

BACKGROUND

- Antibiotic overuse is a key driver in the development of multi-drug resistant pathogens
- More than 2 million people acquire antibiotic-resistance infections and at least 23,000 die annually in the U.S. (CDC).
- Unnecessary antibiotic use also increases the risk for adverse drug events. Notably, antibiotics account for about 20% of all drug-related emergency department visits in the U.S.
- Literature has demonstrated that antibiotic use is frequently inappropriate with rates of at least 30% in outpatient and 20-40% in inpatient.
- The Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria set a goal to decrease inappropriate antibiotic use by 20% and 50% for inpatient and outpatient settings, respectively, by 2020. As such, a new framework must be established to appropriately and comprehensively classify antibiotic misuse.
- Routine benchmarking of antimicrobial usage does not address patient safety and outcomes. Further, antimicrobial consumption metrics do not address *appropriateness of antibiotic use*.
- Vancomycin is one of the most commonly used antibiotics in the hospital setting. Development of novel methods that understand facility-wide vancomycin consumption and correlate metric to patient safety and outcomes are necessary to streamline stewardship interventions.

STUDY AIMS

This study aims to establish and validate a model with which antimicrobial consumption (intravenous vancomycin) can be utilized to identify and predict abnormal use:

- To use regressive strategies to model standardized vancomycin consumption data over time across distinct study sites
- To establish predictive thresholds based on models
- To identify abnormality in vancomycin consumption trends using predictive thresholds

METHODS

Hypothesis

- Statistically high or increased vancomycin use may be indicative of poor antibiotic prescribing or "inappropriate use"

Study Design

- Multi-center, observational, non-interventional study across 3 large academic medical centers: Henry Ford Hospital (HF), Northwestern Medicine (NM), and Michigan Medicine, University of Michigan (UM)

Study Setting and Inclusion Criteria

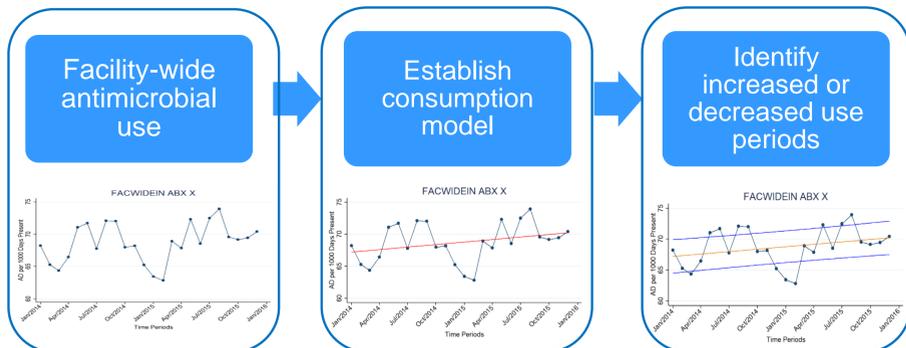
- Inpatient hospital wards at respective study sites and all inpatient administration of intravenous (IV) vancomycin

Study Period

- January 2014 through October 2017 for HF and NM
- July 2014 through October 2017 for UM

Data Sources

- Facility-wide administrations of inpatient, intravenous (IV) vancomycin record/data were compiled using TheraDoc (Premier, Charlotte, NC) across study sites
- For NM specifically,
 - Data was aggregated according to the National Healthcare Safety Network (NHSN) methodology
 - Adjudicated study data was obtained via NHSN



METHODS

Study procedure

- Monthly IV vancomycin consumption data: antimicrobial days (AD)
- AD from study sites were standardized to AD per 1,000 days present (DP) per NHSN criteria
- Data analyses conducted in R.3.5.1 [R Core Team (2018), Vienna, Austria]
- Regressive strategies were performed
- Package *msir* was used to generate LOESS, using non-parametric, locally weighted regression methods [Scrucca, L. (2011) Model-based {SIR} for dimension reduction. Computational Statistics & Data Analysis, 5(11), 3010-3026.]
- 80% Prediction intervals (PI) were generated using:
 - Standard least squares regression
 - Model-based Sliced Inverse Regression method

Study definitions

- AD: aggregate sum of days for which any amount of a specific antimicrobial agent was administered to individual patients as documented in the eMAR and/or BCMA
- DP: time period during which a given patient is at risk for antimicrobial exposure for a given patient location
- Monthly vancomycin consumption exceeding PI threshold was considered a high use period; below the PI threshold was considered a low use period

