

# Research for Health

Center for Molecular Medicine  
Cologne CMMC

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**Prof. Dr. med. Thomas Benzing**  
Center for Molecular Medicine Cologne

# Preface

## The Center for Molecular Medicine Cologne

The Center for Molecular Medicine Cologne (CMMC) was founded in 1994 as an innovative and interdisciplinary institute bringing researchers and clinician scientists together. Since its launch, the Center has made great strides in the expanding and exciting field of molecular medicine.

A key cornerstone of the CMMC is that it transcends the traditional borders of individual disciplines and faculties, allowing researchers and clinician scientists to join ranks and bring new synergies to basic biomedical research and clinical translation. The CMMC has therefore made it its mission to create the optimal research conditions for the best medical talents and places a strong emphasis on highly collaborative, internationally competitive top-level biomedical research.

In this capacity, the CMMC acts as an incubator for Junior Faculty by fostering new research impetus and innovation. Such an environment enables exceptional postdocs and clinician scientists to transition to junior research group leaders as a first step to professorships and other leadership positions. To support up-and-coming scientific talent, the CMMC has a comprehensive junior researcher support program that ranges from funding full junior research groups with generous budgets, to providing high-tech laboratory space in the CMMC Research Building, including the use of the CMMC's excellent research infrastructure and support services as well as access to career development mentoring and other training opportunities.

Importantly, over the years, the CMMC has served as a blueprint for the dynamic development of the Life Science Campus at the University of Cologne by establishing a collaborative spirit which has allowed for the successful funding of multiple Collaborative Research Centers (CRCs) as well as numerous collaborative research activities with CECAD-Cluster of Excellence, the Center of Integrated Oncology, as well as neighboring Max Planck Institutes – to name but a few.

Of note is that the CMMC's philosophy of interdisciplinary cooperation and team spirit as a bedrock of scientific excellence has not only resulted in major contributions to and landmark discoveries in molecular medicine, but also to international recognition of its researchers in terms of honors and awards.

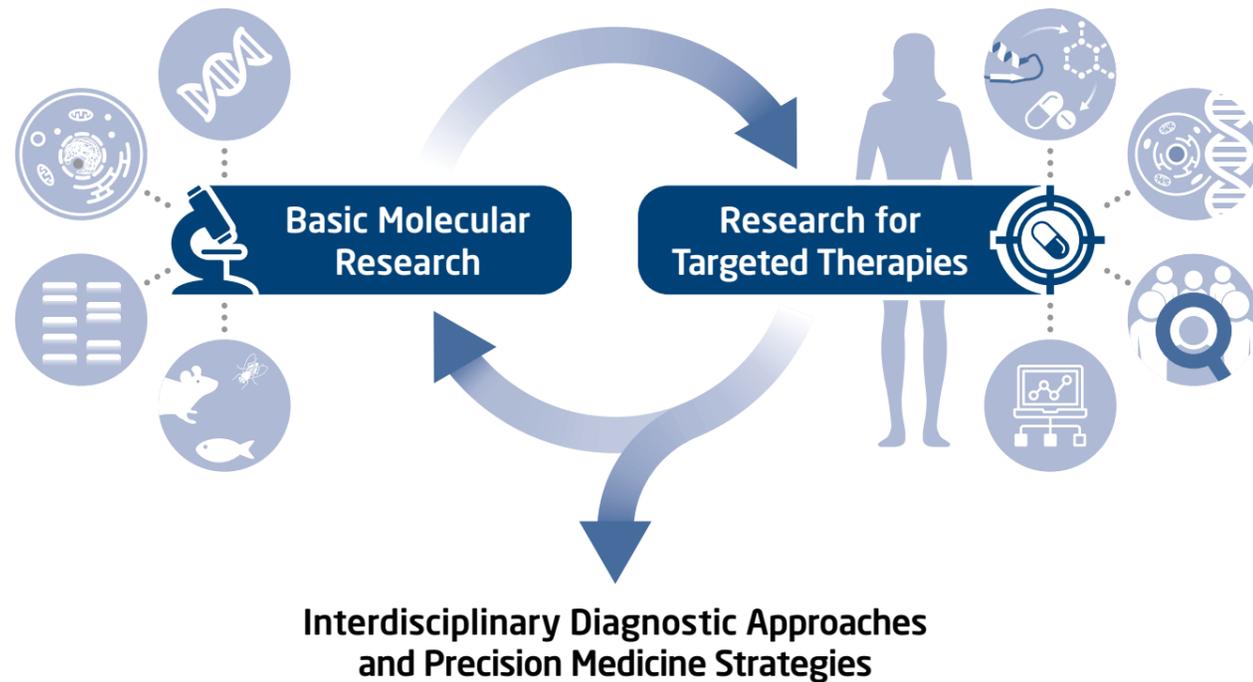
The CMMC is now entering a new phase of development that goes beyond basic biomedical research to encompass clinical translation and applications, especially with diagnostic approaches, targeted therapies, and precision medicine strategies.

We would like to thank all those who have over the years contributed to the success of the CMMC and have been a part of making it the thriving Center it is today.

Sincerely yours  
Prof. Dr. Thomas Benzing  
Chair

# Mission

## Molecular Medicine in the 21st Century



The CMMC pursues biomedical research in three key areas:

- A** Mechanisms of tumor development: intrinsic and extrinsic control of cell proliferation and tissue invasion
- B** Principles of immunity, inflammation, and infection
- C** Molecular mechanisms and metabolic control of tissue degeneration and regeneration

## The Mission of the CMMC and its Research Areas

The Center for Molecular Medicine Cologne is an interdisciplinary biomedical and educational research center embedded in the Life Science Campus at the University of Cologne. It is an innovative joint venture of the Faculty of Medicine and Faculty of Mathematics and Natural Sciences and is affiliated with the University Hospital Cologne.

