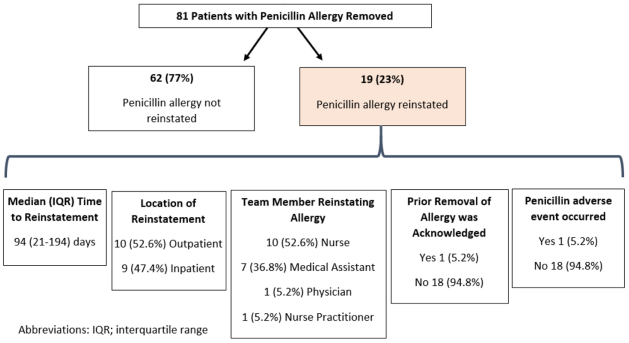
Figure 1: Flow chart of Penicillin Allergy Outcome After Removal



Abbreviations: IQR; interquartile range

Table 1: Comparison of Patients Who Had Penicillin Allergy Reinstated Versus Those Who Did Not

Characteristics	Total (n=81)	Allergy Not Reinstated (n=62)	Penicillin Allergy Reinstated (n=19)	P value
Male Sex, n (%)	36 (44)	27 (43)	9 (47)	0.797
Age years median (IQR)	60 (49 – 68)	59 (48-68)	61 (52-69)	0.482
Age≥65, n (%)	31 (38)	24 (39)	7 (37)	0.884
Self-Reported Race/Ethnicity, n (%)				
Black	38 (47)	27 (44)	11 (58)	0.273
White	38 (47)	30 (48)	8 (42)	0.631
Other	3 (3.7)	3 (5)	0 (0)	0.329
Unknown	2 (2.5)	2 (3)	0 (0)	0.428
Comorbidities				
Coronary Artery Disease or MI, n (%)	25 (31)	19 (31)	6 (32)	0.939
Congestive Heart Failure, n (%)	19 (24)	14 (23)	5 (26)	0.762
COPD, n (%)	25 (31)	16 (26)	9 (47)	0.075
Chronic Kidney Disease, n (%)	40 (49)	30 (48)	10 (53)	0.851
Diabetes	63 (78)	47 (76)	16 (84)	0.606
Solid Organ Cancer, n (%)	7 (9)	14 (23)	4 (21)	0.960
Leukemia or lymphoma, n (%)	8 (10)	6 (10)	2 (11)	0.588
Liver Disease, n (%)	15 (19)	9 (15)	6 (32)	0.105
Dementia, n (%)	0 (0)	0 (0)	0 (0)	NA
Solid Organ Transplant, n (%)	7 (9)	6 (10)	1 (5)	0.549
Psychiatric History, n (%)	22 (27)	16 (26)	6 (32)	0.621
Charlson Comorbidity Index, median (IQR)	6 (3 – 9)	6 (3 – 9)	6 (4.5 – 9)	0.344
Allergy Delabeling Mechanism				
Via History, n (%)	30 (37)	18 (29)	12 (63)	0.013
Skin Test and oral challenge, n (%)	51 (63)	44 (71)	7 (34)	0.013
Readmitted subsequently, n (%)	49 (61)	33 (53)	16 (84)	0.017

Abbreviations: IQR; interquartile range, MI; myocardial infarction, COPD; Chronic Obstructive Pulmonary Disease,

prior removal. Patients who undergo skin testing may be less likely to continue to report a penicillin allergy to medical staff compared to those whose allergy is removed based on history. Increased interactions with the healthcare system may have contributed to having the allergy reinstated.

