

ANNEX 1 - CLUSTER 1: HEALTH

1. Global Challenges and their Drivers

Diseases and disabilities pose a major societal and economic burden on citizens and health systems of the EU and worldwide. Non-communicable diseases, including mental disorders and illnesses, are currently responsible for up to 80% of health care costs in the EU¹⁴. This will further increase should the ageing society¹⁵ not adopt healthier lifestyles and more effective health care approaches. Likewise, infectious diseases, including antimicrobial resistant infections, represent a major health risk to people as well as a serious cross-border health security threat for countries in the EU and worldwide. These challenges call for more health promotion, better disease prevention and more effective solutions to manage diseases and reduce disease burden as well as for health care systems throughout the EU that are reformed to become more accessible, sustainable, resilient and efficient in promoting and protecting everyone's health and delivering health care of high quality to all citizens. To that end, new approaches for integrated, person-centred and equitable health care are required, which take into account specific needs of citizens and population groups throughout the life course, the influence of environmental, behavioural and socio-economic risk factors on human health and well-being, the opportunities offered by new tools, technologies, and digital solutions, and are built on a competent, reliable, secure and competitive European system of health care service developers, suppliers and providers. Research and innovation will be instrumental to develop these new approaches as well as to increase the knowledge, understanding and know-how that underpin innovation for promoting health and for preventing, treating, curing and recovering from diseases, including rehabilitation, reintegration and survivorship. It will also require that new, better and more cost-effective health care services supported by innovative tools, technologies, and digital solutions become available that respond to the health needs of citizens and populations for promoting and protecting their health, preventing and managing their diseases, and assisting them in pursuing a longer, independent and active life in a rapidly changing society. Unleashing the full potential of digital technologies and health data will be a strong driver to achieve this outcome, and contributing to the European Health Data Space¹⁶. Cooperation with other sectors will maximise societal benefits, drive innovation and ensure optimal impact. Accordingly, research and innovation interventions under Cluster 1 Health will be oriented towards the following six health-related challenges (targeted impacts):

- Staying healthy in a rapidly changing society;
- Living and working in a health-promoting environment;
- Tackling diseases and reducing disease burden;
- Ensuring access to sustainable and high-quality health care;
- Unlocking the full potential of new tools, technologies and digital solutions for a healthy society;
- Maintaining a sustainable and globally competitive health-related industry.

These challenges are complex and interdependent. They have been chosen because they address key concerns and provide a clear perspective on what benefits people, patients and populations as well as institutional, social and economic stakeholders can expect from research and innovation interventions supported under this cluster. Moreover, there are challenges transcending both national and continental boundaries and requiring international approaches to address them

¹⁴ Non-communicable - or chronic - diseases are diseases of long duration and generally slow progression, and are the result of a combination of genetic, physiological, environmental and behavioral factors. The four main types of non-communicable diseases (NCDs) are cardiovascular diseases (like heart attacks and stroke), cancer, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma) and diabetes. NCDs are by far the leading cause of death in the world, representing 63% of all annual deaths. NCDs kill more than 36 million people each year. Some 80% of all NCD deaths occur in low- and middle-income countries. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>

¹⁵ The share of the population aged over 65 on average across EU countries has increased from less than 10% in 1960 to nearly 20% in 2015 and is projected to increase further to nearly 30% by 2060.

¹⁶ Mission letter of the Commissioner for health, https://ec.europa.eu/commission/sites/beta-political/files/mission-letter-stella-kyriakides_en.pdf

effectively, including through research and international development cooperation, as part of the Union's commitment to global health, universal health coverage and SDG 3.

1.1 Staying healthy in a rapidly changing society

People's health and care needs are different, depending on their age, stage of life and socio-economic background.¹⁷ Their physical and mental health and well-being can be influenced by their individual situation as well as the broader societal context they are living in. Furthermore, health education and behaviour are important factors. Currently, more than 790'000 deaths per year in Europe are due to risk factors such as smoking, drinking, physical inactivity, and obesity.^{18,19} Upbringing, income, education levels, social and gender aspects also have an impact on health risks and how disease can be prevented. Moreover, people's health can be impacted by a rapidly changing society, making it challenging to keep pace and find its way through new technological tools and societal changes, which both are increasing demands on the individual's resilience. In order to leave no one behind, to reduce health inequalities and to support healthy and active lives for all, it is crucial to provide suitable and tailor-made solutions, including for people with specific needs.

1.2 Living and working in a health-promoting environment

The environment we live and work in has direct beneficial or negative impacts on human health and well-being. It is a major determinant of health, estimated to account for almost 20% of all deaths in Europe.²⁰ The factors causing these impacts on both physical and mental health are not all identified nor their effects comprehensively understood and accounted for in decision-making.²¹ There are still considerable knowledge gaps in the understanding of the environmental, occupational and socio-economic risk factors for health and well-being. These risk factors include pollution, chemicals, noise, radiation, urbanisation, climate and other environmental changes, socio-economic inequalities, and changing working environments, and are influenced by lifestyle and behavioural factors. Moreover, the determinants of a health-promoting environment need further understanding and evidence.

¹⁷ For instance, the number of Europeans over 65 with age-related impairments is expected to grow from 68 million in 2005 to 84 million in 2020. It calls for new and tailor-made innovations that support the elderly in managing their impairment in daily life up to re-establishing body functions and capabilities.

¹⁸ Health at a glance Europe 2018 (OECD, European Commission)

¹⁹ A growing health threat for children and adolescents is overweight and obesity due to raising physical inactivity combined with unhealthy eating habits. Over 60% of children who are overweight before puberty will be overweight in early adulthood. Childhood obesity potentiates the risk for developing cardiovascular disease, type 2 diabetes, physical disabilities, orthopaedic and psychological problems, and underachievement in school. Obesity is one of the greatest public health challenges of the 21st century whose prevalence has tripled in many EU countries since the 1980s.

²⁰ WHO Europe: Environment and Health at <http://www.euro.who.int/en/health-topics/environment-and-health>

²¹ Annually more than 400'000 premature deaths in the EU are caused by outdoor air pollution, mostly due to chronic diseases (with heart and lung being most affected) and respiratory infections. The heat wave that swept across Europe in 2003 resulted in 70'000 premature deaths. WHO estimated that the disease burden preventable through sound management of chemicals in the environment to around 1.6 million lives per year. Between 2030 and 2050, climate change is expected to cause worldwide approximately 250'000 additional deaths per year, from malnutrition, malaria, diarrhoea and heat stress.

1.3 Tackling diseases and reducing disease burden

Communicable and non-communicable diseases cause the greatest amounts of premature death and disability in the EU and worldwide. They pose a major health, societal and economic threat and burden for people. Many people are still dying prematurely and suffering from these diseases. Non-communicable diseases, including mental illnesses and neurodegenerative diseases, are responsible for up to 80% of EU health care costs.²² These costs are spent on the treatment of diseases that are, to a large extent, preventable. Furthermore, although there is a huge potential for prevention, only around 3% of the health care budgets are currently spent on preventive measures. Infectious diseases, including antimicrobial resistant (AMR) infections, remain a major threat to health in the EU and global health security. AMR deaths could exceed 10 million per year worldwide according to some predictions.²³

1.4 Ensuring access to innovative, sustainable and high-quality health care

Health care systems in the EU are committed to provide people with universal access to good quality health care financed on the basis of equity and solidarity. They can contribute to economic prosperity and social cohesion in the EU. It is a main priority for the EU to support Member States in ensuring that health care systems are effective, efficient, equitable, accessible, and resilient while remaining fiscally sustainable in the medium and long term. With a view to this, the role and organisation of health care systems needs to be adapted and reformed to cope with societal trends and changes that include demographic, epidemiological, technological, environmental and socio-economic transitions.

