Deutschland e.V.	North Rhine-Westphalia	Business Angel
First Momentum	Baden-Württemberg	Venture Capital (pre-seed)
Grazia Equity	Baden-Württemberg	Early Stage Investor
High Tech Gründerfonds	Baden-Württemberg	Fonds
Invest BW	Baden-Württemberg	Regional Public Funding
KfW	Hesse	Bank
L-Bank	Baden-Württemberg	Bank
LBBW Venture Capital	Baden-Württemberg	Venture Capital
LEA Partners	Baden-Württemberg	Venture Capital
MBG Baden-Württemberg	Baden-Württemberg	Equity Capital
Smart In Venture GmbH	North Rhine-Westphalia	Venture Capital
VC Ventures	Baden-Württemberg	Venture Capital
W&W brandpool	Baden-Württemberg	Venture Capital

FRANCE		
Adbio Partners	National	Venture Capital
Angels Santé	Regional/National	Business Angels
Bioam	National	Venture Capital
BPI France	National	Bank
Extens	National	Venture Capital
Karista	National	Venture Capital
Kurma Partners	International	Venture Capital
LBO France	National	Venture Capital
Majycc innovation Santé	National	Venture Capital
MH Innov'	National	Venture Capital
Seventure Partners	National	Venture Capital
Sofinnova Partners	National	Venture Capital
Turenne Groupe	National	Venture Capital
XAnge	National	Venture Capital
GREECE		
Alexander Innovation Zone	Thessaloniki	Investments
Anthology Ventures	National	Venture Capital
Gnomon SA	National	Business Angel
Metavallon	Attica	Venture Capital
Uni.Fund	Attica	Venture Capital
VIDAVO	Thessaloniki	Venture Capital
ROMANIA		
Banca Comercială Română	Bucharest	Bank
Libra Bank	Bucharest	Bank
Transilvania Bank	Cluj-Napoca	Bank

PORTUGAL		
Biovance Capital	Lisboa	Venture Capital
FCJ EUROPE	Lisboa	Venture Capital
Ground Capital	Lisboa	Venture Capital
Portugal Ventures	Norte	Venture Capital
Semeia Ventures	Lisboa	Venture Capital

Public Authorities

This is a mapping of relevant public authorities like regional and national innovation/development agencies, ministries and governmental agencies or companies.

Organization Name	Region	Type
GERMANY		
Bio-Pro	Baden-Württemberg	Regional agency
Bundesministerium für Gesundheit	National	Ministry
Bundeszentrale für gesundheitliche Aufklärung	National	Governmental Agency
BW-i	Baden-Württemberg	Regional agency
Ministerium für Soziales, Gesundheit und Integration BW	Baden-Württemberg	Ministry
FRANCE		
Agence de Numérique en Santé (ANS)	National	Governmental Agency
Conseil Régional Ile de France	Régional	Governmental Agency
Ministère de la Santé et de la Prévention	National	Ministry

Observatoire régional de santé (ORS)	Régional	Governmental Agency
GREECE		
Health Regions of Macedonia	Macedonia	Regional Authorities for Public Health
Hellenic Intermunicipal Network of Healthy Cities of the P.O.Y.	National	Network of Municipalities
Regional Development Fund – Central Macedonia	Central Macedonia	Regional Development Agency
RIS3 One Stop Liaison Office	Central Macedonia	Regional Development Agency
ROMANIA		
Hospital Administration Bucharest	Bucharest	Hospital Administration
Ministry of Health Romania	National	Ministry
National Agency for Medicines and Medical Devices of Romania	National	Governmental Agency
National Authority for Data Protection and Freedom of Information	National	Governmental Agency
National Authority for Scientific Research and Innovation (ANCSI)	National	Governmental Agency
National Authority of Quality Management in Health	National	Governmental Agency
National Centre for Health Management	National	Governmental Agency
National Centre for Mental Health	National	Governmental Agency
National Institute of Public Health	National	Governmental Agency
National Institute of Research and	National	Governmental Agency

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Development in Informatics		
National Insurance House Romania	National	
Romanian Agency for Innovation	National	Governmental Agency
Romanian Innovation Relay Center	National	Public Project
PORTUGAL		
Administração Regional de Saúde do Norte	Norte	Ministry
Agrupamento de Centros de Saúde do Grande Porto VII - Gaia	Norte	Public facility
Câmara municipal de Almada	Lisboa	Municipality
Câmara municipal de Matosinhos	Norte	Municipality
Câmara municipal de Sintra	Lisboa	Municipality
Câmara municipal do Porto	Norte	Municipality
Junta de Freguesia do Bonfim	Norte	Municipality
OTHER COUNTRIES		
Galaria	Galicia, Spain	Public Company

Research Institutes

This is a mapping of relevant Research Institutes like public and private research institutes and organisations, competence centres and technology parks.

