Health & Technology
By Convergence

Pre-call for Flagship programs

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#	Title	Public Summary (in Dutch)

#1 Human-centered AI for Sustainable Critical Care: Co-creating AI in ICU and Neonatology Care

Leads

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Although the Dutch healthcare system is of a high standard, the Covid crisis shows the vulnerability of the healthcare system. The growing shortage of ICU nurses leads to operations being cancelled and emergency rooms being closed. Technology can help to increase nursing capacity and improve quality of care, for example by supporting nursing actions through machine learning. However, research and practice show that this is still only moderately successful; nurses (and also doctors) make little use of technological innovations because they do not fit in with their daily work, and/or the technology actually causes more work. In addition, the use of technological innovations such as artifical intelligence (AI) often does not (yet) fit within existing funding agreements and the quality regulations of the Inspectorate, so that innovations cannot be structurally embedded. To make the deployment of technology a success, a broad and participatory approach is needed in which users, developers, funders and regulators work together to achieve appropriate technological care innovation. In this flagship, a learning, transdisciplinary acute care community will be established in which users (nurses, physicians, patients), AI developers and scientists, social scientists, companies and external stakeholders (health insurers, the inspectorate, the Zorginstituut Nederland) will work closely together to develop human-centered AI for intensive care (pediatric ICU; adult ICU; neonatology) and to implement it in healthcare practice. This will build on existing technological innovations and AI applications in care that can be improved and/or adapted to better fit the needs and care processes in practice. The financial and policy frameworks needed for this will be examined. During the study, we will monitor the effects on job satisfaction, quality of care, patient satisfaction, workload and nursing capacity in order to include practical experience in the process of development and implementation.

#2 Organ Transplantation Making unsuitable donor organs suitable for transplantation

Leads

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By 2040, 25% of our population will be over the age of 65. The need for replacement of tissues, such as hip and knee replacement, heart valves and eye lenses will increase by 300-600% by the year 2030. For failing organs, such as heart, lungs, pancreas, kidneys and livers, organ transplantation is the only long-term solution. This is a huge problem, since (1) the demand for organ transplantation will increase significantly, while the availability of donor organs at present is already inadequate to meet current is insufficient to meet the current need; and (2) the aging trend is having its impact on organ transplantation, as an increasing number of donor organs will be deemed unsuitable for transplantation. This is not only because lifestyle factors (including obesity and alcohol consumption) reduce the quality of potential donor organs, but also because older organs do not recover well from transplant surgery. This current situation requires the development of new strategies to solve the shortage of donor organs. A radically new solution to this problem is to test the function of all donor organs outside the body using organ perfusion machines and to be able to repair persistent damage before implantation in the recipient. Thus making unsuitable donor organs suitable for transplantation. This is exactly what this Flagship Organ Transplant aims to achieve. How? By combining Application Form Flagship Program Call 2021 - The Organ Transplantation Flagship unique expertise and using an integrated approach of Erasmus MC (biomedical knowledge), TU Delft (technological knowledge) and Erasmus University (determining economic, ethical, legal, and social impact of new solutions). This flagship will not only provide opportunities to help more patients on the transplant waiting list, but it will also bring the state-of-the-art to a point where a dramatic increase in the number of organ transplants is feasible.

#3 Convergence Imaging Facility and Innovation Centre (CIFIC)

Leads

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Microscopy has been a key technology for unraveling the secrets of life and disease processes for centuries. Nowadays advanced microscopic techniques are used even more intensively than before for basic, translational and (pre)clinical research. Our goal is to maximize the effectiveness and specificity of technological innovation, not only of microscopes, but also of new labeling methods and devices to keep cells and tissues alive while they are being studied. We want to achieve this by combining the forces of technologists and inventors from TU Delft and researchers from Erasmus MC. The interaction between those two parties, the mutual feedback loop, will be catalyzed and channeled by the Optical Imaging Centre (OIC, erasmusoic.nl), an Erasmus MC Core Facility (CoFa) whose participating members not only have excellent technological expertise but also a background in biomedical research (PhD level). In the project, we will link the different modules within the work chain, from preparation and labeling to the design and use of instruments and methods for data analysis, to a range of diverse biomedical research questions related to various disease states. This simultaneous approach allows for integrated optimization of the entire work chain. This will ultimately lead to new medical insights and improved diagnosis and treatment. Moreover, it also makes the technology transfer to commercial collaboration partners more promising and easier. In particular, we are focusing on techniques that combine large image volumes (healthy or diseased tissues) with high resolving power, and on techniques that can even look at the nanometer scale, the scale at which the basic molecular blocks of the cell work together in an extremely complex way, or not at all, as in the case of disease.

#	Title	Public Summary (in Dutch)
#4	**Innovation Platform for Monitoring Health and Disease using Liquid Biopsies (IPLiB)** **Leads** John Martens (Erasmus MC) ***j.martens@erasmusmc.nl*** Marcel Reinders (TU Delft) ***m.j.t.reinders@tudelft.nl***	Liquid biopsies (blood, urine, saliva, ascites, cerebrospinal fluid, etc.) are considered important diagnostic sources because they can be taken at any time with minimal burden to assess the health status of an individual. However, obtaining useful health-related information from body fluids requires ultra-sensitive and highly specific tests and thus technological advances, as such detection methods are mostly unavailable at present. To close this gap, in this flagship, experts in the fields of microfluidics, chip technology, molecular phenotyping and information sciences are working together with experts from relevant clinical fields such as cardiology, toxicology, oncology, microbiology, internal medicine and neurology, through fundamental research to develop new ultra-sensitive detection methods and test their clinical applicability. Our goal is to build a network of researchers who will jointly develop advanced technologies in the field of minimally invasive monitoring. Our end goal is to enable cost-effective monitoring of health and disease in both patients and the general population. This will enable interventions before fatal diseases manifest or before disease progression has occurred. In addition, we expect that the developed sensitive measurement methods will provide better insight into disease onset and progression and help discover new health-related biomarkers that can be used to identify at-risk populations and provide better and more personalized intervention strategies.
#5	**At the intersection of lifestyle and mental wellbeing:Acquiring and maintaininghealth across all ages** **Leads** Annemarie Luik (EMC) ***a.luik@erasmusmc.nl*** Trudy Voortman (EMC) ***trudy.voortman@erasmusmc.nl*** Pieter Bakx (EUR) ***bakx@eshpm.eur.nl*** Jos Kraal (TUD) ***j.j.kraal@tudelft.nl***	A healthy lifestyle and mental well-being are crucial to our health. This is important throughout our lives, from pregnancy and childhood to old age. But what constitutes an optimal lifestyle and mental well-being is up for debate. They are complex constructs, not easily measured and affecting each other. Moreover, what can be considered healthy lifestyle or mental well-being is likely to be different at different stages of life, for men and women. In addition, what constitutes optimal lifestyle and mental well-being may also depend on what health problems you want to avoid - for example, what is a good lifestyle for good brain health is not necessarily the same as the best lifestyle for bone and muscle health. This Flagship will therefore focus on (1) determining what optimal lifestyle and mental well-being are based on individual differences, differences in life stages, and for different types of health (e.g., brain health vs. locomotor functioning) that you want to maintain, (2) setting up a data framework that allows us to combine already collected data from cohort and intervention studies registries, and national databases so that we can make the best use of existing data with high generalizability, (3) measuring lifestyle and well-being using modern techniques and devices, (4) examining why people make certain choices and conflicts in them, and (5) developing recommendations Application Form Flagship Program Call 2021 - open invitation for pre-proposals that are useful and feasible for promoting optimal lifestyles and well-being throughout the population. For this we have brought together a highly motivated team of excellent researchers from Erasmus MC, Erasmus University and TU Delft, with whom we want to create real convergence between the universities and departments. From this Flagship we contribute to the goals for health throughout life, socio-economic equity, and prevention for health maintenance.
#6	**THERANOSTICS** **Leads** Yann Seimbille (EMC) ***y.seimbille@erasmusmc.nl*** Antonia Denkova (TUD) ***a.g.denkova@tudelft.nl*** Lucas Goossens (EUR) ***goossens@eshpm.eur.nl***	'Theranostics' is a combination of medical imaging and therapy in one system, which can lead to much better treatment of patients. With this approach, the effect of the treatment can be directly monitored and adjusted if necessary - 'treat what you see, and see what you treat' - which greatly increases the chances of success. Theranostics can contribute to precision oncology, but it can also be applied in many other treatments. But despite its great scientific, economic and social potential, this integrated approach has not yet been implemented clinically. The goals of our Flagship initiative are therefore: i) to develop a technology for the diagnosis and treatment of diseases and, ii) to establish a national program that covers the entire spectrum of theranostics. To achieve these goals, scientists and clinicians with different forms of expertise (from chemistry to economics) must join forces, share knowledge and infrastructure, and pave the way for convergence of TU Delft, Erasmus MC and Erasmus University Rotterdam. We work with small molecules as well as nanoparticles that allow theranostics. With tests in vitro and in vivo, we are bringing clinical application of these agents closer. Artificial intelligence is used to predict the effects of treatments without animal testing. Finally, flexible health-economic decision models are being developed that can help select and develop promising treatments with high value for patients and affordable costs for society. The project has scientific payoff (new materials and technologies) and societal value: better medical treatments within economically sustainable healthcare systems. systems. Moreover, we expect this flagship to be the start of a long-term collaboration between the three organizations, with new joint projects, a large network and the foundation of a theranostics institute.

