



2023 ANNUAL OVERVIEW

CHANGING THE FUTURE OF HEALTH



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OF HEALTH

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OF OUR ANNUAL REPORT



2023 ANNUAL OVERVIEW

CHANGING THE FUTURE OF HEALTH



Message from the CEO



PROF ULF NEHRBASS
CHIEF EXECUTIVE OFFICER

Dear friends, dear collaborators, dear readers,

I am proud to present to you the annual report 2023 of the Luxembourg Institute of Health.

Our mission is to become a leading translational research institute in Europe, focusing specifically on the elucidation of the mechanisms of the immune system, the immune homeostasis, and how these affect the onset of autoimmune diseases and the emergence of cancer. I am proud to say that we have been able to truly make strides ahead toward this ambitious goal in 2023.

By many standards and parameters, 2023 was a remarkable and successful year. Although it is difficult to single out some of the key successes without omitting many others, I am proud to report that, from a funding perspective, our institute has been able to secure the highest level of outside funding to date. This includes a prestigious grant from the European Research Council (ERC) to support Dr Meiser's research on halting the spread of metastatic cancer. Not only does this grant recognise the excellence of our researchers, but it also provides crucial funding to advance groundbreaking work in cancer biology and therapeutics. Still from the recognition point of view, I should mention the bestowal of the 2023 FNR Award for Outstanding

Scientific Achievement to our Immuno-Pharmacology and Interactomics group, led by Drs Andy Chevigné and Martyna Szpakowska, for their pioneering research on opioid receptors. Furthermore, our flagship digital health cross-border project Clinnova was successfully launched in 2023, promising to revolutionise the way treatment decisions are taken by fostering a federated, standardised and interoperable data environment.

This brings me to another key point, namely the instrumental role of collaborations with external partners and institutions when it comes to tackling a scientific question and ensuring our research is truly patient-centred. Indeed, I am delighted to say that our excellent collaboration with our clinical partners in the neighbouring countries is allowing us to establish the interoperable infrastructure we need in order to be able to exchange data securely and build together on the patient-data dimension.

Moreover, we are participating in several new European-funded initiatives in the field of cancer research, aiming for instance to establish comprehensive cancer care centres and advance glioblastoma treatment. Similarly, together with national and international partners, we are leading another EU-funded initiative that explores how infectious diseases such as COVID-19 can have an impact on the risk of developing neurodegenerative disorders such as Parkinson's disease or dementia.

When we look at the coming years, we can all agree that translational research will become increasingly data-driven. Standardised quality-controlled data will be used on the one hand to drive precision medicine to develop novel therapies, preventive and diagnostic tools, but also to drive fundamental,

hypothesis-driven research. Large interoperable datasets will connect the LIH with all of its research and clinical partners – not just in Europe but across continents. Novel machine-learning and Big Data approaches will become the basis of clinical decision-making. And I believe the LIH will play a key role as an enabler of this futuristic vision, acting as a bridge between patients and clinicians. We are already making huge progress in this context, and I will keep steering our endeavours in this direction over the next years.

Finally, I would like to extend my heartfelt gratitude to the staff for their relentless and passionate work, and thank our stakeholders, notably the Ministry of Higher Education and Research, the Ministry of Health, and the National Research Fund, for unwaveringly supporting all of these efforts.

Thank you,



Prof Ulf Nehrbaas
Chief Executive Officer



Message from the President



DR GREGOR BAERTZ
PRESIDENT OF THE BOARD OF DIRECTORS

Dear reader,

As Chairman of the Board of Directors of the Luxembourg Institute of Health (LIH), I am honored to present the Annual Report for 2023. This report encapsulates a year of remarkable progress and dedication, marking a pivotal chapter in our journey towards becoming a leading translational institute.

This year has been truly transformative. By integrating our efforts across various departments, we have achieved significant advancements, enabling us to produce comprehensive datasets

and groundbreaking results. These achievements would have been unattainable without the invaluable support of our partners. Each department has played a crucial role in this success, contributing unique insights and expertise that have propelled us forward. Our management team has strategically bolstered key areas, such as medical informatics, ensuring we are well-equipped to meet our ambitious goals and respond to the evolving demands of the healthcare landscape.

The growing connection between immunology and cancer has reinforced our organizational model, providing a strong

foundation for our research initiatives. Our Translational Medicine Operations Hub is poised to be instrumental in scaling and validating research in precision and digital health. This hub will not only enhance our capacity to conduct cutting-edge research but also facilitate the translation of scientific discoveries into practical applications that can improve patient outcomes. Through these initiatives, LIH is committed to staying at the forefront of global advancements in digital health data and knowledge, driving innovation and fostering collaboration on an international scale.

We extend our deepest gratitude to the Ministries of Research, Health, and Economy for their unwavering support, which has been critical to our success. We also thank our generous donors, whose contributions have been vital in advancing our mission. Most importantly, we acknowledge the dedication and hard work of every single employee at LIH. Your commitment and passion are the driving forces behind our achievements, and together, we are making significant strides in the field of health research.

As we look ahead to 2024, we are filled with optimism and determination. We anticipate another year of groundbreaking research, innovative solutions, and meaningful impact on global health. We are excited to continue this journey with all our stakeholders, partners, and supporters.

Thank you for your continued support and for being a part of our mission.

Sincerely,



Dr Gregor Baertz
President of the Board of Directors



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1. **Mission & Vision**

Our mission is to leverage knowledge and technology arising from research on patient derived data, with the aim of having a direct and meaningful impact on people's health.

Our vision is to become a leading European institute for precision medicine and precision health, transforming research excellence into tangible benefits for patients, with the long-term goal of preventing diseases.



2. Strategic developments reinforcing LIH's impact and visibility



European Research Council grant awarded to Dr Meiser

In November 2023, Dr Johannes Meiser, Director of the LIH Department of Cancer Research and leader of the Cancer Metabolism Group, secured a 2 million euro grant from the prestigious European Research Council (ERC). This historic milestone marked LIH's first-ever receipt of the ERC grant. The ERC, known for its stringent evaluation process based on scientific excellence, not only supports innovative research projects but also recognises exceptional Principal Investigators addressing significant scientific challenges at a mechanistic level.

Dr Meiser's innovative research, funded in part by the FNR ATTRACT grant, has already revealed the phenomenon of formate overflow, a metabolic process playing a pivotal role in cellular adaptation along the metastatic cascade. Under the project named 4M8, Dr Meiser's research will dissect formate-dependent effects on cells, unravel intrinsic mechanisms relaying the formate signal promoting metastasis, and explore therapeutic strategies targeting formate for cancer cell eradication. This ERC grant positions the LIH to take a significant step forward in their research, offering the potential for groundbreaking treatments in the challenging realm of metastatic cancer, the leading cause of cancer-related deaths.

Clinnova launch

Launched in Luxembourg on April 27th, 2023, the Clinnova project represents a collaborative effort among clinicians and researchers from Luxembourg, France, Germany, and Switzerland. The initiative is supported by key entities, including the Luxembourg National Research Fund, to revolutionise healthcare through data-enabled precision medicine. Led by the LIH and with a total budget of EUR 50 million, the project focuses on developing AI algorithms to aid physicians in precise treatment decisions for diseases like inflammatory bowel disease, rheumatoid diseases, and multiple sclerosis.

Clinnova addresses the challenge of prescribing the right drug to the right patient by focusing on data quality and standardisation. The project also aims to bridge the gap between biomedical research and healthcare by enhancing infrastructure in Luxembourg and federating precision health data across borders. Through its partnerships, Clinnova envisions building a federated precision health network across Europe. This initiative aligns with Luxembourg's national priorities, receiving strong support from the Ministry of Health and contributing significantly to the country's research environment on a global scale.

Clinnova
Federating Digital Medicine in Europe

Luxembourg Institute of Health launches new nation-wide campaign

In February, the LIH communicated its repositioning as a leading European institute for precision health, dedicated to translating research findings into tangible benefits for patients. Born from the 2015 merger of the former Centre de Recherche Publique de la Santé (CRP-Santé) and the Integrated Biobank of Luxembourg (IBBL), the LIH encompassed the Department of Cancer Research (DoCR), the Department of Infection and Immunity (DII), the Department of Precision Health (DoPH), and the Translational Medicine Operations Hub (TMOH). Evolving towards a more patient-oriented role, the LIH is committed to utilising knowledge and technology to directly impact people's health.

The institute's repositioning and updated brand strategy were widely disseminated through a comprehensive mass communication campaign across Luxembourg. Dominique Hansen, former Chief Communication Officer, emphasized the relevance of the LIH's research on cancer and immunological disorders for the general public. The campaign featured posters, QR codes linking to videos showcasing collaborative projects with Luxembourg hospitals, and a revised logo symbolising the close relationship with clinicians and patients.

Arnaud D'Agostini, Head of Marketing and Communication, underscored the shift in perception, portraying scientists as strategic partners in modern-day healthcare, working collaboratively to translate research into tangible solutions for patients. The campaign centred around the patient as the ultimate beneficiary of the LIH's translational research activities, reflecting a collaborative and caregiving aspect in the institute's identity.



The LIH and the LISER establish joint Socio-Economic and Environmental Health and Health Services (CARES) research group

In February 2023, Prof Ulf Nehrbaas, CEO of the LIH, and Prof Aline Muller, CEO of the LISER, convened at the LIH's premises in Strassen to finalise the framework agreement for the establishment of the joint Socio-Economic and Environmental Health and Health Services (CARES) research group.

The collaborative efforts between the LIH and the LISER materialised in the creation of the inter-institutional CARES research group, aimed at bolstering research synergies. Operating under the aegis of the LIH's Department of Precision Health (DoPH), CARES serves as a catalyst for joint research initiatives, spanning health economics, health services research, public health, and environmental health. The group actively stimulates collaborations, organising events, and seminars to foster a dynamic research environment.

Under the leadership of Dr Maria Ruiz-Castell and Prof Marc Suhrcke, the CARES group seeks to understand the complex dynamics that impact health and well-being by undertaking research on health disparities, environmental health risks and healthcare system challenges. This interdisciplinary initiative leverages complementary expertise in health economics, public health, environmental health and epidemiology to develop innovative prevention strategies.

*Prof Ulf Nehrbaas, CEO of LIH
Prof Aline Muller, CEO of LISER*



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SCAN ME

3. Fighting Cancer



New possible cancer treatment by targeting one-carbon metabolism

In April 2023, a collaborative effort between the LIH Cancer Metabolism Group, the University of Sheffield and the Karolinska Institute in Sweden, unveiled an innovative strategy in the fight against cancer. Focusing on one-carbon (1C) metabolism, a pivotal pathway for DNA synthesis and repair, the researchers discovered that cancer cells, driven by an elevated demand for nucleotides, upregulated enzymes involved in this process. Paradoxically, this upregulation opened a potential vulnerability that could be targeted by the innovative small molecule TH9619, designed to selectively eliminate cancer cells by targeting enzymes associated with 1C metabolism.

The study, led by Dr Johannes Meiser and Dr Nicole Kiweler, elucidated the mechanism behind TH9619's efficacy. By inducing the accumulation of the 1C metabolism intermediate 10-formyl-tetrahydrofolate, TH9619 created a "folate trap," starving cancer cells of essential tetrahydrofolate needed for DNA synthesis and repair, ultimately leading to their demise.



This folate trapping mechanism differs from other 1C metabolism inhibitors and anti-folates, making TH9619 a promising new candidate for cancer treatment.

This new approach to attack cancer cells could potentially also be used in combination with existing treatments to enhance their effectiveness



Dr Johannes Meiser and Dr Nicole Kiweler



A new breakthrough in cancer treatment - Neutralising GDF-15

In August 2023, a collaborative effort led by Prof Michel Mittelbronn, Head of the National Centre of Pathology at the Laboratoire Nationale de Santé and the Luxembourg Centre of Neuropathology at the LIH, uncovered a key defence mechanism employed by certain tumours to become resistant to treatment.

Prof Mittelbronn explained that the GDF-15 cytokine, abundantly secreted by solid tumours like melanoma, liver cancer, and bladder cancer, inactivates the immune system, thus strategically blocking its action. By preventing T lymphocytes, the immune system's infantry, from infiltrating the lesion, GDF-15 disrupts the natural defence mechanism against malignant tumours. Furthermore, the study revealed a significant negative correlation between GDF-15 expression and the presence of T lymphocytes in the tumour environment, with patients having a high level of GDF-15 experiencing earlier mortality.

This discovery enhances the potential success of current immunotherapies, underscoring the importance of understanding how malignant cells shield themselves to effectively combat cancer.

