Please note: All photos in which social distancing and other preventive measures are not adhered to were taken during a period when government restrictions on COVID-19 were lifted and new guidance was released.
2021 was an important year for LIH: the 4-year performance contract, which defines the framework with our primary funder MESR, came to conclusion. LIH has realized its targets. Together, we have managed to achieve the expected repositioning towards more patient-centred translational work, while at the same time up-keeping our productivity and scientific excellence. With the exception of EU-funding targets, all of the performance indicators were reached or outperformed. In 2021 alone over 400 scientific manuscripts were published, 95 of which in journals ranked in the top 10 percentile according to their impact factor. This is a significant improvement over the year 2018, when the Times Higher Education ranked LIH number 15 amongst non-academic institutions world-wide. In addition, during 2021 LIH secured seven out of the nine available core grants in the area of life sciences in Luxembourg. Together with Télévie grants and a significant improvement in European funding we secured the financial basis of the Institute’s research. LIH’s research excellence was acknowledged by stakeholders and the public: The 2021 Fonds National de la Recherche (FNR) award for Outstanding Scientific Achievements was bestowed to Prof Dr Simone Niclou and Dr Anna Golebiewska. Dr Pablo Elias Morande received the 2021 FNR award for outstanding mentoring. The Excellent Thesis Award was given to Dr Hannah Wurzer. We all can be very proud of these achievements. All the while delivering scientific excellence, LIH remained engaged in an extended restructuring process. Efforts to become a more translational Institute with a more direct impact on patients were well under way in 2021. Importantly, in 2021 we managed to seamlessly include IBBL into the Translational Medicine Operation Hub (TMOH), making our flagship Biobank
Overall, I think it was a very successful year. The driving force behind it were all of LIH’s staffs and collaborators, whether scientists, clinicians, technicians or administrative support teams. The unwavering support of our funders, stakeholders, collaborators, investors, and, crucially, our patients, made all of our achievement possible.

I am personally very excited to see what we will achieve in 2022 but for now, I can only extend my heartfelt thank you to you all for this year.

To come through on our translational strategy, 2021 saw the launch of large patient-based programs leveraging on TMOH’s capacity. This included an FNR “Initiate” fund for Clinnova in the area of immune-related diseases, or the start the National Center for Translational Cancer Research (NCTCR) in the context of the Plan Cancer. Both directly aim at translating research excellence into patient benefits. Moreover, the advanced COVID-19 programs Predi-Covid and CON-VINCE evolved into successful studies, with both plenty of scientific insights and excellent publications. Many more ideas and initiatives were started during 2021, which go beyond the framework of this foreword. Together they manifest that the translational ambitions of LIH are materializing and becoming tangible.

Finally, with our focus on patient-centred research and real-world data, we started getting active in the regulatory arena. What a challenge! Regulatory work is essential not only for clinical research and the GDPR framework, but also to understand how secondary data can be used beyond research to help patients. This type of regulation is currently moving forward on two levels: top-down from the European Commission through the European Health Data Space (EHDS), and bottom-up through initiatives like Gaia-X. Thanks to our active involvement with Gaia-X during 2021, we became European coordinators of Health-X. It allows us to stay at the forefront of the regulatory challenge and to better understand how to navigate our translational efforts in the medium term.
The Luxembourg Institute of Health was created in 2015 and its motto since that time has been: “Research dedicated to life”.

In recent years, the Institute has passed through a transition from an Institute of clinical and basic research without major interconnections, to an Institute that is more and more interconnected and aims to become a leading translational medicine Institute. We have also increased collaborations with our neighboring countries and the number of shared projects is in constantly rising. Clinnova is only one of the examples, albeit probably the most spectacular.
The year 2021 was marked by the second year of the COVID-19 pandemic, a domain in which we are still running projects, but not the only one. Colive Voice is an example of how the voice can be exploited to simplify healthcare. Indeed, the voice provides a reflection in real time of a patient’s disease and at a certain stage of that disease. Colive Voice has the potential to become a readout that correctly reflects underlying mechanistic problems that can otherwise only be scored by complex ‘omic’ approaches. Voice is much faster and simpler. Time will tell how far this digital avatar can become adoptable.

Fortunately, 2022 will probably be the last year of the COVID-19 pandemic, and in the meantime, we have been able to return to our main objective, which is to bring research to patients.

The creation of the Translational Medicine Operations Hub (TMOH) and the rebranding of two of our three research departments emphasizes this shift towards patient-oriented research. The Department of Oncology became the Department of Cancer Research and the Department of Public Health became the Department of Precision Health. In this setting, we welcomed Dr Guy Fagherazzi and Dr Hermann Thien, who joined in 2021 as leaders of the Department of Precision Health and of the Translational Medicine Operations Hub, respectively. This new structure should bring research closer to the patient, at the right time.

The Board of Directors has been closely following this shift in priorities and supports the LIH staff in and outside of the Institute. Apart from overseeing the Institute’s activities, the board of Directors, together with the management, has also started a series of training in corporate governance in order to improve the leadership performance.

In the name of the Board of Directors, I would like to seize this opportunity to thank all the wonderful people that work every day at the LIH to improve the well-being of our patients.
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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.
LIH renews commitment to COVID-19 research
COVID-19: Mass screening reveals significant transmission risk from asymptomatic carriers

After nearly two years, the COVID-19 pandemic remains a public health emergency. Despite the employment of public health measures, such as restriction of movements and gatherings, personal protection, as well as massive vaccination campaigns, the coronavirus is still largely affecting the mortality and morbidity worldwide, including persisting symptoms after the infection.

Ever since its conception, large-scale testing for SARS-CoV-2 has been a topic of intense political and societal debate, with particular scrutiny placed on the rationale behind screening asymptomatic individuals. Nevertheless, the questionable role played by asymptomatic carriers remains an essential variable in population-based transmission and needs to be addressed.

In May 2020, Luxembourg became one of the first countries to implement a large-scale testing programme, offering all of its residents and cross-border workers the opportunity to receive regular free testing on a voluntary basis. The first phase of testing ran from 27 May until 15 September 2020, covering 49% of the resident and 22% of the cross-border worker populations, subsequently enabling the detection of 26% of all positive cases of the epidemic’s first wave. This provided decision makers with evidence-based data, helping to break infection chains early and slash total case numbers by as much as 43%, based on the results of computer simulations.

The additional benefit of large-scale testing has been to provide a unique test case for assessing the role of asymptomatic carriers in population-based transmission. Using the contact tracing data from phase 1, LIH researchers helped to reveal that asymptomatic SARS-CoV-2 carriers are likely to be just as infectious as their symptomatic counterparts.

The testing strategy was designed in a 3-layered approach, estimating exposure to the disease and physical proximity, before categorising activity sectors into high and medium risk levels. Unsurprisingly, the analysis shows that people who worked in the high-risk sectors had greater odds of testing positive. Furthermore, the data revealed the apparent influence of socioeconomic factors, where individuals with a disposable household income of less than 30k€/year also fell into high risk categories.

By clarifying the role of asymptomatic carriers in the transmission of COVID-19, this analysis provides essential insights for the development of future population-level containment and mitigation strategies.
Predi-COVID extended to children

As the COVID-19 pandemic continues into its third year, the LIH continues to strive to help mitigate its societal impacts and improve patient outcomes through its ongoing research and innovation.

Originally launched in April 2020 with the aim of identifying risk factors and biomarkers associated with COVID-19 severity in the adult population, Predi-COVID (“Luxembourg cohort of positive patients for COVID-19: a stratification study to predict severe prognosis”) has now officially been extended to children. This will serve to elucidate risk factors for COVID-19 severity in the younger population.

Current research around COVID-19 has so far predominantly focused on disease evolution and treatment in adults, due to the higher incidence, severity and mortality observed. Although children typically develop the asymptomatic or milder variants of COVID-19, recent evidence suggests that the SARS-CoV-2 virus may be involved in the onset of more severe manifestations, leading for instance to multiple organ inflammation and failure (Pediatric Inflammatory Multisystem Syndrome) and even cardiac complications, such as myocarditis and coronary artery dilations as in Kawasaki disease. The aim of the paediatric extension of Predi-COVID is therefore to identify such factors and define the clinical, biological and microbiological characteristics of COVID-19 in younger patients.

As with adults, the health evolution and symptoms of children participating in Predi-COVID is being regularly followed through different remote digital tools, depending on whether they are at home or at the hospital. Short evaluations are also carried out to assess potential long-term consequences of COVID-19.

Furthermore, by collecting additional data from COVID-19 positive children, such as clinical and socioeconomic background, as well as biological samples including blood and stool, it may be possible to achieve a more complete understanding of the pathophysiology and dynamics of the disease in young people. For example, the analysis of stool samples from both COVID-19 positive and household contact children will increase the understanding of how the virus is shed in the stool and how the gut microbiome influences COVID-19 infection in children.

As the study continues, the LIH continues to be grateful to the Health Inspection Department of the Ministry of Health and to all other partners involved in the study for the excellent collaboration thus far.
LIH contributes to international COVID-19 research

With its ongoing study Predi-COVID, the Luxembourg Institute of Health (LIH) is adding to its existing efforts to combat COVID-19 by joining the international unCoVer network. This collaboration will create an international, harmonised real-world data bank to better understand the pathophysiology, progression and treatment, as well as epidemiological pattern of this disease.

The unCoVer (Unravelling data for rapid evidence based response to COVID-19) network includes 29 partners from 18 countries, who have been collecting COVID-19 patient information during the pandemic. Among these, LIH researchers from the Department of Precision Health and the Translational Medicine Operations Hub will contribute data from the Predi-COVID study.

