

## LETTER

## RESEARCH LETTER

### Evaluating the inclusiveness of common allergens in expanded series patch tests for children in the pediatric allergic contact dermatitis registry

*To the Editor:* Allergic contact dermatitis is reported to occur in 15% to 25% of the pediatric population,<sup>1</sup> although which allergens to patch test given space limitations are still debated. The Pediatric Allergic Contact Dermatitis Registry was created in 2018, compiling patch test data of children (0-17 years of age) from 10 institutions across the United States.<sup>2</sup> In addition to the standard Pediatric Baseline Series<sup>2</sup> and the Thin Layer Rapid Use Epicutaneous Patch tests (Smart Practice), partner institutions utilized 6 expanded patch test series in the evaluation of pediatric allergic contact dermatitis rates (Supplemental Table I; available via Mendeley at <https://doi.org/10.17632/hg8zvfx4th.6>). Expanded series patch tests have proven efficacious in their ability to evaluate more thoroughly the possible etiologies of allergic contact dermatitis.<sup>3,4</sup> This analysis aims to compare the rates at which various expanded series patch tests sample the most common pediatric allergens.

A total of 296 children were tested between January 2016 and July 2020. There were 113 (38.2%) boys and 183 (61.8%) girls and the mean (SD) age was 10.6 (4.8) years. Of the top 10 and top 20 pediatric allergens, the North American Comprehensive (NAC)-80 (Dormer) series detected 100% (10 of 10) and 95% (19 of 20), respectively (Tables I and II). Of the top 50 most common pediatric allergens, the American Contact Dermatitis Society (ACDS) 80 captured the highest number at 82% (41 of 50) (Table I; Supplemental Table II).

In patients 1 to 5 years of age, the North American Contact Dermatitis Group 70 had the highest percentage of the top 10 and top 20 most common allergens at 70% (7 of 10) and 75% (15 of 20), respectively. Of the top 49 in this age group (there were only 49 unique allergens with a  $\geq 1$  reaction in this category), the ACDS-80 contained the highest percentage at 85.7% (42 of 49) (Table I; Supplemental Table IIIa).

In patients 6 to 12 years of age, the NAC-80 series included the highest percentage of the top 10 and top 20 at 100% (10 of 10) and 100% (20 of 20) and was tied with the ACDS-80 at 82% (41 of 50) of the top 50 (Table I, Supplemental Table IIIb).

**Table I.** Relative rates of common pediatric allergen inclusion by patch series

Categories by age cohort	Pediatric baseline series	TRUE test	ACDS-80	NACDG-70	NAC-80 WashU	ACDS-80 WashU	NAC-80 Dormer	Custom Pediatric Core 60 (MGH)
Overall*†								
Top 10	7 (70%)	5 (50%)	8 (80%)	7 (70%)	8 (80%)	8 (80%)	<b>10 (100%)</b>	7 (70%)
Top 20	14 (70%)	11 (55%)	16 (80%)	15 (75%)	18 (90%)	16 (80%)	<b>19 (95%)</b>	16 (80%)
Top 50	24 (48%)	19 (38%)	<b>41 (82%)</b>	36 (72%)	38 (76%)	38 (76%)	40 (80%)	33 (66%)
Ages 1-5 years*								
Top 10	6 (60%)	3 (30%)	4 (40%)	<b>7 (70%)</b>	5 (50%)	4 (40%)	6 (60%)	<b>7 (70%)</b>
Top 20	10 (50%)	8 (40%)	14 (70%)	<b>15 (75%)</b>	12 (60%)	13 (65%)	13 (65%)	14 (70%)
Top 49†	25 (51%)	20 (41%)	<b>42 (86%)</b>	38 (78%)	35 (71%)	41 (84%)	35 (71%)	39 (80%)
Ages 6-12 years*								
Top 10	8 (80%)	6 (60%)	8 (80%)	8 (80%)	8 (80%)	8 (80%)	<b>10 (100%)</b>	8 (80%)
Top 20	16 (80%)	11 (55%)	16 (80%)	17 (85%)	18 (90%)	16 (80%)	<b>20 (100%)</b>	17 (85%)
Top 50	24 (48%)	19 (38%)	<b>41 (82%)</b>	34 (68%)	39 (78%)	39 (78%)	<b>41 (82%)</b>	30 (60%)
Ages 13-17 years*								
Top 10	6 (60%)	4 (40%)	8 (80%)	6 (60%)	<b>9 (90%)</b>	8 (80%)	<b>9 (90%)</b>	7 (70%)
Top 20	13 (65%)	7 (35%)	<b>17 (85%)</b>	14 (70%)	15 (75%)	<b>17 (85%)</b>	16 (80%)	15 (75%)
Top 50	27 (54%)	21 (42%)	41 (82%)	37 (74%)	44 (88%)	41 (82%)	<b>46 (92%)</b>	34 (68%)

ACDS, American Contact Dermatitis Society; MGH, Massachusetts General Hospital; NAC, North American Comprehensive; NACDG, North American Contact Dermatitis Group; TRUE, Thin Layer Rapid Use Epicutaneous Patch.

