



AI in Personalized Medicine: Genomics, Pharmacogenomics and Patient Stratification



AI in Personalized Medicine: Genomics, Pharmacogenomics and Patient Stratification

Introduction:

AI in personalized medicine promises care matched to each patient's genome and molecular profile, yet many organisations buy or build prediction tools without checking the underlying genomic data, the evidence behind gene-drug recommendations or the representativeness of training cohorts. The result is models that stratify patients poorly, alerts clinicians ignore and pilots that stall at validation. This Core Concept course equips clinical, informatics and life-science staff to evaluate precision medicine AI without writing code, from sequencing outputs to regulatory expectations. Participants produce a Precision Medicine AI Pilot Plan and Validation Checklist.

Course Objectives:

- Interpret genomic and multi-omics data outputs well enough to question how an AI model uses them
- Evaluate risk prediction and patient stratification models using discrimination, calibration and explainability evidence
- Apply CPIC-style gene-drug guidance to judge AI-supported prescribing and treatment selection proposals
- Assess imaging, digital pathology and molecular biomarkers feeding clinical decision support
- Audit genetic data consent, privacy protection, ancestry bias and validation evidence against Good Machine Learning Practice expectations
- Produce a Precision Medicine AI Pilot Plan and Validation Checklist for a real use case

Target Audience:

- Clinicians responsible for applying genomic test results and decision support in patient care
 - Health informatics staff who integrate genotype data and AI outputs into clinical records and workflows
 - Pharmacy and medication safety staff responsible for pharmacogenomic prescribing guidance
 - Pharma and biotech staff responsible for biomarker strategy, companion diagnostics or real-world evidence
 - Clinical research and data governance staff who manage biobank, registry and consent processes
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Course Outline:

Day 1: Precision Medicine Foundations and Genomic Data Literacy

- Personalized Versus Precision Medicine: Stratified Care Model and Terminology
- Genome, Exome and Gene Panel Sequencing Outputs: Variants, VCF Files and Annotation
- Multi-Omics Layers: Transcriptomics, Proteomics and Metabolomics Data Shapes
- Health Record, Registry and Biobank Linkage for Genotype-Phenotype Analysis
- Precision Medicine Readiness Assessment Template

Day 2: AI Methods for Risk Prediction and Patient Stratification

- Supervised Learning Concepts: Classification, Regression and Survival Models Without Code
- Polygenic Risk Scores: Construction, Ancestry Transferability and Interpretation Limits
- Unsupervised Clustering for Disease Subtyping and Cohort Stratification
- Performance Evidence: AUROC, Calibration Plots, Sensitivity and Positive Predictive Value
- Explainability Methods: SHAP Values, Feature Attribution and Counterfactual Reasoning

Day 3: Pharmacogenomics, Treatment Selection and Imaging Biomarkers

- Gene-Drug Pairs: CYP2C19 With Clopidogrel, CYP2C9 and VKORC1 With Warfarin
- CPIC Guideline Interpretation: Genotype to Phenotype to Prescribing Recommendation
- AI-Assisted Treatment Selection Using Companion Diagnostics and Molecular Tumour Profiles
- Radiomics and Digital Pathology Whole-Slide Image Biomarkers
- Decision Support Alert Design for Pre-Emptive Genotype Results in Prescribing Workflows

Day 4: Genetic Data Privacy, Bias, Validation and Regulatory Expectations

- Genetic Data Consent Models: Broad, Dynamic and Tiered Consent With Re-Contact Rules
- Pseudonymisation, Controlled Access and Federated Learning for Genomic Datasets
- Ancestry Bias and Training Cohort Representativeness Audit Checklist
- Software as a Medical Device, Good Machine Learning Practice and Predetermined Change Control Plans
- Analytical Validation, Clinical Validation and Post-Deployment Drift Monitoring

Day 5: Precision Medicine AI Case Work and Pilot Planning

- Oncology Case Study: Molecular Tumour Board Decision Support Review
 - Pharmacy Case Study: Pre-Emptive Pharmacogenomic Panel Rollout Evaluation
 - Cardiometabolic Case Study: Polygenic Risk Screening Programme Critique
 - Pilot Scope, Success Measures and Alignment With WHO Ethics Principles for AI in Health
 - Pilot Plan and Validation Checklist Presentation With Peer Challenge
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Skills You Will Gain:

- Genomic Data Literacy
- Patient Stratification Analysis
- Pharmacogenomic Guideline Interpretation
- Biomarker Evidence Appraisal
- Clinical Decision Support Design
- Genetic Data Governance
- Algorithmic Bias Auditing
- AI Medical Software Validation

Why Attend This Course:

- Leave with a Precision Medicine AI Pilot Plan and Validation Checklist shaped around your own use case
- Question vendor claims about genomic prediction tools using the metrics and bias checks covered on the course
- Understand why gene-drug alerts succeed or fail inside real prescribing workflows
- Compare approaches with peers from hospitals, laboratories, pharmaceutical companies and research institutes

Conclusion:

Precision medicine AI succeeds when genomic data quality, model evidence, clinical workflow and patient consent are handled together. The course moves from sequencing outputs and multi-omics data, through risk prediction and patient stratification methods, to pharmacogenomics, treatment selection and imaging biomarkers, then consent, bias, validation and expectations for AI medical software. The final day applies these methods in oncology, pharmacy and cardiometabolic cases and produces a Precision Medicine AI Pilot Plan and Validation Checklist ready for internal review.
