Alternatives for Allergens in the 2018 American Contact Dermatitis Society Core Series: Report by the American Contact Alternatives Group

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The most successful treatment for contact allergy is allergen avoidance. Patient improvement ultimately relies on identification of safe alternative products, which can be used by the patient. "Safe" personal care product options can typically be found using ingredient database programs. Avoidance of allergens in other products (ie, shoes, clothing, dental care, etc) is often challenging. In this article, the American Contact Alternatives Group discusses how to find specific safe alternatives for the 80 allergens on the American Contact Dermatitis Society core allergen series (*Dermatitis*. 2017;28:141–143). The alternatives listed in this article are accurate as of the date of publication; however, the availability of these alternatives may change in the future (disclaimer).

CORE COSMETIC AND TOPICAL MEDICATION ALLERGENS

By far, the largest allergen source category in the American Contact Dermatitis Society (ACDS) Core Allergen Series of 80 top allergens in North America is topical products.[1] In total, 51 allergens in this series may be found in cosmetic and personal hygiene products, and an additional 11 allergens may be found in topical medications (Table 1). Because patients often need to identify products devoid of a multitude of allergens, finding safe alternatives is complicated. The number of possible combinations of topical allergens is astronomical and ingredients are often listed under multiple names. In addition, many of these allergens have cross-reactive potential with other allergens. For these reasons, finding safe alternative products is best accomplished via reliable computerized database resources.

Some attempts have been made to use bar code scanning to identify products that contain specific allergens. The flaw with this methodology lies in the fact that manufacturers do not change bar codes when formulations change. In addition, bar code scanning will not generally identify synonyms or link the search to cross-reacting substances.

There are also a number of online resources for topical product ingredient information. However, most of these sites are designed for consumer reference and generally do not have the degree of accuracy needed for medical safety. Thus, errors in online product information are common. In addition, most of these sites do not link searches to synonyms and cross-reactors. Furthermore, even when this has been done, if a database is collecting product information from other online sources, errors in product information can lead to products erroneously being listed as a "safe" alternative when it contains the allergen that the individual is attempting to avoid. Because computers are literal, even a comma instead of a space in an ingredient name could result in a product being recommended improperly as safe. It is extremely unlikely that databases that include a vast number of topical products have procedures in place to check each of these product listings for medical accuracy. When patient safety is at stake, it is important for a database to be extremely accurate to prevent inadvertent use of products containing allergens that an affected individual needs to avoid.

THE ACDS CONTACT ALLERGY MANAGEMENT PROGRAM

For these reasons, the ACDS created the Contact Allergy Management Program (CAMP)[2] to assist patients with confirmed contact allergies to find products devoid of any combination of substances to which they are allergic. Currently, this database contains full

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The authors have no funding or conflicts of interest to declare.

DOI: 10.1097/DER.0000000000000453

TABLE 1. Cosmetic and Topical Medication Allergens on the 2017 ACDS Core Allergen Series

CAMP Quick Check Box	(Synonyms)	Category
2-Hydroxyethyl methacrylate		Artificial nails, adhesives
4-Chloro-3-cresol	(*para*-Chloro-meta-cresol, PCMC, *p*-chloro-*m*-cresol)	Cosmetic
Amerchol L101 or wool alcohols	(Lanolin alcohol)	Cosmetic
Amidoamine	(Stearamidopropyl dimethylamine)	Cosmetic
Bacitracin		Medication
Balsam of Peru	(*Myroxylon pereirae*)	Cosmetic, oral
Benzalkonium chloride	(Alkyl dimethylbenzyl ammonium chloride)	Cosmetic
Benzocaine	Use this box for caine mix	Medication
Benzoic acid		Cosmetic, oral
Benzophenone-4	(Sulisobenzone)	Cosmetic
Benzyl alcohol		Cosmetic
BHT	(Butylhydroxytoluene)	Cosmetic, oral
Bronopol	(2-Bromo-2-nitropropane-1,3-diol)	Cosmetic
Budesonide		Medication
Cetylstearyl alcohol		Cosmetic
Chlorhexidine digluconate		Cosmetic, surgical
Cinnamic aldehyde	(Cinnamal)	Cosmetic, oral
Cl + Me–isothiazolinone	(Methylisothiazolinone/methylchloroisothiazolinone, MCI/MI, Kathon CG)	Cosmetic
Clobetasol		Medication
Cocamide DEA	(Cocamide diethanolamine)	Cosmetic
Cocamidopropyl betaine		Cosmetic
Colophony	(Colophonium, rosin)	Cosmetic, household
Compositae mix	Use this box for parthenolide	Cosmetic, garden/airborne, oral
Decyl glucoside		Cosmetic
Desoximetasone		Medication
Diazolidinyl urea		Cosmetic
Dimethylaminopropylamine	(DMAPA)	Cosmetic
DMDM hydantoin		Cosmetic
Ethyl cyanoacrylate		Nail glue, adhesives
Ethylenediamine dihydrochloride		Cosmetic, oral meds
Ethylhexyl glycerol	(Ethylhexylglycerin, ethylhexyl glycerin)	Cosmetic
Formaldehyde		Cosmetic, cloth-like paper, oral
Fragrance mix I		Cosmetic, oral
Fragrance mix II		Cosmetic, oral
Hydrocortisone-17-butyrate	(Hydrocortisone butyrate)	Medication
Imidazolidinyl urea	(Imid urea)	Cosmetic
Iodopropynyl butylcarbamate		Cosmetic
Lavender	(Lavender oil, *Lavandula angustifolia* oil)	Cosmetic, garden/airborne
Lidocaine		Medication
Methyldibromo glutaronitrile		Cosmetic
Methylisothiazolinone	(MI)	Cosmetic
Neomycin sulfate	(Neomycin sulfate, neomycin)	Medication
Oleamidopropyl dimethylamine		Cosmetic
Oxybenzone	(Benzophenone-3, 2-hydroxy-4-methoxy-benzophenone)	Cosmetic
Paraben mix		Cosmetic
PCMX	(*para*-Chloro-meta-xylenol, chloroxylenol, 4-chloro-3,5-xylenol)	Cosmetic
p-Phenylenediamine	(Paraphenylenediamine, PPD)	Hair dye
Phenoxyethanol	(2-Phenoxyethanol)	Cosmetic
Polymyxin	(Polymyxin B Sulfate)	Medication

(Continued on next page)

TABLE 1. *(Continued)*

CAMP Quick Check Box	(Synonyms)	Category
Propolis		Cosmetic, oral
Propylene glycol		Cosmetic, oral
Quaternium-15		Cosmetic
Sesquiterpene lactone mix		Cosmetic, garden/airborne
Sorbic acid		Cosmetic, oral
Sorbitan sesquioleate		Cosmetic
Sodium benzoate		Cosmetic, oral
Tea tree oil	(Melaleuca)	Cosmetic
Tixocortol-21-pivalate	(Tixocortol pivalate)	Medication
Triamcinolone acetonide		Medication
Tosylamide/formaldehyde resin	(TSF resin, toluene sulfonamide formaldehyde resin)	Nail polish
Vitamin E	(Tocopherol, di alpha tocopherol)	Cosmetic, oral
Ylang-ylang	(*Cananga odorata*)	Cosmetic, garden/airborne

Abbreviations: DMDM, dimethylol dimethyl; MI, Methylisothiazolinone; MCI methylchloroisothiazolinone.

ingredient information for approximately 5000 skin, hair, cosmetic, topical medication, and household products, all of which are updated at least annually. It is expected that the number of products in CAMP will be expanded during the next year and that all products will be updated every 6 months.

The ACDS provides the CAMP resource for member providers to assist patients with confirmed contact allergies. The CAMP will only accept ingredient information directly from product labels or from the original manufacturer's website and medical accuracy is maintained through quality control measures. The ACDS has a group of expert physicians who discuss and define CAMP cross-reactor groups, and the physician CAMP director is available for questions/input. The ingredients in each product are transferred to spreadsheets, and each ingredient is carefully checked against the reference source (product label or manufacturer website) for accuracy before being imported into the database. The CAMP data analyst checks every product ingredient list and ensures that ingredient punctuation is entered accurately. Although no database can ensure perfect accuracy, the CAMP provides the highest level of medical accuracy possible within the limitations of human error. The CAMP is a nonprofit endeavor that aims to provide the most accurate cosmetic and personal care product ingredient information available.

The ACDS maintains that each patient should first be adequately patch tested by a qualified physician/provider to properly identify the substances that need to be avoided and to obtain counseling on how to properly avoid confirmed allergens. The ACDS website allows patients to identify qualified physicians/providers near their home to perform this testing.

USING ACDS CAMP TO FIND SAFE ALTERNATIVE PRODUCTS FREE OF SPECIFIC ACDS CORE ALLERGENS

Allergens found to be positive on patch testing are called "excluded allergens" and are placed by the physician/provider into an "Ingredient Exclusion List."

In the ACDS CAMP website, the provider must choose "allergen search" and answer the questions, which appear on the screen (Fig. 1A). The next screen will display allergen quick check boxes for all 80 ACDS core allergens. The provider then checks the corresponding quick check box next to a common allergen and it will be placed in the Ingredient Exclusion List. All of the appropriate quick check boxes must be selected for the patient (Fig. 1B).

