

Cardiac surgery patients with a penicillin allergy history who underwent preoperative allergy evaluation were 27-fold more likely to receive first-line perioperative antibiotic prophylaxis, compared to those without allergy evaluation.

INTRODUCTION

- Surgical site infections (SSIs) increase morbidity, prolong hospitalization, and cost the U.S. healthcare system up to \$3.3 billion annually. Approximately half of SSIs are deemed preventable.
- Cefazolin is the preferred first-line perioperative antibiotic for most procedures, including all cardiac surgeries.
- Patients with a documented penicillin allergy comprise approximately 10% of the surgical population, and often receive second-line antibiotics (e.g. vancomycin) which results in an increased odds of SSI.

OBJECTIVE

- To determine the impact of preoperative penicillin allergy evaluation on perioperative antibiotic use in cardiac surgery patients.

METHODS

Study Design and Population

- Retrospective cohort study of patients with a penicillin allergy history who underwent cardiac surgery at Massachusetts General Hospital (September 2015-December 2018).

Exposure

- Preoperative penicillin allergy evaluation by an Allergy/Immunology provider.

Outcomes

- The primary outcome was first-line perioperative prophylaxis (i.e. cefazolin use). The secondary outcomes were: (1) Hospital length of stay (LOS) (2) SSIs.

Covariates

- Age, sex, race, body mass index (BMI), American Society of Anesthesiologist (ASA) class, surgery type, colonization with resistant organisms, cephalosporin allergy history, and surgery status (elective, urgent or emergent).

