Last update: 18.06.2019

Qualification profile

(Co)-Morbidities: From science to clinic and back

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Description of this qualification profile

How do diseases develop?
And why do patients present with comorbidities?
How do medicines fight against diseases?
How can we improve diagnosis and find novel ways of more targeted therapy?

An improvement of early diagnosis, efficient prevention and directed therapies all require a better understanding of the mechanisms that underlie the development and progression of disease. This holds for single morbidities, but also for comorbidities that are often presented by patients. And although each disease may differ from others in respect to exact pathological causes and best treatment options, specific pathological processes as inflammation, oxidative stress and fibrosis, among others, contribute to the development of many diseases. Basic insight into these pathological mechanisms and how to investigate them is thus an important first step towards the battle against single as well as (co-)morbidities.

In this QP, we will address the following questions:

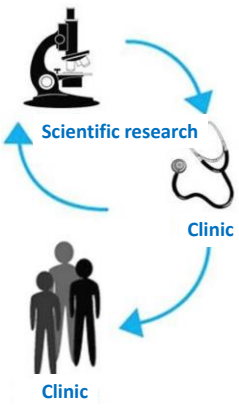
How do morbidities and comorbidities develop?
How can they be investigated?
How are research findings translated into the clinic?

The **main aims** are to provide:

- Basic insights into general pathological mechanisms of disease. This will help to better understand how (co-)morbidities develop and how current treatment strategies work. Also, these insights are absolutely required to improve current diagnosis, prevention and therapy.

- Hands-on experience in basic as well as advanced methods to investigate mechanisms of disease, identify novel pathological mediators as well as biomarkers of disease

- Insights into the translation of basic research findings into the clinic: how can basic research findings find their way into the clinic? What are current hurdles?



Understanding mechanisms of disease

Methods to investigate mechanisms of disease

Translation of research findings into the clinic

KoMORB-01
Multi-Organ diseases

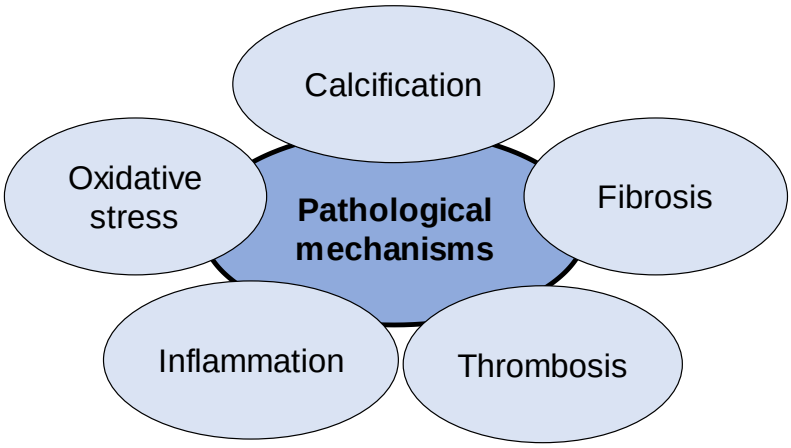
Organiser: Dr. Heidi Noels (IMCAR)

Event type: Lecture with hands-on demonstrations and practice (50% / 50%)

Lecturer (Institute/Clinic):
Dr. H. Noels, PD Dr. V. Jankowski, Dr. E. van der Vorst, Dr. S. Orth-Alampour, Dr. C. Baaten, PD Dr. med. E. Liehn, PD Dr. Koenen, Prof. Dr. J. Jankowski (IMCAR)
Dr. C. Goettsch, Prof. Dr. M. Lehrke, Dr. K. Schütt, Dr. M. Berger (MedI)
Dr. C. Kuppe (MedII)
Prof. Dr. O. Pabst (Institute of Molecular Medicine)

Content description:
Chronic diseases are often associated with damage to multiple organs. This course will discuss the complexity of multi-organ diseases and underline the clinical relevance of interdisciplinary clinical work. For example, patients with chronic kidney damage have a highly increased cardiovascular risk, which cannot be explained by classic cardiovascular risk factors. In lectures, the pathological mechanisms underlying disease and multi-organ diseases will be discussed, e.g. in relation to inflammation, oxidative stress, calcification and fibrosis.
This will be complemented with practical sessions, demonstrating modern biomedical methods to investigate pathological mechanisms. This should lay the foundation to find and successfully perform an experimental doctoral thesis. Furthermore, focus will also be on a critical discussion of data analysis, preparation and interpretation.

