

Original Article

Effect of an Educational Program and Antibiotic Prescribing Guideline on Inpatient Clinical Providers' Antibiotic Prescribing Knowledge

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What is already known about this topic? Patients commonly report allergy to penicillin. General providers lack knowledge of penicillin allergy evaluation. Allergy assessment of inpatients with reported penicillin allergy is important for high quality patient care and appropriate utilization of antibiotics.

What does this article add to our knowledge? Providers lack formal education in drug allergy and express interest in tools to help them care for drug-allergic inpatients. A brief educational initiative, paired with a clinical guideline, was associated with improved drug allergy knowledge.

How does this study impact current management guidelines? Allergists can work effectively with colleagues from infectious diseases and pharmacy to create guidelines that improve the care of inpatients with drug allergy. Inpatient providers will require additional education about drug allergy.

BACKGROUND: Inpatient providers have varying levels of knowledge in managing patients with drug and/or penicillin (PCN) allergy.

OBJECTIVES: Our objectives were (1) to survey inpatient providers to ascertain their baseline drug allergy knowledge and preparedness in caring for patients with PCN allergy, and (2) to assess the impact of an educational program paired with the implementation of a hospital-based clinical guideline.

METHODS: We electronically surveyed 521 inpatient providers at a tertiary care medical center at baseline and again 6 weeks after an educational initiative paired with clinical guideline implementation. The guideline informed providers on drug allergy history taking and antibiotic prescribing for inpatients with PCN or cephalosporin allergy.

RESULTS: Of 323 unique responders, 42% (95% CI, 37-48%) reported no prior education in drug allergy. When considering those who responded to both surveys (n = 213), we observed a significant increase in knowledge about PCN skin testing (35% vs 54%; $P < .001$) and loss of PCN allergy over time (54% vs 80%; $P < .0001$). Among those who reported attending an educational session (n = 62), preparedness to determine if an allergy was severe significantly improved (77% vs 92%; $P = .03$). Other areas, including understanding absolute contraindications to receiving a drug again and PCN cross-reactivity with other antimicrobials, did not improve significantly.

CONCLUSIONS: Inpatient providers have drug allergy knowledge deficits but are interested in tools to help them care for inpatients with drug allergies. Our educational initiative and hospital guideline implementation were associated with increased PCN allergy knowledge in several crucial areas. To improve care of inpatients with drug allergy, more research is needed to evaluate hospital policies and sustainable educational tools. © 2014 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2014;■:■-■)

Key words: Drug; Antibiotic; Penicillin; Cephalosporin; Inpatient; Allergy; Hypersensitivity; Anaphylaxis; Immune-mediated; IgE mediated; Drug allergy; Antibiotic allergy

Approximately half of all patients admitted to the hospital receive antibiotics, and 25% of inpatients who require antibiotics have at least 1 antimicrobial drug allergy.¹ Penicillin (PCN) allergy is reported in up to 10% of the general population and up to 16% of inpatients.¹⁻⁶ Patients with reported PCN allergies receive more costly and broad-spectrum antibiotics than patients without these reported allergies.¹⁻⁶ Furthermore, many patients with reported PCN allergy are not receiving drugs, such as later-generation

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Abbreviations used

HSR- Hypersensitivity reaction

MD- medical doctor

NP- Nurse practitioner

PCN- Penicillin

cephalosporins and carbapenems, that are safely tolerated despite a PCN allergy.^{1,5,7-13} Reported allergies to PCN, however, do not equate with true IgE-mediated allergy. After formal allergy evaluation, including skin testing, up to 99% of patients with reported PCN allergy are found not to be allergic.^{2-5,14,15}

General providers have limited knowledge about drug allergy, PCN cross reactivity with other antibiotics, and the utility of PCN skin testing.^{13,16,17} Despite these knowledge deficits, it is these providers who are evaluating and prescribing antibiotics to inpatients with drug allergy. Prior efforts to survey providers on this topic have been limited by low or unreported response rates, or by a lack of detail.^{13,16-18} Past surveys have not assessed the impact of interventions targeted at improving provider management of patients with drug and PCN allergy. This study sought to identify gaps in PCN and drug allergy knowledge among inpatient providers at a single tertiary care center and to assess the impact of a targeted educational program paired with the implementation of a hospital-based clinical guideline.

