



Safety equipment: When protection becomes a problem

Erin M. Warshaw^{1,2} | Jamie P. Schlarbaum^{1,3} | Jonathan I. Silverberg⁴ |
Joel G. DeKoven⁵ | Howard I. Maibach⁶ | Dennis Sasseville⁷ |
Joseph F. Fowler Jr⁸ | James G. Marks Jr⁹ | Donald V. Belsito¹⁰ | Margo J. Reeder¹¹ |
Toby Mathias¹² | Amber R. Atwater¹³ | James S. Taylor¹⁴ | Anthony F. Fransway¹⁶ |
Melanie D. Pratt¹⁷ | Vincent A. DeLeo¹⁵ | Matthew J. Zirwas¹⁸ | Kathryn A. Zug¹⁹

¹Department of Dermatology, Minneapolis Veterans Affairs Medical Center, Minneapolis, Minnesota

²Department of Dermatology, University of Minnesota, Minneapolis, Minnesota

³University of Minnesota Medical School, Minneapolis, Minnesota

⁴Department of Dermatology, Northwestern University Feinberg School of Medicine, Chicago, Illinois

⁵Division of Dermatology, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada

⁶Department of Dermatology, University of California San Francisco, San Francisco, California

⁷Division of Dermatology, Royal Victoria Hospital, McGill University, Montreal, Quebec, Canada

⁸Department of Medicine, Division of Dermatology, University of Louisville, Louisville, Kentucky

⁹Department of Dermatology, Pennsylvania State University, State College, Pennsylvania

¹⁰Department of Dermatology, Columbia University, New York, New York

¹¹Department of Dermatology, University of Wisconsin Medical School, Madison, Wisconsin

¹²Department of Dermatology, University of Cincinnati, Cincinnati, Ohio

¹³Department of Dermatology, Duke University, Durham, North Carolina

¹⁴Department of Dermatology, Cleveland Clinic, Cleveland, Ohio

¹⁵Department of Dermatology, Keck School of Medicine, Los Angeles, California

¹⁶Associates in Dermatology, Fort Myers, Florida

¹⁷Division of Dermatology, University of Ottawa, Ottawa, Ontario, Canada

¹⁸Department of Dermatology, Ohio State University, Columbus, Ohio

¹⁹Department of Dermatology, Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire

Correspondence

Jamie P. Schlarbaum, Department of Dermatology, Department 111K, Minneapolis Veterans Affairs Medical Center, 1 Veterans Dr., Minneapolis, MN 55417.

Email: schla255@umn.edu

KEY WORDS: allergic contact dermatitis, irritant contact dermatitis, occupational, safety equipment

In 2015, there were >3.2 million non-fatal workplace accidents and an estimated 3876 fatal accidents in the EU.¹ Safety equipment (SE), also known as personal protective equipment, is a required component in most workplaces and is closely regulated. Mandated by the EU's updated Regulation 2016/425, the purpose of SE is to provide protection against respiratory, eye, ear, hand, head or skin insults.² The Occupational Safety and Health Administration in the United States and the Canadian Centre for Occupational Health and Safety regulate

SE in their respective countries. It is important to recognize that SE may be used both inside and outside the workplace (eg, home wood-working and hobby auto repair). Little is known about the risks of contact dermatitis resulting from the use of SE.

METHODS

Data from the North American Contact Dermatitis Group (NACDG) screening series from January 1, 2001 to February 28, 2017 were analysed. Patch testing, reaction evaluation and data coding were performed in accordance with the NACDG standards.³ Occupation and industry were coded by an expert according to the 1990 US Census

Disclaimer This material is the result of work supported with resources and the use of facilities at the Minneapolis Veterans Affairs Medical Center. The contents do not represent the views of the US Department of Veterans Affairs or the United States Government.

Industrial and Occupational Classification Codes.⁴ Patients with a source of “safety equipment (eg, masks and respirators)” as an irritant or suspected cause of allergic contact dermatitis (ACD) were analysed. The SE code specifically excludes gloves, hats, caps, safety helmets, belts, clothing, shoes, sports equipment (including swimming goggles), and medical devices, which are coded separately.

