

# Allergic Contact Dermatitis to Cosmetics

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## KEYWORDS

- Cosmetic • Cosmetic allergy • Allergic contact dermatitis • ACD • Patch testing
- Cosmetic patch testing • Cosmetic series

## KEY POINTS

- Cosmetics may cause allergic contact dermatitis (ACD) due to common allergenic components that are frequently found in cosmetics.
- The most common sites of reaction are the face and neck. The most common allergens in cosmetics are fragrances and preservatives.
- A thorough patient interview is the key to achieving proper diagnosis and management of cosmetic-induced ACD.
- Patch testing is the gold standard for diagnosing cosmetic-induced ACD, and the addition of a cosmetic series and testing of the patients' own products can be helpful.
- The mainstay of management is allergen avoidance.

## INTRODUCTION

The history of cosmetic use is rich and antedates written history, spanning civilizations and centuries that began with the ancient Egyptians using their natural resources to create a myriad of products such as scented oils, creams, lip stains, and eyeliners. Today, cosmetics are used worldwide and create a steadily increasing multibillion-dollar industry. The term "cosmetic", according to the US Food and Drug Administration (FDA), means "(1) articles intended to be rubbed, poured, sprinkled, sprayed on, introduced into, or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance, and (2) articles intended for use as a component of any such articles; except that such term shall not include soap."<sup>1</sup> With a broad definition that encompasses facial makeup, skincare items, perfumes, hair and nail products, shaving gels or creams, and any

personal hygiene product such as toothpaste or deodorant, efforts have been put in place by the creation of the Cosmetic Ingredient Review in 1976 and the FDA to moderate the safety of cosmetic products. However, it is estimated that an adverse reaction to cosmetics occurs approximately once every 13.3 years per person.<sup>2</sup> It is difficult to estimate the frequency of adverse reaction because cosmetics in the general population, and the prevalence is most likely underestimated due to most people do not seek medical advice and simply discontinue use of the product suspected of triggering a reaction.<sup>3</sup>

There are many types of adverse reactions caused by cosmetics. Most adverse reactions are irritant; however, type IV hypersensitivity, contact urticaria, photosensitization, pigmentary disorders, damage of hair and nails, paronychia, acneiform eruptions, folliculitis, and exacerbation of an established dermatosis may also occur.<sup>4</sup>

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Allergic contact dermatitis (ACD), or a type IV hypersensitivity reaction, is much less common than an irritant dermatitis, and several studies have found the prevalence of ACD to be less than 1% in the general population.<sup>5-9</sup> Type IV is a delayed-type hypersensitivity reaction that is T-cell mediated, wherein circulating or resident sensitized T cells are activated by the offending allergen to release pro-inflammatory cytokines. Sensitization depends on several factors including product composition, concentration of potential allergenic components, amount of product applied, application site, skin barrier integrity, and frequency and duration of application.<sup>10,11</sup> Sensitization usually requires repeated exposure and application to damaged skin.

EPIDEMIOLOGY

Although the prevalence of cosmetic allergy is found to be less than 1% in various studies, it is most likely an inaccurate number due to the tendency of patients to forgo seeking medical attention and discontinue use of the product on their own. A study conducted in the United States of patients with suspected ACD by the North American Contact Dermatitis Group (NACDG) found that after patch testing 10,061 patients over 7 years, 23.8% of female patients and 17.8% of male patients had at least one allergic patch-test reaction associated with a cosmetic source.<sup>12</sup> One review found the pooled prevalence rate of ACD to cosmetics in 7 different studies to be 9.8%.<sup>13</sup> The rate varies with time and geographic location, most influenced by the allergenicity of cosmetic ingredients, a population’s increased use of cosmetics over time, and accessibility of allergens to be used in patch

testing.<sup>14,15</sup> Studies reporting the epidemiology of cosmetic allergy characterize the population most affected with cosmetic sensitivity as female between 20 and 55 years of age.<sup>5-7</sup>

EVALUATION

Cosmetic allergy occurs through direct application of an allergen, or the allergen can be airborne or transferred (usually from the hands and fingernails). **Table 1** lists the different ways in which an allergen may come in contact with the skin.

ACD can be considered in the differential diagnosis according to the site of the reaction on the body and the allergen most likely to come in contact with that region. There are certain areas of presentation where ACD should be considered because of their frequency of cosmetic contact and the possible allergens that such cosmetics contain. These areas are the face, eyelid, neck, hands, scalp, and anogenital region.

Patient evaluation should begin with a thorough medical history and careful investigation of products used by the patient in all settings (house and work), followed by a physical examination. A finding of dermatitis on the following areas should make the clinician suspicious of a cosmetic contact allergy.

FACE

The face is the most common site of ACD, and cosmetics are a common cause of this condition.<sup>7,16</sup> Because of the continually exposed nature of the face, cosmetic allergens come into contact with the face not only through direct application, but also indirectly through the air and through transfer from hands. A pattern of ACD on the face can appear patchy even when a product is applied to

| Table 1<br>Modes of allergen transfer |                                                                           |                                                   |
|---------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------|
| Type                                  | Definition                                                                | Example                                           |
| Intentional direct contact            | Allergenic ingredient in cosmetic product                                 | Eye cosmetic, deodorant                           |
| Unintentional direct contact          | Allergen-contaminated surface                                             | Towel, pillow, telephone                          |
| Airborne                              | Gas, droplet, or particle in the atmosphere                               | Epoxy resin (occupation-related), cigarette smoke |
| Connubial                             | Contact with family, friends, colleagues                                  | Perfume or hair dye from spouse                   |
| Ectopic                               | Transfer from one site of body to more sensitive area (ie, face, eyelids) | Fingernail varnish                                |
| Photosensitization                    | Photoallergens exposed to the sun                                         | Photoallergens in sunscreen                       |

the whole face. Facial contact dermatitis is most often thought to be bilateral, but clinicians must still consider this diagnosis even if the whole face is not involved. Of note, dermatitis involving the lateral face, forehead, eyelids, ears, and neck can be observed in patients that experience application of an allergen to the scalp that runs into these adjacent areas, creating a “rinse-off” pattern.<sup>17</sup>

Sometimes an offending agent is not obvious, such as when a patient is sensitized to allergens in cosmetic tools such as the rubber in cosmetic sponges.<sup>18,19</sup> Less obvious is when a cosmetic allergen has been transferred to a surface otherwise considered innocuous, such as a towel or telephone. The patient history is very important in determining the cause of allergy in such cases.

