



Clinical Safety & Effectiveness Cohort # 10

Improving Weight-Based Vancomycin Dosing and Monitoring



Financial Disclosure

Elizabeth A. Walter, MD, has no relevant financial relationships with commercial interests to disclose.

Heta Javeri, MD, MPH Fellow, has no relevant financial relationships with commercial interests to disclose.

The Team

- Infectious Diseases/Clinical Pharm D
 - Dr. Elizabeth Walter, MD
 - Dr. Heta Javeri, MD, MPH
 - James Lewis, Pharm D
 - Bin Xiao, Pharm D
 - Internal Medicine Nursing/Technicians
- Sponsor Department
 - Internal Medicine

What We Are Trying to Accomplish?

OUR AIM STATEMENT

1 a. To improve the use of initial weight-based vancomycin dosing in hospitalized patients by implementing and encouraging the use of a vancomycin dosing order set in Sunrise.

- Currently, 66% of patients with weight > 100 kg are inappropriately dosed with vancomycin and we aim to decrease this to 50%.

1 b. To improve the timing of initial vancomycin trough levels to ensure rapid achievement and maintenance of therapeutic drug levels (TDM).

Project Milestones

- Team Created January 2012
- Aim statement created January 2012
- Weekly Team Meetings February 2012
- Background Data, Brainstorm Sessions,
Workflow and Fishbone Analyses March 2012
- Interventions March 2012
- Data Analysis May 2012
- CS&E Presentation June 2012

Background: Dosing in Obesity

- San Antonio, Texas is one of the most obese cities in the nation.
 - San Antonio obesity rate of 28.2%
 - United States average of 27%¹
- A multicenter evaluation of vancomycin dosing found:
 - 86% of overweight patients (BMI= 25-29.9 kg/m²)
 - 91% of obese patients (BMI \geq 30 kg/m²) with gfr > 60 mL/min
 - Received a fixed dose of 2 g daily divided into two doses⁴
- A pilot study (n=65) conducted at our institution revealed that only 33% of patients > 100 kg received weight-based vancomycin dosing greater than 30 mg/kg/day.

Background: Guidelines



- Doses of 15-20 mg/kg actual body weight every 8-12 hr are optimal for most patients with normal renal function to achieve the suggested serum concentration.
- A loading dose of 25-30 mg/kg (based on ABW) in seriously ill patients to achieve a more rapid target trough concentration³.
- Trough serum vancomycin concentrations of 15–20 mg/L are recommended for complicated infections (bacteremia, endocarditis, osteomyelitis, meningitis and hospital acquired pneumonia) caused by MRSA.
- Maintain trough > 10 mg/L, based on evidence suggesting that strains with VISA like characteristics (hVISA) may develop³.

Current Status of Therapeutic Drug Monitoring (TDM)

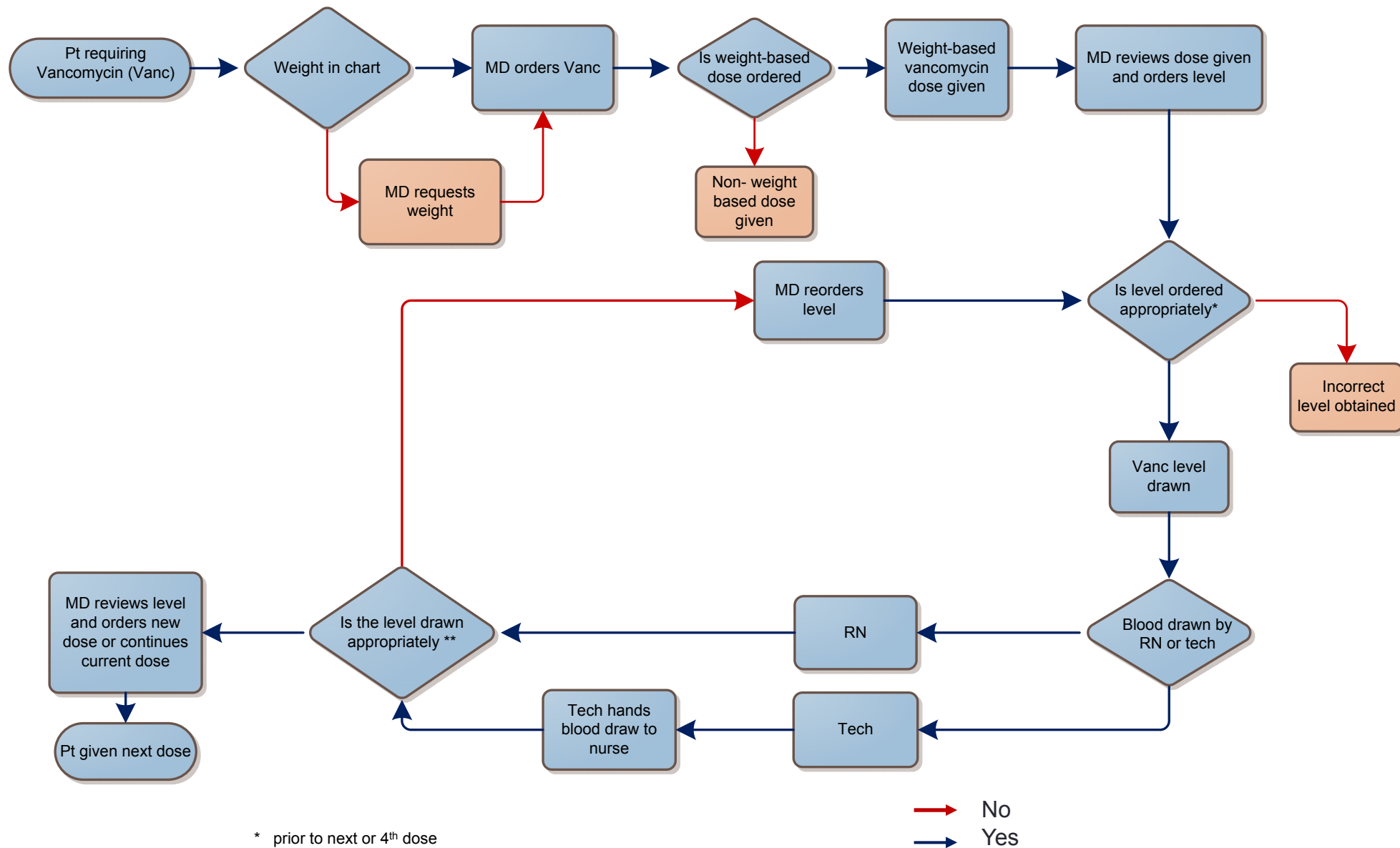
- Large number of vancomycin trough levels incorrectly ordered.
- Difficulty in interpreting results of inappropriately drawn levels.
- Increases unnecessary costs from additional ordering of levels.
- Potential increase length of stay due to inability to ensure target serum concentration prior to patient discharge.

