EP PERMED RITC2026

FROM COMPLEXITY TO CLARITY: AN ACCESSIBLE DIGITAL TOOL FOR PERSONALIZED MULTIMORBIDITY RISK ASSESSMENT

Don't wait for symptoms. Know your risk.

Outlook of the project

Unlike traditional methods that react to symptoms, proactive risk factoring acts on silent signals. It analyzes underlying predispositions and early markers to map a personalized risk landscape, providing a clear, actionable agenda for prevention long before a clinical diagnosis is necessary.

The primary aim of this project is to develop and validate an **innovative**, **web–based** decision support system (DSS) for personalized risk scoring. The system is designed for individuals with, or at risk of developing, multimorbid chronic conditions, with a specific focus on three core diseases: (i) **rheumatic diseases**; (ii) **chronic kidney disease (CKD)**; and (iii) **diabetes**. Within this framework, **peripheral arterial disease (PAD)** will be investigated as a **key intersecting comorbidity** to refine the risk model.

The core innovation is a **science–backed**, **AI–powered**, and **web–based** tool that synthesizes **multimodal data** to generate **highly personalized risk scores**. Although the underlying risk algorithm is extremely complex —enabled by deep personalization and multimodal data integration— its application will be **exceptionally user–friendly**. This is achieved through an **intuitive interfaces** and **explainable outputs**, based on **simple user inputs** that **do not require prior clinical testing**.

This engine powers a dual–purpose platform tailored for two primary user groups:

- **Patient/citizen use**: A patient–facing application for intuitive, home–based self–assessment —**requiring no prior clinical tests for initial use**.
- **Professional use**: A clinical support medical professionals in decision–making and patient management.

The integrated approach represents a significant methodological advance for managing complex, co–occurring chronic diseases, lowering barriers to proactive and personalized assessment.

Value propositions

- **Accessible self-assessment**: The tool is designed for independent use, requiring no prerequisite clinical tests or specialized medical knowledge, allowing individuals to proactively engage with their health status.
- **Home-based convenience**: It is fully suitable for remote use at home, eliminating the need for an initial visit to a medical centre for a preliminary risk evaluation.
- **Highly personalized assessment**: The AI-driven engine delivers tailored risk profiles by analyzing individual data inputs, moving beyond generic health information.
- **Enhanced clinical decision support**: For healthcare professionals, the system supports clinical decision-making by providing structured risk stratification, aiding not only in diagnostic considerations but also in guiding referrals to the most appropriate medical department.
- **Accurate results**: The risk model achieves high reliability by integrating multidisciplinary clinical expertise with multimodal data analysis via cutting-edge machine learning (ML) algorithms, ensuring that risk assessments are both clinically valid and data-driven.
- **Easy-to-use platform**: Designed through intersectoral collaboration, the interface translates advanced algorithmic complexity into a seamless and intuitive user experience for all stakeholders.