## EYELIDS

The eyelids are an extremely sensitive area of the body due to the thinness of skin in this area and ACD is considered the most common dermatologic condition found in association with eyelid dermatitis. The eyelid is a typical site for ectopic contact dermatitis, most commonly caused by allergen from nail varnish or lacquer.<sup>20</sup> Transfer of allergens in hair cosmetics such as p-phenylenediamine (PPD) and ammonium persulfate are widely known to cause a reaction exclusively at the eyelid.<sup>17</sup> Aside from ACD, a differential diagnosis of eyelid dermatitis includes irritant contact dermatitis, protein contact dermatitis, seborrheic dermatitis, atopic eczema, psoriasis, collagen vascular disease, urticaria, rosacea, cutaneous T-cell lymphoma, sarcoidosis, and infections.<sup>21</sup> ACD is presumed to be the most common cause of eyelid dermatitis, occurring in 34% to 74% of patients.<sup>21–23</sup> Patch testing reveals that fragrance components, preservative agents, emulsifiers, hair-care products, and nail cosmetic ingredients such as acrylates are the main cosmetic allergenic agents causing ACD of the eyelids.<sup>24</sup>

Mascara, eyeliner, eye shadow, fake eyelashes, and metal in eyelash curlers are all considered cosmetic sources of eyelid dermatitis.<sup>21,25</sup> Shellac is a commonly used cosmetic agent in mascaras that can cause eyelid dermatitis. In a case report from France, 5 out of 5 patients that were patch tested with shellac had positive reactions.<sup>26</sup> Similarly, a study in the United States found 4 patients referred for evaluation of eyelid dermatitis to have used the same mascara, and shellac was the only individual mascara ingredient to which all 4 patients tested positive.<sup>27</sup>

The NACDG published a study in 2007 that identified a list of 26 top contact allergens that could create a “potential screening series for the

evaluation of patients with eyelid dermatitis, without other areas of involvement.”<sup>20</sup> Gold tops the list as the most common allergen, accounting for exclusive eyelid dermatitis, and is explained by the release of gold particles in the presence of sweat and abrasive materials, such as titanium dioxide, a common component of facial makeup (an opacifying agent) and sunscreens (blocks ultraviolet light).<sup>28</sup> A patient with metal allergy who wears jewelry may experience this as the gold wears down and the skin is exposed to such substances.

## NECK

Similar to the eyelid, the neck is commonly involved in cosmetic-induced ACD due to thinness of the skin and its continual exposure to the environment. ACD affects the neck, either because of products directly applied to the neck or products applied to the face, scalp, and hair that are transferred to the neck, or by contact with metal in jewelry. Nail polish is a well-known cosmetic offender, and a study of ACD from nail varnish determined the face and neck to be the most affected sites. The most common allergen in nail polish was tosylamide formaldehyde resin (TSFR), the ingredient used to create an adhesion between nail polish and the nail.<sup>29</sup> In a separate study, the NACDG found that TSFR was responsible for 4% of positive patch tests.<sup>7</sup> Perfumes are also an obvious source of ACD, as culturally, the neck is the most common place to spray a fragrance. For patients sensitized to fragrances, an “atomizer sign” may develop, wherein repeated application to the neck can cause a focal dermatitis near the prominentia laryngea (Adam’s apple).<sup>30</sup> Such a sign may alert a physician to the cause of neck dermatitis and allow early intervention for proper management.

## HANDS

Irritant and ACD are the leading causes of hand dermatitis, a common condition that constitutes 20% to 35% of all dermatitis.<sup>31</sup> Aside from irritant and ACD, a differential diagnosis of hand dermatitis includes pompholyx, hyperkeratotic, frictional, nummular, vesicular, and atopic hand dermatitis.<sup>32</sup> ACD of the hands is caused by occupational and nonoccupational allergens, and several studies cite that hairdressing is associated with an increased risk of ACD as compared with the general population.<sup>33–36</sup> A retrospective cross-sectional analysis of positive patch-test reactions focusing on cosmetic allergens found that hairdressing is the most common occupation associated with

allergy to cosmetics, and hair products are the most common source of occupation-related reactions.<sup>12</sup> Hands are the most commonly affected site, with rates of hand dermatitis as high as 93% in patch-tested hairdressers and cosmetologists.<sup>37</sup> Studies report an estimated lifetime risk of hand dermatitis in hairdressers and cosmetologists to be 29.1%,<sup>38</sup> 37.6%,<sup>39</sup> and 44.5%.<sup>40</sup>

## SCALP

The scalp can be frequently exposed to cosmetic agents, particularly through the use of hair dyes and shampoos. Because of the thickness of skin on the scalp, it is typically uninvolved in ACD unless the patient is particularly sensitive to PPD, a potent sensitizer commonly used in hair dyes. Such sensitization can lead to edema and crusting of the scalp.<sup>17</sup> The Information Network of Departments of Dermatology, a collaborative effort of multiple dermatology departments in Europe that conducts epidemiologic surveillance of contact allergy, patch tested 1320 patients suspected of ACD of the scalp.<sup>41</sup> They found the most common allergens causing adverse reactions to be hair-coloring agents such as PPD, toluene-2,5-diamine, p-aminophenol, 3-aminophenol, and p-aminoazobenzene. A portion of the patients of this study had their own cosmetic products patch tested. Of those items, medical products, hair tints and bleaches, and hair-cleansing products accounted for approximately two-thirds of positive patch-test reactions, with hair tints and bleaches constituting the largest percentage.

