

Practice Patterns of Dermatologists in the Pediatric Contact Dermatitis Registry

Sharon E. Jacob , M.D.,* Michael B. Lipp, D.O.,†,‡ Eric Suh, M.P.H.,§ and Alina Goldenberg, M.D., M.A.S.¶

**Department of Dermatology, Loma Linda University, Loma Linda, California, †Department of Dermatology, Larkin Community Hospital Palm Springs, Hialeah, Florida, ‡Dermatitis Academy, Redlands, California, §School of Public Health, Loma Linda University, Loma Linda, California, ¶Department of Dermatology, University of California, San Diego, San Diego, California*

Abstract

Background/Objectives: U.S. adults and children are equally likely to have allergic contact dermatitis. Historically the narrow geographic location of data-reporting providers has quantitatively and qualitatively limited the pediatric contact dermatitis data. The Pediatric Contact Dermatitis Registry was used to evaluate self-identified pediatric patch test providers within the United States with regard to demographic characteristics, geographic location, and practice patterns.

Methods: A wide range of U.S. providers were invited to join the registry by completing a secure online 11-question registration survey.

Results: There were 252 respondents from 50 states and the District of Columbia; 28.6% were pediatric dermatologists and members of the Society for Pediatric Dermatology (SPD), and 38% were members of the American Contact Dermatitis Society. The cumulative range of pediatric patch-test evaluations performed each year was 1,726 to 4,613 children. SPD members had a significantly greater likelihood of performing a commercially available patch test (odds ratio 7.14 [95% confidence interval 5.11, 9.97], $p < .001$) than those who were not SPD members. SPD members also had significantly lower odds of performing North American Contact Dermatitis Group standard tests than nonmembers.

Conclusions: The frequency of patch test evaluations in children is significantly underreported. This study provides insight into the practice patterns of various providers who are patch testing children and makes recommendations for evidence-based modifications regarding these practices. Limitations of the study include survey responder selection bias and small sample size.

Address correspondence to Sharon E. Jacob, M.D., Department of Dermatology, Loma Linda University, Faculty Medical Offices, 11370 Anderson Street, Suite 2600, Loma Linda, CA 92354, USA, or e-mail: sjacob@contactderm.net.

Pediatric allergic contact dermatitis (ACD) was once thought to be relatively rare (1,2), but in the last decade there has been a dramatic increase in awareness regarding the prevalence of the condition (3). Patch testing is the standard for ACD diagnosis, and although patch testing does not have a U.S. Food and Drug Administration (FDA) indication in children, pediatric patch testing is being performed. Multiple studies have explored the safety and efficacy of patch testing in children. A Pediatric Research Equity Act (PREA-1) study showed that a commercially available patch test (the Thin-Layer Rapid Use Epicutaneous patch test [T.R.U.E. TEST; Smartpractice, Phoenix, AZ]) was safe and efficacious in children older than 6 years (4). The North American Contact Dermatitis Group (NACDG) reported that 883 children were patch tested in the United States and Canada from 2005 to 2012, an average of 126 patch tests per year (5), which was higher than the previous test period (2001–2004), during which the 13 members tested an average of 98 children each year (6). These studies reflect data that may not be representative of the general population of children undergoing patch testing throughout the United States since they were conducted in a select few locations and reported in small numbers, as mentioned above.

Such low patch testing numbers reported in the literature reflect the paucity of data rather than a low prevalence of ACD in children, as a significant number of pediatric patch tests are not recorded in the literature (7). To address this reporting gap, in November 2014, dermatologists at Loma Linda University (LLU) launched the Pediatric Contact Dermatitis Provider Registry (PCDR) to identify pediatric patch test providers and study their evaluative practices. The first-quarter demographic characteristics of providers have been reported elsewhere (8). Herein we present the first-year results from the LLU PCDR and comment on the patch test practices of these providers in the United States.

MATERIALS AND METHODS

A full description of methods may be found in the first PCDR report (8). All providers registered in the PCDR were invited to enter their pediatric (0–18 yrs old) patch test results. Providers registered in the PCDR were asked to specify their membership affiliations with various dermatologic national societal bodies, including the American Academy of Dermatology (AAD); American Contact Dermatitis Society (ACDS); Society for Pediatric Dermatology (SPD); American Academy of Allergy, Asthma &

Immunology; American College of Allergy, Asthma, and Immunology; Society of Dermatology Physician Assistants; American Osteopathic College of Dermatology; Dermatology Nurses Association; and American Association of Nurse Practitioners. SPD membership was used as a proxy for providers who treat children in any form of dermatologic care. American Academy of Pediatrics membership was not assessed in our study. Membership in SPD was not mutually exclusive of membership in the AAD or American Osteopathic College of Dermatology in our data. Membership in each society was assessed individually as a binary variable; overlapping membership in multiple organizations was not assessed. Data from the patch test results, specifically, the type of patch test used for each case, were combined with provider registration demographic information, which included ethnicity, sex, education, board certification, subspecialty, and subspecialty society membership.

