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Predialysis vancomycin target attainment after post-hemodialysis dosing in Kenya: a prospective observational study

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ABSTRACT

Background

Vancomycin dosing during intermittent hemodialysis is challenging, and access to therapeutic drug monitoring and area-under-the-curve-based dosing may be limited in resource-constrained dialysis settings. Prospective evidence on vancomycin exposure in African hemodialysis populations remains scarce. We evaluated predialysis concentrations achieved after 500- and 1000-mg post-hemodialysis dosing at a Kenyan tertiary hospital.

Methods

We conducted a prospective, single-centre observational study among adults receiving maintenance hemodialysis and empirical intravenous vancomycin for suspected catheter-related bloodstream infection. Participants received a post-hemodialysis dose of 500 mg or 1000 mg, as prescribed by the treating clinicians as part of routine care. Predialysis vancomycin concentrations were measured at study-designated 2-day and 3-day interdialytic intervals. Concentrations were classified relative to a study-defined reference range of 15–20 mg/L. Attainment, within-participant change, differences between dose groups, and exploratory associations with participant characteristics were evaluated. Culture results, including the organisms isolated, were summarised descriptively.

Results

Eighteen participants were enrolled, and 17 had evaluable concentration measurements. Mean predialysis concentrations were 8.51 mg/L (SD 5.19) and 9.52 mg/L (SD 6.04) at the 2-day and 3-day measurements, respectively. Fourteen of 17 participants (82.4%) had concentrations below 15 mg/L at each measurement, and one participant (5.9%) was within the 15–20 mg/L range at both measurements. The median paired change was +0.60 mg/L (IQR 0.00–1.50; P=0.002). Body weight was not associated with patient-mean concentration (Spearman ρ=0.023; P=0.931), and concentrations did not differ detectably between the 500- and 1000-mg groups (P=0.397). Organisms were isolated from 12/18 participants (66.7%), all with at least one Gram-positive organism; *Staphylococcus aureus* was the most frequent isolate (7/18, 38.9%), and six of the seven evaluable participants with *S. aureus* had patient mean predialysis concentrations below 15 mg/L.

Conclusions

Fixed post-hemodialysis dosing frequently resulted in predialysis vancomycin concentrations below the study-defined reference range, while occasional above-range concentrations demonstrated substantial interindividual variability. Because *S. aureus* predominated among culture-positive participants, sustained subtherapeutic exposure is of concern not only for treatment failure but also for the selection of strains with reduced vancomycin susceptibility in hemodialysis patients. These findings support prospective

evaluation of feasible concentration-guided dosing strategies for hemodialysis programmes where more sophisticated pharmacokinetic monitoring is not routinely available.

Keywords: antimicrobial resistance; catheter-related bloodstream infection; hemodialysis; Kenya; *Staphylococcus aureus*; therapeutic drug monitoring; vancomycin

INTRODUCTION

Chronic kidney disease is a major contributor to global morbidity and mortality, with a disproportionate burden in low- and middle-income settings [1]. Among patients requiring maintenance hemodialysis, central venous catheters remain an important source of bloodstream infection [2]. A recent systematic review estimated a pooled prevalence of catheter-related bloodstream infection of 22.8% among hemodialysis populations and 30.4% in African cohorts [3]. In Kenya, invasive vascular access has contributed substantially to healthcare-associated *Staphylococcus aureus* bacteraemia, while methicillin-resistant *S. aureus* (MRSA) remains an important regional antimicrobial-resistance concern [4, 5].

Vancomycin is widely used for empirical Gram-positive coverage when serious catheter-associated infection or MRSA infection is suspected. Its disposition during intermittent hemodialysis is difficult to predict because residual renal clearance, body size, dialysis membrane permeability, dialysis duration, administration timing and interdialytic interval can influence the concentration subsequently measured [6, 7]. A fixed nominal dose can therefore produce substantially different exposure between patients.

Contemporary guidance recommends dosing guided by the area under the concentration–time curve (AUC) for serious MRSA infection in the general population. Intermittent hemodialysis is an important practical exception: direct AUC estimation is difficult in routine dialysis care, and predialysis concentration monitoring remains a recommended practical approach. Predialysis concentrations of 15-20 mg/L are considered likely to correspond to an AUC of approximately 400–600 mg·h/L over the preceding 24 hours when the MIC is 1 mg/L, although the evidence base in hemodialysis is limited [8, 9]. Existing guidance and simulation studies provide weight-informed starting schemes but emphasise subsequent adjustment using measured concentrations [10, 11].

