**Doctoral Thesis:**

**Preoperative multimodal neuroimaging-based ‘brain age’ and adverse surgical outcomes in older-aged patients**

Aging is characterised by the gradual accumulation of cellular and tissue damage, and subsequent attenuation of sensory, motor, and cognitive functions. The brain is particularly susceptible to the effects of aging, undergoing many structural and functional changes over the lifespan. There is, however, considerable interindividual variability in the rate of brain aging and disease risk, which is influenced by genetic and environmental factors. Interindividual differences in the progression of biological brain changes can be investigated through the construct of ‘brain age’. Brain age is a neuro-imaging-based biomarker created for its correlation with chronological age. An older brain age relative to chronological age is considered a sign of advanced brain aging (i.e., greater age-related changes, including the loss of brain tissue volume), and has been linked to poor health and cognitive decline. Hence, brain age may be related to the concept of frailty, conceptualised as a state of increased vulnerability resulting from a decline in physiological reserve and function across multiple organ systems, such that the ability to withstand stressors is impaired. During the perioperative period, anesthesia and surgical operations are also a kind of stress to the body. Frailty is a critical issue in modern surgical practice due to its association with adverse health events and poor post-operative outcomes.

**Hypothesis: a higher preoperative brain age relative to chronological age is related to adverse surgical outcomes such as an increased hospital length of stay following surgery in older-aged patients.**

Furthermore, identification of **electroencephalography-based correlates of brain age could provide a clinically-relevant preoperative risk assessment tool** of potential adverse surgical outcomes.

About the study:  
The study is organised by the Department of Anesthesiology at the Klinikum rechts der Isar in collaboration with the Department of Neuroradiology. We will utilise a state-of-the-art MR sequence to address our hypothesis. Data from 25 patients have already been collected. Further data collection will be conducted by a team of two students alongside their studies and the duration of the data collection phase is expected to be up to one year.   
  
Your tasks:  
**1)** **Data collection:** The student will be trained in independent MR and EEG data collection. Patient recruitment will occur 3-4 times a week between around 5-7pm. Data collection will occur either directly following recruitment in the evening prior to the patient’s surgery day or in the following morning 6-8am just prior to the patient's surgery, depending on what timeslots we can acquire at the MR scanner.

**2)** **Data analysis:** The student will be trained in relevant programming languages and MR analytical pipelines. Home office is acceptable where possible. Full support in analysis will be provided by your mentor.

**3)** **Literature research:** The students will become familiar with the relevant literature and be supported in the write-up of their thesis.  
  
What you will gain:  
1) Skills in the collection of cutting-edge neuroimaging tools  
2) Working directly with patients on a topic with real-world impact  
3) Working in an international lab with friendly people  
  
The students will be officially supervised by the Director of the Anesthesiology clinic - Univ.-Prof. Dr. Schneider - but mentored by Dr. Rachel Nuttall, post-doctoral researcher. If you are interested and/or have any questions, please reach out to [rachel.nuttall@tum.de](mailto:rachel.nuttall@tum.de) so we can arrange a zoom meeting to discuss further details.