Architectural Design of the DSS

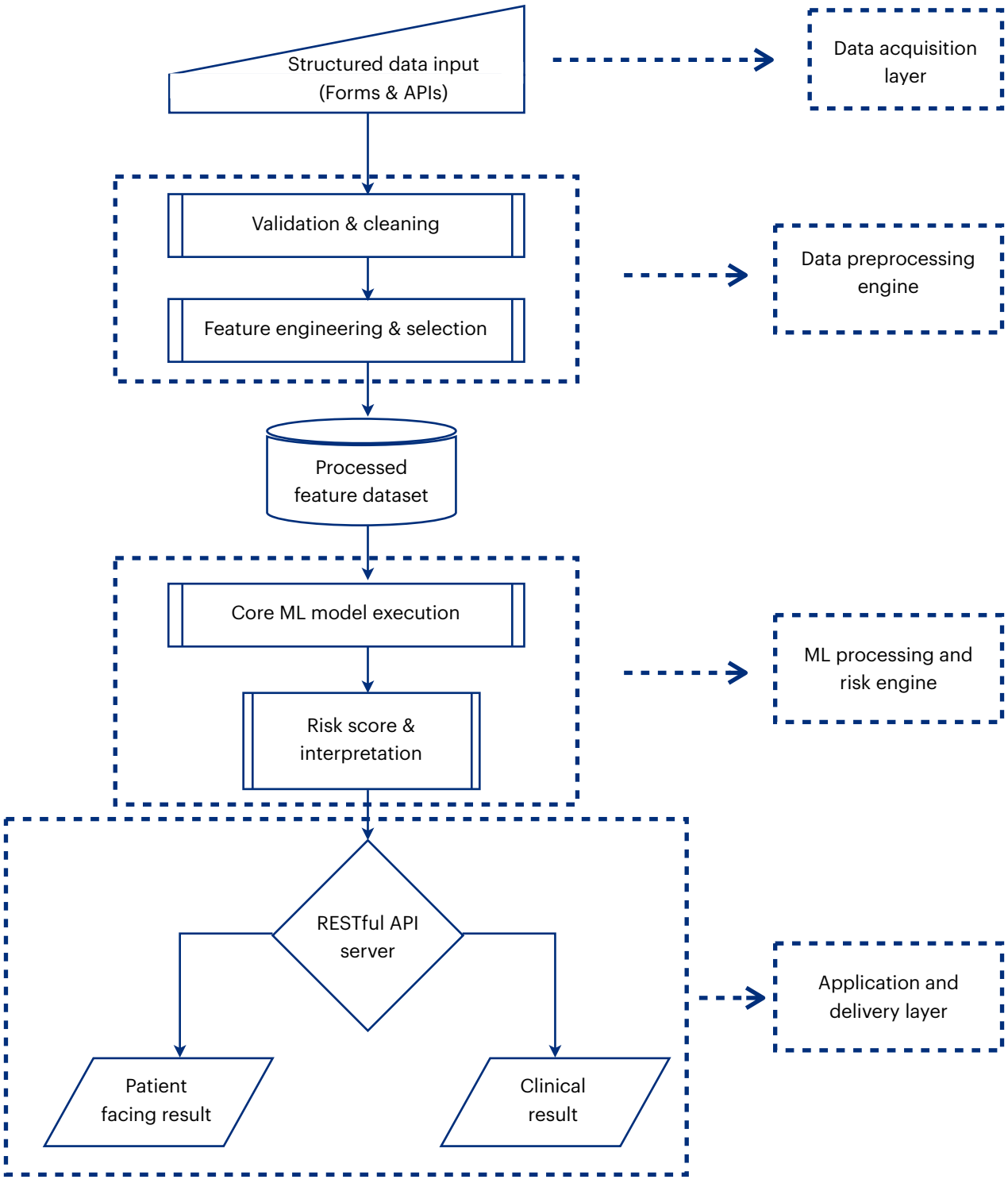
This section details the design of the DSS, centered on a reliable ML–based risk engine that enables its key functionalities: web–based accessibility for preliminary self–assessment and a clinical dashboard for professional decision support.

Below, the architectural design is explained, and then depicted.

- **Data acquisition layer**: Collects structured input data from defined sources.
  - **Structured input interface**: This includes standardized digital forms for patient–reported outcomes.
  - **Standardized data buffer**: A temporary landing zone that receives all incoming data, ensuring it is formatted according to a predefined schema before moving to preprocessing.
- **Data preprocessing engine**: Systematically prepares raw data for ML model performance. This dedicated engine ensures data quality and creates informative features. Serves as the central repository for all input data required by the developed ML models. It will comprise of two modules:
  - **Validation & cleaning module**: Applies rules to check for missing values, outliers, and logical inconsistencies (e.g., upper and lower limits for height and weight values). It executes advanced cleaning techniques like binning, clustering, normalization, data fusion, etc.
  - **Feature engineering & selection module**: The analytical core of preprocessing. It creates new, predictive features from raw inputs (e.g., calculating height/weight ratio). It may also perform dimensionality reduction to select the most relevant features for the model, reducing complexity.
- **ML processing & risk engine**: Executes the core ML models that generate and explain the personalized risk score.
  - **Core ML model**: Employs advanced algorithms (e.g., neural network, ensemble method like XGBoost) suited for preprocessed multimodal data.

- **PAD–comorbidity integration**: PAD–specific features created in the preprocessing engine are fed into the core model. The ML algorithms keep learning their weighted contribution to the overall multimorbidity risk.
- **Explainability module**: Utilizes ML–specific explanation frameworks like SHAP or LIME. This module translates the model's decision into a human–interpretable format, showing which features (e.g., age, PAD indicator) contributed most to an individual's risk score.