Inadequate vancomycin exposure affects more than the individual patient. Subtherapeutic concentrations, particularly troughs below 10 mg/L, have been linked to the emergence of *S. aureus* subpopulations with reduced vancomycin susceptibility. These include heterogeneous vancomycin-intermediate *S. aureus* (hVISA) and vancomycin-intermediate *S. aureus* (VISA), which are in turn associated with persistent bacteraemia and treatment failure [12–14]. Concentrations that exceed the MIC of the susceptible population but are too low to suppress less-susceptible mutants are thought to favour the selective enrichment of these mutants [15]. Patients on maintenance hemodialysis are especially vulnerable to this risk. They often have indwelling vascular catheters, recurrent bloodstream infections, frequent contact with healthcare, and repeated courses of vancomycin. Achieving adequate predialysis vancomycin concentrations therefore matters both for individual treatment outcomes and for containing antimicrobial resistance in dialysis populations.

Evidence on vancomycin exposure during maintenance hemodialysis remains limited in African settings, where dialysis capacity is expanding but access to therapeutic drug monitoring and AUC-based dosing may be constrained. Understanding the performance of routinely feasible dosing approaches is therefore relevant not only to individual treatment but also to antimicrobial stewardship, prevention of antimicrobial resistance and safe delivery of dialysis care in resource-constrained settings. We evaluated whether routinely prescribed 500- and 1000-mg post-hemodialysis doses achieved a study-defined predialysis reference range of 15–20 mg/L, assessed within-participant changes across repeated measurements, and explored associations with body weight, administered dose per kilogram, age, sex, and urine output. We also described the organisms isolated in relation to the concentrations achieved.

MATERIALS AND METHODS

Study design and setting

The study was a prospective, single-centre observational study of predialysis vancomycin concentrations among participants who received a post-hemodialysis vancomycin dose of 500 mg or 1000 mg, as prescribed by the treating clinicians as part of routine care. It was conducted in the hemodialysis unit of Kenyatta National Hospital, Nairobi, Kenya, from 24 June to 1 September 2024. Participants were enrolled under the approved protocol, and all available study records relevant to vancomycin concentration assessment were included.

Participants

Adults aged 18 years or older receiving maintenance hemodialysis were eligible if they had clinical features suggestive of catheter-related bloodstream infection and were prescribed empirical intravenous vancomycin. Recorded presenting features included fever, chills, fatigue, nausea, vomiting and other symptoms documented in the study records. Patients younger than 18 years, pregnant patients and patients who did not provide informed consent were excluded. Culture results, including the identity of any organism isolated, were recorded for all enrolled participants.

Sampling and sample size

A total of 18 eligible patients presenting to the dialysis unit during the study period were enrolled consecutively. One participant died before evaluable predialysis concentration measurements were available, leaving 17 participants for concentration analyses.

Vancomycin dosing and concentration measurements

Vancomycin was administered post-hemodialysis at nominal doses of 500 mg or 1000 mg, as prescribed by the treating clinician. For each evaluable participant, serum vancomycin concentrations were measured immediately before the subsequent dialysis session, at two

time points corresponding to 2-day and 3-day interdialytic intervals. Concentrations were measured using a Cobas Integra 400 plus analyser (Roche Diagnostics, Mannheim, Germany) at the Cerba Lancet Nairobi Main Lab, Kenya.

Study endpoints

The principal endpoints were predialysis concentration at each measurement and the proportion of participants below (<15 mg/L), within (15-20 mg/L) or above (>20 mg/L) the study-defined reference range. Patient-level consistency was described by transitions between these categories and by the proportion within range at both measurements. The paired concentration change was defined as the 3-day concentration minus the 2-day concentration. Exploratory participant-level analyses considered body weight, administered dose per kilogram, age, sex, quantitative urine output and dose group received. Culture results were summarised descriptively as no growth or growth, with isolated organisms reported by species and Gram reaction; reference-range attainment was also described separately for participants with *S. aureus*, for all culture-positive participants and for culture-negative participants.

