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Characterization of Vancomycin Use at a Community Hospital

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OBJECTIVE

- To characterize the use of vancomycin medication therapy at a non-profit community hospital (Parkview Regional Medical Center) in preparation for a potential change to AUC:MIC dosing and monitoring.

BACKGROUND

- Vancomycin is a bactericidal glycopeptide antibiotic that inhibits cell wall synthesis. The spectrum of activity is limited to only gram-stain positive bacteria; however, it is effective against methicillin resistant *Staphylococcus aureus* (MRSA) for which it is the mainstay of treatment.[1]
- Currently, pharmacodynamic monitoring of vancomycin efficacy and safety is by drug trough evaluation when at steady state (typically prior to the fourth dose). For patients who have sporadic renal function (i.e., new onset acute kidney injury, rapidly declining chronic kidney disease, or undergoing hemodialysis), a random drug level may be drawn for closer monitoring.[1]
- Infectious Disease Society of America (IDSA) guidelines cite some evidence that an AUC:MIC dosing strategy may allow clinicians to evaluate vancomycin dosing before steady state (as soon as the second dose), promoting quicker times to therapeutic range and decreased incidence of vancomycin induced nephrotoxicity.[2]
- Monitoring via AUC:MIC is especially beneficial in those with critical illness. For all, the acceptable AUC:MIC therapeutic range is 400 – 600 mg-hr/L, whereas a ratio > 650 mg-hr/L has been associated with an increased incidence of acute kidney injury.[2]

METHODS

- Retrospective analysis at PRMC between January 1, 2021 through May 31, 2022
- Inclusion criteria: > 18 years of age, ≥ 2 doses of vancomycin received
- Exclusion criteria:

Transfer from outlying facility	Orders for any form of dialysis	Pre-operative dosing frequency	Located in the operating room at time of ordering

*If the patient was admitted > 1 time during the study period, only the first encounter was used for data collection

- Data was extracted from the institution's electronic medical record system and manually validated
- Using a random number generator in Microsoft Excel, a subset of 300 patients were chosen to analyze. Upon further review, an additional 36 patients met exclusion criteria and were removed from the analysis.
- Patient demographics, laboratory values, concomitant medications and culture data were gathered.
- Patients were categorized based on whether their vancomycin was:
  - Discontinued, changed to alternate oral therapy, changed to alternate IV therapy, completed, or continued outpatient
  - Incidence of acute kidney injury (AKI) was evaluated with respect to concomitant nephrotoxic medications and increases in serum creatinine
    - AKI was defined as a rise of serum creatinine by 0.3 mg/dL or more within 48 hours of a vancomycin dose being given

RESULTS

- 3386 subjects screened → 1973 subject pool → 300 subject random sample → 264 subject final random sample
  - Most excluded due to transfer from other facility (43%) or dialysis orders (39%)

Table 1: Baseline Characteristics (n = 264)	
Median age (year, IQR)	64 (52 – 73)
Median weight (kg, IQR)	87 (71 – 108)
Body Mass Index (BMI) Classification (n, %)	
Underweight (BMI < 20 kg/m^2)	21 (8)
Healthy weight (BMI 20 – 24.9 kg/m^2)	54 (21)
Overweight (BMI 25 – 29.9 kg/m^2)	62 (24)
Class I obesity (BMI 30 – 34.9 kg/m^2)	55 (21)
Class II obesity (BMI 35 – 39.9 kg/m^2)	26 (10)
Class III obesity (BMI ≥ 40 kg/m^2)	44 (17)
Male sex (n, %)	142 (54)
Use of prior IV antibiotics within 90 days (n, %)	84 (32)
Prior MRSA culture collected within 5 years (n, %)	29 (11)
Positive MRSA nasal swab during admission (n, %)	9 / 73 (12)
Number of orders originating from the Emergency Department (n, %)	156 (59)
Pharmacy to dose consult (n,%)	204 (77)

Figure 1: Percent of Vancomycin Orders by Indication (n = 264)

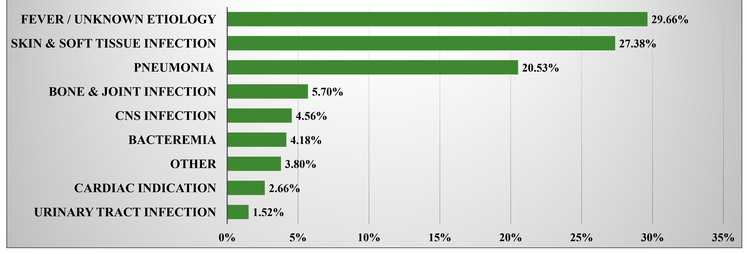


Table 2: Vancomycin Patient Outcomes	
Median length of stay (days, IQR)	6 (3.5 – 11)
Median number of vancomycin doses per patient (IQR)	4 (2 – 6)
Median duration of vancomycin therapy (days, IQR)	2 (1.5 – 3.5)
Mean number of vancomycin levels drawn per patient (SD)	1.49 ± 0.82
Percentage of patients receiving a loading dose (%)	61
Surgical intervention involved (n, %)	33 (13)
Median time to de-escalation (days, IQR)	2 (1.5 – 3.5)

