

Clinical decision support improved allergy documentation of antibiotic test dose results

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Clinical Implications

- Targeted provider-facing alerts can significantly increase the frequency of appropriate β -lactam allergy documentation after drug challenges in acute care settings. Improved allergy documentation increases the effectiveness of β -lactam allergy interventions while generally improving quality and safety.

TO THE EDITOR:

Hospitalized patients with electronic health record (EHR)-documented β -lactam allergies are often treated with β -lactam alternative antibiotics that have a broader spectrum or have a less favorable side-effect profile.¹

Given that most patients with EHR-documented β -lactam allergies can receive β -lactams safely, hospitals have addressed inpatient β -lactam allergies as part of antibiotic stewardship efforts, with interventions including penicillin skin testing and drug challenges (test doses).¹ Partners HealthCare System (PHS) uses an electronic guideline and package of clinical decision support for inpatients with histories of penicillin or cephalosporin allergies; test doses are used, often without allergy consultation or preceding penicillin skin testing.²⁻⁴ The PHS guideline was previously shown to be both safe and effective; hypersensitivity reactions occurred in less than 4% of patients and subsequent β -lactam exposure increased approximately 2-fold.²⁻⁴ Our guideline has since been adapted for learning materials and interventions at non-PHS sites.^{5,6}

The effectiveness of any hospital-based intervention for patients with documented β -lactam allergies is reliant on accurately communicating allergy updates on patient discharge, which must involve documenting in the EHR allergy module. After finding that less than half (45%) of allergy records were updated after PHS antibiotic test dose challenge procedures,⁴ we aimed to develop and assess a targeted alert to improve allergy documentation after β -lactam antibiotic test doses.

We developed a decision support alert in Epic (Epic Systems Corporation, Verona, Wis) for PHS inpatients (Figure 1). The alert fires for physicians, nurse practitioners, and physician assistants at the time they access the order entry screen for all patients who received an antibiotic test dose through the β -lactam antibiotic test dose order set. The alert begins to fire 24 hours after the test dose was ordered and continues to fire for 72 hours. The alert allows providers to access the allergy module to document changes in allergy status. Alternatively, providers can

override the alert, by either documenting that the patient did not receive the test dose (eg, it was cancelled), which will silence the alert for all users, or documenting that the user is not a member of the patient's primary team, which will prevent the alert from firing again for that user only.

The alert was released silently on June 28, 2018. When in silent mode, the alert logged when it would have fired, but no message was shown to the user. After 48 days in silent mode, the alert was made visible on August 15, 2018, and monitored for an additional 48 days, effectively creating 2 assessment periods: a baseline prealert period (where no alert was shown to the user), and a postalert period (when the alert was shown to the user). We manually reviewed ordering provider and patient characteristics for all hospitalizations where a β -lactam test dose was administered to patients with a history of penicillin or cephalosporin allergy during the 2 assessment periods. The primary outcome was an appropriate β -lactam allergy update within a 14-day period. Appropriate updates included (1) allergy deletion, (2) specific β -lactam tolerance documentation, or (3) added or specified β -lactam allergy (for patients who did not tolerate their drug challenge). We compared update frequencies using χ^2 tests in SAS (version 4.2; SAS, Cary, NC). We plotted a Kaplan-Meier curve of time from test dose administration to the update of the β -lactam allergy for both periods, and compared results using the logrank test in R version 3.4.3.

There were 375 hospitalizations where a β -lactam antibiotic test dose was given in 2 periods: 195 hospitalizations during the prealert period and 180 during the postalert period. Hospitalizations occurred across PHS sites: Massachusetts General Hospital (57.9%), North Shore Medical Center (21.1%), Brigham and Women's Hospital (14.4%), Newton Wellesley Hospital (4.5%), and others, including the Massachusetts Eye and Ear Infirmary, Martha's Vineyard Hospital, and the Brigham and Women's Faulkner Hospital (2.1%). Allergy consultation was called in 45 (12.0%) of these hospitalizations: 12.3% in the prealert period and 11.7% in the postalert period ($P = .85$).