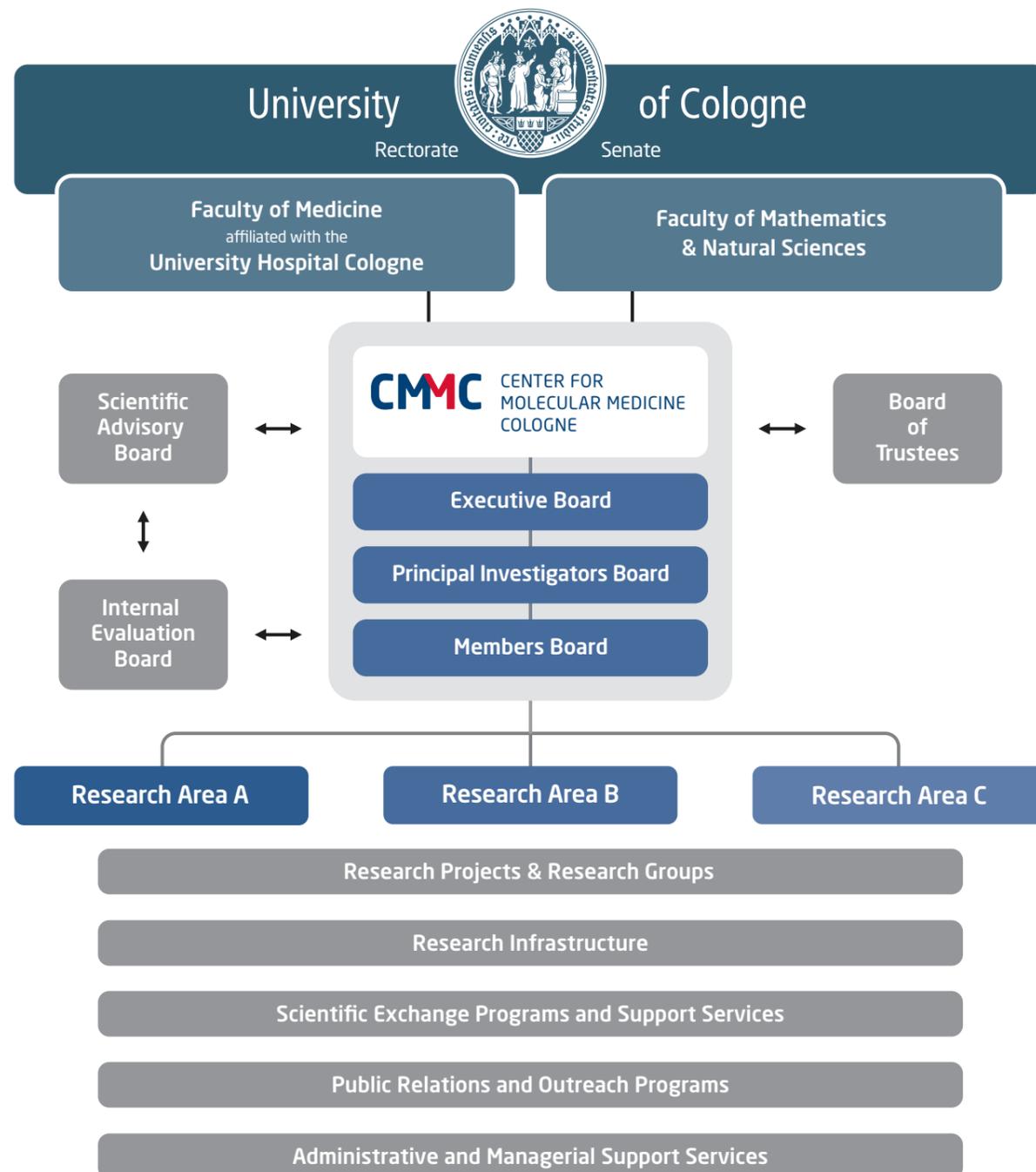
The CMMC is dedicated to advancing our current understanding of the underlying molecular and cellular mechanisms of human diseases as a prelude to clinical translational research. Our ultimate goal is to develop novel tools for prevention, diagnosis, and treatment of many common as well as rare diseases and disorders.

The first cornerstone of the CMMC was its funding support for high-risk / high-gain projects with clinical relevance. Since then, the CMMC has enlarged its funding programs to better support Junior Faculty and the training of biomedical researchers and clinician scientists of tomorrow.

## The CMMC's mission and philosophy

- to facilitate research autonomy, scientific creativity, and independence
- to provide a supportive platform to enable cutting-edge human disease-oriented biomedical research with activities that cut across disciplines and faculties
- to train researchers and clinician scientists in the field of molecular medicine in a highly collaborative approach at all stages of their career paths
- to provide optimal conditions and a vibrant environment to foster scientific interaction, dialogue, and knowledge and experience exchange within groups at the CMMC and beyond
- to provide an inclusive and diverse research environment that promotes scientific integrity, respect for others, along with interdisciplinary cooperation and team spirit
- to promote innovative public outreach activities to facilitate a better understanding of the impact and benefits of basic and translational biomedical research on society as a whole

# Organization



## Governance, Organization, and Funding

The CMMC has implemented strong governance structures to ensure a regular quality control feedback mechanism aimed at maintaining cutting-edge research and high-level education to remain at the forefront of molecular medicine research.

Due to regular external evaluation, the CMMC, the External Advisory Board, and the Board of Trustees regularly review the Center's research profile and supporting research infrastructure along with educational and mentoring activities.

In the current funding period (1/2020 – 12/2022), the CMMC receives an overall budget of over € 5 million per year, from which € 4.45 million are provided to the Faculty of Medicine by the 'Landeszuführungsbetrag' of the State of North Rhine-Westphalia which has been on a sustainable basis since 2004. In addition, the Center receives additional funding from the Faculty of Medicine, the Faculty of Mathematics and Natural Sciences, as well as the University of Cologne.