Real-world data such as those gathered in the unCoVer project are critical to understand and respond to the pandemic, and include, for example, patient characteristics and risk factors, or information on treatment efficacy. The unCoVer approach captures and collects these data in a standardised format, unifying otherwise scattered datasets whilst maintaining patient anonymity across countries.

The network will build ‘big data’ analysis tools, allowing clinicians, data scientists and epidemiologists, to collaboratively address questions including who is susceptible to serious disease. Whereas clinical trials often exclude the most vulnerable groups, unCoVer real-world data specifically includes these groups, therefore complementing and contrasting other studies.

As the pandemic develops and with the emergence of new viral variants, this latest move seeks to improve patient care and provide the basis for successful public health initiatives.
CON-VINCE study enters homestretch

As a member of the global community dealing with the COVID-19 pandemic, Luxembourg has been uniquely placed in its ability to monitor and record the disease in a significant fraction of its population. This continues to be a major asset that allows researchers at the LIH to improve understanding of the disease at both the local and global scales.

Originally launched in April 2020 under the aegis of the Research Luxembourg COVID-19 Taskforce, the CON-VINCE study aims to evaluate the prevalence and dynamics of the spread of COVID-19 within the Luxembourgish population, with a specific focus on asymptomatic and mildly symptomatic (oligosymptomatic) individuals. In order to identify this target group, a panel of over 1,800 individuals, representative of the Luxembourgish population, was tested for the presence of the SARS-CoV-2 virus and monitored over 12 months through a series of follow-up visits.

The last round of testing of the CON-VINCE participants commenced in April 2021, approximately one year after the first set of visits upon inclusion in the study. The data obtained from this final wave will provide a comprehensive insight into the evolution and transmission of the disease over an extended timeframe, particularly from an immunity perspective.

The team, under the leadership of Prof Rejko Krüger, Director of Transversal Translational Medicine (TTM), collected nasopharyngeal swabs in order to carry out PCR testing and detect the presence of the SARS-CoV-2 virus, while blood samples were analysed for antibodies (serological testing) to assess whether the participants had mounted an immune response following exposure to the virus or after vaccination.

The team is obtaining crucial information from this annual follow-up, particularly as pertains to the persistence of the antibody response over a full year. Moreover, this last visit also provided the opportunity to analyse cell-based immunity, thereby giving a more complete picture of the global immune response against the novel SARS-CoV-2. It is hoped that the data collected can now be used to provide meaningful research outcomes for patients and the population in general.
From CON-VINCE to ORCHESTRA

Despite the CON-VINCE study being brought to its final conclusion, researchers at the LIH are always aiming to take their role one step further in the fight against COVID-19. Now, in the footsteps of its predecessor, ORCHESTRA Luxembourg builds on this work to follow the immune response to COVID-19 vaccination over time and to provide evidence for the prevention and treatment of infections caused by SARS-CoV-2.

Led by the Research Luxembourg COVID-19 Taskforce, the CON-VINCE project provided essential data about many aspects of the pandemic in Luxembourg to scientists all over Europe. These included the progression of the infection while confinement measures were in place and the evolution of antibodies in the population following SARS-CoV-2 infection and vaccination. Furthermore, the information collected during the study will continue to help answer questions on immune response, infection pathways, genetic predisposition, mental well-being and the socio-economic impact of COVID-19.

Building on the data and information acquired from CON-VINCE, the European ORCHESTRA (Connecting European Cohorts to Increase Common and Effective Response to SARS-CoV-2 Pandemic) project was launched with the aim to further evaluate the long-term consequences of COVID-19 in the general population, with a focus on post-vaccination monitoring of participants, and the mid-to-long-term psychosocial impact of the pandemic on Luxembourg residents. The consortium is a major initiative, involving 26 partners from 15 countries, which is funded under the European Commission Horizon 2020 “ERAvsCORONA Action Plan”.

Participants of the CON-VINCE study were invited to join ORCHESTRA Luxembourg and to continue their journey to advance research on the pandemic. These volunteers have the opportunity to complete specific questionnaires and provide dried blood spot samples, as well as optional stool samples, four times over the course of 24 months via easy-to-use collection kits delivered at home.

The continuation of CON-VINCE participants in ORCHESTRA Luxembourg is the key to the whole project, as they already provided essential information that can be translated through ORCHESTRA to improve our understanding of the vaccination effectiveness and the overall long-term impact of COVID-19 in the general population. ORCHESTRA participants will contribute to determining how well and how long people are protected from COVID-19 by getting vaccinated, and help to both control the current pandemic and prepare for potential future pandemics.
Developments in precision health at the core of LIH activities
LIH appoints new Director of the Department of Precision Health

The world of healthcare is constantly evolving but never more so than in recent decades with the meteoric rise in digital technologies. In a move to strengthen its digital health and artificial intelligence axis at the start of the year, the LIH moved to appoint Dr Guy Fagherazzi as the new head of its Department of Precision Health (DoPH). His appointment will further deepen the integration of digital data and Artificial Intelligence (AI) within the department’s and the institute’s research activities.

Dr Fagherazzi first joined LIH in June 2019 as Research Leader of the Digital Epidemiology and e-Health hub, having subsequently been appointed Group Leader of the newly established Deep Digital Phenotyping Research Unit. In these positions, he has started developing a transversal priority research axis around the topics of digital epidemiology, with the aim of strengthening the digital capacity of the department’s research groups, ultimately contributing to the creation of new and innovative public health solutions.

Having co-authored more than 200 publications, Dr Fagherazzi has a strong expertise in public health and digital epidemiology research, as well as in the analysis of large cohort studies leveraging AI methods.

As the new Director of DoPH, Dr Fagherazzi’s primary objective is to continue implementing his vision of modern and dynamic public health research and advance this towards the concept of precision health. This will be done by aligning existing research activities in the department with the transversal and translational strategy of LIH, while expanding the use of digital health and AI. Dr Fagherazzi will also concomitantly maintain his present role as Group Leader of the Deep Digital Phenotyping Research Unit.

“I am deeply honoured to have taken on this new position and would like to take this opportunity to thank my predecessor, Prof Laetitia Huiart, for her remarkable work over the past three years. I am looking forward to reinforcing the collaborative work between DoPH and the other LIH departments, in line with the institute’s transversal and translational strategy, as well as continuing developing a relationship of trust with our national stakeholders and international partners” Dr Fagherazzi
New FNR PEARL Chair: Prof Dr Klucken bringing digitalisation to every-day patient care

In order to help guide the fast-paced world of healthcare digitalisation, the LIH is always searching for answers regarding how digital tools can be integrated into healthcare processes, and how data should be visualised to personalise patient care. These are only two of many questions that new FNR PEARL Chair Professor Dr Jochen Klucken began analysing from the middle of last year and will continue to examine over the coming four. Supported by the 3.3 MEUR grant, Prof Dr Klucken will develop digital health concepts for Luxembourg through a joint research programme involving the LIH, the Luxembourg Centre for Systems Biomedicine (LCSB) of the University of Luxembourg and the Centre Hospitalier de Luxembourg (CHL).

Data-driven medicine and innovative digital tools are on the verge of complementing existing healthcare procedures and change the way patients, healthcare providers, and researchers will work together in the near future. New digital patient-centred healthcare services will address the patients’ needs, continuously monitor and accompany individual patient journeys, and support healthcare providers in making clinical decisions. Real-life healthcare data will become available, and thus, add value. Its application in medicine has an enormous potential to reduce disease burden, improve healthcare and generate new solutions and services. Yet, aspects pertaining to the integration into healthcare pathways and the evidence proving the benefit of these new services for patients, healthcare providers and society are not sufficiently clear – this will therefore be the focus of the FNR Digital Medicine Research Project.

Composed of experts in medicine, data science, health economy, IT engineering and social science, the Digital Medicine Group (dMed), led by Professor Dr Klucken, will address the medical benefits, structural and procedural changes, and social acceptance of the resulting digital healthcare services.

Luxembourg provides a unique environment to shape this digitalisation process in medicine. It boasts a comprehensive healthcare ecosystem with close interaction of policymakers, healthcare providers, academic institutions and society/patients. This also aligns with the present changes in medical education, specialisations in medicine and the interdisciplinary research activities in biomedicine and medical engineering underpinning the multidisciplinary nature of digitalisation in medicine. The FNR PEARL Chair in Digital Medicine will support this process with a strong understanding of patient-centered applications and integration into existing and future healthcare services.
The international Colive Voice study kicks off

In line with its drive to excel in the field of digital health, the end of June saw the LIH announce the launch of Colive Voice, a first-of-its-kind digital health study that aims to advance the diagnosis, risk prediction and remote monitoring of various chronic conditions and symptoms by evaluating voice features.

Human voice is a powerful communication medium that conveys feelings and emotions, but that can also immediately reflect the changes in an individual’s health. This notion, coupled with the widespread adoption of digital tools and artificial intelligence in healthcare, makes a case for the use of voice-based technologies for diagnostic and medical purposes. Vocal biomarkers could soon be used in various contexts such as telemedicine purposes, telemonitoring of patients between clinical visits or to assess the effectiveness of a drug in a clinical trial. To this end, audio, clinical, epidemiological data and patient-reported outcomes need to be collected simultaneously and systematically via well-structured methodologies.

In this context, the LIH Deep Digital Phenotyping (DDP) research unit launched the Colive Voice study, a ten-year initiative with the aim of collecting and analysing tens of thousands of voice recordings from volunteers. These will hope to identify vocal biomarkers for a variety of chronic conditions and symptoms, from stress, anxiety and depression to cancer, diabetes, multiple sclerosis, inflammatory bowel disease and even COVID-19. LIH scientists will subsequently process the collected data and extract the most significant audio features, depending on the voice disorder, disease or type of voice recording.

