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MetaFlow: A Living, Hybrid Architecture for Real-Time Meta-Analysis of Antihypertensive Efficacy

Mahmood Ahmad

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Abstract

Traditional systematic reviews are often behind and cochrane reviews take years to publish. We developed MetaFlow, an html file capable of performing true real-time meta-regression of systolic blood pressure (SBP) reduction with cardiovascular outcomes. The system employs a hybrid data intake architecture, which anchors a verified backbone of 23 landmark historical trials (e.g., SPRINT, ALLHAT, HYVET) with a living, multi-vector "swarm" of completed trials mined directly from the ClinicalTrials.gov API v2 via a secure proxy.

The Data processing is then offloaded to a Web Worker, which uses inverse-variance weighted OLS regression to estimate the log-linear dose-response relationship (w = 1/SE^2). Pooled effects are then calculated using a DerSimonian-Laird random-effects model to account for residual heterogeneity. In a representative analysis done on 10/12/2025 (k=47, n=347,044), the engine demonstrated a log-linear association with a regression slope of beta approx -0.015, predicting a 14% relative risk reduction (RR 0.86) per 10 mmHg SBP decrement.

This is set off by substantial residual heterogeneity (I^2 approx 50%) highlights the need for random-effects modeling. MetaFlow demonstrates that distributed, browser-based tools can automate high-rigor evidence synthesis into living, verifiable data artifacts.

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