Currently, the CMMC directly supports around 65 principal investigators and additionally hosts over 30 associated principal investigators from about 20 different countries. The majority of junior principal investigators are housed at the CMMC Research Building – the so-called 'incubator for Junior Faculty' while the more senior principal investigators are located in numerous institutes and clinics at the Life Science Campus.

# Programs



The CMMC provides nine different research funding programs to support researchers and clinician scientists at different career stages from junior to senior faculty for research projects with a disease-oriented focus. Of the nine programs, the Junior Research Group Program (JRGP) and the Individual Project Funding Program (IPFP) are the two most longest-running core programs and receive around 50% and 20% of the Center's annual budget, respectively.

## Research Programs

### Interdisciplinary Program Molecular Medicine - IPMM

- joint venture of the Faculty of Medicine and Faculty of Mathematics and Natural Sciences
- aimed at postgraduate life scientists and research-oriented physicians
- provides doctoral candidates with both biomedical research and complementary skills to promote a career in the field of molecular medicine

### Brain Gain Program - BGP

- facilitates the recruitment of external excellent Junior Faculty
- provides immediate individual bridge funding support
- funding period of a maximum of 1.5 years

### Junior Research Group Program - JRGP

- funds outstanding internationally recruited junior researchers and clinician scientists
- promotes independence and provides a stepping stone for full professorships or equivalent leadership positions by providing mentoring support
- is comparable to the DFG's Emmy Noether Program and equivalent to a non-tenured assistant professorship with a funding period of 5 years (+3 years)

### Associated Junior Research Group Program - Assoc. JRGP

- supports outstanding internationally recruited junior researchers and clinician scientists with their own third-party junior research group funding
- promotes independence and provides a stepping stone for full professorships or equivalent leadership positions by providing mentoring support
- funding period correlates with third-party junior research group funding

# Research Programs



## Career Advancement Program - CAP

- supports high-potential mid-career researchers and clinician scientists at the Life Science Campus aiming for full professorships or equivalent leadership positions
- provides mentoring support
- funding period of 3 years (+ 2 years)

## Rotating Position Program - RPP

- supports clinician scientists to focus on and advance their biomedical research endeavors
- provides the possibility to integrate into up-and-running biomedical research projects
- funding period of 0.5 to 1 year

## Individual Project Funding Program - IPFP

- supports advanced researchers or clinician scientists who have demonstrated scientific excellence (e.g. publication record, third-party funding allocation)
- provides funding for facilitating the development of innovative, long-term, and high-risk / high-gain research projects
- funding period of 3 years

## Associated Research Group Program - Assoc. RGP

- aims to launch new biomedical research groups
- provides a supportive research platform
- facilitates scientific collaboration and exchange

## Senior Research Group Program - SRGP

- supports outstanding CMMC members who are now emeriti professors
- provides a supportive research platform
- provides funding for their research projects

# Infrastructure



## Research Infrastructure and Support Services

The CMMC has continually striven to improve and build on its research infrastructure along with administrative and managerial support services to enable cutting-edge biomedical research. The CMMC offers a range of joint central facilities, such as the Comparative Biology and Proteomics Facilities, as well as in-house services, including histology, microscopy, and IT support. The Life Science Campus also has additional core facilities such as imaging, metabolomics, and bioinformatics.

The decade old CMMC Research Building currently houses over 300 researchers, clinician scientists, and support staff and consists of five stories with a total floor space of 13.000 m<sup>2</sup> providing 6.000 m<sup>2</sup> of state-of-the-art laboratories. These are equipped with the latest instrumentation as well as an iPSCs & Organoid Lab, a Fly Lab, and a S3 & Isotope Lab. The Center also houses seminars rooms with modern digital presentation technology and a common recreation area to promote scientific exchange and team spirit. It also regularly hosts scientific and outreach events organized by various groups from the University of Cologne and the University Hospital Cologne.

The CMMC Office plays a central administrative and managerial role and works in close cooperation with the Deans Office of the Faculty of Medicine and the Rectorate of the University of Cologne. The CMMC Office is also responsible for internal and external communication and acts as an interface between all research groups and the different CMMC Boards and Committees.

Finally, the CMMC research groups are also supported by the Human Resources, Third Party Funding, and the IT Departments of the University Hospital Cologne as well as by the 'Regionales Rechenzentrum' and the Technological Transfer, International, and the Gender Equality & Diversity Offices of the University of Cologne.

# Exchange



## Scientific Events and Exchange

The CMMC offers a wide variety of seminars, workshops, and meetings, including the CMMC Annual Retreat and scientific symposia. All events are not only open to CMMC members, but also to others working at the Life Science Campus, thereby promoting scientific exchange and interdisciplinary cooperation.

A key highlight is the annual international Klenk Symposium in Molecular Medicine organized by the CMMC since 2005. These annual symposia bring together over 400 participants, including both Junior and Senior Faculty and other stakeholders in a forum where they keep up with the latest advances in molecular medicine and share new ideas. Every few years, the annual symposium is combined with an innovative outreach event to foster a better understanding of the benefits of basic and translational biomedical research among the general public.

Finally, the CMMC invites national and international biotech and pharma companies to present their latest technologies and products to better fostering interaction between scientists and industrial partners. In addition, the CMMC is a member of the BioRiver - Life Science im Rheinland organization, which promotes biotech and life science start-ups and industry in the region. The CMMC also has a long-standing partnership with the Cologne Convention Office to highlight the City of Cologne as one of the largest and most innovative science regions in Europe.