Organization Name	Region	Type
GERMANY		
Albert-Ludwigs-Universität Freiburg	Baden-Württemberg	University

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Bosch Health Campus	Baden-Württemberg	Private Research Institute
Centres for personalized medicine	Baden-Württemberg	Competence Centres
Department of Medical Informatics at the University Medical Center Göttingen	Lower Saxony	University Institute
Eberhard-Karls-Universität Tübingen	Baden-Württemberg	University
Fraunhofer FIT (Digital Health)	North Rhine-Westphalia	Public Research Institute
Fraunhofer IML (Applied Artificial Intelligence)	North Rhine-Westphalia	Public Research Institute
Fraunhofer IPA (Clinical health technologies)	Baden-Württemberg	Public Research Institute
Fraunhofer ISI (Artificial Intelligence)	Baden-Württemberg	Public Research Institute
FZI Forschungszentrum Informatik	Baden-Württemberg	Non-profit research institute
German Cancer Research Center	Baden-Württemberg	Foundation
Hahn-Schickard	Baden-Württemberg	Non-profit research institute
Hochschule Heilbronn (GECKO)	Baden-Württemberg	University Institute
Hochschule Offenburg	Baden-Württemberg	Applied University
Institut für Medizintechnologie der Universität Heidelberg und der Hochschule Mannheim	Baden-Württemberg	University Institute
Karlsruhe Institute for Technology	Baden-Württemberg	University
Landeskompetenzzentrum Pflege & Digitalisierung	Baden-Württemberg	Competence Centre

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mannheim institute for human centered innovation	Baden-Württemberg	University Institute
Mannheim Institute for intelligent Systems in Medicine	Baden-Württemberg	University Institute
Medical Informatics Center, University Hospital Leipzig	Saxony	University Institute
Medical Informatics Group, Berlin Institute of Health, Charité - Universitätsmedizin Berlin	Berlin	University Institute
Reutlingen Research Institute	Baden-Württemberg	University Institute
Ruprecht-Karls-Universität Heidelberg	Baden-Württemberg	University
Technische Hochschule Ulm (Institut für Informatik/Medizintechnik und Mechatronik)	Baden-Württemberg	University Institute
Technologiepark Heidelberg	Baden-Württemberg	Technology Park
Technologiepark Karlsruhe	Baden-Württemberg	Technology Park
Universität Ulm	Baden-Württemberg	University
FRANCE		
Campus Santé Rouen	Normandie	Health Campus
Centre de recherche en épidémiologie et santé des populations (INSERM - Université Paris Sud)	Île-de-France	Public Research Institute
CERIM (Centre d'Etudes et de Recherche en Informatique Médicale)	Île-de-France	Public Research Institute
FOReSIGHT - Institut de la Vision, le CHNO des Quinze-Vingts, Sorbonne Université, l'Inserm	Île-de-France	Public Health Research Institute

GIS-IReSP | Institut pour la Recherche en Santé Publique	Île-de-France	Public Research Institute
ICAN - institut du cardiométabolisme et de la nutrition	Île-de-France	Public Health Research Institute
IHU-A-ICM - Institut du Cerveau et de la Moelle épinière	Île-de-France	Public Health Research Institute
IMAGINE - institut des maladies génétiques	Île-de-France	Public Health Research Institute
Institut Cochin	Île-de-France	Public Research Institute
Institut Curie	Île-de-France	Public Research Institute
Institut de la Vision	Île-de-France	Public Research Institute
Institut du Cerveau et de la Moelle épinière	Île-de-France	Public Research Institute
Institut Mines-Télécom	Île-de-France	Public Research Institute
Institut national de la santé et de la recherche médicale	National	Public Research Institute
Institut Pasteur	Île-de-France	Public Research Institute
Institut PPH (Paris Public Health)	Île-de-France	Public Research Institute
SimUSanté	Hauts-de-France	University research centre
GREECE		
Bioinformatics and Human Electrophysiology Laboratory, Department of Informatics, Ionian University	Ionian Islands	University Institute
Biomedical Research and Education Special Unit - AUTH	Central Macedonia	University Institute
Biotechnology Laboratory, University of Ioannina	Epirus	University Institute