#	Title	Public Summary (in Dutch)
#7	**The use of state-of-the-art VR technologies for diagnosis and treatment of socio-affective cognition deficits in mental disorders: From bench to bedside** **Leads** Prof.dr. Matthias Wieser ***wieser@essb.eur.nl*** Prof.dr.ir. Bart De Schutter ***b.deschutter@tudelft.nl*** Dr. Janne Papma ***j.papma@erasmusmc.nl***	Disorders in the social, affective, and cognitive domains underlie a wide range of mental illnesses. The prevalence of mental disorders is increasing due to socio-demographic changes (e.g. dementia) and negative life events such as the Covid pandemic (e.g. anxiety). Such mental health problems cost our society 25 trillion Euros per year without taking into account the additional cost of reduced productivity. These costs can be reduced with reliable and timely diagnoses and treatments, which however are largely lacking due to staff shortages and time-consuming procedures. Technological solutions such as virtual reality (VR) have the potential to overcome these limits, but are not easily developed or accepted by end users (patients, clinicians). The goal of this flagship is to develop intelligent customized VR solutions for the diagnosis and treatment of social-affective cognition disorders in anxiety and dementia. VR is an immersive technology that tricks our minds into believing we are in a place while being physically present somewhere else. Although users are fully aware that they are being misled, the realism of virtual environments can elicit reality-like responses in users, which are very useful for diagnosis and treatment. For example, patients with anxiety disorders or dementia can be tested (diagnostic approach) or trained (therapeutic approach) in virtual interactions. Based on verbal, neurophysiological, and behavioral data, we can then detect exactly the most important (altered) social-affective and cognitive mechanisms for that particular individual, and using a real-time adaptive virtual environment, we can then intervene immediately on the altered mechanisms. However, these efforts would be in vain if end users did not use them. We therefore want to monitor and encourage end-user motivation to ensure the effectiveness of technological solutions. All in all, our flagship will contribute to solutions for more personalized and cost-effective healthcare.
#8	**HOUDINI Holistic approach to understand and target the metastatic niche** **Leads** Wytske van Weerden (associate professor Erasmus MC) ***w.vanweerden@erasmusmc.nl*** Monique Verstegen (assistant professor Erasmus MC) ***m.verstegen@erasmusmc.nl*** Gijsje Koenderink (professor, TU Delft) ***G.H.Koenderink@tudelft.nl***	Metastatic cancer is difficult to treat and accounts for 90% of all cancer related deaths. The development of successful treatments is greatly hindered by the lack of knowledge about why tumor cells have a preference for specific organs. This assumes that this process is strongly influenced by characteristics of the organ. In order to develop effective therapies to inhibit or prevent metastasis, in this project we want to investigate the changes in the organ at the time when the cancer cell invades the tissue. In doing so, we will learn to better understand the interaction between the various cells from the tumor and the organ. This research requires the development of model systems that faithfully represent the physiology and complexity of human tissues. Current developments in biomedical technologies, such as organ-on-chip applications, make it possible to create such relevant (bio)mechanically representative environments. This combined with medical biological knowledge about tumor growth and progression will allow the development of better research models that approximate the biological complexity of normal healthy tissues. This is necessary to elucidate the various steps in the process of metastatic cancer. The research results and the resulting new biological insights will be shared and brought together to identify therapeutic entry points that will enable the reduction or even prevention of metastasis development and growth To build such research models, tissues from patients are essential. This requires the involvement of patients who donate their tissues for use, but also the consideration of ethical aspects that use of, for example, (stem) cells from patients. The economic and societal impact of outcomes related to knowledge generation, new medical insights on how to address metastatic disease, and the use of model systems and assays, will be an integral part of this project and will be evaluated through early health technology assessments.
#9	**Integrative Neuromedicine** **Leads** Daan Brinks, Delft University of Technology, Assistant Professor ***d.brinks@tudelft.nl*** Dimphna Meijer, Delft University of Technology, Assistant Professor ***D.H.M.Meijer@tudelft.nl*** Mario Negrello, Erasmus Medical Center, Assistant Professor ***m.negrello@erasmusmc.nl*** Zhenyu Gao, Erasmus Medical Center, Associate Professor ***Z.Gao@erasmusmc.nl*** Maren Wehrle, Erasmus University Rotterdam, Assistant Professor ***wehrle@esphil.eur.nl*** Katharina Bauer, Erasmus University Rotterdam, Assistant Professor ***bauer@esphil.eur.nl***	An aging population will lead to an increase in disorders related to aging brains. We propose a new paradigm to address the understanding, diagnosis and treatment of these disorders: Integrative Neuromedicine. The concept of Integrative Neuromedicine stems from the observation that healthy brain function is systemic: therefore, addressing age-related disorders requires broadening the scope of analysis beyond single aspects of disease and intervention. At the same time, the influx of new and affordable technology into neurology is greater than ever, and multidisciplinary approaches are second nature to new generations of scientists. We combine these needs and opportunities for integrative neuroscience to propose new pipelines for fundamental understanding, diagnosis and treatment of brain disorders, particularly those exacerbated by aging. It is of paramount importance to integrate knowledge from different developmental stages of the brain, new ways of observing and interacting with the brain, and broad fundamental, technological and clinical approaches. At its core, we aim to integrate data on the brain at different stages of life in order to achieve new insights into the brain in old age. In this flagship proposal, we will use cutting-edge technologies in (optical) electrophysiology, physical and computational brain modeling, AI and drug development to create biological and digital models of the aging brain that can be used for predictive, diagnostic and screening purposes. We will investigate healthy, aging, and diseased models of the same brain regions to create tissue-based and computational models of age-related diseases; use the knowledge gained to find effective intervention pathways in brain function; and to arrive at an integrated understanding and ethical discussion of what can and should be considered a deviation from normality in brains that can be diagnosed and treated. interaction with the brain, and integrate broad fundamental, technological and clinical approaches. At its core, we aim to integrate data on the brain at different stages of life, in order to achieve new insights into the brain in old age. In this flagship proposal, we leverage cutting-edge technologies in (optical) electrophysiology, physical and computational brain modeling, AI and drug development to create biological and digital models of the aging brain that can be used for predictive, diagnostic and screening purposes. We will research healthy, aging, and diseased models of the same brain regions to create tissue-based and computational models of age-related diseases; use the knowledge gained to find effective intervention routes in brain function; and arrive at an integrated understanding and ethical discussion of what can and should be considered a deviation from normality in brains that can be diagnosed and treated.