1.5 Unlocking the full potential of new tools, technologies and digital solutions for a healthy society

Technology is a key driver for innovation in the health and care sector. It can provide better and more cost-efficient solutions with high impact and can be tailored to the specific health and care needs of patients for improving their quality of life. However, novel therapies, technologies and approaches face specific barriers and hurdles in implementation and scale-up before reaching health care systems and patients, including societal issues such as technology acceptance or public outreach. In addition, several emerging disruptive technologies and the availability of vast amounts of data and digitalisation offer big opportunities for transforming health and care and promoting health and well-being of citizens. Unlocking these opportunities depends on the capacity to collect, combine and make sense out of vast amounts of data, on the availability of appropriate regulatory frameworks and data infrastructures that will both safeguard the rights of the individual and of society, and stimulate innovation to develop impactful solutions. European Health Data Space will promote health-data exchange and support research on new preventive strategies, as well as on treatments, medicines, medical devices and outcomes. Due consideration of aspects of safety, effectiveness, appropriateness, accessibility, comparative value-added and fiscal sustainability as well as issues of ethical, legal and regulatory nature will be crucial in order to translate these innovations into health policies, health and care systems, and clinical practice.

1.6 Maintaining an innovative, sustainable and globally competitive health industry

The health industry is a key driver for growth and contributes to employment through high-value jobs and a positive trade balance, and has the capacity to provide health technologies²⁴ to the benefit of patients and providers of health and care services in Europe and worldwide. The development of novel health technologies is associated with high risks as it embraces the highest level of engineering combined with the complexity of life sciences. In addition, the health sector is strongly regulated, and many novel health technologies feature very long development times. Health industries, and in particular small and medium-sized enterprises (SMEs), may encounter

²² Currently, around 50 million people in the EU are estimated to suffer from two or more chronic conditions, and most of these people are over 65. Every day, 22'500 people die in Europe from those diseases, counting of 87% of all deaths. They account for 550'000 premature deaths of people of working age with an estimated €115 billion economic loss per year (0.8% of GDP).

²³ AMR is estimated to be responsible for 25,000 deaths per year in the EU alone and 700,000 deaths per year globally. It has been estimated that AMR might cause more deaths than cancer by 2050.

²⁴ WHO definition of 'health technology': A health technology is the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of lives.

difficulties to access the necessary investments, new markets and value-chains, or in setting-up partnerships and create alliances. Because health innovation impact healthcare, patients and society, the relevant value chains involve a broader variety of key players from supply, demand and regulatory side. A comprehensive approach relies therefore on cooperation and capacity building within a value ecosystem.

2. EU Policy Objectives

The *health and well-being of its people* is a central aim of the European Union, its policies and programmes. According to Article 168 of the Treaty on the Functioning of the EU, high level of human health protection shall be ensured in the definition and implementation of all Union policies and activities. With the proclamation of the European Pillar of Social Rights, the EU set the direction towards a fairer, inclusive and more social Europe for all European citizens based on a European social model that is fit for the challenges of the 21st century. Providing timely access to affordable, preventive and curative health care of good quality to everyone is amongst the key aspirations the EU and its Member States are aiming for, supported by dedicated regulations, policy strategies and programmes.²⁵

The EU is strongly committed to the SDGs, many of which have an important impact on health and well-being, notably SDG 3 (Good Health and Well-being for People) with its nine health-specific targets aiming for universal health coverage for all at all ages by 2030, leaving no one behind, and ending preventable deaths. EU health-related actions aim to complement national health policies and thus support EU Member States in reaching those ambitious goals, which will not be possible without a massive investment in research and innovation at the national, European and international level.

Cluster 1 will also be instrumental in supporting research and innovation actions contributing to initiatives that are part of the political guidelines and mission letters of the Commission 2019-2024, notably to a European Green Deal, to a an economy that works for people, to Europe fit for the digital age, and a stronger Europe in the world, and in particular to:

- implementing the European One Health Action Plan against Antimicrobial Resistance and combatting vaccination hesitancy;
- contributing to a Europe's Beating Cancer Plan to support EU member states in improving cancer control and care;
- creating European Health Data Space to promote health-data exchange and support research;
- developing a new Comprehensive Strategy on Africa.

3. Targeted Impacts

Research and innovation supported under Cluster 1 aims to advance knowledge, build capacities as well as design, develop and demonstrate innovative solutions that will improve the health and well-being of people and support the transformation of health care systems. However, it will also depend on the actors on the ground – those receiving, supporting and delivering health and care services in local communities, regions and countries – to accept, support, take-up, scale-up and

²⁵ For instance: Directive on patients' rights in cross-border healthcare; political declaration on prevention & control of non-communicable diseases; EU decision on serious cross-border threats to health; Commission Communication on effective, accessible and resilient health systems; Commission Communication on upgrading the single market (and its proposed health technology assessments initiative); Council conclusions on nutrition and physical activity; Council conclusion on personalised medicine and pharmaceuticals; Council conclusions on strengthening the balance in the pharmaceutical systems in the EU and its Member States; EU One Health Action Plan against Antimicrobial Resistance; Ostrava Declaration on Environment and Health; Commission Communication on the digital transformation of health and care; Council recommendation on strengthened cooperation against vaccine preventable diseases; Commission Communication 'European Plastics Strategy for a Circular Economy, Commission Communication 'Towards a Comprehensive European Union Framework on Endocrine Disruptors'; Commission Communication 'European Union Strategic Approach to Pharmaceuticals in the Environment'; EU decision on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet'

implement the recommendations and innovative solutions developed through research and innovation to achieve desired impacts. To maximise the benefits of EU investments and support the EU in achieving its goals, the cluster health will promote and foster synergies with public health policies at national and regional level, with other EU programmes and policies, as well as with health-related European infrastructures. Research and innovation activities under this Cluster shall target and contribute to the following interlinked, long-term impacts:

3.1 Staying healthy in a rapidly changing society

Research and innovation aims at supporting citizens in pursuing healthy and active lives (increased 'Healthy Life Years' HLY²⁶) by providing suitable and tailor-made solutions, including for people with specific needs, such as rehabilitation. Targeted impacts are:

1. Pregnancy and birth is safer, maternal mortality is reduced²⁷, preventable deaths of newborns and children under 5 years of age²⁸ are suppressed, and the physical and mental health and well-being of children and adolescents (and their families) is improved.^{29,30,31}
2. Citizens adopt healthier lifestyles and behaviours, make healthier choices (such as healthier food choices) and maintain longer a healthy, independent and active life with a reduced disease burden, including at old ages or in other vulnerable stages of life. They are able and empowered to manage better their own physical and mental health and well-being, monitor their health, and interact with their doctors and health care providers.³²
3. Citizens' trust in knowledge-based health interventions and in guidance from health authorities is strengthened, including through improved health literacy (including in young age), resulting in increased engagement in and adherence to effective strategies for health promotion, diseases prevention and treatment, including increased vaccination rates³³ and patient safety.
4. Citizens are protected from health risks due to misinformation³⁴, manipulation and fraud, including the sale, purchase and use of substandard, falsified³⁵ or inappropriate medicines.
5. Health policies and actions for health promotion and disease prevention are knowledge-based, targeted to citizens' needs, and designed to reduce health inequalities.

3.2 Living and working in a health-promoting environment

Research and innovation aims at protecting citizens' health from negative impacts resulting from environmental and occupational risk factors. Targeted impacts are:

1. Citizens' health and well-being is protected and promoted, and premature deaths, diseases and inequalities related to environmental pollution and degradation are prevented.^{36,37} In

²⁶ 'Healthy Life Years' (HLY), also called 'disability-free life expectancy' (DFLE), is a statistical indicator compiled separately for men and women, at birth and at ages 50 and 65, and is defined as the number of years that a person is expected to continue to live in a healthy condition. It is based on age-specific prevalence (proportions) of the population in healthy and unhealthy condition and age-specific mortality information. A healthy condition is defined as one without limitation in functioning and without disability.

²⁷ SDG3 target 3.1, 3.2, 3.7

²⁸ SDG 3 target 3.2

²⁹SDG 3 targets 3.3,3.4 , 3.5, 3.7, 3.8 and 3a. WHO Framework Convention on Tobacco Control, the Tobacco Products Directive 2014/40/EU, WHO Europe Health 2020 A European policy framework and strategy for the 21st century

³⁰ EU Action Plan on Childhood Obesity 2014-2020,

³¹ WHO Global action plan for the prevention and control of non-communicable diseases 2013-2020

³² Commission Communication on the digital transformation of health and care.