Once the Ingredient Exclusion List is complete, the "Generate Product List" button is checked to create the patient's "safe list" (Fig. 1B). The provider can choose to click print/save and export the list as a PDF file that may be printed or saved to a CD, or click "email" to email to the patient (by using the "Output Result to" option) (Fig. 1C).

The patient-specific allergen identification code that is generated will automatically reload all of the confirmed allergens for a specific patient. This can be used to quickly generate a new list for the patient during a follow-up visit. This code is also needed to use the ACDS CAMP application (app). To generate a code, simply click "Generate Allergen Identification Code" (Fig. 1C).

The ACDS app[3] can be downloaded onto phones and tablets using the iPhone and Android platforms at no cost. Once the app is loaded, a screen will appear asking for the patient's allergen identification codes (Fig. 1D). Once these codes are entered, the patient's individualized allergen safe list will be transferred to their phone or tablet, and a list of general product categories will appear. Unlike a static paper list, the safe products on the app can be easily updated. Before each use, the patient can drag the product category screen (ie, main screen) downward with a finger, and a prompt will appear showing that all of the products on the safe list are being updated (Fig. 1E). This process usually takes approximately 30 seconds. The patient can then click the desired product category, and a list of product subcategories will appear (Fig. 1F). When a subcategory is chosen, a specific list of safe products will appear.

Many allergens have a multitude of names, which may be used on a label. For example, fragrance may also be called parfum. In addition,

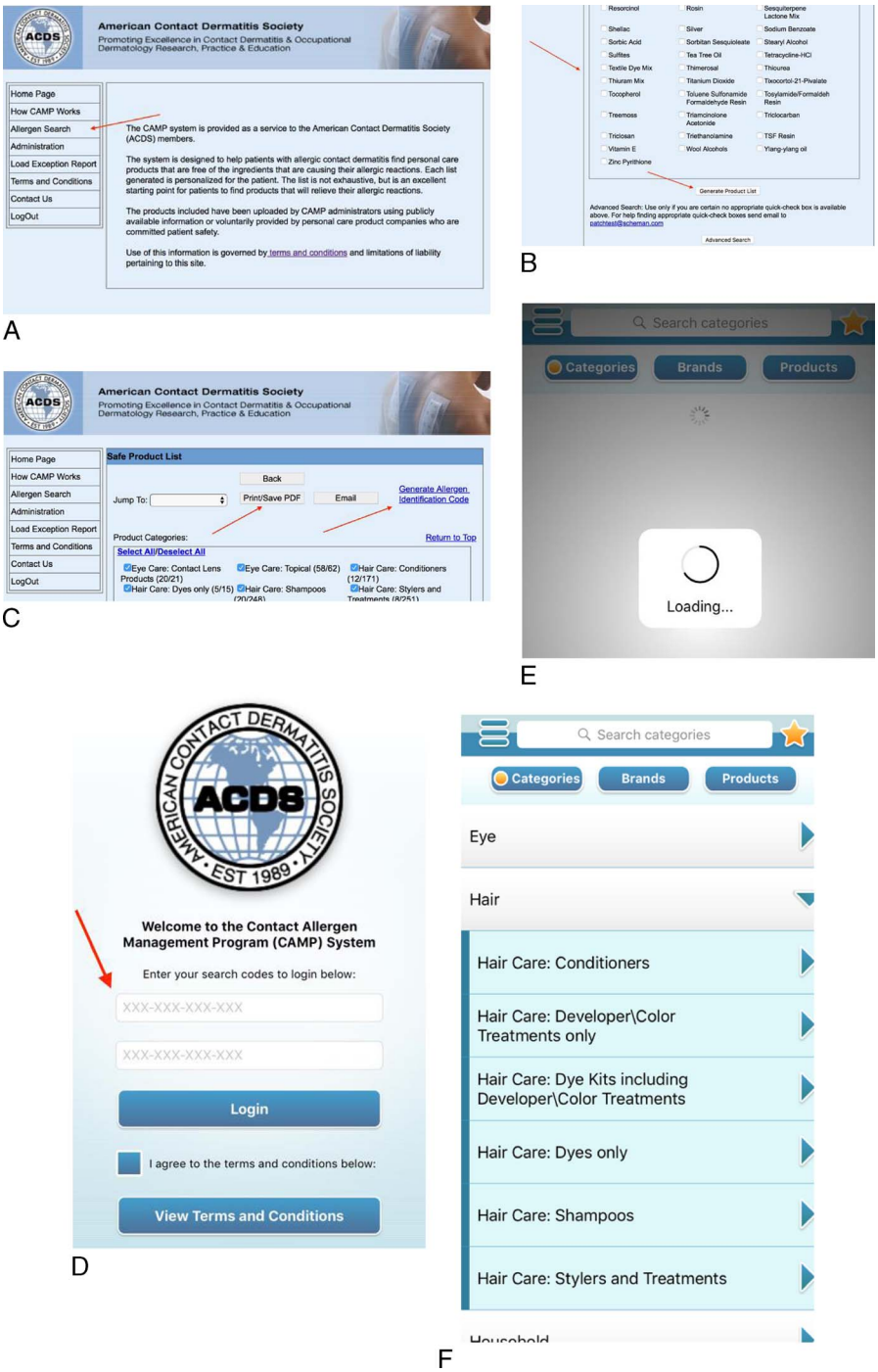

Figure 1. The ACDS CAMP tutorial. A, In ACDS website, choose "Allergen Search." B, Click check boxes that apply and then "Generate Product List." C, Choose "Print/Save PDF", "e-mail" or "Generate Allergen Identification Code." D, Load app, enter search ID codes, agree to terms, and then log on. E, Pull down product screen to update app. F, Choose product category and subcategory.

many ingredients have known "cross-reactors," which most patients who are allergic to the ingredient should also avoid. For example, formaldehyde-allergic patients should also avoid quaternium-15, imidazolidinyl urea, and other formaldehyde releasers.[4]

The ACDS CAMP cross-reactor committee is a panel of contact allergy experts that deliberates on ingredients that should be considered cross-reactors and synonyms based on the best available medical evidence. Evidence that more than 10% of individuals allergic to a substance will react to a second substance is the criterion used by the CAMP for inclusion of the second substance as a cross-reactor. A CAMP search using the allergen quick check boxes is automatically linked with appropriate synonyms and cross-reactors.

Because all ACDS core allergens have corresponding allergen quick check boxes, these quick check boxes should always be used for finding alternatives for the core series.

ISSUES SURROUNDING SPECIFIC ALLERGENS

Finding safe alternatives for certain allergens included in the CAMP and found in topical products is more complicated.

Steroids

The most problematic category in CAMP is topical steroids. Because of their inherent anti-inflammatory properties, topical steroids have a high propensity for false-negative reactions. Therefore, a patient found allergic to 1 steroid may also be allergic to other steroids, which may not be identified by patch testing. Data suggest that C_{16}-methylated steroids are less allergenic than other steroids.[5] The CAMP cross-reactor committee has therefore divided steroids into 2 groups based on the presence or absence of a C_{16} methyl group. However, studies have shown that exceptions to the expected patterns of steroid cross-reaction are common.[4] Therefore, it is recommended for steroid-allergic patients that the "safer" steroids be viewed as suggestions and that a repeat open application test is performed to ensure that the listed "safer" steroids are tolerated.[6] The proposed steroid should be applied with a cotton-tipped applicator twice daily to the upper forearm for 2 weeks to ensure that no reaction occurs before being used on affected sites. Alternatively, the patient can use a calcineurin inhibitor (eg, tacrolimus or pimecrolimus) or crisaborole, provided that the patient is not allergic to anything in these products.

Hair Dye

Another problematic product category is hair dye because a significant number of patients who are allergic to *para*-phenylenediamine (PPD) will cross-react with methylated PPD and/or *para*-toluenediamine and its derivatives.[7] Therefore, CAMP lists almost no safe alternative hair dye products. Individuals allergic to PPD who would like to continue to use hair dye should be tested to a full hair dye series. Regardless of which hair dye–related substances the patient is allergic to, a safe alternative can usually be identified. Water Works Permanent Powder Hair Color contains PPD but does not contain fragrance or any other ACDS core allergens. Alternatively, if a patient is allergic to PPD, L'Oreal Inoa is PPD-free and fragrance-free but contains *para*-toluenediamine sulfate. For *para*-toluenediamine sulfate–allergic patients, it is possible to use Light Mountain Natural Hair dye, which only contains the following 3 ingredients: henna, senna, and indigo. However, this product requires a much longer application time (average 1.5 hours) and will not work for blonde shades. Patients allergic to PPD should also avoid black henna temporary tattoos.

Chlorhexidine in Surgery

Chlorhexidine is an antiseptic cleanser used for presurgical scrubbing. Povidone or ethanol-based scrub products are suitable alternatives.

