



MARIE SKŁODOWSKA-CURIE POSTDOCTORAL FELLOWSHIPS 2025
EXPRESSION OF INTEREST FOR HOSTING MARIE CURIE FELLOWS

HOST INSTITUTION

NOVA Medical School

RESEARCH GROUP AND URL

Data Science and AI Lab for Health

SUPERVISOR (NAME AND E-MAIL)

Jorge M. Mendes (jorge.mendes@nms.unl.pt); Sérgio Laranjo (sergio.laranjo@nms.unl.pt)

SHORT CV OF THE SUPERVISOR

Jorge M. Mendes is currently an Associate Professor of Statistics and Data Science at NOVA Medical School, NOVA University Lisbon. He is deeply invested in advancing quantitative methods across domains such as biostatistics, environmental statistics, mathematical epidemiology, and data science for life sciences. His research interests also span survey methodology and quantitative approaches to epidemiological studies.

He holds a bachelor's degree in Statistics and Information Management from NOVA University of Lisbon, an MSc in Probability and Statistics and a PhD in Statistics and Operations Research from the University of Lisbon. Over his career, he has contributed to national and international research projects, particularly as a member of NOVA's Comprehensive Health Research Centre (CHRC) and formerly of the Management Information Centre (MagIC) at NOVA Information Management School (NOVA IMS).

Before his current role, he led the School of Management and the Bachelor's in Information Management at NOVA Cairo, part of The Knowledge Hub Universities (TKH) in Cairo, Egypt. He previously coordinated several academic programs, including the Master's in Statistics and Information Management at NOVA IMS.

He is an active researcher and author, regularly publishing in scientific journals and serving as a peer reviewer. His dedication to education extends to mentoring MSc and PhD students while frequently acting as an external examiner for graduate programs at other institutions. Passionate about fostering future professionals and researchers, he thrives on connecting data science, statistics, and public health to address global challenges in health and life sciences.

Sérgio Laranjo is a Medical Doctor (Pediatric Cardiologist and Arrhythmologist) with a PhD in Medical Physiology (University of Lisbon), and a postgraduate (Diploma of Advanced Studies in Cardiac Rhythm Management) from Maastricht University.

He is an attending Pediatric Cardiologist at the Santa Marta Hospital, Centro Hospitalar e Universitário de Lisboa Central. He is also an Assistant Professor of Physiology at the Lisbon School of Medicine.

His current research focuses on unravelling the mechanisms of cardiac arrhythmias through novel computational electrophysiology techniques and AI; improving patient care through digital health (smartphone applications, wearable and wireless devices); and developing strategies for primary and secondary prevention of chronic conditions.

5 SELECTED PUBLICATIONS

- Agharafeie, R.; Ramos, J.R.C.; Mendes, J.M.; Oliveira, R. From Shallow to Deep Bioprocess Hybrid Modeling: Advances and Future Perspectives. *Fermentation* 2023, 9, 922.
- Rita Flores, Ana C. Fradinho, Rita Serras Pereira, Jorge M. Mendes, Miguel C. Seabra, Sandra Tenreiro, Ângela Carneiro; Identifying Imaging Predictors of Intermediate Age-Related Macular Degeneration Progression. *Trans. Vis. Sci. Tech.* 2023;12(7):22. <https://doi.org/10.1167/tvst.12.7.22>.