³³ Council recommendation on strengthened cooperation against vaccine preventable diseases

³⁴ Commission Communication on Tackling online disinformation – a European approach

³⁵ Directive on Falsified Medicines

³⁶ Decision No 1386/2013/EU on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet', <http://ec.europa.eu/environment/action-programme/>.

particular, the health threat and burden resulting from hazardous chemicals and air, water and soil pollution and contamination is reduced, including at the workplace, such that the related number of deaths and illnesses is substantially reduced by 2030.³⁸

2. The adaptive capacity and resilience of populations and health systems in the EU to climate and environmental change-related health risks is strengthened³⁹
3. The upstream determinants of disease - related to choices in energy generation, agricultural practices, industrial production, land use planning, built environment and construction - are known, understood and reduced.⁴⁰
4. Living and working environments in European cities and regions are healthier, more inclusive, safer, resilient and sustainable.⁴¹
5. Policy-makers and regulators are aware and better informed about environmental, socio-economic and occupational risk factors as well as health-promoting factors, including the combination of factors, for health and well-being across society.⁴² Accordingly, knowledge-based policies at EU and global level better protect and promote citizens' health and well-being, and reduce health inequalities.⁴³
6. Citizens understand better complex environment and health issues, and effective measures to address them and support related policies and regulations.⁴⁴

3.3 Tackling diseases and reducing disease burden

Research and innovation aims at decreasing the burden of diseases on citizens and health care systems. Targeted impacts are:

1. Health burden of diseases in the EU and worldwide is reduced through effective disease management, including through the development and integration of innovative diagnostic and therapeutic approaches, personalised medicine approaches, digital and other people-centred solutions for health and care. In particular, patients are diagnosed early and accurately and receive effective, cost-efficient and affordable treatment, including patients with a rare disease, due to effective translation of research results into new diagnostic tools and therapies.
2. Premature mortality from non-communicable diseases is reduced by one third (by 2030), mental health and well-being is promoted, and the voluntary targets of the WHO Global Action Plan for the Prevention and Control of NCDs 2013-2020 are attained (by 2025), with an immediate impact on the related disease burden (DALYs).^{45,46, 47}

³⁷ Ostrava Declaration of the Sixth Ministerial Conference on Environment and Health of the WHO Europe, 2017, http://www.euro.who.int/__data/assets/pdf_file/0007/341944/OstravaDeclaration_SIGNED.pdf?ua=1

³⁸ SDG 3 target 3.9

³⁹ Ostrava Declaration of the Sixth Ministerial Conference on Environment and Health of the WHO Europe, 2017, http://www.euro.who.int/__data/assets/pdf_file/0007/341944/OstravaDeclaration_SIGNED.pdf?ua=1

⁴⁰ WHO global strategy on health, environment and climate change. <https://www.who.int/phe/publications/global-strategy/en/>

⁴¹ Ostrava Declaration of the Sixth Ministerial Conference on Environment and Health of the WHO Europe, 2017, http://www.euro.who.int/__data/assets/pdf_file/0007/341944/OstravaDeclaration_SIGNED.pdf?ua=1

⁴² Ostrava Declaration of the Sixth Ministerial Conference on Environment and Health of the WHO Europe, 2017, http://www.euro.who.int/__data/assets/pdf_file/0007/341944/OstravaDeclaration_SIGNED.pdf?ua=1

⁴³ E.g. the EU's future 8th Environment Action Programme, follow-up to its Plastics Strategy and the Strategic Approach to Pharmaceuticals in the Environment, and the WHO environment and health process.

⁴⁴ Ostrava Declaration of the Sixth Ministerial Conference on Environment and Health of the WHO Europe, 2017, http://www.euro.who.int/__data/assets/pdf_file/0007/341944/OstravaDeclaration_SIGNED.pdf?ua=1

⁴⁵ WHO Global Action Plan for the Prevention and Control of NCDs 2013-2020 (resolution WHA66.10). https://www.who.int/nmh/events/ncd_action_plan/en/

3. Health care systems benefit from strengthened research and innovation expertise, human capacities and know-how for combatting communicable and non-communicable diseases, including through international cooperation. In particular, they are better prepared to respond rapidly and effectively to health emergencies and are able to prevent and manage communicable diseases transmissions epidemics, including within healthcare settings.
4. Citizens benefit from reduced (cross-border) health threat of epidemics and AMR pathogens, in the EU and worldwide.^{48,49} In particular, the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases are contained and hepatitis, water-borne diseases and other communicable diseases are being combated.⁵⁰
5. Patients and citizens are knowledgeable of disease threats, involved and empowered to make and shape decisions for their health, and better adhere to knowledge-based disease management strategies and policies (especially for controlling outbreaks and emergencies).
6. The EU benefits from high visibility, leadership and standing in international fora on global health and global health security, especially in partnership with Africa.

3.4 Ensuring access to innovative, sustainable and high-quality health care

Research and innovation aims at supporting health care systems in their transformation to ensure fair access to sustainable health care services of high quality for all citizens. Targeted impacts are:

1. Health and social care services and systems have improved governance and are more effective, efficient, accessible, resilient, trusted and sustainable, both fiscally and environmentally, with health promotion and disease prevention at their heart, by shifting from hospital-centred to community-based, people-centred and integrated health care structures and successfully embedding technological innovations that meet public health needs, while patient safety and quality of services is increased.
2. Health care providers are trained and equipped with the skills and competences suited for the future needs of health care systems that are modernised, digitally transformed and equipped with innovative tools, technologies and digital solutions for health and care. They save time and resources by integrating and applying innovative technologies, which better involve patients in their own care, by reorganising workflows and redistributing tasks and responsibilities throughout the health care system, and by monitoring and analysing corresponding health and care activities.
3. Citizens play a key role in managing their own health and care, informal carers (i.e. unpaid carers) are fully supported (e.g. by preventing overburdening and economic stress) and specific needs of more vulnerable groups are recognised and addressed. They benefit from improved access to health care services, including financial risk protection, timely access to quality essential health care services, including safe, effective, and affordable essential medicines and vaccines.⁵¹

⁴⁶ Including for instance the following voluntary targets (against the 2010 baseline): A 25% relative reduction in the overall mortality from cardiovascular diseases, cancer, diabetes, or chronic respiratory diseases; Halt the rise in diabetes and obesity; An 80% availability of the affordable basic technologies and essential medicines, including generics, required to treat major non-communicable diseases in both public and private facilities.

⁴⁷ Disability-adjusted life year (DALY) is a quantitative indicator of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

⁴⁸ WHO global action plan on antimicrobial resistance, 2015.

⁴⁹ EU One Health Action Plan against AMR, 2017.

⁵⁰ SDG 3 target 3.3

⁵¹ SDG 3 target 3.8

4. Health policy and systems adopt a holistic approach (individuals, communities, organisations, society) for the evaluation of health outcomes and value of public health interventions, the organisation of health and care, and decision-making.

3.5 Unlocking the full potential of new tools, technologies and digital solutions for a healthy society

Research and innovation aims at supporting the integration and deployment of innovation in health care systems. Targeted impacts are:

1. Europe's scientific and technological expertise and know-how, its capabilities for innovation in new tools, technologies and digital solutions, and its ability to take-up, scale-up and integrate innovation in health and care is world-class.
2. Researchers, innovators and health care providers use health data and Artificial Intelligence (AI) supported decision-making in a secure and ethical manner, respecting individual integrity and underpinned with public acceptance and trust.
3. Better informed policies and tailored legal, regulatory and ethical frameworks for the development of innovative health technologies, and better understanding of the societal impacts and acceptance of innovative health technologies and the digital transformation of health and care.
4. Citizens benefit from targeted and faster research resulting in safer, more efficient, cost-effective and affordable tools, technologies and digital solutions for improved (personalised) disease prevention, diagnosis, treatment and monitoring for better patient outcome and well-being, in particular through increasingly shared health resources (interoperable data, infrastructure, expertise, citizen/patient driven co-creation).⁵²
5. Citizens trust and support the opportunities offered by innovation for health and care, are involved in their design and take part in informed decision-making, based on expected health outcomes and potential risks involved.