RESULTS

Figure 1. Linear Model, Vancomycin Consumption at HF, NM, and UM

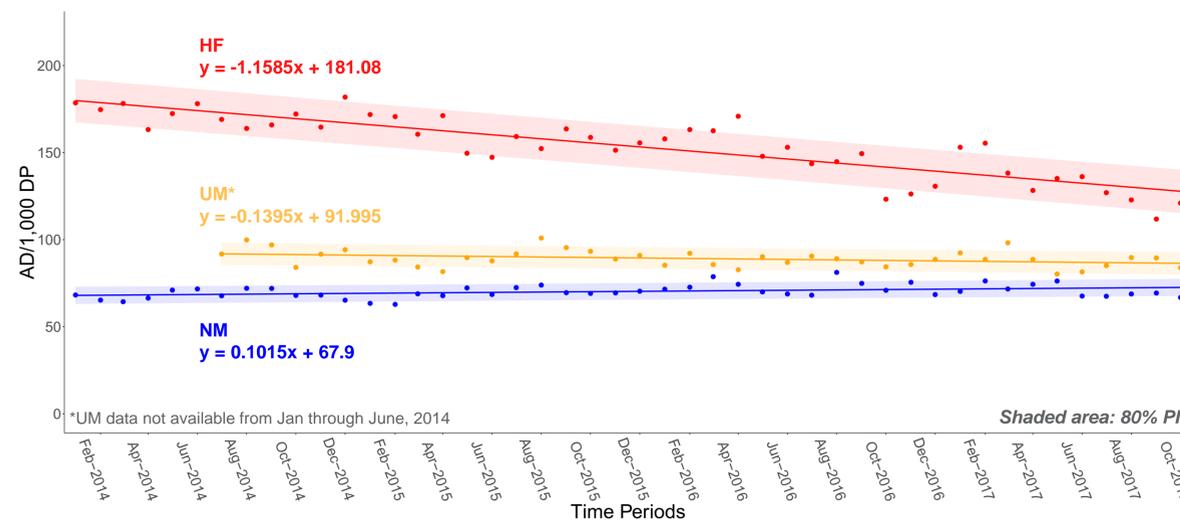
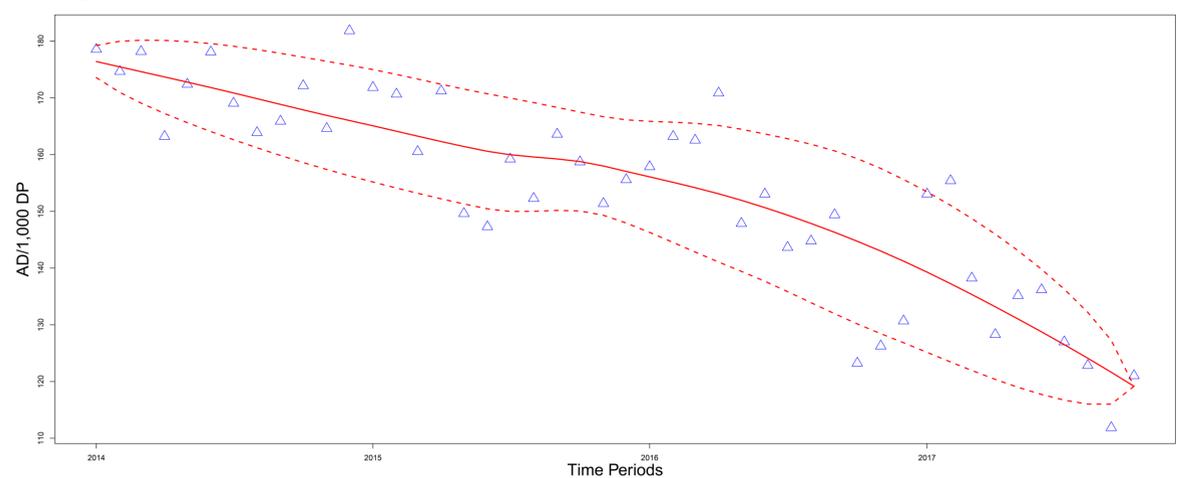


Figure 2a. LOESS Model with 80% PI, Vancomycin Consumption at Henry Ford Hospital (HF)



RESULTS

Figure 2b. LOESS Model with 80% PI, Vancomycin Consumption at University of Michigan (UM)