- Mendes JM, Barbar A., Refaie M. Synthetic data generation: a privacy preserving approach to accelerate rare disease research. *Front. Digit. Health*, 2025, 7:1563991. doi: 10.3389/fdgth.2025.1563991
- M. Mahmudul Hasan, M. Nahidul Islam, N. Sulaiman, M. Mahfuj Hossain and J. M. Mendes, “Real-Time EEG Signal Analysis for Microsleep Detection: Hyper-Opt-ANN as a Key Solution,” in *IEEE Access*, vol. 13, pp. 66354-66372, 2025, doi: 10.1109/ACCESS.2025.3559619.
- Mendes, J.M., Coelho, P.S. The effect of non-pharmaceutical interventions on COVID-19 outcomes: A heterogeneous age-related generalisation of the SEIR model, *Infectious Disease Modelling*, Volume 8, Issue 3, 2023, Pages 742-768, ISSN 2468-0427, <https://doi.org/10.1016/j.idm.2023.05.009>.
- Brás, P.G., Cunha, P.S., Timóteo, A.T. et al. Evaluation of left atrial strain imaging and integrated backscatter as predictors of recurrence in patients with paroxysmal, persistent, and long-standing persistent atrial fibrillation undergoing catheter ablation. *J Interv Card Electrophysiol* 67, 479–492 (2024). <https://doi.org/10.1007/s10840-023-01602-z>
- Silva Cunha P, Laranjo S, Monteiro S, Portugal G, Guerra C, Rocha AC, Pereira M, Ferreira RC, Heijman J and Oliveira MM (2024) The impact of atrial voltage and conduction velocity phenotypes on atrial fibrillation recurrence. *Front. Cardiovasc. Med.* 1:1427841. doi: 10.3389/fcvm.2024.1427841
- Laranjo, S., Fonseca, H., Felix, A. C., Gourine, A. V., Pinto, F. F., Oliveira, M., & Rocha, I. (2025). Haemodynamic Patterns in Reflex Syncope: Insights from Head-Up Tilt Tests in Adults and Children. *Journal of Clinical Medicine*, 14(6), 1874. <https://doi.org/10.3390/jcm14061874>
- Melo X, Lopes A, Coelho R, Simão B, Oliveira I, Marôco JL, et al. (2025) Acute effects of commercial group exercise classes on arterial stiffness and cardiovagal modulation in healthy young and middle-aged adults: A crossover randomized trial. *PLoS ONE* 20(3): e0319130. <https://doi.org/10.1371/journal.pone.0319130>
- Silva Cunha, P., Laranjo, S., Monteiro, S., Almeida, I. G., Mendonça, T., Fontes, I., Ferreira, R. C., Almeida, A. G., Didenko, M., & Oliveira, M. M. (2024). Left Atrial Wall Thickness Estimated by Cardiac CT: Implications for Catheter Ablation of Atrial Fibrillation. *Journal of Clinical Medicine*, 13(18), 5379. <https://doi.org/10.3390/jcm13185379>
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PROJECT TITLE AND SHORT DESCRIPTION

1. HUMAN-XAI: Human-Centred Design of Explanations for AI-Assisted Clinical Decision-Making

Explainable AI in healthcare will only have real value if explanations are designed to support clinicians working under uncertainty, time pressure, and workflow constraints. Many current approaches are technically sophisticated but insufficiently grounded in how healthcare professionals actually interpret evidence, judge plausibility, detect error, or calibrate trust. As a result, explanations may be mathematically convincing yet clinically unhelpful, or worse, create misplaced confidence in model outputs. A more mature approach is needed, one that places human-centred design at the core of explainability research.

This project will develop and evaluate a human-centred framework for explanation design in AI-assisted clinical decision-making. It will combine methodological work in explainable AI with concepts from human-computer interaction, cognitive ergonomics, and implementation science to determine which forms of explanation best support safe and effective use. The expected outputs include design principles for clinically useful explanations, new evaluation frameworks centred on user performance and calibration rather than technical appeal alone, and practical recommendations for integrating explainability into decision-support systems. The project offers strong innovation through its shift from explanation generation to explanation design, and strong impact through its potential to improve clinicians' interactions with AI in



practice. It will also provide advanced interdisciplinary training and deepen the fellow's profile as an independent researcher at the interface of AI, healthcare, and human factors.

2. FED-XAI: Federated and Privacy-Preserving Explainable AI for Multicentre Healthcare

The future of trustworthy AI in healthcare depends on the ability to learn from data distributed across institutions without compromising privacy, governance, or public trust. Federated learning offers an important route forward, but the question of explainability in distributed settings remains largely unresolved. It is still unclear whether explanations derived from federated models are stable across sites, whether they can be meaningfully compared, and how they should be audited when data cannot be centrally pooled. That is a strategic problem for translational research networks seeking to scale AI responsibly.

This project will develop new methods for explainable and privacy-aware AI in federated healthcare environments. It will investigate how explanation techniques can be adapted to distributed model development, how institutional heterogeneity influences interpretability, and how transparent auditing can be supported under strong data protection constraints. The anticipated outcomes include methodological advances at the intersection of federated learning and explainable AI, multicentre validation studies, and practical tools for collaborative AI development across privacy-sensitive settings. The project combines scientific novelty with clear translational relevance. It will provide the fellow with high-level training in distributed AI, privacy-preserving analytics, digital health infrastructure, and cross-institutional collaboration, all of which are increasingly important in European biomedical research.

3. CAUSE-DIGI: Causal Evaluation of Digital Technology Adoption and Workflow Impact in Healthcare

Digital technologies are frequently introduced into healthcare with the promise of improving efficiency, quality, and decision-making. Yet, the evidence based on their real-world effects is often weak. Adoption studies commonly focus on user perceptions or simple before-and-after comparisons, which are not sufficient to determine whether a technology genuinely improves workflow, reduces burden, or changes patient pathways in meaningful ways. Without stronger analytical approaches, healthcare systems risk investing in innovation without robust evidence of value. There is therefore a strong need for causal and policy-relevant evaluation frameworks for digital transformation in clinical settings.

