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Occupational latex exposure: characteristics of contact and systemic reactions in 47 workers

B. Lauren CharousMD^a [[MEDLINE LOOKUP](#)]

Robert G. HamiltonPhD^b [[MEDLINE LOOKUP](#)]

John W. YungingerMD^c [[MEDLINE LOOKUP](#)]

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Abstract

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Background: Recent reports have noted an apparent increase in the prevalence of natural rubber latex (NRL) allergy among workers with occupational latex exposure (OLE). The risk factors for and the natural history of NRL allergy in this population are not well delineated, and the utility and comparability of immunoassays as confirmatory testing are unclear.

Methods: Serum samples and medical histories were obtained from 47 symptomatic workers with OLE, from nine other individuals with a history consistent with NRL allergy, and from 10 atopic asymptomatic NRL-exposed control subjects. Sera were coded and analyzed in a blinded manner

for latex-specific IgE, using a variety of antigen sources, including ammoniated and nonammoniated raw latex preparations and three finished glove preparations.

Results: Risk factors for the latex allergy in workers with OLE appear to include a history of atopy or preexisting dermatitis involving the hands. In this population, NRL allergy is commonly preceded by latex glove–associated contact dermatitis. Serologic testing confirmed the suspected diagnosis in 62% of workers (15 of 24) with systemic symptoms but was only positive in 27% of workers (4 of 15) with symptoms limited to contact urticaria.

Conclusions: The appearance of a latex glove–associated contact rash may precede the development of NRL allergy, particularly in atopic persons. Workers at risk should be advised to use alternate types and brands of latex gloves or to switch to nonlatex gloves entirely. (J ALLERGY CLIN IMMUNOL 1994;94:12-8.)

CD Contact dermatitis

CR Contact reaction

CU Contact urticaria

NRL Natural rubber latex

OLE Occupation latex exposure

SR Systematic reaction

(Click on a term to search this journal for other articles containing that term.)

Key words: [Contact urticaria](#), [latex](#), [occupational asthma](#), [allergic contact dermatitis](#)

The superior characteristics of latex — its tactile qualities, comfort, barrier protection, and sterility — have allowed latex gloves to play an important role in health care for most of this century. Since the mid-1980s, when concern over the transmission of human immunodeficiency virus and other viral contagions led to the initiation of universal precautions, use of latex gloves has increased rapidly. The Occupational Safety and Health Administration estimates that more than 5.6 million American health care and other workers use latex gloves regularly — over 7 billion pairs of gloves a year.¹

Recent reports have demonstrated that latex may serve as a potent allergic sensitizer to both patients and health care providers.^{2,5} More than 1000 reactions to medical devices containing natural rubber latex (NRL), including NRL gloves, characterized as at least “serious,” have been reported to the U.S. Food and Drug Administration (FDA) as of April 1992. The FDA is also aware of at least 15 deaths that have resulted from severe reactions to NRL. Both statistics almost certainly radically understate the number of patients and workers involved because of an underreporting of these reactions.

Workers with occupational latex exposure (OLE), particularly those wearing gloves, appear to be at substantial risk for the development of NRL allergic hypersensitivity because of their exposure to NRL. In a study published in 1987, Turjanmaa⁶ reported that of 512 hospital employees, 4.5% had

suspected NRL sensitivity and in 2.9% the diagnosis could be confirmed with NRL prick and use tests. Of operating room employees (presumably where exposure is greatest), 7.4% of physicians and 5.6% of nursing personnel were allergic to NRL.⁶ Later reports confirmed these findings and demonstrated substantial prevalence rates of NRL sensitization. On a self-reporting survey among active-duty dental officers in the U.S. Army, 8.8% reported symptoms of allergy to latex gloves.⁷ Studies utilizing confirmatory immunoassays or skin tests have reported similar prevalence rates for NRL sensitization: 9.9% among staff anesthesiologists in Toronto, 10.7% among operating room nurses in public hospitals in Marseilles, and 14.7% among operating room personnel in Detroit.⁸⁻¹⁰ NRL may function as a significant occupational aeroallergen, particularly among health care workers, for whom dry glove lubricants may provide antigen carriage.¹¹⁻¹⁵

Our study attempted to retrospectively delineate risk factors for, and the natural history of, NRL hypersensitivity among symptomatic workers with OLE. We also investigated the utility and comparability of immunoassay techniques by using a variety of antigens and methods in two laboratories in confirming a clinical diagnosis of latex allergy.