Blocking the activation of oncogenes to slow down leukaemia

In June 2023, the Tumour Stroma Interactions (TSI) group of the LIH Department of Cancer Research (DoCR) achieved a groundbreaking milestone in cancer treatment. Drs Jérôme Paggetti, Etienne Moussay and Anne Largeot explored the inhibition of mRNA translation in chronic lymphocytic leukaemia (CLL) cells, focusing on oncogenes like MYC. Their findings unveiled the potential of the drug FL3 in inhibiting MYC translation through a newly elucidated mechanism, providing promising therapeutic options for CLL patients.

CLL, the most prevalent form of leukemia, is characterised by the abnormal accumulation of dysfunctional B lymphocytes. The study targeted the translation of oncogenes within CLL cells, aiming to rewire their metabolism and curb their proliferative capacity. The synthetic flavagline FL3, known for inducing cancer cell death, demonstrated effectiveness in inhibiting translation and synthesis of proteins involved in crucial cellular processes. Patient-derived CLL cells exhibited higher sensitivity to FL3-induced death than healthy cells, emphasizing the drug's selective impact on cancerous cells.

FL3's specific targeting of prohibitins (PHBs), proteins directly involved in translation, was identified as a key mechanism. Disrupting the interaction between FL3 and PHBs hindered translation initiation, impeding cancer cell growth. In vivo experiments on mice substantiated the drug's efficacy, showcasing reduced CLL cells in the spleen and improved survival rates. Importantly, FL3 selectively targeted malignant CLL cells without affecting healthy B cells, offering a promising strategy for selectively combating cancerous cells.

Combining FL3 with anti-PD1 immunotherapy enhanced outcomes, suggesting the drug's potential in boosting anti-tumour immunity. The study, titled "Inhibition of MYC Translation through Targeting of the Newly Identified PHB-eIF4F Complex as Therapeutic Strategy in CLL", not only earned a place in the prestigious journal *Blood* but also graced its cover page. This groundbreaking research, made possible through support from various funding sources, opens new avenues for CLL treatment and holds translational significance in addressing relapse and resistance to current therapies.

New insights into chromosomal instability offer potential avenues for targeted cancer therapies

In December, a breakthrough study led by Dr Eric Van Dyck at the LIH uncovered a new role of the DAXX protein in preserving the integrity of our genetic material. This discovery has significant implications for cancers associated with DAXX alterations, providing potential insights and targeted therapeutic strategies, especially in understanding chromosomal instability in certain cancer types.

Within the intricate realm of genetics, Dr Van Dyck's research focused on maintaining the integrity of specific chromosomal regions, such as centromeres, crucial for preventing cancer-driving chromosomal instability. Using paediatric glioma and pancreatic neuroendocrine tumour cell lines, the study revealed a novel function of the DAXX protein, highlighting its crucial role in preventing DNA damage and ensuring chromosome stability.

DAXX, known as a histone chaperone forming a complex with ATRX, was found to play a pivotal role in genome stability by preventing the accumulation of transcription-associated R-loops and DNA double-strand breaks at centromeres. Understanding how DAXX safeguards our genome could unlock potential avenues for treating cancers associated with DAXX alterations, such as paediatric glioma and pancreatic neuroendocrine tumours. This breakthrough not only expands our comprehension but also opens promising avenues for developing innovative therapies against diseases rooted in chromosomal instability.



Colive Cancer launch

In January, the LIH initiated Colive Cancer, a transformative study led by Dr Guy Fagherazzi from the LIH Department of Precision Health Deep Digital Phenotyping research unit. This project, conducted in collaboration with the Ministry of Health under the second National Cancer Plan, aims to enhance the quality and efficiency of the national cancer healthcare system by engaging directly with patients through an innovative online feedback system.

The importance of Colive Cancer is framed by the statistics from the National Cancer Registry and the European Cancer Information System, revealing approximately 3000 new cancer cases annually in Luxembourg, causing around 1100 deaths. Recognising the need for improvement in cancer care, the prioritises translational oncology, data digitalisation, and patient collaboration to enhance cancer diagnosis and treatment.

Colive Cancer, a key component of PNC2, is a pioneering online survey accessible via smartphone or laptop. Its patient-centric approach allows participants to share experiences and opinions on the healthcare system and overall quality of life. The survey covers various aspects, from diagnosis and treatment to care and support received, enabling direct patient feedback to shape improvements in the national cancer care system.



This project is a unique opportunity to improve the cancer care system in Luxembourg, thanks to direct inputs from the patients themselves! This patient-centred approach will allow us, for the first time in Luxembourg, to identify what works well, and also perhaps more importantly, what improvement targets to set for the National Cancer Plan



Dr Guy Fagherazzi, leader of the project

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COLIVE
CANCER



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A new European consortium to create a network of support for EU Mission on Cancer

In May 2023, the LIH proudly announced the initiation of the ECHoS project, “Establishing of Cancer Mission Hubs: Networks and Synergies.” This three-year European consortium aligns with the Horizon Europe Mission on Cancer initiative, striving to enhance coordination in Research & Innovation (R&I) and Healthcare actions on cancer while integrating policy-making processes, ultimately fostering people-centric healthcare and research systems.

The consortium comprises over 58 leading organisations from governmental, healthcare, academic, and nonprofit sectors across 28 countries. The primary objective is to create National Cancer Mission Hubs (NCMHs) in each country, engaging a diverse range of stakeholders in collaborative initiatives and policy dialogues on cancer at national, regional, and local levels.

Driven by the ambitious goal of the Horizon Europe Mission on Cancer to “improve the lives of more than 3 million people by 2030 through prevention, cure, and better living for those affected,” ECHoS plays a crucial role in supporting this initiative. Dr Nikolai Goncharenko, Director of the National Institute of Cancer (INC) and national coordinator of the ECHoS project, emphasizes the importance of establishing networks and synergies in the fight against cancer. Luxembourg, represented by the INC and the LIH, is actively contributing to this project, aiming to promote collaboration at both the national and European levels. By redefining traditional research and health systems, ECHoS aims to create a brighter future in cancer care, reaching from individual citizens to European institutions, civil society, academia, public and private sectors.

CraNE Joint Action: the newest European project in the field of cancer

The CraNE Joint Action-JA, funded under Europe's Beating Cancer Plan (EBCP), aims to establish an EU Network of National Comprehensive Cancer Centres (NCCCs) in every Member State by 2025. Aligned with the goal of ensuring 90% of eligible EU patients have access to high-quality cancer care by 2030, the initiative focuses on early detection, screening, diagnosis, treatment, and support, along with enhancing cancer research and professional training.

The National Institute of Cancer (INC) leads Work Package 6, implementing a national Comprehensive Cancer Care Network in lung cancer. The LIH actively participates in Work Package 7, defining standards for research, innovation, education, and integrating research and care for Comprehensive Cancer Centres. Participation in CraNE JA underscores Luxembourg's commitment to improving cancer care and addressing EU disparities.

The kick-off meeting in November 2022, coordinated by the Slovenian National Institute of Public Health, initiated a two-year project with 44 partners from 25 countries. Funded by the EU Health Program (EU4Health) 2021-2027 through the European Health and Digital Executive Agency (HaDEA), CraNE JA aligns with the broader mission of enhancing cancer care and collaboration across Europe.

LIH to lead European project on treatment resistance in glioblastoma: the PLASTIG project kicks off

The NORLUX Neuro-Oncology Laboratory at the LIH has secured funding from the EU-driven Horizon 2020 TRANSCAN-3 programme for the PLASTIG project. Titled "Tackling tumour heterogeneity and PLASTicity as resistance mechanisms in Glioblastoma," this multinational initiative aims to delve into the intricate resistance mechanisms of glioblastoma (GBM). GBM, the most aggressive primary brain tumour, presents significant challenges in treatment efficacy, with a survival rate of only 5.7% beyond five years.



With GBM recurrence being an inevitable challenge for patients, and the prevalence of GBM expected to rise due to an aging population, the PLASTIG project represents a crucial step towards improving the understanding of treatment resistance mechanisms. Through its innovative research approach, we aim to unlock new avenues for effective treatments that could significantly affect the lives of GBM patients and their families



Dr Golebiewska, leader of the project

The PLASTIG consortium, including the Paris Brain Institute, the University of Freiburg, and the Royal College of Surgeons in Ireland, leverages interdisciplinary expertise in advanced computational approaches, single-cell analysis, and spatial image analysis. The project is financially supported by the EU-funded TRANSCAN-3 project, uniting 31 funding organisations from 20 countries, including Luxembourg's National Research Fund (FNR), to promote high-impact translational cancer research through collaborative efforts.

DISCOVER
PLASTIG



SCAN ME

Five LIH projects selected for funding under the 2023 Télévie call

In June 2023, the LIH celebrated the recognition of its cancer research initiatives with multiple projects securing funding through the 2023 call of the Télévie programme by the Belgian Fund for Scientific Research (FNRS). Of the 88 selected projects, five are led by the LIH in cancer research, while one involves the LIH as a partner. Additionally, three ongoing LIH projects received renewed funding for an additional two years.

PIANO (Exploration of spatial tumour heterogeneity in distinct groups of glioblastoma), led by Dr Eric van Dyck of the LIH's Department of Cancer Research (DoCR), aims to link spatial changes in gene expression to tumour invasion, progression, and treatment response in glioblastoma.

RESTAGE (NR1D2 circadian clock gene as a target for reverting glioblastoma-associated immunosuppression via functional modulation of myeloid cells), is co-led by Drs Aurélie Poli and Alessandro Michelucci of the Neuro-Immunology research group. It investigates the potential of the nuclear receptor NR1D2 in myeloid cells as a target to enhance anti-tumour immunity in glioblastoma.

TNT2-CLL (Translation as novel Therapeutic target in CLL) and **TITLe** (Role of AHR and HIF-1A in regulating Tregs suppressive ability in the tumour microenvironment of leukemia), led by Drs Jerome Paggetti and Etienne Moussay of the Tumour Stroma Interactions (TSI) group: the former focuses on understanding the role of prohibitins PHB and PHB2 in translation inhibition in Chronic Lymphocytic Leukemia (CLL) cells, with a particular emphasis on how the synthetic flavagline FL3 targets these proteins. The latter project explores the mechanisms by which transcription factors AHR and HIF-1a enhance the immunosuppressive capacity of regulatory T cells in CLL.

ACTICAM (Role of ICAM-1 in mediating actin remodeling-dependent tumour immune evasion) led by Dr Clément Thomas of the Cytoskeleton and Cancer Progression group seeks to decipher molecular pathways underlying actin cytoskeleton remodelling during tumour cell recognition and killing by cytotoxic lymphocytes.

MOFIC (Deciphering the role of the microbiome-derived oncometabolite formate on the immune cell compartment in colorectal cancer), in collaboration with the University of Luxembourg, aims to elucidate the role of microbiome-derived oncometabolite formate in colorectal cancer.

Additionally, three ongoing LIH projects received renewed funding: **IMPACT 21-2**, **EVceptor-2**, and **SUNRISE2**. These projects cover diverse areas, including cancer immunotherapy, extracellular vesicles in leukaemia and lymphoma, and cancer cell propagation in glioblastoma.

Roche Pharma renews its funding to TIME research group

In 2023, the TIME research group at the LIH showcased important advancements in the modulation of hypoxia within solid tumours. Hypoxia, marked by decreased oxygen pressure, profoundly influences the microenvironment of solid tumours, rendering them resistant to conventional cancer treatments. The research, led by Dr Bassam Janji, successfully demonstrated that targeting the HIF-1 α gene associated with cancer cell adaptation to hypoxia not only inhibits tumour growth but also mobilizes cytotoxic immune cells to the cancerous tissue. These findings provide a promising avenue for enhancing the efficacy of existing anti-cancer treatments, particularly for melanomas resistant to traditional therapies.

Recognising the potential of this research, major pharmaceutical companies, including Roche Pharmaceuticals, extended their funding commitments to the project. This collaboration seeks to explore innovative therapeutic strategies, leveraging drugs that modulate hypoxia in combination with existing cancer treatment approaches. The TIME research group's work promises to revolutionise anticancer care, offering new hope for patients facing resistant melanomas and challenging solid tumours.



4. The immune system: unravelling its key role in health and disease

DISCOVER
OUR DEPARTMENT
OF INFECTION
AND IMMUNITY



SCAN ME





Targeting cellular metabolism to treat autoimmune diseases

In a study published in March 2023, researchers from the LIH and the University of Luxembourg delved into the manipulation of T cell metabolism to disrupt the function of autoreactive Th17 cells associated with autoimmune diseases. This exploration revealed promising insights into the intricate relationship between cellular metabolism and epigenetic modifications.