METHODS

In anticipation of an educational initiative and implementation of a hospital-wide clinical guideline, we electronically surveyed inpatient providers at the Massachusetts General Hospital, a 947-bed tertiary care facility in Boston, Massachusetts. Providers included house staff from neurology, pediatrics, internal medicine, orthopedic surgery, and general surgery as well as attending hospitalist physicians and nurse practitioners (NP). Participants received a link to a Web-based survey 1 week before implementation of the clinical guideline and 6 weeks after implementation of the clinical guideline. The research protocol was approved by the Partners Human Research Committee. The survey was conducted and data maintained by using research electronic data capture (REDCap) hosted at Partners Healthcare.¹⁹ The survey was voluntary and anonymous. Through the REDCap interface, survey responses between identical responders can be paired though modules for tracking responders and viewing data are separate, allowing for responder anonymity to be maintained.

The survey questions were created by specialists from allergy/immunology (A.B., K.G.B.), infectious diseases (D.C.H., E.S.S.), and 2 survey research experts. Although no validated survey instrument on PCN allergy existed, 2 questions from a previously published instrument were adapted for use.¹⁶ The survey instrument was tested and revised through detailed interviews with 5 Massachusetts General Hospital clinical fellows. Survey questions covered 3 areas: respondent characteristics, preparedness and/or comfort, and knowledge (see [Table E1](#) in this article's Online Repository at www.jaci-inpractice.org).

After the initial survey was conducted, we implemented a hospital-based clinical guideline to help providers in drug allergy history taking and antibiotic prescribing for inpatients with PCN or cephalosporin allergy. The guideline includes a standardized method for primary teams to perform test doses, a limited step graded challenge, to β -lactam antibiotics and institution-specific

information regarding inpatient skin testing and desensitization, antimicrobial resistance patterns, and pharmacy formulary considerations (see this article's Online Repository at www.jaci-inpractice.org). Coincident with guideline implementation, 10-minute educational presentations were offered to 15 different groups of providers throughout the hospital from April 3, 2013, through May 15, 2013. The presentation's goal was to introduce the clinical guideline and show providers how to navigate to the guideline electronically. The educational initiative also relayed antibiotic stewardship goals and key concepts about PCN allergy, including (1) patients with reported PCN allergy may not be truly allergic (IgE-mediated allergy); (2) the evaluation of PCN allergy begins with a drug allergy history; (3) even those who are truly PCN allergic may have lost their allergy over time; (4) skin testing for IgE-mediated PCN allergy is a valid tool that is available; (5) many cephalosporins, especially in the later generations, can be safely tolerated despite true PCN allergy; and (6) severe cutaneous reactions and hypersensitivity reactions (HSR) with organ involvement preclude future use of that drug. After providing brief evidence that supports these concepts, providers were presented with 3 clinical vignettes that highlight the inpatient relevance of the guideline. The educational initiative did not review any answers to the survey instrument questions. After each presentation, cards with figures from the clinical guideline were distributed and posted in hospital workrooms. The full guideline was available electronically to all staff.

Analysis and statistical methods

For preparedness questions, Likert responses were dichotomized into "prepared" (providers who responded very prepared or somewhat prepared) or "unprepared" (providers who responded very unprepared or somewhat unprepared). For knowledge questions, answers were scored as incorrect or correct for single-item questions. For the multi-item questions, frequencies and scores were calculated by using the number each provider got correct of the 13 possible correct for the question on cross-reactivity and of 5 possible correct for the question on absolute contraindications to receiving a drug again. For those ordinal scores, medians and quartiles were reported.

Statistical methods to assess the education and guideline impact included nonparametric tests, such as the Wilcoxon signed rank test for paired continuous and rank data, and the McNemar test for paired binary data. An analysis of providers whose answers changed from the pre- to postsurvey was conducted and assessed by a 1-sample test of proportions. The providers who reported that they had attended one of the educational sessions or used the clinical guideline were compared with those who did not attend by using a nonparametric test for trend. Responses of NPs were compared with those of medical doctors (MD) by using the Fisher exact test or the Wilcoxon rank sum test. Postsurvey responses of 38 people who did not take the first test were compared with those of 285 people who did take the first test by using Wilcoxon rank sum test. All statistical analyses were conducted in SAS version 9.3 (SAS Institute Inc, Cary, NC).

RESULTS

Sixty-two percent of providers (323 of 521) responded to at least 1 of the 2 surveys. Two hundred and eighty-five providers (55%) responded to the presurvey, and 250 (48%) responded to the postsurvey. Two hundred and thirteen inpatient providers (41%) completed both surveys. Of MD respondents to both

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