

Journal Pre-proof

Examining the impact of a penicillin allergy skin testing brochure on inpatient perceptions: a pre-post intervention study

Mikaela Brown, PharmD, Joy Uzoma, Pharm D, Ryan Vansice, Pharm D, Karlie Mahan, PharmD, Kelly M. Conn, PhD, MPH, Allison Ramsey, MD, Mary L. Staicu, PharmD

PII: S2213-2198(20)31205-8

DOI: <https://doi.org/10.1016/j.jaip.2020.10.050>

Reference: JAIP 3228

To appear in: *The Journal of Allergy and Clinical Immunology: In Practice*

Received Date: 12 March 2020

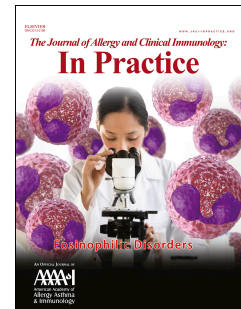
Revised Date: 25 September 2020

Accepted Date: 22 October 2020

Please cite this article as: Brown M, Uzoma J, Vansice R, Mahan K, Conn KM, Ramsey A, Staicu ML, Examining the impact of a penicillin allergy skin testing brochure on inpatient perceptions: a pre-post intervention study, *The Journal of Allergy and Clinical Immunology: In Practice* (2020), doi: <https://doi.org/10.1016/j.jaip.2020.10.050>.

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2020 Published by Elsevier Inc. on behalf of the American Academy of Allergy, Asthma & Immunology



Title Page**Examining the impact of a penicillin allergy skin testing brochure on inpatient perceptions: a pre-post intervention study**

Mikaela Brown, PharmD¹, Joy Uzoma, Pharm D^{1,2}, Ryan Vansice, Pharm D^{1,2}, Karlie Mahan PharmD², Kelly M. Conn, PhD, MPH¹, Allison Ramsey, MD^{2,3}, Mary L Staicu, PharmD²

Affiliations:

¹ St. John Fisher College Wegmans School of Pharmacy, Rochester, New York, USA

² Rochester General Hospital, Rochester, New York, USA

³ University of Rochester School of Medicine and Dentistry, Rochester, New York, USA

Address Correspondence:

Mary Staicu, PharmD

Rochester General Hospital

Pharmacy Department

1425 Portland Avenue

Rochester, NY 14621

(585) 922-5732

(585) 922-2917 (fax)

mary.staicu@rochesterregional.org

Presented as a poster at ID Week, Washington, DC, 2019.

Key words: penicillin allergy, drug allergy, patient education, patient knowledge, penicillin skin testing, brochure

Figures: 1

Supplemental online material: Text with embedded figures

Funding Source: None

Conflicts of Interest: MB, JU, RV, KM, KC, and MS have no competing interests or financial disclosures. AR has received a research grant CSL Behring and is on the speaker's bureau for Sanofi/Regeneron.

Clinical Implications (40/40 words)

Patient-centered brochures have been utilized to educate patients and to assist with health-related decision-making processes. This study is among the first to describe the impact of an educational brochure on inpatient knowledge and perception of penicillin allergy and skin testing.

Text (1,000/1,000)

The penicillin (PCN) allergy label is associated with serious and significant clinical consequences, including increased healthcare exposure, bacterial resistance, and suboptimal clinical outcomes.^{1,2} Despite these risks and the well-described waning of immunoglobulin E (IgE) antibodies over time, only 0.1% of patients labeled penicillin-allergic undergo penicillin skin testing (PST) annually.³ The underutilization of PCN allergy evaluations and subsequent PST may be partially related to knowledge gaps among both healthcare providers and patients, which has been described in the literature.⁴⁻⁹ We sought to evaluate the educational effectiveness and impact of a patient informational brochure on patient knowledge and perception of PCN allergy and PST.

An electronic health record (Hyperspace; Epic Systems Corporation, Verona, Wis) was utilized to identify hospitalized patients with an active PCN allergy between June 2016 and March 2019. Those eligible for the study included patients $\geq$ 18 years of age with a documented PCN allergy history consistent with an IgE-mediated response, defined as symptoms of rash, hives, itching, angioedema, shortness of breath, and/or anaphylaxis. Patients non-English speaking, unable to provide informed consent, or admitted to the intensive care unit at the time of the study were excluded.