Methods

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Subjects

Between August 1991 and October 1992, 47 symptomatic persons with OLE (three medical assistants; 13 medical laboratory technicians; five dialysis, radiology, or surgical technicians; 22 nurses; one physician's assistant; two physicians; and one beautician) and nine others (two adult patients and seven pediatric patients) with a history of possible latex reactions incurred either while receiving medical attention or in nonmedical situations were seen at the Allergy Division of the Milwaukee Medical Clinic. Ten asymptomatic atopic volunteers with OLE were later recruited to serve as a control population for serologic and skin test studies. All participants (or their guardians) signed an informed consent permitting serologic testing and reporting of significant findings.

Historical data were gathered by means of a questionnaire and an interview completed by one of us (B.L.C.). Items included job title; length of OLE; date of first reaction to latex; the use of and reactions induced by changing brands of latex gloves and the use of latex substitutes; the occurrence and nature of reactions to nonglove latex products; the history of reactions while a patient; and the frequency of other allergies and skin conditions.

Allergy tests

With the use of the Multitest system (Lincoln Diagnostics, Inc., Decatur, Ill.), skin prick tests were applied to the volar forearm and included standardized mite and cat allergens, ragweed, grass and tree pollens, banana, cantaloupe, and celery. Wheal reactions greater than 5 mm over albumen-saline controls were considered positive. Because of the lack of an available FDA-licensed latex extract, latex skin testing was not performed on these patients.

Serum IgE levels were measured, using the IMx (Abbott Laboratories, Abbott Park, Ill.), in nanograms per milliliter. Results were reported in percentiles, on the basis of comparison to

normative data for a nonatopic healthy population as reported by Barbee et al.¹⁶ For the purposes of this study, subjects were considered to be atopic if either, or both, of the following was true: (1) their serum IgE was $\geq$ 80% percentile or (2) they had a positive prick skin test result to one of the inhalant antigens.

Sera were sent coded and analyzed for specific IgE antibodies in a blinded manner at both of the participating laboratories (DACI Reference Laboratory, Johns Hopkins University; Allergy Research Laboratory, Mayo Clinic). Details of the immunoassay methods are presented elsewhere.¹⁷ ■ Table I lists the latex allergen sources used in these analyses. In DACI Reference Laboratory, Johns Hopkins University, extracts from nonammoniated latex, ammoniated latex, and a latex glove (Triflex; Baxter Healthcare), were each separately bound to Sepharose particles and incubated overnight with serum, during which time specific IgE, if present, bound to the allergosorbent. After a buffer wash, bound IgE was detected with radiolabeled anti-human IgE Fc. After a second buffer wash, bound radioactivity was measured and counts per minute were interpolated from a reference curve into nanogram per milliliter equivalents of IgE anti-latex. The minimum detectable concentration of these assays is 0.6 ng/ml. Specificity of each positive antibody measurement was confirmed by soluble antigen inhibition of IgE binding to the allergosorbent in a subsequent assay. At the Allergy Research Laboratory of the Mayo Clinic, nonammoniated latex (E5), ammoniated latex (J21), and two glove extracts (YM2, CUS47) were adsorbed on plastic microtiter plates at 10 μ g/ml in carbonate buffer.*■

- **For a listing of manufactures, see ■ Table I*
- After a buffer wash and overnight incubation with serum, unbound serum proteins were removed with a second buffer wash. Bound IgE was detected with radiolabeled anti-human IgE Fc. After a third buffer wash, bound counts per minute obtained with test specimens were computed as a percentage of counts per minute resulting from a negative control serum, and binding ratios > 250% were considered positive.