For further information: *hnoels@ukaachen.de*



Learning aims: The student will be able to:

- Discuss about the complexity and clinical relevance of comorbid diseases and the need of associated interdisciplinary work
- Explain the comorbid association of chronic kidney disease and cardiovascular events
- Name and explain pathomechanistic origins for comorbidities
- Describe and apply latest biomedical methods to study pathological mechanisms
- Accurately analyze data, interpret and critically discuss scientific results
- Present scientific results in a scientific report

Date and place: Block week with seminars and practical sessions in the lecture-free time (40 Uh total) – SS: second week in September
Place will be communicated to the participants

Credit points: 40 Uh => 5 CPs
Proof of performance: Attendance and participation, protocol of the practical sessions
Online selectable: yes
Requirements: Interest in medical questions
Max. number of participants (Sum of all semester): 10
Offered for semester: 4,5,6,7,8,9,10

KoMORB-02
Modern methods and approaches in cardiovascular bioanalytics: *Lecture*

Organiser: PD Dr. V. Jankowski (IMCAR)

Event type: Lecture with hands-on demonstrations and practice (50% / 50%) and seminar

Lecturer (Institute/Clinic):
Prof. Dr. J. Jankowski, PD Dr. V. Jankowski, Dr. Noels, PD Dr. med. Liehn (IMCAR)

Content description:
The module conveys an overview about essential methods in modern bioanalytics in life science with focus on cardiovascular diseases.

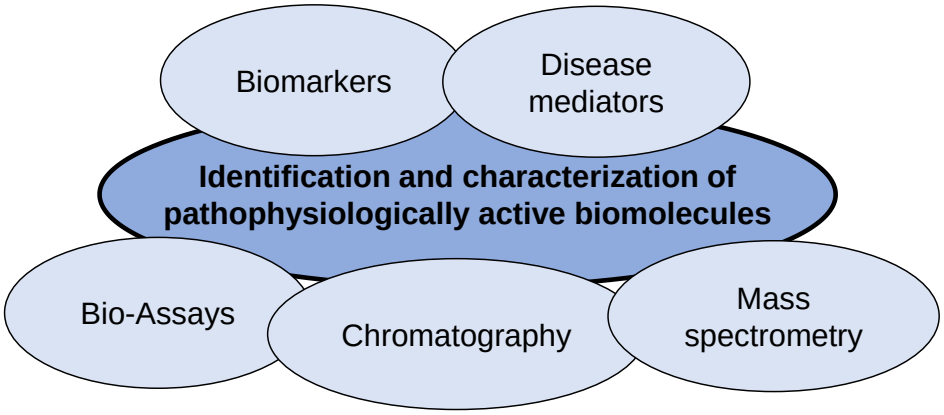
- Basic principles in *isolation of biomolecules* (Chromatography) are taught and bioassay systems in cardiovascular research are introduced, which can be used for characterization of the concerning biomolecules.
- Knowledge about modern mass spectrometric methods is provided. Especially proteomic and peptidomic techniques in cardiovascular research are discussed („*Proteomics*“, „*Peptidomics*“).
- Approaches in systems medicine are explained, performed with examples and discussed in their context of biological, biochemical and medical questions.

The lectures are complemented with practical demonstrations (~50%/50%). Thereby we intend to lay the foundation to find and successfully perform an experimental doctoral thesis.

Furthermore, in a complementary seminar session, an original paper and a review article will be presented by the students using a Powerpoint-presentation and will be discussed with the seminar participants.

At the end of this course, the participants will understand the basics of cardiovascular bioanalytics and will have gained an overview on strategies for the isolation, identification and characterization of biomolecules.

For further information: vjankowski@ukaachen.de



Learning aims: The student will be able to

- Explain strategies and basic principles of isolation, identification and characterization of biomolecules
- Explain the physico-chemical principles of bioanalytical methods (especially of chromatography and mass spectrometry)
- Recognize and explain the corresponding methods in a wider context
- Recognize and explain the importance of these methods to study cardiovascular questions
- Comprehend the content of current original literature and elaborate the key statements

Date and place: 10 sessions on Thursday, 8h45-12h (40 Uh total)
Place will be communicated to the participants

Credit points: 10 sessions, 3h each/ 4Uh = 40Uh => 5 CP
Proof of performance: Attendance, active participation and seminar presentation
Online selectable: yes
Conditions: Interest in actual medical questions, interest in chromatography and mass spectrometry
Max. number of participants (Sum of all semester): 10
Offered for semester: 5,6,7,8,9, 10

KoMORB-03
Modern methods and approaches in cardiovascular bioanalytics: Practicum

Organiser: PD Dr. V. Jankowski (IMCAR)

Event type: Practicum with presentation

Lecturer (Institute/Clinic):
PD Dr. V. Jankowski, Dr. Noels, PD Dr. med. Liehn, Prof. Dr. J. Jankowski (IMCAR)

Content description:
Building on the course "Modern methods and approaches of cardiovascular bioanalytics (KoMORB-02)", this module offers the opportunity to achieve hands-on experience in chromatography and mass spectrometry in the context of cardiovascular research, with the aim to isolate and characterize novel mediators of disease. This should lay the basis for finding an experimental doctoral thesis and successfully fulfilling it.