This project will apply causal inference and quasi-experimental methods to evaluate the impact of digital and AI-enabled technologies on clinical workflow, organisational performance, and service delivery. By integrating routinely collected operational data with implementation indicators, the project will identify what changes after deployment, for whom, and under what conditions. The expected impact lies in establishing a more rigorous standard for evaluating digital adoption and generating evidence to inform procurement, implementation, and scaling decisions. The project also offers important innovation in connecting implementation research with modern causal methods. It will provide the fellow with advanced training in health services research, real-world evaluation, and translational data science.

4. VAL2USE-AI: From Validation to Uptake: Adoption Pathways for AI and Software as a Medical Device

Many AI tools in healthcare achieve encouraging performance in development studies but fail to reach sustained use in practice. This translational gap reflects the fact that adoption is shaped by more than algorithmic accuracy. Interoperability, regulation, procurement, workflow fit, user trust, explainability, training, and post-deployment monitoring all influence whether a tool progresses from technical validation to meaningful integration. These factors are typically studied separately, which leaves healthcare



organisations and technology developers without a coherent framework for understanding how adoption actually unfolds.

This project will characterise and model the pathway through which AI and software as a medical device move from validation to uptake in real healthcare systems. Drawing on comparative case studies and implementation settings, it will identify the technical, organisational, and regulatory conditions that support or hinder translation into routine care. The expected outputs include an integrated translational framework, evidence-informed recommendations for developers and health organisations, and a stronger basis for designing adoption strategies that are realistic, scalable, and aligned with healthcare needs. The project has clear strategic value for institutions investing in digital transformation, and it will offer fellows advanced training in translational medicine, regulatory and implementation science, and the evaluation of digital innovation in complex healthcare environments.

5. ROBUST-Twin: Multicentre Real-World Validation of Cardiac Digital Twins

Cardiac digital twins are now technically mature enough to enter the validation phase that will determine whether they become clinical tools or remain methodological exhibits. The most pressing limitation is not architectural but evidential: published twins are typically demonstrated on a single cohort, with internal cross-validation, no external prospective testing, and almost no analysis of how performance degrades across acquisition protocols, patient subgroups, and care contexts. Without rigorous multicentre validation, claims of patient-specificity and clinical utility cannot be substantiated, and regulatory pathways for in silico medicine will remain blocked.

This project will design and conduct the first systematic multicentre validation of generative cardiac digital twins for inherited arrhythmia risk stratification, using existing infrastructure and partner sites at CARIM-Maastricht. The work will define and implement validation protocols that go beyond predictive accuracy to include calibration, robustness under acquisition shift, subgroup fairness, and counterfactual fidelity against held-out clinical events. Expected outputs are a reusable validation framework aligned with emerging EU MDR and AI Act expectations, evidence on twin generalisability across European populations, and concrete recommendations for the regulatory dossier of in silico medical devices. Training will combine advanced statistical evaluation, regulatory science, multicentre clinical-research operations, and cross-sectoral exposure through industry secondments, equipping the fellow to lead the next generation of in silico clinical trials.

6. PEDIA-PASS: Continuous Outpatient Surveillance after Fontan Palliation

Patients living with single-ventricle physiology after Fontan palliation now constitute a growing adult congenital heart disease population in whom subclinical decompensation typically precedes catastrophic events by weeks to months. Their care is currently structured around in-clinic follow-up at intervals that are demonstrably too coarse to detect early haemodynamic, autonomic, and arrhythmic deterioration. Wearable sensors and home spirometry generate the relevant signals. Still, no validated framework integrates them into a continuous, clinically actionable risk surface for this specific population. The result is a missed opportunity to prevent admissions and improve outcomes in a particularly vulnerable cohort.

This project will develop and prospectively evaluate a continuous outpatient surveillance pathway for Fontan patients, combining multimodal wearable signals, home spirometry, and longitudinal patient-reported outcomes within a clinically governed monitoring platform. The methodological work will adapt self-supervised wearable representations to the unusual physiology of the Fontan circulation, define event-anchored risk states with clinician input, and integrate uncertainty quantification suitable for outpatient



triage. Expected outcomes are a validated digital surveillance pathway, evidence on event-prediction lead time, qualitative findings on patient and family acceptability, and a deployment-ready protocol suitable for replication across European adult-CHD centres. The fellowship offers advanced training in applied AI, real-world clinical evaluation, regulatory-grade study design, and patient and public involvement, addressing a high-priority unmet need with a credible path to direct clinical deployment.