Prior to reading the brochure, participants were given a survey (pre-brochure survey) (Figure E1) which evaluated baseline knowledge of PCN allergy. Participants were then provided an educational brochure (Figure E2) containing information about PCN allergy and PST. Knowledge and perception of the educational materials were then assessed by completing a post-brochure survey (Figure E3) upon return of the brochure to study personnel. Administration of the pre- and post-brochure surveys occurred during the same encounter. Study personnel were not permitted to answer participant questions about the brochure contents until the surveys were returned.

The pre- and post-brochure surveys were completed by the patient by rating their responses to various knowledge- and perception-based statements on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The primary endpoint was agreement with knowledge statements; those who answered strongly agree or agree were included in the “agree” group and those who answered uncertain, disagree, and strongly disagree were categorized into the “disagree” group. Descriptive statistics were used to summarize the population and patient knowledge and perception of PCN allergy and PST. For the primary outcome, identical statements on each survey were used to compare pre- and post-proportions of

those who agreed to knowledge statements. For paired data, McNemar's test was used to compare change in knowledge between the pre- and post-brochure surveys responses. IBM® SPSS® Statistics V24 for Windows (Armonk, NY) and Vassar Stats© were used for analysis.

Out of 125 patients approached 101 (80.8%) completed the survey. Patients were predominantly female (66.3%), > 65 years of age (42.6%), Caucasian (78.2%) and completed a high school education or beyond (81.2%). When assessing background information regarding previous reactions, more than half of subjects (52.3%) reported hypersensitivities to other antibiotics, where 26 (26%) reported requiring medical attention for previous hypersensitivity reactions.

The pre-brochure survey responses indicated that 73 (72.3%) individuals disagreed that one can outgrow a PCN allergy and only 1 in 4 participants (25.7%) had heard of PST from a healthcare provider. At baseline, 1 in 2 participants reported they would be more likely to undergo PST if conducted in a hospital setting (48.5%) and 40 (39.6%) indicated PST would be beneficial for them overall. Cost of PST was not a concern in the majority of patients (71.3%).

After reading the educational brochure, the number of participants who believed people could outgrow a PCN allergy increased 3-fold (24.8% vs. 77.2%; $P < 0.01$) and the number of individuals who felt PST would be helpful also increased (39.6% vs. 66.3%; $P < 0.01$) (Figure 1). When assessing patient understanding of information stated in the post-brochure, 76.2% of patients agreed that PST would help patients receive more effective antibiotics in the future, and 49.5% agreed that PCN antibiotics have less side effects compared to other antibiotics. Additionally, individuals reported they felt better informed about the reasons to undergo PST (86.1%) and the majority (77.2%) agreed that PST may be easier than they thought. At the conclusion of the post-brochure survey, approximately one in three respondents (34.7%) indicated they would still be apprehensive to use PCN regardless of their PST result.

While the clinical implications of the PCN allergy label and the benefits of delabeling have robust supporting literature, little is known about inpatient perception of PCN allergy and the effect of patient education.⁹ We assessed the impact of an educational brochure on inpatient knowledge, perception, and attitude regarding PCN allergy and PST and found that most patients had not engaged in prior discussions with their healthcare providers regarding these topics. Our brochure

helped to close knowledge gaps on important areas that have shown to affect patient care. Despite our educational intervention, some patients remained hesitant to consider PST and/or PCN-based antibiotic use.

Although our findings are encouraging, there are limitations to this study. First, this was a single center analysis with a small sample size where the majority of participants were white elderly women with college degrees. Our results may not apply to other patient populations beyond these demographics. Second, the brochure was only available in English, which may have contributed to participant selection bias and may limit the generalizability of our findings. Third, this study took place over a period of 3 years where patient education about PCN allergy and PST was featured on several news and social media platforms. However valid, these reports may have influenced patient knowledge over time.

Our brochure was successful at educating patients regarding PCN allergy and PST, filling a gap in the medical literature regarding patient perceptions and education surrounding these topics. Implementation of patient educational programs has excellent potential to empower patients to initiate PST and delabeling discussions, improve understanding and encourage shared decision-making with healthcare providers. Further research evaluating the impact of patient education should be studied in broader, more diverse populations and include clinical outcome metrics as well as behavioral components associated with PCN allergy delabeling.