Background: Review of Literature

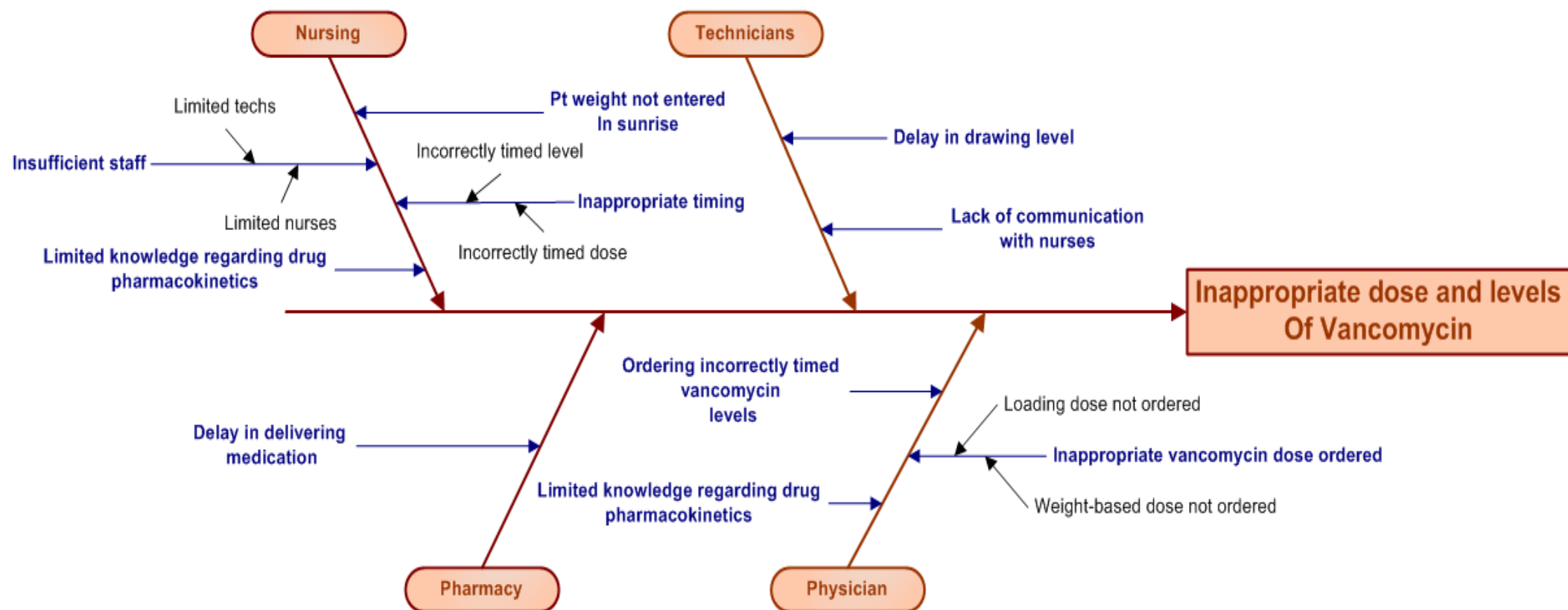
Effect of the implementation of vancomycin dosing and TDM guidelines in computerized prescriber-order-entry (CPOE) system:

- Traugott , et al.
 - Demonstrated a significant increase in the number of appropriately obtained serum vancomycin levels (58% to 68%, $p = 0.02$)⁵
- McCluggage, et al.
 - Observed a significant increase in the percentage of patients with an initial optimal vancomycin regimen that met nomogram recommendations (36% versus 24%, $p = 0.0028$)⁶
- Li, et al.
 - Demonstrated that patients in the post education group on vancomycin dosing protocol had significantly higher, initial median weight-based doses (12.5 mg/kg vs 20.0 mg/kg , $p < 0.001$), trough concentration (6.8 mg/L to 10.1 mg/L, $p = 0.013$) and AUC/MICs (262.5 to 365.0, $p = 0.001$) when compared with the pre-intervention group⁷

Pre-intervention Process Analysis Tool



Decision Making Tool



Plan: Intervention

We implemented the following intervention:

- A vancomycin dosing order set within the computerized prescriber-order-entry (CPOE) system.
- Education of physicians and nursing staff on vancomycin dosing, use of CPOE system and accession of appropriate vancomycin level when indicated.
- Assessment of the effect on vancomycin dosing and therapeutic drug monitoring (TDM).