3.6 Maintaining an innovative, sustainable and globally competitive health industry

Research and innovation aims at supporting the health industry in the development of novel health technologies addressing public health needs and market opportunities. Targeted impacts are:

1. Health industry in the EU is more competitive, sustainable and growing, providing high-value jobs and contributing to economic growth, in particular SMEs, by tapping into new markets and providing European leadership in breakthrough health technologies and innovations.
2. Health industry in the EU, in particular SMEs, gain the ability to grow and reach a critical mass to develop innovative products and services and to tap into international value chains and international markets.
3. Citizens, health care providers and health systems benefit from a swift uptake of innovative health technologies and services offering significant improvements in health outcomes, while health industry in the EU benefit from decreased time-to-market.
4. Health industry is working more efficiently along the value chain from the identification of needs to the scale-up and take-up of solutions at national, regional or local level, including through early engagement with patients, health care providers, health authorities and regulators ensuring suitability and acceptance of solutions.

⁵² Commission Communication on the digital transformation of health and care.

5. Health security in the EU benefits from reliable access to key manufacturing capacity, including timely provision of essential medical supplies of particularly complex or critical supply and distribution chains, such as regards vaccines or medical radioisotopes.
6. European standards, including for operations involving health data, ensure patient safety and quality of healthcare services as well as effectiveness and interoperability of health innovation and productivity of innovators.

4. Key Research and Innovation Orientations

Research and innovation supported under Cluster 1 *Health* should mobilise researchers from academic institutions, research organisations, small and medium enterprises, and large companies, as well as citizens and patients, patients associations, providers of health and care services and regulatory instances, in order to tackle the six health-related challenges and deliver on the targeted impacts. Synergies with the Euratom Research and Training Programme⁵³ will be explored as regards innovation on medical applications of ionising radiation, including improvements in the quality and safety of such applications. Moreover, pan-European research infrastructures⁵⁴ will be harnessed, including those identified by the European Strategy Forum for Research Infrastructures (ESFRI) and those established under the European Research Infrastructures Consortium (ERIC) regulation⁵⁵, to strengthen the productivity of European health research and innovation and to support the development of effective, fiscally and environmentally sustainable solutions while promoting access to health innovation. In order to achieve the greatest impact and benefits for the health and well-being of its population, it is also essential that the EU continues its efforts in cross-border cooperation, coordination and alignment. This includes European Partnerships, major international initiatives and established multilateral networks, e.g., in the area of infectious diseases, non-communicable diseases, rare diseases, brain research, and -omics⁵⁶ and environment and health. International cooperation and partnerships with third countries and other international partners are key for tapping the best expertise and know-how available worldwide, for leveraging a critical scale of resources, and for tackling global health challenges. Infectious diseases outbreaks and the spread of antimicrobial resistance (AMR) do not follow geographical borders, environmental factors in an urban or rural context create similar exposure and occurrences in different regions, and demographic changes due to societal segregation (urbanisation) and ageing as well as the challenges of data are not European challenges only. It will also be important that the cluster health can react swiftly and decisively to Public Health Emergencies of International Concern (PHEIC) declared by WHO and support urgently needed research. Seeking complementarities and synergies with the EU's external actions, development cooperation and trade policies will not only reinforce the links between research and implementation and support evidence-based policy-making but in particular amplify the uptake and deployment of research and innovation results and solutions and thus the impact of EU investments, including with regard to the EU's commitment to the United Nation's 2030 Agenda for Sustainable Development, notably SDG 3, and those in the context of other UN organisations and international initiatives, including the global strategies and plans of action of the World Health Organization (WHO).

The following sections describe the most important short to medium-term outcomes and impacts that contribute to achieving the targeted long-term impacts outlined in the previous chapter. In

⁵³ COM/2018/437 final - 2018/0226 (NLE), Proposal for a Council Regulation establishing the Research and Training Programme of the European Atomic Energy Community for the period 2021-2025 complementing Horizon Europe – the Framework Programme for Research and Innovation

⁵⁴ <https://www.esfri.eu/>

⁵⁵ Such as : European Life-Science Infrastructure for Biological Information (ELIXIR) <https://elixir-europe.org/>, European Clinical Research Infrastructure Network (ECRIN) <https://www.ecrin.org/>; European infrastructure for translational medicine (EATRIS) <https://eatris.eu/>; Survey of Health, Ageing and Retirement in Europe (SHARE) <http://www.share-project.org/>; European research infrastructure for biobanking (BBMRI) <http://www.bbMRI-eric.eu/>; European Social Survey (ESS) <http://www.europeansocialsurvey.org/>.

⁵⁶ '-omics' aims at the collective characterization and quantification of pools of biological molecules that translate into the structure, function, and dynamics of an organism or organisms and includes the genome itself (genomic), transcription products (transcriptomic), protein products (proteomic) and metabolic products (metabolomic).

other words, the following sections outline what research and innovation interventions and results are needed to tackle the health-related challenges. To enhance the societal relevance and impact of the knowledge, technologies and innovations developed under Cluster 1 *Health*, sex-specific and/or gender-specific approaches may be required since “every cell is sexed, every person is gendered”⁵⁷. This will contribute to develop new insights, new products, new services or new markets tailored to specific sex/gender-specific needs, behaviours and attitudes.

4.1 Staying healthy in a rapidly changing society

Research and innovation can provide a better understanding of specific health and care needs throughout the life course, including age-specific and sex/gender-specific needs, and develop more effective solutions for health promotion and disease prevention, including for needs related to chronic health conditions, physical and mental disabilities, or age-related impairments. Research and innovation can help people, as well as communities, in developing innovative services, policies, guidelines and digital solutions, also ensuring that they are accessible, equitable and effective in preventing disease and promoting health. Key to achieving these objectives is the availability and accessibility of real-world health data, which will require appropriate support by research and data infrastructures.

This orientation will support activities aiming at:

1. Better understanding of human health at various developmental stages and their impact on healthy development and ageing, including individual factors affecting health and individual resilience to diseases.
2. Better understanding of specific health and care needs and better solutions for addressing those needs, including specific needs of people in vulnerable stages of life, people with physical or mental impairments, or of population groups with structural socio-economic disadvantages.
3. Personalised solutions for health promotion and disease prevention of individuals or stratified solutions tailored to groups, including for improved prediction and prevention of diseases before/at birth.
4. Development of digital tools applications and other solutions, including social innovation, fostering health literacy and empowering citizens to better manage their own health and well-being throughout their life course and to protect them from health threats, including for countering health-related misinformation, manipulation and fraudulent sales of substandard, falsified or inappropriate medicines and illicit drugs.

Intervention areas:⁵⁸ This challenge requires research and innovation actions under several intervention areas (IA) of cluster 1 but the centre of gravity lies with IA 1.2.1. ‘Health throughout the Life Course’. It is closely linked to IA 1.2.2 ‘Environmental and Social Health Determinants’.

Cross-cluster issues: Synergies with other clusters could be explored through broad cross-sectoral collaboration. For example with cluster 2 ‘Culture, creativity and inclusive societies’ on health inequalities, on other inequalities affecting health, or on end users’ engagement; ii) with cluster 6 ‘Food, Bioeconomy Natural Resources, Agriculture and Environment’ on the role of nutrition for health (incl. human microbiome, mal- and over-nutrition, safe food), personalised diets (incl. food habits in general and childhood obesity in particular) and the impact of food-related environmental stressors on human health (incl. marketing and consumer habits). Other possible synergies could be explored by cooperating on digital tools, telemedicine or smart homes with cluster 4 ‘Digital, Industry and Space’ or with cluster 5 ‘Climate, Energy and Mobility’ on urban health or on mitigating the impact of road traffic accidents and related injuries.

⁵⁷ International Conference on ‘Innovations in Gender, Sex, and Health Research: Every Cell is Sexed, Every Person is Gendered’, Toronto, 22-23 Nov 2010.

⁵⁸ Intervention areas are set in the proposed Specific Programme of Horizon Europe.

International cooperation: Similar health challenges and needs for health promotion and disease prevention are faced by other regions and countries. International cooperation should be sought and promoted in order to benefit from new knowledge and solutions as widely as possible.

