University of Basel

Faculty of Medicine

Certificate of Advanced Studies in Personalized Molecular Oncology

Universitätsspital Basel

SIB

CHUV

CONTINUING EDUCATION

Detailed module program

Edition 6: 2026-2027

Document version 1 – 26 February 2026

CAS Personalized Molecular Oncology | 10 ECTS | Duration: approx. 10 months		
	Module title	Module coordination
Module 1	Tumor biology and genetics	CHUV Cancer Genetic
Module 2	Molecular pathology	USB Pathology
Module 3	Clinical bioinformatics	SIB Clinical Bioinformatics
Module 4	Clinical oncology	USB Oncology
Mini-thesis	Planned in small groups	Program Board

Module 1
Tumor biology & genetics

Dates

- 6, 7; 20, 21 November 2026 (~28h presential teaching).

Location

- Lausanne, CHUV University Hospital.

Main topics

- Basic cytogenetics and molecular genetics
- Introduction in hematological malignancies
- Hereditary vs. acquired genetics.
- Genetic predisposition to cancer in children and adults
- Diagnostic genetic testing
- Clinical usefulness of genomic profiling
- Genetic risk stratification of hematological neoplasia
- Clonal evolution & tumor heterogeneity in hematological malignancies
- Measurable residual disease
- Clonal hematopoiesis of indeterminate potential (CHIP)
- Cellular therapy

Learning objectives for participants

- Understand the mechanisms yielding to genetic variation, and be familiar with the various types of genetic alterations.
- Distinguish hereditary genetic anomalies from acquired genetic anomalies.
- Discuss the advantages and limitations of different genetic laboratory methodologies for diagnostic testing.
- Demonstrate how to interpret non-hotspot mutations using public databases and taking into account overall genomic aberrations and clonal evolution.
- Be aware of ethical implications of incidental genetic findings.
- Have basic knowledge of hematological neoplasia, genetic drivers and treatment options.

Prerequisites to attend the module

- Basic notions of biology.

Module coordinator

- Prof. Jacqueline Schoumans (CHUV)

Course format

- Lectures, exercises, group discussions, workshops analyzing genomic data through various bioinformatic tools in the lab.

Day 1 – Introduction to hematological and hereditary cancers in adults/children and molecular genetics

- [0h30] Welcome
  - Introduction to the CAS (Prof Dr Christian Ruiz, Unibas/ Miriam Tesfai, SIB)
  - Introduction to module 1 (Prof Jacqueline Schoumans, CHUV)
    - All participants introduce themselves and their background
    - Brief introduction of clinical utility of somatic genetic testing with overview of organization of laboratories performing genetic testing at the CHUV

- [1h15] Introduction to molecular genetics (Dr Sinthuja Pachchek, CHUV)
  - Definition of genomics (whole genome, whole exome, panel), transcriptomics, proteomics, metabolomics
  - DNA structure: chromosomes, nucleotides, genes, introns, exons, regulatory elements
  - From DNA to proteins: transcription, translation, post-translational modifications
  - Roles of proteins in cells (regulatory/signaling networks), importance of 3D structure
  - Genetic modifications
  - Definitions of allele, genotype, haplotype, phenotype
  - Types of mutations: SNVs, SNPs, insertions, deletions
  - Effect of the mutations: synonymous, non-synonymous mutations; nonsense, missense mutations; frameshifts
  - Variant nomenclature

- [0h45] The role of a genetic counsellor (Yann Lurton, CHUV)

- [2h00] Hereditary cancer in adults (Dr Benno Röthlisberger, Genetica AG, Zurich)
  - Hereditary breast cancer
  - Genetic testing
  - Genetic counseling
  - Ethical aspects

- [2h45] Hereditary cancer in children (Dr Raffaele Renella, CHUV)
  - Predisposition to cancer by inherited genomic instability
  - Patient demonstration

Day 2 – Introduction to next generation sequencing data analysis and interpretation

- [3h00] Next generation sequencing data analysis and interpretation (Trung Hiew Luu, CHUV)
  - Frequency of mutation in a tumor (VAF) and in population (MAF)
  - Impact of the mutations: variant of uncertain significance, benign variant vs. pathogenic prediction, variant databases
  - Molecular risk stratification in hematological neoplasia

- [1h15] Introduction and start of an interactive NGS data analysis workshop in Genomic variant interpretation focusing on hematological malignancies (practical exercises performed in small groups using Seqpilot software package (laptops will be provided). (Trung Hiew Luu, CHUV)