Psoriasis, which commonly presents on the scalp, is one particular condition that can be exacerbated by an ACD. Two separate cases reported patients with stable psoriasis that developed pustular psoriatic lesions of the scalp, triggered by an ACD to zinc pyrithione, a component of shampoos that treats dandruff and scalp psoriasis.<sup>42,43</sup> Clinicians should be aware of this potential scalp exacerbation due to ACD.

## ANOGENITAL

ACD in the anogenital area is uncommon but a cause of significant discomfort. A retrospective analysis of 1238 patch-tested individuals found only 2.4% of patients with genital dermatitis.<sup>44</sup> It occurs through direct contact with anogenital-specific products such as feminine hygiene products, unintentional contact from nonanogenital products transferred to the area, or through oral administration of substances excreted in urine and feces. Common allergens among patients with anogenital involvement are substances found

in products used in the anogenital area (fragrances, preservatives, corticosteroids).<sup>45</sup> Following this, they include fragrance, balsam of Peru, and nickel.<sup>44–46</sup> Spices and flavorings, such as nutmeg, peppermint oil, coriander, curry mix, peppermint oil, and onion powder, are also reported to be associated with anogenital and vulval pruritus and dermatitis.<sup>47,48</sup>

Due to the natural environment of the genital area, the barrier function is frequently compromised by moisture, friction, and heat, rendering it particularly susceptible to ACD.<sup>49</sup> Reactions can be acute or chronic. Acutely, ACD of the vulva can be severely erythematous, edematous, and ulcerative with possible vesicle formation at the site of contact. Chronic ACD of the vulva occurs via extended exposure to a weak allergen, presenting in a pattern of flares and remission characterized by varying degrees of pruritis. Clinically, the vulva appears erythematous or hyperpigmented, marked by lichenified plaques with variable scale and excoriation.<sup>17,50</sup>

## COMMON ALLERGENS

### Preservatives

#### *Formaldehyde-releasing preservatives:*

#### *Quaternium-15, Imidazolidinyl urea, Diazolidinyl urea, DMDM hydantoin*

Formaldehyde is currently used in a variety of products, such as fertilizers, cleaning products, and waterproof glues; however it is rarely used as a cosmetic preservative because it is a frequent sensitizer.<sup>14</sup> In turn, manufacturers use formaldehyde-releasing preservatives, which include Quaternium-15, Imidazolidinyl urea, Diazolidinyl urea, and DMDM hydantoin,<sup>51</sup> substances that still top the list of allergens causing positive patch-test reactions (**Table 2**). These preservatives are added to numerous skin, hair, and makeup products for their antimicrobial properties. There is legislation in the European Union to limit the amount of these substances in products<sup>52</sup>; in contrast, there is no regulation in the United States on the concentration or use of any formaldehyde-releasing preservatives. According to data from the FDA, approximately 1 in 5 cosmetic products (19.5%) contains a formaldehyde releaser.<sup>53</sup> Cross-reactivity between formaldehyde and formaldehyde-releasers varies, suggesting that allergy to one formaldehyde-releasing preservative does not necessarily restrict the use of the entire class of formaldehyde-releasing preservatives.<sup>51</sup> It is generally understood that the result of a patch test outweighs the theoretical cross-reactions of formaldehyde-releasing preservatives (**Table 3**).

**Table 2**  
**Top 10 NACDG standard screening allergens associated with cosmetic source in females and males**

| Female                                     | Male                                  |
|--------------------------------------------|---------------------------------------|
| Quaternium-15                              | Quaternium-15                         |
| Myroxylon pereirae (balsam of Peru)        | Fragrance mix                         |
| Fragrance mix                              | Myroxylon perierae (balsam of Peru)   |
| PPD                                        | Diazolidinyl urea                     |
| Methyldibromoglutaronitrile/phenoxyethanol | Imidazolidinyl urea                   |
| Formaldehyde                               | Diazolidinyl urea (not in petrolatum) |
| TSFR                                       | Cocamidopropyl betaine                |
| Cocamidopropyl betaine                     | Formaldehyde                          |
| Glyceryl thioglycolate                     | DMDM hydantoin                        |
| Diazolidinyl urea                          | p-Phenylenediamine                    |

Adapted from Warshaw EM, Buchholz HJ, Belsito DV, et al. Allergic patch test reactions associated with cosmetics: retrospective analysis of cross-sectional data from the North American Contact Dermatitis Group, 2001–2004. *J Am Acad Dermatol* 2009;60(1):30–31; with permission.

### **Fragrances and Myroxylon Pereirae**

Several studies document fragrance mix and *Myroxylon pereirae* (balsam of Peru) as the most common cause of cosmetic ACD,<sup>7,54,55</sup> with 42%–54% of patch-tested patients suspected to have cosmetic dermatitis demonstrating positive reactions.<sup>15,56</sup> Fragrances are ubiquitously used in cosmetic products; aside from its obvious use in colognes and perfumes, they are found in makeup, toothpastes, deodorant, household cleaning

products, soaps, medications, and even products that are labeled as “unscented,” as they may contain masking fragrance.<sup>57–61</sup>

*M pereirae*, a naturally produced fragrance from trees of the same name in Central America, contains cinnamic acid, cinnamic aldehyde, methyl cinnamate, benzyl cinnamate, benzyl benzoate, benzoic acid, benzyl alcohol, and vanilla.<sup>62</sup> It is used to screen for fragrance allergy and is reported to detect about 50% of fragrance-sensitive patients.<sup>14,54</sup>