Center for Innovation & Entrepreneurship ARCHIMEDES	Attica	University Center
Centre for Research and Technology Hellas - CERTH	National	Non-profit research institute
Foundation for Research and Technology - Hellas (FORTH)	National	Public research institute
Hellenic Society for Biomedical Technology	Attika	
HYGIEIA Scientific Research and Educational Cluster	Attica	Research Cluster
Institute for the Study of Urologic Diseases (ISUD) – AUTH	Central Macedonia	University Institute
Interdisciplinary Agri-Food Center (KEAGRO) - AUTH	Central Macedonia	University Institute
Medical School of Athens	Attica	University
Open Knowledge Foundation of Greece	National	Non-profit organization
University of Thessaly - Department of Physical Education and Sport Science	Thessaly	University Institute
ROMANIA		
Centre for Health Policies and Services	Bucharest	Non-profit research institute
Institutul Național de Cercetare – Dezvoltare pentru Științe Biologice București (INCDSB)	Bucharest	Public Research Institute
Institutul National De Cercetare-Dezvoltare In Domeniul Patologiei Si Stiintelor Biomedicale "Victor Babes"	Bucharest	Public Research Insitute

National Institute of Infectious Disease "Matei Bals"	National	Public Research Institute
Syreon Research Romania	Bucharest	Private Research Institute
Universitatea De Medicina Si Farmacie Din Craiova	Craiova	University
Universitatea de Medicină și Farmacie Iuliu Hațieganu	Cluj	University
Universitatea De Medicina, Farmacie, Stiinte Si Tehnologie "George Emil Palade" Din Targu Mures	Targul Mures	University
Universitatea Politehnica București	Bucharest	University
Universitatea Politehnica Timișoara	Timisoara	University
University of Medicine and Pharmacy "Carol Davila"	Bucharest	University
PORTUGAL		
Biomaterials, Biodegradables and Biomimetics Research Group of University of Minho	Norte	University institute
CINTESIS – Center for Health Technology and Services Research	National	Public Research Institute
Escola Superior de Enfermagem do Porto	Norte	Nursing School
Escola Superior de Saúde do Politécnico do Porto	Norte	Higher education institution
Escola Superior de Tecnologia da Saúde de Coimbra: ESTESC	Norte	Higher education institution
Escola Superior Saúde Santa Maria	Norte	Nursing School

Fraunhofer Portugal	National	Non-profit research institute
i3s - Instituto de Investigação e Inovação em Saúde da Universidade do Porto	Norte	University Institute
Institute of Molecular Pathology and Immunology of the University of Porto - Ipatimup	Norte	University Institute
Instituto de Engenharia Biomédica – INEB	Norte	Non-profit research institute
Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência	Norte	Non-profit research institute
Instituto de Saúde Pública da Universidade do Porto (ISPUP)	Norte	Non-profit research institute
Instituto Politécnico de Bragança	Norte	Higher education institution
Intituto português de Oncologia	National	Public research institute
ISEP - Instituto Superior de Engenharia do Porto	Norte	Higher education institituion
ISMAI - Instituto superior da Maia	Norte	Higher education institution
NOVA Medical School	Lisboa	Higher education institution
Universidade Católica Portuguesa - Porto	Norte	Higher education institution
Universidade de Aveiro	Centro	University
Universidade do Algarve	Algarve	University
University of Lisbon	Lisboa	Higher education institution
University of Minho	Norte	Higher education institution

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ITALY		
Centro Nazionale delle Ricerche (CNR)	National	Public Research Insitute
Instituto di Gestalt	Sicily	Private Research Institute
University of Catania – Department of Electrical, Electronic and Computer Engineering	Sicily	University
University of Catania – Political and Social science department	Sicily	University
University of Messina	Sicily	University
OTHER COUNTRIES		
ENoLL – European Network of Living Labs	Europe	Living Lab Network
Ghent University - imec	Belgium	University institute
Hincks Centre for Entrepreneurship Excellence	Ireland	Research and Training on Entrepreneurship
IDIAPJGol	Spain	Research Foundation

Public and Private Health institutions

This is a mapping of relevant public and private health institutions, like (university) hospitals, organizations of practitioners, practices and health care professionals.

