

Allergy to Cosmetics: A Literature Review

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The term *cosmetic* has a broad definition and includes personal care products, hair care products, nail care products, and sunscreens. Modern cosmetics are safe for most users, and adverse reactions are very rare because the manufacturers invest heavily in safety, quality control, and product testing before releasing the product to the market. Despite these efforts, adverse reactions occur. Skin care products are major contributors to cosmetic allergic contact dermatitis (ACD), followed by hair care and nail care products. The most common allergens are fragrances and preservatives. The diagnosis of cosmetic allergy is established by reviewing the patient's clinical history and physical examination findings and confirmed with skin patch testing. Patch testing is the standard method for detecting allergens responsible for eliciting ACD. The purpose of this article was to review the prevalence, legislative laws, and role of patch testing in ACD.

Definition

The definition of a cosmetic varies between Europe and the United States. In Europe, the Cosmetic Directive 76/768/EEC¹ defines a "cosmetic product" as any substance/preparation "intended to be placed in contact with various external parts of the body... or with the teeth and the mucous membranes of the oral cavity with a view exclusively or mainly to cleaning them, perfuming them, changing their appearance, and/or correcting body odors and/or protecting them or keeping them in good condition." In the United States,¹ the federal Food, Drug and Cosmetic Act (Food and Drug Administration [FDA]) defines cosmetics as "articles intended to be applied to the human body for cleansing, beautifying, promoting attractiveness, or altering the appearance without affecting the body's structure or function." Thus, some preparations considered as cosmetics in Europe (eg, antiperspirants) are considered to be over-the-counter drugs in the United States and are therefore subject to more stringent regulations.

Prevalence

Cosmetic and skin care products are an integral part of daily grooming in average women using 12 personal care products a day, containing a total of up to 168 ingredients. On average, a man uses 6 personal products with up to 85 ingredients.² Several studies in Europe and the United States found that the incidences of adverse reactions are underestimated because most people with mild adverse reaction do not consult their medical practitioner.^{3,4}

A recent epidemiological survey carried out in the United Kingdom on personal care products over a 1-year period revealed

that adverse reactions were seen in 23% of women and 13.8% of men.¹ Furthermore, a recent study carried out in the United States of 10,061 patients reported 23% of women and 17.8% of the males had a least 1 adverse reaction due to a cosmetic source based on patch test results.⁵

Pooled data of 7 different studies from Europe and the United States involving 30,207 patients patched tested for suspected contact dermatitis due to cosmetic allergy revealed a positive skin patch reaction rate of 9.8%.⁶ In addition, a European population-based study showed that the incidence of contact sensitization to cosmetics has increased in women mainly between the ages of 20 and 55 years and has doubled from 2.4% to 5.8% between 1990 and 1998.⁶

Legislative Laws Timeline in the United States and European Union

Labeling of cosmetic ingredients has been required since 1997 in Europe, but in the United States, it has been required for over 27 years. In 2004, the European Community Cosmetics Directive legislation mandated the publication of ingredients, including fragrances, on all cosmetics products. These requirements facilitate identification and avoidance of allergens in cosmetics for physicians and their patients.¹

The 2004 amendment to the European cosmetics directives states that manufacturers must individually list 26 recognized fragrance sensitizers as opposed just stating that it "contains parfum" (see Table 1 for the 26 individual fragrance ingredients). The American Academy of dermatology at the time also sent a similar request to the US FDA, but the proposal was not approved.¹

Another recent shift in the use of preservatives is banning of Euxyl K400 (methylidibromoglutaronitrile) in the European Union (EU) in March 2007.⁷ Methylidibromoglutaronitrile (which also includes phenoxyethanol) has been recognized as an important sensitizer and irritant in Europe, which has led to recent recommendation that it should be prohibited from "leave-on" products until more information on "safe" consumer levels becomes

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TABLE 1. INCI Name of the 26 Individual Fragrance Ingredients⁹

<i>Evernia furfuracea</i>	<i>Evernia prunastri</i> *
HICC†‡	Cinnamal*
Isoeugenol*	Cinnamyl alcohol
Hydroxycitronellal*	Hexyl cinnamal†
Farnesol*	Butylphenyl methylpropional
Citral†	Eugenol†
Amyl cinnamal*	Coumarin*
Benzyl salicylate	Benzyl alcohol
Anise alcohol	Benzyl cinnamate
Amyl cinnamyl alcohol	Citronellol†
Linalool	Limonene
Geraniol*	α -Isomethyl ionone
Benzyl benzoate	Methyl 2-octynoate
Sorbitan sesquioleate§	

*Fragrance ingredients constituting fragrance mix I.