The manipulation of metabolism in immune cells, especially T cells, is promising for interfering with inflammatory autoimmune diseases



explains Prof Dirk Brenner

T cells, crucial components of the immune system, safeguard the body against pathogens and combat cancer cells. However, Th17 cells, a specific type of T cell, have been implicated in autoimmune diseases. Diseases like multiple sclerosis, psoriasis, and inflammatory bowel disease have been linked to the overactivity of Th17 cells, prompting researchers to investigate the molecular and metabolic regulation of these cells. The study, led by Prof Dirk Brenner, employed sophisticated genetic techniques to alter glucose utilisation in T cells, revealing unexpected impacts on Th17 cell function without inducing an energy crisis. The research shed light on the connection between glucose metabolism and epigenetic modifications, particularly in altering gene expression related to disease-causing functions. This breakthrough offers promising prospects for developing targeted drugs to address autoimmune diseases and cancer, though further research is necessary to fully comprehend the relationship between general metabolic changes and specific epigenetic alterations in immune cells.

Review on Parkinson's disease: the link between microglia activation and DJ-1

Parkinson's disease (PD), a widespread neurodegenerative disorder affecting millions globally, is characterised by the degeneration of dopaminergic neurons, resulting in motor symptoms like tremors and slowness of movement. While the exact causes remain elusive, recent findings suggest a pivotal role of dysregulated immune pathways and microglia activation in PD.

In April, scientists led by Dr Alessandro Michelucci from the LIH Neuro-Immunology Group, presented a comprehensive review shedding light on the role of immune dysfunction in the development of Parkinson's disease (PD). Focused on the PARK7/DJ-1 gene, the review underscores the crucial role of microglia as immune cells in the brain and the identification of neuroinflammatory and neurotoxic processes as key factors in advancing therapeutic targets for PD patients.

Frida Lind-Holm Mogensen, a PhD student in the group and the article's first author, emphasised the importance of understanding microglia's roles as recognising these processes is fundamental to developing therapeutic targets. The review outlined the association between mutations in the PARK7 gene and early-onset PD, with DJ-1 protein exhibiting neuroprotective functions and influencing microglia immune responses. Researchers are exploring compounds targeting DJ-1 to enhance its effects, exhibiting potential neuroprotective impacts that extend beyond neurons.

Maternal diet and gut bacteria influence offspring immune development

In August, a study featured as a cover story in the esteemed EMBO Molecular Medicine journal by the Nutrition, Microbiome, and Immunity Group at the Department of Infection & Immunity, unveiled the significant impact of a mother's diet and gut bacteria composition on the immune development of her offspring. The study, led by Prof Dr Mahesh Desai, delved into the intricate relationship between diet, gut bacteria, and early-life immune system development.

The research focused on the influence of dietary fiber and the gut bacterium *Akkermansia muciniphila* on the development of the offspring's immune system. Using a mouse model, scientists examined the effects of maternal fiber intake and the presence of *A. muciniphila* in the offspring's gut microbiota. Results highlighted that a fiber-rich diet positively influenced microbial community and immune development during the weaning period. The presence of *A. muciniphila* in the offspring's gut microbiota led to distinct alterations in innate and adaptive immune cell types, with effects varying based on maternal fiber intake. Notably, the study suggested a potential role of *A. muciniphila* in inducing colonic Th17 cells linked to autoimmune diseases.

Prof Mahesh Desai emphasised the study's implications, stating,

“

Our study demonstrates the significant impact of the maternal microbiome and dietary fiber intake on the postnatal development of the microbiome and immune system

”

Although conducted in a mouse model, the researchers anticipate substantial implications for human health, particularly as modern lifestyle practices disrupt the delicate balance between gut microbiota and immune function.

Food allergies: more than a “gut feeling”

In September, the Nutrition, Microbiome, and Immunity research group at the LIH Department of Infection and Immunity unveiled compelling insights into the profound impact of a low-fiber diet on the gut microbiome and its link to food allergies. Led by Prof Mahesh Desai, the study published in the prestigious journal Nature Microbiology demonstrated that a diet deficient in fiber leads to the proliferation of the mucolytic bacterium *Akkermansia muciniphila* in the gut, resulting in a compromised mucosal barrier, an inflammatory state, and heightened sensitivity to food allergens.

Using mouse models, the team compared the effects of fiber-free and fiber-rich diets on the gut microbiome. The results revealed an increase in mucolytic bacteria, especially *A. muciniphila*, in fiber-deprived mice, leading to altered immune responses and a predisposition to food allergies. The study highlighted previously undescribed innate immune pathways of allergen sensitisation in the large intestine, dependent on diet-induced changes in mucus-degrading bacteria. The presence of *A. muciniphila* emerged as a critical factor in exacerbating allergic symptoms in sensitised mice, irrespective of their diet, establishing its causal role in heightened allergen susceptibility induced by fiber deprivation.

“

Understanding the role of the various components of the microbiome and how their functions are affected by external factors like diet therefore becomes the key to preventing and treating a broad range of afflictions, from food allergies to neurodegenerative diseases, thereby giving our work a highly translational dimension with an enormous therapeutic potential for many patients around the world

”



Prof Desai

LIH detects allergies in almost half of Luxembourg's adult population

In September a study addressing the escalating global challenge of allergies, was published. Under the leadership of Dr Annette Kuehn and Prof Markus Ollert, alongside Dr Maria Ruiz-Castell and Dr Guy Fagherazzi, the research provided profound insights transcending Luxembourg's borders.

This groundbreaking study, a collaborative effort between the Department of Infection and Immunity (DII) and the Department of Precision Health (DoPH) at the LIH, delved into the allergy burden in the Luxembourg population. Employing cutting-edge technology to study IgE antibody signatures

in human blood, the research generated a comprehensive dataset comprising 480,000 data points from 1,462 adult Luxembourg residents. The study was anchored in the European Health Examination Survey in Luxembourg (EHES-LUX), led by Dr Maria Ruiz-Castell and Dr Guy Fagherazzi, which provided a solid foundation for this first-of-its-kind investigation.

The findings revealed the extensive impact of allergies, with over 42% of participants reporting diagnosed allergies, and a striking 44% testing positive for IgE antibodies indicative of allergic sensitisation. Tree pollens, grass pollens, and mites emerged as the most common sources of sensitisation. Notably, the youngest age group (25–34 years) exhibited the highest sensitisation rates and the greatest need for medical care, suggesting a connection between modern lifestyle, upbringing, living conditions, and the onset of chronic inflammation like allergies. The study thus underscored the necessity for tailored medical care and nationally planned interventions to alleviate the burden of allergies.





5. **COVID-19:
a focus on
risk factors
and longer-term
symptoms**

READ MORE
ABOUT
COVID-19



SCAN ME



Shifts in human gut microbiome due to COVID-19

In March 2020, the World Health Organisation declared COVID-19 a global pandemic, caused by the SARS-CoV-2 virus. While some experienced severe illness, many reported mild-to-moderate symptoms. Later, individuals with COVID-19 reported gastrointestinal symptoms, prompting researchers from the LIH, in collaboration with the University's Luxembourg Centre for Systems Biomedicine, to investigate the impact on the gut microbiome.

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Our study indicates that COVID-19's influence on the infective competence of the gut microbiome may lead to a higher likelihood for other infections

”

Dr Guy Fagherazzi, study contributor

Severe infections were associated with persistent alterations to the gut microbiome for at least six months, potentially leading to bacterial, viral, or fungal co-infections. The findings indicate that COVID-19 influences the infective competence of the gut microbiome, raising the likelihood of other infections. Thus, the findings open new avenues for future research to track links to long-term effects of COVID-19 and explore whether changes in infective competence are common in viral and bacterial infections.

Mental health issues prior to COVID-19 infection affect recovery

The COVID-19 pandemic has profoundly impacted global mental health, revealing both short and long-term psychological symptoms. The Digital Deep Phenotyping unit at the LIH conducted a pioneering study, led by Dr Gloria Aguayo, which analysed mental disorders as determinants of COVID-19 symptom trajectories. Their findings, published in March, highlight pre-existing mental health conditions as a substantial risk factor.

Examining data from the Predi-COVID study, involving 791 adults, the research revealed a crucial link between regular use of psychotropic medication before infection and more severe COVID-19 symptoms. This association extended to a poorer overall prognosis, lack of recovery after two weeks, and a potential heightened risk of Long COVID. The researchers further identified four possible trajectories of COVID-19 severity, with a score reflecting the total number of symptoms. They showed that people that regularly used psychotropic medication before being infected, in particular antidepressants and anxiolytics, had a higher score and worse trajectory, exhibiting poorer recovery during the first two weeks after the infection. These insights emphasise the need to address mental health conditions during the pandemic, therefore helping to provide more tailored COVID-19 care.



EU project COMMUTE investigates links between COVID-19 and neurodegenerative diseases

The LIH Department of Transversal Translational Medicine (TTM), led by Prof. Dr. Rejko Krüger, together with the LIH Department of Infection and Immunology, the University of Luxembourg and other partners across Europe, joined the Horizon Europe-funded project COMMUTE (“COMorbidity Mechanisms UTILized in hEalthcare”), which kicked off in December 2023 during a two-day meeting at the International Center of Information Technology (B-IT) at the University of Bonn. Coordinated by Fraunhofer Institute for Algorithms and Scientific Computing (SCAI; Bonn, Germany), the project aims to advance our understanding of how infectious diseases such as COVID-19 can impact individual risk to develop neurodegenerative disorders such as Parkinson’s disease or dementia. COMMUTE leverages the existing TTM-led cohorts for neurodegenerative and infectious diseases and will benefit from data and samples from the CON-VINCE/ORCHESTRA and Predi-COVID studies on COVID-19 and the NCER-PD Parkinson’s disease programme. Using a combination of machine learning and AI approaches, together with stem cell culture-based models, COMMUTE aims to develop an AI-based model for personalised risk assessment for COVID-induced neurodegeneration, as well as a battery of cellular assay systems for drug repurposing testing. This will ultimately allow the identification of risk profiles that could in the long run train machine-learning models to support healthcare professionals in their treatment decision-making.

A cardiovascular diagnostic test for the surveillance and care of long COVID-19 patients

The “COVIRNA” project, funded by the European Commission’s Horizon 2020 programme and led by the Cardiovascular Research Unit (CVRU) of the LIH, aimed to predict COVID-19 severity and identify patients at risk of post-COVID complications. Recognising the emergence of long-term health problems, including cardiovascular and neurological complications, the objective of the project was to provide a molecular diagnostic tool for tracking cardiovascular effects in those affected by “long-COVID.”

Conceived in response to the European Commission’s fast-track call for COVID-19 projects in March 2020, COVIRNA utilised the expertise of the CVRU in RNAs and cardiology to design a novel, micro RNA-based diagnostic tool allowing the stratification of patients according to anticipated severity of their symptoms. The consortium of 15 institutions across 12 European countries, previously collaborating within the EU-CardioRNA COST Action network, identified RNA molecules in the blood as predictive markers for severe health complications and mortality.