Do: Implementing the Change

1. System Changes within Sunrise

- Meetings were held with pharmacy staff and sunrise informatics specialists to develop the new order set within Sunrise.
- The newly developed order set was tested on a sample patient list within Sunrise to identify flaws in functioning.
- The order set was then reviewed, accepted, implemented by the P & T committee and incorporated into Sunrise on March 1st, 2012.

Do: Implementing the Change

- The order set provided weight-based dosing.
 - Skin/soft tissue infections
 - Serious infections (bacteremia, endocarditis, osteomyelitis, meningitis and hospital acquired pneumonia)
 - Incorporated patient's renal function
- Added a loading dose for serious infections.
- Linked the order for vancomycin trough level to the order set.
 - Default time for vancomycin trough level eliminated
 - Facilitated providers to self-select times for trough levels

Odd dosing and continuous infusion order set were retained.

Order Set

Vancomycin Adult for Serious Infections [2 orders of 3 are selected]

Warnings/Additional Information

Pneumonia

Medications

| Order | Dose | Route | Frequency | PRN ? | PRN Reason | Start Date | Administration Instructions |
|--|------|---------------|---------------|--------------------------|------------|-------------|--|
| Loading Dose - 1 item(s) | | | | | | | |
| <input type="checkbox"/> Vancomycin Inj (ADULT) | g | IV Piggy Back | Once | <input type="checkbox"/> | T | | If "Red Man" syndrome develops, infuse at a lower... |
| Maintenance Dose - 1 item(s) | | | | | | | |
| <input checked="" type="checkbox"/> Vancomycin 1 g IV Piggy Back | 1 g | IV Piggy Back | Every 8 Hours | <input type="checkbox"/> | | May-07-2012 | If "Red Man" syndrome develops, infuse at a lower... |

Labs

☒ Vancomycin Level (Trough) Pre-Dose [* Draw 30 minutes prior to] [Special Instructions]

Measurements

| Ht (in) | Ht (cm) | Wt (lb) | Wt (kg) | BSA (m ²) |
|---------|---------|---------|---------|-----------------------|
| 68 | 172.7 | 242 | 109.6 | 2.21 |

Creatinine Clearance (Estimated (Cockcroft-Gault))

| Cr (mg/dL) | CrCl (est) | <input type="radio"/> Actual | <input checked="" type="radio"/> Estimated |
|------------|------------|------------------------------|--|
| 0.7 | 150.5 | | |

Relevant Results

Creatinine Serum: 0.66
White Blood Cell Count: 10.7
RBC Count: 3.39
Hemoglobin: 10.5

Vancomycin Adult for Skin and Soft Tissue Infections [0 orders of 2 are selected]

Warnings/Additional Information

Medications

| Order | Dose | Route | Frequency | PRN ? | PRN Reason | Start Date | Administration Instructions |
|---|------|---------------|----------------|--------------------------|------------|------------|--|
| < 95 kg - 1 item(s) | | | | | | | |
| <input type="checkbox"/> Vancomycin 1 g IV Piggy Back | g | IV Piggy Back | Every 12 Hours | <input type="checkbox"/> | T | | If "Red Man" syndrome develops, infuse at a lower... |
| >= 95 kg - 1 item(s) | | | | | | | |
| <input type="checkbox"/> Vancomycin 1 g IV Piggy Back | g | IV Piggy Back | Every 8 Hours | <input type="checkbox"/> | T | | If "Red Man" syndrome develops, infuse at a lower... |

Relevant Results

Creatinine Serum: 0.66
White Blood Cell Count: 10.7
RBC Count: 3.39
Hemoglobin: 10.5

Order Set

| | | | | |
|--|--|----------------|-----------|-----------|
| Order: | Vancomycin Level (Trough) | | Order ID: | |
| Requested By: | | Template Name: | | |
| Messages: | Collection Information: * Draw troughs 30 minutes before 4th dose, * Subsequent levels weekly, * Daily levels for renal dysfunction, concurrent nephrotoxins, or HD unstable **Vancomycin monitoring not recommended if: * Expected therapy <1 week, * ORAL Vancomycin | | | |
| Request Date | Request Time | | | |
| May-07-2012 | Pre-Dose | | | |
| Amount / Time of Last Dose | | | | |
| | | | | |
| Specimen Type | Specimen Source | | | |
| Blood | | | | |
| Attending Physician | Indication for Test | | | |
| | | | | |
| Conditional Order | | | | |
| <input type="checkbox"/> Max # of activations: | | | | |
| | | | | |
| Clear | | | | |
| Draw 30 minutes prior to | | | | |
| | | | | |
| Special Instructions | | | | |
| | | | | |
| Repeat | | View Document | | OK Cancel |

Do: Implementing the Change

2. Staff education

➤ Nursing

- Nursing educators for floor 8, 9 and MICU were contacted and education method and materials were discussed with them.
- On an average 3 in-service (training sessions) each lasting 10 minutes were scheduled for each of the floors prior to either the morning or evening shift change.
- The training sessions were conducted by members of the team for the initial 3 sessions and then were followed by nurse educators who were present during the initial training.