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Racial and ethnic differences in penicillin allergy reporting and allergist referral

Charles Bornmann; Christina Ortiz; Rubeen Guardado; Joseph GillisJr; Kristin Huang; Kimberly Blumenthal; Shira Doron; Maureen Campion and Alysse Wurcel

Background: Antimicrobial resistance (AMR) is a global public health crisis. A key strategy to combat AMR is to use targeted antibiotics, which is difficult in patients who report an allergy to penicillin. Increased risk for resistant infections, mortality, and healthcare costs are associated with penicillin allergies; however, up to 90% of those with a reported penicillin allergy do not have a true allergy. We investigated racial and ethnic differences related to penicillin allergy delabeling by analyzing rates of penicillin allergy reporting and referral for allergist consultation. **Methods:** Tufts Medical Center is a teaching medical center in Boston, Massachusetts. This study cohort contains all patients seen in 2019 by clinicians at Primary Care Boston, the main primary care practice at Tufts Medical Center. Demographic data, documented allergies, and referral history were collected from the electronic medical record. We performed univariate and multivariable analyses using logistic regression models. Covariates found to be statistically significant ($P < .05$) in the univariate analyses were included in the multivariable model. **Results:** ***In total,*** 2,391 (11%) patients reported a penicillin allergy, but only 249 (10%) were referred to an allergist (Table 1). Black patients and Asian patients were less likely to report a penicillin allergy than White patients. We detected no differences related to Hispanic ethnicity. Black patients with penicillin allergy were more likely to be referred to an allergist. **Conclusions:** There were low rates of allergist referral for penicillin allergy delabeling in this cohort. We identified racial differences in both penicillin allergy reporting and allergist referral. Allergist consultation is an important opportunity to combat AMR and should be considered for all patients reporting a penicillin allergy. Future work should evaluate equitable access to allergy delabeling resources.

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Table 1A: Factors Associated with Penicillin Allergy Reporting

Characteristic	PCN Allergy (N=21,918)		Univariate			Multivariable		
	No (n=19,527)	Yes (n=2,391)	OR	95% CI	P-Value	OR	95% CI	P-Value
Mean Age, (SD)	50 (18)	53 (19)	1.11	(1.09, 1.14)	< .0001	1.06	(1.04, 1.09)	< .0001
Sex (%)					< .0001			< .0001
Male	8,767 (92)	768 (8)	*Ref*			*Ref*		
Female	10,760 (87)	1,623 (13)	1.72	(1.57, 1.88)		1.58	(1.44, 1.74)	
Race (%)					< .0001			< .0001
White	11,982 (87)	1,744 (13)	*Ref*			*Ref*		
Black	3,216 (90)	371 (10)	0.79	(0.70, 0.89)		0.77	(0.69, 0.87)	
Asian	4,329 (94)	276 (6)	0.44	(0.38, 0.50)		0.47	(0.41, 0.53)	
Hispanic (%)					0.08			-
No	18,756 (89)	2,314 (11)	*Ref*			-	-	
Yes	771 (91)	77 (9)	0.81	(0.64, 1.03)		-	-	
Median Allergy Count, (Range)	0 (0-29)	1 (0-34)	1.35	(1.31, 1.38)	<.0001	1.28	(1.25, 1.31)	< .0001

Table 1B: Factors Associated with Allergist Referral in People with Penicillin Allergy

Characteristic	Referral Allergy (N=2,391)		Univariate			Multivariable		
	No (n=2,142)	Yes (n=249)	OR	95% CI	P-Value	OR	95% CI	P-Value
Mean Age, (SD)	53 (19)	52 (17)	0.95	(0.89, 1.02)	0.171	-	-	-
Sex (%)					<0.001			0.009
Male	715 (93)	53 (7)	*Ref*			*Ref*		
Female	1,427 (88)	196 (12)	1.85	(1.35, 2.54)		1.52	(1.10, 2.10)	
Race (%)					0.033			0.013
White	1,582 (91)	162 (9)	*Ref*			*Ref*		
Black	315 (85)	56 (15)	1.74	(1.25, 2.41)		1.74	(1.25, 2.43)	
Asian	245 (89)	31 (11)	1.23	(0.82, 1.86)		1.35	(0.89, 2.05)	
Hispanic (%)					0.994			-
No	2,073 (90)	241 (10)	*Ref*	-		-	-	
Yes	69 (90)	8 (10)	1	(0.47, 2.10)		-	-	
Median Allergy Count, (Range)	1 (0 - 34)	1 (0 - 22)	1.17	(1.12, 1.22)	<.0001	1.16	(1.11, 1.21)	<.0001