#	Title	**Public Summary** (in Dutch)
#10	**Personalized genetic therapies for rare diseases** **Leads** Prof. dr. Ype Elgersma Department of Clinical Genetics, Erasmus MC ***y.elgersma@erasmusmc.nl*** Prof. dr. Lina M. Sarro Department of Microelectronics, TU Delft ***P.M.Sarro@tudelft.nl*** Prof. dr. Maureen PMH Rutten-Van Molken, Erasmus School of Health Policy & Management, Erasmus University ***m.rutten@eshpm.eur.nl***	With the emergence of new diagnostic DNA analysis methods, the ability to identify a mutation (change) in the disease gene in a patient with a rare disorder has increased dramatically. The identification of these disease genes provides insight into the fundamental biology of the disease, which allows us to investigate underlying mechanisms and develop therapies. One very promising therapy for these patients is one that aims to repair the disease-causing change in the gene. Targeted genetic therapies are increasingly being used in practice. In particular, treatments with so-called antisense oligonucleotides (AON) offer opportunities for personalized treatment. Such a In addition, such a treatment can easily be developed in an academic setting and offered to the patient at cost price. Applying these developments on a large scale comes with great challenges. Induced pluripotent stem cells (iPSC) are a promising technique for testing 'personalized medicine' in cells from patients. In particular, this technique offers many opportunities for research on human tissue that is not easily obtained such as brains and retinas. With iPSC technology, patient blood cells can be changed into such specialized human cells and studied. But these techniques are laborious, time consuming, variable and expensive. This Flagship project therefore brings together a team of TUD and EMC experts, to jointly develop an automated platform that can create iPSCs and tissues derived from them for rare diseases. In addition, functional assays will be set up to investigate targeted therapies, in particular AON therapy. In collaboration with the EUR, ethical issues related to personalized treatments applied in a patient for the first time will also be explored, as well as the economic evaluation of such treatments. This project has the revolutionary potential to enable large-scale personalized medicine applications.
#11	**Personalized Exercise and Sports as medicine** **Leads** Prof. dr. Frans C.T. van der Helm (TUD) ***f.c.t.vanderhelm@tudelft.nl*** Prof. dr. Denise Eygendaal (EMC) ***d.eygendaal@erasmusmc.nl*** Prof. dr. Moniek Buijzen (EUR) ***m.buijzen@eur.nl***	Exercise contributes to healthy aging. It is good for weight, bones, muscles, blood pressure, and contributes to a prevention of numerous diseases. So it is good to load our bodies with exercise and sport. However, in hospitals we also see the downside of strain; overstraining leads to (long-term) sports injuries in active people, and can actually lead to accelerated deterioration in patients with chronic conditions. The balance between load and load capacity is complex. Numerous factors play a role in determining the appropriate load, for example age, BMI, muscle capacity, genetic predisposition, and use of medication. Therefore, there is no generic optimal training program suitable for everyone, while that is of importance for prevention and treatment. In this new partnership, we aim to develop customized training programs for both patients and healthy athletes. Here, the research focuses on the one hand on quantifying load versus load capacity. This can be done by measuring and simulating the load on the heart-lung and muscular skeletal system during exercise. In addition, efforts will be made to track the daily load by developing smart sensors incorporated in clothing. The third pillar in this track is implementation, where the focus is on analyzing and changing human behavior with regard to a healthy lifestyle. There are two lines of research: 1) the prevention of under- and overexertion in patients with chronic diseases 2) the prevention and treatment of injuries in healthy athletes. Each of the research lines is initially supported by a carrier project, namely 'chronically ill children' and 'personal advice to runners'. Eventually, the infrastructure of this flagship will be used for a range of conditions and sports activities and can thus bring about major advances for the Dutch healthcare system.
#12	**Continuity of care from hospital to home** **Leads** Prof. dr. J.M. (Joke) Hendriks ***j.m.hendriks@erasmusmc.nl*** Prof. dr. ir. R.H.M. (Richard) Goossens ***R.H.M.Goossens@tudelft.nl*** Prof. dr. ir. C.T.B. (Kees) Ahaus ***ahaus@eshpm.eur.nl***	Patients like to receive their care closer to home and healthcare providers are increasingly using technology to do so. There is a great urgency to use these technologies to also solve problems surrounding the rising cost of care and staff shortages. There are many technologies that healthcare providers and patients can use, but they are little used. This is due to several reasons. For example, that a technology is not easy to use, is not a standard part of the care process or that no one is willing or able to pay for it. In this Flagship we look at what the hospital of the future should look like. In this hospital, many technologies are used and patients come to the hospital less. The first step is to design the hospital of the future with everyone involved in healthcare. The goal of this is to know what role technologies should have in care and how stakeholders use these technologies. The second step is to investigate what is needed to make technologies an integral part of the care process. For this, we look at professional and patient experiences, health outcomes, conditions for structural reimbursement, data and IT requirements, and quality management, among other things. The final step is the evaluation of technologies in healthcare. For this we need to develop a new way of evaluation that looks beyond the impact on someone's health. We do the three steps of research in different places in healthcare. We have created four groups for this purpose, acute care, chronic care, mental care and complex care. These groups differ in how patients and professionals want to use the technologies and what is needed to use technologies properly. With projects in these groups, we aim to integrate technologies sustainably, with the right technology being used in the right place.

#	Title	Public Summary (in Dutch)
#14	**Adaptive LIving Engineered organs(ALIVE)** **Leads** Amir A. Zadpoor Professor, Section Head Biomaterials and Tissue Biomechanics, TU Delft ***A.A.Zadpoor@tudelft.nl*** Gerjo van Osch Professor, Erasmus MC & TU Delft ***g.vanosch@erasmusmc.nl***	With engineered living materials (ELM), it becomes possible to address socially relevant problems, for which there are currently no good solutions. In this project, we are developing Key Breakthrough Technologies (KBTs) that will allow us to overcome current challenges and develop ELM for healthcare applications. Using the KBTs developed in this project, our goal is to create several types of large, multicellular and vascularized tissues (liver, cartilage-bone, muscle and neural tissues) that can be used to replace diseased and failing organs. The tissues can also be used to perform accurate drug tests and toxicological analyses in the laboratory. Here, ethical aspects are carefully studied and weighed. In this project, a groundbreaking technological toolbox is developed, which guarantees "adaptive spatiotemporal control": the performance of the ELM is continuously monitored and adjusted using (bio)sensors. Computer-controlled algorithms determine the appropriate response to the observed condition. A network of spatiotemporally differentiable (micro) channels inserted into the adaptive ELM then delivers the appropriate response such as release of specific peptides, oxygen or nutrients. An adaptive infection prevention system keeps ELM infection-free. The technological toolbox being developed is highly innovative and, by using an automated closed-loop system, offers the possibility of growing living cells in, complex 3D architecturesof various sizes. The project develops and implements a large number of effective new technologies, including new sensors for single peptide sequencing and metabolite detection, 4D multi-process/multi-material (bio)printing, 2D to 3D folding techniques (origami) and various molecular-biological techniques. In developing the technology toolbox, consideration is also given to the ethical considerations for application of ELM in healthcare.
#15	**Healthy ageing across the life course' – from bench to bedside to the society** **Leads** Prof. R Steegers-Theunissen Obstetrics&Gynaecology ErasmusMC, Full Professor ***r.steegers@erasmusmc.nl*** Prof. M Reinders Computer Science TUDelft, Full Professor ***m.j.t.reinders@tudelft.nl*** Prof. Y van Everdingen Marketing Management EUR, Full Professor ***yeverdingen@rsm.nl***	"Healthy aging" is determined by intrinsic conditions (e.g., age, gender, genes) and modifiable risk factors (e.g., lifestyle, exposures, stress). The Healthy Ageing Flagship will integrate multimodal sources of patient and research data into holistic databases for advanced analysis and development of state-of-the-art medical, lifestyle, social and mental health tools. These will be integrated into a digital and personalized "ecosystem" for healthy aging through the Life Course Care Platform (LCCP). To facilitate humane, medical and social interactions, LCCP will work with an App and Avatar. Individuals and societies will thus be provided with tools, knowledge and capacity to shape their own healthy life course aging journey. This will generate financial benefits for health care and society, which can be fed back to further promote this transformation of health care. Importantly, our Flagship is constantly evolving, as clinicians, technologists and (social) scientists will use state-of-the-art research to generate new 'hot topic' information and tools that can be directly validated and implemented in clinical practice. This knowledge will help in the development and implementation of a new generation of 'point-of-care' testing systems (capacity) of this innovation to further refine and personalize the digital journeys offered. We want to bring the science of healthy aging to society by directly empowering individuals at all ages to make informed choices about maintaining their physical and mental health. As a starting point, we will identify key interactions indicated by knowledge from existing basic research and cohorts. The need for lifecycle care journeys for healthy aging will be explored through "fieldlab methodologies," including co-creation and co-design within social learning communities using human-centered technology and artificial intelligence. Finally, LCCP will be tested for usability, (cost-)effectiveness, (inter-)operability, and implementation in order to ultimately contribute to sustainable technology- based transition in health (care) and creation of resilient societies.
# 16	**Organ-on-Chip technology for disease modeling and personalized medicine** **Leads** Dr. Dik C. van Gent (EMC) ***d.vangent@erasmusmc.nl*** Dr. Hedwig Blommestein (EUR) ***blommestein@eshpm.eur.nl*** Dr. Massimo Mastrangeli (TUD) ***M.Mastrangeli@tudelft.nl***	Research into human disease processes and the prediction of patient-specific responses to drugs require representative organ and disease models that can accurately mimic the real situation. Medical science benefits from patient-specific treatments, but in very many cases good test systems are lacking to actually put this into practice. In recent years, much progress has been made in developing models with cultured human cells and mini-tissues using so-called 'organ-on-chip' technology. This advanced technology requires close collaboration between scientists with specific knowledge from totally different fields: medical biology ('organ') and engineering ('chip'). Now is the time to directly connect these centers of expertise so that existing and new ideas can lead to groundbreaking insights and models. Currently, there is limited interaction between these centers that are also scattered localized. With this Flagship application, we aim to address this problem by establishing a center of excellence that provides researchers with the latest technological chip models and biological knowledge for applicability to different organs within one space. In doing so, we are creating an environment where direct collaboration can take place between scientists from different fields, as well as doctors and policy makers. We make use of the unique combination of knowledge present at TU Delft, Erasmus MC and EUR (microtechnology, sensors, microscopy, cell/tissue biology, health economics and ethics). With this unique knowledge, the Flagship will study various fields of research: processes in organ development, biology of blood vessels, research into cancer processes and predicting patient-specific responses to medication.