As an example, acoustic features extracted from recordings of a sustained vowel such as ‘aaaa’ can help to detect Parkinson’s disease, whereas linguistic features extracted from spontaneous or semi-spontaneous speech could be more suitable for mental health disorders.

Such audio characteristics can then be used to “train” machine- and deep-learning models to automatically predict or classify any clinical, medical or epidemiological outcome of interest, from vocal features alone or in combination with other health-related data.

The study continues, with over 50,000 international adults and adolescents expected to take part in English, French, German and Spanish. As such, it is hoped that the data obtained over the coming years will have broad implications for the international healthcare community and future digitisation of patient care.
Enabling precision cardiometabolic disease prevention through artificial intelligence

The rapid increase in the incidence of cardiometabolic conditions, such as type 2 diabetes and hypertension, urgently calls for better prevention strategies, moving from a one-size-fits-all to a precision approach in the general population. As leaders in the field of research into digital and personalised healthcare, the LIH is utilising cutting edge technologies to navigate the deep complexity of this task.

One of the biggest problems regarding precision care in cardiometabolic disease, is the high variability observed in individuals in terms of genetic profiles, inflammation, oxidative stress, insulin resistance and sugar levels, and how all these variables relate to the ensuing risk of developing cardiometabolic disorders. In this context, artificial intelligence and machine-learning approaches can prove to be very valuable.

In August, researchers from the LIH Department of Precision Health (DoPH) and from the LIH Quantitative biology Unit (QBU) leveraged advanced artificial intelligence and machine-learning approaches to classify a sample of individuals representative of the Luxembourgish population into distinct risk groups, paving the way towards more targeted strategies for the prevention of cardiometabolic diseases at a population level.

The scientists observed that the 1356 participants could be grouped into four distinct clusters varying from Cluster 1 - ‘cardiovascularly healthy’ (53.8% of subjects), to Cluster 4 ‘diabetes, hypertension and poor cardiovascular health’ (2.1% of subjects). These groups were associated with 10 year cardiovascular risk factors, ranging from 0% for the Cluster 1, to as high as 15% for Cluster 4.

The results could therefore indicate that Cluster 1 individuals could benefit from a general prevention strategy, while the other 3 clusters may benefit from a more personalised and intensive approach to improve their health. This could focus specifically on overweight/obesity management, a targeted lifestyle management strategy, or even bariatric surgery, according to the particular cardiovascular health parameters and socioeconomic profiles that characterise the individual.

If externally validated, general practitioners could one day rely on this profiling to have a better picture of a new patient and to optimise several cardiometabolic parameters simultaneously.
Dietary fiber determines predisposition to foodborne enteric pathogens

The gut microbiome is a hot topic in the world of biomedical research, providing a whole new perspective on the intimate relationship between our bodies and our health. Just one aspect of this has been understanding the relationship between diet and health, a subject under intense scrutiny by researchers at the LIH.

Despite step by step improvements in global food safety, infections with foodborne human enteric pathogens, such as *Listeria monocytogenes* and *Salmonella Typhimurium*, still cause large numbers of hospitalisations and fatalities every year. It turns out that some small but specific changes in diet might be a powerful solution, along with a helping hand from our personal microbial armies.

In a study published in November, Prof Mahesh Desai, Leader of the Eco-Immunology and Microbiome research group at DII, looked at the impact of dietary fibre on the susceptibility of mice to *Listeria* and *Salmonella*. They found that depriving mice of dietary fiber protected them from infections with these pathogens compared to mice fed a standard diet.

The team then looked closer to see whether the microbiome also influenced this response and found that, intriguingly, the same effect was observed in mice without microorganisms in their gut, suggesting that the susceptibility to pathogen infections is largely driven by the diet itself. The gut microbiota was found to be able to delay the infection, but the level of fiber in the diet had a more dominant effect on the pathogenicity.

The results suggest that the susceptibility to the human *Listeria* and *Salmonella* pathogens is altered with dietary modulation. Importantly, just the dietary modulation without the gut microbiota could be sufficient to prevent illness. Given the high-healthcare costs associated with foodborne infections, particularly with these two pathogens, the study highlights how dietary modulation could be employed as a translational approach to manage infection.
An apple a day: Could diet be used to manage autoimmune diseases?

Autoimmune diseases, such as multiple sclerosis, rheumatoid arthritis and inflammatory bowel disease are a hallmark of many modern societies. While existing autoimmune disease therapies do not consider the influence of the gut microbiome in pathogenesis, researchers from the Eco-Immunology and Microbiome research group at the LIH have been looking to explore this in a collaboration with the US University of Michigan Medical School (UMMS).

Autoimmune diseases are characterised by an immune system that erroneously attacks the healthy host cells. In the past decades, the incidence of autoimmune diseases has risen sharply and, while their rate is plateauing in industrialized countries, newly industrialised nations are experiencing a similar rise in new cases. These patterns highlight their growing public health burden globally as well as the important role of the non-genetic factors in triggering autoimmune disease.

Existing treatments of autoimmune diseases often focus on dampening the immune response, which can be problematic due to the potential increased risk of infection or cancer. The collaboration between LIH and UMMS in September explored an alternative approach however, examining dietary tools for precise engineering of the gut microbiome. This has led to discussions regarding the potential for diet-based therapies to modulate host–microbiome interaction in the prevention, treatment, and maintenance of remission in autoimmune diseases.

During the work, it was shown that Consumption of specific plant-derived fibers, protein, fats, probiotic foods, as well as the following of exclusion or elimination diets, all modulate the gut microbiota composition and metabolic output in a manner that can promote disease or foster a homeostatic state. As such, refining these dietary interventions could have an important impact on patient compliance and disease evolution.

By exploiting these findings to tailor diets according to a patient’s genetic background, microbial composition or function, and other individualised factors, it may be possible to prolong periods of remission, for example, in diseases such as IBD. Importantly, dietary modulation and the subsequent microbiome engineering could be utilised to supplement the existing therapies combatting autoimmune diseases to enhance the therapeutic efficacy.
Novel game-changing insights in the field of cancer research
A National Center for Translational Cancer Research

As our technologies and understanding of disease and the human body continue to grow, the global healthcare community has never been better equipped to tackle some of the most challenging health issues that we have ever faced. Beating cancer remains one of the toughest endeavors ever undertaken in biomedical research, and the LIH continues to play its part, driving initiatives focused on patient-centric translational research.

As a major addition to its cancer research strategy, in July the LIH announced its coordinating role in a new National Centre for Translational Cancer Research (NCTCR). This initiative of the Plan National Cancer-2 (PNC2), aims to foster patient-oriented cancer research in Luxembourg and provide access to clinical studies and innovative treatments to patients.

Having already received seed funding by the FNR, the project will officially commenced in late April 2022, bringing together the various stakeholders throughout oncology (medical doctors, care providers, researchers, patient-support groups...), to consolidate the consortium and to collect ideas for the future.

The NCTCR will aim to stimulate translational cancer research and build bridges between scientific developments and treatment in the hospital. Overall, the benefits should be felt by patients, with an acceleration of precision oncology efforts at the national scale, and the expansion of access to cutting-edge clinical trials. By its design, the NCTCR will ultimately seek to become a cornerstone for future precision cancer therapeutics in Luxembourg and drive patient-oriented research towards precision oncology.
Hijacking DNA repair to overcome resistance to anti-cancer therapy

How do you treat a disease that can evolve to survive even the most sophisticated therapies? This is just one of the many challenges faced by LIH researchers working to understand some of the most dangerous types of cancer out there.

Treatment resistance of cancers can arise for various reasons, one of these being the reassembly of cancer cell DNA after initial damage by both radiation treatment and chemotherapy. In September groundbreaking research was published by the DNA Repair and Chemoresistance research group led by Dr Eric Van Dyck, where it was shown that the mechanisms involved in the repair of specific ‘double-stranded’ DNA breaks (DSBs) may be responsible for the developed resistance. The group found that by disrupting proteins crucial to the repair pathway, resistant cancer cells were unable to repair the DNA damage correctly and therefore became susceptible to treatment effects.

To do this, the group sought to identify DNA damage response genes that are required for cell proliferation. The analysis was performed on glioblastoma cells, a particularly aggressive cancer well-known for developing treatment resistance. Characterising their results they were able to show, for the first time, that a specific protein, XAB2 is required for the efficient recombinational repair of DSBs, preventing repair errors and the formation of genetic instabilities. Importantly, XAB2 depletion, coupled with the inhibition of a crucial DNA recombinase (that normally helps enable DNA recombination), led to tumour cell death.

The major significance of the research is that it provides new targets for researchers trying to tackle resistance to anti-cancer therapies. Indeed, it is becoming increasingly apparent that targeting DNA repair by inhibiting components of the DNA damage response is an important therapeutic approach against many cancers.
A digital diagnostic tool to revolutionise the identification and treatment of sarcoma

With the development of new technologies comes the potential for innovation in healthcare, particularly with the advent of artificial intelligence and machine learning softwares that enable researchers to analyse data in a whole new way. This can be particularly useful in searching for patterns in large datasets that might be challenging for human eyes. At the LIH, these new technologies are being embraced and developed, lending fresh perspectives to the wealth of data at the fingertips of its researchers. In January, the power of these tools was exemplified in a collaborative publication between the team of Dr Michel Mittelbronn, from the LIH’s Department of Cancer Research, and over 50 partner institutions from around the globe.

In cancer research, sarcomas represent a structurally diverse range of soft tissue and bone tumours that can affect people of all ages. The large variability of these tumours can make them extremely difficult to characterise and identify, especially as many lack clear defining characteristics. As a result, diagnosis of sarcomas can often be difficult, with misclassifications and conflicting identifications being more common than in other forms of cancer.