Statistical analysis

Continuous variables were summarised using means with standard deviations and medians with interquartile ranges; categorical variables were reported as counts and percentages. Wilson 95% confidence intervals were calculated for key attainment proportions. Paired 2-day and 3-day concentrations were compared using the Wilcoxon signed-rank test with Pratt treatment of zero differences, with an exact two-sided sign test excluding zero differences as a direction-only sensitivity analysis. Spearman rank correlation was used for associations of body weight, dose per kilogram, age and urine output with concentration; 95% confidence intervals were estimated from 10,000 participant-level bootstrap resamples. The 500- and 1000-mg dose groups and sex groups were compared using the Mann-Whitney U test. Exploratory clinical-response comparisons used Mann-Whitney or Fisher exact tests as appropriate. A sensitivity analysis assessed the handling of concentrations at the 4.0 mg/L assay reporting boundary by reassigning these values to 2.0 mg/L.

Bias and data-quality considerations

Eligible patients were enrolled consecutively to limit discretionary participant selection. Because vancomycin dose (500 mg or 1000 mg) was determined by the treating clinicians rather than allocated by the study, comparisons between dose groups are descriptive and may be affected by confounding by indication. The uncertain weight value for the deceased participant was excluded from the primary body-weight summary. Post-treatment symptom categories were recorded; because concomitant antimicrobial therapy was also documented, symptom improvement was not attributed specifically to vancomycin.

Ethical considerations

Ethical approval was obtained from the KNH-UoN Ethics and Research Committee before participant enrolment (application/approval number P102/02/2024; letter reference KNH-ERC/A/230; approval dated 20 June 2024). Written informed consent was obtained before enrolment and data collection. Study data were handled according to clinical-research confidentiality procedures and the principles of the Declaration of Helsinki.

RESULTS

Study population

Eighteen participants were enrolled. The cohort comprised 10 (55.6%) male and 8 (44.4%) female participants. Mean age was 46.39 years (SD 9.57), with a median of 45.50 years (IQR 39.50-51.50). Primary body-weight summaries included 17 participants because the deceased participant's recorded weight was uncertain; mean body weight was 66.61 kg (SD 9.04), with a median of 68.00 kg (IQR 63.00-71.00). Prescribed vancomycin doses were 500 mg in 8/18 participants (44.4%) and 1000 mg in 10/18 (55.6%). Participant, dialysis, and clinical characteristics are summarised in Table 1.

Table 1. Participant, dialysis, and clinical characteristics.

Predialysis concentrations and reference-range attainment

At the 2-day measurement, mean predialysis concentration was 8.51 mg/L (SD 5.19) and median concentration was 5.50 mg/L (IQR 4.00-10.40). At the 3-day measurement, mean concentration was 9.52 mg/L (SD 6.04) and median concentration was 8.30 mg/L (IQR 4.00-13.20). Fourteen of 17 participants (82.4%) were below 15 mg/L at each measurement. At 2 days, 3/17 were within 15-20 mg/L and none were above 20 mg/L; at 3 days, 1/17 was within range and 2/17 were above 20 mg/L. Only 1/17 participants (5.9%) was within range at both measurements (Table 2; Figure 1).

Table 2. Predialysis vancomycin concentrations and study-defined reference-range attainment.

Figure 1. Individual predialysis vancomycin concentrations and attainment of the study-defined 15–20 mg/L reference range.

Paired concentration change

The median paired change from the 2-day to the 3-day measurement was +0.60 mg/L (IQR 0.00-1.50). Ten participants had a higher 3-day concentration, seven were unchanged and none had a lower recorded concentration. The Wilcoxon signed-rank analysis with Pratt treatment of zero differences gave P=0.002, and the exact sign test gave P=0.002 (Table 2).

Body weight and dose

Neither body weight (Spearman ϱ=0.023; P=0.931) nor administered dose per kilogram showed a convincing association with patient-mean predialysis concentration, and concentrations overlapped substantially between the 500- and 1000-mg dose groups (P=0.397; Figure 2). Exploratory analyses of age, sex, and urine output similarly showed no clear associations

Figure 2. Body weight, vancomycin dose groups and predialysis vancomycin exposure.

