

FirstHAND

GLOVE - ASSOCIATED REACTIONS



Dermatologist observes a case of severe chronic dermatitis on the hands of a healthcare professional.

In the mid-1800's, hands were recognized as one of the major transmitters of disease in the hospital setting. The introduction of disinfectants greatly lowered rates of infection and with it levels of patient morbidity and mortality. However, this decrease in hospital acquired infections came at a price: an increase in irritant and allergic dermatitis of the hands due to the use of these chemicals.

To protect the hands of health

care professionals from the harsh effects of the disinfectants, natural rubber latex gloves were introduced. Not only did they protect the hands from chemicals, but the gloves also served as a protective barrier between the patient and the healthcare provider.¹ Concern over the increased occupational risk of contracting such diseases as HIV and hepatitis led the Centers for Disease Control to recommend universal precautions in 1987. These precautions were followed by mandatory regulations issued by the Occupational Safety and Health Administration (OSHA) in 1991. As a result, glove usage dramatically increased from less than 1 billion in 1986² to over 20 billion in 1996.³ This escalation has been correlated with an increase in glove-associated reactions. Thus, it is necessary to understand, manage and reduce the risk of developing reactions.

TABLE OF CONTENTS

This publication will review glove-associated reactions, a concern for today's healthcare professional.

Topics addressed are:

- **Non-Allergic Reactions**2
 - Irritation2
- **Allergic Reactions**4
 - Type IV4
 - Type I8

Non-Allergic Reactions

The three glove-associated reactions are irritation, which is a non-allergic reaction, and two allergic reactions: a Type IV hypersensitivity related to chemicals and a Type I hypersensitivity related to natural rubber latex protein allergens. A review of these reactions follows.

Irritation (Irritant Dermatitis, Dermatitis, Irritant Contact Dermatitis)

Irritation is a *non-allergic* inflammation⁴ of the skin and may be caused by either non-glove associated or glove-associated irritants.



Irritant dermatitis is a non-allergic reaction to any of the numerous irritants from both glove and non-glove-associated sources.

Non-glove-associated Irritation

Irritation is often caused by non-glove related irritants in the environment. Detergents, alcohols, surface disinfectants, and chemicals in hand soaps⁵ frequently

cause the skin to breakdown, compromising its natural barrier function. Irritants can build up below or around jewelry if there is inadequate rinsing. Unprotected skin in cold or dry weather may become chapped and vulnerable to further damage. Work conditions that include frequent hand washing often contribute to irritation. While it is imperative from an infection control standpoint for health care professionals to wash their hands frequently, repeated scrubbing can leave skin vulnerable to irritation. Improper handwashing practices that include the use of hot water, harsh soaps or detergents, failure to

remove jewelry and inadequate rinsing and drying can add to skin stress and breakdown.

Glove-associated Irritation

Irritation is the most common of the three glove-associated reactions^{5,6} and may occur when wearing either natural rubber latex or synthetic gloves.⁶ In this publication, the term synthetic refers to any medical glove (vinyl, nitrile, neoprene, etc.) that is not natural rubber latex. Glove-associated irritation may be caused by:

- *Chemicals*
- *Endotoxin*
- *Lack of air to the skin*
- *Powder*
- *Friction*

A certain amount of chemicals, powder and endotoxin may remain on the surface of the glove after its manufacture.⁷ Irritation may be caused if these substances are not removed from the glove by washing or chlorination. For example, glove powder can absorb the skin's natural moisture, oils and lipids leaving the skin extremely dry and chapped.

Also, glove powder inhalation may trigger nasal, throat or respiratory complications in some individuals. This may be merely an irritant activity due to the particulate nature of the powder or to any of the chemicals the powder may have absorbed from the glove or the environment.

Residual chemicals can also irritate the skin. For example, the surface of the glove may have a basic or very high pH that can injure the epidermal cells. Endotoxin from the cell wall of

Non-Allergic Reactions: Irritation (continued)

bacteria can contaminate the glove during manufacturing. Sterilization, curing ovens and the use of disinfectants kill the bacteria but do not destroy irritant causing endotoxin.

Irritation can also result from a glove that fits too tightly and rubs continuously against the skin.⁶ And, when gloves are worn for extended periods of time, the skin can breakdown as a result of insufficient air.

Symptoms

Irritation results in direct injury to the skin followed by local inflammation.⁸ Clinically, glove-associated irritation is evident within minutes to hours after the gloves are donned. The initial symptoms often include an itching or burning sensation⁶ confined to the area of glove contact. Failure to remove the source of irritation may cause more extensive redness, inflammation, swelling and excessive dryness.⁴ Continued exposure may progress to a chronic stage where symptoms include cracks or horizontal fissures, sores, blisters, papules (small, hard bumps) and dry, thickened skin with crusting and peeling. The accumulation of sweat next to the skin in long-term occlusive conditions can lead to dyshidrosis, another form of irritation characterized by vesicular eruptions on the hands that can eventually burst and lead to dermatitis.

It is important to note that if the irritation is associated solely with the gloves,⁹ the irritant symptoms are usually confined to the area of

glove contact and will not progress beyond the border of the glove.

Caution: Irritation can reduce the effectiveness of handwashing, as it is difficult to adequately scrub hands that have open cracks and sores. Once the skin is compromised with open lesions, microorganisms can easily by-pass this natural barrier, increasing the risk of infection. For example, *Staphylococcus* has been reported to colonize the hands of health care professionals with hand irritation.¹⁰

Glove Selection for Irritation Risk Reduction

The risk of developing glove-associated irritation can be reduced by choosing latex or synthetic gloves that are low in residual chemicals and endotoxin. Gloves should also be powder-free and fit properly.