References

1. Huang KH, Cluzet V, Hamilton K, Fadugba O. The impact of reported beta-lactam allergy in hospitalized patients with hematologic malignancies requiring antibiotics. *Clin Infect Dis* 2018;67:27-33.
2. Macy E, Contreras R. Health care use and serious infection prevalence associated with penicillin “allergy” in hospitalized patients: a cohort study. *J Allergy Clin Immunol* 2014; 133:790-6.
3. Joint Task Force on Practice Parameters representing the American Academy of Allergy, Asthma and Immunology; American College of Allergy, Asthma and Immunology; Joint Council of Allergy, Asthma and Immunology. Drug allergy: an updated practice parameter. *Ann Allergy Asthma Immunol.* 2010; 10:259-273.
4. Wanat M, Anthierens S, Butler CC, Savic L, Savic S, Pavitt SH, et al. Patient and Primary Care Physician Perceptions of Penicillin Allergy Testing and Subsequent Use of Penicillin-Containing Antibiotics: A Qualitative Study. *J Allergy Clin Immunol Pract* 2019; 7(6):1888-1893.
5. Staicu M, Soni D, Conn KM, Ramsey A. A survey of inpatient practitioner knowledge of penicillin allergy at 2 community teaching hospitals. *Ann Allergy Asthma Immunol* 2017; 119:42-47.
6. Medrano Martínez V, Callejo-Domínguez JM, Beltrán-Iasco I, Pérez-Carmona N, Abellán-Miralles I, G González-Caballero, et al. Migraine education brochures and patient-perceived satisfaction. *Neurologia* 2015; 30(8):472-478.
7. Messner ER, Reck DL, Curci KM. Effectiveness of a patient education brochure in the emergency department. *Top Emerg Med* 2005; 27(4):251-255.
8. Ramsey A and Staicu ML. Use of a penicillin allergy screening algorithm and penicillin skin testing for transitioning hospitalized patients to first-line antibiotic therapy. *J Allergy Clin Immunol Pract* 2017;6(4):1349-1355.
9. Sundquist BK, Bowen BJ, Otabor U, Celestin J, Sorum PC. Proactive penicillin allergy testing in primary care patients labeled as allergic: outcomes and barriers. *Postgrad Med* 2017;129(8):915-920.

Figure Legends:

Figure 1. Change in Knowledge between Pre- and Post-Brochure Surveys

Figure 1 legend. This figure demonstrates the change in the number of subjects who agreed with PCN allergy and PST knowledge statements on the pre- and post-brochure surveys.