One key way that researchers can attempt to identify cancers is through a process called DNA methylation, where small chemical ‘methyl groups’ attach to DNA segments, altering their activity. The patterns of this ‘methylation’ in the DNA reflect both the cell type of origin, as well as acquired changes during tumour formation. This has already helped researchers to develop a more comprehensive means of classifying brain tumours, and some previously hard to classify sarcomas; however the recent study wanted to go bigger, creating a classification tool for soft tissue and bone sarcomas representing a broad range of subtypes and age groups.

The tool was developed using the collaboration’s combined datasets of over 1000 previously characterised methylation profiles constituting a broad range of soft tissue and bone sarcoma subtypes across the entire age spectrum. When tested on 428 sarcoma-type tumours, the tool was able to classify 322 (over three quarters) of the cases, highlighting its enormous potential for research and diagnostic applications. Tools such as these could be invaluable in future patient care, enabling fast and reliable diagnoses that could have a significant impact on patient outcomes.
Masters of Disguise: New tactics in the hunt for shapeshifting cancers

Glioblastoma (GBM) is a highly aggressive form of cancer that develops in the brain, leaving sufferers with an average survival time of just 12-18 months. This is despite the substantial range of treatments available, including surgical intervention, radiation and chemotherapies. The problem is that with the current tools it is virtually impossible to stop the targeted tumours from growing back.

Back in December, continuing its work investigating the origins of treatment resistant cancers, a team led by Dr Anna Golebiewska, group leader of the NORLUX Neuro-Oncology Laboratory at the Luxembourg Institute of Health (LIH), published a comprehensive review of the existing literature to gain more insights into the issue.

The problem with GBM tumours, is that they are far from straightforward, containing a highly diverse population of interacting cells, including ones that carry stem cell properties. Overcoming this ‘heterogeneity’ within a tumour is difficult enough, but more recently it has been found that GBM cells also contain the ability to change the way they look and function in response to their environment. This ‘plasticity’ of GBM cells combined with inherent resistance to treatment, makes for the perfect enemy, one that can adapt and change to avoid potential threats.

In the face of an adaptable adversary, the time has come for a new approach when it comes to targeting GBM. Indeed, if its key strength is the ability to transform and disguise itself, then perhaps this should be the target, hence enabling other treatments to act on an unmasked foe. It is understanding these drivers of plasticity, fast and reversible or slow and long term, that could help to identify the tumour ‘escape mechanisms’ and therefore provide targeted treatment approaches for future patients.

Overall, the study reveals a paradigm shift in the way that researchers should approach the treatment of GBM and other aggressive tumours. The remaining question, and one which will doubtless be the subject of much future research, is which of the many potential therapeutic avenues could be effective weapons in their arsenal.
‘Suffocating’ cancer: Promising headway in melanoma immunotherapy

The ability of cancers to adapt in order to survive is not limited to just treatment resistance, but also to localised environmental changes, making them extremely robust. But what if some of these more fundamental survival skills of cancer cells were to take a hit? This is the question that was probed back in June by Dr Bassam Janji’s researchers in the LIH’s Tumour Immunotherapy and Microenvironment (TIME) group.

Melanoma is a type of skin cancer that develops from melanocytes, cells that are responsible for the production of pigments. Melanomas become harder to treat if not detected early, with emerging treatment resistance being an important barrier to their effective management.

An interesting aspect of melanoma and other solid tumours is that due to their rapid growth rate and low blood supply, they often exhibit areas of hypoxia, an inadequate oxygenation of tissue. Yet despite this, melanoma cells are not only able to survive oxygen deprivation, but use it to thrive. Taking advantage of the low oxygen environment, the melanoma hijacks the anti-tumour immune response and develops resistance mechanisms to conventional anti-cancer therapies.

A key gene responsible for cancer cell adaptation to hypoxia is HIF-1α (Hypoxia Inducible Factor-1 alpha), so the question posed by Dr Janji’s team was whether melanoma’s strength could also be its weakness. Using gene editing technologies in a mouse model, the team were able to show how targeting HIF-1α could not only inhibit tumour growth, but also drive cytotoxic (toxic to cells) immune cells to the cancer tissue.

Importantly, the study also showed that combining a drug devised to stop hypoxia significantly improves melanoma immunotherapy. Overall, the discovery provides a valuable new target to make resistant melanomas more vulnerable to available anti-cancer treatments. This could serve as an important step towards helping patients who are currently non-responsive to therapy.
A pledge in collaborative programmes that benefit patients
ParkinsonNet Luxembourg celebrates 5 years

At the LIH, improving outcomes and quality of life for patients is a cornerstone of our research. This requires engagement and interaction at all levels, creating networks and collaborations that link patients directly to cutting-edge knowledge and technologies, while ensuring healthcare providers are able to deliver exceptional patient-centered care.

In light of this collaborative mindset, the LIH, along with researchers, health professionals and their patients from various institutions, recently came together to celebrate 5 years of ParkinsonNet Luxembourg; a programme centered on care for patients with Parkinson’s Disease.

ParkinsonNet Luxembourg began full operations in 2018, modelled after the highly effective Dutch programme founded by Prof Dr Bas Bloem from Radboud University Nijmegen. The concept focuses on building an integrated care network for people with Parkinson’s disease (PD) at all stages. Thanks to its close link to international research, it allows its members to benefit, during their continuous training, from the latest findings and use state of the art treatments. The quality of life of people with PD is at the centre of all activities and it continually improves the exchange between the different healthcare professionals.

Research has proven the benefits of ParkinsonNet approach such as the significant lowering of disease-related complications and even the reduction of costs in the Netherlands healthcare system. As the current network perfectly matches with the national effort in establishing ‘réseaux de compétences’ there is a high interest for funding these effective treatments on a national level.

It’s fifth anniversary was celebrated on the 19th of November at the Residence of H.E. Mr. Cees Bansema. Researchers, health professionals and representatives of the Ministry of Health, Caisse Nationale de la Santé (CNS), Luxembourg National Research Fund (FNR), and research institutions from Luxembourg, including the LIH, and the Luxembourg Centre for Systems Biomedicine from the University of Luxembourg, as well as people diagnosed with Parkinson’s disease, attended the event. Achievements were shared, status and future developments of ParkinsonNet Luxembourg were discussed, and the fruitful collaboration between Luxembourg and the Netherlands in the field of Parkinson’s disease was celebrated. Mr. Bansema praised the successful partnership, noting that through the network, the strong bonds between the Netherlands and Luxembourg continue to be reinforced.

Today, ParkinsonNet Luxembourg continually strives to improve the quality of life for people with Parkinson’s. The members are fully committed to continuing medical education as an essential component to best practice for patient support, and crucial to the programme’s success. The lessons learned during ParkinsonNet Luxembourg’s implementation, will be extrapolated for planning additional integrated care networks for other chronic diseases, such as stroke, multiple sclerosis or and inflammatory bowel disease.
The SCOL study is yet another instance of the pioneering clinical efforts carried out in Luxembourg by the LIH and its partners. Indeed, Luxembourg one of the first three countries in the world to be trialing this novel levodopa delivery method, owing to our longstanding expertise in PD exemplified by joint initiatives such as the National Centre of Excellence in Research on Parkinson’s Disease” concludes Prof Rejko Krüger, principal investigator at the CHL clinical site in Luxembourg and Director of Transversal Translational Medicine (TTM) at LIH.
Deconstructing Parkinson’s cell by cell

Beating some of society’s toughest illnesses is a challenge that relies as much on novel treatments as it does on identifying risk factors and enacting effective preventative strategies. In their work on Parkinson’s Disease, researchers at the LIH are picking apart the complex web of mechanisms underlying the development and propagation of the condition. The more they can learn, the closer we come to being able to tackle this and potentially many other destructive illnesses.

The central nervous system, composed of the brain and spinal cord, is the body’s main processing centre, helping to control every aspect of the way we interpret and interact with the world around us. Such an important system requires some serious protection, a role played largely by specialist immune cells called ‘microglia’. These rapid responders account for 10-15% of all the cells found within the brain, and act as the first and main form of active immune defense against pathological stimuli such as invading viruses or bacteria.

The major drawback with microglia playing such an important role in immune response is that if they have even a small problem, such as a weakened or exaggerated response, this could upset a delicate balance, leading to the potential development and progression of neurological conditions such as Parkinson’s Disease (PD). Understanding more about the diversity of microglia in different regions of the brain could help to better inform researchers of this relationship.

In an attempt to bridge this knowledge-gap, a team led by Dr Alessandro Michelucci from the Neuro-Immunology group in the LIH’s department of Cancer Research, began investigating the diversity of microglial cells in the nigrostriatal pathway, a region of the brain that is particularly susceptible to PD. By working with mice, the researchers were able to explore differences between cells, their states and their abundancy, at the level of single cells using RNA sequencing.

Their results were published in March, where researchers discovered a highly diverse and complex population of microglia, demonstrating the wide variety of targets that may play a role in the development of PD. This work can now form a resource for future studies looking to identify specific traits of different microglia subsets, with the goal being to better define the significance of their role in PD and ultimately lead to better therapies for the disease.
Supporting Alzheimer’s disease research: IBBL develops assay to assess the quality of cerebrospinal fluid samples

The Integrated BioBank of Luxembourg (IBBL) plays a major role in the LIH’s strategy to carry out translational research and patient-centred healthcare. Samples are not only collected, processed, analysed and stored, but these stages are also researched in order to optimise sample quality and therefore results obtained. This has a profound impact on a large variety of research projects and their findings.