**Table 3**  
**Formaldehyde-releasing preservatives**

| Formaldehyde-releasing Preservative | Special Features                                                                                                                                                                                                                                                                        |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Quaternium-15                       | <ul style="list-style-type: none"> <li>• Most common cosmetic preservative allergen</li> <li>• More than 8 times as sensitizing as imidazolidinyl urea</li> <li>• Most common coallergen in patients who react positively to formaldehyde</li> </ul>                                    |
| Imidazolidinyl urea                 | <ul style="list-style-type: none"> <li>• Odorless, tasteless, colorless, pH-independent</li> <li>• Previous studies rank this high as a causal cosmetic allergen, but its frequency of causing cosmetic allergy has decreased over time</li> </ul>                                      |
| Diazolidinyl urea                   | <ul style="list-style-type: none"> <li>• Structurally related to imidazolidinyl urea, but with wider antimicrobial spectrum</li> <li>• Cross-reacts with imidazolidinyl urea</li> <li>• Sensitization mainly via formaldehyde release, but primary sensitization is possible</li> </ul> |
| DMDM Hydantoin                      | <ul style="list-style-type: none"> <li>• Found most frequently in shampoos</li> <li>• Positive patch-test reactions from hair care products highly correlated with DMDM hydantoin</li> </ul>                                                                                            |
| Methyldibromoglutaronitrile (MDBGN) | <ul style="list-style-type: none"> <li>• Banned in use of all cosmetics and soaps in European Union in 2008; no corresponding US regulation</li> <li>• Increasing rate of MDBGN allergy in Europe and US</li> </ul>                                                                     |

### ***Cocamidopropyl Betaine***

Cocamidopropyl betaine (CAPB) is a surfactant derived from coconut oil that is used in shampoo, liquid soap, skin cleansers, shower gels, and deodorants.<sup>63,64</sup> CAPB itself is not an allergen. Its allergenic properties are attributed to the impurities involved in its synthesis, dimethylaminopropylamine, and cocamidopropyl dimethylamine (also known as amidoamine or cocamidoamine).<sup>65–67</sup> As of October 2005, 1242 of 22,016 products in the FDA's Voluntary Cosmetic Registration Program contained CAPB.<sup>68</sup>

### ***PPD***

This common hair dye ingredient is an oxidizing agent used in permanent or semi-permanent preparations. Recent reports link this potent sensitizer to henna, popularly used in India and the Middle East for temporary tattoos (mehandi) and hair dying.<sup>69,70</sup> It is added to henna to darken the natural shade and can potentially sensitize the patient to develop an ACD if a patient dyes his/her hair later.<sup>71</sup> It is a leading contact allergen in hair products causing eczema of the face and upper trunk in hair-dyeing customers and a well-known occupation-related cause of allergic hand eczema in hairdressers.<sup>72</sup> Facial dermatitis usually presents proximal to the hairline, but may include the eyelids and neck with possible scalp sparing.<sup>73</sup> Cross-reactivity with other para-amino-group chemicals, such as para-aminobenzoic acid, sulfonamide, procainamide, and hydrochlorothiazide, is possible.<sup>74,75</sup>

### ***Glyceryl Monothioglycolate***

Glyceryl monothioglycolate (GMT) is used in acid permanent wave solutions and can persist up to 3 months in the hair.<sup>76</sup> It allows hair to be curled or waved by altering disulfide bonds in hair keratin. An ACD of the scalp caused by GMT can become severe and result in scaling, edema, and crusting.<sup>77</sup> GMT is capable of penetrating rubber gloves, making it a common sensitizer in hairdressers manifesting in reactions on the hands, forearms, face, and neck.<sup>17</sup> It was the second most common allergen in hair products in one study, causing reactions in 17.5% of female patients and 6.7% of male patients.<sup>12</sup>

### ***TSFR***

TSFR is the classic cause of ectopic dermatitis due to nail polish. It commonly affects the eyelids, lateral part of the neck, and face; less common areas include the chest and groin.<sup>29,78</sup> It is present in more than 90% of nail polishes in Europe and

most lacquers in the United States, forming the product's shiny enamel finish that allows adherence to the nail. Warshaw and colleagues<sup>12</sup> found that 55.6% of 171 female patients with specific allergy to nail products had reactions to TSFR. The allergenic component of TSFR is the resin, not formaldehyde.<sup>79</sup> Nail lacquer can also contain epoxy and (meth)acrylate compounds, and other allergenic copolymers that contribute to a reaction, potentially causing a confusing clinical picture.

### ***Gallates***

Propyl gallate, octyl gallate, and dodecyl gallate are all antioxidants used since 1947 to prevent the deterioration of unsaturated fatty acids that can cause product discoloration and odor.<sup>80</sup> Dodecyl gallate has the greatest sensitizing potential according to Hausen and Beyer,<sup>81</sup> but propyl gallate is the most commonly used gallate in the cosmetic industry.<sup>82</sup> It is most often found in waxy or oily lip products, such as lipstick, lip balms, and salves, causing cheilitis.<sup>83,84</sup> Cosmetic creams and lotions may also contain this antioxidant, but infrequently cause ACD because of low concentrations. Cross-reactions between gallates are possible, so a patient that tests positive for one gallate should avoid the entire class of gallates. However, if multiple gallates are tested and the patient does not react to all of them, the patient should only avoid the specific sensitizing gallate.<sup>80</sup>

### ***Patch Testing***

The ability of a clinician to obtain a thorough history is crucial for the proper diagnosis and management of a patient with cosmetic allergy. Questions leading to a diagnosis of ACD should include inquiries into skin disease history, use of personal products, occupation, work environment, hobbies and activities, causes of exacerbations and improvements, time since onset, lesion severity, progression, and seasonal variation.

A detailed history should be followed with a careful examination of the lesion. Attention must be paid to the morphology, pattern, and extent of involvement, which can be a clue to the causal cosmetic. Once a diagnosis of ACD is considered, the gold standard to assess ACD properly is the patch test, which will re-expose the patient to suspected allergens under a controlled environment. The answers to the questions from the detailed history and the examination should be used to prepare the proper patches for testing, and the clinician may consider including certain samples of patients' own products.