Figure 2: Initial Dosing of Intervals of Vancomycin

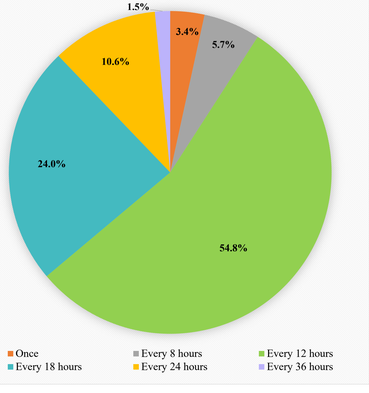
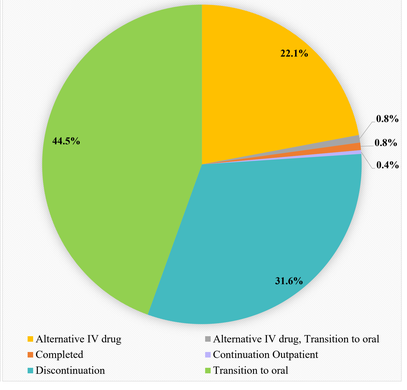


Figure 3: Result of De-escalation



RESULTS

Figure 4: Subsequent Antibiotic Orders After Vancomycin De-escalation (n = 178)

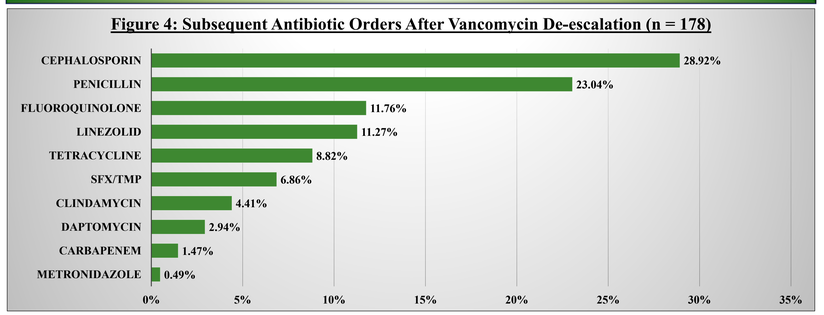
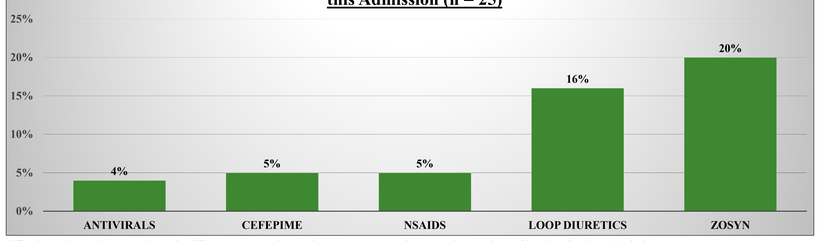


Figure 5: Concomitant Nephrotoxic Medications Among Patients with AKI During this Admission (n = 25)



*Each patient who experienced AKI were exposed to at least one concomitant nephrotoxic medication during admission

DISCUSSION & CONCLUSIONS

- Parkview Health's vancomycin dosing protocol of a 25 mg/kg loading dose for serious infections and a 15 mg/kg (actual body weight) maintenance dose resulted in an AKI incidence of 9.5%, and a median time to de-escalation of 2 days within the study period.
- Most commonly, vancomycin was started for indications of fever & illness of unknown etiology, followed by skin and soft tissue infections, and pneumonia. According to IDSA pneumonia guidelines, empiric coverage of MRSA is not warranted unless specific criteria are met (IV antibiotics within 90 days or prior positive culture of MRSA). These criteria were not met for many patients empirically being treated for pneumonia.
- A small percentage of patients received MRSA nasal swabs (including nasal cultures and nasal PCR tests) although a larger percentage of patients had an indication of pneumonia and/or skin and soft tissue infections for which the testing has evidence to support. There may be potential for more frequent utilization of a MRSA nasal swab.
- Among those who possibly experienced AKI due to vancomycin, each were exposed to at least one prespecified concomitant nephrotoxic drug class during their admission.
- The cost benefit debate of purchasing Bayesian software against manually validating lower-cost alternatives for AUC:MIC vancomycin dosing will require further discussion primarily based around the relatively short time to de-escalation and low incidence of positive MRSA cultures.

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Disclosure

The authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation:
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