Methylisothiazolinone/Methylchloroisothiazolinone

Methylisothiazolinone (MI) and methylchloroisothiazolinone (MCI) have been added to a number of other types of products in addition to topical and household products. A recent study showed that 96% of 47 US residential interior wall paints contained MI.[8]

Airborne allergic contact dermatitis (ACD) to MI in paint has been described and reactions may be persistent. To prevent airborne ACD outbreaks to MI in paint, a retrospective study found that a median delay of 5.5 weeks was necessary for a sensitized patient to be able to enter a freshly painted room without developing an allergic rash.[9]

Nail Products

Several core allergens are specific only to nail products. Specifically, tosylamide/formaldehyde resin is found in standard nail polish. There are excellent alternatives in CAMP, which use substitute resins. Ethyl cyanoacrylate is in most nail glues. Unfortunately, there is no suitable alternative nail glue for individuals allergic to ethyl cyanoacrylate. Individuals allergic to methyl methacrylate and/or 2-hydroxyethyl methacrylate must avoid no-chip, acrylic, gel, and dip nail products but can use most standard nail polishes as an alternative. Acrylates, methacrylates, and cyanoacrylates found in adhesives and dental adhesives are discussed in a later section of this article.

Oral Allergens

Some of the allergens found in topical products are also found in products which are ingested. These allergens can cause oral mucosal contact allergy or can induce systemic contact allergy. Balsam of Peru is highly associated with oral mucosa contact allergy. Some patients with confirmed contact allergy to Balsam of Peru, cinnamic aldehyde, or fragrance mix I or II may respond to balsam-restricted diets.[10] Diets have been published to avoid benzoic acid/sodium benzoate, propylene glycol, and sorbic acid in foods.[11] Foods to be avoided in suspected systemic contact allergy to formaldehyde (ie, aspartame sweeteners)[12] and Compositae plants (ie, bay leaf, sunflower seeds, lettuce, chamomile tea, endive, chicory, and artichoke) have also been reviewed.[13,14] For individuals allergic to propolis, processed honey will likely be safe, whereas raw honey could contain propolis impurities. Oral medications related to ethylenediamine can also trigger systemic contact allergy, and these have also been listed elsewhere.[15]

Airborne and Garden Allergens

Many Compositae extracts (feverfew, chamomile, burdock, bisabolol, etc) are used in topical products. However, persons allergic to Compositae mix, sesquiterpene lactone mix, or lavender will also need to be aware of possible outdoor exposure to these allergens, which will be discussed in a later section of this article on airborne contact allergy.

Formaldehyde

Formaldehyde is found in a number of settings including topical products. One particular formaldehyde exposure is its use in cloth-lined paper products that are made of a cotton and paper blend. It is probably safest for persons allergic to formaldehyde to avoid all fabric softener sheets because even those that are listed as safe in CAMP may have unlisted formaldehyde present in the actual fabric. These patients are best served by choosing a liquid fabric softener from their CAMP safe list. Formaldehyde-allergic individuals should avoid wipes (used for babies, hands, dusting, or as antimicrobial wipes) or wear gloves when handling these products. They should also choose inexpensive plain paper towels. Formaldehyde textile resins will be discussed in a later section of this article.

In addition, recent data suggest that formaldehyde can sometimes be found in topical products which do not list formaldehyde or related chemicals on the product ingredient list.[16] Allergen avoidance due to this issue is very difficult.

Benzalkonium Chloride

Benzalkonium chloride is also found in most antimicrobial wipes but may be listed as alkyl dimethyl benzyl ammonium chloride. Persons allergic to benzalkonium chloride should avoid antimicrobial wet wipes or wear gloves when handling them. Benzalkonium chloride is also used as a preservative in most prescription eye drops. Safe alternative eye drops are listed in the CAMP.

Colophony

Colophony (rosin) is a ubiquitous allergen. It is used in adhesives and shoes, which will be discussed in upcoming sections of this article. Protective gloves should be worn for any household repair projects because many household products contain rosin (ie, adhesives, caulk, polishes, paint, varnish, etc). Plastic grocery bags are the best option because rosin is found in some recycled paper. Synthetic violin rosin is available for violinists (Super Sensitive Clarity Spectrum Hypoallergenic Violin/Viola Rosin). Talc can be used in place of baseball and bowling rosin.

METALS

Nickel

Metals are a significant cause of ACD, especially nickel. The North American Contact Dermatitis Group reports that nickel is the most common allergen identified (20%) in both adults and children referred for patch testing.[17,18] Nickel is widely used because of its durability and relative affordability. Because of this, nickel has become a ubiquitous compound and, as expected, may be difficult to avoid. Although nickel is prevalent in a plethora of items, not all nickel-containing items result in nickel ACD (Ni-ACD). Nickel release rate, rather than nickel contact, is a more specific measure for Ni-ACD potential. Unlike the United States, the European Union regulates nickel items and states that items that have prolonged contact with the skin should not have a nickel release rate greater than 0.5 $\mu g/cm^2$ per week, and piercing items should not surpass 0.2 $\mu g/cm^2$.[19,20]

There is no cure for Ni-ACD; however, specific measures (ie, detection, barrier therapy, chelation therapy, and avoidance) can be implemented to prevent Ni-ACD. Products such as the nickel spot test, nickel alert, chemo nickel test, and reveal-and-conceal nickel spots test kit are visual detection tests that allow users to identify nickel-containing substances (Table 2).[21] In addition to avoidance, barrier and chelation therapy may be used for protection against nickel contact. Barrier therapy is a 2-fold strategy, consisting of either coating nickel-containing products or applying a barrier cream to the epidermal surface. Of these 2 approaches, coating nickel-containing objects has been more clearly documented to be effective. Clear "nail polish type" paint is 1 example of a product that may be used to coat objects.[22] Another approach has been to coat objects with Krylon Clear acrylic paint.[23] In addition, a jeweler can coat nickel-containing jewelry with a layer of rhodium or platinum. Chelation therapy involves applying creams to the skin that prevent nickel diffusion into the epidermis, therefore preventing an inflammatory response.[21] Chelating creams include Nik-L-Blok (Chemotechnique, Vellinge, Sweden) and Protective Cream HPS (Skintifique, Paris, France) (Table 3).

The mainstay of Ni-ACD treatment is allergen avoidance. It is imperative to understand the types of products that may contain nickel and to find nickel-free alternatives. Many products, including

TABLE 2. Nickel "Spot Test" Kits

Website	Size	Price	Link
*Etsy	10 mL	$10.24	https://www.etsy.com/listing/541231831/nickel-spot-test-testing-kit-tester?ga order=most relevant&ga search type=all&ga view type=gallery&ga search query=nickel%20spot%20kit&ref=sr gallery-1-1&organix search click=1 (or search nickel spot kit on Etsy)
Delasco	0.5 oz	$19.00	https://www.delasco.com/pcat/1/Chemicals/Spot Test for Nickel Kit/dlmin009?/
NoNickel.com	0.23 oz	$24.95	https://nonikel.com/products/nickel-alert-nickel-test-kit
Smart Practice	10 swabs	$19.99	http://www.smartpractice.com/Apps/WebObjects/SmartPractice.woa/wa/style?id=DMAL8003&m=|SPA

*Likely best value.

TABLE 3. Nickel and Cobalt Barrier Creams

	Ingredients	Size	Price
*Nik-L-Blok http://www.skincareforall.com/us/SPTDetail.aspx?ProductId=NBC% 20&Pname=%20NIK-L-BLOK	Active: Diethylenetriaminepentaacetic acid (DTPA 7.5%) Inactive: Brij 72, Brij 721, cetostearyl alcohol, chitosan, glycerol, light liquid paraffin, methylparaben, propylparaben, sodium hydroxide, tinogard TT, water.	2.5 oz	$24.95
Skintifique Protective Cream HPS https://www.skintifique.me/en/protective-cream-hps-12.html	Water, calcium carbonate, isononyl isononanoate, *Ricinus communis* (castor) seed oil, cetearyl alcohol, glycerin, 1,2-hexanediol, bisabolol, ceteareth-20, carbomer, chlorphenesin, tocopheryl acetate.	0.67 oz	$23.99

**Likely best value.*

belts, cell phones, and hair accessories, can be spot tested. Furthermore, consumers should aim to find products created with alloys (ie, brass), pewter, stainless steel, platinum, yellow gold, sterling silver, or pure copper.[24] Although nickel-sensitive individuals usually tolerate contact to stainless steel, conditions such as high heat (ie, nickel leaching into food when cooking with stainless steel pots), prolonged contact, and sweat may allow increased nickel release.[22,25] In addition, individuals should beware of inexpensive metal posts on earrings. With regard to nickel release from watches, avoidance strategies such as moleskin, cotton, or duct tape application on the watch backing can prevent nickel diffusion into the skin. Lastly, nickel-releasing watch buckles can be replaced (with brass) or coated (with rhodium) to prevent contact and potential nickel release. Nickel-free products including safe jewelry alternatives are listed in Table 4. Other alternatives and avoidance strategies include plastic eyeglass frames or plastic clothing buttons. However, even items labeled as "nickel-free" should be spot tested to prevent unnecessary exposure. Other nickel-releasing items, such as keys, are also potential sources of nickel exposure. Brass keys are an acceptable alternative, and electroplated keys also work as long as contact with the cut "teeth" of the key is avoided, because the exposed teeth may not have the electroplated coating.