Do: Implementing the Change

- Participation of all staff was ensured by an attendance sign in sheet placed prior to all sessions.
- Entering patient height and weight
- Appropriate charting of the time of medication administration and level drawn
- Check out time of vancomycin level lab draw to oncoming nurses at the time of hand off.
- Schedule lab draw prior to Xth dose as ordered by physician (e.g next, 4th, etc).
- All levels to be drawn by RN only

Do: Implementing the Change

➤Physicians

- Practitioners were educated on the need for weight-based dosing, especially for patients weighing ≥ 95 kg and the need for loading dose in serious infections.
- A 15 minute presentation was made to the Internal medicine housestaff prior to their daily noon conference.
- A similar presentation was also made to the family medicine housestaff prior to their weekly didactic session.

Study: Determining Change

Types of Measures

- Percent of patients who have weight entered into Sunrise
- Percent of physicians/HCWs using the order set
- Comparing pre and post-intervention values of:
 - Patients not receiving weight-based (<30 MG/KG/D) vancomycin dosing
 - Patients weighing less than 95 kg and greater than 95 kg
 - Patients appropriately receiving loading dose
 - Serious infections
 - Patients with appropriate timing of initial vancomycin level
 - Time till first appropriate trough level
 - Time till first appropriately timed level

Performance Improvement Design

- Retrospective chart review
- Collection of baseline, pre-intervention data
 - Patients initiated on vancomycin from Dec 1, 2011 to Feb 29, 2012
- Collection of post-intervention data
 - Patients initiated on vancomycin from April 1, 2012 to April 30, 2012

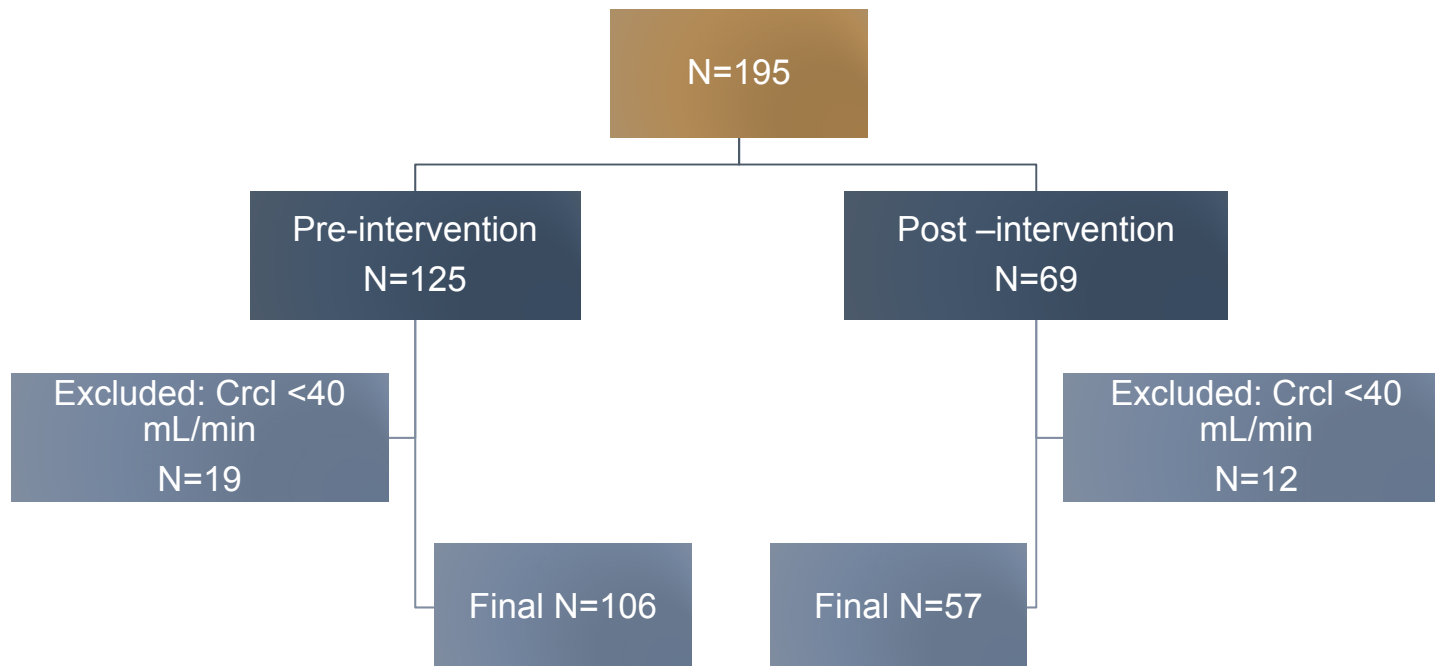


Subjects

- Adult inpatients at University Hospital (UHS).
 - 18 years or older
 - Admitted to UHS Medicine, Family Medicine or ICU teams
 - Receiving at least 1 dose of vancomycin
- Potential subjects were identified through pharmacy records.
- Information collected:
 - Age, gender, race, height, weight, sCr
 - Diagnosis with culture results
 - Initial dosing regimen, loading dose
 - Data on trough level (timing, level, number)
 - Length of vancomycin therapy
 - Length of stay