Microbiology and clinical response

Six of 18 participants (33.3%) had no growth, and 12 (66.7%) had at least one organism isolated, yielding 13 isolates (Tables 1 and 3). All culture-positive participants had a Gram-positive organism. *Staphylococcus aureus* was the most frequent isolate (7/18, 38.9%), including one polymicrobial culture with *Stenotrophomonas maltophilia*. *Streptococcus pyogenes* was isolated from two participants (11.1%), and *Streptococcus pneumoniae* and *Enterococcus faecium* from one participant each (5.6%). Among the seven evaluable participants with *S. aureus*, six (85.7%) had patient-mean predialysis concentrations below 15 mg/L (median 6.85 mg/L; range 4.00–19.00), three of whom had both measurements at or below the 4.0 mg/L assay boundary; only one reached the reference range at either measurement. Overall, 9/11 evaluable culture-positive participants (81.8%) and 5/6 culture-negative participants (83.3%) had patient-mean concentrations below 15 mg/L (Table 3). Post-treatment symptom status was recorded as symptoms resolved in four participants, improvement without complete resolution in 13, and death in one (Table 3).

Table 3. Reported microbiology, reference-range attainment by culture result, and documented post-treatment clinical response.

Assay-boundary sensitivity

Alternative handling of the assay-boundary observations did not materially alter the paired-interval finding: the Wilcoxon-Pratt P value remained 0.002 in the primary analysis, when

explicitly documented <4.0 mg/L values were assigned 2.0 mg/L, and when all exact 4.0 mg/L values were assigned 2.0 mg/L (Supplementary Table S4; Supplementary Figure S1).

DISCUSSION

The principal finding is that fixed post-hemodialysis vancomycin dosing of 500 or 1000 mg did not reliably achieve the study-defined 15-20 mg/L predialysis reference range: more than four-fifths of evaluable participants remained below 15 mg/L at each measurement, and only one participant achieved the target range at both time points. Exposure was not uniformly low, however; two participants exceeded 20 mg/L by the 3-day measurement, and predialysis concentrations rose modestly but consistently between the 2-day and 3-day measurements (median +0.60 mg/L; Wilcoxon-Pratt P=0.002). Taken together, these findings indicate frequent underexposure combined with marked interindividual variability.

This pattern of frequent underexposure is broadly consistent with earlier reports that fixed post-hemodialysis vancomycin doses often fail to achieve target concentrations, reflecting the complex interplay of residual renal clearance, dialysis-membrane permeability, session duration and interdialytic interval that governs vancomycin removal during intermittent hemodialysis [6, 7]. Contemporary consensus guidance for serious MRSA infection favours AUC-guided dosing but recognises intermittent hemodialysis as an important practical exception, in which predialysis concentration monitoring within a target range remains an accepted, though less rigorously validated, alternative [8, 9, 11, 16]. Weight-informed starting-dose schemes derived from population-pharmacokinetic and Monte Carlo simulation studies have been proposed to reduce the frequency of subtherapeutic exposure [10, 17–19], and earlier cohort studies have similarly reported that a meaningful proportion of hemodialysis patients receiving empirical or fixed-dose vancomycin regimens do not achieve target trough concentrations without subsequent adjustment [17–20]. The below-range proportion observed in the present cohort is at the higher end of what has been described in this literature, which may reflect differences in patient case-mix, dialysis prescription, dosing timing or the specific reference range applied; a formal quantitative comparison is, however, limited by heterogeneity across studies in dosing protocols, sampling timing and target-range definitions.

Within this cohort, neither body weight nor administered dose per kilogram showed a convincing association with patient-mean concentration, and the 500- and 1000-mg dose groups overlapped substantially despite the two-fold difference in dose. This finding is compatible with the broader pharmacokinetic literature indicating that vancomycin exposure during intermittent hemodialysis is governed by more than body size alone: residual renal clearance, dialyser flux and membrane characteristics, blood and dialysate flow rates, session duration and, critically, the timing of dosing relative to the dialysis session all influence the

concentration subsequently measured [6, 7]. The modest increase between the 2-day and 3-day measurements may reflect differences in interdialytic drug accumulation, dosing history, redistribution, or other dialysis-related factors [6, 7]. Because exact dose-to-dialysis timing was unavailable, the present study cannot determine the mechanism underlying this pattern.