\*Bolded numbers indicate the highest number in each row. Italicized numbers indicate the lowest number in each row. Numbers are given as "n (%)".

†There were only 49 allergens with positive reactions in the cohort comprising children 1 to 5 years of age.

**Table II.** Top 20 allergens by percentage of positive patch tests in children 1 to 17 years of age and inclusion in expanded patch series

Top 20 allergens*†	No. of positive patch Tests	Total number of patients tested	Positive patch test percentage	Pediatric baseline series-38	TRUE test-35	ACDS-80	NACDG-70	NAC-80 WashU	ACDS 80- WashU	NAC-80-Dorner	Custom Pediatric Core 60 (MGH)
Hydroperoxides of linalool	21	84	25.0							√	
Methylisothiazolinone	43	240	17.9	√		√	√	√	√	√	√
Nickel sulfate	47	281	16.7	√	√	√	√	√	√	√	√
Cobalt chloride	36	276	13.0	√	√	√	√	√	√	√	√
Fragrance mix I	31	286	10.8	√	√	√	√	√	√	√	√
Hydroperoxides of limonene	8	84	9.5							√	
Cocamidopropyl betaine	22	237	9.3	√		√	√	√	√	√	√
Balsam of Peru	24	287	8.4	√	√	√	√	√	√	√	√
Gold sodium thiosulfate	20	242	8.3		√	√		√	√	√	
Amerchol L101	19	234	8.1	√		√	√	√	√	√	√
Benzoyl peroxide	9	114	7.9					√		√	
Formaldehyde	22	286	7.7	√	√	√	√	√	√	√	√
MCI/MI	22	286	7.7	√	√	√	√	√	√	√	√
Neomycin	21	278	7.6	√	√	√	√	√	√	√	√
Amidoamine	11	155	7.1	√			√	√		√	√
Quaternium-15	20	283	7.1	√	√	√	√	√	√	√	√
Benzalkonium chloride	9	128	7.0			√		√	√		√
Iodopropynyl butylcarbamate	15	229	6.6	√		√	√	√	√	√	√
Bronopol	18	281	6.4	√	√	√	√	√	√	√	√
MDBGN‡	17	270	6.3		√	√	√	√	√	√	√
<b>Total</b>				<b>14</b>	<b>11</b>	<b>16</b>	<b>15</b>	<b>18</b>	<b>16</b>	<b>19</b>	<b>16</b>

ACDS, American Contact Dermatitis Society; MDBGN, methylidibromo glutaronitrile; MGH, Massachusetts General Hospital; MCI/MI, methylchloroisothiazolinone/methylisothiazolinone; NAC, North American Comprehensive; NACDG, North American Contact Dermatitis Group; TRUE, Thin Layer Rapid Use Epicutaneous Patch.

\*Excludes allergens tested in fewer than 10% of patients.

†Allergen concentrations may be found in Supplemental Table I.

In patients 13 to 17 years of age, the NAC-80 (WashU) and NAC-80 included the highest percentage of the top 10 at 90% (9 of 10). The ACDS-80 and ACDS-80 (WashU) contained the highest percentage of the top 20 at 85% (17 of 20) and the NAC-80 contained the highest percentage of the top 50 at 92% (Table I, Supplemental Table IIIc). The Thin Layer Rapid Use Epicutaneous Patch test contained the fewest of the top allergens in every category (Table I) and would have missed emerging top allergens, such as the hydroperoxides of linalool and limonene as well as methylisothiazolinone (Table II).<sup>5</sup>

In an era of pediatric patch testing where a variety of standardized and customized expanded series tests exist, choosing the appropriate panel (or allergens) for a patient is important in ensuring the greatest coverage of likely allergens. Although there is no clear “best” patch series, providers should

consider the age of the patient, available space to apply patches, and frequencies of relevant allergens in determining which patch series to utilize.

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#### **Conflicts of interest**

None disclosed.

#### **REFERENCES**

1. Simonsen AB, Deleuran M, Johansen JD, Sommerlund M. Contact allergy and allergic contact dermatitis in children: a review of current data. *Contact Dermatitis*. 2011;65(5):254-265.
2. Tam I, Gole H, Martin KL, Goldminz AM, Yu J. Cross-sectional evaluation of the pediatric baseline series in detection of contact sensitization in children. *J Am Acad Dermatol*. 2021;84(4):1123-1126.
3. Collis RW, Morris GM, Sheinbein DM, Coughlin CC. Expanded series and personalized patch tests for children: a retrospective cohort study. *Dermatitis*. 2020;31(2):144-146.
4. Nelson JL, Mowad CM. Allergic contact dermatitis: patch testing beyond the TRUE test. *J Clin Aesthet Dermatol*. 2010;3(10):36-41.
5. Moustafa D, Yu J. Contact allergy to hydroperoxides of limonene and linalool in a pediatric population. *J Am Acad Dermatol*. 2020;83(3):946-947.

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