Department of Biomedicine:

1. **Group leader and supervisor:** Associate **Professor** Eugenio Gutiérrez Jiménez, eugenio@cfin.au.dk

Project Title: Effect of cardiac arrest in brain microcirculation of murine models

Description:
In this project, we aim to investigate the impact of capillary dysfunction on brain injury after cardiac arrest. We hypothesize that interventions targeting pericyte contraction and capillary flow stalling can ameliorate secondary brain injury, enhancing neurological outcomes after cardiac arrest.

2. **Group leader and supervisor:** Associate Professor Rikke Nielsen, rn@biomed.au.dk

Project Title: Kidney disease and acidosis

Description:
Patients with renal proximal tubulopathies affecting the endolysosomal system have an increased risk of acidosis, but we do not understand the connection. In this project you will contribute to understand the renal mechanisms involved in maintaining acid-base balance in renal diseases with origin in the proximal tubule. Your contribution will be to investigate protein localization of transporters, that we know are involved in acid-base regulation, by immunofluorescence microscopy.

3. **Group leader and supervisor:** Associate Professor Klaus Eyer, eyerk@biomed.au.dk

Project title: Resolving simultaneous and sequential secretion of individual polyfunctional immune cells in health and disease

Description:
In our research, we develop and apply novel technologies for functional single-cell analysis. Recently, we have developed a system that allows us to measure cytokine polyfunctionality (i.e., the secretion of multiple cytokines simultaneously or sequentially) on the single-immune cell level on a throughput of around 10-100'000 cells per experiment over time. Having now access to this novel parameter, the dynamics of polyfunctionality, we would like to study the usefulness of this parameter in defining, stratifying, and altering immune response in health and disease in this project. You will get in contact with single-cell technologies, droplet microfluidics, immunoassays, and flow cytometry during your stay in our lab.

4. **Group leader:** Associate Professor Maria Andreasen, mariaj@biomed.au.dk

Supervisor: Qian Liu

Project title: Effects of PSMα2 peptide on biofilm associated MRSA infections

Description:
The infective ability of the opportunistic pathogen methicillin-resistant Staphylococcus aureus (MRSA), is directly linked to biofilm mediated resistance to host immune response and antibiotics. The structural component of biofilms is comprised of aggregated phenol-soluble modulin (PSM) peptides and the occurrence of these renders the biofilm impossible to disassemble, and hence it also becomes impossible to treat the infection pharmacologically. Unlike the other PSM peptides PSMα2 only aggregates at extreme pH values or when cross-seeded. Using fluorescence plate-reader techniques along with biophysical techniques such as transmission electron microscopy, circular dichroism and microdiffusion the effects of PSMα2 peptide in the MRSA biofilm are studied.

5. **Group leader:** Associate Professor Maria Andreasen, mariaj@biomed.au.dk

Supervisor: Kasper Holst Hansen

Project title: Effects of heparin on biofilm associated *Pseudomonas* infections

Description:
The infective ability of opportunistic pathogens like *Pseudomonas aeruginosa*, linked to chronic lung infections, is directly related to biofilm mediated resistance to host immune response and antibiotics. The structural component of biofilms is comprised of aggregated FapC proteins and the occurrence of these renders the biofilm impossible to disassemble, and hence it also becomes impossible to treat the infection pharmacologically. FapC is capable of interacting with various other macromolecules during aggregation, including the peptidoglycan heparin and extracellular DNA. Using fluorescence plate-reader techniques along with biophysical techniques such as transmission electron microscopy, circular dichroism and microdiffusion the effects of heparin and DNA on FapC aggregation in the *Pseudomonas* biofilm are studied.

6. **Group leader and supervisor:** Associate professor Antoine de Morree, demorree@biomed.au.dk

Project title: Mechanisms of stem cell function during tissue homeostasis and regeneration

Description:
The ability of tissues to heal injuries depends on the function of adult stem cells in those tissues. With age, these adult stem cells stop working, and healing ability declines. In this project, you will contribute to ongoing research aimed at understanding how adult stem cells work. You will learn to isolate and handle adult stem cells from mouse or human muscles, assess their function in vitro and in vivo, and measure gene expression at the RNA and protein level. The end goal is for you to gain hands-on research experience and to contribute to our understanding of how adult stem cells work in health and disease.

