Contact dermatitis is a frequent clinical problem in dermatology and is now known to be as common in children as adults. While irritant dermatitis is still the most common type of contact dermatitis, allergic contact dermatitis (ACD) has become more recognized as a significant condition affecting children. Epicutaneous patch testing is considered to be the gold standard in making the diagnosis of ACD and determining the causative allergen. Studies on the prevalence of ACD in children have been cited at rates ranging between 14 percent and 70 percent of the children referred for patch testing. ACD seems to have similar rates in children with and without atopic diatheses; however, some studies suggest that patients with atopic dermatitis may be at increased risk for allergen sensitization. Along this line, some authors recommend children with recalcitrant atopic dermatitis be patch tested in order to try to identify and eliminate superimposed ACD.

The first step in the management of ACD is identifying a cause and then instituting an avoidance regimen. In children, an investigation for culprit allergens can reveal source exposures from hygiene products and toys to clothes and foods. Of interest, many of the allergens identified in adults have been shown to cause significant disease in children as well. The following review strives to highlight several of the most common and emerging allergens to be aware of in children.

Common and Emerging Presentations of Allergic Contact Dermatitis in Children

Learn to recognize and manage the variety of allergens that cause contact dermatitis in pediatric patients.

By Kathryn Russell, MD and Sharon E. Jacob, MD

Take-Home Tips. Contact dermatitis is now known to be as common in children as adults. While irritant dermatitis is the most common type, allergic contact dermatitis (ACD) has become more recognized as a significant condition affecting children. Epicutaneous patch testing is considered the gold standard in making the diagnosis of ACD and determining the causative allergen. The first step in the management of ACD is identifying a cause and then instituting an avoidance regimen. Source exposures include hygiene products and toys, clothes and foods. Common culprits include nickel, cobalt, gold, neomycin, fragrances, formaldehyde, emollients, and emulsifiers. Recently, cell phones and Crocs sandals have been associated with ACD.
Metal Allergy
The most common metal associated with contact dermatitis is nickel, and 2008 marked the year nickel was named Contact Allergen of the Year by the American Contact Dermatitis Society (ACDS). Retrospective cross-sectional analyses by the North American Contact Dermatitis Group of over 9,000 children from 2001-2004 revealed that nickel was the most common allergen in children referred for patch-testing. When one thinks of nickel associated contact dermatitis, the classic presentation is an earlobe dermatitis from jewelry, facial dermatitis from eyeglass frames and periumbilical dermatitis from jean snaps and belts. However, there are some other presentations to be aware of in children. A classroom chair location (a.k.a. “school chair sign”) has been described as a result of direct contact with nickel-containing screws or legs located on classroom chairs. Certain parts on children’s toys have also been shown to contain nickel and may be a potential source for sensitization.

An emerging source of nickel exposure recently described is mobile phones, often associated with a unilateral dermatitis on the pre-auricular area and lateral cheek. One study found releasable nickel in 10 of the 23 communication devices tested using a dimethylglyoxime test. An additional metal, chromate, has also been identified as a cause of facial contact dermatitis from mobile phone usage. Chromium can also be found in cement, various plated metals, leather and paints.

Cobalt, which is often found commercially as an alloy with nickel or other metals can be found in metal plated objects, braces, amalgams, and vitamins. Studies suggest that patients sensitive to cobalt have a high co-reactivity to nickel; one childhood study found a co-sensitization rate of 68 percent of those with positive cobalt reactions. A case report found an association between the metallic wheels on a skateboard with cobalt as a source of ACD in a young boy.

Gold, another common metal, can be found in jewelry and dental hardware; it was named Contact Allergen of the Year in 2001. Eyelid involvement related to “black dermographism” and allergic contact stomatitis have both been reported as clinical presentations of gold ACD. Of note, metals (nickel, cobalt, gold, and chromium) made up four of the top 10 allergens in children by the above-described retrospective cross-sectional analyses by the North American Contact Dermatitis Group.