In 2009, a panel of contact dermatitis experts from the American Contact Dermatitis Society

developed an extensive Core Allergen Series intended to be broadly useful for all regions of the United States. Composed of 80 allergens, it is larger than any single series and includes allergens that are present in the existing European Standard Series, the Extended International Series, and the British Contact Dermatitis Series, as well as allergens that are not included in any of those series.<sup>85</sup> A study in 1992 reported that a standard series detects 70% to 80% of all causes of ACD.<sup>86</sup> The series includes some cosmetically relevant allergens such as balsam of Peru, fragrance mix, PPD, colophony, and formaldehyde, but there are many important cosmetic allergens missing. To address this issue, many have studied the value of adding a cosmetic series to the standard series. The findings suggest that adding supplemental allergens to a standard series can increase the diagnostic accuracy of patch testing. By adding 12 supplemental cosmetic allergens, one Swedish study identified 25 of 1075 patch-tested patients who did not react to the standard series, but to the supplemental patches alone.<sup>87</sup> Furthermore, a study conducted in Israel found that 32.8% of patch-tested patients demonstrated a positive reaction to at least one allergen in the cosmetic series.<sup>88</sup> Wetter and colleagues<sup>89</sup> evaluated how useful the addition of a cosmetic series would be to the Mayo Clinic standard series, NACDG standard series, and thin-layer rapid use epicutaneous (TRUE) test. They found that a significant number of patients with skin care product allergy would have been overlooked if the standard series were used alone. The TRUE test alone would have overlooked 22.5% of patients with preservative allergy, 11.3% with fragrance allergy, and 17.3% with vehicle allergy. Results with the NACDG are similar (17.9%, 10.1%, and 17.3%, respectively). A study comparing the European standard series versus supplementation with a cosmetic series found that 15% of patients would have had their allergen sensitivity missed had the standard series been used alone.<sup>90</sup> These findings suggest that in patch testing for cosmetic ACD, it is important to test beyond the baseline series.

The utility of adding a cosmetic series to a standard series depends on the clinical suspicion of a cosmetic contact allergy. Only in the correct and relevant setting will a cosmetic series increase the capability to detect causal allergens, and not all components of the cosmetic series may be necessary. For this reason, a thorough history is important, because it will help doctors to determine the most effective patch test possible for the patient. Moreover, studies have highlighted the importance of including patients' own personal products when considering cosmetic allergy.<sup>12,91</sup>

In the analysis by Warshaw and colleagues, 16.3% of cosmetic-allergic patients reacted solely to a non-NACDG standard allergen; these patients would not have uncovered an offending allergen if tested with the standard series alone. It is important to consider testing a patient's own products.

## MANAGEMENT

The cornerstone of management in patients with ACD is avoidance of the triggering allergen. The key to helping a patient do this is to highlight the prevalence of the allergen in various consumer products and to outline the availability of substitutes to achieve successful avoidance. In 1976, the FDA required that ingredients be listed on all consumer cosmetics, which allowed feasibility of allergen avoidance.<sup>92</sup> The United States National Library of Medicine provides a Household Product Database where patients may find information on the specific ingredients found in various cosmetics and household products ([hpd.nlm.nih.gov/index.htm](http://hpd.nlm.nih.gov/index.htm)).

There are some hurdles to achieve complete ease of management. Fragrances are a ubiquitous and leading cause of contact allergy to cosmetics, but components are not individually listed, because they are considered trade secrets.<sup>92</sup> Similarly, formaldehyde is very commonly used and avoidance can be difficult. One study found that formaldehyde content was incorrectly labeled in 23% to 33% of products they tested.<sup>93</sup>

An invaluable tool for physicians and patients to manage cosmetically induced ACD properly is the Contact Allergen Management Program, managed by the American Contact Dermatitis Society ([www.contactderm.org](http://www.contactderm.org)). It is a computerized database of thousands of cosmetics and personal care products that a patient can use to personalize a list of items that are free of the offending allergen. After a patient has been patch tested and the allergen is pinpointed, the offending agent can be entered into the database and a list will be generated of all safe products the patient can use. It makes avoidance of the ingredient causing an allergic reaction more manageable for the patient. Although not an exhaustive list, the database is updated periodically and is a very good resource to manage ACD due to cosmetic use.

Chronic eczematous dermatitis reactions may be encountered when a patient has a chronic sensitivity to a weak allergen. It is more common than acute vesicular eruptions because most cosmetic ingredients are relatively weak allergens. Chronic ACD affecting the hands, feet, and non-flexural areas may be managed with topical corticosteroids. For patients with involvement of the

face or intertriginous area, topical calcineurin inhibitors such as tacrolimus 0.1% ointment or pimecrolimus 1% cream may be used.<sup>94</sup>

## SUMMARY

As cosmetic products remain ubiquitous, frequently used, and constantly developing, ACD due to cosmetic ingredients is a concern among the general population with a likely higher prevalence than currently thought. Clinicians should be aware of the ways in which patients come into contact with allergens, the clinical presentation of a cosmetic-induced allergic reaction, and common allergens in cosmetic products. Patch testing is the gold standard for diagnosing a delayed type hypersensitivity reaction and may be very useful in ascertaining offending cosmetic allergens, leading to proper and effective management of the patient.

