



Allergic to Fashion

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Received: October 12, 2022 / Accepted: October 27, 2022 / Published online: November 9, 2022
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Keywords: Allergic dermatitis; Acetone; Adhesive; Contact dermatitis; Ethyl acetate; Epoxy resin; Irritant dermatitis; Polyvinyl; Spray-on clothing; Spray-on fabric; Textile dermatitis

Key Summary Points

Non-woven fabrics such as spray-on clothing contain multiple ingredients which can serve as contact allergens and pulmonary irritants.

Factors such as distance from spray point, diameter of spray nozzle, concentration of diluent, and spray time can influence the total exposure and sequelae resulting from the material.

Raising awareness among medical providers regarding possible formulations, including ingredients potentially damaging to the skin and airways, and protocols for testing (Table 1) and prevention of relevant exposures can protect patients.

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COMMENTARY

The recent trend of spray-on clothing has generated excitement in the fashion industry with the potential of innovations like this to bridge the gap between expensive, hand-sewn pieces and fast fashion. Beyond the fashion world,

similar spray product technology has potential applications in the realms of wound care, drug delivery, and fracture casts [1]. It presents certain strengths such as allowing customization of products to fulfill individual needs. However, new innovations often pose new challenges and new problems. As dermatologists, the potential health implications of aerosolized material sprayed on the body pose several questions in terms of the consequences to the skin and airways.

Non-woven fabrics contain multiple ingredients that are possible contact allergens and pulmonary irritants. For example, a spray-on fabric recently featured in the fashion news media combined a specific ratio of materials to form a composition that become non-woven fabric when sprayed on to a surface such as the human body [2]. The materials used include a diluent, binder, and fiber. The diluent allows for the materials in the spray canister to be dissolved and suspended, while the binder prevents the aggregation of the fibers in its liquid state but binds them at ambient temperature [2]. Common diluents include fast-evaporating solvents such as acetone, ethyl acetate, methanol, ethanol, butanol, and water. The binder is a polymer such as polyvinyl acetate, polyvinyl butyrate, natural latex, or polyvinyl alcohol. A variety of different fibers can be used including wool, silk, cashmere, and other natural fibers [2]. The composition can additionally contain adhesives, dyes, fragrances, emulsifying agents, and propellants [2]. The diluent acts as a solvent for the binder, creating a suspension of small fibers that can be sprayed to create non-woven fabric. As with other aerosolized compounds that have raised questions in the past (i.e., aerosolized sunscreens), the potential consequences on the respiratory tract also pose a relative health concern. Acetone, ethyl acetate, polyvinyl acetate, 3M spray contact, and epoxy resin in these spray-on clothes can cause irritation of the mucous membranes of the eyes and airways and worsen lung function and respiratory symptoms (e.g., bronchospasm), especially in those with pulmonary comorbidities [3–8]. In some demonstrations of clothing sprayed on models, sprayers and models are not wearing masks. Although the exact health consequences

of the composition are not yet known, as this trend debuts, questions and consequences may emerge with more widespread consumer use. The potential implications on the airway give breathable clothing a whole new meaning.

A proposed formulation of spray-on fabric that can be easily separated from a surface include a combination of acetone or ethyl acetate (solvent), polyvinyl acetate (binder), and 3M spray contact (adhesive) [2]. To create fabric that is intended to permanently adhere to the surface, epoxy resin can be used as the adhesive [2]. Acetone and ethyl acetate are common solvents known to cause irritant contact dermatitis (ICD), as exposure can lead to direct cytotoxic effects on the skin and degenerative changes in the epidermis [9, 10]. It is commonly found in products such as nail polish and remover, which may cause ICD. Patients may experience edema, erythema, fissuring, and paresthesia of the nails and hands [11]. Other body sites with which the nails frequently come in contact can be affected, such as the face, back, and eyes [11]. Acetone may also cause an allergic airborne contact dermatitis (ABCD), presenting a generalized skin reaction [12]. Although a substantial amount of spray-on fabric diluent evaporates before it reaches the surface, factors such as distance from spray point, diameter of spray nozzle, amount of diluent, and spray time can influence the degree of exposure a consumer has to the diluent [2]. Those who are exposed to the spray for several minutes and at closer range may have greater risk of diluents depositing on their skin or inhaling airborne ingredients, leading to irritation of the airways. Although rare, acetone sensitization can occur with repeated exposure, raising possible questions if skin or airway problems develop in those using spray-on materials more than once [13]. A case report also describes accidental, occupational exposure of acetone, which resulted in superficial dermal burns [14]. It is important for providers to recognize and understand the various skin manifestations caused by ingredients of spray-on fabric to identify the cause and initiate appropriate treatment.