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Although we are still in the process of doing some validations before developing the final molecular diagnostic kit, we are confident that our new test will help personalise healthcare and improve the outcomes of COVID-19, particularly in patients developing the so-called long-COVID syndrome

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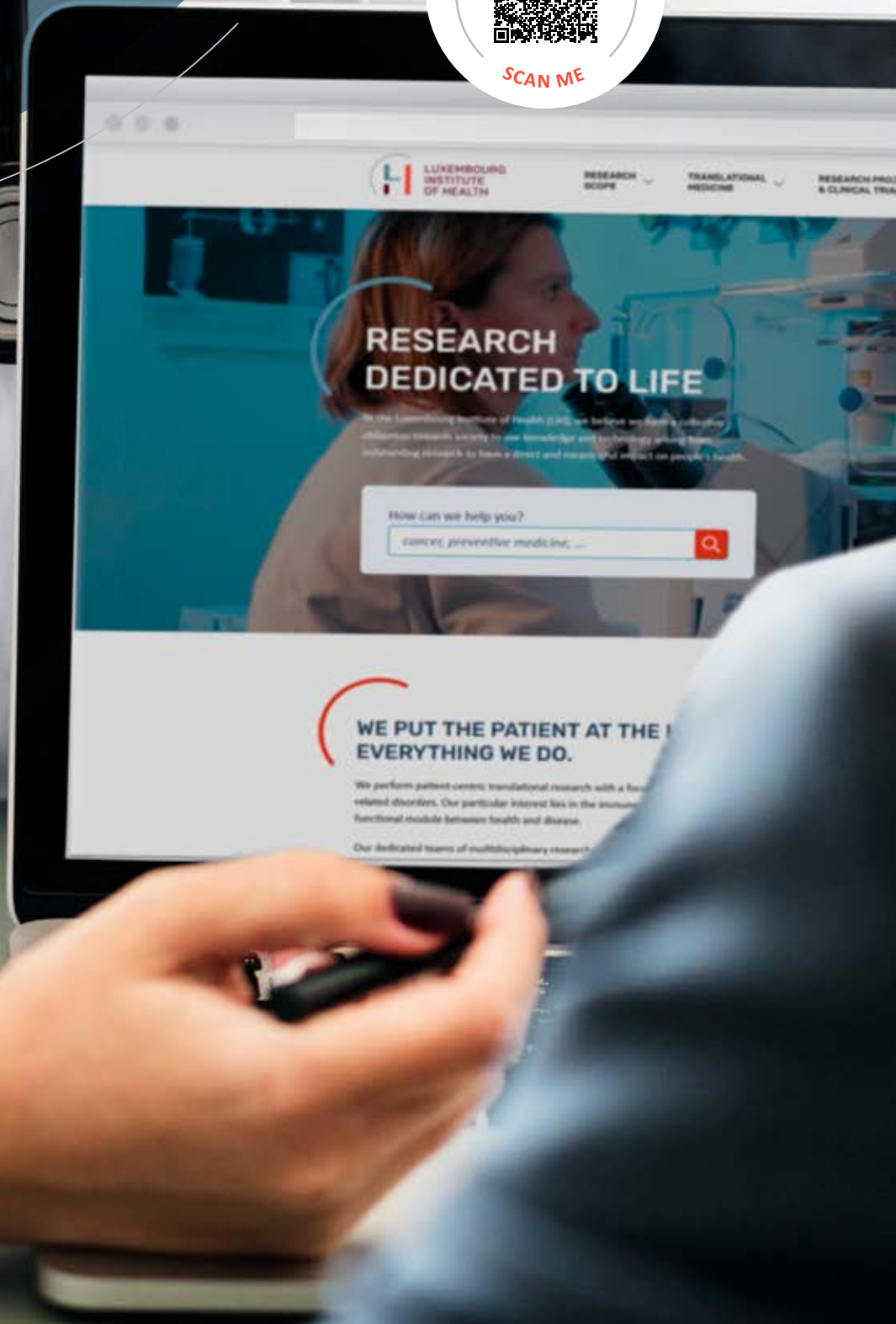
Dr Yvan Devaux, COVIRNA project leader at the LIH

6. Digital health

DISCOVER OUR DEEP DIGITAL PHENOTYPING RESEARCH UNIT



SCAN ME





Deep Digital Phenotyping research group receives extended support for innovative projects

Both the “Société Francophone du Diabète” (SFD) and the “Société Luxembourgeoise de Diabétologie” (SLD) extended crucial support to the Deep Digital Phenotyping (DDP) research unit at the LIH Department of Precision Health (DoPH) for innovative projects.

The SFD granted EUR 30,000 for the SFDT1-IH clinical study, facilitating the development of a digital biomarker predicting the risk of hypoglycemia unawareness in type-1 diabetes patients. This research project, directed by Dr Guy Fagherazzi, leverages machine and deep learning algorithms such as TabTransformer. It was launched in March 2023 and will last for 18 months.

In parallel, the SLD awarded EUR 5,000 to the DDP research unit for the DIAVOX project, dedicated to developing and validating a vocal biomarker for real-time monitoring of diabetes-related distress in Luxembourg. Under the scientific leadership of Dr Fagherazzi, the project will apply advanced machine-learning algorithms to analyse data from the ongoing international Colive Voice cohort, currently including 842 participants with type 1 and type 2 diabetes.

Using machine learning to predict Alzheimer’s and Parkinson’s

In a study published by the Deep Digital Phenotyping research unit in January 2023, researchers demonstrated the use of deep neural networks to predict the onset of neurodegenerative diseases, addressing the increasing threat to the older population’s health and quality of life. The study focused on understanding the complex prodromal phase and early onset factors crucial for disease prediction, risk minimisation, and promotion of protective factors.



The added value of this study is that we present an advanced reproducible methodology, combining a novel approach with state-of-the-art techniques. This analysis can be applied in predictive studies on the general population and clinical cohorts, particularly those of neurodegenerative diseases.

Moreover, deep neural networks have many potential applications in cohorts with rich and diverse epidemiological, clinical and image data, but also in those with missing data



Dr Gloria Aguayo, lead author

LIH to collaborate with LISER on the identification of vocal biomarkers of stress

Dr Guy Fagherazzi, Director of LIH’s Department of Precision Health and leader of the Deep Digital Phenotyping (DDP) unit, joined the team of the FragMent project led by Dr Camille Perchoux from LISER. The project, funded by the European Research Council, aims to assess the impact of the fragmentation of daily-life environment on stress in a Luxembourg-based cohort. In the study, stress, a global concern affecting mental and physical health, is being evaluated through self-reported measurements and vocal biomarkers, developed by the DDP team. Vocal biomarkers provide a quick, non-invasive method for stress assessment, which could be widely used to support stress prevention and be incorporated into public health prevention strategies. The collaborative effort between Dr Fagherazzi and Dr Perchoux explores efficient ways to assess stress in everyday life, contributing to advancements in stress monitoring.



Harnessing the power of clinical data to improve patient care: the LIH joins the medical informatics network HiGHmed

In June, the LIH, through its Data Integration & Analysis (DIA) unit, joined the HiGHmed Consortium, a German medical informatics project uniting hospitals, academia, and industry partners. The project aims to improve access to medical patient data for research and healthcare.

The HiGHmed Consortium addresses challenges in managing diverse health data by building secure Data Integration Centres and developing interoperable digital solutions. These solutions support local and cross-institutional patient care and clinical research, with the ultimate goal of empowering physicians to make data-based, patient-centered decisions.



Joining the HiGHmed Consortium is a strategic and logical decision for the LIH, as it is perfectly aligned with the objectives of the recently-launched CLINNOVA initiative and with our institute's focus on supporting the integration of patient-derived data into our research and, ultimately, into current clinical practice



Dr Maximilian Fünfgeld, Chief Medical Information Officer at the LIH and leader of the Data Integration & Analysis (DIA) unit

HiGHmed, part of the German Medical Informatics Initiative, consists of 12 university hospitals and partners across Germany. The LIH, joining in the current funding phase (2023-2026), is the first international partner.

Establishing a digital health hub in Luxembourg: the LIH and Expon Capital sign a collaboration agreement

In July, the LIH and Expon Capital, a Luxembourg-based venture capital investment firm, joined forces to explore opportunities and synergies in scientific research and technological development within the digital health sector.

Luxembourg's burgeoning health-tech scene, supported by government funding and national institutions like the Luxembourg National Research Fund, are positioning the country as an ideal hub for innovative health-tech companies, particularly in digital health. In line with this vision, the LIH, a leader in translational medicine and digital health, and Expon Capital, specialising in early and late-stage Venture Capital investment in European tech companies, signed a collaboration agreement.

The agreement focuses on identifying, developing, and implementing joint projects and activities. On Expon Capital's side, these include supporting the LIH in organising hackathons and competitions, aiding spin-offs and start-ups, and providing assistance in science commercialisation activities. The LIH offers advisory and scientific support to Expon Capital and assists in developing a joint strategy to foster partnerships between digital health companies and the financial and investor community. This opportunity will help attract innovative e-health companies and unlock the potential of digital health and translational research in Luxembourg.



7. Preventive medicine & population health

DISCOVER
OUR DEPARTMENT
OF PRECISION
HEALTH





New study reveals average Luxembourger spends half the day sitting

In January 2023, the first comprehensive evaluation of physical activity (PA) in Luxembourg, conducted by the Physical Activity, Sport and Health (PASH) Research Group led by Dr Laurent Malisoux at the LIH, aimed to assess the nation's adherence to the World Health Organisation's (WHO) PA guidelines. In 2021, Luxembourg officially embraced the WHO guidelines, recommending 150-300 minutes of moderate PA and 75-150 minutes of vigorous PA per week for adults. The study, led by Dr Paul Collings, obtained data from approximately 1100 adult participants who wore accelerometers on their wrists for a week as part of the ORISCAV-LUX 2 study on cardiovascular health risk. The findings indicated that over 98% of Luxembourg residents adhered to the WHO PA guidelines, comparable to countries like Finland and Germany. However, the study also revealed that despite high PA adherence, residents spent over 12 hours a day sitting, emphasising the challenge of sedentary behaviour in a modern, digitally-driven society.

The researchers, aware of the health risks associated with prolonged sedentary time, recommended public health initiatives in Luxembourg to encourage breaking up sedentary periods with low-intensity PA, particularly among individuals aged 50 and above. They underscored the potential health benefits of incorporating such activities without compromising work productivity, citing studies that support this approach. Additionally, the study suggested dedicating more time to PA in general, especially low-intensity activities, to address the paradoxical situation where high overall PA adherence coexists with extended sedentary periods among Luxembourg residents.

Unlocking the exposome: exploring our environmental exposure

In February, Dr Maria Ruiz-Castell from the Socio-Economic, Environmental Health & Health Services (CARES) group, together with Dr Brice Appenzeller from the Human Biomonitoring Research Unit (HBRU), published a ground-breaking study revealing the cumulative impact of seemingly minor exposures on an individual's health. Their approach based on hair analysis aimed to characterise the adult exposome of the general population of Luxembourg, considering a comprehensive range of environmental factors—chemical, lifestyle, psychosocial, and physical—that individuals encounter over their lifetimes.

The study, which analysed 175 environmental exposures, including a detailed list of chemical pollutants detectable in hair, shed light on correlations and patterns within specific groups (socio-economic status, age, gender, nationality, etc.). A concerning finding was the detection of EU-banned pesticides in many samples, highlighting the prolonged persistence of these harmful chemicals. Gender differences were observed, with higher concentrations of pollutants, especially pesticides and herbicides, in men, while women exhibited higher concentrations of micronutrients and lower alcohol consumption. Some exposures showed moderate correlations, reflecting lifestyle habits, such as the correlation between owning pets and exposure to anti-tick chemicals. This study signifies a shift towards understanding the complexity of the exposome, providing crucial insights into the long-term health effects of various environmental exposures.

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The adult exposome is complex and multidimensional with many components, which means that reducing environmental exposure to a few exposure components may only provide limited benefits. This complete overview will help to better interpret the role that the exposome plays on health

”



Dr Ruiz-Castell, leader of the study

Promoting personalised physical activity through a smartphone solution

In February 2023, the Luxembourg charity “Œuvre Nationale de Secours Grande-Duchesse Charlotte” generously supported the LIH’s PIANISSIMO project. Led by Drs Laurent Malisoux and Bernd Grimm, the initiative focuses on promoting physical activity in individuals with degenerative joint diseases. The project aims to develop Colive Move, a dedicated smartphone solution for patient education and data collection, investigating the real-world relationship between daily physical activity and pain. The project aligns with the institute’s priorities in digital health and preventive medicine, offering potential benefits for future translational research initiatives like CLINNOVA.

Launch of the HealthyW8 project

The HealthyW8 project, spearheaded by the LIH, was officially launched in June, marking a significant step towards advancing obesity prevention initiatives in Europe. Coordinated by the LIH, this Horizon Europe project will unfold over the course of 5 years and bring together expertise and resources from a diverse Europe-wide consortium. Acknowledging that traditional approaches to obesity prevention have had limited impact, HealthyW8 aims to revolutionise strategies by focusing on personalised interventions.

Dr Torsten Bohn and the consortium will target specific demographic groups at risk of transitioning from a healthy weight to overweight and obesity, including schoolchildren and their parents, young adults, and the elderly. The project entails over 40 pan-European pilot trials and long-term randomised control trials across various age groups. A key element of HealthyW8 is the development of the Healthy Lifestyle Recommender Solution (HLRS), a user-centred digital tool considering personal contexts, preferences, and emotional well-being to empower informed decisions about lifestyle factors. With a total budget of 10 million euros and the support of 24 entities from nine European countries, the project is expected to have a substantial impact on the fight against obesity.