In August, the Biospecimen Science Research Group and the Translational Biomarker Group at IBBL researchers broke the mould, with a brand new method of assessing quality in samples of cerebrospinal fluid (CSF) to be used for Alzheimer’s research.

The team had previously observed that, when cerebrospinal fluid was stored at -20 °C for 3 months, the integrity of certain proteins was compromised. Specifically, protein cystatin C, which is involved in Alzheimer’s disease and is considered as a brain tissue biomarker in this disorder, showed a particular breakage. However, it was noted that this was not reported when CSF was stored at -80 °C.

With this in mind the teams sought to develop an immunobrassay that could be used to assess CSF quality based on the specific cleavage of the cystatin C. This eventually consisted of two assays, one to detect the amount of ‘ uncleaved’ protein, and the other to detect the total cystatin C present, thereby revealing the fraction of damaged protein present in the CSF. The test was validated in two subsequent follow-up studies, where it was shown to be effective at detecting damage to samples that had been stored at -20°C.

Using this simple, novel double assay, researchers will be able to easily and quickly confirm that their CSF biospecimens are intact and fit for the purpose of their intended research. This includes biomarker discovery and validation in the context of neurodegenerative and neuroinflammatory diseases such as multiple sclerosis and Alzheimer’s. It also provides a solid basis for the revision of CSF sample storage procedures, helping to avoid sample degradation and therefore preventing inaccurate research results that could hinder the development of new therapies for patients.
New insights into the genetic risk factors of Lewy body dementia

At the beginning of the year, the department of Transversal Translational Medicine at the LIH, demonstrated its role in the international research and healthcare community, by contributing to a major study aiming to shed light into the genetic determinants of Lewy body dementia (LBD).

LBD is a common yet understudied neurodegenerative disease characterised by progressive cognitive decline, parkinsonism and visual hallucinations. There are currently no effective treatments available to slow its progression, with therapeutic approaches being limited to mitigating the symptoms. The distinguishing feature of this disorder is the accumulation in the brain of pathologically altered forms of the protein ‘α-synuclein’ in aggregates known as Lewy bodies, which are coincidently also a hallmark of Parkinson’s disease. Moreover, most LBD patients also report neuropathological traits of Alzheimer’s disease, suggesting that LBD could be genetically related to both Parkinson’s and Alzheimer’s.

In order to confirm this hypothesis and shed light into the genetic basis of LBD, the research team performed a cutting-edge genome sequencing technique, known as whole-genome sequencing, in a large cohort of 2,981 LBD patients and 4,391 neurologically healthy controls, which also included the participants recruited within the Luxembourg study ‘National Center for Excellence in Research on Parkinson’s disease’ (NCER-PD).

The scientists thus identified five distinct genetic regions (known as loci) that influence the risk of developing LBD. Three of these loci were located within genes known to be LBD risk determinants, while the remaining two represented new LBD risk loci. Moreover, the team discovered that rare mutations in one of the genes are equally critical in LBD pathogenesis. Strikingly, all of the identified LBD risk loci are also known to be implicated in other age-related neurodegenerative disorders, including Parkinson’s and Alzheimer’s disease. From this, the researchers were able to show that LBD shares not only overlapping clinical and neuropathological features, but also common genetic molecular traits with these two major neurodegenerative diseases. In line with this result, LBD patients were also found to be at greater risk of developing both Alzheimer’s and Parkinson’s.

The large whole-genome sequence repository of both LBD patients and healthy controls, created with contributions from the Luxembourg Parkinson’s study, constitutes a valuable resource for the international scientific community. This will facilitate the understanding of molecular mechanisms across a broad spectrum of neurodegenerative diseases, thereby accelerating the development of targeted therapeutics and advancing precision medicine.
LIH scientists distinguished by research excellence awards
As a world leading scientific institution dedicated to biomedical research, it comes as no surprise that the LIH hosts some phenomenal talent within its walls. These are the researchers and staff who make it their life’s work to further our knowledge and understanding, bringing about change for those who need it most. In recognition of this, 2021 saw numerous LIH researchers in the public eye, receiving well-deserved awards for their dedication and hard work.

On Thursday 21st of October 2021, the Luxembourg National Research Fund (FNR) hosted the FNR Awards in an annual ceremony that was first introduced in 2009. Awards were presented for different categories, each to recognise the outstanding efforts of researchers and science communicators.

Among numerous applications and noteworthy projects, it was an immense accomplishment when this year, in the presence of the Luxembourg research community, the award for ‘Outstanding Scientific Achievement’ was presented to Dr Golebiewska and Prof Dr Niclou for their ground-breaking translational research in neuro-oncology.

In close cooperation with the major research institutes in Luxembourg, the NORLUX Neuro-Oncology Laboratory team has established a ‘living’ biobank of brain tumours collected from patients undergoing brain surgery in Luxembourg. From the biobank, the team have developed preclinical research models, so-called 3D tumour organoids as well as patient-derived xenografts that are able to faithfully reproduce the biological and molecular features of the original patient tumours. In addition to providing invaluable insights in brain tumour biology, these ‘patient avatars’ have a unique value in precision oncology as a drug-screening platform for preclinical and co-clinical studies. The team hopes to use them to perform large-scale personalised drug efficacy studies, thus increasing the chances of success of clinical trials and paving the way towards improved clinical outcomes for patients.

The success of the LIH researchers at the FNR Awards did not end there. Following a nomination by his peers, Dr Morande of the Tumor Stroma Interactions group was conferred the FNR Outstanding Mentor award. This award is also part of a new category that has been introduced this year, through which the FNR hopes to recognise outstanding mentorship and reward this important but sometimes unappreciated element of research. Upon bestowal, Dr Morande was commended for his great mentorship of PhD students in Luxembourg as well as for his contribution to a productive and healthy research environment in which every employee can thrive and develop to their full academic potential.
Excellent Thesis Award for Hannah Wurzer

As a research institution invested in the future, the LIH is dedicated to training the researchers of tomorrow, guiding their talent with the tools they need to excel in the field of biomedical research. As such, it is always a cause for celebration when we see this talent thrive!

Back in December, the University of Luxembourg held its annual PhD graduation Ceremony with over 150 doctoral candidates graduating from the University’s four doctoral schools in 2021. Of these, only a few were handpicked for their outstanding thesis, one being Postdoctoral Fellow Hannah Wurzer, who was conferred the Excellent Thesis Award for doctoral graduates who demonstrated excellence, originality and depth of knowledge in their thesis.

In her PhD thesis entitled “Tumour Immune Evasion is Promoted by Actin Cytoskeleton-Driven Polarization of Inhibitory Signals to the Immunological Synapse” Hannah described her investigations into how a cytoskeleton remodelling process termed “actin response” can mediate cancer cell resistance to Natural Killer (NK) cell attack. Her research showed the conservation of the resistance mechanism in different cancer types and shed light on the underlying immune evasion mechanisms.

A few months earlier, Hannah impressed the jury during her PhD defence with cutting-edge science and the confident and convincing presentation of the findings in her comprehensive PhD thesis. Hannah contributed to nine scientific articles in recognised peer-reviewed journals, of which four were published as first author. She presented her work in local and international meetings and was awarded with the “Best Poster Prize” at the European Cancer Immunotherapy Meeting (CIMT) in 2019. She also received the Marian Aldrich Award from the Think Pink Foundation Luxembourg in 2021, which supported her research work. Impressed by these outputs, the jury members encouraged Hannah to continue her career in academic research and nominated her for the “Excellent Thesis Award” of the University of Luxembourg.

After finishing her PhD student tenure at LIH as a member of the FNR PRIDE-funded doctoral research and training programme CANBIO on cancer biology, Hannah is currently finalising her research project in Dr Thomas’ group as postdoctoral researcher.
2021 Career Launchpad Award for LIH researcher

As a research institution, the core of LIH is its researchers, whose long and successful careers drive innovation and expertise that can make a difference to patients both now and in the future. Supporting these careers is therefore of the utmost importance.

In light of this, May 2021 saw the LIH proudly award Dr Martyna Szpakowska, a scientist within the Immuno-Pharmacology and Interactomics group of the Department of Infection and Immunity (DII) and the Tumor Immunotherapy and Microenvironment group of the Department of Cancer Research (DoCR), a EUR 10,000 grant under the Wolfgang Baertz Career Launchpad Award (Legs W. Baertz). The funding will allow her to further develop her work targeting tumours with an innovative antibody that has the potential to significantly advance cancer immunotherapies.

Cancer immunotherapy based on drugs known as Immune checkpoint inhibitors (ICIs) is very promising for the treatment of many advanced and aggressive cancers. ICIs act by removing the “brakes” on the immune system, unleashing an immune attack on cancer cells. However, only relatively few cancer patients show significant therapeutic benefits when treated with ICIs alone, since the efficacy of these drugs depends on the infiltration of cytotoxic immune cells into the tumour bed. Therefore, there is a strong clinical need to design combinatorial therapies that drive immune cells into poorly infiltrated tumours, thereby improving response rates and extending the use of ICI-based immunotherapies to a larger number of patients and cancer types.

DII researchers Dr Szpakowska and Dr Andy Chevigné, in collaboration with Dr Bassam Janji and Dr Muhammad Zaeem Noman from the Tumour Immunotherapy and Microenvironment (TIME) group at DoCR, had previously brought forward the potential of certain chemokine receptors, expressed on the surface of cancer cells, as valuable druggable targets, the inhibition of which was shown to increase the recruitment of immune cells into the tumour microenvironment. Specifically, the team aims to identify so-called nanobodies to block and neutralise these receptors.