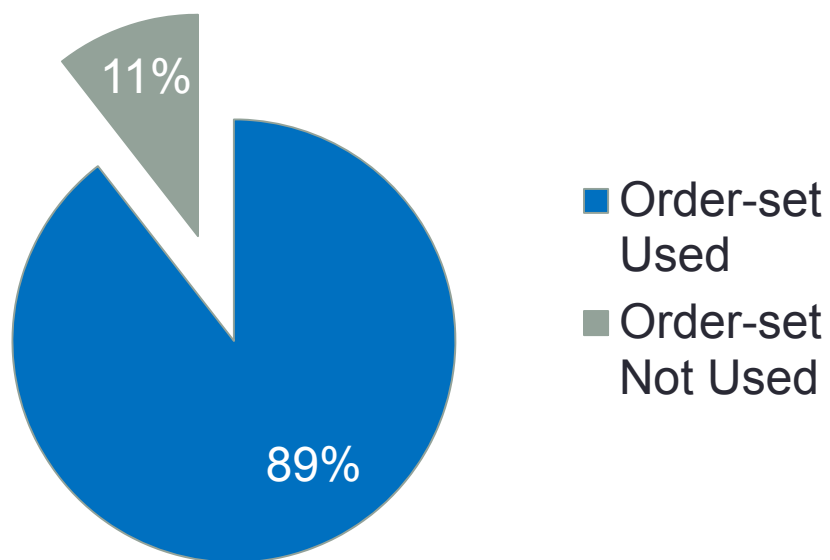
Subjects

- Exclusion criteria:
 - Age <18 years
 - Hemodialysis and chronic kidney disease with creatinine clearance (Crcl) <40 mL/min