The 375 β -lactam test doses were ordered by 274 unique PHS nonallergy specialist providers. β -Lactam test doses were largely performed for β -lactam cross-reactivity concerns (74.1%); fewer β -lactam test doses were to a drug within the same β -lactam drug class (23.2%) and to the identical drug (2.7%).

Overall, the β -lactam allergy was updated within 14 days for 100 of the test doses (51.3%) during the prealert period and 120 test doses (66.7%) during the postalert period ($P = .003$). Allergy updates were more frequent in the postalert period for β -lactam test doses administered within the same drug class as the allergy (72.5% vs 57.5%, $P = .14$) and for test doses administered for cross-reactivity concerns (64.2% vs 50.7%, $P = .023$). In both periods, appropriate allergy updates were performed in all patients receiving a test dose to the identical drug.

Most allergy updates occurred during the hospitalization (95.9%) with no difference in the pre- and postalert periods (96.0% vs 95.8%, $P = .95$). There was an improvement in time-to- β -lactam allergy update during the postperiod (Figure 2, $P = .003$).

We designed and assessed the impact of a targeted provider-facing alert to improve β -lactam allergy documentation after

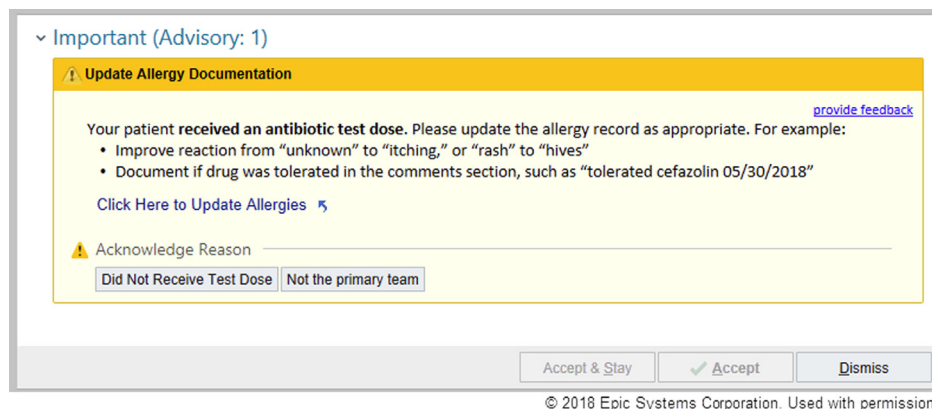


FIGURE 1. Screenshot of provider-facing allergy test dose documentation alert.

inpatient test dose challenges. We previously identified that just 45% of records were updated across our health care system, similar to the 51.3% in the prealert period. The addition of electronic alerting increased allergy documentation to 66.7% overall. In addition to a greater likelihood of updating, updates were made significantly faster in the post-alert period.

β -Lactam allergy documentation is important to both the quality and safety of patient care. One prior study demonstrated that more thorough β -lactam allergy documentation increased prescribing of β -lactams.⁷ Patients with positive test dose challenges to β -lactams need to avoid the drug they are allergic to, and the potentially cross-reactive drugs. In these cases, the allergy list should provide information about the symptoms, severity, and type of reaction that was clinically observed after the test dose. Patients with negative test dose challenges should have their allergy deleted, or qualified to convey information about the antibiotic tolerated. The latter would improve antibiotic choices in outpatient settings, as well as on future admissions, which are not uncommon in these patients.^{8,9}

This study was limited to inpatients at a single health care system in the United States, using a single EHR (Epic). Our study focused on patients who had allergy assessments while hospitalized in the form of a β -lactam antibiotic test dose. Future studies might assess comparable alerts at other clinical sites, settings (eg, outpatients), or with other drug classes. This study was performed as a before-after quasi-experiment, and so causality cannot be assessed. Although quasi-experimental studies can be biased by secular effects, no other allergy documentation interventions occurred during these study periods.