In addition to products that release high rates of nickel, there are foods with notoriously high levels of nickel (Table 5) that may contribute to the development and elicitation of systemic Ni-ACD. Jensen et al[26] reported that of patients sensitized to nickel up to 10% demonstrate cutaneous reactions secondary to oral ingestion of nickel, and there are many reports of improved dermatitis after low-nickel diets.[26] The level of nickel required to elicit dermatitis is unknown and likely varies from patient to patient. Lastly, patients should be informed that stainless pots/pans and tap water may contribute to increased dietary nickel.[27]

Cobalt

Cobalt is a common metal that is found in a wide range of sources. Products that commonly contain cobalt include leather, jewelry, children's toys, and orthopedic and implanted devices. In addition, foods with high levels of cyanocobalamin (vitamin B_{12}) may trigger flares in exquisitely sensitized persons (ie, meat, dairy, apricots, beans, beer, and chocolate). Objects plated with nickel are noted to be the most common source of cobalt. "Antiqued" costume jewelry is often made of a zinc and cobalt alloy. Rarely, topical cosmetics and medications may contain cobalt. Specific "spot tests" have been developed to identify sources of cobalt metal ion release. Coating objects that contain cobalt with a clear acrylic spray may possibly provide a barrier against exposure.

Potassium Dichromate

Potassium dichromate is an indicator for allergy to hexavalent chromium. Exposure to chromates used when tanning leather (see following section on leather) and in Portland cement is a common source of exposure. Occupationally, metallurgical use accounts for more than 90% of chromate usage. Sensitized individuals should avoid direct skin contact with tanned leather and should not do cement work.

Gold

The relevance of positive patch test reactions to gold is often uncertain. Gold exposure may occur from direct exposure to jewelry or gold dental fillings. In addition, reactions to gold often occur at sites where jewelry is not worn because of passive transfer of gold from the hands. Individuals allergic to gold can have a jeweler plate their jewelry with platinum or rhodium. Gold dental fillings causing mucosal contact allergy can be removed and replaced with other dental filling materials.

METALS IN TOPICAL PRODUCTS

Green color cosmetics can contain chromates. Nickel, cobalt, gold, and chromium are also found in a few other types of topical and household products. Instructions on the use of CAMP can be found in the cosmetic section of this article.

METAL DENTAL ALLERGENS

Metals are frequently used in dentistry. For patients with metal allergy, a number of appropriate replacements may be found. Table 6 provides more information.

SHOES

There are a number of potential allergens found in shoes, which will be discussed individually in the following textile dye, leather, shoe

TABLE 4. Products With Nickel-Free Alternatives[4]

Product	Brands
Baby clothing (all snaps are nickel-free)	My O Baby, Sage Creek Organics, Carter's clothes, Dordor and Gorgor, Sofie + Me, Eco Print Works
Belt	Kee-Ka (wide variety), NickelFreeBelts, BELTISCOOL (wide variety), Ferrer (entirely metal-free), NoNickel (nickel-free certified by Athena allergy), Tim Taylor Belts & Buckles (buckles made of sterling silver), Pat Areias (buckles made of sterling silver), Vogt Silversmits (buckles made of sterling silver)
	RattlerStrap (Buckles made of titanium), RockBros (buckles made of titanium), Hot Buckles (customizable), NickelSmart (nickel-free certified by Athena allergy)
Cellphone (tested nickel-free)	iPhone 3, 4, 4s
	Motorola V950 Rugged Flip, Droid
	Blackberry Torch, Curve
Eyeglass frame	Numerous (plastic and titanium, plastic (resin) and titanium, cellulose acetate and titanium)
Make-up brush	Essence of beauty, Eco Tools
Bobby pin and hair clip	Poppy's (brass bobby pins), Hair Hardware, Goody Ouchless Flex Line, HMBdesigns (brass hair clips), Giddy Giddy (hair clips)
iPad case (polyurethane)	Smart Case, KHOMO
Jeans	Calvin Klein (nickel-free buttons), No Nickel branch (button and rivet pack), Levi's (nickel-free buttons), NickelSmart (button and rivet pack), Clean Jeans (nickel-free buttons), Sense Organics (trousers and shorts for 2–6 y)
Jewelry	Simple Whispers (surgical grade stainless steel, some further electroplated with 24K gold), Emitations, Zevaa (niobium), NoNickel (nickel-free certified by Athena allergy), Pugster (sterling silver, Murano glass), Titanium Kay, Blomdahl (medical grade titanium, plastic), Supreme Jewelry, West Coast Jewelry (stainless steel), Crucible, Palm Beach, ELYA (stainless steel), Jaclyn Smith, Attention, BONGO, Sabrina Silver (sterling silver), Prime Pristine, Sea of Diamonds, INPINK Fashion Jewelry, Marimor Jewelry, Palm Beach, Supreme Jewelry, Silver Limit, Brielle, Accessories Unltd, Numerous (sterling silver), Jennifer Rose, Bezel Box (nickel-free, lead-free), Exotic India Art
Razors	Panasonic close curves wet/dry shaver (electronic shaver), Schick (Quattro titanium blade disposable razor)
Tweezers	Artestile (tweezer and nail scissors), Topinox (Tweezer, nail clipper, stainless steel)
Eyelash curler	Rubis Switzerland (designer eyelash curler, stainless steel), Koji (eyelash curler with "anti-metal allergy layer to prevent irritation"), Maybelline (plastic eyelash curler), Japonesque (HD eyelash curler [plastic]), Artestile (eyelash curler)
Watch	Kmart, Skagen, Tense, Invecta, Lucien Piccard, Seiko, Time Teacher, Fossil (stainless steel), Numerous (Target: "nickel-free metal: accessories")
Orthodontic materials	Nexadental Bar CNA wire (orthodontic wire)
	Nexadental Turrin Orthodontic bracket (S/L no metal brackets)
	Nexadental Legacy M brackets and NexAlloy arch wires
	Invisalign (orthodontia)

adhesive, and rubber sections. Shoes free of various allergens are listed in Table 7. In general, patients with shoe allergy should wear only safe shoes until their feet have fully improved. They can then add their other shoes back into their wardrobe, 1 pair weekly. Any shoes that cause a flare-up should be avoided permanently. For rash limited to the soles, it is often possible to simply replace shoe insoles with a safe material or line the inside of the shoe with felt. Alternatives for rubber shoe insoles include ones made of polyurethane, plastic, leather, or cork. If the insole has been attached with glue, the old adhesive should be scraped out and the new insole installed with Elmer's Glue-All. Additional measures that can be implemented are consistent use of socks, avoiding sweating and prolonged exposures, and/or application of antiperspirants to the feet to limit sweat and resulting allergen diffusion potential. For leather allergy, any of the previously mentioned insole types (aside from leather) will be safe alternatives.

TEXTILES

Patients allergic to textile dyes and resins often present with dermatitis accentuated in areas of tight clothing and perspiration (eg, anterior/posterior axillary folds with sparing of the vault), waist, antecubital and popliteal fossae, and groin/medial thighs. However, these areas are also common sites for atopic dermatitis. Therefore, both textile

TABLE 5. Very High-Nickel Foods and Safer Alternatives

High-Nickel Foods: STOP	Lower-Nickel Alternatives: GO
Kale, spirulina	Broccoli, cabbage, cucumber, celery, and brussel sprouts
Tofu	Cheese curd (paneer)
Chocolate ice cream	Frozen kefir
Wheat germ; oat	Cornmeal, barley, and rye (in moderation)
Peanut butter	Coconut butter (in moderation)
Beans, soy	NA

Available at: https://www.torrinomedica.it/studio/alimenti/nichel/en/Nickel_Foods_Alphabetical.asp.

NA, not available.

allergy and atopic eczema (with reaction to commensal organisms) should be considered in patients with dermatitis in these areas.[28,29]

TEXTILE RESINS

Textile resins provide wrinkle resistance to fabrics such as cotton, linen, wool, and rayon. Dimethylol dihydroxyethyleneurea (Fixapret CPN) releases less free formaldehyde than older resins and screens for allergy to textile resins on the ACDS Core Allergen Series. Ethylene urea melamine formaldehyde is used for screening on some other standard testing series.

Formaldehyde-sensitized patients may react to fabrics containing free formaldehyde as a result of being treated with formaldehyde-containing resins. Older textile resins that release high amounts of free formaldehyde are rarely used for apparel fabrics today. However, they may still be present in very stiff fabrics such as upholstery and draperies. Patients reacting to upholstery finish will have dermatitis in exposed areas such as the extensor forearm and posterior legs, rather than the classic textile clothing pattern. For automobile upholstery, some protection can be achieved by providing a barrier, such as a folding seat cushion covered with synthetic materials and/or wearing long sleeves and pants when driving.

Older textile resins may also be found in other settings; melamine formaldehyde resin is used in composite dental molds, and urea formaldehyde resin is used in fiberboard. These types of exposure could be relevant to occasional patients who react to this antigen but have hand dermatitis rather than a typical textile allergy pattern.[30]

Urea and melamine formaldehyde may also be used to bind pigments to fibers on 1 side of fabrics such as polypropylene (Olefin).[31] Patients can be advised to avoid sheets with pattern on only 1 side. In addition, urea formaldehyde and melamine formaldehyde may be used to bind fibers together in nonwoven textiles such as surgical masks.[32]

Textile resin dermatitis from apparel is rarely reported now, because contemporary garments are no longer commonly finished with resins that release sensitizing levels of formaldehyde resin. However, patients allergic to these resins should avoid vintage clothing containing cotton and rayon. Patients allergic to textile finishes are best advised to use fabrics that are not finished (eg, 100% polyester, silk, acrylic, or nylon). Denim jeans are also not finished. Products that may be unfinished include 100% wool and linen that wrinkles easily. On the other hand, rayon is a modified cotton and is often highly finished, as are permanent press garments made of cotton/polyester blends. Uniforms made of shrink proof wool or twill may be heavily finished as well.