TABLE I. Latex allergen extracts used in study

No.	Source material	Latex source	Test assay site
1	Nonammoniated	FDA-Devices*	Johns Hopkins
2	Nonammoniated	FDA-Biologics†	Mayo
3	Ammoniated	FDA-Devices	Johns Hopkins
4	Ammoniated	Johnson & Johnson Medical	Mayo
5	Triflex Surgical glove	Baxter Healthcare	Johns Hopkins
6	Bodyguard glove	TK Glove Products	Mayo
7	Examination glove	Burrows Glove	Mayo

*FDA Center for Devices and Radiological Health.
†FDA Center for Biologics Evaluation and Research.

Historical data

Initial review of the medical histories of the group with OLE yielded data suggesting that systemic reactions (SRs) in workers with OLE was commonly preceded by contact reactions (CRs), either contact dermatitis (CD) or contact urticaria (CU), or both. To elucidate the nature of this transformation, we devised a clinical classification schema, based on previous efforts, which included the criteria presented in [Table II](#).^{[5](#) [18](#) [19](#)}

TABLE II. Classification of latex reactions

Classification	Reaction types	Clinical manifestations
Contact dermatoses	Irritant	Within 1st day: dryness; pruritus; fissuring; cracking At 24-48 hrs: redness; swelling; exudation; crusting Chronic:
	Allergic contact	lichenification; scaling; hyperpigmentation
Contact urticaria		Hives
		Erythema and pruritus within 30 minutes of contact
		Dyshidrotic eczematous reactions
Systemic reaction	Cutaneous	Generalized urticaria
	Respiratory	Asthma; allergic rhinitis or conjunctivitis
	Anaphylactic	Acute respiratory or cardiovascular failure

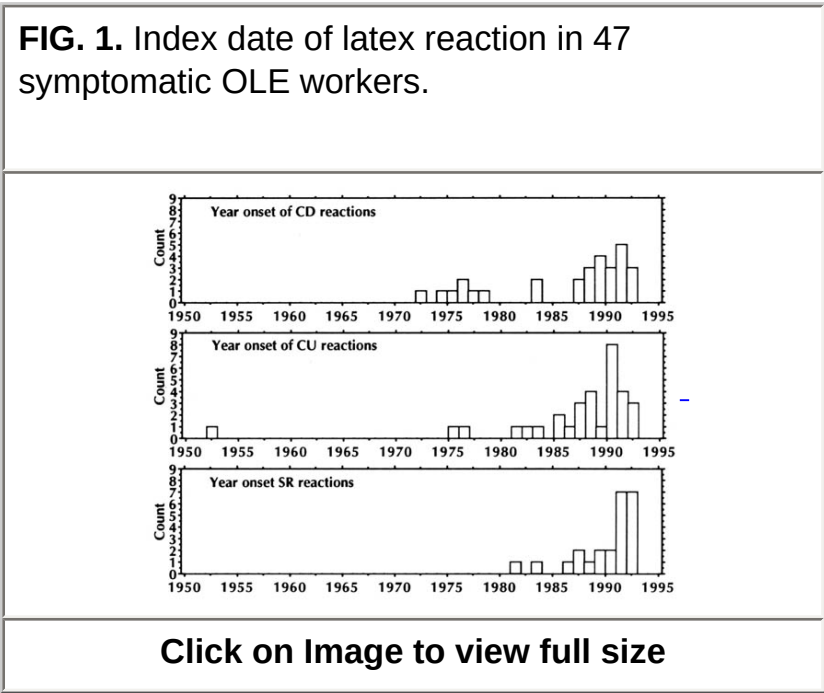
Only 3 of 24 volunteers with OLE had de novo SRs to latex with no history of contact reactions. The clinical progression of reactions was uniform: CD to CU to SRs. In over half the subjects, latex glove-associated CD preceded the onset of both CU and SRs. As shown in [Table III](#), individuals could skip any stage in the progression or, alternatively, could manifest even severe and long-standing CRs without evidence of systemic symptoms.