†Fragrance ingredients constituting fragrance mix II.

‡Hydroxyisohexyl 3-cyclohexene carboxaldehyde.

§Sorbitan sesquioleate is not a fragrance marker but an emulsifier used in fragrance mix I.

available.⁷ For every cosmetic product offered on sale to consumers, regulatory authorities¹ in the United States and the United Kingdom require an ingredient declaration listed in descending order of concentration down to 1%. Any order is permitted for ingredients with a concentration less than 1%.^{1,8} The EU Cosmetic Directive states that cosmetics sold in Europe containing the 26 specific fragrance ingredients known to cause ACD must be declared on the ingredient lists of cosmetic products, when present at more than 10 ppm in leave-on products or more than 100 ppm in rinse-off products. The Cosmetic Directive also states that if a product contains other fragrances, this must also appear on the label as aroma, fragrance, or perfume.^{2,9,10} The EU, through its Scientific Committee for Cosmetic Products and Non-Food Products intended for Consumers, is actively monitoring the labeling of all known fragrance allergens used in cosmetics.¹¹

Legislation in Europe and the United States restricts or outlaws the use of specific allergens based on collated patch test data and published literature. However, there is a lag period after the introduction of a new preservative and the clinical assessment of the resultant ACD. Dermatologists respond to this dynamic situation by adding the emerging contact allergens to the standardized and specialized patch testing series of the North American Contact Dermatitis Group (NACDG) and European community cosmetic directive.^{1,8}

In Sweden, adverse reactions to cosmetics are reported to the Medical Products Agency since 1989. This is a voluntary system, and on average, 40 to 50 reports are received each year, and most are based on a positive patch test result. In the EU, it is not mandatory for authorities to collect information on adverse reactions to cosmetics. In 2013, a new EU regulation on cosmetics will come into force mandating manufacturers, distributors, and government authorities to report severe undesirable effects⁵ (Table 1).

Nomenclature in the EU and United States

The nomenclature used within the EU is the International Nomenclature Cosmetic Ingredient (INCI), which is based on the US Personal Care Product Counsel (formerly known as the Cosmetic, Toiletry, and Fragrance Association) Nomenclature.^{1,12}

These are recognized identifiers for ingredient labeling of personal care products in the United States, the EU, Canada, Japan, and so on. Only names officially assigned by the committee can be called INCI names.¹³ The INCI name does not imply that the ingredient is “approved, certified, or endorsed” by Personal Care Products Council or any other organization or governmental body for use in personal care products. In addition, INCI names do not imply a standard or grade of purity.¹³

The Diagnosis of ACD Is a Challenge

A standard patch testing series is an important starting point for identification of potential contact allergies, but to increase diagnostic accuracy, testing should be based on a detailed medical, environmental, occupational, and vocational history. As the provider gathers this history, particular focus should be paid to potential allergenic exposure so that necessary supplemental patch-testing allergens can be added to the patients’ patch testing.^{14–16}

Once the diagnosis of ACD is established, patients require thorough education on allergen avoidance to facilitate successful compliance.¹⁵ Failure of compliance is often due to lack of understanding or knowledge. To improve successful allergen avoidance, a variety of tools exist including written allergen avoidance handouts and using the Contact Allergen Replacement Database (www.allergyfreeskin.com) or American Contact Dermatitis Society (ACDS)–Contact Allergen Management Program. These electronic tools are designed to help patients with ACD to find personal care products that are free of ingredients causing their allergic reactions by generating a list personalized to that patient. These lists are not exhaustive, but they are excellent starting points for patients to find products that are suitable for them.¹⁶

SKIN PATCH TESTING

Clinics for patch testing have existed since the 1800s, but following World War II, many new clinics opened, first in the United Kingdom and then in the United States. As interest in ACD rose over time, it has become apparent that researchers use different patch testing methods and concentrations of allergens. The International Contact Dermatitis Research Group was formed in 1960s from an amalgamation of European organizations with the aim of coordinating and standardizing patch testing worldwide. This organization inspired the formation of a domestic group called the NACDG, which became active in validation and efficacy studies.¹⁷

Before 1995, the NACDG recommended patch testing to 20 allergens via the Allergen Patch Test Kit.¹⁷ Currently, the only US FDA-approved patch test is the (TRUE) Thin-Layer Rapid Use Epicutaneous test. It was originally composed of 23 allergens but has been expanded to 29 allergens and then to 35 allergens.^{17,18} Over time, the NACDG series increased to 72 allergens and so on based on the most common relevant allergens determined by patch testing data.¹⁸ Some of these allergens are mixes composed of various relevant compounds (eg, fragrance mix) that increase the number of allergens to more than 50. All the 28 of the 29 TRUE test allergens are included in the NACDG series with exception of quinolone.¹⁷ The NACDG updates its number and composition of series every 2 years.

