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## Cefazolin Administration in Penicillin Allergic Patients

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## **Executive Summary**

### **Introduction of the Problem**

Surgical site infections are highly preventable, hospital-acquired infections that lead to poor patient outcomes and increased economic burden. Medicare does not reimburse surgical site infections, and prophylaxis measures have been standardized by past national quality improvement projects such as the Surgical Care Improvement Project (Umscheid et al., 2011). Cefazolin is a first-generation cephalosporin, beta-lactam antibiotic commonly given for surgical site infection prophylaxis. Cephalosporins carry a very low cross-reactivity potential with penicillins. Penicillins are one of the most commonly reported allergies with 10% of all patients reporting a penicillin allergy. Only 10% of the patients reporting a penicillin allergy are truly allergic and experience an IgE-mediated reaction (Joint Task Force on Practice Parameters et al., 2010). Due to a large number of reported penicillin allergies, alternative antibiotics for surgical site prophylaxis, such as clindamycin and vancomycin, are often administered because of the concern of cefazolin cross-reactivity and allergic reaction potential. However, alternative antibiotic administration is directly responsible for a 50% higher chance of developing a surgical site infection when cefazolin is indicated as the first line recommended agent (Blumenthal et al., 2017).

The host facility for this project was a tertiary care center in central Illinois with a significant, diverse surgical population and common use of alternative antibiotics in patients with a reported penicillin allergy. There was a need for a review of the literature and creation of an evidence-based algorithm for anesthesia staff members to optimize antimicrobial surgical site infection prophylaxis and potentially improve patient outcomes.

### **Literature Review**

Cefazolin is the most common first line prophylactic antibiotic for surgery recommended by the Society of Health-System Pharmacists, Infectious Diseases Society of America, Surgical Infection Society, and the Society for Healthcare Epidemiology of America (Bratzler et al., 2013). Cefazolin is inexpensive, has minor side effects, and is bactericidal against the most common bacteria causing surgical site infections (Bratzler et al., 2013). Alternative antibiotics, specifically clindamycin and vancomycin, cause more multidrug-resistant organisms, increase adverse effects, and increase costs (Blumenthal et al., 2018; Joint Task Force on Practice Parameters et al., 2010). There is no decreased incidence of adverse drug reactions in the perioperative period when alternative antibiotics are administered (Grant et al., 2021).

Beta-lactam antibiotics share a beta-lactam ring structure but carry numerous different R1 and R2 side chain compositions. The potential of cross-reactivity resides in similar or identical R1 side chains in penicillins and first and second-generation cephalosporins (Fernandez et al., 2014; Joint Task Force on Practice Parameters et al., 2010; Romano et al., 2018; Yuson et al., 2019). Cefazolin has a unique R1 side chain that is not similar to other first generation cephalosporins and thus a very low risk of cross-reactivity potential, about 3% (Picard et al., 2019; Sousa-Pinto et al., 2021). The incidence of anaphylaxis in patients with a reported penicillin allergy was found to be no different between those who received cefazolin and those who received alternative antibiotics (Anstey et al., 2021). Most patients with a reported penicillin allergy, including anaphylactic reactions, may safely receive cefazolin, except those with a type IV delayed immune-mediated hypersensitivity (Beltran et al., 2015; Fosnot et al., 2021; Grant et al., 2021; Kuruvilla et al., 2020; Otake et al., 2013; Sousa-Pinto et al., 2021; Stone et al., 2019).

Penicillin skin testing and drug provocation testing are ideal methods to delabel reported penicillin allergies. However, broad implementation is unrealistic due to several barriers, namely

the sheer volume of reported penicillin allergies in the general population (Joint Task Force on Practice Parameters et al., 2010; Kuruvilla et al., 2020). A graded challenge, or test dose, is not routinely recommended when administering cefazolin to patients with reported penicillin allergies.

### **Project Methods**

This project aimed to review the literature and develop an algorithm to guide anesthesia providers on evidence-based recommendations for cefazolin administration to patients with a reported penicillin allergy. This project used a non-experimental design. Evidence-based information from the literature was retrieved to develop the algorithm. Literature review findings and the pilot algorithm were presented as a PowerPoint presentation to key stakeholders at a tertiary care facility in central Illinois. A convenience sample of six staff members, four CRNAs and two pharmacists, participated in the presentation and completed the post education survey. The survey was available electronically via Qualtrics QR code and in paper form.

This project was submitted to the Southern Illinois University Edwardsville IRB committee for approval and was deemed quality improvement and exempt from further review. The external stakeholder also approved the project at the host facility before implementation. Participation in this project was voluntary and included minimal risks, such as timing and inconvenience for the participants.

### **Evaluation**

Following the educational presentation and introduction to the pilot algorithm, participants in attendance were asked to complete a 13-question survey. The questions were in multiple choice, true/false, and Likert scale formats in addition to an open-ended question and a

question/comment section. Three demographic questions, five knowledge assessment questions, and five current practice and algorithm application questions were included.

Analysis of the survey results demonstrated that greater than 67% of the participants correctly identified all five knowledge assessment questions. Of the two 5-point Likert scale questions, a mean score of 4.5 suggested the algorithm was easy to understand and follow and a mean score of 4.8 suggested that all participants were likely to support the implementation of a cefazolin administration algorithm as a result of the educational presentation. The themes in the open-ended section of anticipated barriers included provider hesitance and surgeon buy-in. No questions or comments were left in the question/comment section.

Overall, the introduction of the pilot algorithm was positive based on analysis of the post educational survey and participants' verbal comments after the survey. Participants verbalized the need for the literature review and development of the pilot algorithm. Participants also suggested including surgeons and perioperative nursing staff as other key stakeholders in future presentations.

Limitations to this project included sample size and sampling bias. A convenience sample was utilized mainly due to staff availability for a single in-person presentation. One possible idea to overcome the small sample size would be to disseminate in an electronic format in addition to the in-person format. Another idea is to include other key stakeholders, such as surgeons, or even other perioperative departments to obtain a larger sample size to increase generalizability of the results.

### **Impact on Practice**

This project aimed to evaluate the literature regarding cefazolin administration to patients with a reported penicillin allergy and create a pilot algorithm to guide anesthesia providers on

optimal antimicrobial selection and administration. The project's immediate impact included creating and presenting a pilot algorithm for the anesthesia and pharmacy departments at the host facility. Predicted long-term impacts of this project include disseminating the algorithm to all operating rooms at the host facility. Also, the anesthesia department may collaborate with the pharmacy department to create a protocol using the algorithm to optimize antimicrobial selection for surgical site infection prophylaxis and potentially improve patient outcomes.

### **Conclusions**

Surgical site infections are generally preventable, particularly with optimal surgical antimicrobial administration. Cefazolin is the most commonly recommended first line antimicrobial agent for most surgical cases and wound classifications. Cefazolin is safe to administer to most patients reporting a penicillin allergy unless the reaction is a type IV delayed immune-mediated hypersensitivity, the patient has a positive penicillin skin test, or the patient reports an allergy to cefazolin. Optimal administration of cefazolin in the perioperative period has the potential to improve patient outcomes and prevent unnecessary effects directly related to alternative antimicrobial administration. Future projects involving anesthesia and pharmacy collaboration, such as the creation of evidence-based algorithms, may lead to facility-specific, enhanced surgical patient outcomes.

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