Abbreviations: PCN, penicillin; PST, penicillin skin testing

Figure 1. Change in Knowledge between Pre- and Post-Brochure Surveys

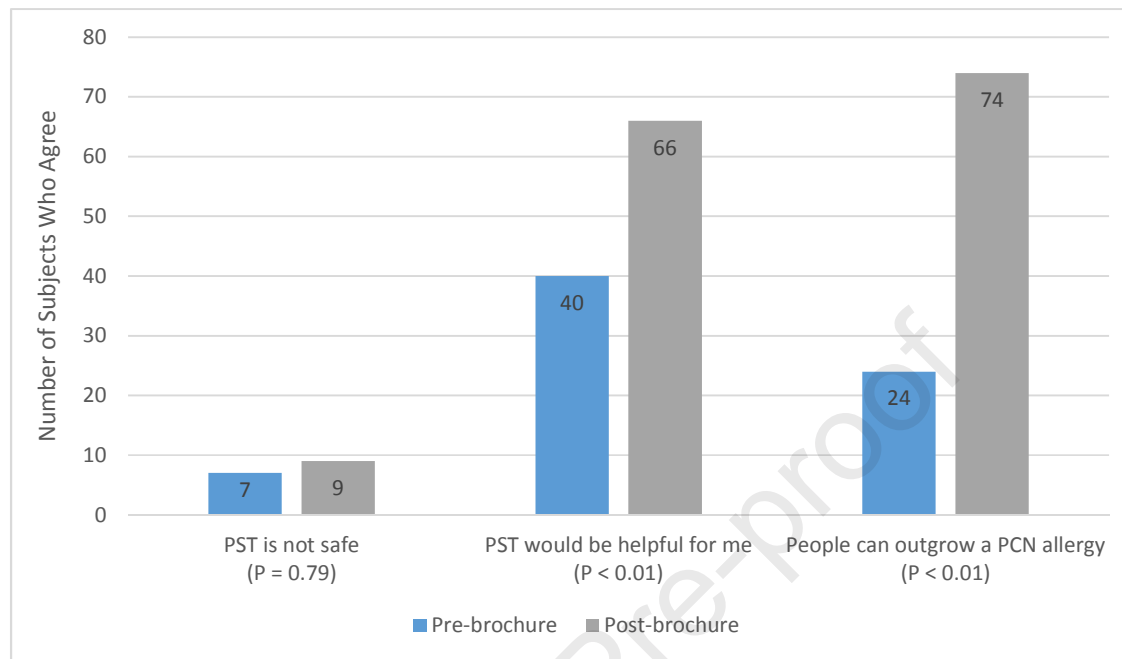


Figure E1. Baseline Questionnaire

Please read the following statements and indicate the extent to which you agree or disagree by circling the answer that best describes your thoughts.

		Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
a.	I have heard of penicillin skin testing before	5	4	3	2	1
b.	A health care provider has mentioned penicillin skin testing to me before	5	4	3	2	1
c.	I have been allergy tested to other allergens in the past	5	4	3	2	1
d.	People can outgrow a penicillin allergy	5	4	3	2	1
e.	Penicillin skin testing would be helpful for me	5	4	3	2	1
f.	A history of a serious reaction to penicillin means that I cannot undergo skin testing to penicillin	5	4	3	2	1
g.	Penicillins are generally less expensive than most antibiotics	5	4	3	2	1
h.	Penicillins are more effective antibiotics for some infections	5	4	3	2	1
i.	I would be more likely to get penicillin skin testing if I were in the hospital	5	4	3	2	1
j.	I would be more likely to get penicillin skin testing at an outpatient office	5	4	3	2	1
k.	I am concerned about the cost of penicillin skin testing	5	4	3	2	1
l.	Penicillin skin testing is not safe	5	4	3	2	1
m.	Penicillin skin testing will be uncomfortable	5	4	3	2	1
n.	Reintroduction of penicillin into my body through penicillin skin testing will cause a reaction	5	4	3	2	1
o.	Testing or reintroduction of penicillin into my body through penicillin skin testing will interact with my medical problems and/or medications	5	4	3	2	1

Figure E2. Penicillin Skin Testing Patient Brochure

Did You Know?

- Penicillin allergy has been linked to longer and costlier hospital stays.
- Ninety percent of patients who claim a penicillin allergy are not truly allergic. They can safely take penicillin and related antibiotics.
- Patients with a penicillin allergy are more likely to be prescribed other antibiotics. These may be more expensive, less effective and more likely to cause greater side effects.
- Some alternative antibiotics can lead to severe diarrhea caused by a germ called *Clostridium difficile*, also known as *C.diff*.

To discuss penicillin skin testing with an allergist or to set up an appointment:

Allergy, Immunology and Rheumatology
Office Locations

Rochester/Alexander Park
222 Alexander St.
Ste. 3000
Rochester, NY 14607

Greece
2300 West Ridge Rd.
Fifth Floor
Rochester, NY 14626

Penfield/Linden Oaks
10 Hagen Dr.
Ste. 20
Rochester, NY 14625

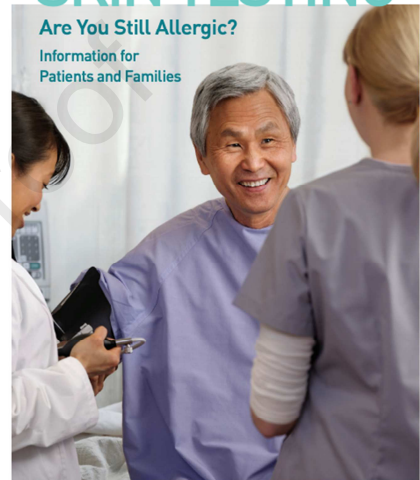
P 585.922.8350

F 585.922.8355

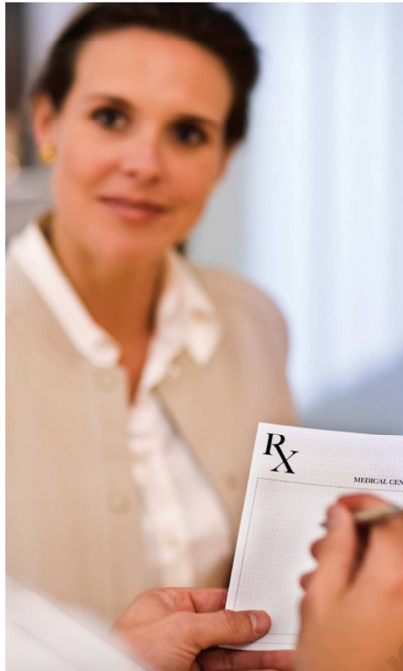
PENICILLIN SKIN TESTING

Are You Still Allergic?