- [1h30] Interactive workshop continued

- [1h00] Discussion of results of practical exercises (Trung Hiew Luu, CHUV)

Day 3 – Cell biology and tumor genetics focusing on hematological malignancies

- [1h45] Precision medicine in hematological malignancies (Prof Sabine Blum, CHUV)
  - History of first targeted therapy (precision medicine) in chronic myeloid leukemia (CML)
  - Development of Tyrosine kinase inhibitors (TKI)
  - Acquired resistant mutations
  - Monitoring of treatment response by Minimal Residual Disease measurements (MRD

- [1h00] Clonal hematopoiesis of indeterminate potential (CHIP) and aging (Prof Jacqueline Schoumans, CHUV)
  - Clonal hematopoiesis and aging
  - (CHIP) mutations in myeloide and lymphoide neoplasia

- [1h30] Usefulness of conventional cytogenetics in hematological neoplasia (Prof Jacqueline Schoumans, CHUV)
  - Confirmation and WHO classification of disease
  - Prognostication with scoring systems and risk stratification
  - Interactive interpretive exercises with chromosome anomalies

- [2h00] Tumor genetics in the lab (Prof Jacqueline Schoumans, CHUV)
  - Hereditary cancer genetics vs. acquired genetics
  - Overview of laboratory technologies and their capabilities and limitations for detecting various types of genomic aberrations in cancer

- [0h45] Introduction to hematological neoplasia (Prof Caroline Arber, CHUV)
  - Introduction to hematopoiesis

- Classification of hematopoietic neoplasms (WHO)
- Overview of technologies needed for classification
- Overview of treatment options

- [0h45] Cellular therapies in hematologic malignancies (Prof Caroline Arber, CHUV)
  - Hematopoietic stem cell transplantation
  - Chimeric antigen receptor T cell therapies

Day 4 – Diagnostic applications of tumor genetics focusing on hematological malignancies

- [1h30] Introduction to group exercises genomic testing strategies in onco-hematology (Prof Jacqueline Schoumans, CHUV)
  - Practical exercises concerning genetic testing strategies and interpretation of results will be solved in small groups and discussed at the end of the session in the entire group

- [2h15] Practical demonstration and hand-son analysis of genetic methodologies and automation at the oncogenomic hematology laboratory, CHUV participants will be devided in 4 groups that will rotate between the different genomic units
  - Conventional karyotyping (Anne Rajakumar, CHUV)
  - FISH (Isabel Pinto, CHUV)
  - SNP-array (Kilian Buhler, CHUV)
  - NGS gene panels and complementary molecular tests (Marion Rebeaud, CHUV)

- [2h45] Practical demonstration and hand-son analysis continued

- [0h30] Summary and end of module 1, information about online exam gather in room BH18/549 (Prof Jacqueline Schoumans, CHUV)

Module 2
Molecular pathology

Dates

- 15, 16 January; 29, 30 January 2027 (~28h presential teaching).

Location

- Basel, Basel University Hospital.

Main topics

- Sample classification and preparation
- Principles of nucleic acids extraction
- Sequencing platforms and setup
- Understanding gene panels
- Internal / external quality controls
- Laboratory accreditation
- Reporting clinically relevant genomic variants
- Interpreting a molecular profile

Learning objectives for participants

- Gain knowledge about the different types of specimens (e.g. tissue biopsy, cytology, resections, blood samples).
- Get an overview about the currently used technological platforms in molecular diagnostics (comparison with the research setting).
- Get familiar with all the steps that lead from sample collection to final molecular report generation along with all possible bottlenecks.
- Algorithms for appropriate gene panel selection.
- Understand the basics (procedures and rules) of an accredited clinical laboratory, including internal and external quality controls.
- Get familiar with the most common clinically relevant variants along with their interpretation and classification system.

Prerequisites to attend the module

- Module 1 or equivalent knowledge.

Module coordinators

- PD Dr. Christian Ruiz (Unibas), PD Dr. Matthias Matter (USB)

Course format

- Lectures, exercises, group discussions and lab visit.