TABLE III. Historical progression of latex reactions

Study group	<i>n</i>	Gender	Age (mean ± SEM)
OLE — Contact reaction	23	1M 22F	36.9 ± 2.4
CD	8	1M 7F	34.4 ± 4.3
CD → CU	6	6F	38.8 ± 5.6
CU	9	9F	37.9 ± 3.4

OLE –Systemic reaction	24	1M 23F	37.8 ± 1.3
CD→SR	4	4F	39.0 ± 2.7
CD→CU→SR	11	1M 9F	35.6 ± 2.0
CU→SR	6	6F	38.5 ± 1.5
De novo SR	3	3F	
Patients	9	4M 5F	15.1 ± 3.8
Controls	10	5M 5F	41.8 ± 3.2

In the study group, the number of persons with SRs and, to a lesser extent, the number of persons with CU increased over the last 6 years, as noted in ■Fig. 1. In contrast, the number of persons reporting new CD reactions has increased only slightly.



Analysis of historical risk factors revealed a high prevalence of preexisting nonspecific dermatitis in the CR group (15 of 23). In the SR group, 19 of 24 had a history of hand dermatitis before having either CU or SRs. Of this group, four had a history of solely nonspecific dermatitis; nine had a history of nonspecific dermatitis with subsequent evolution of latex glove–induced CD; and six had a history of solely latex glove–induced CD. As seen in ■Table IV, the prevalence of atopy in the SR group was substantially higher than that observed in either of the CR groups. Banana skin prick testing was positive in 6 of 24 in the SR group and negative in all others tested; but only two persons had any history of symptoms after ingestion. In general, SR developed later during occupational latex glove exposure; more than half of the SRs developed only after 100 months. In contrast, more than half the CD reactions developed within the first 20 months, and half the CU reactions developed within 40 months. A history of medication or food allergy did not appear to be associated with any type of latex or latex-associated reactions.

TABLE IV. Possible risk factors for developing latex hypersensitivity in OLE

workers

Patient group	Preexisting dermatitis	Atopic	Medication allergy	Food allergy
CR	15/23	10/23	6/23	5/23
SR	19/24	20/24	8/24	10/24
Seropositive	12/15	15/15	4/15	5/15
Seronegative	6/9	5/9	4/9	5/9
Patients	1/9	3/9	0/9	2/9

A history of latex reactions induced by latex-containing products other than gloves was elicited commonly from subjects in each group, but surprisingly, this did not appear to occur with greater frequency in SR than in CD or CU subjects.

In the patient group, five persons had recognizable risk factors, such as spina bifida, or other conditions necessitating frequent operative intervention or instrumentation, such as Hirschsprung's disease, endometriosis, bladder lymphangioma, spina bifida, and an omphalocele. One of these patients had a history of latex-induced SR dating to 1967, occurring more than a decade before the first report of latex allergy.²⁰ Of four pediatric patients with convincing histories of SR and no recognizable risk factor, two had detectable levels of circulating anti-latex IgE.

Immunoassay

Serologic findings are summarized in ■Table V. No seropositive reactions were found among the group with only CD reactions. Of 15 subjects describing a history of CU with OLE, only four (27%) had detectable latex-specific IgE. In two of these four seropositive CU subjects, SR developed during the course of the study, indicating that detectable latex-specific IgE may precede the onset of SR in patients with CU. In contrast, of 24 patients with a history of SR, 15 (62%) had detectable latex-specific IgE.

TABLE V. Summary of serologic findings by group

Patient group	n	Latex seropositive (%)
CR	23	17
CR-CD	8	0
CR-CU	15	27
SR	24	62
Patients	9	77
Controls	10	10

Of the 10 controls, one had significant levels of circulating anti-latex IgE. This subject remains without symptoms 10 months later.