The broader relevance of these findings lies in the implementation gap between increasingly individualised vancomycin dosing recommendations and the realities of dialysis care in settings where AUC estimation, Bayesian dosing software, or frequent therapeutic drug monitoring may not be routinely available. As dialysis services expand in sub-Saharan Africa, pragmatic approaches that balance pharmacological precision with laboratory capacity, cost, staffing, and treatment workflows will be needed. The present study provides preliminary prospective evidence to inform such implementation research.

These findings have practical implications for hemodialysis units, particularly in African settings where catheter-related bloodstream infection and methicillin-resistant *S. aureus* remain important clinical concerns [3–5] and where access to therapeutic drug monitoring and AUC-based dosing software is often limited [11]. The high proportion of predialysis concentrations below the study-defined reference range under standard fixed-dose practice raises a plausible concern for undertreatment of serious Gram-positive and MRSA infections, while the minority of patients who exceeded the target range illustrates the risk of unintended overexposure should doses be escalated uniformly rather than individually. From an antimicrobial stewardship perspective, this reinforces the case for structured predialysis concentration monitoring, where feasible, as a pragmatic means of individualising therapy in settings where direct AUC estimation is not routinely achievable [8, 9, 11]. Concentration-guided adjustment could help identify both below-range exposure and unintended accumulation, particularly where residual kidney function and dialysis characteristics vary between patients.

The microbiological findings strengthen these concerns. Gram-positive organisms were isolated from every culture-positive participant, and *S. aureus*, the principal target of empirical vancomycin therapy for catheter-related bloodstream infection [16], was the most frequent isolate; yet six of the seven evaluable participants with *S. aureus* had patient-mean concentrations below 15 mg/L, three of them at or below the assay boundary. Predialysis concentration relative to the infecting organism's MIC, and AUC relative to MIC, have been associated with treatment outcomes and early clinical response in hemodialysis patients with MRSA and other Gram-positive infections [21, 22]. Beyond treatment failure, prolonged exposure to subtherapeutic vancomycin concentrations is a recognised driver of reduced susceptibility in *S. aureus*: low serum vancomycin levels have been associated with hVISA bacteraemia [14], troughs below 10 mg/L have been linked to the emergence of VISA [12, 13], and concentrations persisting within the mutant selection window are expected to enrich less-

susceptible subpopulations [15]. Hemodialysis patients combine several features that amplify this risk, including indwelling vascular catheters, recurrent infection, frequent healthcare contact and repeated vancomycin courses, and were prominent among the earliest reported VISA and VRSA cases [23, 24]. In a setting where MRSA is a recognised regional concern [4, 5] and vancomycin MIC testing was not captured, persistently low exposure may therefore carry implications for antimicrobial resistance at the dialysis-unit level as well as for individual patients. The isolation of *Stenotrophomonas maltophilia*, a Gram-negative organism outside the spectrum of vancomycin and intrinsically resistant to many β-lactams, further illustrates why culture and susceptibility results should be used promptly to guide targeted therapy and de-escalation.

Rather than supporting a new fixed- or weight-based dosing rule, these findings identify a priority for prospective implementation research. Future studies should evaluate whether structured predialysis concentration monitoring with individualised dose adjustment is feasible, affordable, and clinically beneficial in African hemodialysis programmes, while prospectively capturing exact dosing and dialysis timing, residual kidney function, antimicrobial susceptibility, surveillance for reduced vancomycin susceptibility, and patient-centred outcomes.

This study had several limitations. The small sample size (17 evaluable participants) yielded wide confidence intervals and limited power for between-group comparisons, and the single-centre design may limit generalizability. In addition, because doses were prescribed clinically rather than allocated by the study, comparisons between the 500- and 1000-mg groups may be confounded and should be interpreted as descriptive.

CONCLUSIONS

In this small prospective study from a Kenyan tertiary hemodialysis unit, fixed post-hemodialysis vancomycin dosing frequently resulted in predialysis concentrations below the study-defined 15–20 mg/L reference range, while occasional above-range concentrations demonstrated substantial interindividual variability. *Staphylococcus aureus* was the most common isolate, and most participants with *S. aureus* had concentrations below the reference range, a pattern that risks both treatment failure and the selection of strains with reduced vancomycin susceptibility. These findings highlight the need to prospectively evaluate feasible concentration-guided individualisation strategies in African dialysis settings, particularly where access to AUC-based therapeutic drug monitoring is limited.