Day 1 – General Introduction into Pathology and Molecular Pathology

- [0h30] Welcome and Introduction to the Institute of Pathology in Basel (Prof. Dr. Matthias Matter, USB, Prof. Dr. Christian Ruiz, Unibas)
- [1h00] Introduction into general pathology: general concepts of neoplasia (Prof. Dr. Matthias Matter, USB)
- [0h30] Overview of the techniques used in molecular pathology, Part I (Prof. Dr. Matthias Matter, USB)
- [0h30] Overview of the techniques used in molecular pathology, Part II (Prof. Dr. Matthias Matter, USB)
- [0h30] Sample requirements for molecular analysis (Prof. Dr. Matthias Matter, USB)
- [2h00] Lab visits:
  - I: General pathology laboratory (60 min) (PD Dr. Thomas Menter, USB)
  - II: Molecular pathology (60 min) (Dr. Ivana Bratic, USB, Dr. Ilaria Alborelli, USB)
- [0h45] Practical/Hands-on: real-life cases of clinical pathology (Prof. Dr. Matthias Matter, USB)
- [0h30] Wrap up of the day, questions & answers (Prof. Dr. Matthias Matter, USB, Prof. Dr. Christian Ruiz, Unibas)

Day 2 – Intro into genomics/ Tumor specific molecular pathology/ Accreditation. Molecular Pathology: Analysis of different tumor types

- [1h] Laboratory Accreditation (PD Dr. Thomas Menter, USB)
- [0h45] Molecular Pathology of Hematological Disease (PD Dr. Thomas Menter, USB)
- [0h45] Introduction into Genomics & NGS (Dr. Ilaria Alborelli, USB)
- [0h30] How are variants classified? What is considered clinically significant? (Dr. Ilaria Alborelli, USB)
- [0h45] Cell-Free DNA for diagnostics (Prof. Dr. Matthias Matter, USB)
- [0h45] Guidelines for diagnostic reporting (Prof. Dr. Matthias Matter, USB)
- [0h45] Molecular Pathology in Urogenital Cancers (PD Dr. Tatjana Vlajnic, USB)
- [1h15] Practical/Hands-on: real-life cases, Part 1 (Dr. Ilaria Alborelli, USB, Dr. Ivana Bratic, USB, Valeria Perrina, USB)
- [1h00] Practical/Hands-on: real-life cases, Part 2 (Dr. Ilaria Alborelli, USB, Dr. Ivana Bratic, USB, Valeria Perrina, USB)

Day 3 – New Technologies in Molecular Pathology

- [0h45] Infectious pathology (Prof. Dr. Kirsten Mertz, USB)
- [0h45] Molecular Pathology of the Lung (PD Dr. Spasenija Savic, USB)
- [0h45] Molecular Pathology of Breast and Endometrium Carcinoma (Prof. Dr. Simone Münst, USB)
- [0h30] Molecular Pathology of Soft Tissue and Bone Tumors (Prof. Dr. Daniel Baumhoer, USB)
- [0h45] Copy Number Alterations, Homologous Recombination Deficiency and BRCAness (Prof. Dr. Tom McKee, Aurigen SA)
- [0h45] Proteomics in molecular pathology (Dr. Nikolaus Deigendesch, University of Bonn)
- [1h00] Digital Pathology (Prof. Dr. Viktor Kölzer, USB)
- [0h45] AI-based biomarkers for precision oncology (Prof. Dr. Jakob Nikolas Kather, TU Dresden) **REMOTELY**

Day 4 – Results, Data Interpretation, data usage, etc.

- [1h00] NGS panels for genomic analyses, BRCAness, TMB, genomic biomarkers (Dr. Ilaria Alborrelli, USB)
- [0h45] Organoids for Diagnostics (Dr. Clémentine Le Magnen, USB)
- [1h00] Computational Analysis (Dr. Charlotte Ng, Humanitas University, Italy)
- [1h00] Analysis of real-life cases using –omics technologies (TBC)
- [0h30] Molecular Pathology of Gastrointestinal Tumors (Colorectal Cancer, GIST) (Prof. Dr. Matthias Matter, USB, Prof. Dr. Luigi Terracciano, Unibas)
- [1h00] Methylome Analysis, Brain Tumors (Dr. Jürgen Hench, USB)
- [1h00] Nanopore Sequencing (Dr. Jürgen Hench, USB)
- [1h00] “What’s the future of digital health in healthcare? - from the lens of Roche’s 10-year journey with digital biomarkers and AI algorithms” (Feifei Wei, Roche)
- [1h00] Wrap up of the day, questions & answers (Prof. Dr. Matthias Matter, USB, Prof. Dr. Christian Ruiz, Unibas)

Module 3
Clinical bioinformatics

Dates

- 12, 13 March; 26, 27 March 2027 (~28h presential teaching).

Location

- Lausanne, University of Lausanne, campus UNIL-Sorge, building Amphipôle.