In our study a variety of antigen sources, including both ammoniated and nonammoniated latex, as well as antigens eluted from finished glove products, yielded similar results in blinded parallel testing, as shown in ■Table VI, findings more completely examined elsewhere.¹⁷

TABLE VI. Immunoassay results

Patient group	n	% Positive for each extract no.						
		1	2	3	4	5	6	7
CR	23	17	17	17	1	17	17	17
SR	24	58	62	58	29	62	62	42
Patients	9	67	78	67	67	67	67	67
Controls	10	10	10	0	0	10	10	10

Discussion

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Latex-induced CD has been well recognized for more than 40 years. The recent increase in incidence and prevalence of IgE-mediated sensitization to NRL is an unanticipated medical problem. First described in well-defined patient populations,²¹⁻²³ NRL sensitization has become a common illness in workers with OLE. The observations made in this population of workers with OLE highlights two aspects of this problem. First, in our study group, the number of patients reporting the onset of latex-induced CD appears relatively constant, whereas the number of patients with CU and SRs has markedly increased over the past few years, consistent with other observations.²⁴ Second, we are unaware of any other multicomponent contact sensitizing agent that has been associated with a qualitative shift from a predominantly (and virtually exclusively) type IV antigenicity to a potent type I sensitizer capable of eliciting IgE antibodies. That over half of the workers with OLE and SR studied had a history of latex-associated CD suggests the need for prospective epidemiologic studies involving health care workers to investigate the whether latex glove–induced CD may predispose OLE workers to SRs.

The underlying cause for this development remains obscure despite intense investigation. As opposed to a recent report by Kurup et al.,²⁵ this study suggests that raw latex, in either the ammoniated or the nonammoniated form, is virtually equivalent to extracts eluted from finished glove products as a source of antigen for identification of persons allergic to latex by serologic testing. These findings imply that the sensitizing latex antigens are likely not neo-antigens formed in the manufacture of rubber products. One recent report demonstrated that changes in a variety of production methods — especially leaching and washing conditions, chlorination procedures, and

autoclaving — have measurable effects on the levels of extractable proteins and, thus, quite likely in the levels of allergenic proteins as well.²⁶ Some of the chemicals used in rubber processing, including accelerators, antioxidants, and lubricants, may generate potent CU and SRs, including anaphylaxis, on their own,^{5 27 34}; thus they may act to disrupt the normal skin barrier and facilitate the transport of sensitizing latex proteins or possibly serve as haptens or adjuvants in eliciting an IgE response.

Despite the lack of confirmatory NRL skin testing, immunoassay results in our study demonstrate similar rates of seropositivity for the study as a whole and for the defined clinical subgroups as reported in previous studies. Turjanmaa et al.⁴ and Jaeger et al.³⁵ noted seropositivity rates of 53% and 62%, respectively, in studies of health care workers with OLE with latex allergy — figures comparable to the overall rate (49%) we observed, but less than the 73% skin test positivity rate found by Kelly et al.³⁶ in 15 health care workers reporting symptoms of latex allergy. For health care workers with a history limited to CU reactions, immunoassay results have ranged from 0% to 57% positive in earlier studies,^{10 18 37} again comparable to our results. Jaeger et al.³⁵ reported finding detectable anti-latex IgE in well over 70% of persons with a history of SRs and found a positive correlation between symptoms and the antibody concentration.³⁵ Our observations showed a lower rate of seropositivity (62%), and we were unable to find any clear relationship between the severity of symptoms and antibody levels.