TEXTILE DYES

Textile dyes are the most common source of ACD to apparel. Disperse dyes are used to color polyester and other synthetic fabrics and blends; reactive dyes are used to color cotton or cotton blend fabrics.[33]

Disperse dyes are the most common allergenic textile dyes. Disperse orange 3 and a mixture of disperse blues 106 and 124 are on the ACDS core allergen series. Patients with disperse dye allergy may also react to *p*-aminoazobenzene or PPD. These compounds and samples of dampened fabric from suspect garments should be included when testing with a disperse dye series.[34] One patient sensitized to PPD in a temporary black henna tattoo later reacted to cross-reacting clothing dyes.[35]

Disperse dyes are released from synthetic fabrics such as polyester, acrylic, acetate, and nylon. Disperse blue dyes are commonly found in black or navy blue acetate liners of dress clothing or in

TABLE 6. Dental Materials

Procedure (Metal Based)	Material	Products (Brands)
Crowns and bridges	Nickel, chromium, aluminum, molybdenum	4all- Williams
	Cobalt, chromium, molybdenum	Wirobond C (Bergo)
	Titanium alloy (nickel, chromium, and cobalt-free)	Titanium (Girrbach)
	Gold, palladium, silver, zinc	Aurolite CB (Aurium)
Dentures	Resin (acrylate and metal-free)	Valplast Resin
Orthodontic wires (braces)	Titanium (nickel-free)	Nexalloy Archwires
	Titanium, molybdenum, zirconium, tin (nickel-free)	Nexadental Bar CNA Wire
Orthodontic brackets (braces)	Iron and chrome cobalt (nickel-free)	Nexalloy Legacy M Brackets
	Ceramic and hybrid composite	Nexadental
Braces alternative	Polyurethane (metal-free)	Invisalign

TABLE 7. Shoe Allergens

	Brand	L	Chrom	Co	PTBFR	Coloph	TM	Carba	Benza	TU	BR
Boot	**Wesco Boots**	Yes	No	No	No	No	No	No	No	No	No
	Multnomah Leather Shop	Yes	No	No	No	No	No	No	No	No	No
	Loveless Shoes	Yes	No	No	No	No	No	No	No	No	No
Sandal	**Crocs** (Plastic co-polymer)	No	No	No	No	No	No	No	No	No	No
	Birkenstock (Cork foot, EVA sole, Birkibuc)	No	No	No	No	No	No	No	No	No	No
	Juju Footwear (Plastic)	No	No	No	No	No	No	No	No	No	No
	Jellies (Plastic)	No	No	No	No	No	No	No	No	No	No
Casual	**Beyond Skin** (Vegan and wide variety)	No	No	No	?	?	No	No	No	No	No
	TOMS (canvas upper)	No	No	No	No	Yes	PO	PO	PO	PO	PO
	SeaVees (Canvas upper, cotton insole.)	No	No	No	?	?	?	?	?	?	?
Gym	**All-birds** (wool, recycled plastic bottles, and recycled cardboard)	No	No	No	No	?	No	No	No	No	No
	Saucony * (see comment below)	No (unless leather upper)	No (unless leather upper)	No (unless leather upper)	No	No	PO	PO	PO	PO	PO
Work	**Servus Injection Molded Footwear** (PVC with steel toe protection)	No	No	No	No	No	No	No	No	No	No

Abbreviations: ?, information on this allergen was omitted by the manufacturer; B, benzothiazoles; BR, black rubber; Carba, carbamates; Chrom, chromates; Co, cobalt; Coloph, colophony; EVA, ethyl vinyl acetate; L, leather; PO, probably OK; PTBFR, para-tert-butylphenolformaldehyde resin; PU, polyurethane; TM, thiurams; TU, thioureas.

Contact and extra info about shoe brands:

Wesco Boots–*Custom Leather Boots can be made vegetable tanned and hand nailed. 52828 NW Shoe Factory Lane, PO Box 607 Scappoose, OR 97056. Toll Free: 800-326-2711 (US and Canada only), Ext 200; Tel: 503-543-7114, Ext 200; Fax: 503-543-7110.*

Multnomah Leather Shop–*Custom boots and clogs: vegetable tanned, no glue. Nob Hill Shoe Repair, 511 NW 21st St, Portland, OR 97209. Tel: (503)227-4887, email: mark@multnomahleather.com.*

Loveless Shoes–*Custom boots: vegetable tanned. 4400 SW 21st St, Oklahoma City, OK 73108. Tel: 405-631-9731, Fax: 405-634-9717, email: contact@lovelessboots.com.*

Servus Injection Molded Footwear*, email: https://www.honeywellsafety.com/Products/Footwear/PRO%C2%AE_PVC_Footwear.aspx?site=/usa.*

****Saucony–****Must look at the description of the shoe to determine if it is safe to use. It is recommended to pick a shoe with an EVA or PU Midsole.*

dark-colored polyester velour. Compared with acetate, acrylic, and polyester, disperse dyes are more color-fast on nylon, but nylon stockings can occasionally be the culprit in dermatitis of the posteromedial thighs in women sensitized to disperse dyes. Disperse dyes sensitivity can sometimes present as pigmented purpura.[36–38]

As with textile resin allergy, there is no product labeling of the dyes used in the United States. There is poor correlation between positive patch tests to disperse dyes and presence of those dyes in the garments that patients suspect as the cause of their symptoms.[39] Patients allergic to disperse dyes should avoid colored polyester, nylon, acrylic, and acetate fabrics, including blends of fabrics with these fibers with cotton. For synthetic fabrics, white is the safest choice for these patients. Dark synthetic liners can be removed from dress clothing and replaced with white liners. One hundred percent cotton, rayon, Tencel (Lyocell), silk, linen, denim, or wool of any color is also an alternative choice. Dyes are water soluble, and washing clothing before use may be of some benefit in removing dye.[40] Reactive dyes are more color-fast than disperse dyes and therefore rarely cause contact allergy.[33]

Oeko-Tex Labeling

In Europe, fabrics certified by Oeko-Tex are not dyed with disperse blues 1, 3, 7, 26, 35, 102, 106, and/or 124; disperse brown 1; disperse yellows 1, 3, 9, 39, and 49; disperse orange 1, 3, 37, 59, and 76; and disperse reds 1, 11, and 17.[41]

This labeling also signifies minimal formaldehyde release.[41] Fabrics certified by Oeko-Tex should be safe for patients with textile dye or finish allergies. In the United States, 1 way to locate bedding and clothing with this certification is by searching Amazon for "Oeko-Tex."

LEATHER

Chromate, cobalt, and formaldehyde are allergens in leather that may cause dermatitis from contact with leather furniture,[42] clothes, belts, purses, and briefcases. These allergens in leather are discussed in the previous section on metals, and avoidance of contact with leather is recommended for allergic patients. Leather shoe and boot alternatives are listed in Table 7.

ADHESIVES

For patients with suspected ACD to adhesives, a number of allergens must be considered. The North American Contact Dermatitis Group standard tray contains several screening allergens for adhesive allergy, including colophony, epoxy resin, ethyl acrylate, methyl methacrylate, multiple rubber allergens, and *para*-tertiary-butylphenol formaldehyde resin. Other allergens to consider include cyanoacrylates and other acrylates and methacrylates. In addition, mass spectrometry analysis of 38 consumer adhesives showed that 44.7% contained MI and 31.6% contained MCI.[43] Methylisothiazolinone is an emerging problem in glues used by school children, including those used in "slime making."

Unfortunately, a number of challenges exist when recommending alternate adhesives. For household adhesives, many of the products on store shelves do not list ingredients. This information may be found on manufacturers' websites or from the household product database, available online at the US National Library of Medicine

TABLE 8. General Household Adhesives*

Material to Be Glued	Glue Types	Products
Ceramics	Acrylate	Elmer's Craft Bond Ceramic and Glass Cement
	Epoxy	Elmer's Fiberglass Repair System
	Cyanoacrylate	Krazy Glue-quick setting
	Synthetic rubber	Elmer's Professional Contact Cement
		Elmer's Heavy Duty Grip Cement
	Polyurethane	Gorilla Glue
Fabric	Polyvinyl acetate based (PVAC)	Elmer's Glue-All–all-purpose white glue
	Rubber based	Elmer's Craft Bond Rubber Cement
	Polyurethane	Gorilla Glue
Glass	Cyanoacrylate	Krazy Glue-quick setting
	Polyurethane	Gorilla Glue
	Acrylate	Elmer's Craft Bond Ceramic and Glass Cement
	Epoxy	Elmer's Fiberglass Repair System
Metal	Cyanoacrylate	Krazy Glue-quick setting
	Epoxy	Loctite Quick-Set Epoxy
	Synthetic rubber	Elmer's Professional Contact Cement
		Elmer's Heavy Duty Grip Cement
Organic	Acrylate	Elmer's Craft Bond Ceramic and Glass Cement
	Cyanoacrylate	Krazy Glue-quick setting
	Polyurethane	Gorilla Glue
	Rubber based	Elmer's Craft Bond acid-free spray
	Epoxy	Loctite Quick-Set Epoxy
Paper	Polyvinyl acetate based (PVAC)	Elmer's Glue-All–all-purpose white glue
	Acrylate	Elmer's Craft Bond Ceramic and Glass Cement
	Polyurethane	Gorilla Glue
	Rubber based	Elmer's Craft Bond acid-free spray
	Cyanoacrylate	Krazy Glue–quick setting
Plastic	Polyvinyl acetate based (PVAC)	Elmer's Glue-All–all-purpose white glue
	Synthetic rubber	Elmer's Professional Contact Cement
	Cyanoacrylate	Krazy Glue-quick setting
	Epoxy	Loctite Quick-Set Epoxy
	Rubber based	Elmer's Craft Bond acid-free spray
	Polyvinyl acetate based (PVAC)	Elmer's Glue-All–all-purpose white glue
Wood	Synthetic rubber	Elmer's Professional Contact Cement
		Elmer's Heavy Duty Grip Cement
	Polyvinyl acetate based (PVAC)	Elmer's Glue-All–all-purpose white glue
	Epoxy	Elmer's Wood Repair
		Elmer's Superfast Epoxy Cement