In 2009, the ACDS unveiled a recommended core-screening tray. Table 2 lists several international core allergen series).^{19–22}

CONTACT ALLERGY SURVEILLANCE GROUPS IN THE UNITED STATES AND EU

Contact allergy surveillance groups are organizations that monitor and evaluate contact sensitization based on clinical data collected by participating dermatology departments.²⁴

In the United States, the contact allergy surveillance systems are described along the “Guidelines for Evaluating Surveillance System” of the Centers for Disease Control, Atlanta, Ga; this relates to public health importance, objectives, elements, and attributes such as sensitivity, timeliness, representativeness, accuracy, completeness, and flexibility. The objectives include showing the persistence of the problem, putting into perspective an assumed problem, identifying emerging problems by monitoring trends, and proving the success of interventions. The main objective, however, is the provision of valid, up-to-date data as a basis for evidence-based prevention (see Table 3 for current active contact allergy networks).²

The usefulness of contact allergy surveillance networks for public health purposes has been proven, with broader multinational networks such as the European Surveillance System on Contact Allergies, linking European dermatology departments from 11 countries since 2001.^{5,10,15}

European Surveillance System on Contact Allergies aims to protect the population from contact allergens by detecting trends and monitoring frequency of contact sensitization, evaluating the effectiveness of intervention (government legislation), and

TABLE 2. International Core Allergen Series^{2,23}

International Core Allergen Series	No. Allergens
ACDS Core Allergens Series	Contains 80 allergens
NACDG	Contains 72 allergens
European Standard Series	Contains 28 allergens
International Extended Series	Contains 33 allergens
BCDS	Contains 41 allergens
Swedish series	Contains 29 allergens

TABLE 3. Currently Active Contact Allergy Networks, Not Including Multicenter Studies of National Contact Dermatitis Groups That Are Not Based on a Formal, Preexisting IT-Based Network²

Network (Area Covered)	
BCDS (United Kingdom)	British Contact Dermatitis Society
DCDG (DK)	Danish Contact Dermatitis Group
ESSCA (Europe)	European Surveillance System on Contact Allergies (39 participants from 11 countries)
GEIDAC-REVAC (E)	Grupo Español en Investigación de Dermatitis de Contacto y Alergia Cutánea (Spanish Contact Dermatitis Group)—Red Española de Vigilancia en Alergia de Contacto (Spanish Surveillance System on Contact Allergies)
IVDK (D, CH, A)	Informationsverbund Dermatologischer Kliniken (Information Network of Departments of Dermatology)
NACDG (United States, CAN)	North American Contact Dermatitis Group
NEICDG (I)	North-East Italy Contact Dermatitis Group
REVIDAL-GERDA(F, B)	Réseau de Vigilance en Dermato-Allergologie (Surveillance network in Dermato-Allergologie)—Groupe d'Etudes et de Recherche en Dermato-Allergologie (French Research Group in Dermatoallergology)
SIDAPA (I)	Società italiana dermatologica allergologica professionale e ambientale (Italian society for allergic, occupational, and environmental dermatology)

improving standardization of the patch test procedure on an international level^{10,15,25} (Table 4).

Supplementary Series

TABLE 4. Countries and Departments Included in the European Surveillance System ESS on Contact Allergy Network¹⁵

Country	No. Departments
Austria	1
Denmark	1
Finland	2
Germany	6
Italy	3 (4*)
Lithuania	1
The Netherlands	2
Poland	3
Spain	5
Switzerland	3
United Kingdom	12

*Pavdova pediatric not included in the population analysis, owing to an entirely pediatric population.

There are more than 3000 substances known to cause ACD, making the identification of offending allergens a difficult task.

In the United Kingdom, allergens with rates of positive reactivity greater than 1% are added to the British Contact Dermatitis Society standard series. Allergens with a lower prevalence of positive reaction (<1%) are considered for inclusion in additional specialized and specific series.⁸

Despite the expansion of the initial TRUE test series to include a third panel, the test continues to represent an incomplete screen for many patients. Although no standard series can include all allergens encountered in the environment of every patient, larger standard series increase the sensitivity of the patch test in identification of clinically relevant allergens in patients with suspected ACD¹⁴ (see Table 5 for important allergens to include in the cosmetic screening series).