Antibiotic Allergy
In 2010, the ACDS named neomycin as the Contact Allergen of the Year, which has ranked second only to nickel for the last three decades as an offender in adult populations. Neomycin, an aminoglycoside antibiotic, can be found in topical creams, ointments, lotions, eye preparations and eardrops. Notably, it is a common presentation in hand and foot dermatitis, as patients or their parents often “self treat” their primary dermatitis with an over-the-counter medication containing neomycin. Bacitracin and gentamicin are other topical antibiotics that have been associated with ACD in children. There have even been several
case reports of anaphylactic reactions to topically applied neomycin and bacitracin,\textsuperscript{25,26} which was named Contact Allergen of the Year in 2003 by the ACDS.

**Fragrance Allergy**
ACD to fragrances is very common among children, especially females. 2007 marked the year that the ACDS named fragrance Allergen of the Year. Notable common exposure sources are perfumes, moisturizers, deodorants, soaps, laundry detergent, toys and other cosmetic products. Importantly, many of the ‘fragrance-based’ chemicals are also used as flavorants, underscoring yet another common source for the patient and provider to recognize. Areas of involvement often relate to the source exposure such as the face, neck and arms where the products are typically applied. Over 100 fragrance ingredients have been identified and associated with ACD.\textsuperscript{27} A significant majority of the causative agents can be identified through standardized patch testing using balsam of Peru, fragrance mix 1 [containing: a-amylcinnamaldehyde, cinnamyl alcohol, cinnamaldehyde, eugenol, geraniol, hydroxycitronellal, isoeugenol, and oak moss] and fragrance mix 2 [containing: Citronellol, Hydroxyisohexyl 3-cyclohexene carboxaldehyde (Lyral), Hexyl cinnamal, Citral, Coumarin, Farnesol]. Of note, FMI is available on the T.R.U.E test panel 1.1, site #6 (ALLERDERM). FM II is available from Chemotechnique Diagnostics AB. One final point is to be aware that “unscented,” by definition, is the odor of nothing and thus can mean a masking fragrance has been added to the ingredients and therefore is not equivalent to “fragrance-free.”

**Formaldehyde and Formaldehyde Associated Allergy**
Formaldehyde is a preservative with antimicrobial properties found in many soaps, shampoos, cosmetics, cleaning agents, textiles and other household agents such as adhesives and paints. It can also be found in cigarette smoke, certain medications and naturally in some foods such as smoked ham, maple syrup and shiitake mushrooms.\textsuperscript{28} Formaldehyde has been widely recognized as a cause of ACD and is listed as a “probable carcinogen” by the US Environmental Protection Agency; therefore, its use is regulated in many countries.

It is important to recognize formaldehyde-releasing preservatives as a potential exposure source for patients. These include: quaternium-15, imidazolidinyl urea, diazolidinyl urea, dimethylol-dimethyl hydantoin, bronopol, benzylhemiformal, and sodium hydroxymethylglycinate. In a study of 81 adult patients known to have patch test proven formaldehyde related contact dermatitis, 79 percent (64 out of 81 subjects) were found to be sensitized to other formaldehyde-releasing compounds.\textsuperscript{29}

The usual dermatitis associated with formaldehyde and formaldehyde releasers, like fragrances, often includes the areas of contact with the personal hygiene product containing the allergen, such as the face, eyelids and neck. That being said, areas such as the dorsum of the feet and legs from resins in shoes, hockey pads and soccer shin guards have also been reported.\textsuperscript{30} Athletic tape containing formaldehyde resins and tincture of benzoin has also been associated with ACD in athletes.\textsuperscript{30} Finally, as with fragrances, formaldehyde can be an important source of systemic contact dermatitis.\textsuperscript{31}

**Emollient, Emulsifier, and Vehicle Allergy**
Lanolin is a moiety derived from sheep sebum which is used in a variety of products from cosmetics to rust preventing (anti-corrosive) coatings. Studies in children have shown lanolin to be among the most common offenders of ACD.\textsuperscript{2,17} Another emulsifying agent, sorbitol and its derivatives appear to be increasingly associated with ACD.