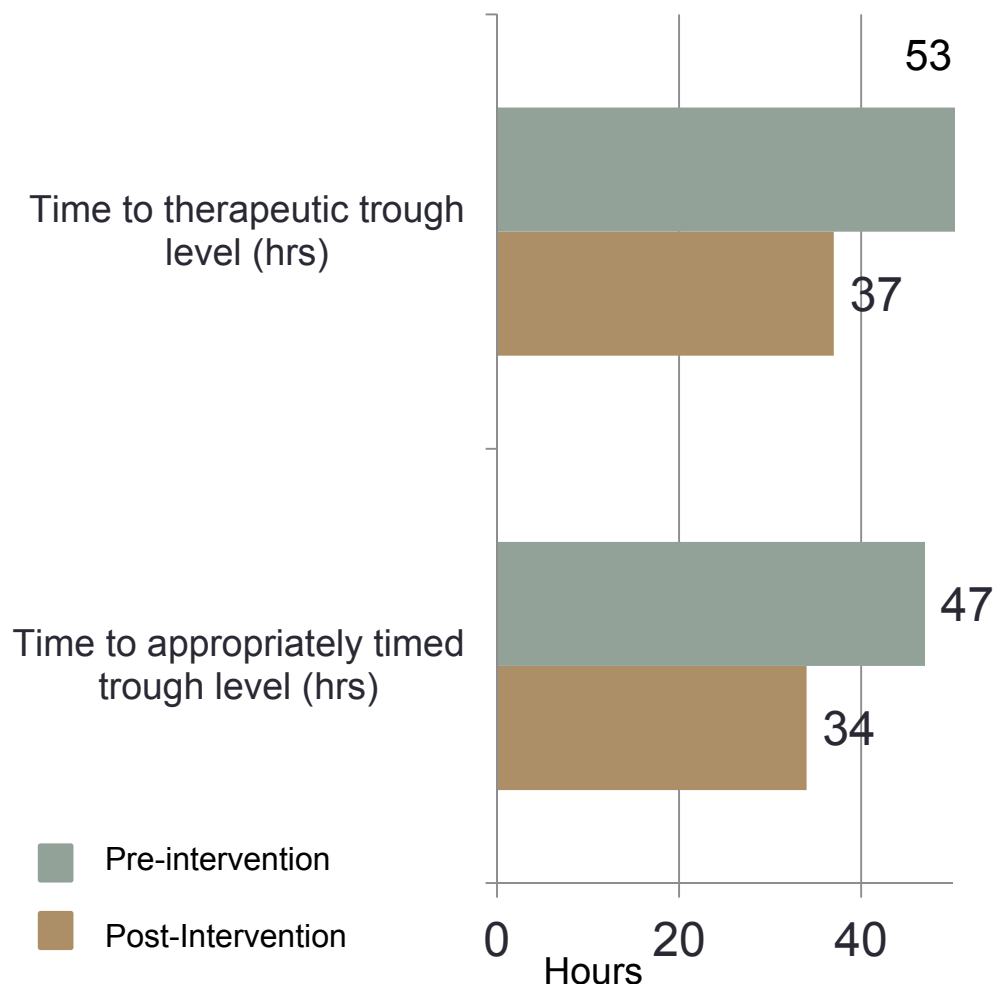


Results

No. of patients prescribed vancomycin using the order set

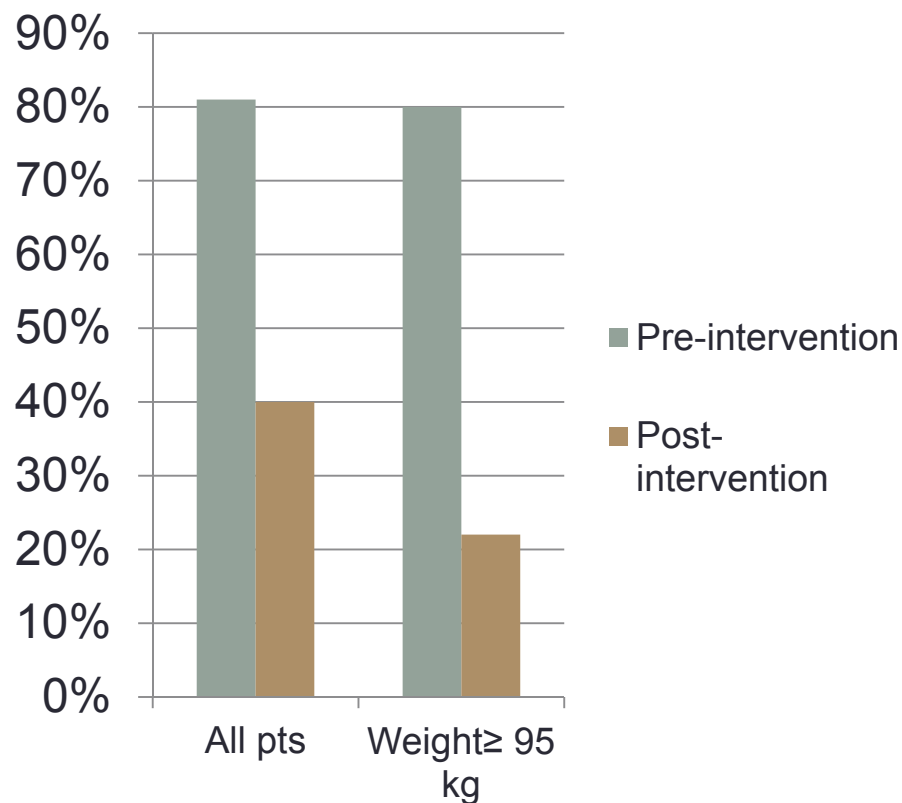


Therapeutic Drug Monitoring

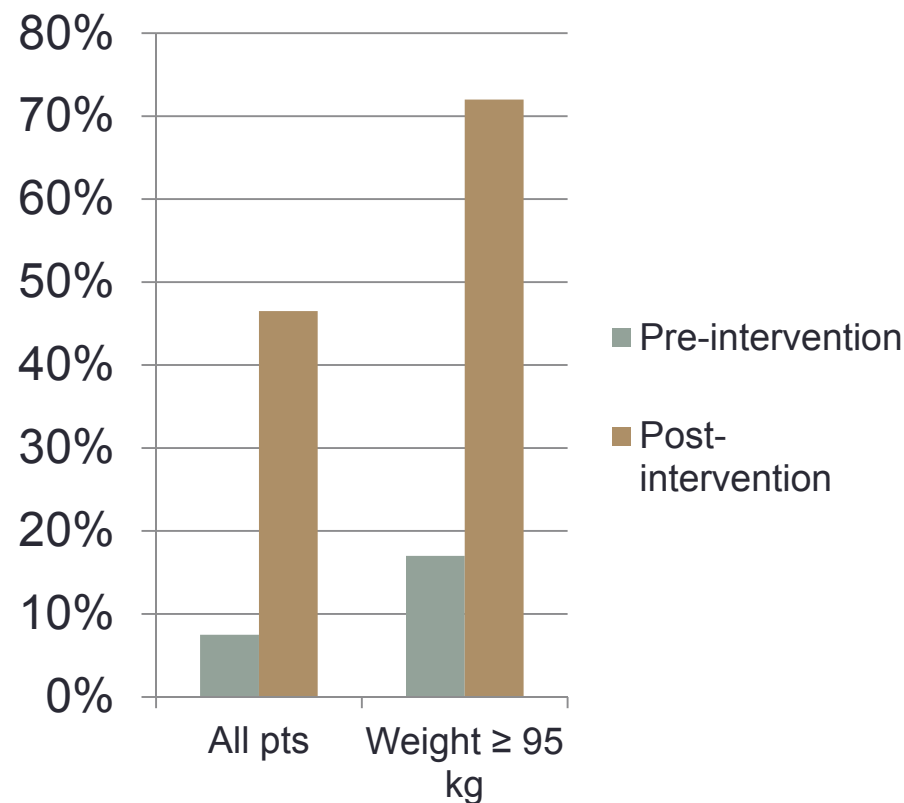


Results

Lower dose vancomycin (1 gm Q12H)