# Outreach

## Public Relations and Outreach Programs

The CMMC recognizes the importance to generate interest and excitement in basic biomedical and translational research. To this end, the Center is actively involved in numerous innovative outreach activities ranging from school students to senior citizens.

For example, the CMMC participates in the 'Kölner Kinder und Junior Universität' as well as Boys and Girls Day. It also provides lab visits for older students and hosts information days for school classes. The Center specifically aims to encourage young people from a non-academic background to take an interest in science and apply to higher education.

Another highlight of the Center's outreach activities is the Project 'Die Sonne und Wir'. This innovative educational outreach project is aimed at children, young adults, teaching staff, and parents, to increase their awareness towards ultraviolet radiation of the sun as a primary preventive strategy to decrease skin cancer rates. Since 2015, this project is a partner in the nationwide skin cancer prevention campaign CLEVER IN SONNE UND SCHATTEN initiated and supported by the Deutsche Krebshilfe among others.

Finally, the CMMC also provides outreach activities for a diverse range of stakeholders, including local companies and public services, who express an interest in the activities of the Center.

# Development

(1994-2020)



## Research Development and Activities

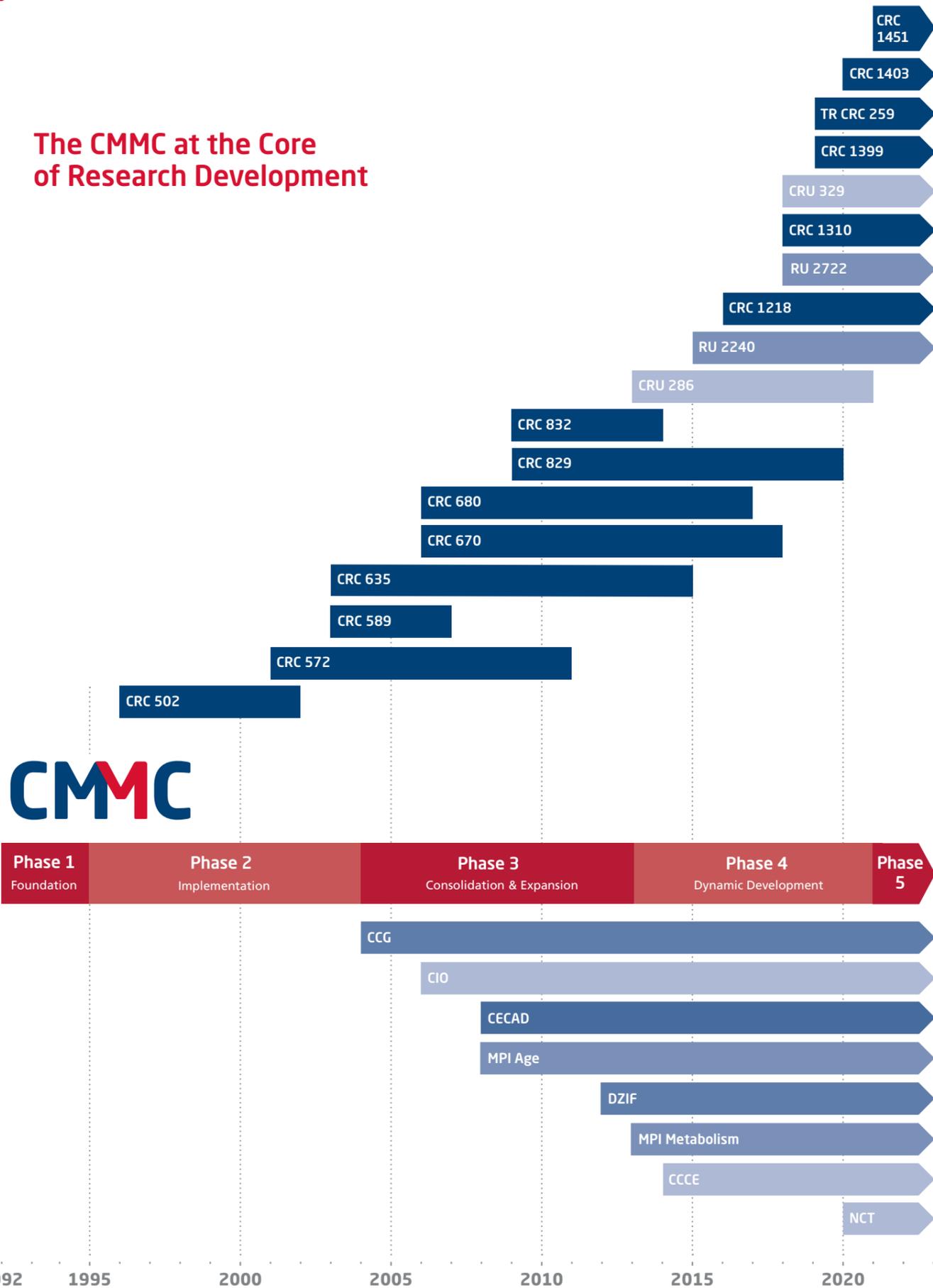
Since its foundation in 1994, the CMMC has been solving health problems by bringing together researchers and clinician scientists. At the end of Phase 2 'Implementation' in 2003, the Federal Ministry of Education and Research (BMBF) acknowledged the successful launch of the CMMC which has since become a world-class biomedical research center.

Since then, the CMMC has markedly helped to foster further development of biomedical research in Cologne as evidenced by the allocation of 18 Collaborative Research Centers (13 CRCs and 1 TR-CRC), 2 Clinical Research Units (CRUs), and 2 Research Units (RUs), of which 14 were or are being led by CMMC members, in addition to participation of CMMC members as project leaders.