#	Title	Public Summary (in Dutch)
#17	**Designing Digital Technologies for Aging in Place: An Interdisciplinary Emancipatory Approach** **Leads** Prof. Bas Donkers Professor of Marketing Research (EUR) ***donkers@ese.eur.nl*** Prof. Francesco Mattace- Raso Head of the Division of Geriatric Medicine (EMC) ***f.mattaceraso@erasmusmc.nl*** Dr. Marco C. Rozendaal Associate Professor at Human-Centered Design (TUD) ***m.c.rozendaal@tudelft.nl***	The Dutch population is aging rapidly. 95% of people aged 65 or older in the Netherlands live independently at home. While this is encouraged by the Dutch government, it also brings several challenges. This flagship project investigates the bottlenecks and opportunities for older people living at home and asks how digital technologies can support and promote 'aging in place'. Aging in place is a concept from geriatrics and gerontology that refers to the importance of aging in one's own environment. In recent years, a range of digital technologies have been developed that seem capable of supporting aging in place. Interventions such as assisted living, telecare systems, social robots, and Internet of Things technologies have been introduced as efficient and cost-effective solutions to the various challenges faced by independent living aging adults and their formal and informal caregivers. Remarkably, such technological interventions rarely work out in practice. The stakeholders for whom these technological interventions are designed often choose not to use them, leaving extensively researched and expensively developed systems underutilized. Our Flagship's research generates insights into the key drivers behind the adoption, effectiveness, and sustained use of digital technologies that support home-based aging. In doing so, we are focusing on the following four aspects in particular: improving quality of life, encouraging active lifestyles, slowing health decline, and improving the organization of care. These insights are brought together in an interdisciplinary framework for understanding and designing digital technologies for aging in place. This framework addresses how complementary disciplines: anthropology, data science, design, and ethics of technology, are crucial to understanding and developing such digital technologies.
#18	**The Brain, Exposed (BrainX)** **Leads** Michiel Pertijs (TUD) ***m.a.p.pertijs@tudelft.nl*** Pieter Kruizinga (EMC) ***p.kruizinga@erasmusmc.nl***	Currently, a surgeon who removes a brain tumor is guided only by simple, time-based, functional brain maps. These maps are too coarse to accurately guide the surgeon, resulting in a very delicate balance: cutting too little and risking premature tumor recurrence; cutting too much and risking inadvertently compromising the patient's unique neurological make-up. These limited mapping capabilities call for a radical shift in functional brain imaging to a more personalized and detailed approach. Here we present BrainX, a Convergence Flagship that addresses this challenge on multiple levels, through cross-cutting objectives. By combining the development of a novel, personalized wearable functional brain imaging device with a dedicated neurosurgical experimental OR facility, and through outreach, training, dissemination and exploitation efforts, we will bring to light the first wearable imaging shaping device that uses hemodynamics-based functional ultrasound to capture chronic 3D videos of the human brain. Smart innovations in data compression through an acoustic hologram, breakthrough sensor chip technology and computational image-formation will enable such a world-first, portable, minimally invasive, ultrasound-based brain scanner. By implanting this device preoperatively, a dynamic, patient-specific brain map can be created, serving as a reference for subsequent peri- and intra-operative clinical decision-making. Interrogating a patient's brain activity prior to surgery will allow for better preservation of the patient's neurological make-up and more effective post-operative rehabilitation. In addition to brain tumors, BrainX has the potential to revolutionize our understanding of and treatment strategies for other neurological conditions such as neurovascular malformations, trauma and epilepsy. BrainX builds on the consortium's unique ultrasound research and infrastructure and their ability to clinically test the prototype device. The multidisciplinary team will develop the technology, integrate the building blocks into a prototype, and conduct initial clinical testing in an experimental operating room to achieve a functional proof-of-concept.
#19	**RED (REDUCTION EXPENDITURE DRUGS)** **Leads** Prof dr Hugo van der Kuy Hospitalpharmacy, Erasmus MC ***h.vanderkuy@erasmusmc.nl*** Prof dr Carin Uyl ESHPM, EUR ***uyl@eshpm.eur.nl*** Prof dr Marileen Dogterom Department of Bionanoscience, TU Delft ***m.dogterom@tudelft.nl***	In recent years, expensive medicines have received a lot of attention in society and the media. More and more expensive medicines are coming onto the market and there are concerns about their accessibility and financing. The cost of expensive medicines has increased in recent years from €1.71 billion in 2014 to €2.46 billion in 2019. Especially at university or STZ hospitals the costs are rising. Such increases cannot be absorbed within current healthcare budgets. Expensive medicines will drugs will therefore displace other care and thus become the "cuckoo kid" of healthcare. Yet every Dutch person should continue to have access to these effective medicines. In addition to increasing the available financial resources, there are also actions that healthcare professionals and hospitals themselves can/should take. Erasmus MC should play an active role in this with a wide range of measures that other hospitals and prescribers of DGM can take. Goal: In this "Flagship" program, we strive for the bold goal of reducing the spending on expensive drugs, to make the spending sustainable and acceptable. The goal is to reduce Erasmus MC's budget for expensive drugs by 5% (price level 2021) in 5 years and 10% in 2030. This means that expenditures will be reduced annually by 12M starting in 2026 and 23M starting in 2030. To achieve these goals, workpackages with different topics will be used. The topics that will be further elaborated are: - Procurement - Local production - Proper indications - Different dosage regimes - Switching between preparations - Input from patients and physicians to make difficult choices in the future - Alternative pricing methods

#	Title	Public Summary (in Dutch)
#20	**'Deep' Medical Imaging of Structure, Physiologyand Function** **Leads** Martin Verweij Associate professor Imaging Physics, TUDelft; Biomedical Engineering, ErasmusMC ***m.d.verweij@tudelft.nl*** Marion Smits Full professor Radiology and Nuclear Medicine, ErasmusMC ***marion.smits@erasmusmc.nl***	This flagship project aims to bring the latest ultrasound and MRI techniques into practice to significantly improve diagnosis and prediction of disease course. It brings together experts from TUDelft, ErasmusMC and EUR who have all the knowledge about imaging, analysis of images (including through artificial intelligence) and clinical applications. Ordinary' imaging techniques are influenced by a variety of external factors. This makes it impossible to compare the signal in images from different patients, or to follow within a patient over time. New quantitative MRI (qMRI) and functional ultrasound (fUS) remedy this and enable accurate measurement and obtaining functional information about blood flow, among other things. In this flagship, we will bring together and further develop such non-invasive techniques. We will use imaging as a virtual, functional biopsy, representing tissue structure and type, as well as function. The flagship will focus on: 1. Optimization of fUS and qMRI imaging. 2. Artificial intelligence-based indicators of disease (so-called biomarkers) 3. Clinical review and acceptance that together will advance the value of imaging in clinical practice techniques. Within themes we focus on applications in heart, brain and placenta.
#21	**Tailoring Technology for Healthy Neighbourhoods** **Leads** Samantha Copeland (TUD) ***s.m.copeland@tudelft.nl*** Like Oldenhof (EUR) ***oldenhof@eshpm.eur.nl*** Famke Molenberg (EMC) ***f.molenberg@erasmusmc.nl***	Health disparities among neighborhoods are widening. One of the reasons for this is the increasing technologization and digitization of healthcare, such as in apps and monitoring devices, which is causing the health of those neighborhoods to lag behind where people live who are less digitally savvy and who have less interest and time for health. These neighborhoods are high on the agenda of overarching health policies with the result that many interventions are developed for these neighborhoods - unfortunately often without catching on, working in tandem, or meeting the needs of the residents. Sustainable embedding of interventions in a neighbourhood is firstly hampered by the high diversity in health interests and skills of the residents within an 'unhealthy' neighbourhood. Second, most interventions take very little account of the dynamic nature, in human interactions and change processes, within a neighborhood. In this flagship, we will explore the potential of technology for health inequity with the goal of developing and applying a stable bottom-up driven health strategy to tailoring existing technology. To this end, first the health attitudes of residents in neighborhoods with various health profiles will be mapped and the influences on them of media, social environment, built environment, health care, health technology and programs (EUR). Subsequently, cocreative research will be done (TUD, EURMC) into the health potential of existing technology in the relationships between neighbourhood residents, e.g. social media, and between residents and their environment. Finally, we will co-develop a strategy (EUR, TUD, EURMC) to combine, tailor, and support health of existing technology to enable a sustainable embedding in a changing neighborhood.
#22	**IMMUNOMICS & eHEALTH** **Leads** Rudi Hendriks ***r.hendriks@erasmusmc.nl*** Marlies Wijsenbeek ***m.wijsenbeek-lourens@erasmusmc.nl*** Janneke Samsom ***j.samsom@erasmusmc.nl*** Marcel Reinders ***m.j.t.reinders@tudelft.nl*** Rik Wehrens ***wehrens@eshpm.eur.nl***	Treatment of patients with chronic disease, including immune-mediated mucosal disease (IMZ) of the lung or gut, often has limited or variable effect. Determining the appropriate treatment is now often based on clinical signs of disease rather than the underlying causes. In order to identify these causes and better understand these diseases, increasing amounts of complex clinical, immunological and molecular research data ('big data') are being obtained. However, it is not yet possible to aggregate these 'big data' to get a clearer picture of the disease. However, this is very much needed to classify patients into the right treatment group and to develop suitable methods to monitor the severity and course of the disease on a daily basis at home. In this project, we want to combine knowledge from four different fields in order to create an individual immune profile of patients that can better predict which treatment is most suitable for the individual patient. For this purpose large data sets will be generated with the latest laboratory techniques (Erasmus MC). New analysis methods will be developed to combine and integrate these into an individual immune profile (TU Delft). From the immune profiles we will then extract a number of key factors that can be used to build new monitoring systems, such as systems can be built, based among other things on newly developed sensitive biosensors that can measure very low amounts of substances in the body non-invasively (TU Delft). The usability and suitability of this new home monitoring system and its effects on health care will be carefully evaluated (Erasmus University Rotterdam), together with patients, patient associations, physicians and other health care providers. Ultimately, this system will give IMZ patients more control over their disease and treatment and lead to better and more future-proof care, where the developed high technology will also be of interest to patients with other chronic diseases.