Information for
Patients and Families



Your healthcare team thinks penicillin skin testing may be right for you.



What you should know about your penicillin allergy

Penicillin allergy is the most common medication allergy. However, up to 90 percent of patients who think they are allergic to penicillin may be able to take penicillin-based antibiotics.

The most common reasons are:

- Patients lose their allergy to penicillin over time.
- The initial reaction was not caused by penicillin.

Penicillin skin testing is the best way to determine if you are still allergic to penicillin.

A test can help if, in the past, penicillin has given you:

Rashes
Itching
Hives
Swelling in your face or throat
Low blood pressure

How do penicillin allergy skin tests work?

There are two types of skin tests. In the first, a drop of penicillin is pricked or scratched on the surface of your arm. If you are allergic, you will have a small spot of redness or itching where the penicillin was placed.

If the test is negative, we will give you a second test. For this test, we will inject a small amount of penicillin into the skin of your upper arm.

How long does it take to get skin test results?

For both types of skin tests, positive reactions such as redness and itching at the test spot usually appear within 15 minutes. If both tests are negative, you will receive a test dose of penicillin in the allergy office. You will be monitored for an allergic reaction for 30 minutes.

If your penicillin skin test is negative and you have no reaction to your test dose, you are no longer allergic to penicillin. Your chance of an allergic reaction to penicillin-based antibiotics is as low as it is for most people.

What are the benefits of penicillin skin testing?

Knowing if you are allergic to penicillin is important. For many illnesses, penicillin antibiotics are the best treatment options available.

- Penicillin antibiotics are often less expensive than other antibiotics.
- Other kinds of antibiotics may cause side effects.
- Antibiotics without penicillin may lead to drug resistance (commonly called "superbugs"), which may make antibiotics less effective in the future.

How much does penicillin skin testing cost?

The cost of penicillin skin testing depends on your insurance plan. Contact your insurance company to learn more.

Medications to avoid before penicillin skin testing

Certain medications may interact with penicillin allergy testing. You will receive a complete list of these medications from the allergy office once you make an appointment. It is important to talk to your primary care doctor or allergist before stopping your medications.

Figure E3. Post-Brochure Questionnaire

When reading the brochure, please tell us how helpful the following information was for you in influencing your decision on penicillin skin testing. Please use the following scale to determine how much more likely or less likely you are to get skin testing based on different pieces of information you saw in the brochure.

		Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
a.	People can outgrow a penicillin allergy	5	4	3	2	1
b.	Penicillin skin testing would be helpful for me	5	4	3	2	1
c.	A history of a serious reaction to penicillin means that I cannot undergo skin testing to penicillin	5	4	3	2	1
d.	Penicillin skin testing is not safe	5	4	3	2	1
e.	Penicillin skin testing will be uncomfortable	5	4	3	2	1
f.	Reintroduction of penicillin into my body through penicillin skin testing will cause a reaction	5	4	3	2	1
g.	Testing or reintroduction of penicillin into my body through penicillin skin testing will interact with my medical problems and/or medications	5	4	3	2	1
h.	Penicillin skin testing may help me to get put on more effective antibiotics in the future	5	4	3	2	1
i.	Penicillin antibiotics generally have less side effects than non-penicillin antibiotics	5	4	3	2	1
j.	Penicillin skin testing may allow me to take penicillin again which is may be less expensive than non-penicillin antibiotics	5	4	3	2	1
k.	Penicillin allergy is associated with resistant bacteria	5	4	3	2	1
l.	After reading the brochure, I feel better informed about reasons for penicillin skin testing	5	4	3	2	1
m.	After reading the brochure, I realize penicillin skin testing may be easier than I thought	5	4	3	2	1
n.	Regardless of the results of my penicillin skin test, I would be scared to use penicillin again in the future	5	4	3	2	1

After reading the brochure, please tell us below about any other thoughts you have regarding penicillin allergy or penicillin skin testing:
