WaterNajia

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Can a browser-based Bayesian risk engine provide probabilistic water safety assessments calibrated to regional bacteria prevalence for low-resource settings? We built WaterNajia as a 1,784-line single-file application implementing logit-scale risk scoring with Monte Carlo simulation across 15 environmental and infrastructure risk factors for six water source types. The engine uses exponential decay modelling for time-since-contamination events, factor-group exclusivity logic, and region-specific bacteria prevalence priors derived from WHO and UNICEF surveillance data. For the full risk stack scenario with piped water, the posterior contamination probability was 0.92 (95% credible interval 0.87 to 0.96) from 200 Monte Carlo samples with seed-deterministic XorShift128Plus pseudorandom generation. A parallel Rust and WebAssembly implementation achieved bit-exact agreement with the JavaScript reference across all five golden test vectors. Real-time probabilistic water safety scoring could support field-level decision-making in humanitarian and public health contexts. The risk model relies on aggregate regional prevalence data and cannot capture hyperlocal contamination sources or seasonal variation.