#	Title	**Public Summary** (in Dutch)
#23	**I-GUIDE: Image guided minimally invasive interventions** **Leads** Prof. dr. Aad (A.) van der Lugt (EMC) ***a.vanderlugt@erasmusmc.nl*** Dr. Ken (K.) Redekop (EUR) ***redekop@eshpm.eur.nl*** Prof. dr. Jenny (J.) Dankelman, (TUD) ***j.dankelman@tudelft.nl***	Image-guided minimally invasive interventions (BMII) result in a more precise and safer procedure with less damage to healthy tissue and thus faster recovery. Image guidance supports the clinician to accurately visualize and approach the surgical site. BMII is being applied in an ever-increasing range of clinical scenarios, such as catheter and needle interventions and minimally invasive surgery. BMII uses real-time images during the intervention over which virtual can be presented that allow innovative image-guided instruments to be accurately navigated to a target. These innovative instruments also contain miniature sensors for determining tissue properties, such as tumor tissue or vein calcification. calcification. Within the Flagship Image Guided Interventions (I-GUIDE) we want to join forces to bring (new) intra-operative imaging, sensing, steering and navigation technology into the clinical practice of BMII and provide radiologists and surgeons with additional information in a user-friendly way, so that unnecessary tissue damage, wrongly placed stents and needles, incomplete (tumor) resection and pain, can be largely reduced. Within the I-GUIDE, we will focus on cardiovascular and oncology clinical applications. New tools and methods that will be developed within I-GUIDE focus on endovascular, minimally-invasive surgical and radiotherapeutic procedures, using intra-operative imaging (e.g. ultrasound, US, VR, AR, microscopy) and sensing (e.g. optical, impedance) for guidance (e.g. user-friendly steering and navigation methods, image capture, instrument tracking and visualization). The technical challenges of I-GUIDE Flagship are e.g.: integration, miniaturization, navigation and guidance, and intuitive interfaces. To take the developed innovative I-GUIDE instruments to a higher TRL level, we will leverage experience in instrument prototyping, intra-operative imaging, and clinical and translational/valorization expertise together. Hereby, within this consortium, the three research institutes, TU Delft, Erasmus MC, and Erasmus University, will work closely together with small spin-offs, SMEs, and large companies to bring the innovative instruments for image-guided minimally development and implementation.
#24	**Novel Research Methods to Support Patient-Centered Care** **Leads** Irene Grossmann (TUD) ***i.grossmann@tudelft.nl*** Miao-Ping Chien (EMC) ***m.p.chien@erasmusMC.nl***	Common research methods in medicine have a number of important limitations. For example, the most commonly used studies often do not include the most vulnerable groups. As a result, it is not certain whether the results are valid for them, while this information often matters to them. Also, the outcome is strongly focused on the average and stated in black and white, such as 'it either works or it doesn't', while an average patient does not exist and the circumstances are also important. In addition, outcomes are skewed in the literature because, for example, negative outcomes are published less frequently. We are focusing our research on developing research methods that do more justice to reality and to individual patients. We are working on a number of approaches that are already under development and are characterized by the same underlying philosophy. These principles are: doing justice to the complex, dynamic reality; doing justice to all patients; focusing on the individual patient in his context. The first step involves the use of mathematical modeling of the course of the disease and the interactions between the cancer cell, patient and treatment. Depending on the type of cancer, the target and the context, different models are applicable. Including prediction models for colon cancer, where the benefit of major surgery is uncertain, and 'game theory' modeling combined with genetic information in patients with metastatic lung cancer or head/neck tumors. The second step deals with the decision-making process, with all factors involved. The goal is to generate an understandable and manageable range of information and considerations for the patient. The overarching theme concerns the evaluation of underlying values, such as inclusiveness and safety. Based on these evaluations, the methods may be revised or adapted to do better justice to the patient.
#25	**OR2030: Orchestrating efficiency and safety in the perioperative workflow** **Leads** Dr. John van den Dobbelsteen (TUD) ***j.j.vandendobbelsteen@tudelft.nl*** Dr.ir. Jan-Wiebe Korstanje (EMC) ***j.korstanje@erasmusmc.nl*** Prof.dr. Carina Hilders (EUR) ***hilders@rdgg.nl***	In the operating room (OR), thousands of patients are treated each year by a team of medical specialists, nurses, technicians, support staff and managers. The work is complex and the organization requires careful planning with good logistics, structured checks of equipment and instruments and conclusive communication and reporting. However, the workload in Dutch hospitals is high and the complexity of the cases makes the patient vulnerable. This increases the risk of errors or carelessness in the work processes, with potentially disastrous consequences for the patient. The goal of OK2030 is to use artificial intelligence (AI) to distill potential structural improvement opportunities for the surgical process from large amounts of data on the course of many operations. By applying these algorithms in real-time, risks to patient safety and operational inefficiencies can be recognized in a timely manner, overcome and processes automated. In this way, OK2030 develops the medical technology of tomorrow that relieves and supports the healthcare professional with comprehensible and structured information. In addition, making surgical processes visible and measurable will provide a reliable monitoring tool or quality indicator."

#	Title	Public Summary (in Dutch)
#26	**Decoding Real-Time, Personalized Health Impact of Climate Change and Pollution** **Leads** Pilar Garcia-Gomez ***garciagomez@ese.eur.nl;*** Hok Bing Thio ***h.thio@erasmusmc.nl*** Alina Rwei ***a.y.rwei@tudelft.nl***	Climate change and air pollution can adversely affect our health with 13 million deaths globally each year. It is a major scientific challenge to be able to address environment-related health problems in an individual, efficient manner, since the direct "real-time" impact of climate change and pollution on personal health is largely unknown. This project aims to be able to provide possible solutions through measurements and rationally design interventions to be able to prevent environmentally induced health problems on an individual scale. We will combine the expertise of clinicians, technological scientists, engineers, and economists to make a revolutionary transition in this field with integrated measurement and intervention strategies, focusing primarily on the following three aspects:(1)enable clinicians to develop personalized intervention strategies based on "real-time" immunological measurements in patients by designing novel wearable biosensors for non-invasive immunological (cytokines) measurements;(2) understand the biological response of skin and lung tissues following exposure to environmental stressors (e.g. pollutants) by developing skin and lung-on-a-chip systems as models in a cost-effective and time-saving manner;(3) analyze the links between human health and air pollution concentrations and climate/meteorological variables, as well as studying individual behavior (influenced by pollution or influenced by pollution) using a data-driven approach and state-of-the-art micro-econometric methods to further investigate the ultimate impact of interventions for further guidance to our policy makers. Our scientific multidisciplinary research project will focus on the intersections of biochemistry, microelectronics, data science, health economics, dermatology and pulmonary medicine to generate new actionable knowledge that can effectively prevent and modulate potential health problems arising from the greatest challenges of our time, namely climate change and pollution. Information will also be gathered in this way to better inform policies for our future generations.
#27	**Sustainable intensive care: from linear to circular** **Leads** Dr. Nicole Hunfeld (IC, EMC) ***n.hunfeld@erasmusmc.nl*** Dr. ir. JC Diehl (IDE, TUD) ***j.c.diehl@tudelft.nl*** Prof. dr. Erik van Raaij (RSM & ESHPM, EUR) ***eraaij@rsm.nl***	Climate change is causing a lot of health damage worldwide. In the Netherlands, healthcare is responsible for 7% of the CO2 footprint. A recent project in the ICU of Erasmus MC showed that the ICU contributes substantially to this 7%. One way to reduce the CO2 footprint in the ICU is to change from a linear economy to a circular one. To achieve this change, we will start with an analysis phase in our Flagship. During this phase, we will investigate what are the most polluting materials used in the IC, the so-called hotspots. With our research team we look at patient safety, the logistics chain, costs, environmental impact, regulations and behavior of doctors and nurses in relation to these hotspots. We take 3 care paths in which the ICU is involved. These care paths can serve as a model for all other care paths in the ICU. In the subsequent development and implementation phase, we will search with stakeholders for new solutions for the hotspots. These solutions can either be designed and researched quickly (e.g. by recycling) or more slowly (via co-creation or system analysis). In the final evaluation phase, we examine the impact of our solutions on the environment, costs, logistics, behavior, rules and guidelines. We will also include the operating rooms and emergency rooms in our analysis (from the care paths). Thus, the circular approach is also spread across these departments. In addition, our research will include the ICs and Acute Care departments of the hospitals in the Rijnmond region. Our goal is to work 100% circular in the IC of Erasmus MC by 2030. Other goals are 50% circularity at the other Acute Care departments of Erasmus MC and 25% circularity at the ICs and Acute Care departments of the hospitals in the Rijnmond region.
#28	**Convergence Human Mobility Center; towards minimally supervised motorrehabilitation** **Leads** Prof. Gerard Ribbers (EMC) ***g.ribbers@erasmusmc.nl*** dr. Laura Marchal Crespo (TUD) ***L.MarchalCrespo@tudelft.nl*** Prof. dr. Jane Murray Cramm (EUR) ***cramm@eshpm.eur.nl***	In the Netherlands, 45,000 patients suffer a stroke each year, 60,000 are hospitalized due to traumatic brain injury, and 2,000 patients suffer a paraplegia. 17,000 patients have multiple sclerosis. Parkinson's disease is the most common neurodegenerative disease after Alzheimer's disease. All examples of conditions associated with motor impairment. Over 1.5 million patients have motor problems, about 250 thousand people are wheelchair dependent and 500,000 people experience social isolation due to motor limitations (www.handicap.nl). Double aging and improved acute care are increasing these numbers where the capacity to treat this cannot increase proportionally. Motor rehabilitation is challenged to become more effective and efficient. To this end, the expertise of TU Delft, Erasmus MC and Erasmus University is combined in the Convergence Human Mobility Center. Developments in sensor technology, supported by artificial intelligence and data-driven modeling, enable individualized remote monitoring and clinical decision-making. Personalized biomechanotronics, combined with virtual or augmented reality (VR/AR) techniques are targeted to train those functional tasks with minimal therapist supervision. We aim for a paradigm shift from a therapist/robot providing therapy to the patient to patients having control over their own therapy preferably at home and using low cost assistive robotics. The Convergence Human Mobility Center will strengthen our international leadership position in this area. We will create short lines of communication between innovation and clinical care, and have a focus on sustainable business models. By doing so, we will attract start-up companies and stimulate technological transitions in healthcare. We aim to be a knowledge center where students, scientists, clinicians. medtech companies and patients meet, collaborate and co-create to improve the quality of life of people with mobility disorders.