Furthermore, Mayo Clinic enumerated 16 additional allergens beyond the TRUE test that may increase the diagnostic yield in

TABLE 5. Important Allergens for Consideration in a Cosmetic Screening Series¹

Allergen	Function
Amerchol L101	Emulsifier
Benzophenone 3	Sunscreen
2-Bromo-2-nitropropane-1,3-diol (Bronopol)	Preservative
Butylated hydroxyanisole	Antioxidant
Butylated hydroxytoluene (BHT)	Antioxidant
Cetyl/stearyl alcohol	Emulsifier
Cocamidopropyl betaine	Surfactant
Diazolidinyl urea	Preservative
Dimethylol dimethyl (DMDM) hydantoin	Preservative
Formaldehyde	Preservative
Fragrance mix	Fragrance
Hydroxyl-3-cyclohexene carboxaldehyde (HMPPC Lyrall)	Fragrance
Imidazolidinyl urea	Preservative
Iodopropynyl butylcarbamate	Preservative
Methylisothiazolinone/methylchlorisothiazolinone	Preservative
Methyldibromoglutaronitrile	Preservative
Balsam of Peru (<i>Myroxylon pereirae</i>)	Fragrance material
4-Aminobenzoic acid	Sunscreen
Parabens mix	Preservative
PPD	Hair dye
Phenoxyethanol	Preservative
Propylene glycol	Humectant and viscosity decreasing agent
Quaternium 15	Preservative
Tosylamide/formaldehyde resin	Nail cosmetic resin
Tea tree oil	Essential oil
Wool alcohol	Blinder, emulsion stabilizer, viscosity-increasing agent

TABLE 6. Additional Allergens Beyond Those of the TRUE Test That Could Be Considered for Patch Testing Evaluation of Patients With Allergic Contact Dermatitis to Personal Care Products¹⁵

Amidoamine	Benzalkonium chloride
Cinnamic aldehyde	Benzoic acid
Cocamidopropyl betaine	DMDM hydantoin
2-Hydroxy-4-methoxybenzophenone-5-sulfonic acid	Dodecyl gallate
Jasmine absolute	Methyldibromoglutaronitrile/phenoxyethanol
Oleamidopropyl dimethylamine	α -Tocopherol (vitamin E)
Propolis	Propylene glycol
Triclosan	Ylang-ylang oil

the evaluation of patients with ACD to personal care products (Table 6).

By design, the TRUE test was developed to include the common allergens and therefore identifies or rules out the most common causes of ACD. Therefore, in an era of limited resources, using such a limited panel may be a reasonable first step in obtaining a diagnosis based on the patient's individual case history. If the result of the TRUE test is positive to common allergens and the patient responds to the appropriate treatment, then performing patch tests with a wider panel may needlessly subject patients to potential sensitizing agents.

ALLERGEN GROUPS

Fragrances

Fragrances account for up to 30% to 40% of allergic reactions to cosmetics in patients with eczema.^{1,7,8} Typically, fragrances consist of several hundred different chemicals that have a unique odor. In the past, fragrances were derived from plant and animal origin, but currently many are synthesized for reasons of purity, cost, and standardization. The prototype fragrance testing allergen is fragrance mix I, containing 8 perfume components (α -amyl cinnamal also known as amyl cinnamal, cinnamal also known as cinnamic aldehyde, cinnamyl alcohol, hydroxycitronellal, eugenol, isoeugenol, geraniol, and *Evernia prunastri* [oakmoss] extract, all diluted 1% in petrolatum and emulsified with sorbitan sesquiolate).⁶⁻⁸ Because it remains the best screening agent for contact allergy to perfumes, detecting 70% to 80% of all perfume allergies, it is present in all standard series. Despite the breadth of fragrance allergy fragrance mix I identified, testing with additional markers is necessary to increase the sensitivity.^{6-8,11}

Fragrance-Free Products

The use of "fragrance-free" products does not ensure that the product is actually free of fragrance. Fragrance is defined as a natural or synthetic substance used to impart a scent to a cosmetic product, acting as preservative, emollient, fixative, or

disinfectant, and can be included in the claimed “fragrance-free product.” In addition, fragrance-free products contain natural plant extract and essential oils such as rose, chamomile, and sandalwood, all of which are fragrances.²⁶ There is no US federal standard definition that governs the use of the term *hypoallergenic*, and manufacturers of these cosmetics are not required to submit substantiation of their hypoallergenic claim to the FDA.²⁶ In addition, it has been noted that comparing the labels of various cosmetic ingredients demonstrated no meaningful difference between the hypoallergenic cosmetics and the others that do not claim to be so.²⁶

Preservatives

Preservatives have been identified as common cosmetic allergens in many studies.⁶ They are divided into 3 categories: antimicrobials, antioxidants, and UV light absorbers.