4.2 Living and working in a health-promoting environment

Research and innovation will produce the knowledge necessary to identify and assess the risks and benefits for health, and to enable health promoting and disease preventive policy actions. Results will support the EU's environment and health policies and overarching policy frameworks such as the European Green Deal, the future 8th Environment Action Programme, the EU Strategic Framework on Health and Safety at Work⁵⁹ and the European Environment and Health Process (EHP)⁶⁰. The outcome will also contribute to the development of new and improved health interventions and technologies. In order to achieve sustainable impacts, research and innovation must provide solid evidence and stimulate its uptake into a large number of environmental, occupational, social, economic, fiscal and health policies at the EU, national and regional level. Strong collaborations across sectors and with other Horizon Europe clusters dealing with issues such as agriculture, food, environment, climate, mobility, security, urban planning, social inclusion and gender will be needed to ensure that maximal societal benefits will be reached. Likewise, international cooperation, including at science-policy level, will be key to drive forward and tackle this challenge.

This research and innovation orientation will support activities aiming at:

1. Collection, combination and analysis of environmental, occupational and human health-related data, taking advantage of the exposome⁶¹ approach.
2. Identification and characterisations of emerging and persistent environmental, occupational and climate change-related stressors.
3. Establishment and quantification of causal relationships between exposure to the identified stressors and health impacts.
4. Development of innovative methods to better estimate the socio-economic and health costs of exposure to identified stressors and co-benefits of preventive actions across sectors.
5. Translation of research results into early warnings and evidence for regulatory preparedness, targeted at policy levels where action is needed.
6. Elaboration of cross-sectoral approaches to mitigate and prevent adverse health outcomes and promote beneficial health impacts, together with actors inside and outside the health area.

Intervention areas:⁶² This challenge involves research and innovation actions under several intervention areas (IA) of cluster 1 and other clusters, but the centre of gravity lies with IA 1.2.2. 'Environmental and Social Health Determinants'. It is closely linked to IA 1.2.1 'Health throughout the Life Course'.

Cross-cluster issues: Synergies with other clusters could be explored through broad cross-sectoral collaboration, for example with cluster 6 'Food, Bioeconomy Natural Resources, Agriculture and Environment' on human biomonitoring, on healthy ecosystems and human habitats (incl. nature-based solutions for health and well-being), or on the sustainable management of clean water, soil and air. Other possible synergies could be explored by cooperating i) with cluster 4 'Digital, Industry and Space' on health-related space research and innovation for location-based services, geo-observation and monitoring (e.g. of pollution), ii) with cluster 5 'Climate, Energy and Mobility' on the surveillance, prediction and mitigation of the health impact of climate change, on the health

⁵⁹ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0332>

⁶⁰ http://www.euro.who.int/__data/assets/pdf_file/0009/341946/Annex2_20June.pdf?ua=1

⁶¹ The concept of the exposome refers to the totality of environmental exposures (diet, lifestyle, occupational and environmental factors) from conception onwards, including its external and internal components.

⁶² Intervention areas are set in the proposed Specific Programme of Horizon Europe.

impact of transport-related environmental pollution (such as air and noise pollution), on transport and mobility related risks on health, or on concepts/technologies for smart and healthy homes, rural areas and cities, and iii) with cluster 4, 5 and 6 on health impact assessment, e.g. the impacts on health and well-being of infrastructure, urban planning, transport, technologies, chemicals and other substances (incl. pollution), or iv) with clusters 5 and 6 on preventable environmental causes of diseases.

International cooperation: Exposures to environmental stressors of relevance to human health are not confined locally but transcend national borders and are connected to global political and economic relationships and interactions. International cooperation is thus key to tackle this challenge effectively, including by cooperating with international actors and initiatives like the WHO and the WHO Europe environment and health process (incl. WHO European Centre for Environment and Health, Chemical Risk Assessment Network, Global EMF project); United Nations Environment Programme; US National Institute for Environmental Health Sciences; US CDC (NHANES biomonitoring programme); US Environmental Protection Agency; OECD (chemicals testing).

European Partnerships: "*European Partnership on Chemical Risk Assessment*": A partnership on chemicals risk assessment would be launched in 2022 to support the EU/national chemical risk assessment and management authorities by providing new evidence and methodologies and stimulate their uptake in regulatory processes. The joint research and innovation programme would target established chemical regulatory processes and facilitate their adaptation to and preparedness for persistent or emerging challenges. It would aim to strengthen European capacities in the areas of: human biomonitoring; environmental and food monitoring; toxicology and hazard assessments; exposure assessment; emerging chemicals; chemical mixtures; validation, standardisation and reference materials; risk assessment methodologies; data management and analysis; risk communication, dissemination and training; priority setting and sustainability. The partnership would not replace already existing mandatory reporting or monitoring schemes enshrined in EU regulations, but enrich them with new knowledge and tools where necessary. The partnership would contribute to the sustainability of the human biomonitoring platform developed by HBM4EU (2017-2021), by incorporating it into a wider chemical risk assessment initiative as recommended during the 2018 Human Biomonitoring conference. In fine, the partnership would provide an EU-wide research platform complementing the EU chemical regulatory system, thereby strengthening the EU-MS collaborations for chemical risk assessment and management.

4.3 Tackling diseases and reducing disease burden

There is an urgent need for research and innovation on new prevention, diagnostics, vaccines, therapies, alternatives to antibiotics, as well as to improve existing prevention strategies to create tangible impacts, taking into account sex/gender-related issues. This will require international cooperation to pool the best expertise and know-how available worldwide, to access world-class research infrastructures and to leverage critical scales of investments on priority needs through better alignment with other funders of international health research and innovation cooperation. The continuation of international partnerships and cooperation with international organisations is particularly needed to combat infectious diseases, including antimicrobial resistances, to respond to major unmet needs for global health security, including the global burden of non-communicable diseases, and to strengthen patient safety.

This research and innovation orientation will support activities aiming at:

1. Better understanding of diseases, their drivers and consequences, including pain and the causative links between health determinants and diseases, and better evidence-base for policy-making.
2. Better methodologies and diagnostics that allow timely and accurate diagnosis, identification of personalised treatment options and assessment of health outcomes, including for patients with a rare disease.
3. Development and validation of effective intervention for better surveillance, prevention, detection, treatment and crisis management of infectious disease threats.
4. Innovative health technologies developed and tested in clinical practice, including personalised medicine approaches and use of digital tools to optimise clinical workflows.

5. New and advanced therapies for non-communicable diseases, including rare diseases developed in particular for those without approved options, supported by strategies to make them affordable for the public payer.
6. Scientific evidence for improved/tailored policies and legal frameworks and to inform major policy initiatives at global level (e.g. WHO Framework Convention on Tobacco Control; UNEA Pollution Implementation Plan).

Intervention areas:⁶³ This challenge requires research and innovation actions under several intervention areas (IA) in cluster 1 but the centre of gravity lies with IAs 1.2.3. 'Non-Communicable and Rare Diseases' and 1.2.4. 'Infectious Diseases'. It is closely linked to IA 1.2.2 'Environmental and Social Health Determinants'.

Cross-cluster issues: Synergies with other clusters could be explored through broad cross-sectoral collaboration, for example with cluster 3 "Civil security for society" on health security/emergencies (preparedness and response, medical counter measures, epidemic outbreaks/pandemics, natural disasters and technological incidents, bioterrorism), or with cluster 4 "Digital, Industry and Space" on decision-support systems or on geo-observation and monitoring (e.g. of disease vectors, epidemics). Other possible synergies could be explored by cooperating with cluster 6 "Food, bioeconomy, natural resources, agriculture and environment" on health security and AMR (one-health: human/animal/plant/soil/water health).