**Choose glue type to which patient is not allergic.*

(https://householdproducts.nlm.nih.gov/). Patients must always be cautioned that some product ingredient lists will only include information from material safety data sheets (MSDSs). These may be of limited utility for contact allergy, because most allergens are not listed as hazardous ingredients.

Table 8 provides an overview of household adhesives, categorized by function. Likely safe alternatives can be selected for various purposes using this table.

Bandage Adhesives

In the category of medical products, adhesives may be used in bandages, in adhesive tapes, and in wound dressings. These may use allergens such as colophony or rubber additives. Unfortunately, the ingredient composition of medical adhesives is not required on labels and can be difficult to determine.

Table 9 lists medical bandage and tape alternatives for allergic patients. Potential alternatives for rubber allergy include bandages or adhesive tapes that contain acrylate copolymers. Although these don't often cross-react with acrylate and methacrylate monomers and are unlikely to trigger contact allergy, newer bandages with silicone-based adhesives are probably a safer choice. For routine wound care, to use medical tape to bandage a wound, a nonstick dressing (such as Telfa) can be cut to the desired size, placed over the wound, and taped over.

Nail Product Adhesives

To achieve longer nails or longer-lasting polishes, various types of nail products have been developed. Almost all of these products use acrylates and methacrylates and should be avoided by patients allergic to these compounds.

Acrylic nails use liquid mixed with acrylic powder that is applied to the nail plate, sculpted to the desired shape, and allowed to dry.

UV-gel nails also use acrylates/methacrylates. They are usually done in the salon (there are now a few home gel units), and a UV light is used for activation of the polish.

Dip powder requires a base coat (bond) to be applied; then, each nail is dipped into an acrylic powder. An activating liquid is then applied to dry and harden the powder.

No-light gels are gel ("no-chip") nail polishes that can be done at home. Most of these products contain 2-hydroxyethyl methacrylate and other acrylates/methacrylates. These products do not require activation by light.

Because acrylates and methacrylates commonly cross-react, patients allergic to either should avoid all of the above types of nail products and instead use standard nail polishes listed on their CAMP safe list.

Preformed nails are pieces of preformed plastic that are applied to the nail using an adhesive glue. Tips are shorter pieces of plastic that can be glued to the end of the nails, to achieve longer length. Wraps are pieces of silk, linen, or fiberglass that are cut to a desired shape and glued to the nail plate. Various types of plastics are used in these types of products. There are also dip nail products using cyanoacrylate as a base coat. If patients are patch test negative to ethyl cyanoacrylate, they can use preformed nails attached with cyanoacrylate adhesive, as long as they are free of acrylates and methacrylates.

Eyelash Adhesives

False eyelashes may be purchased individually, in clusters, or as full strips that may be applied to the base of the eyelid (where the roots of the eyelashes are) with a temporary adhesive. Eyelash extensions require professional application of false lashes onto natural lashes individually, with semipermanent adhesive. Eyelash adhesives may contain latex rubber, cyanoacrylate, or other acrylates (Table 10).

TABLE 9. Bandage Adhesives*

Adhesive Type	Brand (Product ID)	Product
Acrylic	Mactac (MD2122)	Double Coated Polyester Tape
	Mactac (TM8500)	Medical Double Coated Polyester Film Tape
	3M	Micropore Tape (acrylate copolymers), Single Sided Medical Foam Tape, Tegaderm Waterproof Transparent Dressing
	Sait-Gobain (OP7)	Double Coated Urethane Foam Tape–high-performance optical tape
	Hypafix	Hypafix
Rubber	Mactac (TM1039)	Adhesive Transfer Tape
	3M	Medical Adhesive Transfer Tape–Hi-Tack Adhesive
	Mactac (TM8710A)	Medical Double Coated Polyester Film Tape
Silicone	3M	Spunlaced Polyester Nonwoven Fabric Medical Tape
	Pderm (PS-1829)	High Adhesion Silicone Gel Adhesive Coated Polyurethane Film
	Vancive MED (5500SI)	Medical Single Coated Duolaminate Polyurethane Film Tape with Soft Silicone Adhesive
	3M	Kind Removal Silicone Tape
	Curad	Truly Ouchless Flexible Fabric Bandages

Choose adhesive type to which patient is not allergic.

TABLE 10. Eyelash Adhesives*

Type of Eyelash Product	Adhesive Type	Product
False eyelashes	Rubber (latex)	Duo Eyelash Adhesive (Black or White)
	Cyanoacrylate	Novalash (Sensitive Eyes Lash Adhesive)
	Methacrylate/acrylate	House of Lashes (Lash Adhesive)
		Velour Lashes (Lash Adhesive)
		Duo (Brush-On Striplash Adhesive)
Eyelash extensions	Cyanoacrylate	Lash Professional (Lash Adhesive-Sensitive)
Alternative approaches to lengthen eyelashes		Bimatoprost ophthalmic soln. 0.03% (Latisse)

**Choose adhesive type to which patient is not allergic.*

Alternatives include topical growth products, such as bimatoprost, which can be applied to the lash-line daily until a desired length is accomplished.

Electrocardiogram Electrode Adhesives

Patients may also react to adhesives used to tape on the electrodes during an electrocardiogram (ECG). Table 11 shows alternative ECG electrodes for allergic patients.

Dental Adhesives

For patients allergic to acrylates, epoxies, and metals, finding safe dental products may be challenging. It is important that patients discuss these allergies with their dentist. Acrylate and methacrylate allergy in particular must be reviewed, because modern dentistry makes frequent use of these materials. Although some materials may be considered appropriate from an allergy standpoint, multiple other issues, including function and durability, must be considered. In some cases, patients may need to consult a prosthodontist. These dental specialists are trained in formulating replacements for structures of the oral cavity.

For patients with acrylate allergies, a number of factors must be taken into account when planning dental procedures. Acrylates are chemical monomers that can cross-link to form "plastic" substances. The monomers may be in the form of a powder, liquid, or gel that is easily manipulated. For example, monomers can be poured into a cavity, such as a dental filling, or applied between objects, as in dental cements. The mixture can then be hardened in a process known as curing. During this process, the monomers undergo polymerization. Some acrylates are "self-curing" and polymerization will occur after the addition of a catalyst. In other cases, curing is initiated by a UV light, heat, or the absence of oxygen. The lower-molecular-weight monomers serve as allergens; once full polymerization occurs, the object is no longer allergenic. Unfortunately, studies have indicated that residual monomers may persist after curing, with the highest levels noted after self-cured acrylates. Self-cured acrylates are often used in temporary crowns and denture repair.

TABLE 11. ECG Electrode Adhesives*

Adhesive Type	Product
Acrylic	Electrically Conductive Cushioning Gasket Tape (3M)
	Vermed SofTouch ECG Electrode
Silicone	XYZ-axis Electrically Conductive Transfer Tape (3M)
Rubber	High Permeability Magnetic Shielding Sheet (3M 1380)

**Choose adhesive type to which patient is not allergic.*

For patients allergic to acrylates and epoxies, the main concerns are with materials used in dental cements or in dental restorations. Dental restorations are used to replace missing or damaged tooth structures. This includes fillings, as well as permanent restorations such as crowns and bridges. Removable restorations, such as dentures, may also be an issue.