- **Application & delivery layer**: Serves the risk intelligence to end–users via stable interfaces.
  - **API & model server**: A reliable backend that hosts the trained ML pipeline and serves predictions via secure APIs.
  - **Dual front–end**: The Patient Facing App provides a simple interface for self–assessment, while the Clinical Dashboard offers detailed visualizations, cohort analytics, and access to the explainability outputs for healthcare professionals.


Structured data input
(Forms & APIs)
Data acquisition layer
Validation & cleaning
Feature engineering & selection
Data preprocessing engine
Processed feature dataset
Core ML model execution
Risk score & interpretation
ML processing and risk engine
RESTful API server
Patient facing result
Clinical result
Application and delivery layer

Business model

To align the societal goal of equitable access with the necessity for economic viability, the DSS is grounded in a sustainable business model designed for two distinct user groups: empowered patients and healthcare systems.

Tier	Target user	Revenue mechanism
Freemium model	- Patients - Citizens	- Non-monetary. - Drives adoption, user data (with consent), and fulfills the core societal mission.
Premium model	- Healthcare institutions - Universities - Education centres - Insurance firms	- Subscription licence (e.g., annual fee per clinician or per patient). - Provides a clear path to sustainability and scaling.

Outcomes of the project

In direct response to the EP PerMed call objectives, the anticipated outcomes of this project are structured to provide verifiable evidence on the novel tool's functionality, its clinical integration pathway, and its broader health economic value.

Outcomes	**Deliverables**	**Measurable verification indices**
Novel ML models with high accuracy	- Published methodology - Reusable data pipeline	- Accuracy rate >0.9 - Recall >0.9 - Precision >0.9 - F1-score >0.9
Patient empowerment	- Patient self-assessment portal - Educational materials	- Mean system usability scale (SUS) score >68 (indicating 'good' to 'excellent') - All key functions pass WCAG 2.1 AA accessibility standards
Clinical dashboard	- Clinical validation report - Clinical guidelines	- In pilot, >80% of the clinicians report the tool improved confidence in risk assessment
A validated web-based tool	- Seamlessly integrated engines and layers - Functional web-based usage	- >90% of risk scores accompanied by a validated SHAP explanation - Platform uptime >99.5% - Mean response time > 2 seconds
Socio-economic impact	- Health economic analysis - Equity	- >15% improvement according to cost-benefit analysis - Reaching out to >X% of individuals from specified demographic structures
Dissemination	- Published scientific papers - Published project website	- Minimum of 2 publications in impactful journals - Minimum of 2 proceedings in reputable conferences

What we need?

- University hospital or specialty clinic with departments in rheumatology, nephrology, and endocrinology. They provide access to patient cohorts, clinical expertise for model validation, and real–world test environments.
- Medical doctor, researcher, and/or academician who has profession in **at least** one of the following diseases: rheumatic diseases, chronic kidney disease (CKD), diabetes, and/or peripheral arterial disease (PAD).
- Patient association for rheumatic diseases, kidney failure, or diabetes. They will ensure the tool meets patient needs and to help design relevant research questions.
- Citizen/consumer health organization who can provide input on the design of the free, citizen–facing module to ensure it is accessible and easy to use.
- A national/regional health authority/ministry who will provide governmental goals, strategies, limitations, etc.
- Research groups, SMEs or startups who have a solid expertise in AI/ML for healthcare. They will develop novel ML algorithms fulfilling targeted performance indices.
- Med–tech companies with expertise in handling multimodal healthcare, and data interoperability. A startup is preferred.
- An SME or startup specializing in back–end and/or front–end coding for technical build, integration, and deployment of the final product/service.
- A partner who can assess the cost–effectiveness and develop strategies for integrating the tool into clinical workflows.
- A legal entity who will navigate regulatory, legal, and branding pathways.

Final words

- Since there is not much time, acting promptly is required in case of collaboration.
- Project proposal is under construction. It needs to be tailored based on contribution of the involved partner(s).
- For more information about Pallas, you may visit: https://www.pallasconsultancy.com.
- If you foresee a synergetic contribution for this project, please feel free to contact to aykanakincilar@pallasconsultancy.com.