Organization Name	Region	Type
GERMANY		
Bund Deutscher Psychologinnen und Psychologen	National	Professional association
Bundesärztekammer	National	Professional association
Charité – Universitätsmedizin Berlin	Berlin	University Hospital

Deutscher Berufsverband für Pflegeberufe e.V.	National	Professional association
Klinikum Stuttgart	Baden-Württemberg	University Hospital
Landesärztekammer Baden-Württemberg	Baden-Württemberg	Professional association
LMU Klinikum München	Bavaria	University Hospital
Städtisches Klinikum Karlsruhe	Baden-Württemberg	University Hospital
Universitätsklinikum Bonn	North Rhine-Westphalia	University Hospital
Universitätsklinikum Freiburg	Baden-Württemberg	University Hospital
Universitätsklinikum Heidelberg	Baden-Württemberg	University Hospital
Universitätsklinikum Leipzig	Saxony	University Hospital
Universitätsklinikum Tübingen	Baden-Württemberg	University Hospital
Universitätsklinikum Ulm	Baden-Württemberg	University Hospital
Universitätsmedizin Essen	North Rhine-Westphalia	University Hospital
Universitätsmedizin Göttingen	Lower Saxony	University Hospital
Universitätsmedizin Mannheim	Baden-Württemberg	University Hospital
FRANCE		
APHP - Assistance publique – Hôpitaux de Paris	Île-de-France	Public Health Institution
AP-HP . Centre – Université Paris Cité	Île-de-France	Public Health Institution
AP-HP . Nord – Université Paris Cité	Île-de-France	Public Health Institution
AP-HP. Hôpitaux Universitaires Henri Mondor	Île-de-France	Public Health Institution

AP-HP. Hôpitaux Universitaires Paris Seine-Saint-Denis	Île-de-France	Public Health Institution
AP-HP. Sorbonne Université	Île-de-France	Public Health Institution
AP-HP. Université Paris Saclay	Île-de-France	Public Health Institution
Centre Hospitalier Régional D'Orléans, CHU Orléans	Centre-Val de Loire	University Hospital
CHRU de Nancy	Grand Est	Universtiy Hospital
CHU Amiens-Picardie	Hauts-de-France	University Hospital
CHU de Bordeaux	Nouvelle-Aquitaine	University Hospital
CHU de Caen Normandie	Normandie	University Hospital
CHU de Nice	Provence-Alpes-Côte d'Azur	University Hospital
CHU de Rouen	Normandie	University Hospital
CHU de Toulouse	Occitanie	University Hospital
CHU de Tours	Grand Ouest	University Hospital
CHU du Brest	Bretagne	University Hospital
CHU Montpellier	Occitanie	University Hospital
CHU Rennes - Pontchaillou Hospital	Bretagne	University Hospital
Hospices Civils de Lyon - CHU de Lyon	Auvergne-Rhône-Alpes	University Hospital
L'association Santé Bien être des Coquelicots	Auvergne-Rhône-Alpes	Physical Therapy
Les Hôpitaux Universitaires De Strasbourg	Grand Est	University Hospital
GREECE		
AHEPA General Hospital	Central Macedonia	University Hospital
Athens Eye Hospital	Attica	Specialised Hospital

Athens Medical Group	National	Private Healthcare Group
Charisio Nursing Home	Central Macedonia	Nursing Home
Civil Non-Profit Company IASIS NGO	Attika	Non-profit organisation
Hellenic Healthcare Group	National	Private Healthcare Group
Hellenic Society of Medical Oncology (HeSMO)	National	Scientific Organization
Ippokrateio General Hospital	Central Macedonia	University Hospital
Papageorgiou General Hospital	Central Macedonia	University Hospital
REA Obstetrics Gynecology Clinic	Attica	Specialised Hospital
ROMANIA		
Clinical Hospital of Obstetrics and Gynaecology "Elena Doamna"	Iasi	Public Hospital
Emergency Children Hospital "Grigore Alexandrescu"	Bucharest	Public Hospital
Infectious and Tropical Disease Hospital "Victor Babes"	Bucharest	Public Hospital
Municipal Emergency Hospital Barlad	Vaslui	Public Hospital
National Society of Family Physicians	National	Professional association
Order of General Nurses, Midwives and Nurses of Romania	National	Professional Association
Romanian College of Physicians	National	Professional Association
Romanian Society of Pneumatologists	National	Professional Association

