Vancomycin Area Under the Concentration-Time Curve Estimation Using a Bayesian Approach Versus First-Order Pharmacokinetic Equations: a Pilot Study

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Background

- Current guidelines endorse vancomycin area under the concentration-time curve (AUC)-based monitoring over trough-only monitoring for serious methicillin-resistant *Staphylococcus aureus* (MRSA) infections[1]
- Vancomycin AUC can be estimated using either Bayesian modeling software or first-order pharmacokinetic (PK) calculations
- Both methods have pros and cons; Bayesian software is generally more expensive, but can estimate an AUC using potentially just one vancomycin level
- **Purpose**: to compare a Bayesian modeling program and first order PK equations in terms of efficiency for calculating the estimated vancomycin AUC

Compared to first-order PK equations, estimating a vancomycin AUC with Bayesian software (if integrated in the EHR):

- Required **less time** to calculate vancomycin AUC
- Allowed for **greater flexibility** with regards to timing levels, which led to fewer unusable vancomycin levels
- Required **fewer overall vancomycin levels** to be drawn

Take a picture of the QR code for more info (protocol, education examples, methods poster), and/or reach out on Twitter to further discuss!

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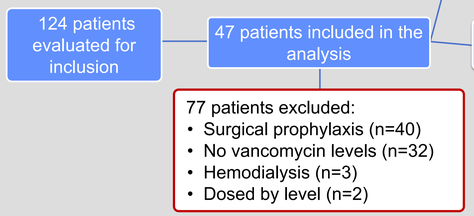
Methods

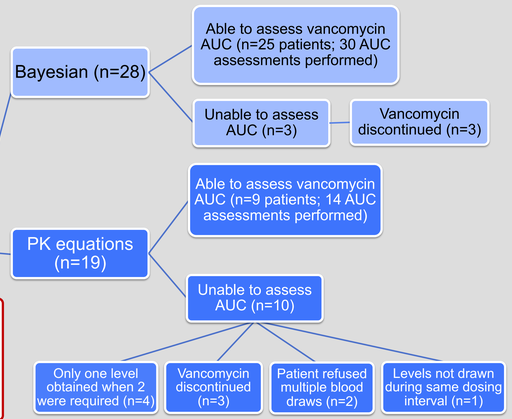
- Single-center, prospective, crossover study
- 4 medical/surgical units at Brigham & Women's Hospital over a 2-month time period (11/11/19 – 1/13/20)
- Intervention
  - Vancomycin concentration monitoring by Bayesian modeling (InsightRX®) versus PK calculations (EPIC® Kinetics Navigator)
  - Extensive education to clinicians, pharmacists, and nursing on the changes to the protocol for vancomycin monitoring (see specific examples in QR code)
- Primary endpoint
  - Time taken to estimate a vancomycin AUC and determine dose adjustments with PK calculations compared to Bayesian modeling, with and without electronic health record (EHR) integration (see full protocol in QR code for details)
- Secondary endpoint
  - Number of vancomycin levels drawn & percentage that were usable for AUC calculations
- Partners Healthcare Institutional Review Board deemed project exempt as it was a quality improvement initiative
- Inclusion Criteria:
  - All adult patients receiving vancomycin during the study period on the pilot floors
- Exclusion Criteria:
  - Vancomycin for surgical prophylaxis
  - No vancomycin levels drawn
  - Patients on hemodialysis
  - Vancomycin dosed by level
    - *due to acute kidney injury*

Patient Enrollment



Results

Level Assessment Breakdown



Primary Endpoint: Time to Estimate AUC

Variable (n=level assessments)	Bayesian (n=30)	PK equations (n=14)	p-value
Total time: Bayesian versus PK equations	9.3 (7.8-12.4)	6.8 (4.8-8)	0.004
Adjusted time if Bayesian software is EHR-integrated versus PK equations	3.8 (2.3-6.9)	6.8 (4.8-8)	0.019

*All data presented in minutes as median (IQR)

Secondary Endpoint: Vancomycin Levels

Variable (n=levels)	Bayesian (n=34)	PK equations (n=58)	p-value
Usable vancomycin levels to calculate AUC, n (%)	30/34 (88.2%)	28/58 (48.3%)	0.001

Limitations

- Single-center study with a small sample size
- Primary endpoint only applicable to Bayesian modeling using InsightRX®
- Access to InsightRX® was through a web-based program, so time was adjusted to infer pharmacists' time if integrated into EHR

Conclusion

- The Bayesian approach using InsightRX® takes less time to calculate vancomycin AUC and recommend dose changes if integrated into the EHR
- Individual institutions should weigh the pros and cons of different vancomycin monitoring solutions to determine the best methods for their needs

Disclosures

- Bayesian modeling software was donated by InsightRx® for the purposes of this project
- All authors have nothing else to disclose

Reference

1. Rybak M, Le J, Lodise, TP, et al. Therapeutic monitoring of vancomycin: A revised consensus guideline and review of the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, the Pediatric Infectious Diseases Society and the Society of Infectious Diseases Pharmacists. Am J Health Syst Pharm. 2020;77(11):835-864. doi:10.1093/ajhp/zxaa036.