## REFERENCES

1. US Food and Drug Administration. The federal food, drug, and cosmetic act subchapter II - definitions. Available at: <http://www.fda.gov/RegulatoryInformation/Legislation/FederalFoodDrugandCosmeticAct/FDCAAct/FDCAActChaptersIandII/ShortTitleandDefinitions/default.htm>. Accessed March 15, 2013.
2. Menkart J. An analysis of adverse reactions to cosmetics. *Cutis* 1979;24(6):599–662.
3. Mehta SS, Reddy BS. Cosmetic dermatitis - current perspectives. *Int J Dermatol* 2003;42(7):533–42.
4. Engasser PG. Cosmetics and contact dermatitis. *Dermatol Clin* 1991;9(1):69–80.
5. Eiermann HJ, Larsen W, Maibach HI, et al. Prospective study of cosmetic reactions: 1977–1980. North American Contact Dermatitis Group. *J Am Acad Dermatol* 1982;6(5):909–17.
6. Romaguera C, Camarasa JM, Alomar A, et al. Patch tests with allergens related to cosmetics. *Contact Dermatitis* 1983;9(2):167–8.
7. Adams RM, Maibach HI. A five-year study of cosmetic reactions. *J Am Acad Dermatol* 1985;13(6):1062–9.
8. de Groot AC. Contact allergy to cosmetics: causative ingredients. *Contact Dermatitis* 1987;17(1):26–34.
9. Nielsen NH, Menne T. Allergic contact sensitization in an unselected Danish population. The Glostrup Allergy Study, Denmark. *Acta Derm Venereol* 1992;72(6):456–60.
10. Dooms-Goossens A. Cosmetics as causes of allergic contact dermatitis. *Cutis* 1993;52(5):316–20.
11. Robinson MK, Gerberick GF, Ryan CA, et al. The importance of exposure estimation in the assessment of skin sensitization risk. *Contact Dermatitis* 2000;42(5):251–9.
12. Warshaw EM, Buchholz HJ, Belsito DV, et al. Allergic patch test reactions associated with cosmetics: retrospective analysis of cross-sectional data from the North American Contact Dermatitis Group, 2001–2004. *J Am Acad Dermatol* 2009;60(1):23–38.
13. Biehl KA, Warshaw EM. Allergic contact dermatitis to cosmetics. *Dermatol Clin* 2006;24(2):215–32, vii.
14. Orton DI, Wilkinson JD. Cosmetic allergy: incidence, diagnosis, and management. *Am J Clin Dermatol* 2004;5(5):327–37.
15. Kohl L, Blondeel A, Song M. Allergic contact dermatitis from cosmetics. Retrospective analysis of 819 patch-tested patients. *Dermatology* 2002;204(4):334–7.
16. Schnuch A, Szliska C, Uter W. Facial allergic contact dermatitis. Data from the IVDK and review of literature. *Hautarzt* 2009;60(1):13–21 [in German].
17. Fisher AA, Rietschel R, Fowler JF. Fisher's contact dermatitis. 6th edition. Hamilton (ON): BC Decker; 2008.
18. Soga F, Kato N, Inoue T, et al. Allergic contact dermatitis as a result of diethyldithiocarbamate in a rubber cosmetic sponge. *Contact Dermatitis* 2008;58(2):116–7.
19. Helbling I, Beck MH. Rubber sponge applicator responsible for “cosmetic” facial dermatitis. *Contact Dermatitis* 1998;39(1):43.
20. Rietschel RL, Warshaw EM, Sasseville D, et al. Common contact allergens associated with eyelid dermatitis: data from the North American Contact Dermatitis Group 2003–2004 study period. *Dermatitis* 2007;18(2):78–81.
21. Guin JD. Eyelid dermatitis: experience in 203 cases. *J Am Acad Dermatol* 2002;47(5):755–65.
22. Ayala F, Fabbrocini G, Bacchilega R, et al. Eyelid dermatitis: an evaluation of 447 patients. *Am J Contact Dermat* 2003;14(2):69–74.
23. Temesvari E, Ponyai G, Nemeth I, et al. Periocular dermatitis: a report of 401 patients. *J Eur Acad Dermatol Venereol* 2009;23(2):124–8.
24. Goossens A. Contact allergic reactions on the eyes and eyelids. *Bull Soc Belge Ophtalmol* 2004;(292):11–7.
25. Brandrup F. Nickel eyelid dermatitis from an eyelash curler. *Contact Dermatitis* 1991;25(1):77.
26. Le Coz CJ, Leclerc JM, Arnoult E, et al. Allergic contact dermatitis from shellac in mascara. *Contact Dermatitis* 2002;46(3):149–52.
27. Shaw T, Oostman H, Rainey D, et al. A rare eyelid dermatitis allergen: shellac in a popular mascara. *Dermatitis* 2009;20(6):341–5.
28. Nedorost S, Wagman A. Positive patch-test reactions to gold: patients' perception of relevance and the role of titanium dioxide in cosmetics. *Dermatitis* 2005;16(2):67–70 [quiz: 55–66].