Temporary restorations are of particular concern. Temporary crowns, which are often left in place for weeks before the permanent crown is available, are a concerning source of allergenic unpolymerized acrylate monomers. The use of temporary crowns in allergic patients has resulted in severe symptoms.[44]

Because acrylate monomers may cross-react, switching from 1 monomer to another may not be sufficient. In addition, information in the MSDS may not be reliable. One study evaluated acrylates in commercial dental restoration materials using gas chromatography. Results indicated that the MSDS provided accurate information on the methacrylates present in these commercial materials for approximately only half of the products.[45]

Table 12 provides information on dental alternatives for acrylate allergy, including for fillings, crowns, veneers, and dentures. Acrylates are frequently used in "white" or "plastic" fillings. These are made of composite resins. Composites consist of hard filler particles, which are surrounded by a matrix that acts to bind the filler particles together. Dental composite fillings contain an inorganic "filler" such as quartz or silica to provide strength, surrounded by a resin material that acts as a "binder." The first dental composites consisted of silica powder with a methacrylate monomer system and many commercial dental composites today still make use of methacrylate monomer derivatives. Although residual monomers have been demonstrated in composite resin fillings,[46,47] newer formulations may result in fewer residual monomers.[48] For patients allergic to acrylates or epoxies, amalgam fillings are a potential alternative. Dental amalgams include mercury and an alloy

TABLE 12. Dental Adhesives: Acrylate-Free Alternatives*

Procedure	Material	Products (Brands)
Permanent luting (dental cement)	Zinc phosphate	Tenacin (Caulk), Fleck's (Mizzy)
	Glass ionomer	Fuji (GC), Ketac-Cem (ESPE)
	Resin (amine-peroxide) modified ionomer	Advance (Caulk), Vitremer Luting (3 M)
	Resin (BISGMA or urethane acrylate) cement	Panavia 21 (J. Morita), Clearfil CR Inlay (J.Morita)
Temporary luting (dental cement)	Zinc oxide-eugenol, colophony (Temp-Bond)†	Temp-bond (Kerr), Fynal (Caulk)
	Zinc oxide EBA (ethoxy benzioc acid)	Generic
	2-HEMA, colophony	Rely-X
Thermal-insulating base (cavity repair)	Zinc oxide-eugenol, colophony (Temp-bond)	Temp-bond (Kerr), Fynal (Caulk)
	Zinc oxyphosphate	Zinc Cement (Mission White), Fleck's Cement (Mizzy)
Cavity liners and bases	Glass ionomer	Fuji (GC), Ketac-Cem (ESPE)
	Resin (amine-peroxide) modified ionomer	Advance (Caulk), Vitremer Luting (3 M)
	Zinc oxide-eugenol, colophony (Temp-bond)	Temp-bond (Kerr), Fynal (Caulk)
Veneers	Resin (BISGMA or urethane acrylate) cement	Panavia 21 (J. Morita), Clearfil CR Inlay (J.Morita)
	Resin (methacrylate) cement	Resinomer (Bisco), Enforce (Dentsply)
	Zinc phosphate	Tenacin (Caulk), Fleck's (Mizzy)
Root canal sealants	Zinc oxide-eugenol, colophony (Temp-bond)	Temp-bond (Kerr), Fynal (Caulk)

*Choose material to which patient is not allergic.

†Temp-bond and Rely-X–available with eugenol-free (NE) versions.

powder, usually composed of silver, zinc, tin, copper, or palladium. Other possible alternative metal fillings include nickel, cobalt chrome alloy, and gold. Porcelain fillings may also be used in some settings, but because they are hard and brittle, they are not recommended for certain teeth.

For crowns, which are permanent dental restorations, alternate materials include porcelain or metals, cemented in place with an appropriate material. In the case of veneers, which are shells affixed to the tooth to improve appearance, porcelain may be used instead of composite resins. Because these need to be bonded in place, appropriate bonding materials should be used.

Shoe Adhesives

Colophony derivatives may be found in shoe adhesives. One common use is a tackifier in the rubber cements that are used for attaching the sole or for attaching layers below the insole. *para*-Tertiary-butylphenol formaldehyde resin is often used to adhere leather parts in shoes. Rubber-based adhesives are also common in shoes. Shoe alternatives are shown in Table 7.

Rubber Allergy and Accelerators

Rubber products are commonplace, both in personal lives and in the workplace. Rubber (polyisoprene) can be naturally derived in the form of latex from the rubber tree, *Hevea brasiliensis*, or it can be made synthetically. Whereas *H. brasiliensis* is the main source of rubber latex, other potential natural sources include the *Parthenium argentatum* shrub (known as guayule rubber) and the Russian dandelion (*Taraxacum koksaghyz*).[49] Both natural and synthetic polyisoprenes are resistant to damage and tearing, have good elasticity and flexibility, and are waterproof. Synthetic polyisoprenes have better weather resistance and relatively less odor compared with natural latex; however, natural rubber has slightly better strength and resiliency.[50] Common sources of latex include gloves, balloons, condoms, diaphragms, bandages, carpeting, resistance bands, pacifiers, baby bottles, tourniquets, erasers, and rubber bands.

Other synthetic rubbers include nitrile (acrylonitrile-butadiene) and neoprene (polychloroprene). Nitrile is favored at times because it overall performs comparably to natural rubber latex but is more chemically resistant and highly puncture resistant (3–5 times more than latex).[51] Common sources of nitrile include footwear, adhesives, sealants, hoses, belts, gloves, floor mats, and synthetic leather. Neoprene is a synthetic rubber, which is favored because of its soft texture, cushioning properties, and resistance to degradation and burning. It can also be made into a foam, which is waterproof and insulating. Thus, it is commonly used for wetsuits and diving gloves. Other common sources of neoprene include laptop sleeves and tablet holders, mouse pads, foam weather strips, make-up applicators, car seats and covers, shoe insoles, adhesives, orthopedic braces, wrist supports, gloves, swimming goggles, and Continuous Positive Airway Pressure masks.[52]

Allergy to natural rubber can be either a type I (immediate) or type IV (delayed hypersensitivity) reaction. Approximately 1% of the general population has a type I sensitivity to latex, which are due to allergenic proteins (*Hev b* 1–15) in the natural latex itself.[53] Because of increasing rates of type I latex allergy among the general population, synthetic rubbers became increasingly used. This, however, resulted in an increase in type IV delayed hypersensitivity reactions.[54] These reactions are in large part due to rubber accelerators (thiurams, dithiocarbamates, mercaptobenzothiazoles, and diphenylguanidine). These accelerators become impregnated in the final rubber product but are not bound by chemical bonds and have limited compatibility with rubber itself, and thus these become free on the surface of rubber materials leading to sensitization.[55]

Rubber production includes the creation of chemical cross-links through the formation of covalent bonds with sulfur between the rubber chains to produce ideal mechanical and physical properties; this process is known as vulcanization. Rubber accelerators are used to speed up this vulcanization process, and typically, more than 1 accelerator is used in production to optimize vulcanization.[55] There are several families of accelerators represented on the ACDS core series, which are classified according to the speed at which they facilitate vulcanization. Fast accelerators include thiurams (thiuram mix) and dithiocarbamates (carba mix). Moderately fast accelerators include 1,3-diphenylguanidine (which is not a carbamate but is part of carba mix) and benzothiazoles (mercaptobenzothiazole and mercapto mix). Slow accelerators include thioureas (mixed dialkyl thioureas).[52,55]

In gloves, thiurams were traditionally the primary accelerant used and also a major source of sensitization. Given this, there has been a shift away from using this accelerator, and instead, use of dithiocarbamates and diphenylguanidine. In neoprene, it is the thioureas that are the most frequent sensitizer.[52] Other potential type IV sensitizers in rubber include rubber antioxidants, which are added to inhibit rubber degeneration by ozone (black rubber PPD mix).

Table 13 lists medical examination, surgical, household, and industrial gloves that are latex-free and free of all of the rubber accelerators and black rubber mix antioxidants found on the ACDS core series. Table 14 lists other consumer items, which are also free of these substances. Table 7 lists shoes and other footwear free of specific rubber-related substances.

Rubber in Sports Protective Equipment

Table 14 shows safe athletic equipment alternatives for those with rubber accelerator allergies. For some common sports, such as hockey and football, we were unable to confirm safe alternative equipment products. However, prosthetics and orthotics makers can apply a polyurethane foam to protective equipment that will establish a barrier between the allergen(s) and the skin. The application of a foam will require the use of an adhesive, so it is important to ensure that the orthotics provider does not use a rubber-based adhesive. Although insurance will likely not cover these services, 1 orthotic company estimated that applying polyurethane foam to a piece of protective equipment would likely cost less than US $100. Nonetheless, prices may fluctuate by region or by sport. Another possible approach is to have a tailor line equipment with Gore-Tex

TABLE 13. Accelerator-free Gloves (Free of Thiurams, Carbamates, Benzothiazoles, Thioureas, Diphenylguanidine, Latex Protein)

Company	Ordering	Website	Product
Medical examination gloves			
Ansell Healthcare LLC	1-855-868-5540	http://www.ansell.com	Microflex Sensation Nitrile Exam, Micro-Touch NitraFree Nitrile Exam
Cardinal Health	1-800-964-5227	http://www.cardinalhealth.com	Low Dermatitis Potential Nitrile Exam
Dynarex Corporation	1-888-396-2739	http://www.dynarex.com	Tillotson True Advantage Nitrile Exam Gloves
Hourglass International, Inc	1-800-277-0994	http://www.hourglass-intl.com	HandPRO FreeStyle1100 Nitrile Exam
Sempermed USA, Inc	1-800-366-9545	http://www.sempermedusa.com	SemperSure Nitrile Exam
SmartPractice	1-800-365-6868	http://www.smartpractice.com	Reflection Sapphire Sensitive Nitrile PF Violet Blue
Surgical gloves			
Ansell Healthcare LLC	1-855-868-5540	http://www.ansell.com	GAMMEX Non-Latex Polyisoprene Surgical Glove, GAMMEX Non-Latex Sensitive Synthetic Sensoprene Surgical Glove
Medline Industries, Inc	1-800-633-5463	http://www.medline.com	DermAssure Green Powder-Free Neoprene Surgical Glove
Mölnlycke Health Care US LLC	1-800-843-8497	http://www.molnlycke.com	Biogel NeoDerm Neoprene Surgical Glove