We described an alert that increased the frequency and timeliness of β -lactam allergy documentation updates after inpatients received β -lactam drug challenges. This significant improvement is encouraging and may be useful to other organizations with interventions for β -lactam allergic inpatients. However, the frequency of allergy documentation updating was still far below 100%, yet was at 100% for the test doses performed to the identical drug, which suggests that there may be a knowledge gap related to modifying a patient's allergy record. Additional methods, such as more automation or a centralized population-based approach, may be required to close the residual

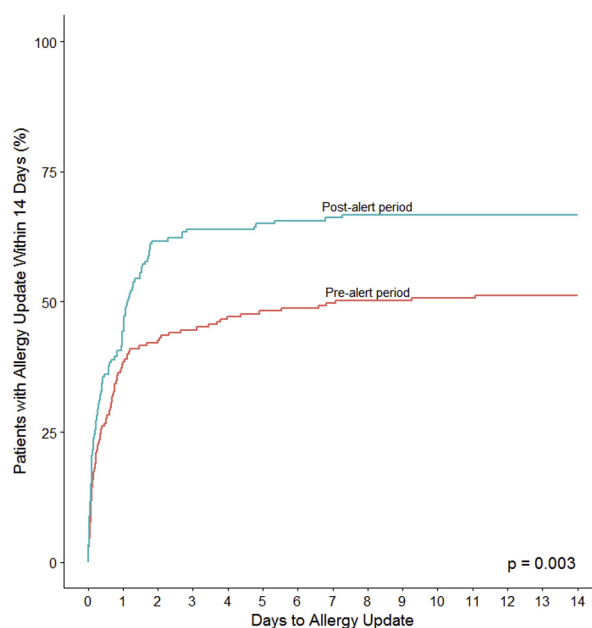


FIGURE 2. Kaplan-Meier plot for time to β -lactam allergy update after test dose in prealert and postalert periods.

documentation gap, especially considering that it is infeasible to educate all of the various providers who order β -lactam test doses across this large health care system.

Acknowledgments

The authors thank current and past Partners Penicillin Hypersensitivity Pathway team members: David N. Berkowitz, PharmD, Barbara B. Lambl, MD, MPH, Joyce T. Hsu, MD, Monique M. Freeley, RPh, Alana Gruszecki, PharmD, Kathleen A. Marquis, PhD, PharmD, Ramy Elshaboury, PharmD, BCPS, AQID, Ronak G. Gandhi, PharmD, BCPS, David W. Kubiak, PharmD, BCPS, Praveen Meka, MD, Diana Balekian, MD, MPH, and Roger P. Clark, DO. The authors thank Partners Quality, Safety, and Value and Clinical Process Improvement

Leadership Program sponsors: Brian Cummings, MD, and Thomas Sequist, MD, MPH. They also thank Christian Mancini for his research assistance and Xiaoqing Fu, MS, for statistical support.

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This work was supported by Partners Quality, Safety, and Value and the Partners Clinical Process Improvement Leadership Program (CPIP). K. G. Blumenthal received career development support from the National Institutes of Health (NIH) K01AI125631, the American Academy of Allergy Asthma and Immunology Foundation, and the MGH Claflin Distinguished Scholar Award. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH, AAAI Foundation nor the MGH.

Conflicts of interest: E. S. Shenoy and K. G. Blumenthal report a licensed clinical decision support tool for inpatient β -lactam allergy evaluation. The rest of the authors declare that they have no relevant conflicts of interest.

Received for publication February 11, 2019; revised March 27, 2019; accepted for publication April 26, 2019.

Available online May 25, 2019.

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2213-2198

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<https://doi.org/10.1016/j.jaip.2019.04.052>

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