**“Derivation and validation of a predictive model for disease activity in patients with Juvenile Idiopathic Arthritis”**

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**Abstract**

**Introduction:** Juvenile Idiopathic Arthritis (JIA) is a chronic inflammatory condition affecting children and adolescents. Its management is challenging due to limited access to specialized care. Telemedicine has emerged as a potential solution to enhance care accessibility. However, no predictive models are currently available to forecast disease activity in JIA patients, limiting its optimal use. While machine learning (ML) models have effectively predicted disease activity in adult rheumatology with Rheumatoid Arthritis, similar models for JIA are absent.

**Objectives:** Develop and validate a predictive model for forecasting disease activity in patients under 18 years old with JIA at the next consultation, and validated its applicability in a cohort of adult JIA patients.This model will utilize patient characteristics, current medications, disease activity measures, patient-reported outcomes (PROs), and inflammatory markers. Secondary objectives include assessing the model's performance across different JIA subtypes and comparing various ML algorithms to identify the most effective approach.

**Methods:** An observational, retrospective cohort study will use data from Reuma.pt, a long-term registry by the Portuguese Society of Rheumatology. The model will be derived and internally validated using approximately 13,000 appointments from 1,369 JIA patients under 18 years old from 72 Portuguese centers. After model development it will be validated in reuma.pt Portuguese cohort of adult JIA patients. External validation and refinement will involve about

2,000 appointments from 446 JIA patients from 12 Brazilian centers. Variables include demographic data, clinical characteristics, laboratory values, PROs, and medication use. Supervised ML algorithms, such as random forests and neural networks, will be applied to construct the predictive model, with performance assessed using metrics like sensitivity, specificity, and the area under the ROC curve.

**Conclusion:** Developing a machine learning–based predictive model for disease activity in JIA patients addresses a significant gap in pediatric rheumatology care. The model can enhance clinical decision-making, optimize treatment strategies, and improve patient outcomes by anticipating disease progression.