7. RECOVER-SYNCOPE: From a Tilt-Table Cohort to a European Decision-Support Tool

Syncope is among the most common reasons for unscheduled cardiology evaluation. Yet, diagnostic pathways remain fragmented and tilt-table testing — the established mechanistic gold standard — is interpreted with substantial centre-level variability. Years of structured tilt-table data accumulated within a single high-volume syncope unit constitute a methodologically rich yet underexploited resource: a longitudinal cohort with rigorous ground-truth labels, beat-to-beat haemodynamic and autonomic signals, and follow-up outcomes. It is precisely the configuration needed to build a reusable decision-support tool for syncope triage. Still, no such resource has yet been turned into a validated, deployable system.

This project will transform an existing tilt-table cohort into a clinically useful decision-support tool for syncope, combining interpretable autonomic-signal modelling with phenotype clustering anchored on clinical outcomes rather than tilt response alone. The work will pre-register an external validation study across at least two additional European syncope centres, integrate the model into a clinically governed prototype within the host hospital information system, and quantify its impact on referral patterns, time to diagnosis, and avoidable admissions. Expected outputs include a validated triage model, an interpretable autonomic-phenotyping framework applicable beyond syncope, and a deployment template suitable for European syncope networks. Training will combine signal processing, implementation science, regulatory pathways for software as a medical device, and health services evaluation, offering an exceptionally complete translational profile.

8. CHILD-RAG: Conversational Health Literacy for Paediatric CHD Caregivers

Caregivers of children with congenital heart disease navigate a long, often isolating health-literacy journey across multiple specialities, languages, and care transitions. The information they need is highly individualised, evolves with the child's age and surgical pathway, and is currently fragmented across institutional websites, support groups, and clinician encounters that are inevitably brief. Generic medical chatbots are unsafe for this population because they hallucinate, ignore developmental context, and cannot be governed by the clinical team responsible for the patient. There is a clear unmet need for a clinically governed, family-centred conversational system designed specifically for paediatric CHD trajectories.

This project will develop, evaluate, and culturally adapt a conversational health-literacy assistant for paediatric CHD caregivers, building on the existing CardioLearn infrastructure. The methodological work will combine retrieval over guideline-grade and patient-information sources with safety guardrails defined by clinicians, multilingual adaptation across at least three European languages, and a feedback loop in which clinician-validated interactions improve subsequent retrieval. Evaluation will follow a mixed-methods design with measures of factual accuracy, caregiver-reported usefulness, equity of use across socio-economic strata, and impact on outpatient visit content. Expected outputs include an open evaluation benchmark for family-facing clinical chatbots, peer-reviewed evidence on caregiver outcomes, and a governance template transferable to other rare paediatric conditions. Training will span clinical NLP, participatory design, multilingual AI evaluation, and digital-health regulation, preparing the fellow for leadership in patient-facing generative AI.

9. TWIN-OMICS: Genotype-to-Wearable Personalised Risk in Inherited Arrhythmia Syndromes



Inherited arrhythmia syndromes — Brugada, Long-QT, ARVC, CPVT — are framed clinically by genotype yet stratified almost entirely by sparse hospital phenotyping. A patient's day-to-day arrhythmic substrate fluctuates with autonomic tone, sleep, fever, and exercise, none of which is captured in current risk scores. The convergence of wearable continuous monitoring, gene-specific mechanistic models, and digital twins finally enables the bridging of genotype, free-living phenotype, and personalised risk. Still, no published framework integrates the three coherently for inherited arrhythmias.

This project will develop a genotype-to-wearable risk framework that personalises *in silico* risk by combining variant-specific mechanistic priors, longitudinal wearable phenotypes, and Bayesian updating against incident arrhythmic events. Methodologically, the work will fuse mechanistic ionic-channel modelling with free-living wearable representations and a hierarchical risk model that propagates uncertainty from variant pathogenicity through to clinical recommendation. Clinical evaluation will leverage existing inherited arrhythmia cohorts at the host institution and partner sites within ERN GUARD-Heart, with prespecified endpoints including risk recalibration over time, agreement with implantable device events, and clinical utility compared with current guideline-based stratification. Expected outputs are a validated personalised-risk framework, prospective evidence in at least two inherited arrhythmia syndromes, and a methodological template extensible to other channelopathies. Training will integrate computational electrophysiology, wearable analytics, Bayesian risk modelling, and clinical genetics, building an exceptional profile in personalised *in silico* cardiology.

SCIENTIFIC AREA WHERE THE PROJECT FITS BEST*

LIF

***Scientific Area where the project fits best** – Please select/indicate the scientific area according to the panel evaluation areas: Chemistry (CHE) • Social Sciences and Humanities (SOC) • Economic Sciences (ECO) • Information Science and Engineering (ENG) • Environment and Geosciences (ENV) • Life Sciences (LIF) • Mathematics (MAT) • Physics (PHY)