29. Lazzarini R, Duarte I, de Farias DC, et al. Frequency and main sites of allergic contact dermatitis caused by nail varnish. *Dermatitis* 2008;19(6):319–22.
30. Jacob SE, Castanedo-Tardan MP. A diagnostic pearl in allergic contact dermatitis to fragrances: the atomizer sign. *Cutis* 2008;82(5):317–8.
31. Elston DM, Ahmed DD, Watsky KL, et al. Hand dermatitis. *J Am Acad Dermatol* 2002;47(2):291–9.
32. Warshaw E, Lee G, Storrs FJ. Hand dermatitis: a review of clinical features, therapeutic options, and long-term outcomes. *Am J Contact Dermat* 2003;14(3):119–37.
33. Valks R, Conde-Salazar L, Malfeito J, et al. Contact dermatitis in hairdressers, 10 years later: patch-test results in 300 hairdressers (1994 to 2003) and comparison with previous study. *Dermatitis* 2005;16(1):28–31.
34. Iorizzo M, Parente G, Vincenzi C, et al. Allergic contact dermatitis in hairdressers: frequency and source of sensitisation. *Eur J Dermatol* 2002;12(2):179–82.
35. Sertoli A, Francalanci S, Acciai MC, et al. Epidemiological survey of contact dermatitis in Italy (1984–1993) by GIRDCA (Gruppo Italiano Ricerca Dermatiti da Contatto e Ambientali). *Am J Contact Dermat* 1999;10(1):18–30.
36. Bordel-Gomez MT, Miranda-Romero A, Castro-deza-Sanz J. Epidemiology of contact dermatitis: prevalence of sensitization to different allergens and associated factors. *Actas Dermosifiliogr* 2010;101(1):59–75 [in Spanish].
37. Uter W, Lessmann H, Geier J, et al. Contact allergy to hairdressing allergens in female hairdressers and clients—current data from the IVDK, 2003–2006. *J Dtsch Dermatol Ges* 2007;5(11):993–1001.
38. Lind ML, Albin M, Brisman J, et al. Incidence of hand eczema in female Swedish hairdressers. *Occup Environ Med* 2007;64(3):191–5.
39. Lysdal SH, Sosted H, Andersen KE, et al. Hand eczema in hairdressers: a Danish register-based study of the prevalence of hand eczema and its career consequences. *Contact Dermatitis* 2011;65(3):151–8.
40. Hansen HS, Sosted H. Hand eczema in Copenhagen hairdressers—prevalence and under-reporting to occupational registers. *Contact Dermatitis* 2009;61(6):361–3.
41. Hillen U, Grabbe S, Uter W. Patch test results in patients with scalp dermatitis: analysis of data of the Information Network of Departments of Dermatology. *Contact Dermatitis* 2007;56(2):87–93.
42. Jo JH, Jang HS, Ko HC, et al. Pustular psoriasis and the Kobner phenomenon caused by allergic contact dermatitis from zinc pyrithione-containing shampoo. *Contact Dermatitis* 2005;52(3):142–4.
43. Nielsen NH, Menne T. Allergic contact dermatitis caused by zinc pyrithione associated with pustular psoriasis. *Am J Contact Dermat* 1997;8(3):170–1.
44. Bhate K, Landeck L, Gonzalez E, et al. Genital contact dermatitis: a retrospective analysis. *Dermatitis* 2010;21(6):317–20.
45. Warshaw EM, Furda LM, Maibach HI, et al. Anogenital dermatitis in patients referred for patch testing: retrospective analysis of cross-sectional data from the North American Contact Dermatitis Group, 1994–2004. *Arch Dermatol* 2008;144(6):749–55.
46. Kugler K, Brinkmeier T, Frosch PJ, et al. Anogenital dermatoses—allergic and irritative causative factors. Analysis of IVDK data and review of the literature. *J Dtsch Dermatol Ges* 2005;3(12):979–86 [in German].
47. Vermaat H, Smienk F, Rustemeyer T, et al. Anogenital allergic contact dermatitis, the role of spices and flavour allergy. *Contact Dermatitis* 2008;59(4):233–7.
48. Vermaat H, van Meurs T, Rustemeyer T, et al. Vulvar allergic contact dermatitis due to peppermint oil in herbal tea. *Contact Dermatitis* 2008;58(6):364–5.
49. Farage M, Maibach HI. The vulvar epithelium differs from the skin: implications for cutaneous testing to address topical vulvar exposures. *Contact Dermatitis* 2004;51(4):201–9.
50. Pincus SH. Vulvar dermatoses and pruritus vulvae. *Dermatol Clin* 1992;10(2):297–308.
51. Herbert C, Rietschel RL. Formaldehyde and formaldehyde releasers: how much avoidance of cross-reacting agents is required? *Contact Dermatitis* 2004;50(6):371–3.
52. Scientific Committee on Cosmetic Products and Non-food Products. Opinion concerning a clarification on the formaldehyde and para-formaldehyde entry in Directive 76/768/EEC on cosmetic products. 2002. Available at: [http://ec.europa.eu/food/fs/sc/scscp/out187\\_en.pdf](http://ec.europa.eu/food/fs/sc/scscp/out187_en.pdf). Accessed March 20, 2013.
53. de Groot AC, Veenstra M. Formaldehyde-releasers in cosmetics in the USA and in Europe. *Contact Dermatitis* 2010;62(4):221–4.
54. de Groot AC, Bruynzeel DP, Bos JD, et al. The allergens in cosmetics. *Arch Dermatol* 1988;124(10):1525–9.
55. Larsen WG. Perfume dermatitis. *J Am Acad Dermatol* 1985;12(1 Pt 1):1–9.
56. Maltén KE, van Ketel WG, Nater JP, et al. Reactions in selected patients to 22 fragrance materials. *Contact Dermatitis* 1984;11(1):1–10.
57. Buckley DA, Wakelin SH, Seed PT, et al. The frequency of fragrance allergy in a patch-test population over a 17-year period. *Br J Dermatol* 2000;142(2):279–83.
58. Heisterberg MV, Menne T, Andersen KE, et al. Deodorants are the leading cause of allergic contact