Romanian Society of Rheumatologist	National	Professional Association
PORTUGAL		
ACeS Gaia	Norte	Primary care provider
Centro Hospitalar Universitário Santo António	Norte	University Hospital
CHU São João	Norte	Public Hospital
CIDIFAD - Santa Casa da Misericórdia de Riba de Ave	Norte	Care provider for Dementia
Hospital de Braga EPE	Norte	Public Hospital
Lusíadas Saúde	National	Private Hospital
Mello Saúde	National	Private Hospital
NeuroCog	Lisboa	Rehabilitation Center
Ordem dos Enfermeiros	Norte	Professional association
Ordem dos Nutrionistas	National	Professional association
Ordem dos Psicólogos	National	Professional association
Secção Regional do Norte Ordem dos Médicos	Norte	Professional association
Somos saúde	Norte	Physical Therapy
Unidade Local de Saúde de Matosinhos	Norte	Primary care provider
ITALY		
Azienda ospedaliera Universitaria San Marco	Sicily	University Hospital
Ospedale Galeazzi	Lombardy	Private Hospital
OTHER COUNTRIES		
AMEN - Nursing Home	Cyprus	Nursing Home
EFPIA - European Federation of	European	Industry association

Pharmaceutical Industries and Associations		
International Society of Geriatric Oncology (SIOG)	International	Professional association

Patients and Citizens Organizations

This is a mapping of relevant Patients and Citizens organisations.

Organization Name	Region	Type
GERMANY		
BundesArbeitsGemeinschaft der PatientInnenstellen	National	Patient Organisation
Deutsche Arbeitsgemeinschaft Selbsthilfegruppen	National	Patient Organisation
Deutscher Behindertenrat	National	Patient Organisation
Verbraucherzentrale Bundesverband e.V.	National	Citizens Organisation
FRANCE		
Santé respiratoire France	National	Patient Organisation
GREECE		
Alma Zois: Association of Women with Breast Cancer	Thessaloniki	Patients Organisation
Angelman Syndrome Greece Association	National	Patients Organisation
Association of Parkinson's Patients and Friends of Northern Greece	Northern Greece	Patients & Citizens Organisation
Athens Alzheimer Association	Attica	Patients Organisation
Floga – Parents' Association of Children with Cancer	National	Patients Organisation
Greek Association of Alzheimer's Disease and	National	Patients Organisation

Related Disorders of Chalkida		
Greek Carers Network (EPIONI)	National	Association of informal carers
Greek Patients Association	National	Patients Organisation
Greek Society of Migraine and Headache Patients	National	Patients Organisation
Hellas for Us	National	NGO
Hellenic Association of Women with Breast Cancer "Alma Zois"	National	Patients Organisation
Hellenic Cystic Fibrosis Association	National	Patients Organisation
Hellenic Headache Alliance	National	Patients Organisation
Hellenic Pulmonary Fibrosis Association	National	Patients Organisation
HELLESCC Hellenic Society of Crohn's Disease and Ulcerative Colitis' Patients	National	Patients Organisation
K.E.F.I. Association of Cancer Patients, volunteers, Friends and Doctors of Athens	Attica	Patients Organisation
K3-Cancer Patient Guidance Center	Central Macedonia	Patients Organisation (Cancer)
Long Covid Greece	National	Patients Organisation
National Confederation of Disabled People (ESAEA)	National	Citizens Organisation
Society of Patients and Friends of Patients with Inherited Metabolic Disease "KRIKOS ZOIS"	National	Patients Organisation
ROMANIA		
Alaturi de Voi Romania Foundation	Bucharest	NGO