MET’HOOD project delves into the connection between a residential neighbourhood and cardio-metabolic health

Cardio-metabolic diseases, including diabetes, heart attack, and stroke, are influenced by known risk factors such as obesity and high blood pressure, although lifestyle choices are also emerging as an important element. In this context, the MET’HOOD project, initiated in 2021 by the LIH and the Luxembourg Institute of Socio-Economic Research (LISER), uniquely focused on the geographical environment’s impact on cardio-metabolic health in Luxembourg. The project aimed to analyse the long-term effects of residential neighbourhood characteristics and address social inequalities in order to inform urban policies supporting health equity.

The weight of pollution: exposure linked to obesity

Innovative research led by Dr Brice Appenzeller from the Human Biomonitoring research Unit (HBRU) discovered an association between chronic exposure to environmental pollutants and an increased risk of obesity, diabetes, and dyslipidemia. Published in November, the study involved an extensive investigation into the effects of pollutants, specifically polychlorinated biphenyls (PCBs) and various pesticides, on cardiovascular health. These pollutants, commonly found in the environment, homes, and food, were revealed to have significant associations with cardiovascular disease (CVD).

The project built on data from the NESCAV survey, a cross-sectional study conducted from 2007 to 2013 across Luxembourg and Belgium. Dr Feng-Jiao Peng, lead author of the publication and part of the Human Biomonitoring Research Unit, highlighted the study's findings, showcasing associations between CVD risk factors and chronic environmental exposure to these pollutants in both Belgian and Luxembourgish adult populations.



Ours was the first study to utilise hair samples to investigate CVD risk factors in relation to pollutant exposure. We were able to find an unprecedented association between CVD risk factors and chronic environmental exposure to currently used pesticides, which are still found in most countries. Our results show a clear need for further research into these associations to protect the welfare of citizens worldwide



Dr Appenzeller, leader of the HBRU group

Hair as a “witness” to exposure to fast-elimination chemicals

In November, a collaborative study conducted by the French National Health and Safety Agency (ANSES), the LIH, and the French National Institute for the Industrial Environment and Risks (Ineris) revealed the efficacy of hair analysis in monitoring exposure to rapidly eliminated chemicals. Led by Claire Beausoleil, a toxicologist within ANSES, the study focused on substances like bisphenols, phthalates, and pesticides, commonly found in the environment or food but quickly eliminated from the body. Traditional blood or urine analyses faces challenges in assessing long-term exposure due to the substances' rapid elimination and frequent re-exposure.

To address this, the scientists exposed rats to a mixture of 17 pollutants and analysed hair and urine samples. The results demonstrated a strong correlation between exposure dose and metabolite concentrations in the hair for 14 of the 17 substances. Notably, hair analysis proved to be a better method to assess exposure than blood analysis, as hair samples capture the exposure to pollutants over longer periods compared to blood samples.



A novel blood serum assay for the diagnosis of neurodegenerative diseases

In May, an international collaboration between researchers from Japan and Luxembourg, led by Professor Nobutaka Hattori from Juntendo University, resulted in the publication of a significant breakthrough in *Nature Medicine*. The research introduced a groundbreaking method, IP/RT-QuIC, capable of using pathological forms of the alpha-synuclein protein found in patients' blood for the diagnosis of Parkinson's disease and differentiation from other neurodegenerative motor disorders. The study addressed synucleinopathies, including Parkinson's disease, Lewy body dementia, and multiple system atrophy, caused by abnormal aggregation of the alpha-synuclein protein.

The researchers, including scientists from the Luxembourg Centre for Systems Biomedicine (LCSB) at the University of Luxembourg, the LIH, and the Laboratoire National de Santé (LNS), collaborated to develop the innovative diagnostic method. IP/RT-QuIC involved immunoprecipitation and real-time quaking-induced conversion to detect alpha-synuclein seeds in the serum. Leveraging a unique longitudinal clinical and neuropathological database from Luxembourg, the researchers successfully detected alpha-synuclein seeds in the serum of 95% of patients with synucleinopathies. The method also revealed distinct patterns in the structure of these seeds, differentiating between diseases. This breakthrough opens the door to a simple blood test for the diagnosis of synucleinopathies, particularly Parkinson's disease, representing a significant advancement in the field. Professor Rejko Krüger, director of Transversal Translational Medicine at the LIH and head of the Translational Neuroscience group at the LCSB, underlined the potential impact of a blood test for Parkinson's disease, marking a major progress in diagnosis compared to the current reliance on clinical examinations.

Closing the translational cycle - from research excellence to excellent care

In September 2023, Luxembourg marked a significant step in neurodegenerative disease care with the launch of the Réseau de compétences maladies neurodégénératives "ParkinsonNet Luxembourg" (RdC-MN). As a direct return on Luxembourg's investment into the first National Centre for Excellence in Research for Parkinson's disease (NCER-PD) supported by the FNR, the initiative aims to provide tailored and personalised care for individuals with neurodegenerative diseases, starting with Parkinson's disease as a first use case. Led by Professor Rejko Krüger, the RdC-MN fosters collaboration among various healthcare professionals, facilitating improved communication and information exchange to enhance patient care. The network, initially focused on Parkinson's disease, plans to expand to include additional healthcare professions and develop personalised treatment and prevention plans.

Luxembourg's international recognition in the area of neurosciences, notably through the NCER-PD, highlights the success of 8 years of well-defined and excellent research programs. The NCER-PD programme generated new knowledge leading to earlier and better diagnosis of PD and to the implementation of precision medicine strategies. Additionally, the research results of NCER-PD opened new avenues for translational research, which will be explored in the upcoming years, using the vast amount of clinical data and samples collected thanks to the active participations of people with and without PD. NCER-PD will continue its clinical research activities by leveraging the strong alliance built between Luxembourgish research and healthcare institutions under the coordination of the LIH. The success of NCER-PD and of the ParkinsonNet concepts in Luxembourg points towards a promising model, with plans to gradually extend the initiative to comprehensively address other neurodegenerative diseases.





Immune cell markers for early Parkinson's detection with particular relevance to women

In an innovative study recently published in "Nature Communications," scientists from the LIH and the Luxembourg Centre for Systems Biomedicine (LCSB) have unveiled non-invasive cellular immune biomarkers that could revolutionise early Parkinson's disease diagnosis. Parkinson's disease (PD), affecting around 10 million individuals globally, poses diagnostic challenges due to its slow onset and variable symptoms. The research reveals a direct link between disturbances in the peripheral immune system and PD, particularly in its early stages. This breakthrough, marking a major step forward in clinical diagnostics, involves analysing circulating immune cells in a patient's blood sample, providing highly precise results within approximately five hours.

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Our work demonstrates, for the first time, a tangible connection between a disrupted peripheral immune system and a chronic brain disease like Parkinson's. This could have far-reaching diagnostic implications, especially for patients without a defined genetic cause for their condition

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Dr Feng Hefeng

The study builds on previous work on rare familial forms of Parkinson's and explores immune system changes in individuals with the common sporadic form. The research team identified a specific subtype of immune cell, CD8 T lymphocytes with strong killing functions (CD8 TEMRA cells), elevated in number in patients with early-to-mid stage Parkinson's compared to healthy individuals of the same age. The study underscores the power of translational research and interdisciplinary collaborations, setting the stage for a potential shift in Parkinson's disease diagnosis.

8. Awards & Prizes



NATIONAL

The Plooschter Projet continues to support the LIH

On January 21st, 2023, the Luxembourgish non-profit association Plooschter Projet reaffirmed its commitment to supporting leukaemia research in Luxembourg. The association made a generous donation of EUR 30,000 to the Tumour Stroma Interactions (TSI) group at the Department of Cancer Research (DoCR). This marks the fourth consecutive donation by Plooschter Projet, following contributions in 2021, 2020, and 2019. The TSI group, led by Dr Etienne Moussay and Dr Jérôme Paggetti, focuses on investigating mechanisms promoting cancer progression, with a specific emphasis on chronic lymphocytic leukaemia (CLL). The research project supported by Plooschter Projet aims to meticulously characterise the cellular microenvironment of CLL patients' lymph nodes. The researchers will employ high-throughput imaging techniques such as Imaging Mass Cytometry and CyTOF analysis of T cells in collaboration with Sorbonne University (Paris, France). The goal is to gain insights into cellular localisation and understand how functions are subverted by tumour immune escape mechanisms, providing potential targets for innovative immunotherapies.



Think Pink Lux 'Marian Aldred Award' to Clément Thomas and Diogo Pereira Fernandes

On January 13th, 2023, Diogo Pereira Fernandes, a Master's student in the Cytoskeleton and Cancer Progression group at the LIH, and Dr Clément Thomas, the group leader, received the 'Marian Aldred Award' from Think Pink Lux (TPL). The €25,000 award will support Diogo's research project focused on exploring signalling pathways responsible for tumour immune resistance. This knowledge is crucial for developing strategies to enhance antitumour immune responses in patients and improve the efficacy of current immunotherapies.



Fighting cancer in Luxembourg: Legs Kanning Prize 2022 to Pablo Morande

On January 17th, 2023, Dr Pablo Morande, a Marie Skłodowska-Curie Senior Post-doctoral Fellow in the Tumour Stroma Interactions (TSI) group at the LIH Department of Cancer Research, received the "Legs Kanning Prize" from the association "Action Lions Vaincre le Cancer." The prize, amounting to EUR 7,500, was awarded in recognition of Dr Morande's outstanding research achievements in cancer. Dr Morande discussed evolutionary approaches in understanding cancer progression and their implications for future therapeutic applications. He highlighted the significance of perceiving cancer relapse as a Darwinian process and shared insights into ongoing projects by the TSI group at the LIH.



Luxembourg's COVID-19 Task Force wins Science for Society Prize

The Research Luxembourg COVID-19 Task Force, initiated by the LIH, has been honoured with the 2022 Science for Society Prize by the Science for Society Foundation under the Fondation de Luxembourg. Recognised for its pivotal role in coordinating national research support during the pandemic, the Task Force played a crucial part in disseminating COVID-related research findings to the public and assisting the government in vital decisions, such as the implementation of a large-scale testing program. The OECD praised Luxembourg's pandemic response, specifically acknowledging the Task Force's creation at the crisis onset. The World Health Organization (WHO) highlighted Luxembourg's lowest rate of excess mortality among European countries throughout the pandemic, attributing this success to the Task Force's commendable efforts. The Science for Society Prize, awarded by an independent jury, includes a 5,000 EUR prize to be presented at an upcoming ceremony, with Prof Paul Wilmes from the University of Luxembourg accepting the award on behalf of the Task Force.



Ministry of Higher Education and Research honours Dr Christiane Hilger

On Monday June 19, the Ministry of Higher Education and Research (MESR) awarded 12 researchers in Luxembourg with the Grand Ducal Order of the Oak Crown for their years of service and continued commitment to education and research.

Dr Christiane Hilger, Group leader of the Molecular and Translational Allergology Group was one of those selected and awarded by Minister Claude Meisch due to her 30 years of service at the LIH.



LIH scientists triumph at the 2023 FNR awards

At the 2023 FNR Awards, the Immuno-Pharmacology and Interactomics group at the LIH received the Outstanding Scientific Achievement award for their groundbreaking research on the novel opioid receptor ACKR3. This receptor, identified as a "scavenger receptor," has the potential to revolutionise the treatment of opioid-related disorders by modulating its function and restoring natural analgesic opioid peptide levels. The research, led by Dr Andy Chevigne and Dr Martyna Szpakowska, addresses the limitations and side effects associated with conventional painkillers, offering a promising solution to the ongoing opioid crisis.



INTERNATIONAL

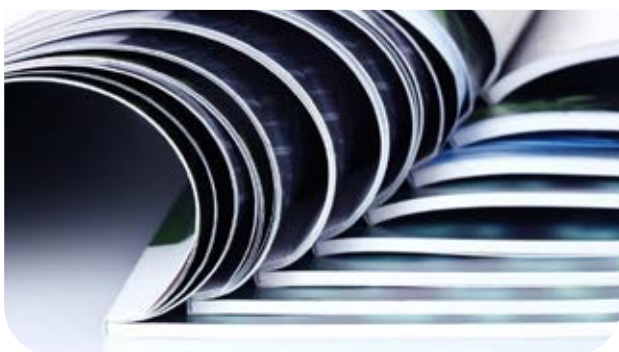
Rosalind Franklin Society Award bestowed to LIH researcher

In July 2023, Kathleen Mommaerts, a researcher in the Biospecimen Science Research group at the Integrated Biobank of Luxembourg (IBBL), received the Rosalind Franklin Society Award in Science for her article on induced pluripotent stem cells published in the journal “Biopreservation and Biobanking” in February 2022. The award, launched by Mary Ann Liebert Inc. in partnership with the Rosalind Franklin Society, honours the best paper of the year by a woman or underrepresented minority in science across the publisher’s 100 peer-reviewed journals in science, medicine, and biotechnology. Dr Mommaerts’ winning article outlines a method for processing skin biopsies, specifically isolating, culturing, and cryopreserving skin-derived fibroblasts that can be reprogrammed into induced pluripotent stem cells.