The main objective of the project supported by the Award is to generate and identify nanobodies targeting specifically one of these receptors to be used in combination with classical ICI-based immunotherapy, either as a soluble protein or presented on a specific “support” developed by DII. This will ultimately help address an urgent unmet patient need in the field of immuno-oncology and will constitute an important pre-clinical step for further development of innovative combinatorial approaches for cancer treatment.
I am deeply humbled to have received such a prestigious and unique award, and from the Grand Duke himself! As scientists we always hope that our discoveries will travel beyond the labs, to make a difference in the lives of the public, the patients. Receiving this recognition, this award for our contribution to the culture of Luxembourg, is an acknowledgment that we are travelling in the right direction and making an impact that is heard far and wide,” commented Dr Bohn.

LIH scientist in the royal spotlight

Awards in the scientific community often focus solely on the development of knowledge, however it is the impact of this knowledge on the wider community where we tend to see its true value. As such, the LIH puts a strong emphasis on public facing research, putting knowledge from the hands of researchers into those of the people it is designed to help.

In a royal nod to these efforts, the Grand Duke of Luxembourg has besowed Dr Torsten Bohn, Group leader of the Nutrition and Health Research team, the esteemed title of ‘Chevalier de l’Ordre de Mérite du Grand-Duché de Luxembourg’, for his contributions to the culture of Luxembourg.

The highly prestigious title was awarded in recognition of his services and cultural contributions to Luxembourg and was presented during a ceremony that took place on the 21st of June 2021 at the Neumünster Abbey. The initial nomination came from Pierre Seck, President of the Sciences Section of the Institute Grand-Ducal, where Dr Bohn acts as a librarian and with whom Dr Bohn collaborated in a series of general outreach projects in 2017.

Dr Bohn is one of the leading experts in nutrition in Luxembourg and has recently received an accolade for making the list of most cited global scientists in the field of Agricultural Sciences (2021 edition of Clarivate’s “Highly Cited Researchers”). His research at LIH focuses on the impact of nutrition on health, with a special focus on nutrient and secondary plant bioactive bioavailability, dietary patterns, inflammation and oxidative stress. Dr Bohn is also well-known for his outreach ventures: a collaboration with the Institute Grand-Ducal, where he took part in a series of lectures to educate the general public on nutrition, as well as for his quizzes on nutrition with the Luxembourg National Research Fund (FNR): “Does diet contribute to a longer life?”
Additional 2021 highlights

More news, events, awards and nominations
I LH appoints new Director of the Department of Precision Health

Dr Guy Fagherazzi, Group Leader of the Deep Digital Phenotyping Research Unit at the LIH Department of Precision Health (DoPH), ensured the leadership of DoPH effective January 1st 2021. His appointment further deepened the integration of digital data and Artificial Intelligence (AI) within the department’s and the institute’s research activities.

The i2TRON PhD Training Programme kicks off

On February 1st, the new i2TRON (Integrating immune strategies for Translational Research in Oncology and Neurology) research and training programme for PhD candidates officially started. Its overarching goal is to develop the ability of doctoral candidates to successfully translate fundamental research findings into innovative pre-clinical and clinical applications, thereby contributing to shaping the next generation of translational researchers and to develop advanced medicine and care.

TIME group consolidates collaboration with Pharma company Sprint Bioscience

The Tumor Immunotherapy and Microenvironment (TIME) research group of the LIH Department of Cancer Research (DoCR) teamed up with Swedish Pharma company Sprint Bioscience to investigate the therapeutic benefit of small molecules inhibiting key pathways in cancer cells. The aim is to potentiate the effectiveness of immunotherapy and provide innovative and translational approaches to treating several cancers.

FNR 2020 CORE Call funds three DoCR projects

On February 25th, three LIH group leaders from the Department of Cancer Research (DoCR) were awarded a symbolic cheque by the Fondation Cancer and the Luxembourg National Research Fund (FNR) in support of their cancer research projects, in the presence of Dr Marc Schiltz, CEO of the FNR, Dr Bauer, president of the Fondation Cancer, and Ulf Nehrbass, CEO of LIH. The three studies, set to start throughout 2021, benefit from the joint support of the Fondation Cancer and the FNR through the 2020 CORE funding scheme, following a thorough evaluation by an international expert jury.
The GLASS-LUX project receives funding from the FNR and the Fondation Cancer

On February 25th, Prof Simone Niclou, Director of the LIH Department of Cancer Research (DoCR) and group leader of the NORLUX Neuro-Oncology Laboratory, was awarded an EUR 850,000 cheque by the Fondation Cancer and the Luxembourg National Research Fund (FNR) in support of the GLASS-LUX study, in the presence of Dr Marc Schiltz, CEO of the FNR, and Dr Bauer, president of the Fondation Cancer. GLASS-LUX (Glioma Longitudinal AnalySiS in Luxembourg: ex vivo and in vivo Functional Profiling of Recurrent Gliomas), which was launched in the spring for a duration of 36 months, and aims to characterise the molecular and genetic differences between primary and recurrent brain tumours, and test their differential responses to a broad selection of both novel and existing drugs. This will enable the prediction of personalised treatment options for recurrent glioma patients after the standard of care has been unsuccessful. The FNR/Fondation Cancer funding for GLASS-LUX was bestowed in parallel to two other financial commitments to two additional DoCR projects under the 2020 FNR CORE programme.

LIH Ph.D. candidates contribute to new edition of LUX:ploration comic

Several PhD candidates from the LIH Departments of Infection and Immunity (DII), Precision Health (DoPH) and Cancer Research (DoCR) contributed to “LUX:plorations”, an innovative series of catchy cartoons promoted by the Doctoral Education in Science Communication (DESCOM) project of the University of Luxembourg. The aim of the initiative? Explaining science and research to the lay public in a colourful and artistic way!

Two LIH Ph.D. scholars awarded the Pelican Grant

On February 9th, Eleftheria Charalambous and Mohaned Benzarti, doctoral candidates from the LIH Department of Infection and Immunity (DII) and the LIH Department of Cancer Research (DoCR), respectively, were awarded the 2020 Pelican Grant by the Fondation du Pélican de Mie et Pierre Hippert-Faber. The grant was to support training and mobility activities in the context of their research projects on the microbiome and on cancer metabolism.
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Predi-COVID study extended to children

Originally launched in April 2020 with the aim of identifying risk factors and biomarkers associated with COVID-19 severity in the adult population, Predi-COVID (“Luxembourg cohort of positive patients for COVID-19: a stratification study to predict severe prognosis”) was officially extended to children in March 2021. The study, coordinated by the Luxembourg Institute of Health (LIH) and carried out under the aegis of the Research Luxembourg COVID-19 Task Force, particularly benefits from the collaboration with the Centre Hospitalier de Luxembourg (CHL) for the recruitment of younger children.

APRIL

09

LIH leukaemia research further supported by Plooschter Projet donation

The Luxembourgish non-profit association Plooschter Projet renewed its financial commitment to the TSI group of the LIH Department of Cancer Research (DoCR) in support of its research on the detailed characterisation of the identity and features of cells from the tumour microenvironment in chronic lymphocytic leukaemia.

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Think Pink Lux ‘Marian Aldred Award’ awarded to LIH researchers

On April 26th 2021, Hannah Wurzer, doctoral candidate within the Cytoskeleton and Cancer Progression (CCP) group of the LIH Department of Cancer Research (DoCR), and Dr Clément Thomas, Leader of the research group, were awarded the ‘Marian Aldred Award’ by Think Pink Lux (TPL). The symbolic EUR 20,000 cheque was handed over to the two awardees during a ceremony that took place at the LIH premises in Strassen, in the presence of Mrs Carrie Cannon and Mr Laurent Vanot from the Think Pink Lux committee.
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Luxembourg and Canada researchers join forces under AUDACE programme

Following a first call for proposals in December 2020, a bilateral project involving the Human Biomonitoring Research Unit (HBRU) of the LIH Department of Precision Health (DoPH) and the University of Québec in Montréal (UQAM) was selected for funding on March 29th under the Québec-Luxembourg programme AUDACE, a joint initiative of the Luxembourg National Research Fund (FNR) and of the Quebec Research Fund (FRQ). The scheme aims to support and innovate high-impact interdisciplinary and intersectoral collaborations between Quebec and Luxembourg scientists.

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LIH cancer research supported by Schëfflenger Kriibshëllef donation

On May 20th 2021, the Luxembourgish non-profit association “Schëfflenger Kriibshëllef” made a donation to the LIH Department of Cancer Research (DoCR) to support the acquisition of new laboratory equipment for cancer research.

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Luxembourg hosts international flagship cancer epidemiology conference

From May 12th until May 14th, about 150 international scientists, clinicians, healthcare professionals and policymakers from 17 nations gathered for the 45th edition of the Group of Cancer Epidemiology and Registration in Latin Language Countries (GRELL) conference. Organised in Luxembourg for the first time by the National Cancer Registry of Luxembourg (Registre National du Cancer – RNC) at the Luxembourg Institute of Health (LIH), the meeting featured several prominent speakers, providing an opportunity to discuss the latest developments in the field of cancer epidemiology with a particular focus on COVID-19 and cancer, as well as childhood and adolescent cancers. This 2021 edition of the GRELL conference was dedicated to the memory of the late Dr Michel Untereiner, oncologist and Scientific Director of the RNC between January 2013 and March 2021. The three-day event started with an opening statement from Her Royal Highness the Grand Duchess of Luxembourg. As the honorary president of the Fondation Cancer, the Grand Duchess is deeply committed to the fight against cancer, having supported numerous Luxembourgish charities and research institutes active in this field over the years.
LIH contributes to new era of healthcare digitalisation with FNR PEARL Chair support

Digitalisation is moving forward fast in every field, including medicine. But how can digital tools be integrated into healthcare processes, and how should data be visualised to personalise patient care? These are only two of many questions that Professor Dr Jochen Klucken will analyse over the upcoming five years. Supported by a 3.3 MEUR FNR PEARL Chair, Prof Dr Klucken will develop digital health concepts for Luxembourg through a joint research programme involving the Luxembourg Centre for Systems Biomedicine (LCSB) of the University of Luxembourg, the Luxembourg Institute of Health (LIH) and the Centre Hospitalier de Luxembourg (CHL), which kicked-off in June.