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Antimicrobial use patterns during the COVID-19 pandemic at an academic medical center

Jacob Pierce; Erin Deja; Kimberly Lee; Michelle Doll and Michael Stevens

Background: The COVID-19 pandemic has made a significant impact on antimicrobial use patterns across health systems. We have described antibiotic use patterns at an academic medical center in Richmond, Virginia, before and after the onset of COVID-19. We also examined the impact on the proportional consumption of carbapenems (PoCC) metric. PoCC represents meropenem utilization relative to the narrower-spectrum antipseudomonal agents cefepime and piperacillin-tazobactam. Our institution practices antimicrobial restriction for meropenem. All other antibiotics included in the study data can be freely ordered by any provider. **Methods:** We evaluated antimicrobial use data from September 2018 through August 2021 using days of therapy (DOT) per 1,000 patient days. We included 18 months of data before and after the first recorded COVID-19 admission at our institution in March 2020. Mean comparisons were performed using the Welch 2-sample *t* test. The Bonferonni correction

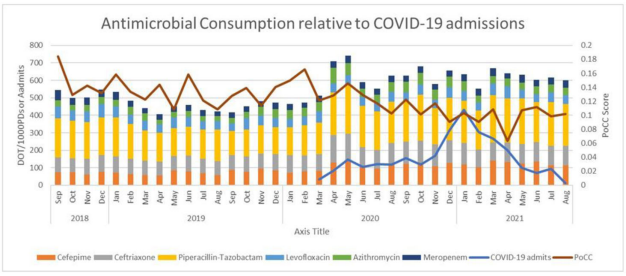

Fig. 1. Antimicrobial consumption relative to COVID-19 admissions from September 2018 to August 2021. The left y-axis represents days of therapy per 1,000 patient days (DOT per 1,000 PD) for antibiotics and total COVID-19 admissions for the respective variables. *PoCC = [(meropenem DOT per 1,000 PD)/(meropenem DOT per 1,000 PD + cefepime DOT per 1,000 PD + piperacillin-tazobactam DOT per 1,000 PD)]

for multiple comparisons was utilized to determine significance with an initial baseline α of 0.05. All data analyses were performed using R software (R Foundation for Statistical Computing, Vienna, Austria, 2021). **Results:** Normality was evaluated with QQ-plots and all data demonstrated normality. Bonferroni correction produced an adjusted α value of 0.007. We detected significant increases in the use of cefepime, piperacillin-tazobactam, ceftriaxone, and azithromycin following the onset of the COVID-19 pandemic. We noted a significant decrease in the PoCC metric during this period. No significant change was noted for levofloxacin or meropenem. **Conclusions:** The COVID-19 pandemic produced significant changes in antimicrobial use patterns at our institution. We noted statistically significant increases in bacterial community-acquired pneumonia-focused antibiotics (ceftriaxone and azithromycin). We observed significant increases for cefepime and piperacillin-tazobactam. Interestingly, relative utilization of carbapenems as measured by the PoCC metric continued to decrease during this time. This trend was primarily driven by increases in cefepime and piperacillin-tazobactam utilization while meropenem utilization remained relatively constant. This study highlights the importance of looking at normalized antibiotic consumption data and not relative-use data alone.