7. **Group leader:** Professor Anders Børglum, anders@biomed.au.dk

Supervisor: Assistant professor Anna Starnawska, as@biomed.au.dk

Project title: How do pregnancy and birth complications impact child's health?

Description:
Prenatal environment has a strong impact on child's development and risk of common diseases, but the molecular mechanisms responsible for these effects are not known. Aim of this project is to investigate if pregnancy and birth complications (e.g. neonatal asphyxia, insufficient placenta, maternal preeclampsia, premature birth) cause changes in child's epigenetics. In this project you will learn about epigenetics, epigenome-wide association studies, and gain skills in bioinformatics.

8. **Group leader:** Associate professor Felicity Davis, felicity@biomed.au.dk

Daily supervisor: Postdoc Mathilde Folacci, mfolacci@biomed.au.dk

Project title: Study of the mammary basal cell network during lactation

Description:
The mammary epithelium is composed of two main cell types: the luminal cells, responsible for the production of milk, and the surrounding contractile basal cells. These cells are interdependent and form a functional network. The project will focus on characterizing the organization and the intercellular interactions between the basal cells in lactating mice mammary glands. The main techniques employed will be live tissue imaging, tissue clearing, immunostaining, and confocal microscopy.

9. **Group leader and supervisor:** Associate professor Helle Damkier, hd@biomed.au.dk

Project title: Regulation of bicarbonate transporters in the choroid plexus

Description:
The choroid plexus secretes the majority of the cerebrospinal fluid (CSF) in the brain. The pH of the CSF is tightly regulated and follows blood pH even though it contains very little protein and should not be able to. How is this possible? In this project the student will investigate the role of the bicarbonate transporters in acid/base disturbances using a choroid plexus cell line. The techniques used are cell culturing, quantitative PCR, immunoblotting and immunocytochemistry.

10. **Group leader and supervisor:** Associate professor Joanna Kalucka, Joanna.kalucka@biomed.au.dk

Project title: Mechanism driving vessel co-option in colorectal cancer tumor metastasis

Description:
The proposed project aims to investigate the mechanisms driving vessel co-option in colorectal cancer metastasis, a process where tumors co-opt existing blood vessels rather than inducing new ones. Vessel co-option has been increasingly recognized as a key factor in cancer progression and resistance to anti-angiogenic therapies. By focusing on colorectal cancer metastases, we will examine the molecular pathways and cellular interactions that facilitate this process. Understanding these mechanisms could uncover novel therapeutic targets to inhibit metastasis and improve

treatment outcomes for colorectal cancer patients. To achieve these objectives, we will employ techniques such as endothelial cell culture, CRISPR/Cas9, qPCR, Western blotting, and immunohistochemistry to characterize the endothelium and explore the role of fatty liver disease in these mechanisms.

Department of Clinical Medicine:

11. **Group leader:** Professor Diego Vidaurre, dvidaurre@cfin.au.dk

Daily supervisors: Diego Vidaurre, Nick Larsen and Janus Rønn Lind Kobbersmed

Project title: Breaking down disease labels by modelling their relation to whole-brain neuroimaging

Description:
In order to provide better and more individualised treatments and more accurate diagnoses, we need statistical tools to characterise the heterogeneity of both the causes and the symptoms of diseases. Current diagnostic labels, however, are criticized because patients often show a mixture of various (possibly interrelated) pathological diseases with overlapping symptoms. Here, we will apply advanced statistical methods to existing data sets to try to break down these labels according to differences in whole-brain network configurations between subjects.

12. **Group leader:** Associate professor Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Assistant professor Jan Stupacher, Center for Music in the Brain

Project title: Social belonging and social reward in music videos vs. music reaction videos

Description:
This research project investigates the differences in social belonging and social rewards experienced by viewers when watching traditional music videos versus music reaction videos on YouTube. While traditional music videos offer a direct artistic representation of a song, music reaction videos allow viewers to experience music through the lens of others, creating a sense of authenticity and relatability that may resonate with viewers on a social level. We will test the hypothesis that viewers experience a higher sense of social belonging and greater perceived social rewards when watching music reaction videos compared to traditional music videos. Depending on the interests and time restrictions of the research team, ratings of music videos could be collected online or ratings and physiological data (e.g. skin conductance or heart rate variability) could be collected in person. By adding to the understanding of viewer engagement and the potential of music reaction videos to enhance social interaction and community building, this research can inform various stakeholders about the importance of fostering connection and well-being through digital media.