RESULTS

Of the 38 543 individuals tested, 88 (0.2%) had skin diseases related to SE. Most were men (57%) and Caucasian (90%), with an average age of 37.9 years. Forty-two per cent of patients had a self-reported history of atopy, including allergic rhinitis, childhood eczema, or asthma. There were a total of 155 sites of involvement. The most common sites of skin disease were the face (28%), hands (17%), and arms (13%). There were a total of 120 final diagnoses. ACD was the final diagnosis in 67 individuals (77.0%), and irritant contact dermatitis (ICD) was diagnosed in 25 individuals (28.7%) (10 had both). Forty-seven per cent had occupation-related skin conditions (Table S1). Excluding the unemployed, retired, homemakers, and students (3.3%), the top occupations included health workers (30%), machine operators, assemblers, and inspectors (20%), mechanics and repairers (10%), and construction workers (10%). SE was reported as an irritant in 31 individuals.

There were 83 reactions to 18 NACDG screening allergens that were both clinically relevant and related to SE (Table 1). Three quarters were rubber allergens (73%) and 14% were metals. Importantly, an additional 14 patients had non-NACDG allergens identified (specific allergen names not collected by the NACDG) associated with SE.

TABLE 1 Relevant allergens suspected to be present in safety equipment (2001–2016); clinically relevant allergens suspected to be present in safety equipment in individuals with allergic contact dermatitis

Allergen	n (%) (N = 83)
Carba mix, 3% pet.	21 (25.3)
Thiuram mix, 1% pet.	19 (22.9)
Mixed dialkyl thioureas, 1% pet.	9 (10.8)
Nickel sulfate, 2.5% pet.	7 (8.4)
p-Phenylenediamine, 1% pet.	4 (4.8)
Black rubber mix, 0.6% pet.	4 (4.8)
Formaldehyde, 1.0% aq.	3 (3.6)
Cobalt chloride, 1% pet.	3 (3.6)
Mercaptobenzothiazole, 1% pet.	2 (2.4)
4-tert-Butylphenol formaldehyde resin, 1% pet.	2 (2.4)
Potassium dichromate, 0.25% pet.	2 (2.4)
Colophonium, 20% pet.	1 (1.2)
Mercapto mix, 1% pet.	1 (1.2)
2-Bromo-2-nitro-1,3-propanediol, 0.5% pet.	1 (1.2)
Bisphenol A epoxy resin, 1.0% pet.	1 (1.2)
Diphenylguanidine, 1% pet.	1 (1.2)
Iodopropynyl butylcarbamate, 0.5% pet.	1 (1.2)
Ethyl acrylate, 0.1% pet.	1 (1.2)

DISCUSSION

This study found that SE is associated with both ICD and ACD in patients referred for patch testing. A recent study by Bhojru et al of SE-related occupational dermatoses (including footwear and clothing, but excluding gloves) found that ACD was diagnosed in 47.4% of individuals, and ICD was diagnosed in 16.0% of individuals.⁵ This differs from the frequencies in our study (ACD, 77.0%; ICD, 28.7%), probably because of differences in study design and definitions. Bhojru et al found a higher rate of dermatitis in healthcare occupations (15.5%), although the frequency of dermatitis in manufacturing occupations was similar to that in our study (18.6%). Importantly, they only examined workplace SE, whereas our study highlights the fact that the majority of SE-related skin disease are not occupationally related (53%).

Most of our cases involved skin disease on the face and hands. Bhojru et al reported only five cases of facial mask-related and headwear-related dermatitis.⁵ The high number of reactions to rubber accelerators and metals found in our study could be consistent with components in masks, respirators, and goggles.⁶ In an outbreak of facial dermatitis during the severe acute respiratory syndrome epidemic, it was found that N95 respirators contained formaldehyde⁷; similarly, surgical masks and shields have been shown to contain formaldehyde, methyldibromo glutaronitrile, and other preservatives.^{8,9} Although gloves were excluded from our analysis, arm sleeve guards and tool guards were not. The possible presence of rubber accelerators and preservatives in these types of SE could explain other relevant non-glove sources of hand and arm dermatitis; however, there is little reported information in the literature regarding these specific sources.

