

New model for vancomycin patients on hemodialysis improves predictive performance

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At InsightRX, we continuously refine population pharmacokinetic (popPK) models to support precision dosing in at-risk populations. Adults undergoing hemodialysis and treated with vancomycin represent a group with limited validated PK models and scarce real-world performance data. To address this, we evaluated existing models [1-5] using clinical data from 83 sites and developed a new model using our continuous learning process. This model is now integrated into InsightRX Nova to improve individualized vancomycin dosing in hemodialysis patients.

Data collection: Patient data were collected during routine clinical care of adult patients treated with vancomycin undergoing continuous renal replacement therapy (CRRT). Randomly sampled data from non-HD patients were added to stabilize model estimation. Data entered into InsightRX Nova between June 2015 and June 2025 were de-identified and analyzed retrospectively. Patients were included if they were at least 18 years old and had at least one serum vancomycin level collected, resulting in a data set of 2489 patients across 83 sites.

Model fitting: The data set was split into a training (70%) and test (30%) set. We tested various approaches and covariates to describe hemodialysis, ultimately selecting a two-compartment popPK model with fat free mass, serum creatinine, and age as covariates, with physiological and CRRT clearance modeled additively.

Model predictive performance: For each patient in the test set,

population PK parameters were used to predict the value of the first serum vancomycin level. Subsequent levels were predicted using individualized PK parameter estimates using *maximum a posteriori* (MAP) Bayesian estimation, and these parameters were iteratively used to predict the next level. That is, the (N+1)th observation was estimated using all data up to the Nth observation. Prediction error was assessed using accuracy, mean percent error (MPE), and normalized root mean square error (nRMSE) of the predictions. A prediction was deemed accurate if the prediction was within 20% or 2.5 mg/L of the observation.

Results: The newly fitted model for hemodialysis significantly improved accuracy, and decreased bias and error across patients undergoing hemodialysis in the test set. The Oda model [6], which requires additional covariates not routinely collected, performed worse than the modified Goti ("mG") model [5] in another model comparison [7].

Conclusion: InsightRX recommends using the new Tong model as the default for dosing vancomycin in adult patients undergoing CRRT.

