Oslo University Hospital

13 August 2026

Dear IHPBA Research Committee,

The Kenneth Warren Fellowship has made possible something that would have been hard to arrange otherwise: a year of full-time research at Oslo University Hospital, under the supervision of Prof. Pål Dag Line along with Dr. Åsmund Avdem Fretland and Dr. Varatharajan Nainamalai, carried out in close partnership with my home unit (HPB Surgery and Liver Transplantation at Padova University Hospital, directed by Prof. Umberto Cillo). I am sincerely grateful to the Research Committee for the opportunity, and I am glad to be able to report on where the project now stands.

The project sets out to develop and validate AI-derived volumetric and radiomic biomarkers of recurrence after liver transplantation for unresectable colorectal liver metastases. Everything downstream, however, rests on a single prerequisite: the automated segmentation of hepatic lesions and vessels. The availability of annotated imaging is the real rate-limiting step for any analysis of this kind, and reliable segmentation tools are what allow the rest of the work to scale, which is why the greater part of our effort so far has gone precisely there.

Access to the Oslo-COMET and NEW-COMET imaging datasets was secured early on, and annotation of the Oslo CT cohorts is now complete. Clinical data collection is finalised for Oslo-COMET and still ongoing for NEW-COMET. In parallel, we are retrieving the CT and PET-CT studies of the corresponding patient cohort in Padova, which will serve as an external validation set; annotation of those scans is currently underway. On the computational side, the high-performance computing infrastructure in Padova has been configured to run the inference and active-learning loop of the segmentation pipeline.

Lesion segmentation is performing well, and the models discriminate viable tumour from post-treatment areas a distinction of direct clinical relevance in the follow-up of these patients. Vessels have been the harder problem. Both datasets consist of venous-phase acquisitions only, so arterial anatomy is poorly enhanced and, unsurprisingly, difficult for the models to identify. The venous systems are delineated reliably, but separating portal from hepatic venous branches remains error-prone. We are developing and testing several strategies, and the one we currently find most promising is a cascade approach, in which each completed segmentation becomes the anatomical context for the next: liver parenchyma, inferior vena cava and main portal trunk first, then the peripheral branches grown outward from these landmarks by following the vascular tree. The intention is to reproduce the sequence a human reader actually follows when interpreting hepatic vascular anatomy, rather than asking the network to solve the whole problem in one step. We expect to submit the first manuscript on this work in October.

NEW-COMET offers a further and rather unusual opportunity, three CT studies per patient: preoperative, at the end of the procedure, and at three months. This allows us to work on the co-registration of serial studies in the same patient, which will be the subject of a dedicated study and, if all goes as planned, of a public release of the annotated dataset with three CTs per patient. The same longitudinal structure may also give us a foothold for prognostic modelling of treatment outcome.

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Co-registration and segmentation are, in turn, the prerequisites for the PET-CT arm of the project, which will follow once these tools are consolidated.

The environment here has been a genuinely vibrant one, and alongside the main project I have been able to contribute to several other studies with the Padova group: an analysis of portal vein thrombosis in liver transplantation, now being refined after completion of the preliminary analysis; a study of outcomes after DBD and DCD liver transplantation in the Italian setting; a machine-learning analysis of HCC recurrence after liver transplantation, accepted as a poster at the IHPBA 2026 World Congress; and the ongoing development of a pipeline for automated data extraction and policy mining from electronic health records.

The second half of the fellowship will be devoted to consolidating the lesion and vessel segmentation models and releasing them as open-source tools, completing the Padova external validation cohort, and turning to the clinical questions at the core of the project: whether volumetric tumour dynamics during bridging therapy carry prognostic information that RECIST 1.1 misses, and how far the pipeline can be extended to PET-CT for metabolic tumour volume.

My thanks again to the Research Committee. I look forward to the World Congress in Singapore this autumn, and to presenting the completed work of this project at the 2028 Congress.

Sincerely,

Mattia Ballo