Polyvinyl acetate is a common binder used in bookbinding, paper coating, and textile

Table 1 Patch testing recommendations to potential allergens found in spray-on fabric

Allergens to purchase individually	Bisphenol A epoxy resin 1% pet-1/2 Glyoxal trimeric dihydrate 1% pet-1 Formaldehyde 1% aq or 2% aq-1/2 Ammonium persulfate 2.5% pet-1/2 Methylchloroisothiazolinone/methylisothiazolinone 0.01% aq-1 Methylisothiazolinone 0.2% aq/pet-1/2 2- <i>n</i> -Octyl-4-isothiazolin-3-one 0.1% pet-2 or octylisothiazolinone 0.025% pet-1
Allergen series (with multiple relevant allergens)	Adhesives: “(Meth)Acrylate series—adhesives” (27 allergens)-2 Dyes: “Textile colors and finish” (34 allergens)-2 Epoxy: “Epoxy series” (11 allergens)-2 Fragrance: “Fragrance series” (48 allergens)-2 Emulsifying agents: “External agents/emulsifiers” (29 allergens)-1
Potential irritants and not commercially available allergens	Polyvinyl acetate Polyvinyl butyrate Polyvinyl alcohol Ethyl acetate Dibutyl maleate
Latex testing	IgE blood test (serology)

aq aqueous, *pet* petrolatum

Manufacturers: 1, Allergeaze (www.smartpracticecanada.com); 2, Dormer/Chemotechniques (www.dormer.com)

preparation [5]. While polyvinyls are not generally sensitizing, occupational exposure to vinyl acetate has been associated with dryness; irritation to eyes, airways, and lungs; and blister formation, particularly with prolonged contact (i.e., clothing wet with vinyl acetate) on thin skin [5, 15, 16]. Additives of polyvinyl resins can also cause ACD [17]. Two case reports document ACD from exposure to polyvinyl acetate adhesive containing dibutyl maleate. Patients with occupational exposures to adhesive residues developed red, scaly lesions on the hands. Patch testing confirmed positivity to undiluted glue and a constituent, dibutyl maleate [18]. Another case describes hand dermatitis secondary to aqueous polyvinyl resin, an adhesive

formed by the emulsion of vinyl acetate, glyoxal, formaldehyde, and ammonium persulfate [19]. Patch testing showed allergy to such resin emulsion. An alternative binder, polyvinyl alcohol, is used in a wide range of cosmetic products, and the Cosmetic Ingredient Review (CIR) panel considers it to be generally safe. Results of a patch testing of 104 panelists using peel off masks containing 5% polyvinyl alcohol showed no significant dermal irritation or sensitization [20]. However, one case documents contact dermatitis secondary to the use of polyvinyl alcohol cooling towels. The towels were manufactured with the preservative isothiazolinone, which was identified as the contact allergen [21]. Therefore, it is imperative

for manufacturers to list additives and preservatives used in polyvinyl resins, as the individual components may affect the skin.

A typical compound used in spray-on fabric includes 3M Photo Mount spray, a professional-grade adhesive developed for mounting photos and prints [2]. The safety datasheet of this product underscores that its use is not intended for the skin, and it is classified as a category 1B skin sensitizer [6]. Certain ingredients used to create 3M photo mount spray include known irritants such as toluene and methylene chloride [6]. When using this product, the manufacturer encourages the use of personal protective equipment such as gloves and eye/face protection. This could raise questions, particularly for those with compromised skin barriers. Additionally, epoxy resin is an alternative adhesive utilized in spray-on fabric intended to permanently adhere to a surface [2]. For example, product can be sprayed on to a piece of clothing for embellishment or repair. Epoxy resin is a common cause of ACD with a prevalence of 1% [22]. A case of a patient with erythema and pruritus of the neck highlights ACD due to epoxy resin in clothing labels [23]. In sewing and ironing workers, a study shows epoxy as the fourth most common cause of allergic textile dermatitis among 35 allergens [24]. Airborne contact dermatitis has also been reported with epoxy resin, specifically bisphenol A epoxy resin, found in wall paint [25, 26]. There is also evidence to suggest development of persistent photosensitivity after epoxy ACD [27].

Although it remains to be seen what the incidence of sensitization to ingredients in spray-on fabric will be as these products become more available to consumers, it is important for medical providers to be aware of the possible formulations and implications for patients. With the potential pulmonary and dermatologic effects, dermatologists have an integral role in monitoring such trends. Our recommendations for patch testing to potential allergens in spray-on fabric are listed in Table 1. By staying current and anticipating the impacts for patients, we may prevent this “season’s latest trends” from becoming next year’s public health hazards.

ACKNOWLEDGEMENTS

Funding. No funding or sponsorship was received for this study or publication of this article.

Author Contributions. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Data availability. Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Disclosures. Medha Rao, Samara Pollock, Arianne Shadi Kourosh, and Jenny Murase have nothing to disclose.

Compliance with Ethics Guidelines. This article does not contain any new studies with human participants or animals performed by any of the authors.

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