#	Title	**Public Summary** (in Dutch)
#29	**Next Generation Personalized Medicine for ALL** **Leads** Prof.dr. Hester Lingsma prof. Medical Decision Making, Department of Public Health (MGZ) (EMC) ***h.lingsma@erasmusmc.nl*** Prof.dr. Maureen Rutten-van Mölken prof. of Economic Evaluation of Innovations for Health, Erasmus School of Health Policy & Management (ESHPM) (EUR) ***m.rutten@eshpm.eur.nl*** Prof.dr.ir. Caspar Chorus, prof. Choice Behavior Modeling, dept. Engineering Systems and Services (ESS) (TUD) ***C.G.Chorus@tudelft.nl***	The topic of this Flagship is "personalized medicine" (PM), a term used to describe a preventive or therapeutic intervention that is specifically tailored to a person's unique medical, hereditary and personal characteristics, circumstances and preferences. This is in contrast to the usual "one-size-fits-all" approach for an average patient, which does not actually exist. In this Flagship, we develop, test and implement PM interventions for cardiovascular disease, cancer and mental health. For each of these disease areas, there are promising PM interventions that span the entire range from primary prevention to treatment. Many are ready for use, but their dissemination in daily practice is slow. There are many barriers to overcome. In this Flagship, we are developing solutions to the most important barriers. The solutions involve combining data from multiple sources better and more often, improving statistical methods to identify differences among individuals, providing evidence that PM adds value over the standard approach and that that value exceeds the cost of PM. Other solutions involve implementation strategies with suggestions for changes in the healthcare system to ensure sustainable embedding of PM, especially if they disrupt the normal routine. Developing transparent and reliable decision-support systems that are accessible to hard-to-reach groups can also contribute to the solution. Finally, increasing public support for PM, especially if it involves hereditary information. In this way, offering personalized prevention, screening and treatment will contribute to improving the health and well-being of citizens throughout their lives and improve the efficiency of the healthcare system.
#30	**Healthy Joints:a comprehensive research program from multiscale modelling towards early stage and personalized treatment.** **Leads** Prof. dr. Sita Bierma-Zeinstra, General practice Orthopedics & Sports medicine Erasmus MC ***s.bierma-zeinstra @erasmusmc.nl*** Prof. dr.ir. Jaap Harlaar, Clinical biomechanics, BioMechanical Engineering TU Delft, Orthopedics & Sportsmedicine Erasmus MC ***j.harlaar@tudelft.nl***	Joint disorders are a major problem, for the patient because of a great loss of quality of life, and for society because of reduced work capacity and medical costs. Of these conditions, osteoarthritis will increase significantly in the coming years; in fact, soon it will be the most frequent chronic condition. Pain in osteoarthritis is difficult to treat, and the disease itself cannot be cured. Therefore, we will have to prevent osteoarthritis where possible (prevention), or intervene much earlier and specifically for each patient. For this purpose, it is essential that we recognize osteo-arthritis at an early stage and distinguish the specific subtypes. We will do this by examining osteoarthritis in all its facets, using modern technologies to do this as accurately as possible. From the point at which the joint develops in childhood to the point at which there are early osteoarthritis symptoms. With this, we will develop subtype-specific and early treatments to be introduced into clinical practice. For this we need the clinical, radiological, genetic and laboratory expertise, and research data from large patient collections from Erasmus MC. This is combined with the data-analytical expertise and biomechanical expertise of TU Delft for early recognition, pattern recognition, building simulation models, and for precise and early diagnosis of joint strain and disease processes. Based on the expertise from Erasmus University, we will explore how patient preferences will play a role in treatment choices at an early stage of disease, and what the costs and benefits might be in the long term. After these thorough analyses, the developed person-centered treatments are ready to be tested in patients. With this, we are taking an important step in the prevention and early, targeted treatment of osteoarthritis. We aim to add 5 healthy years to the life of the osteoarthritis patient.
#31	**Convergence in a dish: Individualized CELLular modelsof disease diversity in the population** **Leads** Prof. Joyce van Meurs (EMC) ***j.vanmeurs@erasmusmc.nl;*** Dr. Daan Brinks (TUD) ***D.brinks@tudelft.nl*** Dr. Ken Redekop (EUR) ***redekop@eshpm.eur.nl***	Every individual is unique, and to some extent so is every disease. We see great differences between people in susceptibility to disease, or susceptibility to treatment. For many diseases, we do not understand the cause of these differences. More knowledge is needed for better treatment or prevention of disease for each individual. To properly and efficiently study the effect of differences between people, new models are needed that reflect an individual's characteristics in the laboratory. Within the flagship "convergence in a dish", we will combine advanced technologies to develop cellular systems for each individual (I-CELL) that can be used as a model for all diseases. I-CELL will be used to investigate hereditary predisposition and environmental risk factors of common diseases, such as cancer and diseases of aging. The results will then be used to analyze individual disease characteristics and tailor treatment. I-CELL will be developed by a multidisciplinary team of scientists from Erasmus MC, TU Delft and Erasmus University. The applicability of I-CELL will be ensured by the early identification of cost-effective applications and the stimulation of social acceptance of this promising new technology.