DECLARATIONS

Ethics approval and consent to participate

The study was reviewed and approved by the Kenyatta National Hospital–University of

Nairobi Ethics and Research Committee (KNH-UoN ERC; approval number P102/02/2024; reference KNH-ERC/A/230; approved 20 June 2024, approval period 20 June 2024 to 19 June 2025). All study procedures were performed in accordance with the approved protocol and the Declaration of Helsinki.

Written informed consent was obtained from all participants before enrolment.

Consent for publication

Not applicable.

Availability of data and materials

The de-identified dataset supporting the findings of this study is available from the corresponding author on reasonable request, subject to approval under applicable institutional and ethical requirements. The dataset is not publicly deposited because it contains individual-level clinical information from a small study population.

Competing interests: The authors declare no competing interests.

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Authors' contributions

WL: Conceptualization, Methodology, Investigation, Writing Original Draft

RM: Software, Formal Analysis, Validation, Writing, Review & Editing

DN: Validation, Writing, Review & Editing

AF: Formal Analysis, Validation, Writing, Review & Editing

CT: Conceptualization, Methodology, Formal Analysis, Writing, Review & Editing

BW: Conceptualization, Methodology, Project Administration, Supervision

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ABBREVIATIONS

AUC	**Area under the concentration-time curve**
CI	**Confidence interval**
CKD	**Chronic kidney disease**
CRBSI	**Catheter-related bloodstream infection**
hVISA	**Heterogeneous vancomycin-intermediate *Staphylococcus aureus***
IQR	**Interquartile range**
KNH	**Kenyatta National Hospital**
MIC	**Minimum inhibitory concentration**
MRSA	**Methicillin-resistant *Staphylococcus aureus***
SD	**Standard deviation**
TDM	**Therapeutic drug monitoring**
VISA	**Vancomycin-intermediate *Staphylococcus aureus***
VRSA	**Vancomycin-resistant *Staphylococcus aureus***

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Table 1. Participant, dialysis, and clinical characteristics.

Characteristic	Level	n available	Summary
Participants enrolled		18	18
Sex	Male	18	10 (55.6%)
Sex	Female	18	8 (44.4%)
Age, years		18	mean 46.39; SD 9.57; median 45.50; IQR 39.50-51.50; range 31.00-68.00
Body weight, kg		17	mean 66.61; SD 9.04; median 68.00; IQR 63.00-71.00; range 49.00-81.90
Height, cm		18	mean 164.31; SD 7.12; median 164.55; IQR 158.50-170.00; range 154.00-178.00
Vancomycin dose received	500 mg	18	8 (44.4%)
Vancomycin dose received	1000 mg	18	10 (55.6%)
Dialysate flow, mL/min		18	mean 494.44; SD 93.76; median 500.00; IQR 500.00-500.00; range 200.00-650.00
Blood flow, mL/min		18	mean 308.33; SD 84.38; median 300.00; IQR 300.00-300.00; range 150.00-600.00
Urine output, mL/24 h		18	mean 622.22; SD 524.19; median 550.00; IQR 225.00-1000.00; range 0.00-2000.00
Hypertension	Yes	18	17 (94.4%)
Hypertension	No	18	1 (5.6%)
Reported culture result	Explicit no growth	18	6 (33.3%)
Reported culture result	Organism(s) isolated	18	12 (66.7%)
Organism isolated†	*Staphylococcus aureus*	18	7 (38.9%)
Organism isolated†	*Staphylococcus* spp., not further identified	18	1 (5.6%)

Characteristic	Level	n available	Summary
Organism isolated†	*Streptococcus pyogenes*	18	2 (11.1%)
Organism isolated†	*Streptococcus pneumoniae*	18	1 (5.6%)
Organism isolated†	*Enterococcus faecium*	18	1 (5.6%)
Organism isolated†	*Stenotrophomonas maltophilia*‡	18	1 (5.6%)
Antimicrobial susceptibility	Methicillin resistance / vancomycin MIC	0	Not recorded
Post-treatment symptom status	Symptoms resolved	18	4 (22.2%)
Post-treatment symptom status	Improved but not fully resolved	18	13 (72.2%)
Post-treatment symptom status	Deceased	18	1 (5.6%)

†Participants with each organism; one participant had a polymicrobial culture (*S. aureus* and *S. maltophilia*), so organism counts sum to 13 isolates from 12 culture-positive participants. ‡Gram-negative organism, outside the spectrum of vancomycin. MIC, minimum inhibitory concentration.