The international Colive Voice study kicks off

On the 24th of June, the Luxembourg Institute of Health (LIH) announced the launch of Colive Voice, a first-of-its kind digital health study that aims to advance the diagnosis, risk prediction and remote monitoring of various chronic conditions and symptoms by evaluating voice features. Leveraging breakthrough artificial intelligence approaches, the study will collect and analyse voice recordings in several languages from both the general population and people living with chronic or infectious diseases, to identify so-called ‘vocal biomarkers’. Colive Voice is led by the Deep Digital Phenotyping research unit of the LIH Department of Precision Health (DoPH) and is set to run for up to 10 years.

Innovative up-cycling venture generates political interest

Claude Turmes, the Minister of Energy and Spatial Planning in Luxembourg, visited the LIH on June 25, 2021. As part of the guided tour, Dr Torsten Bohn of the LIH gave a short presentation on the BIOVAL project, a collaboration that aims to up-cycle the organic waste produced from the brewing of beer to create other food and chemical products.

LIH establishes the Translational Medicine Operations Hub (TMOH) to support translational medicine research

With the ultimate aim of improving patients’ lives by providing Operational Excellence, the Translational Medicine Operations Hub (TMOH) ensures a full support to clinical research from their operational planning to their execution. Launched in July, the TMOH provides the infrastructure to intra-institutional research and aims to be the single point of contact regarding research services for both internal and external stakeholders. Dr Hermann Thien, current head of IBBL, was appointed Director of TMOH. Hermann gained over 20 years of experience in the Pharmaceutical and Diagnostics Industry before joining LIH in March 2021. He will be able to guide this new structure to foster LIH’s mission: to translate excellent biomedical research into patient benefits.
ParkinsonNet Luxembourg celebrates 5 years

On the 19th of November at the Residence of H.E. Mr. Cees Bansema, Ambassador of the Kingdom of the Netherlands, ParkinsonNet Luxembourg celebrated 5 years. Modelled after the highly effective Dutch programme founded by Prof Dr Bas Bloem from Radboud University Nijmegen, the concept focuses on building an integrated care network for people with Parkinson’s disease (PD) at all stages. Thanks to its close link to international research, it allows its members to benefit, during their continuous training of the latest findings and use state of the art treatments. The quality of life of people with PD is at the centre of all activities and it continually improves the exchange between the different healthcare professionals.

LIH scientist at the forefront of European nutritional health

On July 1st 2021, Dr Torsten Bohn from the Nutrition and Health Research Group (DoPH), became part of the European Food Safety Authority (EFSA) panel for Nutrition, Novel Foods and Allergens (NDA). This highly sought-after position makes Dr Bohn one of only 16 external EFSA experts able to advise on Diet and Health decisions for the whole of Europe.

The EATRIS Luxembourg Node receives the Node Reward Framework award

In August 2021, the Luxembourg node of the European Research Infrastructure for Translational Medicine (EATRIS) network was granted the EATRIS Node Reward Framework award for its significant contribution to the efforts and impact of the European infrastructure in advancing translational medicine in 2020.

ORCHESTRA study launched

In April 2020, the CON-VINCE project was launched to capture the COVID-19 spread in Luxembourg. Now, in the footsteps of its predecessor, ORCHESTRA Luxembourg builds on this work to follow the immune response to COVID-19 vaccination over time and to provide evidence for the prevention and treatment of infections caused by SARS-CoV-2, with its official launch in September 2021.
LIH leukaemia project to be supported by “Marie Sklodowska-Curie Individual Fellowships”

Dr Pablo Elias Morande, postdoctoral fellow within the Tumor Stroma Interactions (TSI) research group at the LIH Department of Cancer Research (DoCR), was awarded financial support in the framework of the European Commission’s “Marie Sklodowska-Curie Individual Fellowships” funding scheme with an exceptional score of 99.2%. The grant will back the scientist’s work on the elucidation of some of the specific mechanisms underlying chronic lymphocytic leukaemia (CLL), thereby advancing the understanding of tumour progression and improving therapy response.

EU-funded SPIDIA4P project wins CEN/CENELEC Standards+Innovation Award

On October 5, the 2021 edition of the CEN and CENELEC Standards+Innovation Awards was held as an online event to celebrate and acknowledge the important contribution of research and innovation to standardisation.

LIH joins forces with Advanced BioDesign to improve cancer immunotherapy

In October 2021, the Tumor Immunotherapy and Microenvironment (TIME) research group of the LIH Department of Cancer Research (DoCR) teamed-up with Advanced BioDesign to develop innovative combinatorial immunotherapy approaches. The aim is to potentiate the effectiveness of immunotherapy and provide a ground-breaking approach to treat cancers.
EU-CardioRNA COST action: LIH plays leading role in international collaborative research on heart disease

The LIH is not only a privileged research partner in Luxembourg, but also worldwide as a lead institution in large-scale collaborative initiatives. One of the most recent examples is the EU-CardioRNA COST Action CA17129, established in October 2021, which aims to understand the complex role of transcriptomics in cardiovascular disease.

LIH revamps its visual identity

Since its establishment, LIH has evolved from a local pioneer in an up-and-coming health-tech scene to an internationally recognised player in a now established biomedical research environment. At the end of 2019, LIH adopted a new corporate strategy focusing on translational research and entailing several internal structural reorganisations. In light of the repositioning of our corporate strategy, the visual identity of LIH was also adapted to better reflect the new strategy and adhere to the rest of the Corporate Identity.
COVID-19 research boosted by private funding

On November 9th, the Luxembourg Institute of Health and the University of Luxembourg / LCSB, under the aegis of Research Luxembourg, welcomed the André Losch Fondation and representatives from the Luxembourg National Research Fund (FNR) to a special event dedicated to thanking both organisations for their financial support in COVID research.

Project “Young50#Stay Healthy – Cardiovascular Risk Prevention” launched in Luxembourg

YOUNG 50 is a European Commission funded project to screen and prevent cardiovascular disease (CVD) risk factors in people aged 50. The project aims to use an integrated model of assistance to help modify or reduce risk factors among healthy people, promote interventions to improve lifestyle habits, and increase knowledge and perceptions of CVD risks among the general population.

LIH contributes to international COVID-19 research

In response to the ongoing COVID-19 pandemic, the international unCoVer network plans to exploit available real-world data from numerous partners worldwide to better understand the pathophysiology, progression and treatment, as well as epidemiological pattern of this disease. With its ongoing study Predi-COVID, the Luxembourg Institute of Health added to its existing efforts to combat COVID-19 by joining the unCoVer network, contributing to creating an international, harmonised real-world data bank.
Institutional organisation and figures
The Board of Directors is nominated by the Government and is composed of nine external members of different professional backgrounds. Its mission is to oversee the activities at LIH. It is responsible for the general organisation, for defining internal rules, for budget control, for framework contracts with partner organisations and for approving new strategies.

The Executive Committee, composed of the Chief Executive Officer, the Chief Financial and Administrative Officer and the directors of the four 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. It guarantees the compliance with ethical principles, conventions and national laws.

The Coordinating Council is a consultative body composed of internal representatives of the researchers, the personal 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.
KEY FACTS 2021*

- 408 Publications**
- 16.2 Mio€ Third-party income**
- 152 New agreements signed**
- 322 Ongoing projects
- 2 Patent applications
- 8 New partnerships with a private partner

*figures as at 31st December 2021
**including IBBL
***cumulative figures as at 31st December 2021
180,303 Total samples distributed (IBBL)

431 Employees

44 Nationalities

218 Scientists

3.1 million Total samples collected and aliquots created (IBBL)

18 PhD defences

180,303 Total samples distributed (IBBL)

660 Mentions of LIH in the press (479 national and 182 international)
**IBBL collection statistics**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Samples Collected and Aliquots Created</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>685,421</td>
</tr>
<tr>
<td>2019</td>
<td>1,585,862</td>
</tr>
<tr>
<td>2020</td>
<td>2,083,094</td>
</tr>
<tr>
<td>2021</td>
<td>3,087,906</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>69,364</td>
</tr>
<tr>
<td>2019</td>
<td>88,417</td>
</tr>
<tr>
<td>2020</td>
<td>109,675</td>
</tr>
<tr>
<td>2021</td>
<td>180,303</td>
</tr>
</tbody>
</table>
SAMPLES BY TYPE

- Blood derivatives: 1,996,388
- Urine derivatives: 484,324
- Tissue derivatives: 146,547
- Nucleic acids: 83,530
- Others: 151,140
- Cells: 225,977

SAMPLES BY PROGRAMME

- Service contracts: 2,204,460
- Neurodegenerative diseases: 289,520
- Cohort: 172,269
- Diabetes: 55,297
- Cancer: 89,668
- Controls: 276,692
Human Resources

