ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Project title: Mixed-Effects Joint Modelling for Multivariate Clinical Longitudinal and Time-to-Event Data
Acronym: MIXCARE
Name and Department of the UNIBO scientific coordinator: Silvia Cagnone - Department of Statistical Sciences "Paolo Fortunati"

Project objectives
MIXCARE addresses a key methodological challenge in clinical and epidemiological research: how to jointly analyse multiple longitudinal outcomes together with time-to-event data (e.g., disease progression, hospitalisation, treatment failure). Traditional joint models are powerful but difficult to apply when studies involve many heterogeneous outcomes measured repeatedly over time.

The project develops a scalable statistical framework based on mixed-effects modelling combined with pairwise likelihood estimation. This approach reduces computational burden while preserving interpretability and robustness, making it suitable for high-dimensional clinical data.

The main objective is to develop, validate, and disseminate this modelling framework across diverse medical contexts. Specific goals include extending joint models to heterogeneous outcomes, investigating dynamic prediction and robustness, validating the methodology on real clinical datasets (including prosthesis-related data), and strengthening collaboration and methodological capacity within the Una Europa Alliance.

Activities
MIXCARE combines methodological research, collaboration and capacity building through the following actions:

- Methodological Development on High-Dimensional Joint Modelling: to develop the MIXCARE framework for joint analysis of longitudinal and time-to-event data, using real datasets like prosthesis outcomes. A postdoc will support methodology, implementation, and validation, with regular coordination across partners;
- Seminar Series: a cross-institutional online seminar series will cover methods, practical implementation, and case studies on joint modelling of longitudinal and time-to-event data. It promotes scientific exchange and training for early-career researchers across partners;
- Short Research Fellowships and Mobility Exchanges: to enable early-career researchers to visit partner institutions, supporting collaboration on methodology, data analysis, and joint outputs.
- Dissemination, Open-source research code, and Best-Practice Guidelines: to turn methodological developments into open-source MIXCARE code, reproducible pipelines and best-practice guidelines.
- Final Workshop and Planning of Future Joint Funding Proposals.

Partnership
The project brings together three UNA Europa partners with complementary expertise, coordinated by the University of Bologna:

- KU Leuven: leading expertise in mixed-effects and joint modelling; major contribution to methodological development; host institution for mobility fellows; co-organisation of workshops and seminars

- Leiden University: contribution to longitudinal modelling and association structures; participation in methodological development, workshops, and mobility exchanges.

Expected impact
MIXCARE will enhance the capacity of the partner institutions to analyse complex clinical datasets by providing scalable and interpretable modelling tools. It will strengthen international collaboration within Una Europa through coordinated methodological development and shared scientific outputs.

The project will support early-career researchers through mobility and co-supervision, fostering long-term research networks. Tangible short-term results include open-source analytical tools, methodological documentation, workshops and seminars, and joint publications, laying the groundwork for future European funding applications and sustained cooperation within the Alliance.