#	Title	**Public Summary** (in Dutch)
#32	**PROTECT ME** **Leads** Prof. dr. Loes Keijsers ***keijsers@essb.eur.nl*** Prof. dr. Manon Hillegers ***m.hillegers@erasmusmc.nl*** Dr.ir. Willem-Paul Brinkman ***w.p.brinkman@tudelft.nl***	Societal problem. 13-25% of Dutch adolescents (12-25 years) experience depressive feelings or anxiety. This has long-term serious negative effects, such as school dropout, poorer physical health, greater inequality. It leads to social costs of up to 2 billion euros per year. Currently, treatment often comes too late, due to long waiting lists, the lack of monitoring, and the lack of accessible prevention strategies (e.g. eHealth apps). Therefore, systematic changes in our approach to mental health are badly needed. Scientific ambition: Optimizing well-being of Dutch adolescents aged 10-25 years by: (WP 1) improving early identification of mental health problems with advanced real-time measurement tools and data analysis; (WP 2) improving decision-making about who needs which intervention when (human expertise combined with artificial intelligence); and (WP 3) developing and testing new technology-driven interventions (e.g. eHealth and VR). At each step we involve users (young people, professionals) and stakeholders (educators, professionals, policy makers, funders) (WP 4); and build a sustainable infrastructure and collaboration between scientists and society (WP 5). Output, outcome, impact. We are unraveling the causes of mental health problems and creating new ways to detect and refer young people with problems earlier and better. We are also building a new generation of user-friendly and cost-effective solutions for young people and professionals. This project contributes to accessible and cost-effective prevention of these problems. The measurable social impact of this is, a decrease in: 1) the number of young people entering specialized mental health care (GGZ), 2) waiting lists, and 3) social costs of mental health problems. But above all: optimal well-being of all young people. Convergence. Medical sciences, social sciences, humanities, and technology are converging to advance major mental health transitions for those who need us most; our children, our future.
#33	**The Rare Disease Innovation Center; Towards a National Flagship** **Leads** Prof. Ans T. van der Ploeg ***a.vanderploeg@erasmusmc.nl*** Dr. Marjon H. Cnossen ***m.cnossen@erasmusmc.nl*** Dr.ir. Armagan Albayrak ***a.Albayrak@tudelft.nl*** Prof. Carin Uyl- de Groot ***uyl@eshpm.eur.nl***	In the Netherlands, more than 1 million people, or 6-8% of the population, have a rare disease. Each year, an additional 10,000-13,000 children are born with a rare disease. With this national Rare Disease Innovation Center, we want to connect scientists from many disciplines working at Erasmus MC, TU Delft and EUR to innovate the care for patients with rare diseases and to proactively address unmet needs of patients. We hope to improve the health and resilience of this large group of patients whose care is characterized by complex diagnoses, innovative and experimental treatments, and increasing costs. Expertise in technology, industrial design, business and the social sciences can help to create better care innovations with a long-term impact on society. Needs of patients with rare diseases can be divided into five domains: 1) Visibility and awareness of society; 2) Complex diagnostics; 3) Development and application of innovative treatments; 4) Life course medicine and 5) Importance of basic scientific research. We introduce four WPs that aim to improve these aspects of rare diseases with interdisciplinary expertise. Thus addressing the objectives set by Convergence: a life-course approach to health and well-being, taking into account socio-economic principles; with implementation of tailor-made treatment (WP2,3); prevention of symptoms and complications through early and rapid diagnosis (WP1), integrated interdisciplinary problem-solving approaches to the needs of the disease group while pursuing major societal breakthroughs, involving all stakeholders from the sickbed to society at large. Taking into account end-user, ethical considerations and both positive and negative effects of innovation (WP0,1,2,3).
#34	**Rare ODC 2030 - Optimizing Diagnostic Care for Rare Genetic DiseaseTowards technology driven optimal care for undiagnosed genetic disease in 2030** **Leads** Dr. Stefan Barakat Erasmus MC, dept of Clinical Genetics. Assistant professor ***t.barakat@erasmusmc.nl*** Dr. Tjakko van Ham Erasmus MC, dept of Clinical Genetics. ***t.vanham@erasmusmc.nl*** Dr. Jan van Gemert TU Delft, dept of Intelligent Systems ***j.c.vangemert@tudelft.nl*** Prof. Carin Uyl-de Groot Erasmus University Rotterdam, Institute for Medical Technology Assessment ***uyl@eshpm.eur.nl***	About 3.5-5.9% of the world's population has a rare genetic disease (Rare Genetic Disease, RGD). 70% start in childhood, and place a huge burden on patients, and the healthcare system. With the establishment of a diagnosis, the "diagnostic-odyssey" ends, often leading to a modified clinical policy, in terms of treatment, counseling, and better/directed therapy, preventive care, and personalized medicine. Despite technological advances, in > 50% of RGD patients no precise diagnosis is made. In addition, not all RGD patients find their way to genetic care, leading to a long journey to appropriate care and higher healthcare costs. With this Flagship, we outline the genetic care center of 2030, where new technology is rapidly implemented cost-effectively, used effectively, and widely accessible to RGD patients. To that end, geneticists, neurologists, psychologists, internists, biologists, computational and artificial-intelligence specialists, and health-care scientists work together aimed at advancing new technology for clinical care (whole-genome and transcriptome sequencing (WGS/WTS), methylated DNA/Med-Seq, proteomics, metabolomics). We build on our successful experience in experimentally implementing these techniques combined with innovative artificial intelligence for integrating "omics" data with clinical features (WP 1), to elucidate hidden disease mechanisms, such as abnormalities in the non-coding genome. In addition, we will develop face-to-face Gestalt recognition, self-learning image analysis software (WP 2) that allows to objectively recognize dysmorphic and clinical features in syndromic patients, as screening, for improving clinical diagnoses. We are mapping care pathways and costs for RGDs (WP 3), to determine in which patients a dedicated pathway (WP1/2) would add the most in a cost-effective way. Broad consent at the gate will allow for rapid transition from clinic to laboratory with ongoing lines of research. Finally, we will improve accessibility for genetic care for relatively underrepresented groups through close collaboration with relevant community stakeholders (WP 4). Our Flagship will improve the speed and precision of RGD molecular diagnoses. This will directly improve the care of RGD patients, but also catalyze multidisciplinary academic excellence for new combined fields of research bridging from basic to translational/clinical research, directly following clinically-relevant questions.

#	Title	Public Summary (in Dutch)
#35	**Resilient HealthCare** **Leads** Dr Saba Hinrichs-Krapels *s.hinrichs@tudelft.nl* Professor Robert Baatenburg de Jong *r.j.baatenburgdejong@erasmusmc.nl* Professor Hester Lingsma *h.lingsma@erasmusmc.nl* Professor Roland Bal *r.bal@eshpm.eur.nl*	The COVID-19 pandemic has shown the importance of resilient healthcare organizations and systems--or healthcare that can cope with periods of turbulence and return to its previous state or emerge even stronger. In this project, we are conducting research on strengthening resilience in healthcare organizations. What mechanisms and tools contribute to this? How can we develop and implement these? We do this using a case study, namely the optimal use of operating room capacity. Previously, a model was developed for prioritizing patients for operations in times of scarcity; in this project, we take that as a basis and extend it to models for planning resources-people and materials-and processes in the OR. With these models, we simulate different situations (such as a pandemic or staff shortage) and contribute to a more resilient planning and organization of the OR. Models alone are not enough; they also need to be used. Therefore, we are also conducting research on the process of planning in the OR and on experiences with the use of the models. By involving practice and models in a process of co-creation, we refine the models and make them more compatible with the practice of the OR; at the same time, we secure the new form of planning and organization in the OR. For this we use various methods, such as observations on the work floor, interviews and workshops with those directly involved (nurses, doctors, managers). We are also looking at the influence of the new method on the financing of the OR. With this project we are developing principles for a resilient healthcare organization that we also want to translate to other parts of healthcare-inside the acute axis, but also in the clinic and the outpatient department.
#36	**Radiation Therapy Centre 2030: Personalized Self-Steering Radiotherapy** **Leads** Prof. dr. Remi (R.A.) Nout Radiotherapy, Erasmus MC *R.nout@erasmusmc.nl* Dr. Hedwig Blommestein ESHPM, EUR *Blommestein@eshpm.eur.nl* Dr. ir. Dennis (D.R.) Schaart TNW, TU Delft *D.R.Schaart@tudelft.nl*	For more than half of all patients with cancer, radiotherapy (irradiation) is part of the treatment, often combined with other therapies. Recent treatments have improved survival, but are also associated with high prices, costs and demand for staff. As a result, there are challenges to accessibility, capacity planning and funding. In addition, an increased number of survivors are struggling with long-term consequences of treatment, with associated consequences for patients and society. Current insights underline the importance of diversity among patients, with regard to the biological behavior of cancer, response to treatment, and personal preferences. Much is expected in the future from personalized cancer treatments contributed by different disciplines involved. One example is the combination of targeted drug therapy with high-precision adaptive radiotherapy. However, making the right treatment decisions for individual patients, and highly precise radiotherapy during each treatment session, are proving to be major challenges. This is because individual patient preferences, a very large increase in the amount of available data, and different treatment options for each patient must be taken into account. To develop personalized cancer treatment with radiotherapy (Radiotherapy Center 2030), a Convergence consortium with socioeconomic, technical and (bio)medical scientists is needed. AI-driven multi-criteria decision support will be developed to make the right decisions at any time during the treatment process. Smart X-ray detectors will be applied to improve the image quality and thus the accuracy of image-guided radiotherapy. AI-driven automation of image analysis, dose adaptation and delivery, will enable self-directed adaptive radiotherapy. Systematic evaluation for medical technologies and choice experiments will be used to develop and implement cost-effective applications. This will take into account patient preferences and interests of all stakeholders. In summary, this Flagship will generate a Convergence research program that combines an infrastructure for accelerated MedTech development with value optimization and validation of personalized self-directed radiotherapy in synergy with other targeted cancer treatments.
#37	**SHIELDED-AI (Support for Healthy Independent Enhanced Living using Decentralized EDge AI)** **Leads** Jason Pridmore Associate Professor, Erasmus University Rotterdam (ESHCC) *pridmore@eshcc.eur.nl* Aaron Ding Tenured Assistant Professor, TU Delft *aaron.ding@tudelft.nl* Prof. Hein Raat, Full Professor, Erasmus MC *h.raat@erasmusmc.nl* Martina Buljac Tenured Assistant Professor, Erasmus University Rotterdam (ESHPM) *buljac@eshpm.eur.nl*	This flagship SHIELDED-AI convergence proposal focuses on the effective and appropriate use of emerging technologies. The focus is on acceptance by all users and stakeholders through privacy-by-design of the technology. The project pays attention to health and social care, with a user-centered approach - users in this case include clients/patients as well as the professionals and the broader support network of the client/ patient. The project is based on the recognition that user acceptance is a critical element in creating a successful implementation of new technology. This proposal focuses on two specific activities. First, a pilot test case that will be developed jointly by the center CIs and their teams. This pilot test case demonstrates the long-term goals of the flagship and leads to a step beyond the initial test case. Second, grant applications are written by the multidisciplinary team that build on the knowledge derived from this initial case. The outcomes and broad professional networks of ongoing national, European, and global projects the participants in this flagship proposal are leveraged. The first pilot test case focuses on identifying, developing and deploying decentralized Edge AI to support and improve health and social care for vulnerable individuals. This will provide reliable and trusted monitoring tools that clients/patients and their networks can control themselves in a secure and privacy preserving manner. A concrete demonstration will focus on supporting elderly care with the development and deployment of AI-enhanced edge devices. This first joint effort will prove the flagship's potential through its holistic approach to research, co-creation and interdisciplinary collaboration. In addition to developing the first test case, the proposal will realize talent development and joint research and innovation proposals.