Company	Ordering	Website	Product	Purpose	Type
Household and industrial gloves					
Allerderm	1-800-365-6868	http://www.myskinallergy.com	Allerderm Heavy Duty Vinyl Gloves	Cleaning, dishes	Reusable
Showa Group	1-800-241-0323	http://www.showagroup.com	N-Dex 9500 PF Nitrile	Longer, thicker nitrile glove	Disposable
Showa Group	1-800-241-0323	http://www.showagroup.com	7712 PVC	Chemical protection (chemical list on Showa website)	Reusable
Honeywell	1-800-234-7437	http://www.fishersci.ca	Honeywell North Silver Shield/4H Gloves	Extremely Chemical resistant	Reusable

TABLE 14. Other Accelerator-Free Products

Category	Brand	Latex- and Rubber-Free Products
Swimwear	Decent Exposures	Two Piece Suit (Nylon/Lycra), Tank Suit (Nylon/Lycra), Tankini (Nylon/Lycra)
	Rawganique	100% Organic Hemp Bikini Swim and Bra Tops, Hemp Swim Trunks (must request while ordering that elastic is removed)
Undergarments	Decent Exposures	Original UnBra, Front Closure Unbra, Strapless Unbra, Nursing Flap Unbra, Bikini Underpants, French Hipster Underpants, Hipster Underpants, Full Brief Underpants, French Brief Underpants, Men's and Boy's Underpants
	Cottonique	Bras: Women's Bra Liner, Women's Drawstring Bra, Women's Front Closure Support Bra, Women's Racer Back Croptop Bra, Women's Racer Back Front Closure Support Bra, Women's Side-Tie Bra, Women's Slimfit Bra with Adjustable Band, Women's Slimfit Drawstring Bra, Women's Slimfit Pullover Bra Women's Underwear: Women's Bikini Brief, Women's Drawstring Boxer Short, Women's Drawstring Lounge Pants, Women's Elasticized Boxer Brief, Women's High-Cut Panty, Women's Lounge Short, Women's Waist Brief, Women's Low Rise Contoured Brief Men's Underwear: Men's Drawstring Loose Boxer Shorts, Men's Drawstring Lounge Pants, Men's Elasticized Loose Boxer Shorts, Men's Hipster Brief, Men's Lounge Short, Men's Rib Drawstring Boxer Brief w/ Fly
Socks	Dr. Leonard's Healthcare Corp	Non-Binding Cotton Socks (99% cotton, 1% Nylon), Men's Non-Binding Socks (99% cotton, 1% Nylon)
	Vermont Country Store	Non-Elastic Crew Socks (99% cotton, 1% nylon), Buster Brown Cotton Ankle Socks
	Cottonique	Latex-Free Adult Booties, Elite Elastic-Free 100% Cotton Socks natural
Condoms	Church & Dwight	Naturalamb (lamb caecum) http://www.globalprotection.com
	LifeStyles Healthcare North America	Skyn Original Condoms (polyisoprene)
	The Female Health Co	FC2 (PU)
Diaphragms	FemCap, Inc	FemCap (silicone)
Athletic tape	ACE	Waterproof Sports Tape (foam and acrylate)
Diapers	Luvs	All Luvs Products (Spandex elastic)
	Pampers	All Pampers Products, excluding (Spandex elastic), Pampers Pures (no elastic)
Feminine hygiene	Natracare LLC	All tampons, pads, liners, and incontinence pads
	Cora	Applicator Tampons, Applicator Free tampons, Period Pads *Cora is a subscription based, mail-order service
Support braces	BioSkin	All BioSkin supports and braces (PU and Lycra, free of neoprene and latex) *According to customer service representatives, it is company policy to offer a refund if any breakout occurs
	Bauerfeind	VenoTrain micro (Nylon/Lycra/Cotton), VenoTrain business (Nylon/Lycra/Cotton)
Swim goggles	Speedo	Hydrospex series*, Vanquisher 2.0 (including Mirrored and Jr.)*, Fastskin 3 Elite Mirrored *Breakdown of components: gasket (silicone), lens (PC), strap (silicone), nose bridge (PU), back clip (polycarbonate)
Swim caps	Speedo	Solid Silicone Cap (including Jr.), Nylon/Lycra Blend Cap
	Tyr	Lycra Fiber Swim Cap, Multi Silicone Swim Cap, Wrinkle-Free Silicone Swim Cap, Silicone Comfort Cap
Mouth guards	Shock Doctor, Inc	Braces mouthguard (silicone), Double braces mouthguard (silicone)
Earplugs	Mack's Ear Plugs	Pillow Soft Silicone Putty Earplugs, Soft Moldable Silicone Putty Earplugs–Kids Size
	Howard-Leight	Disposable Max, including Small and Lite (PU), Max Lite (PU), FirmFit (PVC), Multi Max (PU), X-Treme (PU)
Soccer equipment	Nike	Protega Shield Men's Soccer Shin Guards (9% nylon, 23% polyester, 23% EVA, 45% polypropylene)
Baseball equipment	All-Star	Sports S7 Adult Digi Camo Batting Helmet S7 Youth Solid Gloss Batting Helmet

cloth. Gore-Tex has been established as an effective barrier against contact allergy to rubber medical gloves and may possibly be broadly protective for rubber-related allergens.[56]

Rubber in Bandages

Bandages for rubber allergic patients have been discussed in the adhesives section previously. Alternatives are listed in Table 9.

COMPOSITAE

Compositae (Asteraceae) family of plants has long been reported to cause ACD from direct contact and airborne exposure. There are more than 32,000 known species of Compositae plants. The ACDS Core Allergen Series includes Compositae mix, which consists of German chamomile, arnica, feverfew, tansy, and yarrow. Other well-known plants in this family include sunflowers, dandelions, lettuce, ragweed, and *Parthenium*; the latter has been responsible for an epidemic of airborne ACD in India.[57] The most important sensitizers in this group of plants are sesquiterpene lactones, which are oil constituents found in stems, leaves, and pollen. The ACDS Core Allergen Series also includes a sesquiterpene lactone mix of alantolactone, dehydrocostus lactone, and costunolide. Classic airborne allergy due to Compositae and/or sesquiterpene lactones appears in the typical airborne clinical distribution. Flares typically occur in the spring and summer, whereas remissions typically occur in winter, although chronic severe cases can persist year-round.[58] Although most airborne ACD to Compositae results from outdoor plant exposure, some individuals may react to edible Compositae plants; facial airborne ACD has been reported from chamomile tea vapor.[59]

Allergen avoidance strategies are necessary to prevent flares of Compositae-related dermatitis. Avoidance of Compositae in topical products can be achieved using ACDS CAMP. Clicking the quick check box for either Compositae mix or sesquiterpene lactone mix will avoid all Compositae allergens in the database. Avoiding of direct contact with Compositae plants is also essential. Examples of common garden plants to avoid are aster, black-eyed susan, coreopsis, chrysanthemum, coneflower, cosmos, dahlia, daisy, marguerite, marigold, sunflower, yarrow (colored), and zinnia. Avoidance of Compositae weeds is more difficult. Some common Compositae weeds are burdock, chicory, cocklebur, dandelion, feverfew, fireweed, goldenrod, mayweed, ragweed, sagebrush, thistle, and yarrow (white). Protective gloves and long-sleeve shirts when gardening will be helpful; however, gardeners should avoid contact with used gardening clothes, which should be washed after each usage. Avoidance of airborne ACD is even more difficult. Two case reports describe adequate control of long-standing Compositae dermatitis after removing Compositae plants, which were in close proximity to their homes.[60,61] An informal, verbal survey of attendees at the 29th Annual ACDS meeting (San Diego, February 15, 2018) revealed no success with barrier creams for airborne ACD (verbal communication, Erin Warshaw, MD).

The current mainstay of treatment of airborne ACD is immunosuppression. For mild disease, it may be possible to manage symptoms with topical steroids alone. For more severe disease, oral steroids may be used for short-term therapy. Systemic immunotherapy has been used successfully as steroid-sparing treatment in India to address *Parthenium* airborne ACD. Commonly, azathioprine (100 mg daily or 300 mg weekly) has been coupled with a short course of oral steroids during treatment initiation.[62–68] More recent studies have shown that methotrexate may also be effective (15 mg/wk).[69] A study of 30 patients with airborne ACD to *Parthenium* in India compared 100 mg daily azathioprine with 15 mg daily methotrexate and found that the safety and efficacy of both drugs were comparable, although methotrexate response was earlier than azathioprine (5.6 vs 9.5 weeks to 75% clearance).[70] Finally, cyclosporine has been mentioned in 2 case reports to successfully control symptoms at a dose of 2.5 mg/kg per day.[71] Narrowband (nb)-UVB has also been reported as an effective method to treat airborne ACD. In a 2004 case report, a man with severe *Parthenium* airborne contact allergy was successfully treated with nb-UVB 3 times weekly at an initiating dose of 280 mJ cm^2, increasing by 20% each visit, and achieved almost complete remission after 6 to 8 weeks of therapy. After completion of therapy, he was successfully maintained with biweekly nb-UVB thereafter.[72]

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