13. **Group leader:** Associate professor Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Kira Vibe Jespersen, assoc. professor, Center for Music in the Brain

Project title: Insomnia, music and interoception

Description:
Sleep problems are highly prevalent in modern society, and many people listen to music as a strategy to facilitate sleep. In a line of projects, we investigate the neurophysiological underpinnings of insomnia and the use of music as a sleep aid. We evaluate changes in internal bodily sensations (interoception) related to insomnia, map the reasons people use music for sleep, and investigate the neurophysiological mechanisms underlying the impact of music on sleep.

14. **Group leader:** Associate professor Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Massimo Lumaca assoc. professor, Center for Music in the Brain

Project title: Connectivity in brain 'hubs' predict rhythmical musicality

Description:
Humans naturally respond to rhythms, but the ability to perceive and produce rhythms varies from person to person. This project offers you the opportunity to explore the brain mechanisms that contribute to this variability. Using a mathematical approach known as 'graph theory' applied to functional magnetic resonance imaging (fMRI) data, you will investigate how the capacity of brain networks to integrate and segregate information relates to rhythmical abilities. The student is expected to use Matlab and Python. By the end of this project, the student will have gained hands-on experience in cutting-edge neuroscience research and techniques, which might be advantageous as they progress in their medical studies and future career. More than one student is welcome to work on this project.

15. **Group leader:** Boris Kleber, assoc. professor, Center for Music in the Brain, boris.kleber@clin.au.dk

Supervisor: Anna Zamorano, assistant professor, Center for Music in the Brain

Project title: The Impact of Musculoskeletal Pain on the Central Nervous System of Professional Musicians.

Description:
Summary: This empirical bachelor project aims to explore the intricate impact of musculoskeletal pain on the established use-dependent plasticity of trained musicians—the brain's ability to adapt and reorganize neural circuits in response to repeated environmental and sensorimotor tasks. By employing neurophysiology techniques and incorporating insights from psychology, pain and music

neuroscience, this project aims to shed light on the physiological dynamics that influence pain development and motor training, providing valuable insights to optimize pain treatment strategies.

16. **Group leader:** Associate professor Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Leonardo Bonetti, assoc. professor, Center for Music in the Brain

Project title: Using linear decomposition techniques (FREQ-NESS) to derive brain networks from magnetoencephalographic (MEG) data

Description:
The brain is a dynamic system whose network organisation is often studied by focusing on specific frequency bands or anatomical regions, leading to fragmented insights, or by employing complex and elaborate methods that hinder straightforward interpretations. To address this issue, we have recently introduced a novel method called FREQuency-resolved Network Estimation via Source Separation (FREQ-NESS). This method is designed to estimate the activation and spatial configuration of simultaneous brain networks across frequencies by analysing the frequency-resolved multivariate covariance between whole-brain voxel time series. Applications of such method to neural data have returned highly relevant insights into the brain functional organisation. The aim of the current project is to learn how to use FREQ-NESS (and related tools) aiming to derive brain networks from the high-dimensional MEG data collected during a variety of tasks (e.g. resting state, auditory perception, musical memory).

17. **Group leader:** Associate professor Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Boris Kleber, assoc. professor, Center for Music in the Brain

Project title: Acoustic Signatures of Depression: Exploring Vocal Modulation in MDD Research

Description:
Recent diagnostic advancements highlight vocal acoustic features—variations in pitch, tone, and speech patterns—as promising indicators of Major Depressive Disorder (MDD). Utilizing these patterns as emerging biomarkers and capitalizing on innovations in studying the vocal expression of emotion, this project will collect high-quality data on depressed speech to identify the acoustic features most affected by depression. Using a reverse-engineering approach, we aim to explore whether altering patients' vocal tone can modulate emotional states, offering new insights into the emotional dysregulation in MDD. The project is suitable for a joint empirical BA thesis.