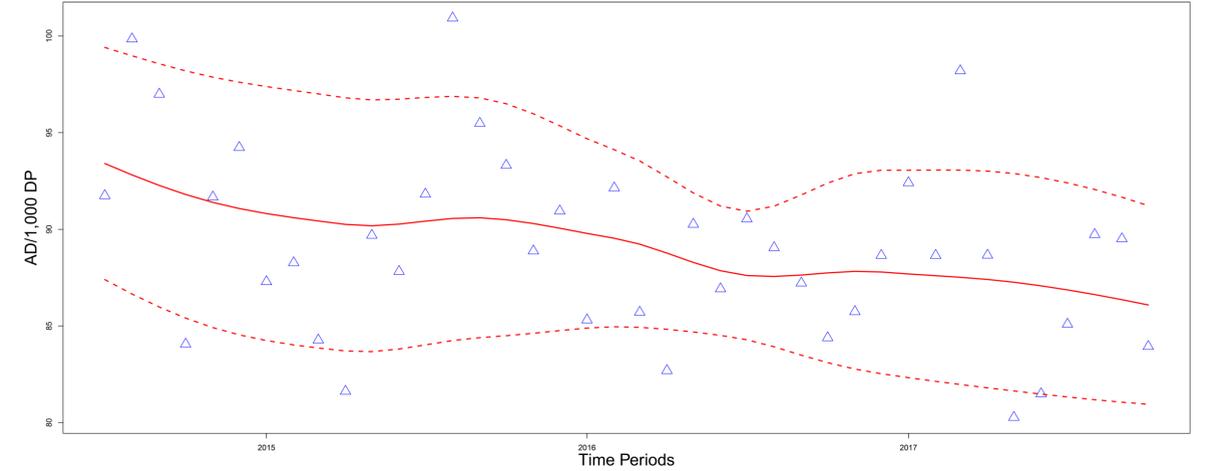
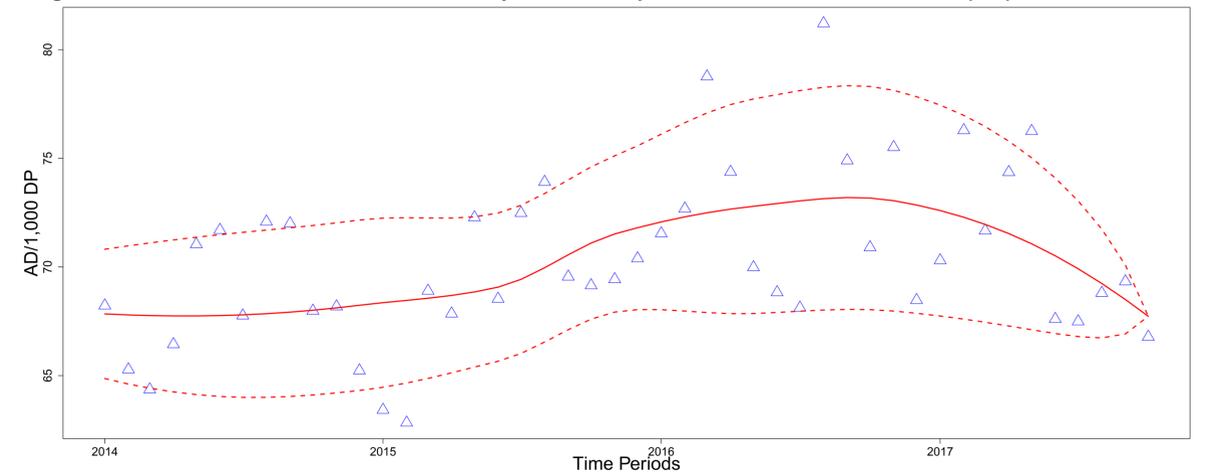


Figure 2c. LOESS Model with 80% PI, Vancomycin Consumption at Northwestern Medicine (NM)



Models	Classification based on 80% PI	HF	UM	NM
Linear Model	High use periods	6	3	2
LOESS	High use periods	4	3	7
Linear Model	Low use periods	5	5	3
LOESS	Low use periods	6	4	4

CONCLUSIONS

- Linear and loess trends were similar for HF, but loess identified multi-phasic movement. Further analyses are needed to discern the similarity and difference between 2 models
- Future investigation is warranted to examine if high and/or low consumption is associated with inappropriate use

DISCLOSURE

- The project is supported by an investigator initiated grant from Merck & Co., Inc.