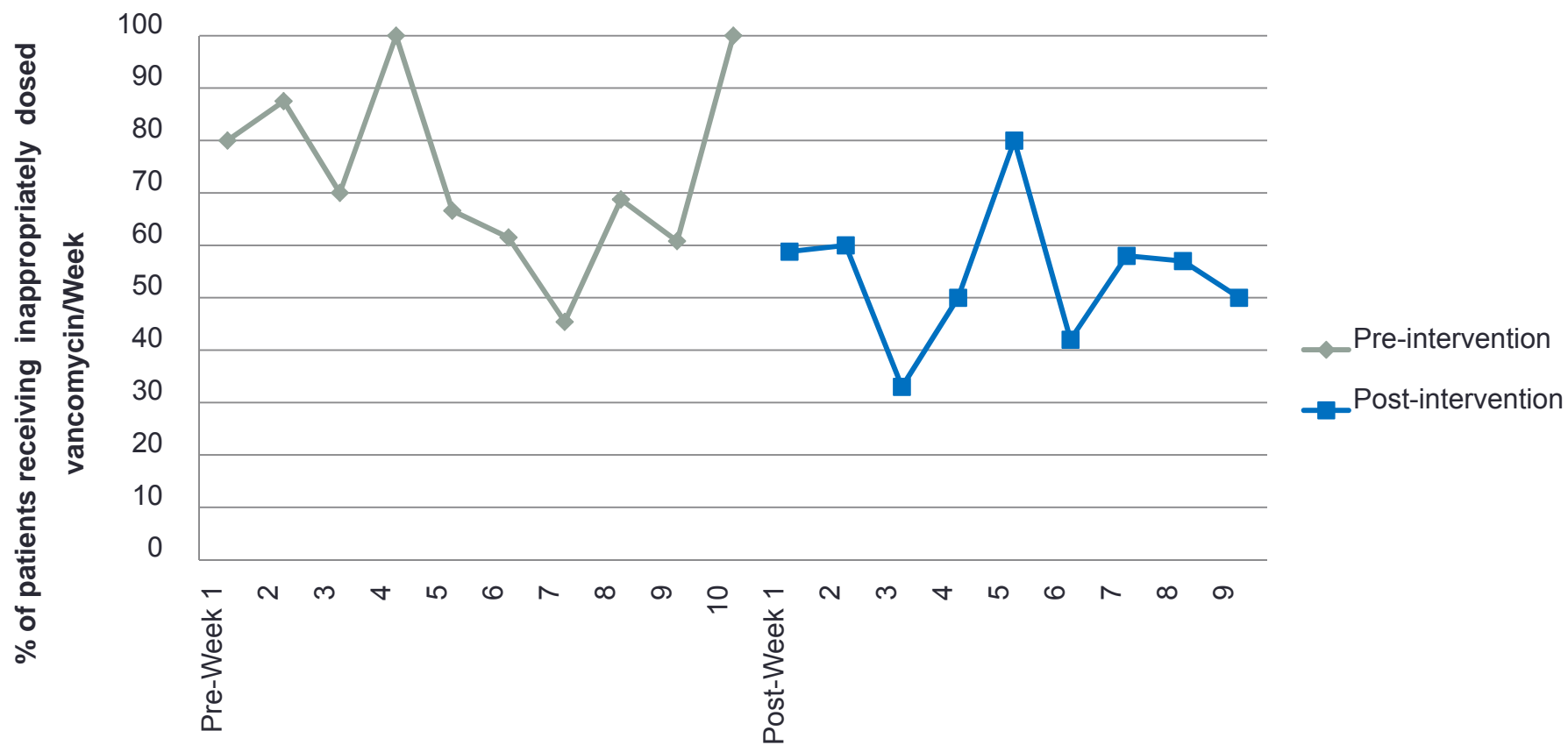


Higher dose vancomycin (1 gm Q8H)