The CMMC has also played a pivotal role in initiating and supporting key structural as well as strategic scientific developments at the Life Science Campus at the University of Cologne. For example, the Center was the driving force in establishing of the Cologne Center for Genomics (CCG) and IPMM Program based on the interfaculty concept that integrates the Faculty of Medicine and the Faculty of Mathematics and Natural Sciences. In addition, it has fostered the further development of biomedical research in Cologne, for example the establishment of the Center for Integrated Oncology (CIO), CECAD - Cluster of Excellence, and the Max Planck Institute for Biology of Ageing – thereby adding further critical mass and research momentum to the biomedical activities at the University of Cologne.

The opening of the CMMC Research Building in 2008 ushered in a new era of construction activities at the Life Science Campus that have contributed and will continue to further provide state-of-the-art-research laboratories as well as research infrastructure, including the Center for Translational Research for Infection and Oncology (TRIO) and the Center for Metabolism Research.

## The CMMC at the Core of Research Development



Collaborative Research Centers (CRCs) and Transregional Collaborative Research Centers (TR CRCs)			
CRC 1451	<b>Key mechanism of motor control in health and disease</b> Faculty of Medicine   since 2021	CRC 829	<b>Molecular mechanisms regulating skin homeostasis</b> Faculty of Medicine   2009-2020
CRC 1403	<b>Cell death in immunity, inflammation and disease</b> Faculty of Mathematics & Natural Sciences   since 2020	CRC 680	<b>Molecular basis of evolutionary innovations</b> Faculty of Mathematics & Natural Sciences   2006-2017
TR CRC 259	<b>Aortic diseases</b> Universities Bonn, Cologne & Düsseldorf I since 2019	CRC 670	<b>Cell-autonomous immunity</b> Faculty of Medicine   2006-2018
CRC 1399	<b>Mechanisms of drug sensitivity and resistance in small cell bronchial carcinoma</b> Faculty of Medicine I since 2019	CRC 635	<b>Posttranslational control of protein function</b> Faculty of Mathematics & Natural Sciences   2003-2015
CRC 1310	<b>Predictability in evolution</b> Faculty of Mathematics & Natural Sciences   since 2018	CRC 589	<b>Molecular basis of structural and functional barriers in the skin</b> Faculty of Medicine   2003-2007
CRC 1218	<b>Mitochondrial regulation of cellular function</b> Faculty of Mathematics & Natural Sciences   since 2016	CRC 572	<b>Commitment of cell arrays and cell type specification</b> Faculty of Mathematics & Natural Sciences   2001-2011
CRC 832	<b>Molecular basis and modulation of cellular interaction in the tumor microenvironment</b> Faculty of Medicine I 2009-2014	CRC 502	<b>Molecular aspects of pathogenesis, diagnostics and therapy of morbus hodgkin and related diseases</b> Faculty of Medicine   1996-2002

Clinical Research Units (CRUs) & Research Units (RUs)			
CRU 329	<b>Disease pathways in podocyte injury - from molecular mechanisms to individualized treatment options</b> Faculty of Medicine   since 2018	RU 2240	<b>(Lymph)Angiogenesis and cellular immunity in the inflammatory disease of the eye</b> Medical Faculty   since 2015
RU 2722	<b>Novel molecular for musculoskeletal extracellular matrix homeostasis - a systematic approach</b> Faculty of Medicine   since 2018	CRU 286	<b>Exploiting defects in the DNA damage response for the development of novel, targeted CLL therapy</b> Faculty of Medicine   2013-2021

Research Centers			
CCG	<b>Cologne Center for Genomics</b> Faculty of Medicine & Faculty of Mathematics and Natural Sciences   founded in 2004 & opening of the CCG building in 2010	DZIF	<b>German Center for Infection Research, partner site Bonn-Cologne</b> Founded by Federal Ministry of Education and Research (BMBF) in 2012
CIO	<b>Center for Integrated Oncology Aachen - Bonn - Cologne - Düsseldorf</b> Faculty of Medicine & University Hospital I founded in 2006, supported by the German Cancer Aid & opening of the CIO building in 2018	MPI Metabolism	<b>Max Planck Institute for Metabolism Research</b> Founded by the Max Planck Society in 2014 & opening of the renovated MPI building in 2010
CECAD	<b>Cologne Excellence Cluster on Cellular Stress Responses in Aging-Associated Diseases</b> Faculty of Medicine & Faculty of Mathematics and Natural Sciences   founded in 2007 & opening of the CECAD building in 2013	CCCE	<b>Cancer Research Center Cologne Essen</b> Faculty of Medicine & University Hospital   founded in 2018 & supported by the Federal Minister for Culture and Science of the State North Rhine-Westphalia
MPI Age	<b>Max Planck Institute for Biology of Ageing</b> Founded by the Max Planck Society in 2008 & opening of the MPI building in 2014	NCT	<b>National Center for Tumor Diseases</b> The CCCE was selected as a NCT by the Federal Ministry of Education and Research in 2020

# Research

## Research

The mission of the CMMC is to advance knowledge in the molecular mechanisms underlying human disease by generating unique opportunities for interactions across disciplines and across faculties. By combining rigorous scientific research and the excitement of discovery with the support of an interactive environment and state-of-the-art core facilities our researchers and clinician scientists have made landmark discoveries which provided profound insights into the pathomechanisms of diseases. Our scientists also translated this new knowledge to develop novel therapeutic concepts and new strategies to improve human health.

From 1995 to 2021, CMMC members published over 3300 original peer-reviewed papers, 1700 publications published in only the last seven years. About 300 publications appeared in double-digit impact factor journals. The leadership of CMMC investigators was recognized with numerous prizes and awards.