SRs to latex appear to occur only uncommonly de novo. In the group studied, SRs occurred most commonly in atopic persons with a history of hand dermatitis, including CRs to latex. The possibility of developing a systemic reaction does not disappear with long-term uneventful exposure, and even after decades of use, some workers with OLE have experienced the onset of CRs and later the onset of systemic hypersensitivity. In this sense, CU may well be a less severe, earlier expression of NRL allergy than SRs in some patients. In the group studied, more than 20% of the group with CRs had new CU or SRs (or both) during a 24-month period of observation. On the other hand, many workers with OLE appear to suffer significant CD that is unchanged in severity over years, which they may self-treat without formal medical attention.

Once sensitized, many persons have remained clinically sensitive for prolonged periods. Of the study subjects, six with SRs and 12 with CU have experienced reactivity for over 5 years. This perceived persistence of latex sensitivity may reflect ascertainment bias in our observations; alternatively, the ongoing stimulation engendered by chronic exposure to latex, a ubiquitous substance both in and out of the workplace, may serve to reinforce the allergic response, in contrast to the natural history of stinging insect–venom hypersensitivity, in which in slightly less than half the cases reactivity abates over time.^{38 39} Long-term prospective studies will be required to confirm this observation about the natural history of latex allergy.

While immunoassay tests appear useful to confirm a clinical diagnosis of latex allergy, particularly in atopic persons, outside of the United States commercial extracts have proved valuable and safe for diagnostic skin testing, a procedure of greater sensitivity.^{6 8 10} Unfortunately, no commercial reagent has been approved by the FDA, and attempts to use glove-extract antigens for immediate hypersensitivity testing has been complicated by an unacceptable rate of systemic reactions.³⁶ It is hoped that this situation will be rectified in the near future, given the seriousness of this medical

problem and the increased frequency with which latex-sensitive persons are appearing for evaluation.

References

TOP

1. Voelker R. OSHA mandates universal precautions. AMA News Dec 16 1992.
2. Morales C, Basomba A, Carreira J, Sastre A. Anaphylaxis produced by rubber glove contact. Clin Exp Allergy 1989;19:425-30.
[MEDLINE](#)
3. Pecquet C, Leynadier F, Dry J. Contact urticaria and anaphylaxis to natural latex. J Am Acad Dermatol 1990;22:631-3.
[MEDLINE](#)
4. Turjanmaa K, Laurila K, Mäkinen-Kiljunen S, Reunala T. Rubber contact urticaria. Contact Dermatitis 1988;19:362-7.
[MEDLINE](#)
5. Wrangsjö K, Mellström G, Axelsson G. Discomfort from rubber gloves indicating contact urticaria. Contact Dermatitis 1986;15:79-84.
[MEDLINE](#)
6. Turjanmaa K. Incidence of immediate allergy to latex gloves in hospital personnel. Contact Dermatitis 1987;17:270-5.
[MEDLINE](#)
7. Berky Z, Luciano J, James W. Latex glove allergy — a survey of the US Army dental corps. JAMA 1992;268:2695-7.
[MEDLINE](#)
8. Arellano R, Bradley J, Sussman G. Prevalence of latex sensitization among hospital physicians occupationally exposed to latex gloves. Anesthesiology 1992;77:905-8.
[MEDLINE](#)
9. Iacobelli A, McCullough J, Ownby D. The prevalence of latex allergy in high risk medical personnel [Abstract]. J ALLERGY CLIN IMMUNOL 1993;91(1:2):216.
10. Lagier F, Vervloet D, Lhermet I, Poyen D, Charpin D. Latex allergy in nurses. J ALLERGY CLIN IMMUNOL 1992;90(3:1):319-22.
[MEDLINE](#)
11. Baur X, Jaeger D. Airborne antigens from latex gloves. Lancet 1990;335:912.

MEDLINE

12. Beezhold D, Beck W. Surgical glove powders bind latex antigens. Arch Surg 1992;127:1354-7.

MEDLINE

13. Carrillo T, Cuevas M, Munoz T, Hinojosa M, Moneo I. Contact urticaria and rhinitis from latex surgical gloves. Contact Dermatitis 1986;15:69-72.