International cooperation: Effective international cooperation is essential to reduce disease burden and to protect people against cross-border health threats including the rise and spread of AMR and (re)emerging epidemics. The EU should continue its efforts to initiate and participate in cross-border coordination and integration of research and innovation. To address these challenges of global dimension, it will require international cooperation to pool the best expertise and know-how available worldwide, enable a better alignment with actions in the rest of the world, and contribute to the achievement of SDG 3 'Healthy lives and well-being for all'. This includes international collaboration with major EU and global initiatives in the area of infectious diseases (Global Research Collaboration for Infectious Disease Preparedness, GloPID-R), non-communicable diseases (Global Alliance for Chronic Diseases, GACD), rare diseases (International Rare Diseases Research Consortium, IRDiRC), brain research (International Traumatic Brain Injury Research, InTBiR), personalised medicine (International Consortium for Personalised Medicine, ICPeMed), and -omics⁶⁴ (e.g. the International Human Epigenome Consortium, IHEC, the 1 Million Genomes Initiative), and global health (World Health Organisation and other UN agencies)

European Partnerships:

i) "*EU-Africa global health partnership to tackle infectious diseases*": This research and innovation partnership would aim to increase global health security in sub-Saharan Africa (SSA) and Europe, by accelerating the clinical development of effective, safe, accessible, suitable and affordable health technologies as well as health systems interventions for infectious diseases in partnership with Africa and international funders. It would also support implementation research and health systems research for the uptake of new, improved or existing medical interventions. This partnership would be the successor initiative of the EDCTP2 partnership programme and be launched in 2021. It could be established as an institutionalised partnership based on Article 185/187 TFEU.

ii) "*Rare Diseases*": This research and innovation partnership would aim to improve the lives of rare diseases patients. It would build on the results and experiences the ERA-Net E-Rare which was continued in the frame of the European Joint Programme on Rare Diseases (EJP RD). The EJP RD has been launched in December 2018 to further help in coordinating the research efforts of European, Associated and non-European countries in the field of rare diseases and implement the objectives of the International Rare Disease Research Consortium (IRDiRC). The proposed

⁶³ Intervention areas are set in the proposed Specific Programme of Horizon Europe.

⁶⁴ '-omics' aims at the collective characterization and quantification of pools of biological molecules that translate into the structure, function, and dynamics of an organism or organisms and includes the genome itself (genomic), transcription products (transcriptomic), protein products (proteomic) and metabolic products (metabolomic).

research and innovation partnership would be established as co-funded partnership programme, starting in 2024.

iii) "*Fostering an ERA for Health Research*": Several existing Horizon2020-funded partnerships involve the very same health research and innovation funders but are simply focused on different thematic priority areas. The proposed research and innovation partnerships would aim to establish a flexible and more effective coordination between programme owners (typically ministries) and programme funders (typically funding agencies) of the numerous networks established in the European Research Area (ERA) for Health and Well-being. It would focus on establishing a strategic research agenda and joint funding strategy between major European funders, public and private, on translational health research and innovation, and would be established as a co-funded partnership, starting in 2023/2024.

iv) "*One Health AMR*": At the highest political levels antimicrobial resistance (AMR) is recognised as a major threat to the health of our citizens and our society. The EU One Health Action Plan against AMR provides the framework within which action should be taken against this threat. However, the AMR research landscape is currently fragmented addressing human health, animal health, food safety and environment in silos. The proposed research partnership aims to bring together the many aspects of AMR to overcome this fragmentation, and integrate the various different research fields. It will engage public health, animal health and environment research funders from EU member states as main partners to support the implementation and financing of a strategic research agenda as part of a joint research programme. This candidate partnership builds on the ERA-Net EXEDRA (ends in 2020) that supports the JPIAMR and on the One Health EJP (ends in December 2022). It would be established as co-funded partnership, starting in 2023/2024.

4.4 Ensuring access to innovative, sustainable and high-quality health care

Research and innovation can help by supporting the development of innovative solutions for health care systems in all their various dimensions (e.g. governance, financing, generation of human and physical resources, health service provision, and patient empowerment). In addition, research and innovation can provide decision-makers with new evidence, methods and tools to successfully implement those innovative solutions into their health care systems. It will in turn help to improve the governance of health care systems as well as to allocate resources according to people's needs and preferences while delivering fiscal sustainability to make sure those needs can be met in the long-term.

This research and innovation orientation will support activities aiming at:

1. Innovative solutions to support modernisation of health care systems (e.g. organisational models; innovative health service delivery models; integrated care models; long-term care; digitalised services; personalised approaches; financing models, including financing of health care systems; remuneration models; incentive mechanisms; new payment/ reimbursement models of health technologies⁶⁵; accelerated access models in case of health emergencies; human resources planning, education and training, incl. on digital skills and health data management).
2. Methods, tools and demonstrated pilots for uptake and scale-up of innovation in health systems (e.g. technological and organisational innovation), as well as for their transferability/adaptation from one country/region to another.
3. Simulation models to support policy-making, taking into account the complexity and specificities of health care systems and the need to protect access and pursue long-term fiscal sustainability.
4. Innovative solutions to support people-centred health and care throughout the life course, and to improve citizen empowerment, access of citizens to their own health data, health literacy, self-care, informal care, and community care.

⁶⁵ WHO definition of 'health technology': A health technology is the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of lives.

5. Successful models, strategies and solutions increasing patient safety by preventing and reducing risks for patients during the delivery of health care services.
6. Framework for better interoperability between data sources and infrastructures, for sharing, access, use and analysis of real-world data that will in turn improve the efficiency of health care systems by strengthening their governance, informing policy development and decision-making, facilitating monitoring and evaluation of health interventions with due attention to security, data protection, privacy, interoperability, standards, comparability and integrity.
7. Innovative full health technology assessment methods (i.e. including all relevant aspects such as clinical effectiveness, cost-effectiveness, ethics, organisational aspects, etc.) to support better allocation of resources, including reinvestment from low to high value care for patients.
8. Methods to assess performance and efficiency of healthcare organisations and health care systems based on outcomes that matter for patients and carers, aiming at reducing health inequality and allowing for international comparability.
9. Identification of factors accounting for health care systems resilience in absorbing the impact of crises, such as the expected dementia raise, and accommodating disruptive innovation.

Intervention areas:⁶⁶ All research and innovation areas of cluster 1 are concerned but the centre of gravity lies with IA 1.2.6 'Health Care Systems'. It is closely linked to IA 1.2.1 'Health throughout the Life Course' as well as IA 1.2.5. 'Tools, Technologies and Digital Solutions for Health and Care'.

Cross-cluster issues: Synergies with other clusters could be explored through broad cross-sectoral collaboration, for example with cluster 2 "Culture, Creativity and Inclusive Society" on health economics and economic models, on cost-effectiveness, fiscal sustainability and accessibility of healthcare, or on adaptation of public health systems to societal challenges (climate change, migration, demographic change) thereby contributing to building resilience, or with cluster 3 "Civil security for society" on security of health care infrastructures, incl. digital health infrastructures, or health systems preparedness and response to natural disasters and emergencies. Other possible synergies could be explored by cooperating with cluster 4 "Digital, Industry and Space" on cybersecurity of (public) health systems, products and infrastructures of digitalised health and care, or on health impact assessment (e.g. related to consumer products, working place innovation).

International cooperation: Cross-border learning from practices and good models of health promotion and care is key in this area of research. Research on health care systems will benefit from cooperation with international actors: such as the World Health Organization's Science Division and national public health institutes (e.g. Canadian institutes of health research and Agency for healthcare research and quality (AHRQ) in the United States that are already partners of EU-funded projects in health systems research). Universal health coverage is also an important area of international development cooperation, in particular as regards sexual and reproductive health and rights.

European Partnerships:

i) "*Health and Care Systems Transformation*". This research and innovation partnership with health and care systems owners/organisers and the respective research and innovation funders would aim at boosting research for policy making, uptake and scale-up of innovative solutions to accelerate transformation of national/regional health and care systems. Specific objectives would be to provide evidence for innovative solutions that support cost-effective and fiscally sustainable health and care policies, to build knowledge on the conditions for transferability and up-scaling of innovative solutions across and within EU countries, to develop and test a mechanism to support diffusion of innovative solutions, to unleash unmet needs of citizens and health and care systems and to establish an research and innovation platform that brings together the different actors as well as health data across health and care systems to enable data-driven policy and exchange. The partnership would build on the strategic research agenda developed by the Horizon 2020-funded support action TO-REACH, will draw on the expertise and experiences from the Member States and

⁶⁶ Intervention areas are set in the proposed Specific Programme of Horizon Europe.

network of regions involved in the European Innovation Partnership on Active and Healthy Ageing (EIP-AHA), the Second 'Active and Assisted Living' programme (AAL2), the InfAct Joint Action, the MYBL JPI and work in synergy with the EIT KIC-Health. A strong synergistic link will be created with the European partnership on 'Innovative Health Initiative'. It would be established as co-funded partnership, starting in 2021.

ii) "*Personalised Medicine*": This research and innovation partnership would align priority setting and funding for research projects in the area of personalised medicine between the EU Member States and regions, associated countries and international partner countries. It would be the successor initiative of the Horizon2020-funded ERA-PerMed partnership and also build on the Horizon2020-funded actions in support of the International Consortium for Personalised Medicine (ICPerMed) led by several EU Member States. Based on the on the results and experiences with ERA-PerMed, the proposed partnership would continue to align national research strategies, promote research and innovation excellence, reinforce the competitiveness of European players in personalised medicine and enhance the European collaboration with non-EU countries, including by supporting collaborative innovative research projects through joint transnational calls for proposals. It would be established as co-funded or co-programmed partnership programme, starting in 2023.