Antimicrobials

To prevent contamination, preservatives (including biocides) are added to cosmetic products that can lead to ACD, and varying concentrations of the same preservative are found in related products.⁸ The antimicrobials are divided into formaldehyde preservatives, formaldehyde releasers, and non-formaldehyde-releasing preservatives.⁷ Formaldehyde and formaldehyde-releasing preservatives (including imidazolidinyl urea, diazolidinyl urea, quaternium 15, and dimethylol dimethyl hydantoin) have inherent antibacterial and antifungal properties but also have a formaldehyde-releasing action that can induce sensitization by repeat exposure, thereby provoking ACD.^{1,3,7} The methyl- and methylchloro-isothiazolinone mixture (non-formaldehyde-releasing preservatives) commonly used in the 1980s was found to cause contact allergies. The mixture has been recommended (up to 15 ppm) to be used only in rinse-off products or replaced by methylisothiazolinone alone because it is less allergenic. However, methyl- and methylchloro-isothiazolinone mixtures are still found in some leave-on products, for example, moisturizers and baby wipes, leading to ACD.^{1,6,7} In a European study, paraben¹ (non-formaldehyde-releasing preservative) is used commonly and is found in 99% of leave-on products and 77% of rinse-off products. Parabens appear to be a weak cosmetic sensitizer at the usual concentration of 0.1% to 0.3%.¹

Antioxidants

Antioxidants such as butylhydroxyanisole, tertiary butylhydroquinone, butylhydroxytoluene, gallates, and tocopherol/ vitamin E are all potential, albeit somewhat rare, sensitizers and are typically added to cosmetics to prevent the deterioration of fatty acids.¹

UV Light Absorbers

There are several sunscreen products on the market that can cause ACD such as para-aminobenzoic acid (PABA), a UV-B blocker, and oxybenzone (benzophenone 3) and avobenzone, both UV-A blockers. Para-aminobenzoic acid is an early chemical sunscreen

agent rarely found today because it was associated with contact and photosensitivity reactions. However, its esters (primarily octyl dimethyl para-aminobenzoic acid) are commonly used in many formulations and have not been associated with the problems of PABA.²⁷ Photoallergic dermatitis can be caused by derivatives of PABA and its esters, benzophenones, cinnamates, and dibenzoylmethanes.²⁶ Ethylhexyl methoxycinnamate and octyl methoxycinnamate (also known as cinnamates) rarely cause contact dermatitis and are very insoluble in water. Dibenzoylmethane compound exclusively absorbs in the UV-A range.^{26,27} Sunscreens are added to some cosmetics such as facial skin care products, to protect the skin (UV filters) and to prevent photodegradation of the product itself. These cosmetics ingredients cause contact dermatitis after exposure to UV radiation. The most frequent adverse reaction to sunscreen preparations is irritation, occurring in 15% of users.¹²

Natural Botanicals

Plant extracts and herbal remedies have become more popular in recent years, and they have been recognized as potential causes of contact dermatitis.⁶ Patients who are allergic to perfume components should avoid cosmetics containing plant extracts such as essential oils, including tea tree oil.⁶ Intriguingly, protein-derived ingredients used in skin products such as oat meal, hydrolyzed wheat, and soya bean extract to treat dry or atopic skin rarely lead to ACD or contact urticarial.⁶

Vehicles

Vehicles play an important role in causing ACD; the most common vehicles are lanolin and propylene glycol.¹³ Many of the current vehicles, in particular the water-washable creams and lotions, have a complex formulation composed of many different chemicals such as solubilizers, antioxidants, emulsifiers, preservatives, surfactants, and so on.²⁸ Lanolin is commonly used as an emollient and emulsifier and is derived from sheep's wool.¹³ Lanolin is a natural product and is composed of hundreds of different chemicals, making the diagnosis of the relevant contact allergen difficult. Lanolin is included in the standard set recommended by British Contact Dermatitis Group and the ACDS core allergens series.¹