Statistical analysis of the data was conducted in two stages. The first stage tested for any significant association between SPD membership and the four defined patch test screening series and systems included in the survey. The chi-square test of association showed significant associations between the T.R.U.E. TEST and the NACDG screening panel. Assumptions of independence and adequate sample size were confirmed to ensure the validity of test results. Once the presence of significant associations was confirmed, analysis entered the second stage, which involved measuring the strength of those associations. Logistic regression was performed to determine the odds of SPD members and nonmembers using patch tests. Ninety-five percent confidence intervals and p-values were obtained from analysis as well. All analysis was performed using SAS version 9.4 (SAS Institute, Cary, NC).

RESULTS

Demographic characteristics and estimated patch test frequencies are reported in Table 1, which are in agreement with previously reported first-quarter data (8). The majority of members were affiliated with the AAD (61.5%), followed by the ACDS (37.7%) and SPD (29.4%) (Table 1). In the respondent group, stratification of SPD members and nonmembers according to patch test type revealed that SPD members were more likely than nonmembers to patch test using the T.R.U.E. TEST ($p < 0.001$) (Table 2). Conversely, nonmembers were more likely to patch test using the NACDG series and to use custom patch testing ($p < 0.001$).

TABLE 1. Provider Demographic Characteristics (N = 252)

Characteristic	Value
Sex, n (%)	
Female	157 (62.3)
Male	95 (37.7)
Race, n (%)	
Non-Hispanic white	202 (80.2)
Asian	25 (9.9)
Hispanic	6 (2.4)
African American	4 (1.6)
Other	15 (6)
Role, n (%)	
Medical doctor	190 (75.4)
Physician assistant	47 (18.7)
Osteopath	8 (3.2)
Nurse practitioner	7 (2.8)
Specialty, n (%)	
Dermatology	
Total	201 (79.8)
Pediatric	72 (28.6)
Internal medicine	27 (10.7)
Allergy	42 (16.7)
Pediatrics	15 (6)
Family medicine	3 (1.2)
Occupational medicine	5 (2)
Patch tests per year (average), n (%)	
1–10	129 (51.2)
11–25	56 (22.2)
26–50	21 (8.3)
51–99	6 (2.4)
100–199	1 (0.4)
Estimated patch tests per year, range	1,726–4,613
Practice type, n (%)	
Academic	110 (43.7)
Private practice group	82 (32.5)
Private practice individual	47 (18.7)
Hospital	5 (2)
Joint academic and private	7 (2.8)
Academic association, n (%)*	
American Academy of Dermatology	155 (61.5)
American Contact Dermatitis Society	95 (37.7)
Society for Pediatric Dermatology	74 (29.4)
Society for Dermatology Physician Assistants	50 (19.8)
American Academy of Allergy, Asthma & Immunology	35 (13.9)
American College of Asthma Allergy and Immunology	24 (9.5)
American Osteopathic College of Dermatology	4 (1.6)
Dermatology Nurses Association	2 (0.8)
American Academy of Nurse Practitioners	1 (0.4)

*Society memberships were not mutually exclusive of one another.

DISCUSSION

The PCDR providers were primarily dermatologists, with pediatric dermatology being the largest related subspecialty (28.6%) (Table 1). Similar to the first-quarter results, dermatologists and allergists accounted for the majority of providers caring for children with contact dermatitis (8); 37.7% were

TABLE 2. Patch Tests Performed According to Membership in the Society for Pediatric Dermatology

Patch test	Member n	Nonmember	Odds ratio (95% confidence interval)	p-Value
T.R.U.E. TEST				
No	254	674	7.14 (5.11–9.97)	<0.001
Yes	156	58		
T.R.U.E. TEST plus supplemental*				
No	388	677	0.70 (0.42–1.16)	0.17
Yes	22	55		
North American Contact Dermatitis Group Standard (2014)				
No	337	512	0.50 (0.37–0.68)	<0.001
Yes	73	220		
American Contact Dermatitis Society Core 80 (2014)				
No	375	663	0.90 (0.59–1.37)	0.62
Yes	35	69		
Other				
No	279	402	0.57 (0.44–0.74)	<0.001
Yes	131	330		

*Not a subset of the Thin-layer Rapid Use Epicutaneous patch test (T.R.U.E. TEST) group.

members of the ACDS (the professional education and research society for contact dermatitis in the United States).