MEDLINE

14. Lagier F, Badier M, Martigny J, Charpin D, Vervloet D. Latex as aeroallergen. Lancet 1990;336:516-17.

MEDLINE

15. Tarlo S, Wong L, Roos J, Booth N. Occupational asthma caused by latex in a surgical glove manufacturing plant. J ALLERGY CLIN IMMUNOL 1990;85:626-31.

MEDLINE

16. Barbee R, Halomen M, Lebowitz M, Burrows B. Distribution of IgE in a community population sample: correlations with age, sex and allergen skin test reactivity. J ALLERGY CLIN IMMUNOL 1981;68:106-11.

MEDLINE

17. Hamilton RG, Charous BL, Adkinson NF Jr, Yunginger JW. Serologic methods in the laboratory diagnosis of latex rubber allergy: study of nonammoniated, ammoniated latex, and glove (end-product) extracts as allergen reagent sources. J Lab Clin Med 1994;123:594-604.

MEDLINE

18. Wrangsjö K, Wahlberg J, Axelsson G. IgE-mediated allergy to natural rubber in 30 patients with contact urticaria. Contact Dermatitis 1988;19:264-71.

MEDLINE

19. Krogh G, Maibach H. The contact urticaria syndrome — an updated review. J Am Acad Dermatol 1981;5:328-42.

MEDLINE

20. Nutter A. Contact urticaria to rubber. Br J Dermatol 1979;101:597-8.

MEDLINE

21. Kelly K, Setlock M, Davis J. Anaphylactic reactions during general anesthesia among pediatric patients — United States, January 1990–January 1991. MMWR 1991;40:437-43.

22. Ownby D, Tomlanovich M, Sammons N, McCullough J. Anaphylaxis associated with latex allergy during barium enema examinations. AJR Am J Roentgenol 1991;156:903-7.

MEDLINE

23. Slater J. Rubber anaphylaxis. N Engl J Med 1989;320:1126-30.

MEDLINE

24. Fransway A. Epidemiologic drift in healthcare workers with occupational hand dermatoses [Abstract]. International latex conference: sensitivity to latex in medical devices. Baltimore: U.S. Food and Drug Administration, Center for Devices and Radiological Health, 1992:43.

25. Kurup V, Kelly K, Turjanmaa D, et al. Immunoglobulin E reactivity to latex antigen in the sera of patients from Finland and the United States. J ALLERGY CLIN IMMUNOL 1993;91:1128-34.

MEDLINE

26. Dalrymple S, Audley B. Allergenic proteins in dipped products: factors influencing extractable protein levels. Rubber Developments 1992;45(2/3):51-60.

27. Bosquet J, Michel F-B. Allergy to formaldehyde and ethylene oxide. Clin Rev Allergy 1991;9:357-70.

MEDLINE

28. Estlander T, Jolanki R, Kanerva L. Dermatitis and urticaria from rubber and plastic gloves. Contact Dermatitis 1986;14:20-5.

MEDLINE

29. Fisher A. Contact urticaria and anaphylactoid reaction due to corn starch surgical glove powder. Contact Dermatitis 1987;16:224-5.

MEDLINE

30. Rich P, Belozor M, Norris P, Storrs F. Allergic contact dermatitis to two antioxidants in latex gloves: 4,4'thiobis(6-*tert*-butyl-*meta*-cresol) (Lowinox 44S36) and butylhydroxyanisole. J Am Acad Dermatol 1991;24:37-43.

MEDLINE

ABSTRACT

31. Seggev J, Mawhinney T, Yunginger J, Braun S. Anaphylaxis due to cornstarch surgical glove powder. Ann Allergy 1990;65:152-5.

MEDLINE

32. Shmunes E, Darby T. Contact dermatitis due to endotoxin in irradiated latex gloves. Contact Dermatitis 1984;10:240-4.

MEDLINE

33. Van der Meeren H, van Erp P. Life-threatening contact urticaria from glove powder. Contact Dermatitis 1986;14:190-1.

MEDLINE

34. van Ketel W. Contact urticaria from rubber gloves after dermatitis from thiurams. *Contact Dermatitis* 1984;11:323-4.