The following paragraphs summarize some of the research activities of the three research areas. For complete and detailed information, please visit the CMMC Research Projects:



<https://www.cmmc-uni-koeln.de/research/research-areas-projects>

### **Mechanisms of tumor development: intrinsic and extrinsic control of cell proliferation and tissue invasion**

# A

The CMMC provides a hub for basic and mechanistic cancer research with an immediate impact on translation and improved patient therapies. Researchers from the CMMC successfully developed novel therapies and diagnostic approaches for Lung Cancers, Chronic Lymphocytic Leukemia, Pediatric Cancers and HPV-associated Head and Neck Cancers. Understanding mechanistically oncogenic drivers, clonal evolution, cell growth and cell death signaling as well as interactions with the adaptive and innate immune system led to precision therapies with high efficacy and less systemic toxicity both for rare and common cancer entities.

Targeting B cell receptor (BCR)-associated kinases by small molecule kinase inhibitors has generated tremendous advances in the therapy of B cell malignancies, including chronic lymphocytic leukemia (CLL). Follow-

ing the introduction of these inhibitors in routine therapy, compelling evidence has emerged showing that their efficacy does not only rely on the inhibition of B cell-autonomous functions. Instead, their mechanism of action can be explained to a large extent by the modulation of distinct cell types within the lymphoid tumor microenvironment (TME). Recently the CMMC researchers have discovered an unexpected, non-CLL cell-dependent potent functional role of Lyn kinase, a central signaling component of the BCR, for the creation of a pro-malignant leukemia microenvironment. Particularly, they observed that the presence of Lyn kinase is required to maintain the leukemia-supporting capacity of both hematopoietic and non-hematopoietic cells. The ongoing research is aimed at gaining a deep understanding of the regulatory role of Lyn kinase as a potential master regulator for the TME of lymphoid malignancies. The findings will have implications on the creation of new therapeutic principles for lymphoid malignancies.

CMMC researchers have discovered the genetic determinants of tumor progression and spontaneous regression in the pediatric tumor neuroblastoma. High-risk disease is defined by activation of telomere maintenance mechanisms, while the absence of these is prerequisite for spontaneous regression of the tumor. These findings led to a mechanistic classification of clinical neuroblastoma phenotypes, and substantiates the potential value of telomere maintenance as a targetable vulnerability in cancer in general.

The first comprehensive landscape of small cell lung cancer (SCLC) was obtained by applying computational approaches to assess recurrent events in point mutations, copy numbers, and rearrangements. In particular, an almost universal bi-allelic deactivation of TP53 and RB1 in these tumors was detected and can therefore be considered as hallmark of SCLC. The study uncovers several key biological processes and identifies candidate therapeutic targets in this highly lethal form of cancer.

Long-term research interest in Human Papillomavirus (HPV)-positive Oropharyngeal Squamous Cell Carcinoma (OPSCC) resulted in the identification of p16INK4a as surrogate marker. In this entity, viral oncoprotein activity, as well as genetic and epigenetic alterations play a key role

during carcinogenesis. HPV-DNA as marker in Liquid Biopsy and Computational Pathology using Artificial Image Analysis is currently used to optimize diagnosis, treatment monitoring and early detection of recurrence during follow up in OPSCC patients.

# B

## Principles of immunity, inflammation and infection

The overarching aim of the research area is to deliver interdisciplinary research uncovering the pathogenic mechanisms of infections, of immunological and inflammatory diseases in human. The scientific discoveries are exploited to improve the diseases diagnosis and to design novel therapeutic concepts for clinical trials. Some examples are summarized below:

In the early 1990s, research activities at the CMMC on chimeric antigen receptor (CAR) T cells paved the way for immunotherapy of cancer. Subsequently, second generation CARs were developed and successfully introduced into clinical practice worldwide. By inventing several molecular modifications this research now led to the development of next generation CARs (TRUCKs) additionally armed with immune stimulatory cytokines to develop the highly efficient mediators of immunotherapy of cancer.

Long-term research activities to understand the role of cell death in human diseases led to the discovery of groundbreaking knowledge about how cell death controls inflammation and contributes to the pathogenesis of autoimmunity, colitis, psoriasis, infection and cancer. Different modes of cell death were shown to emit distinct molecules and to direct diverse tissue responses. Unleashed apoptosis or necroptosis were shown to trigger severe inflammatory destruction of barrier tissues resembling the pathology of human inflammatory diseases involving skin and intestine. Furthermore, the dynamic interconnectivity of different cell death pathways was shown to safeguard cell death as a pivotal immune response to pathogens or during the course of malignant transformation. These findings shed new light on how cell death contributes to disease pathogenesis and provide basis for the development of novel therapeutic concepts for autoimmunity, infection and cancer.



# Research

Corneal blindness is the second most common cause of blindness worldwide which is commonly treated by corneal transplantation. CMMC research activities led to the development of immunomodulatory and anti(lymph)angiogenic strategies to improve corneal graft survival and was successful in both the low-risk and the high-risk corneal transplant setting. Several of these novel concepts have been tested in phase I/II or III clinical trials, have been patented, or are already in clinical use nowadays.

Ischemia-(IHF) and chemotherapy-induced heart failure (CIHF) share similar routes of maladaptive cardiac remodeling, accompanied by deterioration of cardiomyocyte function. Research focusing on the importance of leukocytes led to the identification that leukocyte-derived heme enzyme myeloperoxidase (MPO) serves as a biomarker for the outcome of patients suffering from ischemic and cardiotoxic injury and acts as a potent propagator of fibrotic myocardial remodeling. These findings may evolve as a novel pharmacological target for secondary disease prevention after myocardial ischemia.

## **Molecular mechanisms and metabolic control of tissue degeneration and regeneration**

The main goal of this research area is to uncover the molecular and cellular mechanisms regulating tissue regeneration and to identify how disturbances result in disease processes. Some of these studies have already led to new therapeutic strategies and are in more detail described in the following paragraphs:

Chronic kidney diseases affect more than 10% of the world's population, and most cases arise from disorders of the kidney's filtration barrier. However, the molecular design and function of the filtration barrier remained elusive until recently. Spectacular advances at the CMMC clarified how the kidneys filter enormous amounts of fluid while retaining proteins in plasma. These studies pave the way to developing new treatment strategies to attack kidney disease and hypertension.