Specific Cosmetic Products

Hair Care Products

Contact allergies to hair dye *p*-phenylenediamine (PPD) remain an important cause of ACD.^{1,7} *p*-Phenylenediamine and its derivatives are the primary coloring agents found in permanent and semipermanent hair dyes. Clinical reactions to PPD can be severe, and “spot testing” is recommended before using the product. *p*-Phenylenediamine is also the main allergen in reactions to impure “henna” decorative skin paintings. Other potential allergens in hair products include ammonium persulfate, resorcinol, sunscreens, and fragrance and therefore should be considered for

TABLE 7. Common Hair Product Allergens²⁰

Shampoos	Triethanolamine
	Rosin
	Benzophenone-4
	Decyl glucoside
	Sorbic acid
	Diazolidinyl urea
	Benzoic acid
	Cinnamates
	Oxybenzone
	Lanolin
	Propolis
	Imidazolidinyl urea
	Quaternium 15
	Avobenzene
	BHT
	Fragrance
	Cetylstearyl alcohol
	Cocamidopropyl betaine
	Sorbitan sesquioleate
	Propylene glycol
Conditioners	Vitamin E
	Chlorhexidine digluconate
	Methylisothiazolinone/methylchloroisothiazolinone
	Lanolin
	Triethanolamine
	Benzophenone
	Avobenzene
	Rosin
	Cinnamates
	Oxybenzone
	Propolis
	Benzoic acid
	Sodium benzoate
	Cocamide DEA
	PABA
	2-Bromo-2-nitropropane-1/3-diol
	BHT
	Fragrance
	Propylene glycol
	Cetylstearyl alcohol
	Sorbitan sesquioleate
	Benzoic acid
	Benzophenone 4
	Triethanolamine
	Oxybenzoate
Styling products	Methylisothiazolinone/methylchloroisothiazolinone
	Cocamidopropyl betaine
	Avobenzene
	Propolis
	Sodium benzoate
	PABA
	BHT
	Chlorhexidine digluconate
	Quaternium 15
	Benzalkonium chloride

patch testing in the appropriate clinical setting (see Table 7 for common hair product allergens).^{1,7}

Nail Products and Artificial Nails

Most allergic reactions to nail polish, artificial nail polish, and nail hardeners are caused by tosylamide formaldehyde resin (toluene sulfonamide formaldehyde resin).^{29–31} Other allergens such as acrylates, fragrance, and sunscreen can be present in the nail lacquer (see Table 8 for reported individual constituents of nail cosmetics known to cause adverse reactions). Artificial nails contain methyl methacrylate as the main sensitizer. However, all nail acrylates can cause dermatitis. According to EU legislation,^{29–31} except for nail hardeners that may contain maximum of 5% formaldehyde, the maximum allowed concentration of formaldehyde in finished products is 0.2% and any product that exceeds 0.05% has to include a warning that the product contains formaldehyde.³⁰ As an alternative, some manufacturers use alkyl polyester resin and label this as “hypoallergenic.” However, patients who are sensitive to acrylates usually cannot wear any kind of artificial nail because of potential cross reactions.^{30–32}

Eye Products

The skin of the eye is particularly susceptible to irritant and ACD. Eyelid dermatitis has been reported in patients with nickel allergic dermatitis when they were exposed to nickel containing mascara and eye shadow.³³ Pigmented make-up can contain nickel and other metal allergens.³⁴ Eye shadow pressed powder is applied to the skin in the form of talc, and its main ingredients include pigments with zinc and magnesium stearate (used as binders). These are impurities in the pigments of eye shadow. Some eye shadows give metallic brilliant finish, which is created by using, for example, copper, aluminum, brass, gold, or silver powder.³³ The European Council Directive 76/768/EEC disciplined the metal release quantity in products which are designed to enter in direct and/or long contact with the skin to minimize the risk of

TABLE 8. Reported Individual Constituents of Nail Cosmetics Known to Cause Adverse Reactions³¹

Nail polish	Nitrocellulose
	Formaldehyde
	Tosylamide-formaldehyde resin
	Dibutyl phthalate
Nail polish removers	Butyl stearate
	D and C yellow 11
	γ-Butyrolactone
	Methyl acrylate
Nail adhesive	Ethyl 2-cyanoacrylate
	Methacrylate
Acrylic nails	Hydroxyethyl
	Benzoyl peroxide
	UV light
	Photobonded gel nails
Gel nails	

allergic dermatitis, and has banned the use of nickel, cobalt, and chromium.³³ A recent study³³ showed that the concentrations of cadmium, chromium, and cobalt eye shadow products made in the United States and Italy were characteristically low and within the acceptable and safe concentration, whereas Chinese products exceeded the safe limit (see Table 9 for the relevant contact allergens that cause eyelid dermatitis). The metals involved in eye allergic dermatitis are nickel, cobalt, and chromium, in order of incidence.^{33,34}