Innovation Procurement: Innovation procurement is a mean to drive innovation from the demand side. Procurers (e.g. health care providers) are potential buyers of innovative solutions to public health interest needs that are not yet available, or in insufficient quantity, on the market. Innovation procurements can initiate innovation through the purchase of R&D services, when market solutions are missing, or boost the marketing of existing solutions for early adopters. Innovation procurement can then open market opportunities for European companies, including SMEs.

4.5 Unlocking the full potential of new tools, technologies and digital solutions for a healthy society

Research and innovation is needed on the large spectrum of tools and technologies for bio-medical research, prevention, diagnosis, therapy and monitoring. Managing benefits and risks of new technologies and due consideration of aspects of safety, effectiveness, inter-operability, appropriateness, accessibility, comparative value-added, affordability and sustainability (environmental, fiscal, socio-economic) and issues of ethical, societal, regulatory and legal nature will be crucial in order to boost the acceptability of these novelties and to translate these innovations into health policies, health and care systems, and clinical practice responsibly. Moreover, to provide high-quality healthcare and reduce health inequalities, end users' engagement in multidisciplinary, cross-sectorial cooperation with key stakeholders (patients, health care providers, researchers, regulatory bodies, policy-makers, funders) could help addressing specific unmet needs for health tools, technologies and digital solutions with limited commercial interest but also designing and developing suitable health products and services tailored to specific needs related to sex/gender or other aspects. Artificial Intelligence technologies have recently shown great promise for analysing high volumes of health data, with high potential for advancing biomedical research, personalised medicine and health care and for supporting health care systems in their clinical, organisational and logistical functions.

This research and innovation orientation will support activities aiming at:

1. New tools and technologies for biomedical research, prevention, diagnosis and therapy of diseases and tools for monitoring diseases as well as treatment progression are designed, developed, tested or validated for the benefit of patients and the health and care systems. These solutions can include a variety of technologies and approaches such as nano medicines, advanced therapies, biomaterials, medical devices, hybrid technologies, digital solutions, Artificial Intelligence applications, robotics, -omics⁶⁷ and other data-driven interventions and procedures.

⁶⁷ '-omics' aims at the collective characterization and quantification of pools of biological molecules that translate into the structure, function, and dynamics of an organism or organisms and includes the genome itself (genomic), transcription products (transcriptomic), protein products (proteomic) and metabolic products (metabolomic).

2. Health data accessibility and interoperability across the EU, including the free flow and secure exchange of health data, leaning on existing research infrastructures⁶⁸ as well as the creation of a European Health Data Space to promote health-data exchange and support research.
3. Improved risk-benefit ratio of the developed innovative tools, technologies and approaches owing to powerful digital solutions using and processing big data for better detection, diagnosis and monitoring of disease, including real-world data, for efficient value assessment.
4. Efficient up-scaling and production systems, including bioprinting, additive manufacturing and other advanced manufacturing techniques, enabling targeted and personalized health interventions.
5. Improved health technologies and interventions based on digital solutions, which support timely health information and secure use of health data.
6. New data-driven approaches, computer models and -simulations and other digital solutions are developed, translated and optimised for the prevention, health care and person-centred care, including smart data infrastructures and AI-based data analytics.

Intervention areas:⁶⁹ This challenge will benefit from research and innovation actions under several intervention areas (IA) of cluster 1 but the centre of gravity lies with IA 1.2.5 'Tools, Technologies and Digital Solutions for Health and Care'.

Cross-cluster issues: Synergies with other clusters could be explored through broad cross-sectoral collaboration, in particular with cluster 4 "Digital, Industry and Space" on: digitalisation of the health sector, incl. health technologies, medical devices and key enabling technologies; assisted, autonomous, independent and empowered living; smart homes; decision support systems; health impact assessment (e.g. related to consumer products, working place innovation). Moreover, research and innovation actions under cluster health may be inspired by research achievements under Pillar I (Open Science) or may benefit from follow-on support under Pillar III (Open Innovation).

Innovation Procurement: Innovation procurement is a means to drive innovation from the demand side. Procurers are potential buyers of innovative solutions to public interest needs that are not yet available, or in insufficient quantity, on the market. Public procurements can initiate innovation through the purchase of R&D services, when market solutions are missing, or boost the marketing of existing solutions for early adopters. Innovation procurement can then open market opportunities for European companies, including SMEs.

4.6 Maintaining an innovative, sustainable and globally competitive health industry

There is a convergence and a need for cross-sectorial research and innovation (integrating medical technologies, pharmaceuticals, biotechnologies, digital health and eHealth technologies) to strengthen the single market, including by implementing the Digital Single Market strategy, supporting the standardisation policy, driving innovation from the demand side and providing evidence and guidelines for stakeholders and regulators to ensure take-up of innovations supports sustainability (environmental, fiscal, socio-economic) while fostering access and reducing health inequalities.

The health sector is subjected to strict regulatory requirements that impose the demonstration of clinical benefit(s) and safety. This means additional development steps, uncertainties and a longer time to market. Support to studies for health assessment procedures, clinical performance demonstration, quality assurance schemes and standardisation are therefore important elements.

This research and innovation orientation will support activities aiming at:

⁶⁸ Such as the European Life-Science Infrastructure for Biological Information (ELIXIR: <https://elixir-europe.org/>), identified by the European Strategy Forum for Research Infrastructures (ESFRI).

⁶⁹ Intervention areas are set in the proposed Specific Programme of Horizon Europe.

1. Efficient innovation management strategies, including intellectual property, to translate breakthrough technologies into health care applications.
2. Efficient collaboration with regulatory authorities and health care providers for an optimal time to patient access.
3. Novel methodologies and metrics adapted to new tools, technologies, digital solutions and interventions for their assessment, validation and translation into health care practice, including ethical aspects, their societal impact and integration into regulatory frameworks, and for allowing swift access by health care providers, patients and healthy citizens.
4. Regulatory authorities supported with better methodologies and interdisciplinary approaches to assess new health technologies and interventions.
5. New European standards and quality assurance schemes developed for submission to standardisation bodies and implementation by stakeholders that, e.g., support a fast, reliable and secure handling of health data, health products or health services.
6. Safe and clinically validated tools, technologies and services developed and delivered by European health industry that meet the needs of citizens, patients, health care providers and systems.
7. Greener pharmaceuticals and health technologies.

Intervention areas: All research and innovation areas of cluster 1 are concerned but the centre of gravity lies with IA 1.2.5. 'Tools, Technologies and Digital Solutions for Health and Care', while it is closely linked to IA 1.2.6 'Health Care Systems'.

Cross-cluster issues: Synergies with other clusters could be explored through broad cross-sectoral collaboration, in particular with cluster 4 "Digital, Industry and Space" on: industrial research and innovation infrastructures (pilot plants, testing and simulation facilities, open innovation hubs); additive manufacturing (3D/4D printing) and other production technologies (incl. bio manufacturing); safe, smart and sustainable materials. Synergies could also be explored with Pillar III, "Open Innovation", in particular the scheme of the EIC that supports breakthrough and risky innovations.