Table 2. Predialysis vancomycin concentrations and study-defined reference-range attainment.

Measure	Category	n	Estimate	95% CI	Note
2-day		17	mean 8.51; SD 5.19; median 5.50; IQR 4.00-10.40; range 4.00-18.70		
2-day	below	14	82.4%	59.0-93.8%	Wilson 95% CI
2-day	within	3	17.6%	6.2-41.0%	Wilson 95% CI
2-day	above	0	0.0%	0.0-18.4%	Wilson 95% CI
3-day		17	mean 9.52; SD 6.04; median 8.30; IQR 4.00-13.20; range 4.00-20.90		
3-day	below	14	82.4%	59.0-93.8%	Wilson 95% CI
3-day	within	1	5.9%	1.0-27.0%	Wilson 95% CI
3-day	above	2	11.8%	3.3-34.3%	Wilson 95% CI
patient mean		17	mean 9.02; SD 5.60; median 6.85; IQR 4.00-11.80; range 4.00-19.80		
patient mean	below	14	82.4%	59.0-93.8%	Wilson 95% CI
patient mean	within	3	17.6%	6.2-41.0%	Wilson 95% CI
patient mean	above	0	0.0%	0.0-18.4%	Wilson 95% CI
within 15-20 mg/L at both measurements		1	5.9%	1.0-27.0%	Wilson 95% CI
3-day minus 2-day	delta	17	median 0.60; IQR 0.00-1.50; increased 10; unchanged 7; decreased 0		Wilcoxon-Pratt P=0.002; exact sign P=0.002

Table 3. Reported microbiology, reference-range attainment by culture result, and documented post-treatment clinical response.

Domain	Category	n	Percent
culture summary	Explicit no growth	6	33.3

Domain	Category	n	Percent
culture summary	Organism(s) isolated	12	66.7
organism isolated†	*Staphylococcus aureus*	7	38.9
organism isolated†	*Staphylococcus* spp., not further identified	1	5.6
organism isolated†	*Streptococcus pyogenes*	2	11.1
organism isolated†	*Streptococcus pneumoniae*	1	5.6
organism isolated†	*Enterococcus faecium*	1	5.6
organism isolated†	*Stenotrophomonas maltophilia*	1	5.6
patient-mean <15 mg/L by culture	*Staphylococcus aureus* (7 evaluable)	6	85.7
patient-mean <15 mg/L by culture	Any organism isolated (11 evaluable)	9	81.8
patient-mean <15 mg/L by culture	No growth (6 evaluable)	5	83.3
documented clinical response	Symptoms resolved	4	22.2
documented clinical response	Improved but not fully resolved	13	72.2
documented clinical response	Deceased	1	5.6

†Participants with each organism; one participant had a polymicrobial culture (*S. aureus* and *S. maltophilia*), so organism counts sum to 13. Percentages for culture summary and organisms use all 18 enrolled participants as the denominator; attainment percentages use evaluable participants in each culture category.

FIGURE LEGENDS

Figure 1. *Individual predialysis vancomycin concentrations and attainment of the study-defined 15-20 mg/L reference range. Panel A shows paired 2-day and 3-day predialysis concentrations with the reference band shaded; Panel B shows the number of participants below, within and above the reference range at each measurement.*

Figure 2. *Body weight, vancomycin dose groups and predialysis vancomycin exposure. Panel A shows body weight versus patient-mean predialysis concentration, distinguishing participants who received 500- and 1000-mg doses. Panel B compares patient-mean concentration between the 500- and 1000-mg dose groups. Panel C shows administered dose per kilogram versus patient-mean concentration. The shaded region indicates 15-20 mg/L.*

FIGURES