Sorbitol derivatives such as sorbitan sesquioleate and polysorbate are commonly used in moisturizing creams, lotions, topical retinoids, topical corticosteroids, inks and paints. A case study in 2008 reported that the sorbitan sesquioleate found in corticosteroid prescriptives was a propagating factor in children with recalcitrant dermatitis.\textsuperscript{32}

Another emulsifying agent, propylene glycol (PG), functions as a vehicle and emulsifier in cosmetics, topical medications, oral medications, food and other food additives. PG was found to be among the top allergens in a German patch test analysis of over 200
children and 2,000 adolescents. Of note, PG is both an irritant and an allergen and delayed readings are suggested when evaluating this allergen.

It is important to recognize that many emulsifiers, additives and vehicles found in topical therapies and medicated creams prescribed or recommended by health care providers can contain allergens. Lanolin, sorbitans, PG, FRPs, parabens, methylchloroisothiazolinone/methylisothiazolinone, and fragrances (including benzyl alcohol, compositae oils and bisabolol) may serve as chemical culprits.34,35

Emerging Sources
There are many products that may be overlooked as a potential cause of ACD in children, such as nickel in toys (described above), sports gear, boating shoes, toilet seats and car seats. Shin guards used in soccer have been reported to cause dermatitis on the anterior shins of children who play soccer, basketball, rollerblading and field hockey.36 The causative agents are thought to be a urea-formaldehyde resin or thiourea rubber accelerators.9 However, on patch testing many patients are found to have positive patch tests to the gear instead of the chemicals available for standard patch testing, underscoring the reality of proprietary production ingredients in manufacturing. Along the same lines, the popular boating sandals worn by both children and adults, Crocs (Crocs Inc.), have been linked to contact dermatitis. The exact allergen could not be elucidated, as the chemicals used in production are proprietary; but of note, the dermatitis resolved with cessation of sandal wearing or adding socks with use.37

Another emerging allergen, neoprene, is found in a variety of items including swimming goggles, wet suits, shoes and splints used after an injury. The two main ‘neoprene cement allergens’ are para-tertiary-butylphenol-formaldehyde resin and ‘thioureas’.30 Notably, mixed dialkyl thioureas (i.e. diethyithiourea and dibutylthiourea) was named Allergen of the Year by the ACDS in 2009 for its growing prevalence.

Toilet seats have been implicated as a cause of ACD in children. Both plastic and wooden varieties have been reported, with the wood-associated believed to be secondary to the varnish and lacquer ingredients.38,39 As expected, the dermatitis involves the area of the buttocks and posterior thighs. Litvinov, et al. recently reported a re-emergence of the associated dermatitis in five children.38 In each case, symptoms improved after changing toilet seats or using toilet seat covers.

In 2008, Ghali, et al. reported infant car seats as a potential source of ACD.4 Areas affected correspond to those in contact with the seat such as the occipital scalp, the posterior arms, upper thighs and calves. As with the toilet seats, it is unclear if the dermatitis is purely allergic, irritant or a combination but it was noted that symptoms improved with decreased exposure to the seat surfaces.

Conclusion
The list of potential allergens seems endless, but with a thorough history and some investigation, an astute health care provider may be able to identify the offending agent. Patch testing has proven to be both useful and effective in the diagnosis of ACD in children.4,40 Once an allergen is identified, treatment relies on careful avoidance. Depending on the severity, short-term topical and oral steroids likely will play an adjunctive role in symptomatic treatment while an avoidance regimen is instituted.40

Dr. Jacob was the principal investigator on the PREA trial evaluating the TRUE Test TM safety and efficacy in Children and is a speaker for Coria. Dr. Russell has no relevant disclosures.

Allergic Contact Dermatitis


