



Next Steps in Predicting Anti-MRSA Antibiotic Prescribing

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INTRODUCTION

- ❖ Comparisons of antibiotic use across hospitals can assist in directing antimicrobial stewardship efforts by providing a benchmark for use
- ❖ Patient mix and facility characteristics impact antibiotic use
- ❖ Benchmarking requires risk adjustment for patient- and facility-level factors so remaining differences in antibiotic use are only attributable to prescribing practices
- ❖ Antibiotics for treatment of methicillin-resistant *Staphylococcus aureus* (MRSA) are a common target for stewardship intervention

OBJECTIVE

To identify predictors of anti-MRSA antibiotic use in a nationwide network of hospitals

METHODS

Design

- ❖ Cross sectional analysis of electronic pharmacy data from facilities contributing to Vizient Clinical DataBase Resource Manager

Inclusion/Exclusion Criteria

- ❖ Adult and pediatric inpatients in 2016

Outcome

- ❖ Anti-MRSA antibiotic use expressed as days of therapy per patient days present
 - Included agents: ceftaroline, dalbavancin, daptomycin, linezolid, oritavancin, quinupristin/dalfopristin, tedizolid, telavancin, IV vancomycin

Predictors

- ❖ Facility-level: teaching status, hospital bed size, geographic region
- ❖ Patient-level: age, sex, race, ethnicity, diagnosis related group (DRG), ICU days, admit month

Analysis

- ❖ Negative binomial regression model constructed to explore potential predictors of anti-MRSA antibiotic use
- ❖ Variable selection conducted using backwards stepwise approach based on likelihood ratio test to identify significant ($p < 0.05$) predictors
- ❖ Deviance-based pseudo R^2 calculated from the final model to assess its performance

METHODS (Cont.)

- ❖ Clinical framework used to categorize DRGs based on risk of anti-MRSA antibiotic use
- ❖ Four categories specific to MRSA infections identified (Table 1)

Table 1: MRSA-specific DRG categories

DRG Name	DRG Code(s)
Infections requiring empiric MRSA coverage	
Bacterial & Tuberculosis Infections of Nervous System	94, 95, 96
Non-Bacterial Infections of Nervous System	98, 99
Acute Major Eye Infections	121, 122
Respiratory Infections and Inflammations	177, 178, 179
Pleural Effusion	186, 187, 188
Simple Pneumonia & Pleurisy	193, 194, 195
Fever	864
Septicemia or Severe Sepsis	870, 871, 872
Viral Meningitis	75, 76
Infections highly likely due to <i>Staphylococcus aureus</i>	
Septic Arthritis	548, 549, 550
Skin Graft for Skin Ulcer or Cellulitis	573, 574, 575
Skin Graft except for Skin Ulcer or Cellulitis	576, 577, 578
Cellulitis	602, 603
Infections likely to require long term MRSA coverage	
Acute & Sub-acute Endocarditis	288, 289, 290
Osteomyelitis	539, 540, 541
Infections not likely due to <i>Staphylococcus aureus</i>	
Otitis Media & URI	152, 153
Bronchitis & Asthma	202, 203
Major Gastrointestinal Disorders & Peritoneal Infections	371, 372, 373
Knee Procedures With Prior Diagnosis of Infection	485, 486, 487
Kidney, Urinary Tract, & Female Reproductive System Infections	689, 690, 757, 758, 759
Infectious & Parasitic Diseases With OR Procedure	853, 854, 855
Post-operative and/or Post-Traumatic Infections with or without OR Procedure	856, 857, 858, 862, 863
Viral Illness	865, 866
Other Infectious & Parasitic Diseases Diagnoses	867, 868, 869

Abbreviations: DRG: diagnosis related group; MRSA: methicillin-resistant *Staphylococcus aureus*; OR: operating room; URI: upper respiratory infection

RESULTS

- ❖ Among 145 hospitals contributing data
 - 3,608,711 admissions for 3,081,042 unique patients
 - 19,663,805 total patient days (median 3; IQR 2-6)
- ❖ All predictors considered in the model were significant
- ❖ Predictors with the greatest magnitude of association were DRG categories and age (Table 3)
- ❖ Model performance: Deviance-based pseudo $R^2 = 0.19$

Table 2: Characteristics of inpatient admissions

Characteristic	n	(%)
Female	1,949,013	54.6
White	2,287,337	63.4
Non-Hispanic	2,772,644	76.8
Age (years)		
<18	548,555	15.2
18-64	1,971,273	54.6
>65	1,088,883	30.2
Length of stay (days)		
0-2	1,355,225	37.6
3-7	1,605,129	44.5
8+	648,357	18.0
Teaching hospital	3,070,562	85.1
Hospital bed size		
1-249	238,495	6.6
250-499	569,781	15.8
500-749	1,256,943	34.8
750+	1,450,179	40.2
Region		
New England/Mid-Atlantic	1,238,445	34.3
Southeastern	657,467	18.2
Midwestern/Mid-Continent	1,285,309	35.6
Western	427,480	11.9

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Table 3: Specified predictors of anti-MRSA antibiotic use

	Relative Risk (95% CI)
DRG Category*	
Other medical	Ref
Abdominal operative	0.79 (0.78, 0.81)
Bone marrow transplants	0.78 (0.76, 0.80)
Burns	0.74 (0.71, 0.78)
Cardio thoracic operative	0.65 (0.64, 0.66)
Dialysis/renal failure	0.79 (0.77, 0.81)
Hematologic disorders	0.83 (0.82, 0.85)
Implantable device/shunt	0.91 (0.90, 0.93)
Infections highly likely due to <i>S. aureus</i>	1.66 (1.64, 1.67)
Infections likely to receive long-term MRSA coverage	1.49 (1.45, 1.53)
Infections not likely caused by <i>S. aureus</i>	1.22 (1.22, 1.23)
Infections requiring empiric MRSA coverage	1.24 (1.23, 1.24)
Invasive life support	0.90 (0.89, 0.91)
Neurology operative	0.77 (0.76, 0.78)
Obstetric operative	0.98 (0.95, 1.01)
Orthopedic operative	1.09 (1.08, 1.10)
Other surgery	1.09 (1.08, 1.10)
Solid organ transplants	0.72 (0.71, 0.73)
Solid tumors	0.90 (0.88, 0.92)
Trauma	1.01 (1.00, 1.03)
Age (years)	
<2	Ref
2-9	1.64 (1.59, 1.68)
10-17	1.60 (1.56, 1.64)
18-64	1.54 (1.51, 1.56)
65+	1.33 (1.30, 1.35)

Adjusted for sex, race, ethnicity, region, hospital bed size, teaching status, and month of admission
*Clinical framework used to categorize DRGs based on risk of anti-MRSA antibiotic use

CONCLUSIONS

- ❖ DRGs were significant predictors of anti-MRSA antibiotic use
 - Especially infections highly likely due to *S. aureus* and diagnoses likely to receive long-term MRSA coverage
- ❖ Deviance-based pseudo R^2 indicates good model fit
- ❖ Patient characteristics may explain variability in anti-MRSA antibiotic use beyond that of facility-level factors
- ❖ Future work needed to explore additional patient-level factors including ICD-10 infection codes and comorbidities