Historical data on pediatric ACD has been quantitatively and qualitatively limited to tertiary care centers. Data gathered from the PCDR database cover a wide geographic and practice type range (tertiary care centers, community clinics, private practices) for patch test providers in all 50 states and the District of Columbia. The majority (84.5%) of providers reported patch testing at least one child per year (Table 1). At the end of the first recruitment year, registrants had reported that 1,726 to 4,613 U.S. children were patch tested yearly (Table 1). This 14- to 37-fold increase compared with previously reported patch test evaluations by the NACDG substantiates the value of a larger and more diverse group of participants (9). Furthermore, the lack of a commercially available patch test series with an FDA pediatric indication has not impeded patch testing in children by specialists in multiple disciplines.

There were notable differences in practice patterns between SPD members and nonmembers. SPD members used the T.R.U.E. TEST with significantly higher frequency than nonmembers (who used standard comprehensive patch testing with greater frequency). One of the explanations for this may be that SPD members may generally not be patch testing large numbers of patients annually and therefore find it more practical and cost effective to use the commercially available, preloaded, limited-screening series (e.g., T.R.U.E. TEST). Furthermore, the comprehensive patch test series has a limited shelf life and

often needs to be replaced, which may be impractical and costly to maintain for practitioners patch testing only a small number of children yearly. In addition, because of inherent skin surface area limitations on children's backs, testing using a larger series may pose a practical problem because of the greater amount of space required to accommodate more patches. That being said, using only the T.R.U.E. TEST might miss relevant allergens, lead to misdiagnosis, and significantly affect reported prevalence rates of sensitization.

There are inclusions and omissions on the T.R.U.E. TEST that may be pertinent for pediatric care providers; gold and thimerosal, which are included in the commercially available screening kit, have been shown to have low clinical relevance in children and were removed from the NACDG screening series in 2003 (6,10). Furthermore, the Consumer Protective Safety Commission has deemed paraphenylenediamine (PPD) and epoxy, allergens also included in the T.R.U.E. TEST, to be strong sensitizers and has suggested that they be tested only for confirmation when history indicates a high index of suspicion (11,12). It has also been suggested that in children with a history of allergic reactions to PPD (e.g., from exposure to black henna tattoos or hair dye), a controlled titration test should be performed beginning at a maximal concentration of 0.05% (13).

On the other hand, certain allergens with known relevance may be undetected if the commercially available screening test is used, as they are not included in the standardized T.R.U.E. TEST (5,14). It is believed that the prevalence of isothiazolinone allergy is at epidemic proportions (9), but the screening kit tests only the combination of methylchloroisothiazolinone and methylisothiazolinone (MI). It has been reported that by testing with the combination preservative, 33% to 60% of MI allergies are missed (15). A significant number of patch testing centers across Europe and the United States specifically test MI separately at 0.2% and have increased detection of this important allergen (16). Based on a meta-analysis of the last 5 years of U.S.-based pediatric patch test data, highly prevalent pediatric allergens that would be missed by solely screening using the commercially available patch test kit are cocamidopropyl betaine, propylene glycol, glucosides, propolis, α -tocopherol (vitamin E), carmine, and fragrance mix 2 (17). Supplementation with these allergens may increase the utility of patch testing; Cohen et al (18) reported that increasing the number of tested allergens improves the yield and diagnostic sensitivity of patch tests.

LIMITATIONS

Our study had several limitations. Although we had enrollees from all 50 states and the District of Columbia, our sample size was small and it is likely that the number of enrollees underestimates the true number of practitioners conducting pediatric patch testing, limiting the generalizability of our data to the full population of pediatric patch test providers. Additionally, only 58 of the 732 non-SPD members used T.R.U.E. TEST to evaluate children for ACD, suggesting a potential selection bias, as a greater response rate was noted from ACDS members who specifically specialize in patch test evaluations. Lastly, we used membership in the SPD as a proxy for pediatric dermatologists, but not all SPD members subspecialize in pediatric dermatology.