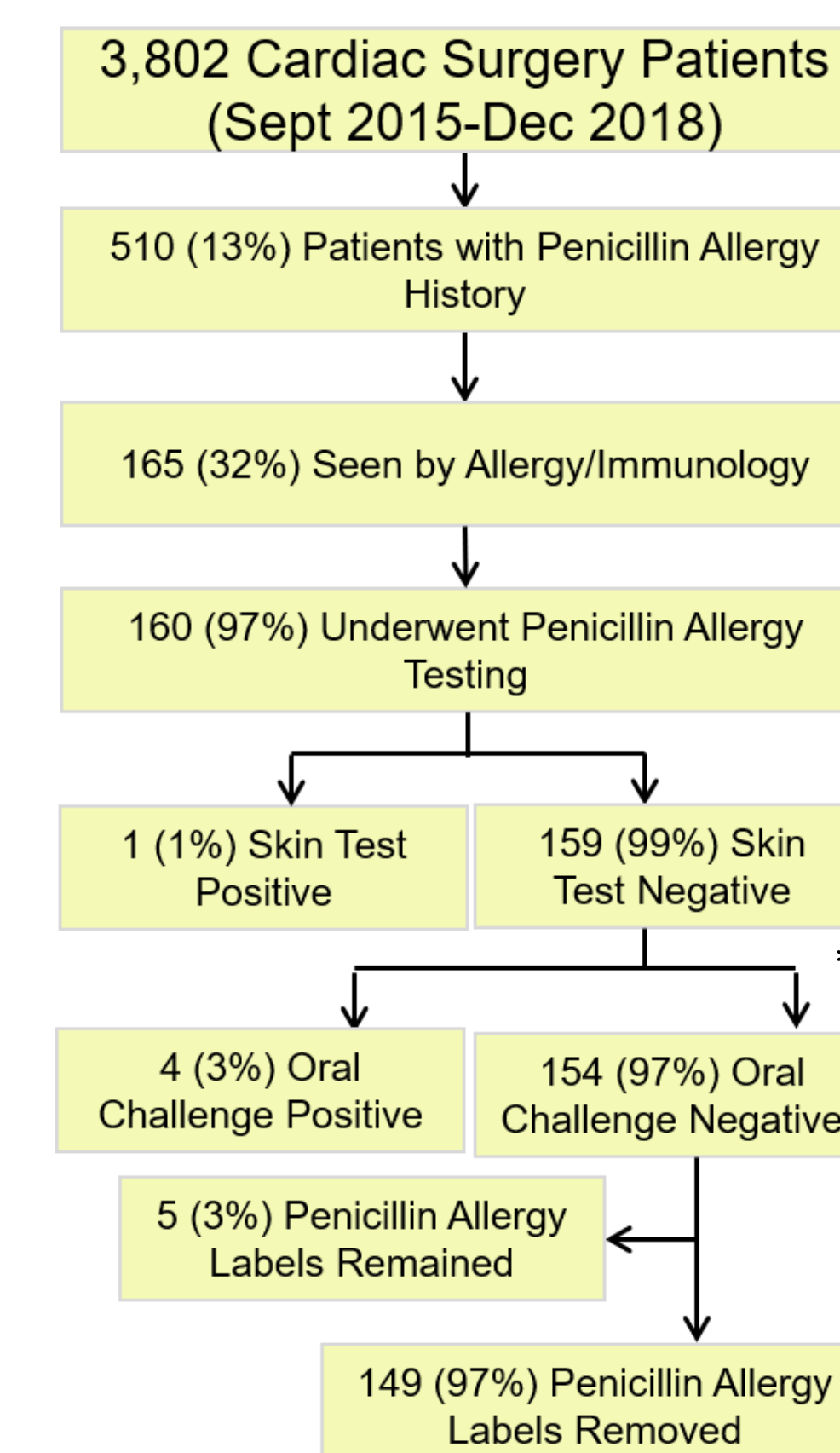
Statistical Analysis

- Patient and procedure characteristics in patients with a penicillin allergy history who did and did not undergo preoperative allergy evaluation were compared using the T-test for continuous variables and chi-squared tests for binary/categorical variables.
- A multivariate logistic regression model was used to evaluate the relation between penicillin allergy and first-line perioperative antibiotic use.
- Wilcoxon rank sum test was used to compare median LOS.

RESULTS

- 3,802 patients underwent cardiac surgery (**Figure 1**). Of those, 510 (13%) had a documented penicillin allergy and 165 (32%) were evaluated by Allergy/Immunology.

Figure 1. Flow diagram of cardiac surgery patients with a documented penicillin allergy. *1 patient did not have challenge



RESULTS

Table 1. Clinical characteristics of patients reporting a penicillin allergy

	Penicillin Allergy Evaluation (n= 165)	No Penicillin Allergy Evaluation (n=345)
Demographics		
Age (μ + SD)	63 ± 13	65 ± 14
Sex		
Male	82 (50)	191 (55)
Female	83 (50)	154 (45)
Race		
White	149 (90)	311 (90)
Black	4 (2)	7 (2)
Hispanic	2 (1)	6 (2)
Asian	4 (2)	4 (1)
Other	6 (4)	17 (5)
BMI (μ + SD)	29.4 ± 7	29.2 ± 6
Surgical Details		
ASA class		
II	7 (4)	7 (2)
III	105 (64)	196 (57)
IV	53 (32)	136 (39)
V	0 (0)	6 (2)
Type of Surgery		
CABG	28 (17)	139 (40)
AVR, MVR, MV Repair	63 (38)	47 (14)
CABG + MVR/AVR	9 (5)	24 (7)
Other	65 (39)	135 (39)
Status of Surgery		
Elective	139 (84)	144 (42)
Urgent	25 (15)	173 (50)
Emergent	1 (1)	28 (8)
MRSA colonization	6 (4)	10 (3)
VRE colonization	5 (3)	17 (5)
Penicillin Allergy		
Rash	63 (38)	104 (30)
Urticaria	44 (27)	60 (17)
Gastrointestinal Symptoms	5 (3)	54 (16)
Angioedema/swelling	18 (11)	27 (8)
Anaphylaxis/hypotension	7 (4)	18 (5)
Itching/flushing	11 (7)	10 (3)
Shortness of breath	4 (2)	6 (2)
Acute interstitial nephritis	0 (0)	2 (<1)
Other	8 (5)	35 (10)
Unknown	27 (16)	72 (21)

Abbreviations: BMI, body mass index; ASA, American Society of Anesthesiologists; CABG, coronary artery bypass graft; AVR, aortic valve replacement; MVR, mitral valve replacement; MV, mitral valve; MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin resistant *Enterococci*

Patients Characteristics

- Patients who did and did not undergo penicillin allergy evaluation were similar (**Table 1**). Patients were more likely to have preoperative allergy evaluation if they had valve surgeries, elective surgeries, and allergy histories including urticaria and itching/flushing. Patients were less likely to have preoperative allergy evaluation if they had CABG surgeries, urgent / emergent surgeries, or allergy histories including GI symptoms or unknown.