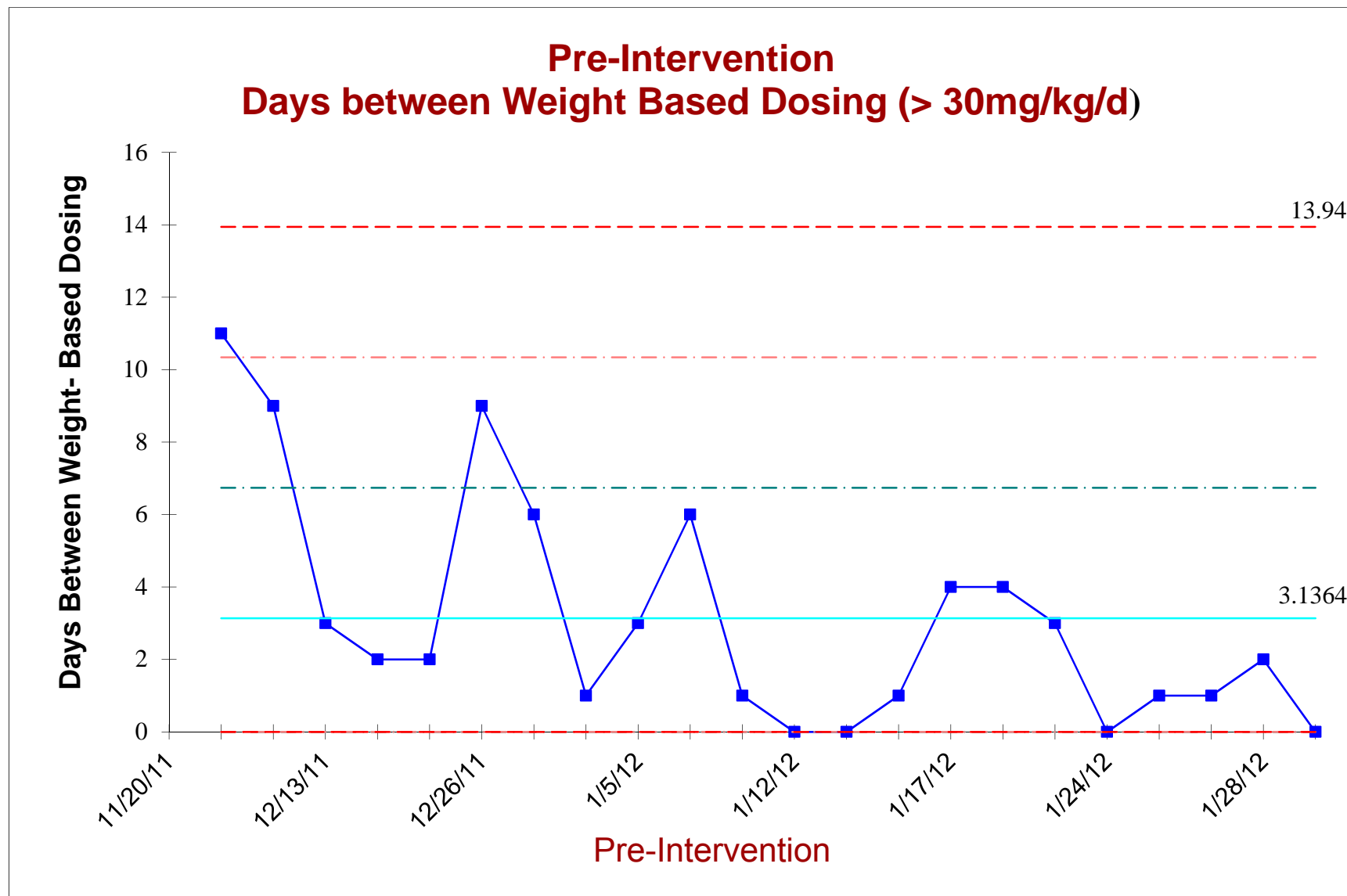


Results

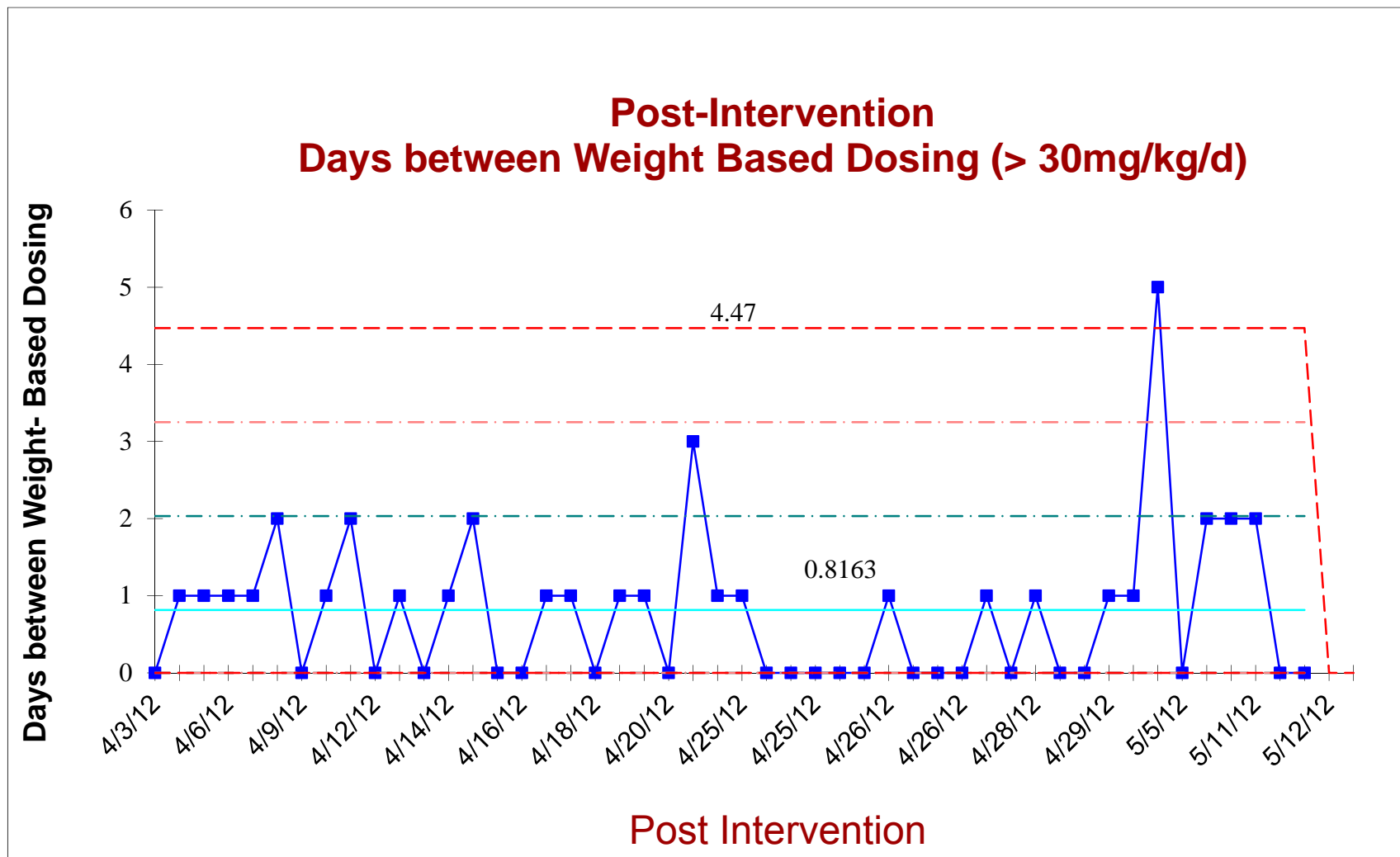
Inappropriate Weight-based (30 mg/kg/d) Vancomycin dosing



G Chart: Time Between Events



Results



Results

- Length of stay was 2 days shorter in the post-intervention group.

Return on Investment

| Estimated Project Costs | | Estimated Project Savings | |
|---------------------------------------|---------|---|----------|
| Project labor (IT personnel) | \$514 | Increased revenue from decreased length of stay | \$31,200 |
| Implementation costs (RN time) | \$7,000 | Saved costs from decreased levels ordered | \$2,543 |
| | | Soft savings from reduced LVN time | \$5,120 |
| ROI Calculation: | | | |
| Internal Rate of Return: 109% | | | |
| Modified Internal Rate of Return: 56% | | | |

Act: The Next Step...

- Continuing education.
- Plan to expand staff and physician education to other floors and services of the hospital.
- Post intervention survey.

Limitations

- Retrospective nature of the study may have led to inaccuracies in data collection.
- Small sample size.
- Educational intervention may not have captured all physicians and nursing staff.
- Ensuring continuing education of all staff.
- Caution should be exercised in the population with renal impairment as this were not evaluated in this study.

Conclusion

- The incorporation of a vancomycin dosing order set within the CPOE system in concurrence with provider and nursing staff education led to:
 - Increased the rate of appropriate weight-based dosing.
 - Shortened mean time to achieving appropriate, target serum trough concentrations.
 - Decreased overall length of stay.

References

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Thank you!