European Partnerships:

"Innovative Health Initiative": This partnership would provide a cross-sectoral collaborative platform bringing the pharmaceuticals, diagnostics, medical devices, imaging and digital industries together with public sector and other relevant stakeholders. It would contribute significantly to *"Enabling the digital transformation of health and care in the Digital Single market"* by supporting precompetitive research and innovation in areas of unmet public health and accelerating the development of people-centred health care innovations that can be taken up in health and care systems. It intends to overcome barriers that prevent exploiting the full potential of digitalisation and data exchange, through standards, methods and tools for interconnectivity and interoperability as well as to deliver tools, data, platforms, technologies and processes that enable the delivery of innovative health products and services to predict, prevent, intercept, diagnose and manage diseases more efficiently, that meet the needs of the end users and payers. A strong synergistic link will be created with the European Partnership on 'Large-scale innovation and transformation of health systems in a digital and ageing society', thereby warranting the usefulness, transferability and the potential uptake of the developed health solutions into public health systems. This partnership would be the successor initiative of the IMI2 partnership programme as a possible institutionalised Partnership based on Article 187 TFEU. It will be launched in 2021.

Innovation Procurement: Innovation procurement is a mean to drive innovation from the demand side. Procurers are potential buyers of innovative solutions to public interest needs that are not yet available, or in insufficient quantity, on the market. Public procurements can initiate innovation through the purchase of R&D services, when market solutions are missing, or boost the marketing of existing solutions for early adopters. Innovation procurement can then open market opportunities for European companies, including SMEs.

5. International Cooperation

The EU is a major leader in research and innovation for developing health technologies, improving health services or adapting health systems that promote health and well-being and prevent, treat and cure diseases in Europe and worldwide. In order to maintain and extend its leadership role, international cooperation and partnerships with third countries and other international partners are key for tapping the best expertise and know-how available worldwide, for leveraging a critical scale of resources, and for tackling global societal challenges. Infectious diseases outbreaks and the spread of antimicrobial resistance (AMR) do not follow geographical borders, environmental factors in an urban or rural context create similar exposure and experiences in different regions and the burden of the ageing society as well as the challenges of treating health care data are not European challenges only. Horizon Europe's cluster health will remain an essential vehicle to realise and contribute to the EU's international commitments on global health, notably the health-related SDG 3, including its targets on global maternal, new-born and child mortality, its pollution-related morbidity and mortality targets, as well as the objectives and targets of WHO action plans and programmes of action. It will also be important that the cluster health can react swiftly and decisively to Public Health Emergencies of International Concern (PHEIC) declared by WHO and support urgently needed research. Seeking complementarities and synergies with the EU's external cooperation policies and programmes will not only reinforce the links between research and implementation and support evidence-based policy-making but in particular amplify the uptake and deployment of research and innovation results and solutions and thus the impact of EU investments. Geographic and thematic considerations will be key for setting priorities in promoting cooperation between research and innovation institutions in MS/AC with those in third countries, building research and innovation capacities, identifying market access opportunities, shortening innovation cycles, or contributing to international commitments in global fora or in a bilateral context, in particular with regard to the EU-Africa partnership. For cooperation with countries of high S&T capacities important perspectives are the opportunities of data-driven innovation and digitalisation of health and care, need for jointly tackling global health challenges, and building international value chains in delivering new healthcare solutions. For cooperation with developing countries the promotion of sustainable development, including circular economy approaches and by providing assistance for an evidence-based transformation of their health policy-making could be important drivers of work. Horizon Europe's cluster 1 is well positioned to contribute to the realisation of EU development policy objectives for the health sector and in particular in the following priority areas: (i) Disease Prevention and Health Promotion; (ii) sustainable and efficient Health Systems and Healthcare Financing; (iii) e-health/ digital technology for health; iv) AMR/ Infectious diseases/Pandemic Preparedness/ Health Security. Such priority areas should always take due account of low- and middle-income partner countries' own priorities.

In order to achieve the greatest impact and benefits for the health and well-being of its population, it is essential that the EU continues its international efforts in cross-border cooperation, coordination and alignment. This includes major international initiatives and established multilateral networks, e.g., in the area of infectious diseases, non-communicable diseases, rare diseases, brain research, and -omics and environment and health.

In addition, European research and innovation partnerships may involve international partners, in particular when addressing global health issues (health, environment and pollution; poverty-related and neglected infectious diseases; AMR), where a critical scale of resources, patients and health data calls for international approaches (genomics; personalised medicine; rare diseases), or where international partners offer access to critical know-how, resources and best practice (incl. on governance models and policies for cost-efficient and sustainable quality health care systems and services). Moreover, if research and innovation is expected to provide evidence for better informed policies and clinical practice, the involvement of normative or standard-setting international bodies, like WHO, may be essential.

6. European Partnerships

Partnerships provide mechanisms to consistently aggregate research and innovation efforts into more effective responses to the policy needs of the Union, developing close synergies with national and regional programmes, bringing together a broad range of actors to work towards a common goal, and turning research and innovation into socio-economic results. As such, they are powerful instruments to address global challenges by translating common priorities into concrete roadmaps and coordinated implementation of activities. EU-funded health research and innovation played a pioneering role in establishing and testing first approaches and forms of cooperation between

public and private funders, both within Europe and at international level. Under the previous research and innovation programme, Horizon 2020 (2014-2020), 36% of the budget allocated to collaborative health research and innovation was invested through European health research and innovation partnerships (€2.680bn of €7.472bn).

For the requested rationalisation and reform of European Partnerships under Horizon Europe, the following two considerations were taken into account under Cluster Health, mainly to increase the openness and reduce the number of partnerships:

1. Widening the scope and/or objectives of partnerships, e.g.
 - to widening participation
 - to extend private sector participation and improve leverage of funding
 - to set the ground towards better uptake and systemic impact of related research and innovation
2. Discontinuation and merging partnerships
 - to simplify the funding landscape, improve coherence and increase transparency
 - to create (additional) economies of scale

Following these considerations, the following five co-funded European Partnerships are proposed for the first four years of Horizon Europe:

1. "Health and Care Systems Transformation" (as of 2021);
2. "Chemicals risk assessment" (as of 2022);
3. "Fostering an ERA for Health Research" (as of 2023/2024);
4. "Personalised Medicine" (as of 2023);
5. "Rare Diseases" (as of 2024);
6. "One Health AMR" (as of 2023/2024).

In addition, two possible institutionalised European Partnerships (based on Article 185/187 TFEU) are proposed in the area "Faster development and safer use of health innovations for European patients, and global health" set by the legislator:

1. "EU-Africa research partnership on global health security to tackle infectious diseases" (as of 2021);
2. "Innovative Health Initiative" (as of 2021).

On the one hand, these partnerships provide significant leverage of investments and alignment on common priorities which allow sharing expertise, resources and the financial risks involved and thus achieving critical scales that a single member state or company would not be able to achieve alone. On the other hand, they allow raising awareness and attracting interest from policy-makers, stakeholders and the wider public as well as gaining support from additional partners. As opposed to regular calls for proposals, a European Partnership can bring together a broader spectrum of stakeholders, both private and public, to align agendas across industrial sectors and/or public policies with a higher level of commitment and over a longer time-scale to implement activities needed for major changes and impacts. Traditional calls for proposals will neither achieve the same level of coordination, alignment or integration nor allow the same level of sharing of resources, responsibilities and financial risks involved. This is particularly true in cases where the number of disease cases (individual patients) is low, such as for rare diseases, or in cases where the market prospects (return of investments) do not match the financial risks involved, such as for poverty-related and neglected infectious diseases. Moreover, maximizing the impact on the health and well-being of citizens, patients or health systems requires building a long-term strategy and annual programming for a wide range of activities including research, innovation, networking, training, demonstration and dissemination, which is not possible through traditional collaborative projects.

Activities within the Cluster "Health" will also be closely related and collaborate with relevant EIT KICs. Thanks to their societal challenge-driven approach and their portfolio of activities, ranging from entrepreneurial education and training, to innovation projects, business creation activities and support services for start-ups, scale-ups and SMEs, the EIT KICs, in particular EIT Health (www.eithealth.eu), EIT Food (<https://eitfood.eu/>) and EIT Climate-KIC (<https://www.climate-kic.org/>) are well equipped to develop synergies and complementarities with Cluster "Health" activities.

7. Missions

Activities within the Cluster Health will be particularly relevant to the Mission(s) identified within the Cancer mission area. Depending on the scope of future specific Mission(s), further alignment may be identified with other missions such as within the Soil Health and Food mission area and with the Climate-Neutral and Smart Cities mission area.