- dermatitis to fragrance ingredients. *Contact Dermatitis* 2011;64(5):258–64.
59. Johansen JD. Fragrance contact allergy: a clinical review. *Am J Clin Dermatol* 2003;4(11):789–98.
  60. Scheinman PL. Is it really fragrance-free? *Am J Contact Dermat* 1997;8(4):239–42.
  61. Scheinman PL. Exposing covert fragrance chemicals. *Am J Contact Dermat* 2001;12(4):225–8.
  62. Scheinman PL. Allergic contact dermatitis to fragrance: a review. *Am J Contact Dermat* 1996;7(2):65–76.
  63. Fowler JF Jr. Cocamidopropyl betaine: the significance of positive patch test results in twelve patients. *Cutis* 1993;52(5):281–4.
  64. de Groot AC, van der Walle HB, Weyland JW. Contact allergy to cocamidopropyl betaine. *Contact Dermatitis* 1995;33(6):419–22.
  65. Foti C, Bonamonte D, Mascolo G, et al. The role of 3-dimethylaminopropylamine and amidoamine in contact allergy to cocamidopropylbetaine. *Contact Dermatitis* 2003;48(4):194–8.
  66. Moreau L, Sasseville D. Allergic contact dermatitis from cocamidopropyl betaine, cocamidoamine, 3-(dimethylamino)propylamine, and oleamidopropyl dimethylamine: co-reactions or cross-reactions? *Dermatitis* 2004;15(3):146–9.
  67. Fowler JF, Fowler LM, Hunter JE. Allergy to cocamidopropyl betaine may be due to amidoamine: a patch test and product use test study. *Contact Dermatitis* 1997;37(6):276–81.
  68. Jacob SE, Amini S. Cocamidopropyl betaine. *Dermatitis* 2008;19(3):157–60.
  69. Kind F, Scherer K, Bircher AJ. Contact dermatitis to para-phenylenediamine in hair dye following sensitization to black henna tattoos - an ongoing problem. *J Dtsch Dermatol Ges* 2012;10(8):572–8.
  70. Nawaf AM, Joshi A, Nour-Eldin O. Acute allergic contact dermatitis due to para-phenylenediamine after temporary henna painting. *J Dermatol* 2003;30(11):797–800.
  71. Le Coz CJ, Lefebvre C, Keller F, et al. Allergic contact dermatitis caused by skin painting (pseudotattooing) with black henna, a mixture of henna and p-phenylenediamine and its derivatives. *Arch Dermatol* 2000;136(12):1515–7.
  72. Handa S, Mahajan R, De D. Contact dermatitis to hair dye: an update. *Indian J Dermatol Venereol Leprol* 2012;78(5):583–90.
  73. Zapolanski T, Jacob SE. para-Phenylenediamine. *Dermatitis* 2008;19(3):E20–1.
  74. LaBerge L, Pratt M, Fong B, et al. A 10-year review of p-phenylenediamine allergy and related para-amino compounds at the Ottawa Patch Test Clinic. *Dermatitis* 2011;22(6):332–4.
  75. Arroyo MP. Black henna tattoo reaction in a person with sulfonamide and benzocaine drug allergies. *J Am Acad Dermatol* 2003;48(2):301–2.
  76. Morrison LH, Storrs FJ. Persistence of an allergen in hair after glyceryl monothioglycolate-containing permanent wave solutions. *J Am Acad Dermatol* 1988;19(1 Pt 1):52–9.
  77. Parsons LM. Glyceryl monothioglycolate. *Dermatitis* 2008;19(6):E51–2.
  78. Liden C, Berg M, Farm G, et al. Nail varnish allergy with far-reaching consequences. *Br J Dermatol* 1993;128(1):57–62.
  79. Fisher AA. *Contact dermatitis*. 3rd edition. Philadelphia: Lea & Febiger; 1986.
  80. Jacob SE, Caperton CV. Allergen avoidance. *Gallates. Dermatitis* 2007;18(3). Last two pages of journal. No numbers given.
  81. Hausen BM, Beyer W. The sensitizing capacity of the antioxidants propyl, octyl, and dodecyl gallate and some related gallic acid esters. *Contact Dermatitis* 1992;26(4):253–8.
  82. Garcia-Melgares ML, de la Cuadra J, Martin B, et al. Sensitization to gallates: review of 46 cases. *Actas Dermosifiliogr* 2007;98(10):688–93 [in Spanish].
  83. Serra-Baldrich E, Puig LL, Gimenez Arnau A, et al. Lipstick allergic contact dermatitis from gallates. *Contact Dermatitis* 1995;32(6):359–60.
  84. Athavale NV, Srinivas CR. Contact cheilitis from propyl gallate in lipstick. *Contact Dermatitis* 1994;30(5):307.
  85. Lee J, Warshaw E, Zirwas MJ. Allergens in the American Contact Dermatitis Society Core Series. *Clin Dermatol* 2011;29(3):266–72.
  86. James WD, Rosenthal LE, Brancaccio RR, et al. American Academy of Dermatology Patch Testing Survey: use and effectiveness of this procedure. *J Am Acad Dermatol* 1992;26(6):991–4.
  87. Lindberg M, Tammela M, Bostrom A, et al. Are adverse skin reactions to cosmetics underestimated in the clinical assessment of contact dermatitis? A prospective study among 1075 patients attending Swedish patch test clinics. *Acta Derm Venereol* 2004;84(4):291–5.
  88. Trattner A, Farchi Y, David M. Cosmetics patch tests: first report from Israel. *Contact Dermatitis* 2002;47(3):180–1.
  89. Wetter DA, Yiannias JA, Prakash AV, et al. Results of patch testing to personal care product allergens in a standard series and a supplemental cosmetic series: an analysis of 945 patients from the Mayo Clinic Contact Dermatitis Group, 2000–2007. *J Am Acad Dermatol* 2010;63(5):789–98.
  90. Ada S, Seckin D. Patch testing in allergic contact dermatitis: is it useful to perform the cosmetic series in addition to the European standard series? *J Eur Acad Dermatol Venereol* 2010;24(10):1192–6.

91. Uter W, Balzer C, Geier J, et al. Patch testing with patients' own cosmetics and toiletries—results of the IVDK\*, 1998-2002. *Contact Dermatitis* 2005; 53(4):226–33.
92. Greif M, Maibach HI. United States cosmetic ingredient labeling. *Contact Dermatitis* 1977; 3(2):94–7.
93. Rastogi SC. Analytical control of preservative labeling on skin creams. *Contact Dermatitis* 2000;43(6): 339–43.
94. Belsito D, Wilson DC, Warshaw E, et al. A prospective randomized clinical trial of 0.1% tacrolimus ointment in a model of chronic allergic contact dermatitis. *J Am Acad Dermatol* 2006;55(1):40–6.