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Recommendations for antimicrobial stewardship during end-of-life patient care

Erin Balkenende; Cassie Goedken; Daniel Livorsi; Karleen Giannitrapani; Matthew McCaa and Eli Perencevich

Background: Antimicrobials are frequently used during end-of-life care and may be prescribed without a clear clinical indication. Overuse of antimicrobials is a major public health concern because of the development of multidrug resistant organisms (MDROs). Antimicrobial stewardship programs are associated with reductions in antibiotic resistance and antibiotic-associated adverse events. We sought to identify and describe opportunities to successfully incorporate stewardship strategies into end-of-life care. **Methods:** We completed semistructured interviews with 15 healthcare providers at 2 VA medical centers, 1 inpatient setting and 1 long-term care setting. Interviews were conducted via telephone between November 2020 and June 2021 and covered topics related to antibiotic prescribing for hospice and palliative-care patients, including how to improve antimicrobial stewardship during the end-of-life period. We targeted healthcare providers who are involved in prescribing antibiotics during the end-of-life period, including hospitalists, infectious disease physicians, palliative care and hospice physicians, and pharmacists. All interviews were recorded, transcribed, and analyzed using consensus-based inductive and deductive coding. **Results:** End-of-life care, particularly hospice care, was described as an underutilized resource for patients, who are often enrolled in their final days of life rather than earlier in the dying process. Even at facilities with established antimicrobial stewardship programs, healthcare providers interviewed believed that opportunities for antimicrobial stewardship in the hospice and palliative care settings were missed. Recommendations for how stewardship should be incorporated in end-of-life care included receiving feedback on antimicrobial prescribing, increasing pharmacist involvement in prescribing decisions, and targeted education for providers on end-of-life care, including the value of shared decision making with patients around antibiotic use. **Conclusions:** Improved antibiotic prescribing during end-of-life care is critical in the effort to combat antimicrobial resistance. Healthcare providers discussed antimicrobial stewardship activities during end-of-life patient care as a potential avenue to improve appropriate antibiotic prescribing. Future research should evaluate the feasibility and effectiveness of incorporating these strategies into end-of-life patient care.

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Assessment of antibiotic appropriateness in hospitalized veterans with COVID-19 in the VA MidSouth Healthcare Network (VISN9)

Derek Forster; Morgan Johnson; Milner Staub; Jessica Bennett; Hans Scheerenberger; Angela Kaucher; Neena Thomas-Gosain and Kelly Davis

Background: Bacterial coinfections with COVID-19 appear to be rare, yet antibiotic use in this population is high. Limited guidance is available regarding the use of antibiotics in these patients. In response, a multidisciplinary group of physicians and pharmacists from 5 VISN9 facilities developed a guideline for the use of antibiotics with COVID-19 in July 2021. This guideline created a network-wide standard for antibiotic use and facilitates the assessment of antibiotic appropriateness in hospitalized veterans with COVID-19. **Methods:** In this observational, cross-sectional study, we reviewed veterans diagnosed with COVID-19 from August 1 through September 30, 2021, who were admitted to VISN9 facilities. Use of antibiotics was assessed during the first 4 days of admission. If antibiotics were prescribed, their use was determined to be appropriate or inappropriate based on the presence or absence of a finding concerning for bacterial coinfection as outlined in the guideline (Table 1). Additional data including procalcitonin results as well as positive sputum cultures were collected. **Results:** In total, 377 veterans were admitted for COVID-19 during the study period. Among them, 42 veterans (11%) received antibiotics for nonrespiratory infections and were removed from this analysis. Of the remaining 335 veterans, 229 (68%) received antibiotics and 116 (51%) of those met guideline criteria that were concerning for bacterial coinfection. Additionally, 32 (14%) of the 229 veterans who received antibiotics had >1 finding concerning for bacterial coinfection. Procalcitonin levels were obtained in 97 (42%) of 229. Only 33 veterans (14%) who received antibiotics had an elevated procalcitonin, and only 19 (8%) had a positive sputum culture. **Conclusions:** Antibiotic use was common in hospitalized veterans with COVID-19 in VISN9 facilities. This results are comparable to findings in the published literature. Among those receiving antibiotics

Table 1. Findings concerning for bacterial co-infection in patients with COVID-19

Any of the following:
Elevated leukocyte count
Unilateral lobar consolidation on chest imaging
Recrudescence of fever after initial defervescence
Septic Shock