Main topics

- Data pre-processing
- Read mapping
- Variant calling
- Quality control
- Variant annotation
- Hardware, security, privacy
- Artificial intelligence (AI) basics
- AI current and future applications

Learning objectives for participants

- Communicate efficiently with bioinformaticians.
- Describe a bioinformatics analysis pipeline to call mutations from NGS data.
- Perform quality control at the run, read and variant levels.
- Use off-the-shelf bioinformatics tools to annotate and support the interpretation of variants.
- Consider hardware, security and privacy issues when managing omics data.
- Understand how artificial intelligence contributes to and will further impact personalized oncology.

Prerequisites to attend the module

- Modules 1 and 2, or equivalent knowledge.

Module coordinators

- Valérie Barbié (SIB)

Course format

- Lectures, hands-on, exercises and group discussions.

Day 1 – Computational modeling

- [0h30] Introduction and general overview (TBC)
- [1h30] Computational Cancer Pharmacogenomics (Dr. Michael Menden, University of Melbourne) **REMOTELY**
- [1h15] HANDS-ON Computational Cancer Pharmacogenomics (Dr. Michael Menden, University of Melbourne) **REMOTELY**
- [1h30] Molecular modeling: predicting the impact of variants on proteins (Prof. Dr. Vincent Zoete, UNIL/CHUV/SIB)
- [1h30] HANDS-ON Molecular modeling (Prof. Dr. Vincent Zoete, UNIL/CHUV/SIB)
- [1h45] Personalized cancer immunotherapy: predicting neo-epitopes (Prof. Dr. David Gfeller, UNIL/CHUV/SIB)

Day 2 – NGS bioinformatics & IT infrastructure

I. NGS bioinformatics

- [1h45] NGS bioinformatics quality control (TBC)
- [0h30] Copy number variants (CNVs) and other structural variants (SVs) (TBC)
- [0h45] HANDS-ON on SVs in IGV (TBC)
- [0h30] Effect and functional impact predictions (TBC)

II. IT infrastructure and data management for NGS analysis

- [0h45] Data handling and IT regulations (Dr. Thierry Sengstag, Unibas)
- [0h45] A real-life use case with SwissGenVar (Valérie Barbié, SIB)
- [1h45] Database queries (Florent Tassy, SIB, Dillenn Terumalai, SIB)

Day 3 – Emerging technologies

- [2h00] Large Language Models (Dr. Ana-Claudia Sima, SIB)
- [1h00] Glycomics (Dr. Frédérique Lisacek, Unige & SIB) **REMOTELY**
- [1h00] RNA-seq analyses (Agnieszka Kraft, ETHZ) **REMOTELY**
- [2h00] Single-cell-seq analyses, including HANDS-ON on ASAP (Dr.Vincent Gardeux, EPFL)
- [1h30] Multi-omics data integration (Dr. Florence Mehl)

Day 4 – Digital pathology and machine learning

- [1h30] Machine learning basics (TBC)
- [1h00] Introduction to image analysis (Dr. Andrew Janowczyk, HUG)
- [1h15] HANDS-ON: Features extraction (Dr. Andrew Janowczyk, HUG)
- [2h00] HANDS-ON: predicting diagnosis from the extracted features (Dr. Andrew Janowczyk, HUG)

Module 4
Clinical oncology

Dates

- 7, 8 May; 21, 22 May 2027 (~28h presential teaching).

Location

- Basel, Basel University Hospital.

Main topics

- Tumor Physiology
- Tumor Immunology
- Cancer Statistics and Epidemiology
- Prognostic and Predictive Markers
- Targeted Therapies in Clinical Oncology
- Risks / probabilities for the interpretation of genetic results and counseling
- Clinical Trials in Molecular Oncology
- Molecular Tumor Board

Learning objectives for participants

- Describe main intracellular signaling pathways in solid tumors and molecular aberrations hampering this signaling.
- Get detailed knowledge of immunological mechanisms and how these may be used to optimize therapeutic approaches.
- Get a basic understanding of the principles underlying the design and analysis of clinical trials in oncology.
- Understand the importance of predictive markers in molecular oncology.
- Get familiar with the most frequent molecular aberrations in solid tumors and routinely used targeted therapies.
- Learn about genetic counseling and its implications for patients and families.

Prerequisites to attend the module

- Modules 1, 2, 3 or equivalent knowledge.

Module coordinators

- Prof. Dr. Dr. Sacha Rothschild (KSB), Prof. Dr. Dr. Andreas Wicki (UZH), PD Dr. Dr. Benjamin Kasenda (USB)

Course format

- Lectures, exercises and group discussions.