Lip Products

Lipstick ingredients such as shellac (a naturally occurring bio-adhesive polymer resin), butylhydroxyanisole, and lanolin are the most frequent allergens involved in allergic contact cheilitis.¹

TABLE 9. Relevant Contact Allergens that Cause Eyelid Dermatitis¹⁹

Eyeliner	BHT
	Cetylstearyl alcohol
	Propylene glycol
	Phenoxyethanol
	Sorbic acid
	Lanolin
	Triethanolamine
	Parabens
	BHT
	Phenoxyethanol
Eye shadow	Chromate pigments
	Cetylstearyl alcohol
	Vitamin E
	Lanolin
	Sorbitan sesquioleate
	Sorbic acid
	Fragrances
	Propolis
	Parabens
	Phenoxyethanol
Mascaras	Chromate pigments
	Vitamin E
	Sorbitan sesquioleate
	BHT
	Imidazolidinyl urea
	Diazolidinyl urea
	Quaternium 15
	Cetylstearyl alcohol
	Chromate pigments
	BHT
Concealer	Propolis
	Triethanolamine
	Parabens
	Vitamin E
	Fragrance
	Sorbitan sesquioleate

CONCLUSIONS

Cosmetics have been an important part of our daily lives for thousands of years. Many of us take cosmetics for granted when using, for example, shampoo, make-up, or toothpaste for personal hygiene. In addition, almost everyone is using cosmetics products to clean, perfume, change the appearance, protect the body from odors, and to protect and keep the skin, teeth, and mucosal membranes in good condition.⁷ New cosmetic products continue to be released, and the variety of individual ingredients used to make them continues to change.³⁵ Hence, allergic reactions to cosmetics are increasingly reported.⁷ Legislations in Europe and the United States have changed over time and now restrict or outlaw the use of specific allergens based on collated patch test data and published literature. The diagnosis of ACD is challenging and requires a high degree of expertise and experience. Patch testing is the standard method for detecting allergens responsible for eliciting ACD.^{14,15,36} A careful review of patient's clinical history and physical examination findings, confirmed with standard patch testing, facilitates achievement of an accurate diagnosis. Studies have provided additional support for patch testing to a supplemental cosmetic series when the clinical diagnosis is a cosmetic contact dermatitis.^{4,15,37} Armed with the knowledge of a patient's patch test reactions, the experienced clinician can help teach the patient to successfully avoid their allergens.^{14,17}

REFERENCES

- Orton DI, Wilkinson JD. Cosmetic allergy, incidence, diagnosis, and management. *Am J Clin Dermatol* 2004;5:327–337.
- Schnuch A, Geier J, Lessmann H, et al. Surveillance of contact allergies: methods and results of the Information Network of Department of Dermatology (IVDK). *Allergy* 2012;67:847–857.
- Nelson J, Mowad CM. Allergic contact dermatitis patch testing beyond the TRUE test. *The J Clin Anaesth Dermatol* 2010;3:36–41.
- Held E, Johansen JD, Agner T, et al. contact allergy to cosmetics: testing patient's own products. *Contact Dermatitis* 1999;40:310–135.
- Tammela M, Lindberg M, Isaksson M, et al. Patch testing with own cosmetics—a prospective study of testing and reporting of adverse affects to the Swedish Medical Products Agency. *Contact Dermatitis* 2012;67:42–46.
- Hamilton T, De Gannes GC. Allergic contact dermatitis to preservatives and fragrances in cosmetics. *Skin Ther Lett* 2011;16:1–4.
- Goossens A. Review article contact-allergic reactions to cosmetics. *J Allergy* 2011;2011:1–6.
- Davis RF, Johnston GA. New and emerging cosmetic allergens. *Clin Dermatol* 2011;29:311–315.
- Heisterberg MV, Menne T, Johansen JD. Contact allergy to the 26 specific fragrance ingredients to be declared on cosmetic products in accordance with EU Cosmetic Directive. *Contact Dermatitis* 2011;65:266–275.
- Bruze M, Svedman C, Andersen KE, et al. Patch test concentrations (dose in mg/cm²) for the 12 non-mix fragrance substances regulated by European legislation. *Contact Dermatitis* 2012;66:131–136.
- Beck MH. Fragrance allergy. Editorial comments. *Br J Dermatol* 2000;142:203–209.