#	Title	Public Summary (in Dutch)
#39	**Child Brain Lab** **Leads** MLC Van Veelen (EMC, Medical specialist) ***m.l.c.vanveelen@erasmusmc.nl*** M.A.Gielen (TUD, assistant prof) ***M.A.Gielen@tudelft.nl*** Porte (EUR, assistant prof) ***porte@eshpm.eur.nl***	In the Child Brain Center, professionals from Erasmus MC, TUD and EUR combine their expertise to enable the optimal development of children with brain disorders. We want to integrate care and research to quickly translate new insights and treatments to patients and their families. The Children's Brain Lab is part of the Child Brain Center. In the Child Brain Lab, we measure in a fun way how children at different ages function in key domains; from in important areas; from brain function and growth to quality of life, behavior and school. In the lab, the child's perspective is central. We use modern techniques (e.g. high resolution EEG, MRI, movement meter) to collect data, but also questionnaires. As many as 1000 children per year can participate in online questionnaires and 200-400 per year will go through the full testing circuit in the Child Brain Lab. By having children with different brain disorders participate disorders, we are building a unique cohort in which overlap between different disorders can be investigated. Because we look at things from many angles and with the facilities in the Child Brain Lab, we create a wonderful opportunity to test treatments that are aimed at influencing disease mechanisms, improving functioning and influencing behavior. By treating disorders as early in life as possible, the plasticity of the developing brain can be optimally exploited so that interventions have the greatest benefit. Our three goals are: 1) To create developmental curves for meaningful domains in children with brain disorders to disorders to detect abnormal course early and predict personalized pathways. 2) Using advanced data analytics and AI to identify early features that predict long-term development. 3) Encouraging patient engagement by embedding the data from the Child Brain Lab into everyday care and in support of value driven care (WGZ).
#40	**From macro to micro level; a microbial safe environment for hospital patient care; the ENVI-BE-SAFE flagship** **Leads** Prof Dr Margreet C. Vos ***m.vos@erasmusmc.nl*** Dr A. Ir. Loeve ***A.J.Loeve@tudelft.nl*** Dr Martina Buljac ***buljac@eshpm.eur.nl***	ENVI-BE-SAFE will enable microbially-safe future hospital care by creating an environment where the adage "do no harm" is central. In a microbial-safe environment, patients will not receive exogenous infections, i.e., from a source outside their own body. How? by optimizing the design of the hospital and making the environment microbially safe using optimal and evidence-based ventilation and microbially safe surfaces/coatings. We will study biofilm in the wet and dry environment; on large surfaces (sinks) and on small surfaces/lumina of endoscopes. This will lead to knowledge, interventions and prevention of biofilm and thus prevention of transmission of microorganisms present in these invisible biofilms. Transmission requires a contaminated environment, as well as patients and personnel who generate this contamination and transmission. Therefore, we will study the carrier of infectious pathogens and optimize nursing procedures, educate and train staff and students in "low risk" behavior; working safely in an isolation room. Within the ENVI-BE-SAFE-program, a permanent living lab will be built to serve as an experimental patient isolation room with all the facilities of controllable ventilation, inventory, surfaces, coatings, etc. and in addition about 3 different designs of sinks, for experiments. Here, optimization of nursing procedures will happen and training will be given and different disinfection techniques and sink designs will be studied and find their way into clinical practice. This clearly requires a multidisciplinary approach and that is why we need the convergence program, since the challenges we face to combat exogenous sources require disciplines such as medicine, behavioral sciences, industrial design, engineering sciences, architects, etc. ENVI-BE-SAFE consortium is sustainable , comes from the three institutes and has high scientific quality and experience in this field. ENVI-BE-SAFE will provide a safe environment where microorganisms do not lurk, where situations and behaviors make transmission impossible, and brought together, no preventable infections of vulnerable patients occur.
#41	**Center for Bayesian Adaptive Trials -CBAT** **Leads** Eric Boersma ***h.boersma@erasmusmc.nl*** Gui Liberali ***g.liberali@erasmusmc.nl***	The goal of this initiative is to establish and further develop a knowledge center related to Bayesian adaptive clinical trials in medicine. The center is structured around a research program that develops frameworks, new methods and guidelines required for the design, implementation and monitoring of such trials. Bayesian adaptive clinical trials have a potentially important social impact in two ways. First, the Bayesian adaptive method minimizes the number of patients (subjects) exposed to a treatment that proves to be inferior as the clinical trial progresses. In addition, the method will lead to a reduction in the time-to-market of new medical drugs, as the total number of patients (subjects) in the trial is optimized (read: minimized). As a proof-of-concept, the lead applicants of this Flagship recently developed and applied adaptive Bayesian methods to study data (data from individual patients) from two large-scale clinical trials in cardiology. The research has been submitted for publication in the medical literature. The non-medical applicant has previously applied adaptive Bayesian methods in various non-medical settings. He has published on the subject. The research output of the knowledge center will be in the form of articles in the medical literature. These articles will describe both methodological concepts (new Bayesian adaptive methods) as well as concrete applications within medicine. In the first five years, the knowledge center will focus primarily on developing and testing methods (based on data from existing clinical trials) and disseminating Bayesian adaptive research approaches to academics, trialists, regulators, and industry. From years 6 to 10, the center will focus more intensively on promoting and co-executing full Bayesian adaptive clinical trials.

#	Title	Public Summary (in Dutch)
#42	**Biosystems modeling of cell-cell communication (BioComm)** **Leads** Duncan McMillan Assistant professor, TU Delft ***d.g.g.mcmillan@tudelft.nl*** Hanan El Marroun Full professor, EUR & EMC ***elmarroun@essb.eur.nl*** Kerstin Wendt Associate professor, Erasmus MC ***k.wendt@erasmusmc.nl***	Future medical innovations will be faster and more targeted if we gain a better cellular and molecular understanding of the development and functioning of healthy and diseased human tissues and organs. The overarching goal of this flagship is to better understand the self-organization principles of healthy and diseased tissues. Central to this proposal is the development of multicellular in vitro models, defined here as "biosystems," that accurately mimic the formation of human tissues in order to understand their self-organization. Although this flagship is currently focused on brain and lungs, in the future we want to apply our knowledge to make other biosystems. Current biosystems (such as spheroids, organoids, as assembloids) are very heterogeneous and lack the complexity, spatial organization, and functional capacity of tissues in vivo. The first objective of our proposal is to integrate modern cellular models and culture methods with advanced engineering science to create reproducible and physiologically relevant biosystems. These will be studied in 4D using fluorescence microscopy and -omics techniques to unravel cellular complexity, regional identity and differentiation traces within the biosystems. By introducing mutated proteins or abnormal cells, we will also learn how diseases arise. The second objective of our flagship is to describe cell-cell communication and behavior in our biosystems with mathematical models. These models integrate information from microscopy, -omics and biosensor measurements to describe the self-organization principles of tissues. Our flagship program will provide revolutionary new insights into the development and organization of tissues under normal and pathological conditions.
#43	**Smart Surgery Lab 2030** **Leads** Dr. Welmoed van Deen ***vandeen@eshpm.eur.nl*** Prof.dr Paul Breedveld ***p.breedveld@tudelft.nl*** Prof.dr. Eppo Wolvius ***e.wolvius@erasmusmc.nl***	Technological innovations are becoming increasingly important in surgical disciplines. Technological advances-e.g., in medical imaging, preoperative surgical planning tools, advanced instrumentation, and intra-operative navigation systems-are providing more accurate, reliable, and safe surgical procedures. These developments can be used to treat a wide variety of congenital, oncological and traumatic conditions, both simple and complex. Currently, Erasmus MC uses surgical navigation (Brainlab, Germany) for head and neck surgery, orthopedic surgery, trauma/congenital surgery and neurosurgery. This has led to improved surgical treatment of complex congenital maxillofacial defects, brain tumors, malunions using corrective osteotomies, conditions requiring prostheses and (maxillofacial) trauma. In addition, surgical procedures are increasingly planned preoperatively using techniques such as virtual reality (MedicalVR, Netherlands), 3D modeling and 3D printing (e.g. patient-specific surgical guides from Materialise, Belgium. Moreover, the use of innovative technologies such as Virtual and Augmented Reality (VR and AR) is promising in terms of optimizing the communication and patient experience around surgery. This Flagship aims to deliver personalized surgical devices and implants, within 24 hours, at low cost using streamlined automated scheduling and 3D printing facilities. AR and VR will be used for planning procedures and patient communication and experience. The ultimate goal here is to improve the accuracy, safety, predictability and outcomes of surgical procedures. We aim to continue and expand the collaboration and initiatives of the Smart Surgery Lab (Erasmus MC/TU Delft), and we want to ensure that this development also has a prominent place within the Convergence. Within this Flagship we want to focus on developments and applications the following areas: 1. Advanced image processing and automation of surgical planning 2. Extended reality: VR and AR 3. 3D printing of advanced patient-specific surgical instruments, molds and implants 4. Usability, effectiveness and cost-effectiveness.