In summary, it is important to consider SE as a potential cause of ACD and ICD, both in the workplace and at home.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to report.

ORCID

Jamie P. Schlarbaum  <https://orcid.org/0000-0001-7403-499X>

Dennis Sasseville  <https://orcid.org/0000-0001-9104-2342>

REFERENCES

1. Eurostat. Accidents at work statistics: Statistics explained. European Commission-Eurostat, Luxembourg, 2018.
2. European Union. Regulation (EU) 2016/425 of the European Parliament and of the Council of 9 March 2016 on personal protective equipment and repealing Council Directive 89/686/EEC. *Official Journal of the European Union*. 2016; 81,31.3.2016:51-98.
3. DeKoven JG, Warsaw EM, Zug KA, et al. North American Contact Dermatitis Group patch test results: 2015–2016. *Dermatitis*. 2018;29: 297-309.
4. US Bureau of Labor Statistics. NLSY97 Attachment 1: 1990 Census Industrial & Occupational Classification Codes. From the NLSY97 Codebook Supplement. US Department of Commerce, Bureau of the Census, Washington, DC.
5. Bhojru B, Lecamwasam K, Wilkinson M, et al. A review of non-glove personal protective equipment-related occupational dermatoses

reported to EPIDERM between 1993 and 2013. *Contact Dermatitis*. 2019;80:217-221.

6. Bruze M, Kestrup L. Occupational allergic contact dermatitis from diphenylguanidine in a gas mask. *Contact Dermatitis*. 1994;31:125-126.
7. Donovan J, Kudla I, Holness L, et al. Skin reactions following use of N95 facial masks. *Dermatitis*. 2007;18:104.
8. Al Badri F. Surgical mask contact dermatitis and epidemiology of contact dermatitis in healthcare workers. *Curr Allergy Clin Immunol*. 2017; 30:183-188.
9. Kosann M, Brancaccio R, Cohen D. Occupational allergic contact dermatitis in an obstetrics and gynecology resident. *Dermatitis*. 2003;14: 217-218.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Warshaw EM, Schlarbaum JP, Silverberg JI, et al. Safety equipment: When protection becomes a problem. *Contact Dermatitis*. 2019;81:130–132. <https://doi.org/10.1111/cod.13254>

Online supplemental Table 1. Patient demographics of individuals with safety equipment relevant to skin disease.

	n (%), N=88
<i>Sex</i>	
Male [†]	50 (56.8)
<i>Age</i>	
Mean (y) [†]	37.9
>40 [†]	41 (46.6)
<18	14 (15.9)
19-39	32 (36.4)
40-59	34 (38.6)
≥ 60	5 (9.1)
<i>Race</i>	
Caucasian	79 (89.8)
<i>History of Atopy</i> ^{††}	37 (42)
<i>Site of Dermatitis</i> [‡]	
Scattered generalized	15 (9.7)
Hand [†]	27 (17.4)
Foot	5 (3.2)
Face [†]	44 (28.4)
Scalp, ears, neck	9 (5.8)
Arm	20 (12.9)
Leg [†]	14 (9.0)
Trunk	16 (10.3)
Other [¶]	5 (3.2)
<i>Final diagnosis</i> [§]	
Allergic contact dermatitis	67 (55.8)
Irritant contact dermatitis	25 (20.8)
Atopic dermatitis	10 (8.4)
Psoriasis	16 (1.0)
Other ^{¶¶}	18 (15.0)
<i>Occupational-related Skin Condition</i> [†]	41 (46.6)

NOS=not otherwise specified.

† MOHFLA Index

†† Atopic dermatitis, asthma, or allergic rhinitis

‡ Total number of final diagnoses (up to 3 diagnoses per patient), N=120

§ Total number of sites of involvement (up to 3 sites per patient), N=155

¶ Other sites of dermatitis include anal/genital (n=1), most exposed areas (n=1), only under clothing (n=1), and other (n=2).

¶¶ Other final diagnoses include psoriasis (n=2), photo dermatitis (n=1), other dermatitis (n=5), other dermatoses (n=6), seborrheic dermatitis (n=2), and contact urticaria (n=2).