For further information: vjankowski@ukaachen.de

Learning aims: The student will be able to:
- Apply the methodological approaches of bioanalytical methods to medical questions in general
- Apply bioanalytical methods in the specific context of cardiovascular disease
- Design and execute experiments and apply the acquired bioanalytical competences in research
- Accurately analyze, interpret and critically discuss scientific results
- Present the results of a scientific study and summarize them in a scientific report

Date and place: 5 weeks 4Uh/week (20Uh total); Dates upon agreement.
Place will be communicated to the participants

Credit points: 2.5 CP
Proof of performance: Attendance, active participation and report
Online selectable: yes
Conditions: Interest in chromatography and mass spectrometry; successful participation in KoMORB-02
Max. number of participants (Sum of all semester): 4
Offered for semester: 6,7,8,9

KoMORB-04
Workshop Cardiovascular Methods

Organiser: PD Dr. med. Elisa Liehn (IMCAR)

Event type: Lectures + practical exercise

Lecturer (Institute/Clinic):
PD Dr. med. Liehn, Dr. med. Baleanu-Curaj, Dr. Noels, Dr. Alampour, PD Dr. Vera Jankowski, Prof. Dr. Jankowski (IMCAR)

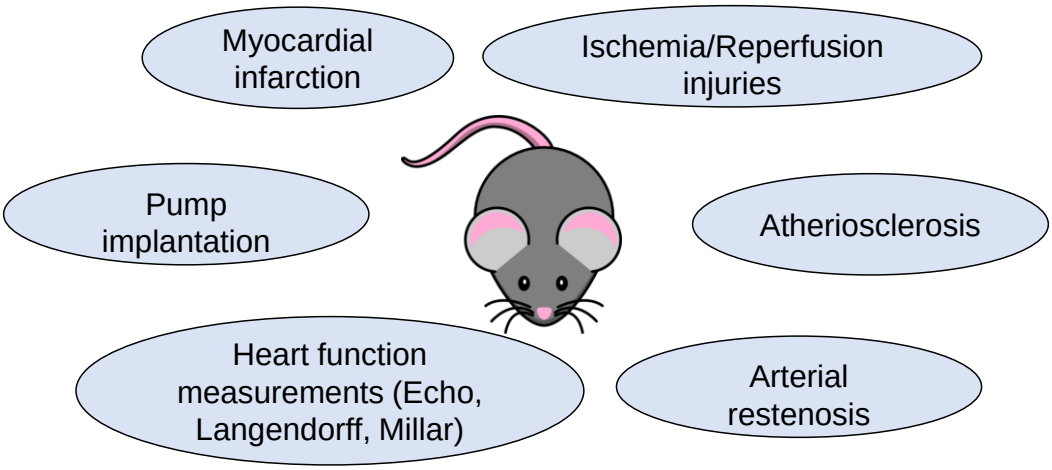
Content description:
Cardiovascular disease is the leading cause of death worldwide. Thus, studying the underlying mechanisms to find new therapeutic methods to treat cardiovascular disease is of great importance for the society. However, human studies offer only limited information on pathological mechanisms. Animal models can provide detailed insight into pathological mechanisms, but are often complex and require intensive training and expertise.

This course aims to teach the basic techniques and analysis methods of cardiovascular mouse models, preparing to pursue own experiments and to contribute to scientific advancement in the field. This course will combine seminars, video presentations and experimental work with animals in small groups.

Learning these techniques during this course will lead to a shorter learning curve of the scientists involved and to a significant reduction in the required number of animals for scientific studies, thus fulfilling the requirements of the 3R principle (Reducement, Refinement and Reduction of Animal experiment, Russell and Burch 1959).

Methods: Myocardial infarction, cell therapy and transplantation techniques in mice, heart function measurements (Echocardiography, Langendorff, Millar), arterial restenosis, ischemia/reperfusion injury, atherosclerosis, pump implantation, histological analysis

For further information: sknarren@ukaachen.de



Learning aims: The student will be able to:

- Explain the principle of Reducement, Refinement and Reduction of animal experiments
- Explain the pathology of cardiovascular disease, more specifically atherosclerosis, restenosis and myocardial infarction
- Explain basic techniques and analytical methods in cardiovascular mouse models
- Apply basic techniques and analytical methods in cardiovascular mouse models in preparation of own experimental work and a doctoral thesis, with focus on atherosclerosis and myocardial infarction

Date and place: 1 week in the lecture-free period (40 Uh)
Date and place will be communicated to the participants

Credit points: 5 CP
Proof of performance: Attendance and active participation
Online selectable: No. Email to Mrs. Knarren: sknarren@ukaachen.de
Conditions: Interest in animal-based methods and research
Max. number of participants (Sum of all semester): 6
Offered for semester: 4,5,6,7,8,9,10

