

Title: Integrated decision support system for Hypertrophic cardiomyopathy stratification and disease management

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Abstract

Hypertrophic cardiomyopathy (HCM) is a complex and heterogenous heart disease requiring longitudinal monitoring across electrocardiography (ECG), cardiac imaging, clinical biomarkers, and genetic data. Existing clinical tools often lack integration and intuitive visualization, limiting timely intervention and pattern recognition. Clinicians emphasize the need for tools that enable exploration of risk scores, ECG and imaging data, and provide actionable insights for HCM management.

This work presents a decision support system (DSS) developed within the EU project SMASH-HCM¹ to deliver a reproducible and scalable digital-twin based platform unifying multimodal data with mechanistic, machine-learning, and deep-learning models. The architecture separates data processing, analysis, and visualization layers, supporting advanced risk stratification and patient-specific disease progression modelling.

The system employs a Flask² backend and Plotly Dash³ frontend in separate Docker⁴ containers, communicating via REST protocols. This design allows models developed in different programming languages to run locally within the container or remotely through MEDAI API⁵. The interface enables to explore ECG and imaging data, visualize model outputs with uncertainty estimates, assess biomarker importance, and access management recommendations. Current implementation supports tracking of risk scores like ESC sudden cardiac death with colour coding, integrating of model-based insights into decision-making. Initial use cases show the ability to process multimodal HCM data, integrate heterogenous models, and provide clinically meaningful support.

Future development will extend functionality with genetic data integration, patient similarity exploration, clustering visualization, and explainable AI. This work establishes a modular, extensible DSS for broader clinical and patient-facing application in HCM management.

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