2nd Transatlantic Exchange Program focusses on Artificial Intelligence and Data Science in Oncology

Paris, France and Boston, MA -- Hundreds of attendees (on-site and virtually) joined the 2nd Transatlantic Exchange program on Friday, 5 May 2023, in Paris, France. The day-long session focused on artificial intelligence (AI) and data science in oncology.

The Masterclass presented in collaboration with Dana-Farber Cancer Institute and Gustave Roussy, with the support of L'Institut Servier, included presentations looking at the revolutionizing impact of AI and data science including how it is improving diagnosis and prognosis, easing decision-making and addressing public health needs leading to better treatment options and patients' quality of life.

The program opened by Chairs: Toni Choueiri, MD, Director, The Lank Center for Genitourinary Oncology, Medical Director of International and Strategic programs at Dana-Farber, and the Jerome and Nancy Kohlberg Chair and Professor of Medicine at Harvard Medical School; and, Karim Fizazi, MD, PhD, Professor of Medicine, Head of International Academic Network Gustave Roussy, Université Paris Saclay, Villejuif.

Summary of the sessions:

Session 1 (Moderators: Fabrice André MD, PhD and Franziska Michor, PhD):

- Deep Learning in Computational Oncology: Methods and Clinical Perspectives (Paul-Henry Cournède, PhD):

  In this talk, Dr. Paul-Henry Cournède presents his work regarding multiomics integration for precision oncology. The idea behind this concept is that molecular portraits of cancer rely on various data types (e.g. genome, transcriptome, proteome, metabolome), which characterize different and interacting biological processes. Using variational autoencoders in a hierarchical approach, Dr. Cournède shows how it is possible to leverage the different sources of information to achieve clinically relevant goals, including diagnosis, prognosis and patient stratification.

- Applications of AI in Oncology: From Screening to Treatment and Follow-Up (Jean-Emmanuel Bibault, MD, PhD):

One of the current challenges related to the use of Artificial Intelligence (AI) in clinical practice is related to the interpretability of the results generated. In this talk, Dr. Jean-Emmanuel Bibault discusses the different applications of AI in oncological practice (e.g. diagnosis, survival and treatment assessment), characterized by a high degree of interpretability. Concrete examples related to the use of AI to tailor the therapeutic plan of patients with cancer are presented, helping to illustrate this emerging concept.

- Deep Learning Methods for Medical Imaging in Precision Oncology (Maria Vakalopoulou, PhD):

  Dr. Maria Vakalopoulou discusses the use of deep learning models applied to clinical practice to optimize therapeutic decisions, with a focus on medical imaging. More specifically, Dr. Vakalopoulou presents her current work exploring pretrained models and their use on multimodal learning, including the integration of clinical attributes (into text). This approach is further complemented by the use of contrasting learning to match medical imaging with text, enhancing the explainability and boosting the performance of the model. Additionally, the concept of prompt-based learning (as opposed to pre-trained models) and its applications at the histopathological level is discussed.

- Digital Twins for Predictive Oncology (Benoît Gallix, MD, PhD):

  In this talk, Dr. Benoît Gallix presents current efforts to use tissue and organ simulation, based on high-resolution imaging data, applied to specific clinical scenarios (of which liver regeneration is one). The concept of "Digital Twins" in Medicine, and its benefits in this context are discussed, including its role in achieving more informed decision-making. Additionally, the issue of interoperability at different scales is outlined.

- AI in Imaging: Challenges and Opportunities (Valérie Paradis, MD, PhD):

  Dr. Paradis discusses the technical aspects of computational pathology and its different applications in Oncology, including the diagnosis and classification of liver lesions, the development of prognostic scores, and the prediction of mutations and clinical outcomes. The specificities of whole-slide imaging (WSI) are discussed from a computational perspective, in addition to the use of deep learning models to achieve clinically-relevant goals.

- Genomes and AI – Chromatin Organization as a Biomarker for Cancer (Caroline Uhler, PhD):

  In this talk, Dr. Uhler discussed the application of AI to high-dimensional data types, including RNA-sequencing and cellular imaging, using a methodological combination of autoencoders and optimal transport. Results related to transporting between different

modalities/perturbations are presented, exemplifying the use of such model designs to achieve a high concordance.

Session 2 (Moderators: Paul-Henry Cournède, PhD and Eliezer M Van Allen, MD):

- **KEYNOTE**: Cancer Evolution Meets Computational Oncology (Charles Swanton, MBPhD, FRCP, FMedSci, FRS):

  The Keynote Talk of the Second Transatlantic Exchanges meeting was presented by Dr. Charles Swanton, who outlined his work using computational biology to identify a pathway leading to lung cancer among non-smokers, through air pollution. The impact of PM2.5 levels on the increasing incidence of EGFR-mutant lung cancer is discussed, supported by molecular findings showing the role of air pollutants in promoting lung cancer. These include macrophage-mediated inflammation leading to reprogramming of lung cells to a more progenitor-like state and the expression of IL-1β, leading to the expansion of pre-existing mutant cells in normal tissues.

- Somatic Evolution of Human Cancer (Franziska Michor, PhD):

  In this talk, Dr. Michor discusses different perspectives regarding the use of data science to investigate translational and clinical hypotheses. She presents her research efforts characterizing the spatial intra-tumor heterogeneity in lung cancer, using cell immunofluorescence to enable cell type decomposition. Additionally, she shows how machine-learning helps to identify optimal therapeutic schedules for systemic therapies used among patients with lung cancer.

- AI-driven Multimodal Computational Pathology (Faisal Mahmood, PhD):

  Dr. Mahmood presents current research efforts using interpretable multimodal deep learning models, to achieve an accurate diagnosis of cancer types at a pan-cancer level through an integrative analysis encompassing diagnostic histologic images and molecular profile data. Furthermore, the practical implementation of this approach to diagnose accurately cancers of unknown primary is outlined, highlighting its relevance in clinical oncology.

- Towards AI-driven Immunoradiotherapy (Charlotte Robert, PhD):

  In this talk, Dr. Robert outlines the use of AI in the field of Radiation Oncology. Clinically meaningful issues are tackled, such as determinants of radiation-induced lymphopenia with an evaluation of the lymphocyte compartments, and pathology-driven definition of target volumes for radiation therapy with a translation from histopathology to imaging using dedicated algorithms and models.

- AI for Breast Cancer Screening: From Algorithms to Clinical Integration (Bill Lotter, PhD):

  Dr. Lotter presents his work on the development of an algorithm for the accurate detection of breast cancer. The development of 3D models on the basis of 2D images, helping to capture precisely suspicious anomalies in the breasts and classify them is discussed. Dr. Lotter exposes all the different steps from problem definition to clinical integration, helping to understand the requirements and challenges in regard to the design and implementation of data science driven technologies.

- AI for Cancer Symptoms Monitoring: Supporting Patient Needs and Lowering Burden (Charlotta Lindvall, MD, PhD):

  In this talk, Dr. Lindvall outlines the use of computational tools in oncological and palliative medicine, using dedicated algorithms and machine-learning models to achieve an accurate detection of patient symptoms. More specifically, Dr. Lindvall shows how various sources of information, including patient notes (i.e. text notes), can be used to identify relevant symptoms through deep natural language processing (NLP) models.

A recording of the day-long session will soon be available for viewing at institut-servier.com

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