Energy sensing neurons in the brain represent key regulators of energy homeostasis and glucose metabolism. Researchers within the CMMC have successfully unraveled specific novel neuronal populations in this



# Research

regulation, have defined their neurocircuit integration as well as critical mechanisms, how disease-associated alterations in this fine-tuned regulation contribute to the development of prevalent metabolic disorders, such as obesity and type 2 diabetes mellitus, paving the ground for the development of novel therapeutics.

Major contributions were made by CMMC researchers also in the field of spinal muscular atrophy (SMA) and the development of innovative therapies. Four SMA protective modifiers were identified in humans or animal models. Based on the novel SMA protective modifier, NCALD, a combinatorial SMA therapy has been developed together with low-dose SMN-antisense oligonucleotides. The four SMA protective modifiers helped to unravel endocytosis as a major cellular pathway disturbed in SMA, but restored by these modifiers.

The elucidation of the molecular basis of molybdenum cofactor deficiency, a rare inborn error in metabolism characterized by severe and rapidly progressing neurodegeneration and early childhood death led to the development of a first therapy with cyclic pyranopterin monophosphate (cPMP), which was finally approved by the FDA in 2021.

A range of degenerative diseases in diverse tissues are linked to decreased adult stem cell function. Using skin stem cells, CMMC researchers uncovered how mechanical forces impact on cellular adhesion, and the epigenetic regulation of stem cell activation and differentiation, enabling selforganization of tissue regeneration. Age-dependent changes in the metabolic or mechanical properties of the niche decreases stem cell renewal and regenerative capacity. Together these studies provide novel concepts to booster stem cell functions in age-dependent diseases.

Seminal contributions of research activities led to the elucidation of the mechanisms by which the immune system intervenes in the healing response or its failure by identifying novel inflammatory proteases and targets. These studies have also led to the discovery of new control mechanisms for proteins of the VEGF family and contributed to the understanding of the role of VEGF proteins and their receptors in vessel formation and tissue regeneration.

# Activities



## Awards and Activities

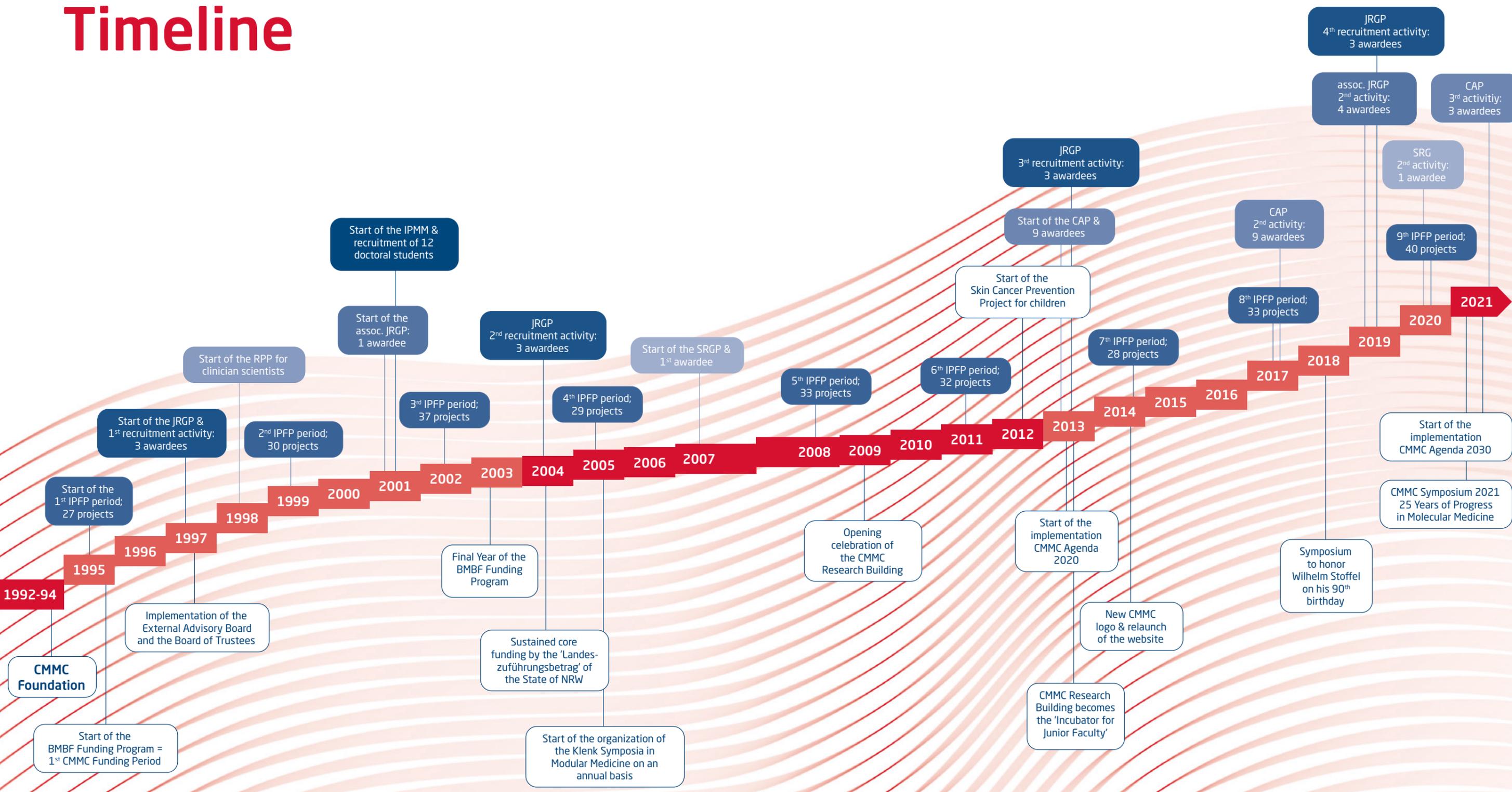
Importantly, the scientific excellence of the CMMC members has been recognized by numerous national and international prizes and awards, including the Gottfried Wilhelm Leibniz Prize of the DFG, the Ernst Jung Prize in Medicine, ERC Grant Awards, Heisenberg Fellowships, awardees of the Emmy Noether Program and the Max Eder Program, as well as the Innovation Prize North Rhine Westphalia. Finally, the quality of our Junior Faculty is demonstrated by Human Science Frontier Awards and EMBO Fellowships.