STAFF PER DEPARTMENT

<table>
<thead>
<tr>
<th>Department</th>
<th>Staff Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPARTMENT OF INFECTION AND IMMUNITY</td>
<td>85</td>
<td>20%</td>
</tr>
<tr>
<td>DEPARTMENT OF CANCER RESEARCH</td>
<td>92</td>
<td>21%</td>
</tr>
<tr>
<td>DEPARTMENT OF POPULATION HEALTH</td>
<td>64</td>
<td>15%</td>
</tr>
<tr>
<td>TRANSVERSAL TRANSLATIONAL MEDICINE</td>
<td>7</td>
<td>2%</td>
</tr>
<tr>
<td>ADMINISTRATION</td>
<td>42</td>
<td>10%</td>
</tr>
<tr>
<td>TRANSLATIONAL MEDICINE OPERATIONS HUB</td>
<td>105</td>
<td>24%</td>
</tr>
<tr>
<td>GENERAL MANAGEMENT</td>
<td>36</td>
<td>8%</td>
</tr>
<tr>
<td>TRANSVERSAL MEDICINE</td>
<td>7</td>
<td>2%</td>
</tr>
<tr>
<td>OPERATIONS HUB</td>
<td>105</td>
<td>24%</td>
</tr>
<tr>
<td>TECHNICIANS</td>
<td>218</td>
<td>50.6%</td>
</tr>
<tr>
<td>RESEARCHERS</td>
<td>107</td>
<td>24.8%</td>
</tr>
<tr>
<td>SUPPORT STAFF</td>
<td>106</td>
<td>24.6%</td>
</tr>
</tbody>
</table>

STAFF BY FUNCTION
STAFF BY GENDER

- Male: 275 (64%)
- Female: 156 (36%)

STAFF BY WORK CONTRACT TYPES

- Permanent: 280 (65%)
- Fixed-term: 145 (34%)
- External: 6 (1%)

STAFF BY NATIONALITY

- French: 137 (32%)
- Other European nationalities: 77 (18%)
- Luxembourgish: 68 (16%)
- Belgian: 57 (13%)
- German: 49 (11%)
- Non-European nationalities: 43 (10%)
### LIH

#### % SOURCES OF FUNDING
- **70.6%** Ministry of Higher Education and Research: €33,028,415
- **10.3%** Competitive Funding National: €4,809,021
- **3.8%** Competitive Funding International: €1,770,536
- **1.3%** H2020: €585,777
- **3.45%** Depreciations: €1,612,204
- **11%** LST COVID-19: €841,065
- **1.8%** Others: €579,783
- **22.24%** Other Operating Costs: €10,398,851

#### % COST CATEGORIES
- **65.35%** Staff Costs: €30,554,695
- **8.79%** Raw Materials and Consumables: €4,111,098
- **22.94%** Other Operating Costs: €10,398,851
- **0.17%** Interests and Other Financial Charges: €80,316
- **3.45%** Depreciations: €1,612,204
- **1.2%** Collaborative Funding: €5,142,566
- **1.8%** Others: €579,783

### IBBL

#### % SOURCES OF FUNDING
- **50.6%** Ministry of Higher Education and Research: €3,123,951
- **22.9%** Competitive Funding (National & International): €1,162,696
- **18.8%** Collaborative Funding: €1,162,696
- **21.57%** Other Operating Costs: €1,332,728
- **65.84%** Staff Costs: €3,162,961
- **9.37%** Depreciations: €578,582

#### % COST CATEGORIES
- **51.20%** Staff Costs: €3,162,961
- **17.87%** Raw Materials and Consumables: €1,103,760
- **22.9%** Other Operating Costs: €1,332,728
- **0.1%** Others: €1,221
<table>
<thead>
<tr>
<th>Description</th>
<th>2021</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Net turnover</td>
<td>4,107,400</td>
<td>3,441,243</td>
</tr>
<tr>
<td>2. Subsidies</td>
<td>49,258,295</td>
<td>75,933,814</td>
</tr>
<tr>
<td>3. Other income</td>
<td>111,256</td>
<td>126,953</td>
</tr>
<tr>
<td>4. Use of merchandise, raw materials and consumable materials</td>
<td>-5,214,858</td>
<td>-5,359,692</td>
</tr>
<tr>
<td>5. Other expenses</td>
<td>-11,731,579</td>
<td>-38,522,301</td>
</tr>
<tr>
<td>6. Staff costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Salaries and wages</td>
<td>-29,733,606</td>
<td>-29,230,886</td>
</tr>
<tr>
<td>b. Social security on salaries and wages</td>
<td>-3,984,051</td>
<td>-3,892,048</td>
</tr>
<tr>
<td>7. Value adjustment on intangible, tangible assets and financial assets</td>
<td>-2,253,000</td>
<td>-2,922,580</td>
</tr>
<tr>
<td>8. Value adjustment on current assets</td>
<td>62,214</td>
<td>-62,214</td>
</tr>
<tr>
<td>9. Other interest receivable and similar income</td>
<td>2,035</td>
<td>12,550</td>
</tr>
<tr>
<td>10. Interest payable and similar expenses</td>
<td>-80,316</td>
<td>-52,507</td>
</tr>
</tbody>
</table>

RESULT OF THE YEAR

<table>
<thead>
<tr>
<th></th>
<th>2021</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>543,790</td>
<td>-527,668</td>
</tr>
<tr>
<td>ASSETS (EUR)</td>
<td>2021 01.01 - 31.12.21</td>
<td>2020 01.01 - 31.12.20</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td><strong>FIXED ASSETS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intangible fixed assets</td>
<td>478,856</td>
<td>586,689</td>
</tr>
<tr>
<td>Tangible fixed assets</td>
<td>5,297,426</td>
<td>6,196,510</td>
</tr>
<tr>
<td>Financial fixed assets</td>
<td>1,380</td>
<td>1,380</td>
</tr>
<tr>
<td><strong>TOTAL FIXED ASSETS</strong></td>
<td><strong>5,777,662</strong></td>
<td><strong>6,784,579</strong></td>
</tr>
<tr>
<td><strong>CURRENT ASSETS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw materials and consumables</td>
<td>0</td>
<td>633,730</td>
</tr>
<tr>
<td>Debtors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Trade debtors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Becoming due and payable within one year</td>
<td>2,067,058</td>
<td>2,367,235</td>
</tr>
<tr>
<td>b. Becoming due and payable after more than one year</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. Other debtors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Becoming due and payable within one year</td>
<td>584,336</td>
<td>922,981</td>
</tr>
<tr>
<td>Cash at bank and in hand</td>
<td>49,607,800</td>
<td>39,664,638</td>
</tr>
<tr>
<td><strong>TOTAL CURRENT ASSETS</strong></td>
<td><strong>52,259,194</strong></td>
<td><strong>43,588,584</strong></td>
</tr>
<tr>
<td>Prepayments</td>
<td>1,083,965</td>
<td>916,057</td>
</tr>
<tr>
<td><strong>TOTAL ASSETS</strong></td>
<td><strong>59,120,821</strong></td>
<td><strong>51,289,220</strong></td>
</tr>
</tbody>
</table>
# Capital, Reserves and Liabilities (EUR)

<table>
<thead>
<tr>
<th></th>
<th>2021 01.01 - 31.12.21</th>
<th>2020 01.01 - 31.12.20</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital and Reserves</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial wealth</td>
<td>4,099,157</td>
<td>4,099,157</td>
</tr>
<tr>
<td>Reserves</td>
<td>18,469,181</td>
<td>1,486,881</td>
</tr>
<tr>
<td>Profit or loss brought forward</td>
<td>0</td>
<td>7,509,968</td>
</tr>
<tr>
<td>Profit or loss for the financial year</td>
<td>543,790</td>
<td>-527,668</td>
</tr>
<tr>
<td>Capital investment subsidies</td>
<td>5,427,337</td>
<td>7,336,688</td>
</tr>
<tr>
<td><strong>Total Capital and Reserves</strong></td>
<td><strong>28,539,465</strong></td>
<td><strong>19,905,026</strong></td>
</tr>
<tr>
<td>Available reserve for projects</td>
<td>23,894,807</td>
<td>24,101,854</td>
</tr>
<tr>
<td>Provisions for risks and charges</td>
<td>1,382,655</td>
<td>1,637,156</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Creditors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Trade creditors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Becoming due and payable within one year</td>
<td>3,050,808</td>
<td>2,402,971</td>
</tr>
<tr>
<td>b. Becoming due and payable after more than one year</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. Tax and social security debts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Tax authorities</td>
<td>9,691</td>
<td>9,720</td>
</tr>
<tr>
<td>b. Social security authorities</td>
<td>1,085,052</td>
<td>1,045,875</td>
</tr>
<tr>
<td>3. Other creditors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Becoming due and payable within one year</td>
<td>1,151,310</td>
<td>2,175,354</td>
</tr>
<tr>
<td><strong>Total Available Reserve for Projects, Provisions and Creditors</strong></td>
<td><strong>30,574,323</strong></td>
<td><strong>31,372,930</strong></td>
</tr>
<tr>
<td>Deferred income</td>
<td>7,033</td>
<td>11,264</td>
</tr>
<tr>
<td><strong>Total Capital, Reserves and Liabilities</strong></td>
<td><strong>59,120,821</strong></td>
<td><strong>51,289,220</strong></td>
</tr>
</tbody>
</table>
of the effects of a work-related allergy to seafood on the reduction of earning
SM, Mahler V, Skudlik C, Weisshaar E, Werfel T, Geier J, Diepgen TL.
approaches.
Czolk R, Klueber J, Sorensen M, Wilmes P, Codreanu-Morel F, Skov PS, Hilger C,
Gromova I, Espinoza JA, Grauslund M, Santoni-Rugiu E, Moller Talman ML, van
Gross M, Speckmann C, May A, Gajardo-Carrasco T, Wustrau K, Maier SL,
Guerrero CL, Guyonnet L, Goudot G, Revets D, Konstantinou M, Chipont A,


TRANSLATIONAL MEDICINE OPERATIONS HUB


https://www.ncbi.nlm.nih.gov/pubmed/33481069


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