Association for Counselling and Education in Healthcare	Iasi	NGO
Association for Development and Inclusion	Bucharest	NGO
Association My Child My Heart	National	Patient organisation
Association of Alternation Methods of Social Integration	Bucharest	NGO
Association of Atopic Dermatitis	National	Patient organisation
Association of Patients with Fabry Disease in Romania (APBFR)	National	Patient organisation
Association of Patients with Myasthenia Gravis	National	Patient organisation
Association of Patients with Pulmonary Hypertension	National	Patient organisation
Association of Patients with Rheumatic Inflammatory Disease	National	Patient organisation
Association of Patients with Scleroderma	National	Patient organisation
Association of Patients with Transplants	National	Patient organisation
Association of Patients with Tuberculosis Multidrug resistance	National	Patient organisation
Association of Young People with Diabetes	National	Patient organisation
Bethany Foundation of Social Services	Iasi	NGO
Concordia Academia	Bucharest	NGO
Health for Community Association	National	Patient organisation

National Alliance of Rare Disease	National	Patient organisation
National Unions of People with HIV/SIDA	National	Patient organisation
Rebeca Faith Love Association	National	Patient organisation
Romanian Angel Appeal Foundation	Bucharest	NGO
Romanian Association of Haemophilia	National	Patient organisation
Romanian Society of People suffering from Alzheimer	National	Patient organisation
Save the children association	Bucharest	NGO
PORTUGAL		
Associação Alzheimer Portugal	National	Patient organisation
Associação Portuguesa de Tratamento de Feridas	National	Patient organisation
Associação Protectora dos Diabéticos de Portugal (APDP)	National	Patient organisation
Caritas Coimbra	Norte	NGO
Impulso positivo	National	Citizen organisation
Médicos do Mundo	National	NGO
Santa casa da Misericordia da Amadora	Lisboa	Citizen organisation
ITALY		
AIMaC - Italian Association of Cancer Patients, Relatives and Friends	National	Patient Organisation
Associatione Italiana Diabetici	National	Patient Organisation

Associazione di Promozione Sociale Food Allergy Italia	National	Patient Organisation
Associazione Pazienti BPCO	National	Patient Organisation
CESIE	Sicily	Centre Of Studies And Initiatives
Cittadinanzattiva APS	Rome	Citizen organisation
e-Medine - Europe Direct Catania	Sicily	Non-profit Organisation
F.A.I.S. OdV (Federazione Associazioni Incontinenti e Stomizzati)	National	Patient Organisation
FederASMA e ALLERGIE Odv – Federazione Italiana Pazienti	National	Patient Organisation
OTHER COUNTRIES		
Asociación Cultural Gallega de Formación Permanente de Adultos - ATEGAL	Spain	Citizens Organisation
Bulgarian Association for Patients Defence	Bulgaria	Patient Organisation
European AIDS Treatment Group (EATG)	Europe	Patient Organisation
European Cancer Organisation	Europe	NGO
European Heart Network	Europe	Alliance
European Institute for Local Development	Europe	NGO
European Patients Forum	Europe	Patient organisation
EURORDIS – Rare Diseases Europe	Europe	Alliance
Foro Español de Pacientes	Spain	Patient Organisation
NAPO - National Association of Patient Organizations	Czech Republic	Patient Organisation

National Patient Organisation Bulgaria	Bulgaria	Patient Organisation

Start-Ups, SMEs and other companies

This is a mapping of relevant Business Support Organisations and Innovation Intermediaries like clusters, networks, incubators, accelerators, commerce chambers.

Organization Name	Region
GERMANY	
Actimi GmbH	Baden-Württemberg
Ada Health	Berlin
AIRAmed GmbH	Baden-Württemberg
Averbis	Baden-Württemberg
Avetana	Baden-Württemberg
Becure GmbH	Baden-Württemberg
Beurer	Baden-Württemberg
Bosch Healthcare	Baden-Württemberg
Buddy	Berlin
Derma Intelligence GmbH	Baden-Württemberg
Fimo Health GmbH	North Rhine-Westphalia
Honic	Baden-Württemberg
idana	Baden-Württemberg
Living Brain	Baden-Württemberg
Mawendo GmbH	Baden-Württemberg
Mesalvo GmbH	Baden-Württemberg
PURAITE	North Rhine-Westphalia
SMART IN MEDIA AG	North Rhine-Westphalia
zana technologie	Baden-Württemberg