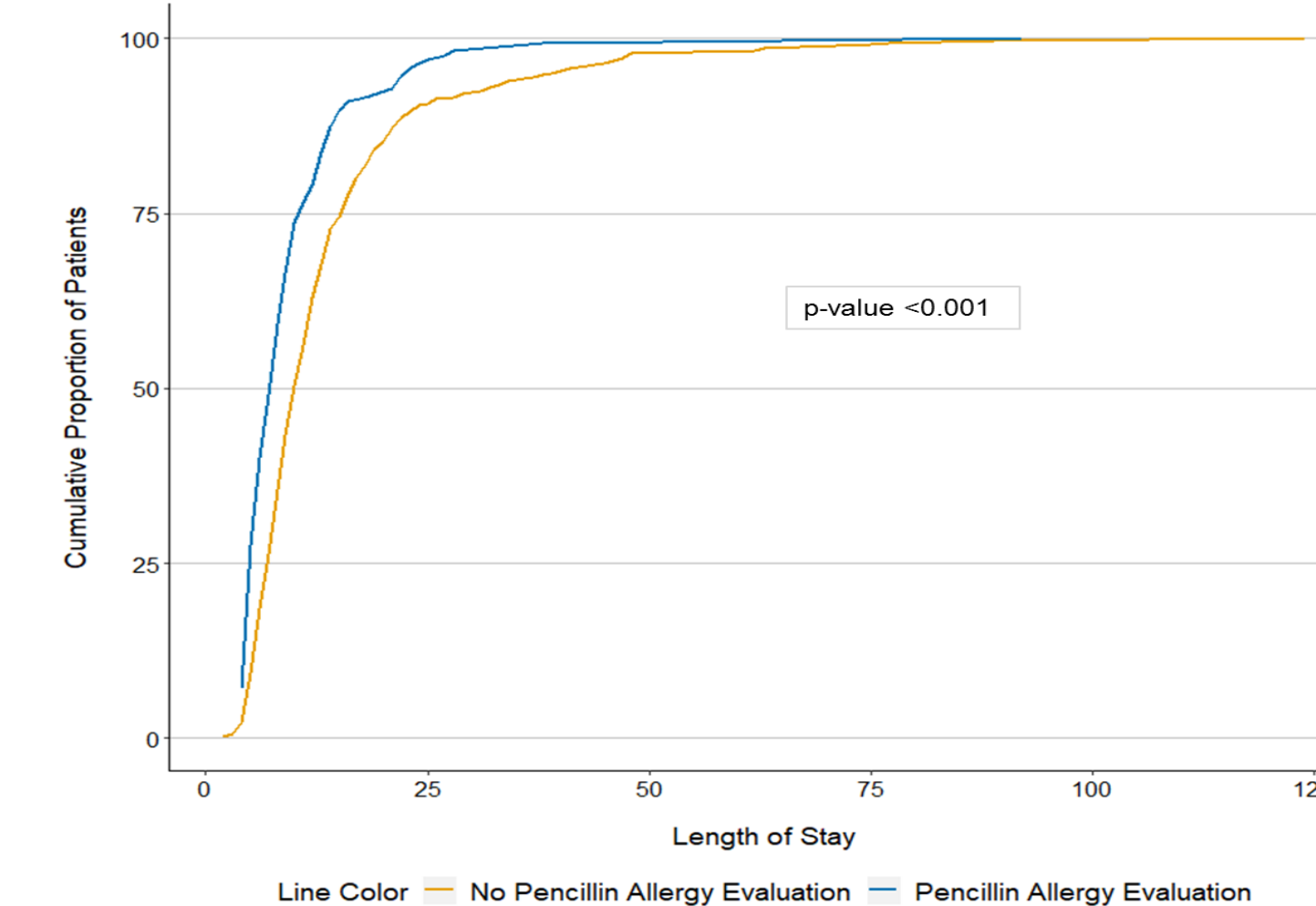
Primary Outcome

- Patients who underwent preoperative penicillin allergy evaluation were more likely to receive first-line perioperative antibiotics (92% vs 38%, p<0.001).
- Adjusting for age, BMI, gender, race, ASA class, surgery type, surgery status, resistant organism colonization, penicillin reaction, and cephalosporin allergy history, patients who underwent penicillin allergy evaluation had an increased odds of receiving first-line perioperative antibiotics (adjusted odds ratio 26.6 [12.8, 55.2]).

Secondary Outcomes

- Patients who underwent preoperative penicillin allergy evaluation had shorter median hospital lengths of stay (8 days vs 10 days [Interquartile Range 7 days, 16 days], p <0.001, **Figure 1**).
- There was a similar SSI frequency in patients with and without penicillin allergy evaluation (1.8% vs 2.9%, p =0.47).

Figure 1. Length of stay in cardiac surgery patients with a documented penicillin allergy



LIMITATIONS

- This was a retrospective, observational study.
- We captured only Allergy/Immunology evaluations that occurred within our healthcare system; however, if patients with outside penicillin allergy assessments were included in the "No Penicillin Allergy Evaluation" group, this would make our findings more conservative.
- We studied only one method of penicillin allergy evaluation (i.e. allergist performed penicillin skin testing followed by amoxicillin challenge, if negative).

CONCLUSIONS

- Allergist-driven preoperative penicillin allergy assessment was associated with a 27-fold increase in first-line antibiotic use in cardiac surgery patients.
- There is a need to identify methods to assess penicillin allergy in the inpatient setting as well as in urgent and emergent procedures.
- Future efforts must evaluate methods to ensure that all patients who are not penicillin allergic are effectively de-labeled.

FUNDING

- NIH K01AI125631, the American Academy of Allergy Asthma and Immunology (AAAAI) Foundation, and the MGH Claflin Distinguished Scholar Award.