CONCLUSION

The PCDR continues to aim at identifying providers evaluating children for contact dermatitis in the United States. This study focused on self-identified pediatric patch test providers and analyzed provider demographic characteristics and practice patterns. Patch testing in children is performed at a higher rate than previously reported, and more investigation is needed to fully understand the burden of this disease, its causative factors, and barriers to regulating the top chemical sensitizers in the United States. Given that fully comprehensive standardized testing is not universally available, supplemental synchronous testing of highly relevant allergens and omission of lower-prevalence allergens not indicated by history could improve patch test efficacy and safety.

ACKNOWLEDGMENTS

Sharon Jacob, M.D., the founder and CEO of Dermatitis Academy, served as coordinating principal investigator on the safety and efficacy of T.R.U.E. TEST Panels 1.1, 2.1, and 3.1 in children and adolescents; the Pediatric Research Equity Act (PREA-1) trial; and as a consultant for Johnson & Johnson. MBL is a scholar of the Dermatitis Academy. This project was made possible with the support of a Society of Pediatric Dermatology Pilot Project grant.

REFERENCES

1. Mortz CG, Andersen KE. Allergic contact dermatitis in children and adolescents. *Contact Dermatitis* 1999; 41:121–130.

2. Storrs FJ. Patch testing children—what should we change? *Pediatr Dermatol* 2008;25:420–423.
3. Militello G, Jacob SE, Crawford GH. Allergic contact dermatitis in children. *Curr Opin Pediatr* 2006;18:385–390.
4. Jacob SE, Herro EM, Sullivan K et al. Safety and efficacy evaluation of TRUE TEST panels 1.1, 2.1, and 3.1 in children and adolescents. *Dermatitis* 2011; 22:204–210.
5. Zug KA, Pham AK, Belsito DV et al. Patch testing in children from 2005 to 2012: results from the North American Contact Dermatitis Group. *Dermatitis* 2014;25:345–355.
6. Zug KA, McGinley-Smith D, Warshaw EM et al. Contact allergy in children referred for patch testing: north American Contact Dermatitis Group data, 2001–2004. *Arch Dermatol* 2008;144:1329–1336.
7. Nickel-Directed US Health Policy. <http://www.thedermatologist.com/content/goblin%E2%80%99s-copper-%E2%80%94time-nickel-directed-us-health-policy-here> (accessed April 20, 2016).
8. Goldenberg A, Jacob SE. Demographics of US pediatric contact dermatitis registry providers. *Dermatitis* 2015;26:184–188.
9. Warshaw EM, Maibach HI, Taylor JS et al. North American contact dermatitis group patch test results: 2011–2012. *Dermatitis* 2015;26:49–59.
10. Bruze M, Edman B, Björkner B et al. Clinical relevance of contact allergy to gold sodium thiosulfate. *J Am Acad Dermatol* 1994;31:579–583.
11. Jacob SE, Admani S, Herro EM. Invited commentary: recommendation for a North American pediatric patch test series. *Curr Allergy Asthma Rep* 2014;14:444.
12. Hazardous Substances and Articles; Administration and Enforcement Regulations: Final Rule; Revisions to Supplemental Definition of “Strong Sensitizer”. <https://www.federalregister.gov/documents/2014/02/14/2014-03260/hazardous-substances-and-articles-administration-and-enforcement-regulations-final-rule-revisions-to> (accessed April 20, 2016).
13. Spornraft-Ragaller P, Schnuch A, Uter W. Extreme patch test reactivity to p-phenylenediamine but not to other allergens in children. *Contact Dermatitis* 2011; 65:220–226.
14. Yu SH, Sood A, Taylor JS. Patch testing for methylisothiazolinone and methylchloroisothiazolinone-methylisothiazolinone contact allergy. *JAMA Dermatol* 2016;152:67–72.
15. Castaneda-Tardana MP, Zug KA. Methylisothiazolinone. *Dermatitis* 2013;24:2–6.
16. Suneja T, Belsito DV. Comparative study of Finn chambers and T.R.U.E. Test methodologies in detecting the relevant allergens inducing contact dermatitis. *J Am Acad Dermatol* 2001;45:836–839.
17. Hill H, Goldenberg A, Golkar L et al. Pre-Emptive Avoidance Strategy (P.E.A.S.)—addressing allergic contact dermatitis in pediatric populations. *Expert Rev Clin Immunol* 2016;12:551–561.
18. Cohen DE, Rao S, Brancaccio RR. Use of the North American contact dermatitis group standard 65-allergen series alone in the evaluation of allergic contact dermatitis: a series of 794 patients. *Dermatitis* 2008;19:137–141.