FRANCE	
ALOGIA Groupe	Île-de-France
BOUGER	Hauts-de-France
Dépist&vous	Nouvelle-Aquitaine
FACIL'ITI	Nouvelle-Aquitaine
H'ability	Grand Est
IDP SANTE	Grand Ouest
Lojelis SAS	Auvergne-Rhône-Alpes
Louise	Nouvelle-Aquitaine
MediWAT	Hauts-de-France
Moha – My Own Health Activity	Hauts-de-France
Myotact	Nouvelle-Aquitaine
ReMotion	Hauts-de-France
TheraCinetic SARL	Nouvelle-Aquitaine
VERTEXA	Hauts-de-France
WAVE UP	Nouvelle-Aquitaine
GREECE	
A FINE HOUSE SA	Attica
ABCURED	Eastern Macedonia & Thrace
Advanced Biochemicals and Consulting PSE	Attica
ADVANTIS MEDICAL IMAGING	Attica
AIDPLEX MIKE	Central Macedonia
BioAssist	Dytiki Ellada
Capemed	Epirus
CAPTAIN Coach	Central Macedonia
CibusMed	Attica

Cogninn	Attica
Computer Solutions	Attica
DeepMed IO	Attica
EMMA	Central Macedonia
Enios Applications PC	Attica
EYE PCR	Crete
GNOMON SA	Central Macedonia
Hellenic Development and Testing Electronics (HDTE)	Central Greece
iKnowHow	Attica
Intelligencia	Attica
Metabio	Central Macedonia
MindMed	Crete
Netcompany-Intrasoft SA	Central Macedonia
ResQ Biotech	Dytiki Ellada
VIDAVO	Central Macedonia
ViLabs	Central Macedonia
ROMANIA	
Asociatia Eurocomunicare	Bucharest
Dateligens Systems SRL	Bucharest
Gnome Design SRL	Sfantu Gheorghe
Handilug SRL	Lugoj
SC Asist Rom S.R.L.	Brasov
SC Ato Em S.R.L.	Oradea, Cluj, Zalau, Satu Mare, Hunedoara
SC Biosintex SRL	Snagov
SC Caloris Group SA	Brasov
SC Cautis J B 93 Prodcom Impex SRL	Bucharest

SC Cavrom SRL	Cluj
SC Dds Diagnostic SRL	Bucharest
SC Mebra SRL	Brasov
SC Med-Orto Janto SRL	Arad, Timisoara
SC Tehnoplus Medical SRL	Bucharest
Siemens SRL	Bucharest
SILOSI Medical Tech S.R.L.	Craiova
Smart EpiGenetX	Ilfov
Software Imagination & Vision SRL	Bucharest
Telios Care	Cluj-Napoca
Wiz Development & Services SRL	Sibiu
Wolfpack Digital SRL	Cluj-Napoca
PORTUGAL	
Ablute	Norte
Actif online	Lisbon
Addaptech	Norte
Appy Book	Norte
ASSEDIUS	Norte
BioStrike	Norte
Bright Digital	Norte
Cardio Id	Norte
Cardio On	Norte
Chaperone	Norte
Complear	Norte
Everythink	Norte
FES Agency	Norte

Flainar	Norte
Fykia Biotech	Norte
Gripwise Tech	Norte
Humanized Solutions	Lisbon
iLof	Norte
i-medical	Norte
IMMUNETHEP	Norte
Impacting Group	Norte
Inova+	Norte
Inovapotek	Norte
Kinetikos Health	Lisbon
Knok Care	Norte
LeGut	Norte
Lipowise	Norte
MedSky	Norte
Metablue Solution	Norte
Mycareforce	Norte
Neuroinova	Norte
Nuada	Norte
Onya	Norte
Orgavalue	Norte
OVANTIS	Norte
Papayya	Norte
Peek Med	Norte
Promptly	Norte
Ruby NanoMed	Norte

Sensing Future Technologies	Centro
Spinnerdynamics	Norte
Surgeon Mate	Norte
Virtual Care	Norte
Wisify	Norte
ITALY	
HT APPS	Sicily
Infobiotech	Sicily
PMF RESEARCH	Sicily
VITALE TECNOLOGIE COMUNICAZIONE - VITECO SRL	Sicily
WITA	Trentino-Alto Adige

REPORT/ DELIVERABLE NAME