12. De Groot AC. Contact allergens—what's new? Cosmetic dermatitis. *Clin Dermatol* 1997;15:485–491.
13. DOW Answers Centre. Home and personal care. INCI Nomenclature. Updated May 12, 2011. Available at: http://dowhpc.custhelp.com/app/answers/detail/a_id/4163/É/incinomenclature. Accessed September 14, 2012.
14. Patel D, Belsito DV. The detection of clinically relevant contact allergens with a standard screening tray of 28 allergens. *Contact Dermatitis* 2012; 66:154–158.
15. Wetter DA, Yiannias JA, Parkash AV, et al. Results of patch testing to personal care products 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* 2000;2763:789–798.
16. American Contact Dermatitis Society web site. Available at: <http://www.contactderm.org/i4a/pages/index.cfm?pageid=3291>. Accessed December, 2012.
17. 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.
18. Camacho-Halili M, Axelrod S, Michelis MA, et al. A multi-center retrospective review of patch testing for contact dermatitis in allergy practices. *Ann Allergy* 2011;107:487–492.
19. Scheman A, Jacob S, Katta R, et al. Part 1 of a 4 part series. Facial cosmetics: trends and alternatives. Data from the American Contact Alternative Group. *J Clin Aesthet Dermatol* 2011;4:25–30.
20. Scheman A, Jacob S, Katta R, et al. Part 2 of a 4 part series. Hair cosmetics: trends and alternatives. Data from the American Contact Alternative Group. *J Clin Aesthet Dermatol* 2011;4:42–46.
21. Scheman A, Jacob S, Katta R, et al. Part 3 of a 4 part series. Lips and common Dental Care products: trends and alternatives. Data from the American Contact Alternative Group. *J Clin Aesthet Dermatol* 2011; 4:50–53.
22. Scheman A, Jacob S, Katta R, et al. Part 4 of a 4 part series. Miscellaneous products: trends and alternatives in deodorants, antiperspirants, sunblocks, shaving products, powder, and wipes. Data from the American Contact Alternative Group. *J Clin Aesthet Dermatol* 2011;4:35–39.
23. Lee J, Warshaw E, Zirwas M. Allergens in the American contact Dermatitis Society series. *Clin Dermatol* 2011;29:266–272.
24. The ESSCA Writing Group. The European surveillance system of contact allergies (ESSCA): results of patch testing the standard series, 2004. *JEADV* 2008;22:174–181.
25. European baseline series. Cited July 25, 2012. Available at: www.escd.org.
26. Wolf R, Wolf D, Tuzun B, Tuzun Y. Cosmetic and contact dermatitis. *Dermatol Ther* 2001;14:181–187.
27. Naylor MF, Farmer KC. The Internet Dermatology Society. Sunscreens; 2010. Updated 2010. Cited September 14, 2012. Available at: <http://telemedicine.org/sundam/sundam2.4.2.html>.
28. Fisher AA, Pascher F, Kanof NB. Allergic contact dermatitis due to ingredients of vehicles a “vehicle tray” for patch testing. *Arch Dermatol* 1971;104:286–290.
29. Baran R. Nail cosmetics allergies and irritations, review article. *Am J Clin Dermatol* 2002;3:547–555.
30. Travassos AR, Claes L, Boey L, et al. Non-fragrance allergens in specific cosmetic products. *Contact Dermatitis* 2011;65:276–285.
31. Madnani NA, Khan KJ. Nail cosmetics. *Indian J Dermatol Venereol Leprol* 2012;78:309–318.
32. Ortiz K, Yiannias JA. Contact dermatitis to cosmetics, fragrances, and botanicals. *Dermatol Ther* 2004;17:264–271.
33. Vople MG, Nazzaro M, Coppola R, et al. Determination and assessments of selected heavy metals in eye shadow cosmetics from China, Italy and USA. *Microchem J* 2012;101:65–69.
34. Loden M, Nilsson G, Parvardeh M, et al. No skin reactions to mineral powders in nickel-sensitive subjects. *J Contact Dermatitis* 2011;66:210–214.
35. 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;18:78–81.
36. Noiesen E, Larsen K, Agner T. Compliance in contact allergy with focus on cosmetic labelling: a qualitative project. *Contact Dermatitis* 2004; 51:189–195.
37. Thappa DM. Do cosmetics cause airway allergy? Letter to editor. *J Cosmet Dermatol* 2005;5:76–80.