KoMORB-05
Lipids in health & disease

Organiser: Dr. Heidi Noels (IMCAR)

Event type: Lectures

Lecturer (Institute/Clinic):
IMCAR (Prof. J Jankowski, PD Dr V Jankowski, Dr Noels, PD Dr med Liehn, PD Dr Koenen)
MedI (PD Dr Lehrke)
ExMI (Prof. Lammers)

Guest speakers in cooperation with IMCAR:
University Maastricht (Prof. F. Schaap, Dr. Shane Ellis, Prof. Martinez)
University Leuven (Prof. J. Swinnen)
University Hasselt (Prof. J. Hendriks)
DSM (Dr. Y. Mengerink)

Content description:
Lipids are of decisive importance for many diseases, such as cardiovascular diseases (e.g. infarctions), neuronal diseases (e.g. Alzheimer's disease) and cancer. These are the most important diseases in western societies and cause a high mortality. Lipids are also essential for the function of biomaterials and can be used in drug delivery devices. In this course we aim to describe the role of lipids in human health and disease, as well as their application in biomaterials and drug delivery systems.

1. Course Introduction

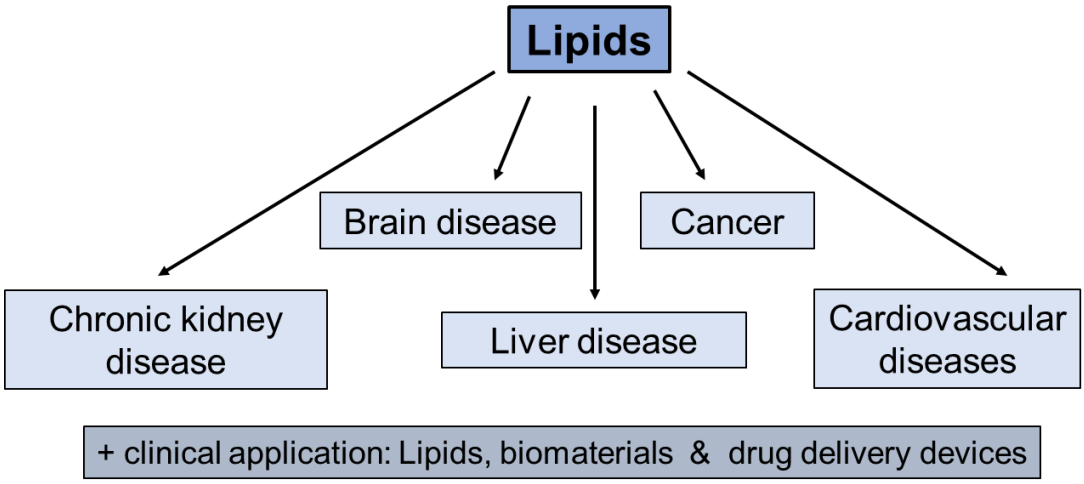
2. Biochemistry of lipids (IMCAR)

3. Lipids in health & disease – cardiovascular disease (IMCAR, MedI)
4. Lipids in health & disease – chronic kidney disease (IMCAR)
5. Lipids in health & disease – bile acids, lipids and liver disease (IMCAR/Frank Schaap, University Maastricht)
6. Lipids in health & disease – cancer (IMCAR/Johan Swinnen, University Leuven)
7. Lipids in health & disease – fatty acids & brain disease => (IMCAR/Prof. Jerome Hendriks, University Hasselt)
8. Lipids in health & disease – Structural (sphingo)lipids in neurological diseases (IMCAR/Prof. Martinez, University Maastricht)

9. Lipid fingerprinting in disease: basic principles of chromatography and mass spectrometry (IMCAR)
10. Lipid Imaging and Identification using Mass Spectrometry (IMCAR/Shane Ellis, University Maastricht)

11. Application: Lipid-based nano- and micromaterials for diagnosis and therapy (Twan Lammers, ExMI)
12. Application: Lipids & biomaterials (IMCAR/Ynze Mengerink, DSM)

Language: English!



Learning aims: The student will be able to

- Explain the biochemistry of lipids and the role of lipids in cellular processes
- Describe different lipid-mediated diseases at the molecular level
- Explain the use of lipids in diagnosis and therapy
- Explain methods of lipid analysis, with a focus on mass spectrometry
- Apply new knowledge and principles to understand molecular mechanisms of normal cellular processes and lipid-related diseases

Date and place: 12 lectures; Monday 17h15-18h45
Place will be communicated to the participants

Credit points: 3 CP

Proof of performance: Short question series at end of each lecture
Online selectable: yes
Requirement: interest in understanding mechanisms of disease
Max. number of participants (Sum of all semester): /
Offered for semester: 4,5,6,7,8,9,10