Day 1 – Tumor Biology, Epidemiology and Basic Concepts of Cancer Therapy

- [0h30] Introduction to Module 4 (PD Dr. Dr. Benjamin Kasenda, USB)
- [1h15] Cancer statistics and epidemiology (PD Dr. Dr. Benjamin Kasenda, USB)
- [1h15] Familiar cancer, cancer genetics (Prof. Karl Heinimann, USB)
- [2h15] Tumor immunology: how to get an immune response against cancer (Prof. Dr. Dr. Heinz Läubli, USB)
  - What mechanisms prevent the immune system to attack cancer cells?
  - How can we overcome silencing of the immune system?
  - What are druggable targets for immuno-oncology?
  - Clinical data for drugs targeting the immune system
  - Clinical data for markers of benefit in immune therapies
- [2h15] Tumor biology: from molecular biology of cancer to targets for anti-cancer drugs (Dr. Nicola Miglino, USZ/UZH)
  - What are the hallmarks of cancer (Weinstein/Hanahan)?
  - What hallmarks are druggable?
  - Clinical data for drugs targeting hallmarks of cancer
  - Novel molecular pathologies in cancer

Day 2 – Tumor Immunology, Genomic Reports, Response Prediction

- [1h45] Basic concepts of cancer therapy: (Prof. Dr. Dr. Sacha Rothschild, KSB)
  - Surgery, radiation therapy, systemic therapy
  - Adjuvant, neoadjuvant, palliative
  - Markers for systemic therapy: prognostic, predictive
  - Definitions: OS, PFS, ORR, etc.
- [2h15] Using genetic markers to predict therapy in cancer patients (Prof. Dr. Dr. Andreas Wicki, USZ/UZH)
  - Clinical and radiology parameters
  - Histology, Immunohistochemistry, FISH
  - Comparative genomic hybridization
  - Sequencing of DNA, RNA (genomics, transcriptomics)
  - Tissue vs. liquid biopsy
  - Targeted sequencing vs. whole exome/genome sequencing
- [1h15] How do you read a genomic report as a clinician? (Prof. Dr. Dr. Sacha Rothschild, KSB)
  - Integration of genetic data in clinical routine
  - Basics: sources of information, databases
  - Service providers in Switzerland
  - Tips and tricks
  - HANDS-ON: interpret bulk DNA sequencing report

- [2h00] Clinical Trials in Oncology (PD Dr. Dr. Benjamin Kasenda, USB)
  - Basic concepts of trial development
  - Types of clinical trials
  - Clinical trial protocol, role of ethical committees and Swissmedic, informed consent
  - Clinical trial protocol, role of ethical committees and Swissmedic, informed consent
  - Relevant and surrogate endpoints
  - Subgroup analyses
  - How to interpret a clinical trial

Day 3 – Clinical Oncology, Drug Development in Oncology

- [2h15] Current clinical standard: Interpreting predictive markers (both genomics and others) in the big four: part 1 (lung and urogenital) (Prof. Dr. Dr. Sacha Rothschild, KSB / Prof. Dr. Arnoud Templeton, Claraspital Basel)

- [2h15] Current clinical standard: Interpreting predictive markers (both genomics and others) in the big four: part 2 (breast and colorectal) (Dr. Elena-Diana Chiru, KSBL / Prof. Dr. Dr. Andreas Wicki, USZ/UZH)

- [2h15] Overview: drug development in oncology (Tobias Porz, Head Global Oncology Commerical Operations, Bayer Pharmaceuticals)
  - Preclinical
  - Early phase
  - Late phase and approval
  - Post marketing studies
  - Collaboration academy – industry

- [0h30] CAS mini-thesis: presentation of topics and general explanations (Dr. Aitana Neves, SIB)

Day 4 – Predictive Biomarkers in Clinical Trials, Molecular Tumor Board

- [1h15] Reimbursement: how to get a drug after your test predicts utility (Prof. Dr. Dr. Sacha Rothschild, KSB)
  - DISCUSSION: assurance of equal treatment for all patients (“off-label” use)

- [2h15] Beyond genetics in therapy prediction (Prof. Dr. Dr. Andreas Wicki, USZ/UZH)
  - Proteomics
  - Single cell phenotyping
  - Machine-based learning

- [1h45] Algorithm trials: how to transform data in a robust prediction (Prof. Dr. Dr. Andreas Wicki, USZ/UZH)

- [1h45] Point of care: decisions at the molecular tumor board (Prof. Dr. Dr. Sacha Rothschild, KSB)
    - How can a molecular board improve care for cancer patients?
    - HANDS ON: simulate molecular board

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