The CMMC members also belong to prestigious national and international research societies, such as American Clinical and Climatological Association (ACCA), American Society for Clinical Investigation (ASCI), EMBO, and the German National Academy of Sciences Leopoldina.

A cornerstone of the CMMC is its incubator activities for Junior Faculty to support scientific excellence. This is evidenced by the academic career development of the Junior Research Group Leaders awardees, including the associated ones as well as the CAP awardees. For example, eight out of eleven former Junior Research Group Leader and six out of nine former CAP awardees are now full or endowed professors following their CMMC support.

Finally, CMMC PIs are regularly invited as keynote speakers to leading international meetings, such as FASEB, Gordon, and EMBO conferences, as well as help organize these events, thereby further raising the international visibility of the Life Science Campus.

# Timeline



JRGP  
4<sup>th</sup> recruitment activity:  
3 awardees

assoc. JRGP  
2<sup>nd</sup> activity:  
4 awardees

CAP  
3<sup>rd</sup> activity:  
3 awardees

SRG  
2<sup>nd</sup> activity:  
1 awardee

JRGP  
3<sup>rd</sup> recruitment activity:  
3 awardees

Start of the CAP &  
9 awardees

CAP  
2<sup>nd</sup> activity:  
9 awardees

9<sup>th</sup> IPFP period;  
40 projects

Start of the IPMM &  
recruitment of 12  
doctoral students

Start of the assoc. JRGP:  
1 awardee

JRGP  
2<sup>nd</sup> recruitment activity:  
3 awardees

Start of the SRGP &  
1<sup>st</sup> awardee

Start of the RPP for  
clinician scientists

3<sup>rd</sup> IPFP period;  
37 projects

4<sup>th</sup> IPFP period;  
29 projects

5<sup>th</sup> IPFP period;  
33 projects

6<sup>th</sup> IPFP period;  
32 projects

7<sup>th</sup> IPFP period;  
28 projects

8<sup>th</sup> IPFP period;  
33 projects

Start of the JRGP &  
1<sup>st</sup> recruitment activity:  
3 awardees

2<sup>nd</sup> IPFP period;  
30 projects

Start of the  
1<sup>st</sup> IPFP period;  
27 projects

Opening  
celebration of  
the CMMC  
Research Building

Start of the  
implementation  
CMMC Agenda  
2020

New CMMC  
logo & relaunch  
of the website

Symposium  
to honor  
Wilhelm Stoffel  
on his 90<sup>th</sup>  
birthday

Start of the  
implementation  
CMMC Agenda 2030

CMMC Symposium 2021  
25 Years of Progress  
in Molecular Medicine

CMMC  
Foundation

Start of the  
BMBF Funding Program =  
1<sup>st</sup> CMMC Funding Period

Sustained core  
funding by the 'Landes-  
zuführungsbetrag' of  
the State of NRW

Start of the organization of  
the Klenk Symposia in  
Modular Medicine on an  
annual basis

CMMC Research  
Building becomes  
the 'Incubator for  
Junior Faculty'

# Outlook



## Outlook

Over the last 25 years, the life sciences have undergone transformative change due to technological advances such as deep sequencing technologies, ultrasresolution imaging, high throughput molecular analyses, and the advent of bioinformatics and systems biology.

Availability of powerful new enabling technologies that can capture the molecular makeup of individual cells in time and space and detect the emergence of disease or therapy resistance much earlier than before lead to breakthrough discoveries and a deep insight into molecular principles of disease. Collectively, these advances have significantly contributed to better diagnosis, treatment, and prevention of many common diseases and have paved the way for targeted therapies and precision medicine strategies.

The CMMC participated in these developments and has played a key role in developing the Life Science Campus in Cologne. The CMMC will continue to promote comprehensive multidisciplinary research approaches both in-house and with its partners. Cross-faculty interdisciplinary research collaborations are a central hallmark of the mission of the CMMC and will be developed further by integrating theoretical disciplines into the life sciences.

Moreover, the Center looks forward to the up-and-coming openings of new buildings such as the Center for Translational Research for Infection and Oncology (TRIO), which is directly linked to the CMMC Research Building, as well as the Center for Metabolism Research across the street. It is envisioned that the new groups starting there will generate additional research momentum and scientific exchange and collaboration.

The CMMC Symposium '25 Years of Progress in Molecular Medicine: From Basic Research to Clinical Application' (September 26 to 28, 2021) celebrates the CMMC's research achievements and symbolically marks both the CMMC's 25<sup>th</sup> anniversary and the start of the implementation of the 'CMMC Agenda 2030' which will pave the way to promote integration of theoretical and computational sciences on one hand and the consolidation of translational research on the other.



## Scientific Advisory Board

### Current Chair and Members

<b>Prof. Dr. Roland Schüle</b> since 2019 - Chair	Center for Clinical Research University of Freiburg Medical School Freiburg
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