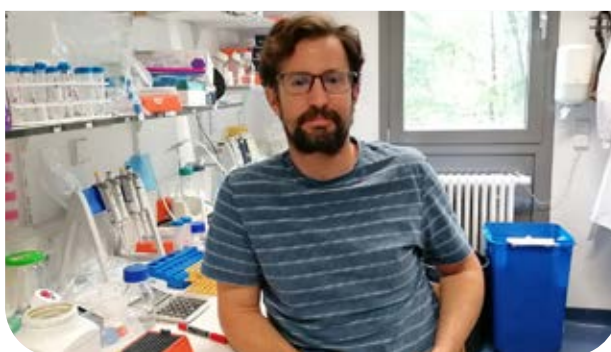
LIH scientist Dr Torsten Bohn again among the world’s most highly cited researchers

On November 15th, Clarivate™ released its annual “Highly Cited Researchers” report, acknowledging pioneers in science and technology with multiple top-cited papers. In the 2023 edition, four Luxembourg researchers, including Dr Torsten Bohn, Leader of the Nutrition and Health Research (NutriHealth) group at the LIH, were featured. Dr Bohn has been selected for the fifth consecutive year in the Agricultural Sciences category. Over the past decade, he has published 224 papers focusing on nutrition’s health impact, bioavailability of micronutrients, and dietary patterns’ relation to inflammation and associated diseases, and has been cited over 12,000 times.



American Society of Hematology Selects LIH researcher for Global Research Award

In July 2023, Dr Pablo Elias Morande, a Postdoctoral Fellow in the Tumour Stroma Interactions (TSI) group at the LIH Department of Cancer Research (DoCR), was awarded the 2023 Global Research Award by the American Society of Hematology (ASH). The award supports international haematology leaders during the transition to independent careers. Dr Morande, one of 12 recipients, will explore the role of Histones 1 in chronic lymphocytic leukaemia and Richter transformation. The ASH grant, spanning three years, facilitates collaboration between LIH and the IMEX-CONICET Institute in Buenos Aires, Argentina. Mentored by Dr Etienne Moussay locally and Dr Jan Burger globally, Dr Morande expressed gratitude for the prestigious award and emphasised its motivational impact.



Dr Claudine Backes elected President of the GRELL

Dr Claudine Backes, Epidemiologist and Scientific Director of the Luxembourg National Cancer Registry at the LIH, was elected as the new President of the Group for Cancer Epidemiology and Registration in Latin Language Countries (GRELL). GRELL, one of the oldest and most prestigious cancer research associations worldwide, has over 300 members from 20+ countries, specialising in cancer epidemiology and data collection. Dr Backes’ leadership role will continue to contribute significantly to advancing cancer research globally, focusing on understanding cancer, improving prevention, enhancing treatment, and supporting healthcare planning. As the first Luxembourgish cancer epidemiologist to assume this role, Dr Backes’ appointment is a milestone for Luxembourg’s visibility and excellence in international cancer research.





9. Additional highlights

JANUARY

LAUNCH OF THE NATIONAL CENTRES OF EXCELLENCE IN RESEARCH (NCER)

On January 24, the Minister of Higher Education and Research, Claude Meisch, along with the FNR President of the Board of Directors, Martine Reicherts, and the FNR General Secretary, Marc Schiltz, presented a new funding programme, the National Centres of Excellence in Research (NCER). NCER builds on the pilot project NCER-PD, launched in 2015. One of the main beneficiaries of this new funding instrument is Clinnova, an international program focused on digitalisation in healthcare and precision medicine.



MARCH

EMPOWERING CANCER PATIENTS: NCTCR PATIENT TRAINING

The LIH conducted a successful training session for 12 cancer patients, introducing them to research processes and encouraging active participation in projects at the National Centre for Translational Cancer Research (NCTCR). This initiative is part of Luxembourg's Plan National Cancer 2 (PNC2), focusing on involving patients in research collaborations. The session highlighted successful partnerships between patients and researchers, showcasing activities such as understanding research processes, ensuring the readability of patient materials, and making research results more accessible.

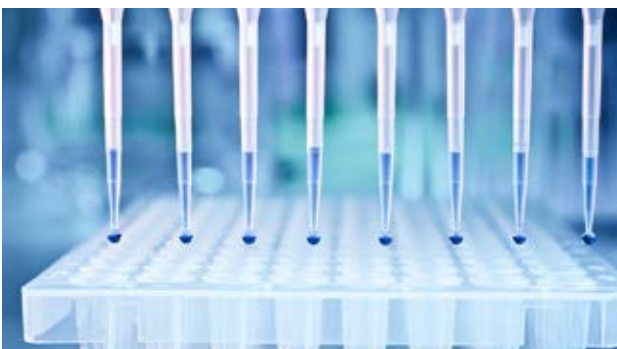


PROF DIRK BRENNER INVITED TO JOIN THE SCIENTIFIC ADVISORY BOARD OF THE VIB CENTER FOR INFLAMMATION RESEARCH

Prof Dirk Brenner, Deputy Director of the Department of Infection and Immunity (Strategy & Research), was appointed as Chairman of the Scientific Advisory Board of the VIB Center for Inflammation Research, one of Europe's most prestigious biomedical research institutions located in Belgium.



APRIL



"MARIE SKLODOWSKA-CURIE INDIVIDUAL FELLOWSHIPS" TO T. RAMOS

The European Commission's "Marie Skłodowska-Curie Individual Fellowships" programme was awarded to Dr Teresa L. Ramos from the Tumor Immunotherapy and Microenvironment (TIME) group, with a fellowship to conduct a two-year research project known as INCEPTOR. The project aims to investigate the mechanisms of tumour escape from immune cells, a major obstacle in cancer immunotherapy.

MAY

BEST POSTER PRESENTATION AWARD TO DR MAFRA

Dr Allini Mafra, postdoctoral fellow of the Cancer Epidemiology and Prevention Group (EPI CAN), received the Best Poster Presentation Award at the GRELL (Group for Epidemiology and Cancer Registry in Latin Language Countries) 2023 Conference (31 May – 2 June 2023) in Mont Saint-Michel, France for the poster entitled “Cancer Mortality Trends Over Time in the Grand Duchy of Luxembourg”.

JUNE

HEREDITARY GRAND DUKE VISIT TO LCTR

On Tuesday, June 20th, the LIH and the Centre Hospitalier de Luxembourg (CHL) welcomed H.R.H. Prince Guillaume, Hereditary Grand Duke of Luxembourg, Mr Franz Fayot, Minister of Economy, and Mr Claude Meisch, Minister of Higher Education and Research, for a visit of the Luxembourg Clinical and Translational Research Centre (LCTR Fuerschungsklinik Lëtzebuerg), which aimed to illustrate its operations and role in promoting societal and economic development in the Grand Duchy.



MSCA GRANT FOR VINCENT MARTIN

Dr Vincent Martin was awarded the European Commission’s “Marie Skłodowska-Curie Individual Fellowships” to conduct the two-year research project MATER. The project focuses on monitoring of mental health in breast cancer patients. Dr Martin will conduct his research in the Deep Digital Phenotyping Group of the DoPH under the supervision of Dr Guy Fagherazzi. The project started in September 2023 and will end in August 2025.



LIH RESEARCHERS SHINE AT THE 27th MEETING OF THE SOCIETY FOR HAIR TESTING

The LIH team attended the 27th meeting of the Society of Hair Testing (SoHT), in Lisbon, during which Paul Palazzi received the award of the best oral communication of the congress. Additionally, Dr Brice Appenzeller was re-elected member of the Board of SoHT, and appointed vice-president of the society.

PRIZE FOR OUTSTANDING SESSION PRESENTATION AT EAACI

Naphisabet Wanniang, PhD student in Dr Annette Kuehn’s allergy research group, received a prize for outstanding session presentation at the annual European Academy of Allergy and Clinical Immunology (EAACI), that was held in Hamburg, 9-11th June 2023. Her research is the first study of its kind that leveraged a population based survey (EHES-LUX) and deep-immune profiling along with computational approach to assess the allergy burden in Luxembourg adults.



RESCOM GRANT TO CLAUDINE BACKES

The Luxembourg National Research Fund awarded Dr Claudine Backes, Leader of the Cancer Epidemiology group (EPICAN), a grant within the RESCOM funding scheme to support a lecture series dedicated to Epidemiology & Prevention, with a particular focus on cancer. Between December 2023 and November 2024, the Lecture Series – coordinated by Dr Allini Mafra from the EPICAN) led by Dr Backes – will host eight renowned international speakers.

JULY

ERNEST “SHORT TERM SCIENTIFIC MISSION GRANT” FOR DII PHD CANDIDATE

PhD student Giulia D’Uonnolo from the Immuno-Pharmacology and Interactomics research group at the Department of Infection and Immunity received a EUR 2,300 scholarship from ERNEST. This enables her to undertake a 6-week Short Term Scientific Mission at the University Hospital Jena, Germany, focusing on the molecular characterisation of the chemokine receptor CXCR3. The research explores its trafficking, crucial for the efficacy of anti-PD-1 immunotherapy.

OCTOBER

THE RNC CELEBRATES ITS 10th ANNIVERSARY

On Thursday, October 5th, the National Cancer Registry of Luxembourg (Registre National du Cancer – RNC) at the LIH celebrated the 10th anniversary of its implementation. The scientific conference, which was hosted by Dr Sophie Couffignal, Operational Director of the RNC, and Dr Claudine Backes, Scientific Director of the RNC, featured several prominent speakers, providing an opportunity to discuss the latest developments in the field of cancer care in Luxembourg, with a particular focus on breast and childhood cancer.



LAUNCH OF THE PPI INITIATIVE AT LIH

The LIH launches the Patient and Public Involvement program, aiming to include diverse perspectives, accelerating progress and making research resonate with real-world needs.



MINISTER LENERT STOPS BY THE LIH TO PRESENT NUTRI-SCORE STUDY

Minister Paulette Lenert presented positive results from a monitoring study on the Nutri-Score in Luxembourg, emphasising its success in promoting informed dietary choices. Dr Torsten Bohn, who provided scientific advice to the Ministry on the development and implementation of these indicators in the country, highlighted the Nutri-Score’s criteria and consumer awareness. Despite challenges, the Minister expressed satisfaction with the Nutri-Score’s positive impact on transparency and health in the food sector.

YVAN DEVAUX APPOINTED AS A WORKING GROUP MEMBER OF THE EUROPEAN HEART FAILURE MISSION OF THE HFPN



In the continuous fight against preventable hospitalisations, the Heart Failure Policy Network is dedicated to enhancing patient outcomes through strategic collaboration with stakeholders. As a working group member of the European Heart Failure Mission of the HFPN, Dr Yvan Devaux will play a pivotal role in advancing the prioritisation of heart failure prevention in European policies.

TOP RANKING ABSTRACT AWARD ATTRIBUTED TO TSI GROUP AT IWCLL 2023



The Tumor Stroma Interactions study, “Targeting Translation Initiation as Novel Therapeutic in CLL,” earned them the prestigious Top-Ranking Abstract award at the International Workshop on Chronic Lymphocytic Leukemia, while their research on extracellular vesicles in the CLL microenvironment was also recognised, showcasing their innovative contributions to CLL research.

NOVEMBER

DII PAPER ON DIET, MICROBES AND FOOD ALLERGY CAPTURES THE INTEREST OF RENOWNED MAGAZINE “DER SPIEGEL”

The German weekly news magazine published a comprehensive article in its “Medicine” section, covering the latest prestigious publication of the Nutrition, Microbiome and Immunity research group of the LIH Department of Infection and Immunity (DII) in the journal Nature Microbiology on the relationship between dietary fibre intake, mucus-degrading gut bacteria and food allergy.



LIH RECOGNIZED FOR OUTSTANDING QUALITY MANAGEMENT PROJECT

The LIH was honoured with the “PROJET COUP DE COEUR DE MLQE – 2023” award for its innovative approach in the management of non-conformities.



LIH AT THE SCIENCE FESTIVAL!



At the Science Festival held at Abbaye Neumünster from November 9th to 12th, the LIH featured in four booths where researchers engaged attendees, including children, in the world of science.