18. **Group leader:** Associate professor Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Boris Kleber, assoc. professor, Center for Music in the Brain

Project title: Passion for Singing: Exploring the Role of Reward in the Natural Motivation to Sing

Description:
Singing transcends cultures as a profound expression of emotion, fostering social connections and enhancing well-being, despite offering no direct biological advantage. This project seeks to understand the innate human joy in singing by investigating its mental and physical health benefits through objective measures. Specifically, you will be involved in piloting a singing paradigm that integrates cognitive neuroscience with music psychology to examine how individual differences in enjoyment of singing correlate with activity in the brain's reward system. This innovative approach aims to uncover the neurobiological underpinnings of singing as a rewarding activity, providing insights into its role in human behavior and health.

19. **Group leader:** Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Associate Professor Deirdre Cronin Fenton, PhD, dc@clin.au.dk

Project title: The impact of overweight and obesity on response to immunotherapy in cancer patients

Description:
This systematic literature review and meta-analysis will evaluate the impact of overweight/obesity compared with normal weight on response to immunotherapy in cancer patients. The primary focus is to assemble the evidence from clinical trials investigating the response to immunotherapy. The review will include all types of solid tumours, but not haematological cancer. Immunotherapy will include all types of treatment except for vaccines.

20. **Group leader:** Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Associate Professor Deirdre Cronin Fenton, PhD, dc@clin.au.dk

Project title: Factors impacting treatment adherence in breast cancer

Description:
This systematic literature review will investigate factors that influence patient adherence to endocrine therapy in breast cancer survivors. Such factors could include comorbidities, low socioeconomic position, concurrent drug use, stage of disease, etc. For this to be empirical BA, the student will need to conduct a meta-analysis.

21. **Group leader and supervisor:** Professor Vera Ehrenstein, MPH, DSc, ve@clin.au.dk

Project title: What's in a name? Topics in study design

Description:
Even experienced epidemiologists may get their study design wrong: there are multiple published

papers describing a cohort study, which is actually a cross-sectional study. Using published examples, we will prepare a commentary on this topic and submit it for publication to a peer-reviewed journal, possibly as a letter to the Editor.

22. **Group leader:** Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Professor Alma B. Pedersen, MD, PhD, DMsc, abp@clin.au.dk

Project title: The impact of mental disorders on the chronic opioid use after hip fracture

Description:
The systematic literature review and meta-analysis will evaluate the impact of common mental disorders on the continuous and chronic opioid use after hip fracture surgery.

23. **Group leader:** Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Professor Alma B. Pedersen, MD, PhD, DMsc, abp@clin.au.dk

Project title: Social inequality in chronic opioid use after hip fracture

Description:
The systematic literature review and meta-analysis will evaluate the association between socioecomic status (SES) and the continuous and chronic opioid use after hip fracture surgery. Studies using individual-level and area-based SES measures will be analysed.

24. **Group leader:** Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Professor Christian Fynbo Christiansen, MD, PhD, consultant, cfc@clin.au.dk

Project title: Temporal trends in use of lipid-lowering drugs in Denmark

Description:
Lipid-lowering drugs may be associated with acute kidney complications, but also with long-term decreased risk of kidney diseases. The aim of this project is to describe any temporal changes in the use of different types of lipid-lowering drugs during the last decades. The project will use aggregated data on prescribed medicine in Denmark.

25. **Group leader:** Professor Vera Ehrenstein, MPH, DSc, ve@clin.au.dk

Supervisor: Professor Christian Fynbo Christiansen, MD, PhD, consultant, cfc@clin.au.dk

Project title: Do treatment bundles improve the prognosis of acute kidney injury?

Description:
Acute kidney injury occurs in 20% of hospitalized patients. Consensus treatment for acute kidney injury is mainly supportive and includes a consensus-defined bundle of care including among other discontinuation of nephrotoxic drugs and appropriate fluid treatment. The aim of this project is to

conduct a systematic review and meta-analysis of studies examining the prognostic impact of AKI care bundles on the prognosis.

26. **Group leader:** Professor Vera Ehrenstein, MPH, DSc, ve@clin.au.dk

Supervisor: Clinical ProfessorPeter Jepsen, MD, PhD, DMSc, consultant, pj@clin.au.dk

Project title: Changing recommendations and reimbursements for pneumococcal vaccination to patients with cirrhosis

Description:
This study will use data on pneumococcal vaccinations administered to patients with cirrhosis and matched comparators from the general population. The research question is whether changes in the use of pneumococcal vaccination can be explained by changes in recommendations and/or reimbursement.