MEDLINE

35. Jaeger D, Kleinhans D, Czuppon A, Baur X. Latex-specific proteins causing immediate-type cutaneous, nasal, bronchial and systemic reactions. *J ALLERGY CLIN IMMUNOL* 1992;89:759-68.

MEDLINE

36. Kelly K, Kurup V, Zacharisen M, Resnick A, Fink J. Skin and serologic testing in the diagnosis of latex allergy. *J ALLERGY CLIN IMMUNOL* 1993;91:1140-5.

MEDLINE

37. Fuchs T, Wahl R. Immediate reactions to rubber products. *Allergy Proc* 1992;13(2):61-6.

MEDLINE

38. Reisman R. Natural history of insect sting allergy: relationship of severity of symptoms of initial sting anaphylaxis to re-sting reactions. *J ALLERGY CLIN IMMUNOL* 1992;90(3:1):335-40.

MEDLINE

39. Savliwala M, Reisman R. Studies of the natural history of stinging-insect allergy: long-term follow-up of patients without immunotherapy. *J ALLERGY CLIN IMMUNOL* 1987;80:741-5.

MEDLINE

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- From the ^aMilwaukee Medical Clinic, Milwaukee, Wisc.; the ^bJohns Hopkins Asthma and Allergy Center, Johns Hopkins University School of Medicine, Baltimore, Md.; and the ^cResearch Laboratory for Allergic Diseases, Mayo Clinic, Rochester, Minn.
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Epidemiology of latex sensitization and allergies in health care workers

Journal of Allergy and Clinical Immunology, The

August 2002, part 2 • Volume 110 • Number 2

David H. Garabrant, MD, MPH^a, Sarah Schweitzer, MS^b

[ABSTRACT](#)

[FULL TEXT](#)

Latex allergy: The perspective from the surgical suite

Journal of Allergy and Clinical Immunology, The

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Beth A. Elliott, MD

[ABSTRACT](#)

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A hooded exposure chamber method for semiquantitative latex aeroallergen challenge

Journal of Allergy and Clinical Immunology, The

January 2001 • Volume 107 • Number 1

Kenneth M. Kurtz, MD^a, Robert G. Hamilton, PhD^a, John A. Schaefer, CIH^b, N. Franklin Adkinson, Jr, MD^a

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Latex allergy

A review for the dental professional

Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology

January 1999 • Volume 87 • Number 1

Anthony M. Spina, DDS, MD^a, Hal J. Levine, DMD, MD^b

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Diagnosis of natural rubber latex allergy: Multicenter latex skin testing efficacy study

Journal of Allergy and Clinical Immunology, The

September 1998 • Volume 102 • Number 3

Robert G. Hamilton, PhD, DABMLI, N. Franklin Adkinson, Jr, MDthe Multi-Center Latex Skin Testing Study Task Force*

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Latex allergy

Journal of the American Academy of Dermatology (JAAD)

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Erin M. Warshaw, MD

[ABSTRACT](#)

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Latex: A cause of allergic contact eczema in users of natural rubber gloves

Journal of the American Academy of Dermatology (JAAD)

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S. Mark Wilkinson, MD, MRCP, Robert Burd, MRCP

[ABSTRACT](#)

[FULL TEXT](#)

Latex sensitivity in dental students and staff: A cross-sectional study

Journal of Allergy and Clinical Immunology, The

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Susan M. Tarlo, MB, BS, Gordon L. Sussman, MD, D. Linn Holness, MD

Toronto, Ontario, Canada

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The relationship between latex skin prick test responses and clinical allergic responses

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June 1996 • Volume 97 • Number 6

Denis Hadjiliadis, MD , Daniel E. Banks, MD , Susan M. Tarlo, MBBS, FRCP(C)

Toronto, Ontario, Canada

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