EATRIS NEXT GEN SCIENTIST AWARD TO ANUJA LIPSA



Dr Anuja Lipsa, a Postdoctoral Fellow in the NORLUX Neuro-Oncology Laboratory, received the inaugural EATRIS Next Gen Scientist Award at the EATRIS@10 conference in The Hague on November 21st. The award, introduced to celebrate the 10th anniversary of EATRIS, aims to showcase early-stage translational researchers’ work through creative media. Dr Lipsa’s winning submission was a video illustrating NORLUX’s efforts to advance glioblastoma treatment using patient-derived preclinical models.

VIEW
THE VIDEO



SCAN ME

DECEMBER

MINISTER FOR HIGHER EDUCATION AND RESEARCH VISITS THE LCTR

The LIH welcomed the newly elected Minister for Higher Education and Research Mrs Stéphanie Obertin for a guided tour of the LCTR Fuerschungsklinik.



FNR 2023 CORE CALL



The Luxembourg National Research Fund (FNR) announced the final results of its 2023 CORE Call. A total of 42 out of the 188 eligible proposals were retained for funding, corresponding to an FNR financial commitment of over EUR 29 million. An additional two LIH projects were confirmed for funding, on top of the four previously announced in November 2023, bringing the total of funded projects involving the LIH to six. This corresponds to a total financial support of just under EUR 3.7 million.

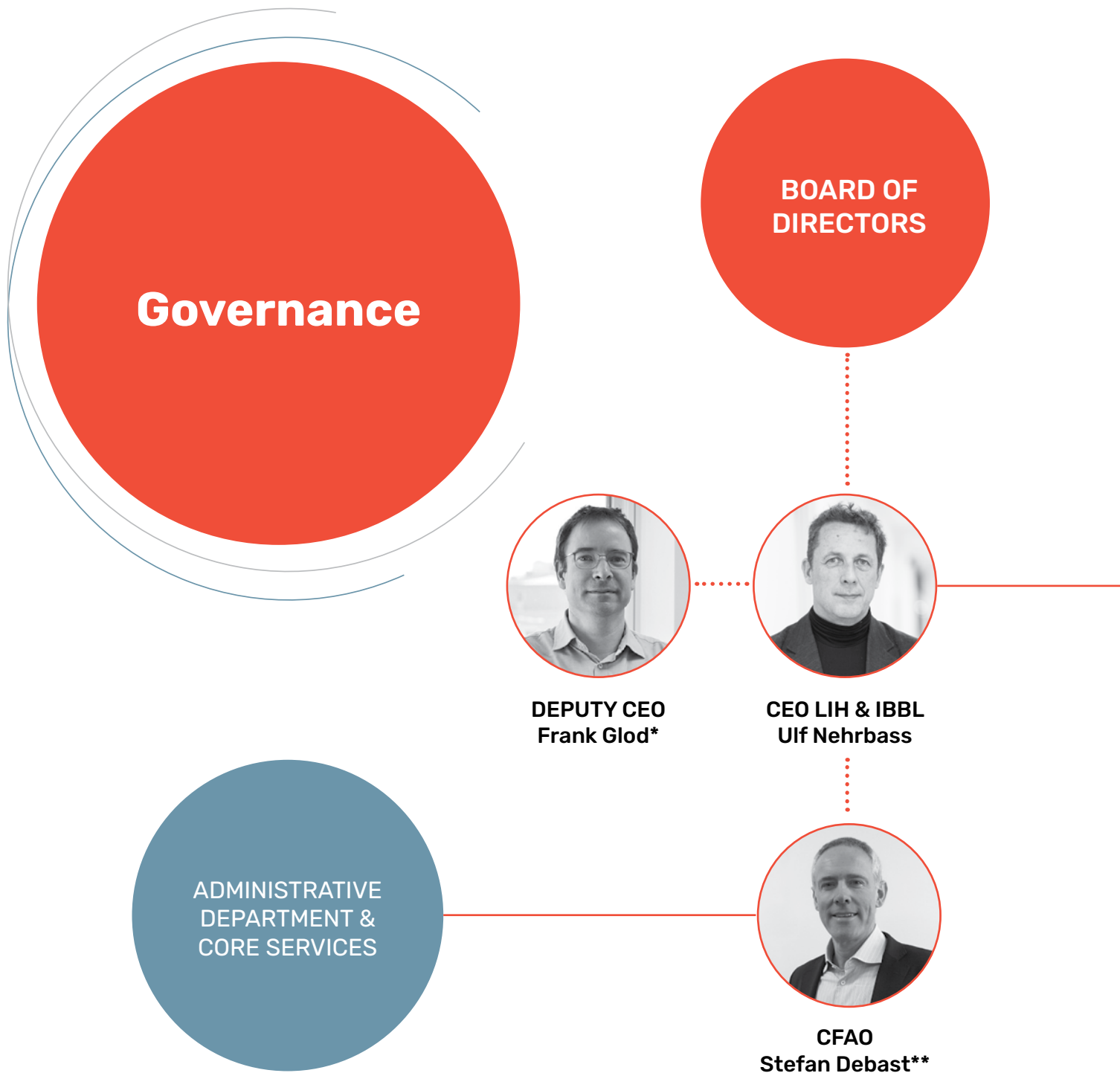
EXCELLENT DOCTORAL THESIS AWARDS 2023 IN SCIENCE TO MOHANED BENZARTI

Dr Mohaned Benzarti, former PhD student in the Cancer Metabolism Group (CMG) at LIH's Department of Cancer Research, was awarded the Excellent Doctoral Thesis Awards 2023 in Science from the University of Luxembourg for his PhD thesis "Elucidating the metabolic flexibility and plasticity of one-carbon cycle in cancer cells under stressful metabolic environments" during a dedicated ceremony on December 15th 2023. Dr Benzarti is among the 10 doctoral candidates recognised by the Doctoral School of Science and Engineering (DSSE) for their outstanding doctoral research.



10. Institutional organisation and figures





Board of Directors

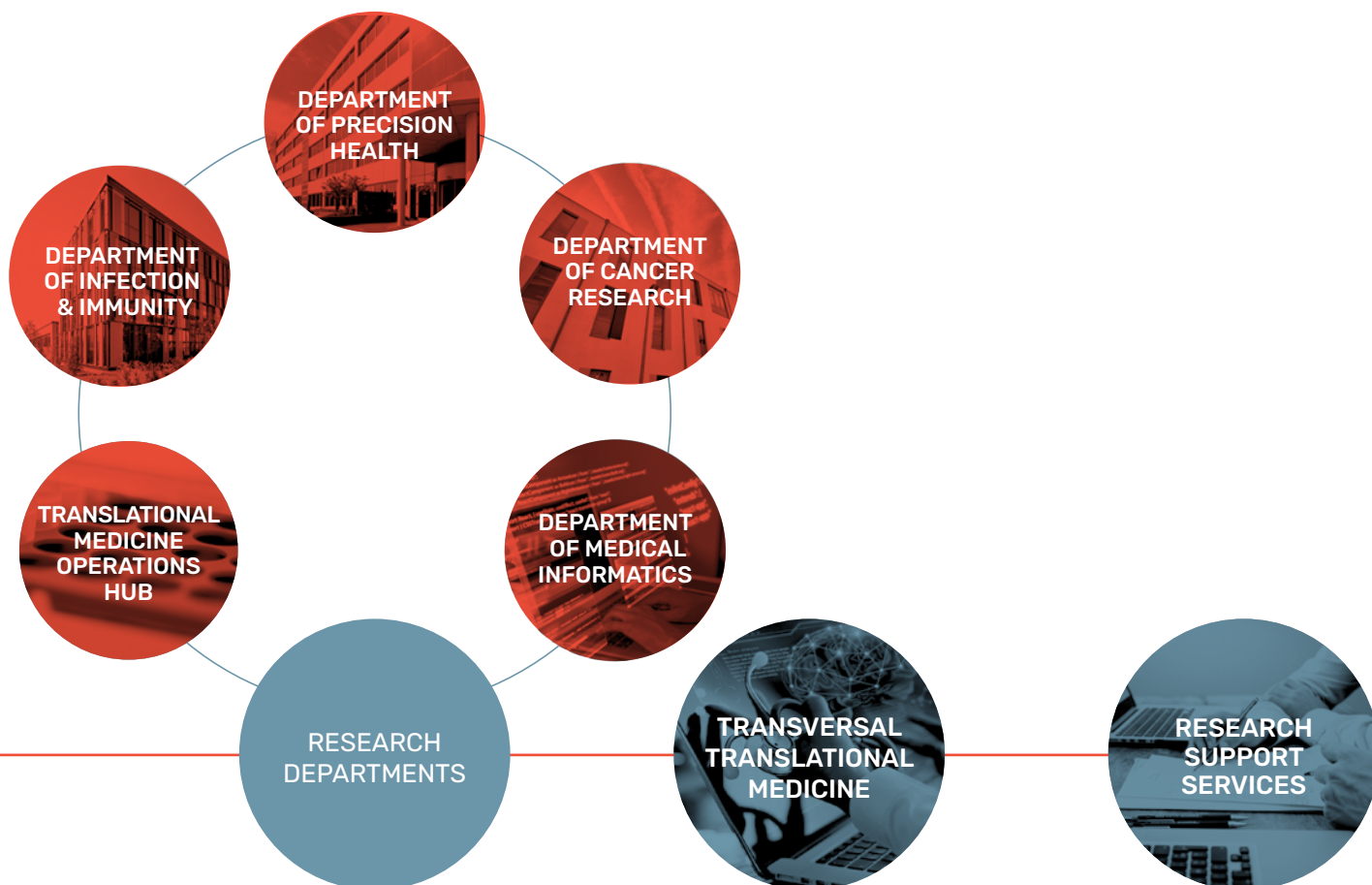
The Board of Directors is the highest decision-making body of the LIH. It is composed of 11 members, including 9 external members proposed and appointed by the Government, the president of the Staff Delegation, and the representative of the Coordinating Council. Its mission is to define the general policy, strategy and research activities of the LIH. The Board is organised into 3 sub-committees, which meet once a quarter, namely:

- Sub-committee 1: Finance, remuneration and social benefits
- Sub-committee 2: Research strategy
- Sub-committee 3: Governance and risk management

The Executive Committee, composed of the Chief Executive Officer, the Deputy Chief Executive Officer, the Chief Financial and Administrative Officer and the directors of the five research departments, is responsible for the implementation of the strategy approved by the Board of Directors and for day-to-day management of the institution.

*Since 01.01.2024

**Since 01.04.2024



It guarantees compliance with ethical principles, conventions and national laws.

The Coordinating Council is a consultative body composed of internal representatives of the researchers, the staff delegation and the research and innovation support personnel. It issues advisory opinions to the Board of Directors regarding research policy, development and innovation and can advise on the content of the plurennial performance contract to be concluded with the Government.

Each research department has a Scientific Advisory Board. These boards are consultative bodies to the Board of Directors and comprise high-ranking external scientists. Their composition reflects the scientific area in which the departments are active. Their main tasks are to advise on the strategic and scientific orientations of the departments and to provide a scientific evaluation of the research units.

5,942***

Number of participant inclusions and follow-ups in collaborative research projects

Key facts 2023*

3,540,915

Total samples collected and aliquots created (IBBL)

484

Number of employees



259

Number of researchers

271,510

Total samples distributed (IBBL)

*Figures as at December 31st 2023

**Including peer-reviewed journal articles, books and book chapters, public health reports and doctoral theses

***All types of visits and interactions with participants in research projects, clinical trials and clinical studies



19.8
Mio€
Third party income

391

Number of LIH
press mentions
(national and international)

3

Number of patent
applications filed

386**
Number of scientific
publications



55

Nationalities

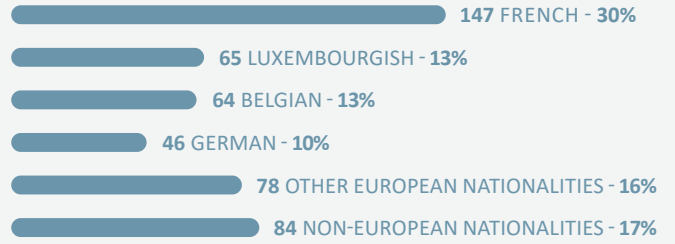
71
New projects,
total funding **16 M EUR**

21
National competitive
17
International competitive
15
National collaborative
3
International collaborative
15
Others

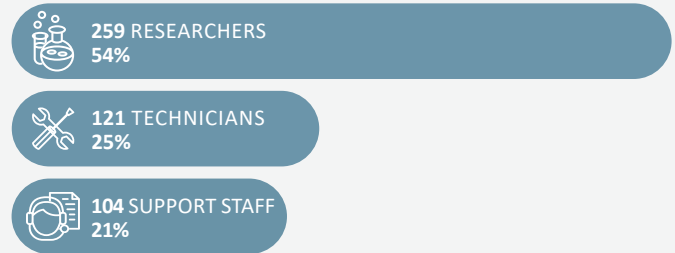
239
Number of ongoing
projects

Human resources

STAFF BY NATIONALITY

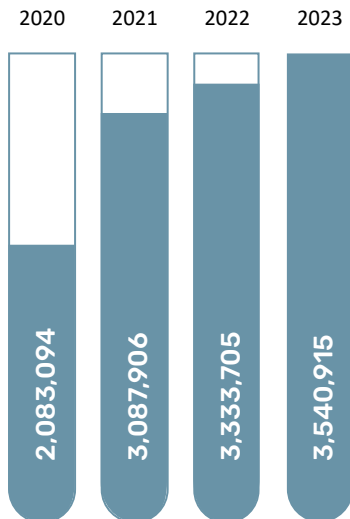


STAFF BY FUNCTION

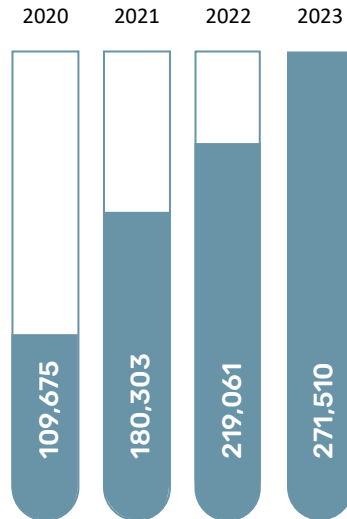


IBBL collection statistics*

TOTAL SAMPLES COLLECTED AND ALIQUOTS CREATED

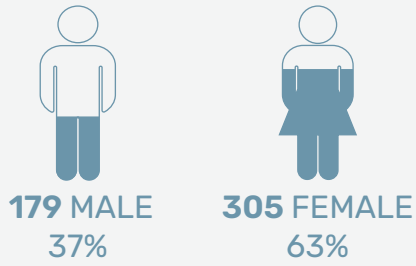


DISTRIBUTED



*Cumulative figures as at December 31st

STAFF BY GENDER

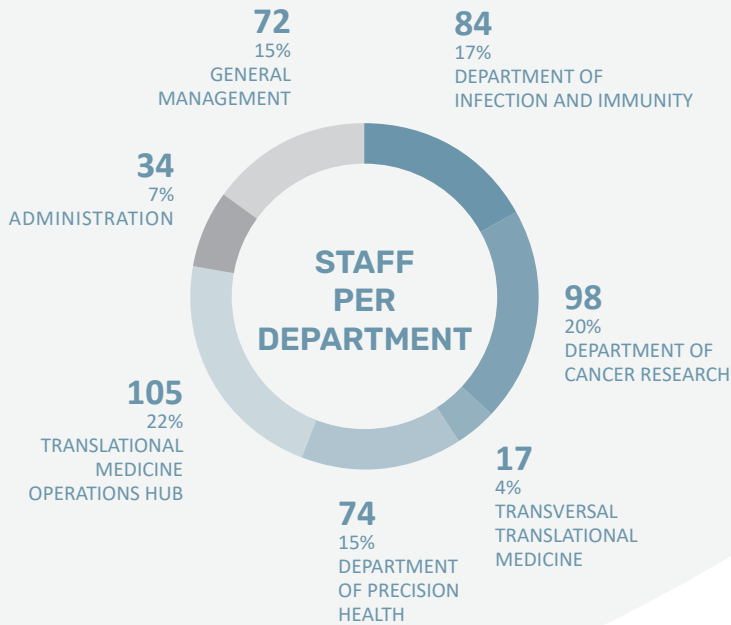


4
1%
EXTERNAL

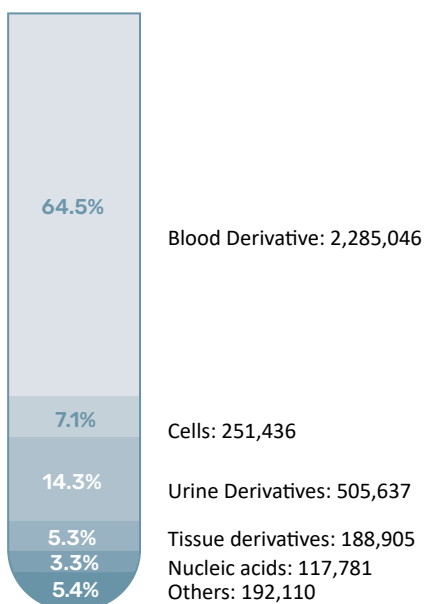
196
40%
FIXED TERM

STAFF BY WORK CONTRACT TYPES

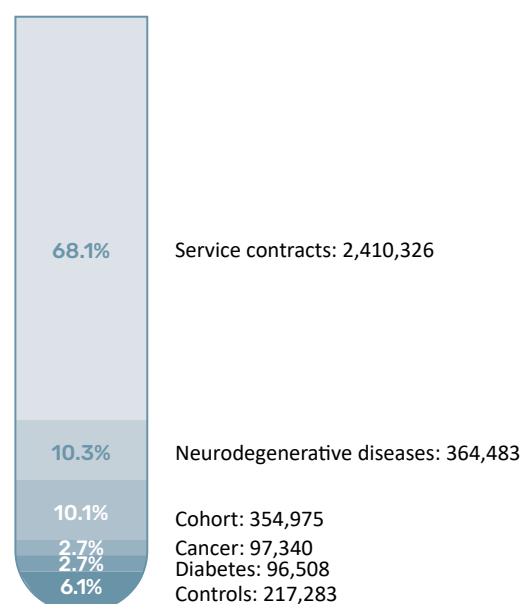
288
59%
PERMANENT



SAMPLES BY TYPE



SAMPLES BY PROGRAMME

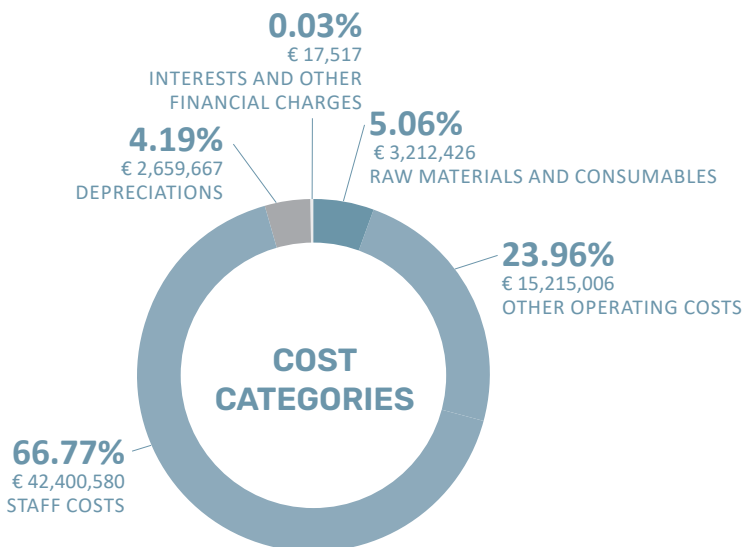
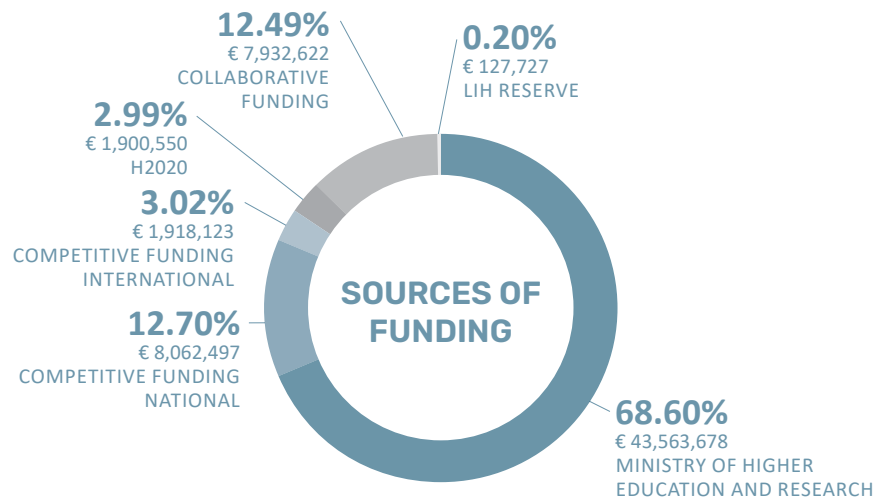


Finances



The accounts were audited by the statutory auditors Grant Thornton and approved by the Board of Directors during their meeting of 22 March 2024.

Statutory Expenses



PROFIT AND LOSS ACCOUNT (EUR)	2023 01.01 - 31.12.2023	2022 01.01 - 31.12.2022
Net turnover	4,525,929	4,592,637
Subsidies	57,488,077	52,691,228
Other income	68,627	80,718
Use of merchandise, raw materials and consumable materials	-3,212,426	-3,343,652
Other expenses	-15,215,006	-14,845,556
Staff costs		
a) Salaries and wages	-37,217,392	-32,640,914
b) Social security on salaries and wages	-5,183,188	-4,411,039
Value adjustment on intangible, tangible assets and financial assets	-2,643,079	-2,295,885
Value adjustment on current assets	-16,588	0
Other interest receivable and similar income	1,308,141	94,598
Interest payable and similar expenses	-17,517	-67,692
RESULT OF THE YEAR	-114,424	-145,557

Profit and loss account
(31st december 2023)

Balance sheet

(31st december 2023)

ASSETS	2023 01.01 - 31.12.2023	2022 01.01 - 31.12.2022
FIXED ASSETS		
Intangible assets	556,421	590,399
Tangible assets	10,632,702	7,606,738
Financial assets	6,330	5,580
TOTAL FIXED ASSETS	11,195,453	8,202,717
CURRENT ASSETS		
DEBTORS		
Trade debtors	2,522,940	4,372,731
Becoming due and payable within one year	2,522,940	4,372,731
Becoming due and payable after more than one year	0	
Other debtors	7,827,145	771,774
Becoming due and payable within one year	7,827,145	771,774
Cash at bank and in hand	53,403,904	55,338,852
TOTAL CURRENT ASSETS	63,753,989	60,483,357
Prepayments	1,141,240	1,348,294
TOTAL ASSETS	76,090,683	70,034,367

CAPITAL, RESERVES AND LIABILITIES	2023 01.01 - 31.12.2023	2022 01.01 - 31.12.2022
CAPITAL AND RESERVES		
Financial wealth	4,099,157	4,099,157
Reserves	18,867,414	19,012,971
Profit or loss brought forward		0
Profit or loss for the financial year	-114,424	-145,557
Capital investment subsidies	8,493,982	6,955,454
TOTAL CAPITAL AND RESERVES	31,346,130	29,922,025
Available reserve for projects	37,045,830	28,794,677
Provisions for risks and charges	1,365,682	1,353,027
CREDITORS		
Trade creditors	3,335,312	6,487,422
Becoming due and payable within one year	3,335,312	6,487,422
Becoming due and payable after more than one year		0
Tax and social security debts	2,177,583	1,231,660
Tax authorities	11,697	9,720
Social security authorities	2,165,886	1,221,940
Other creditors	814,831	2,239,568
Becoming due and payable within one year	814,831	2,239,568
TOTAL AVAILABLE RESERVE FOR PROJECTS, PROVISIONS AND CREDITORS	44,739,238	40,106,354
Deferred income	5,315	5,988
TOTAL CAPITAL, RESERVES AND LIABILITIES	76,090,683	70,034,367

11. Publications

DISCOVER
THE FULL LIST
OF 2023 LIH
SCIENTIFIC
PUBLICATIONS*



SCAN ME

16

Doctoral
theses

137

Publications
in top 10%
journals

54

Joint publications
with other Luxembourg
research institutes

365

Scientific publications
(including peer-reviewed
journal articles, books
and book chapters)

5

Public Health
reports

* The list includes the 386 scientific publications (peer-reviewed journal articles, books and book chapters, public health reports and doctoral theses), plus published patents, meeting abstracts and preprints.

Discover
the **new**
digital version
of our annual
report





Redaction, Design & Execution:

Marketing & Communication LIH: communication@lih.lu

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We would like to thank everyone involved in the development of this Annual Report



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