Management

If a glove-associated irritation is suspected, consult with the supervisor, employee health and/or occupational health professional. A dermatologist should be consulted if symptoms persist. Management practices may include:

- *Wearing a larger glove to increase air circulation until hands heal.*
- *Changing gloves more frequently to allow air to get to the hands if gloves are worn for long periods.*
- *Wearing powder-free gloves.*
- *Considering anti-inflammatory creams; however, avoid petroleum based creams while wearing gloves as they may compromise glove barrier integrity.*
- *Choosing gloves low in residual chemicals.*
- *Considering the use of glove liners made of cotton, nylon or other materials.**

* If you choose to use liners, be sure to replace them every time gloves are changed. Glove liners do not replace hand washing.



Allergic Reactions

While anyone can suffer from irritation, only individuals who are genetically prone to respond to specific allergens are capable of experiencing an allergic response. The other two types of glove-associated reactions, Type IV and Type I, are different from irritation in that they are *allergic* reactions to specific allergens that may be present in the gloves.

For susceptible individuals, repeated exposure to the specific allergen(s) to which they are vulnerable increases their level of sensitization until their unique critical symptom threshold is reached. It is at this point that further exposure to the allergen can result in a reaction. The time it takes to reach this threshold level may be days, weeks, months, years or never. This will depend on the individual's genetic make-up, environment and allergen exposure.

Type IV (Allergic Contact Dermatitis, Delayed Hypersensitivity, Chemical Allergy)



The symptoms of a Type IV, chemical allergy are shown in this photograph. Note the presence of open lesions that increase the risk of cross-infection.

A Type IV reaction is a T-cell-mediated^{5,6,8} allergic response to specific chemicals referred to as contact sensitizers. If an individual has the DNA instructions to create a receptor site on the T-cell to a specific chemical contact sensitizer, that individual is considered genetically prone to develop a Type IV allergy to that specific chemical. Examples of this type of allergy include poison ivy and nickel allergies.^{8,11}

Non-glove associated Type IV

More than 2,800 non-glove substances have been identified as contact sensitizers or chemical allergens. The potential for these substances to cause a Type IV reaction varies greatly. Therefore, determining the cause of any dermal outbreak should include consideration of soaps, detergents, lotions, jewelry, nickel, fragrances, gluteraldehyde, quaternary ammonias, formaldehyde, and many other substances in the work, home and outdoor environment.

Glove-associated Type IV

A Type IV allergic reaction may also be due to gloves. If so, the allergy is usually caused by the chemicals added during manufacturing which can be found in both natural rubber latex and synthetic gloves.⁸

Allergic Reactions: Type IV (continued)

Chemical accelerators (e.g. thiurams, thiazoles, and carbamates) have been linked to glove-associated Type IV reactions^{6,8} more than any other chemicals used in the manufacture of gloves.⁹ However, there are several other chemical contact sensitizers in synthetic and natural rubber latex gloves, which may cause this chemical allergy. Some contact sensitizers that may be in gloves are listed in Table 1.^{4,8}

Table 1

<p>Accelerators/Curing Agents</p> <ul style="list-style-type: none"> • <i>Aldehyde-amine reaction products</i> • <i>Benzothiazoles</i> • <i>Dithiocarbamates</i> • <i>Dithiophosphates</i> • <i>Guanidines</i> • <i>Thiourea</i> • <i>Thiurams</i> • <i>Thiocabamyl sulfenamides</i> • <i>Alkylphenol disulfides</i> • <i>Paraphenylenediamine derivatives</i> 	<p>Plasticizers</p> <ul style="list-style-type: none"> • <i>Paratoluene sulfonamide</i> • <i>Phthalates</i> • <i>Naphthylamines</i> <p>Stabilizers</p> <ul style="list-style-type: none"> • <i>Dibutyl tin dilaurate</i> • <i>Dibutyl tin maleate</i> • <i>Epoxy resins</i> <p>Antioxidants & Antiozonates</p> <ul style="list-style-type: none"> • <i>Amines</i> • <i>Phenols</i> • <i>Sulfides</i> • <i>Phosphites</i> • <i>PPD Series</i> 	<p>Donning Agents</p> <ul style="list-style-type: none"> • <i>Powders</i> • <i>Lubricants</i> <p>Processing Agents</p> <ul style="list-style-type: none"> • <i>Surfactants</i> <p>Retarders</p> <ul style="list-style-type: none"> • <i>N-nitrosodiphenylamine</i> • <i>Phthalic anhydride</i> • <i>Sulfonamide derivatives</i> <p>Biocides</p>
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Symptoms

A Type IV glove-associated reaction has a delayed response where the time from exposure to maximum expression of physical symptoms is 6 to 48 hours.^{4,12} Symptoms include redness, swelling and small blisters or clustered vesicles that often elicit pain when scratched. Chronic conditions, the result of repeated contact, may be accompanied by dry, thickened skin, crusting, scabbing, sores, papule formation, peeling, scaling and open lesions.⁴

Visually distinguishing between irritation and Type IV reactions is difficult. Both invoke similar inflammatory responses. Identification is aided by remembering that glove-associated irritation is confined to the area of glove contact⁹ and symptoms become rapidly apparent. Symptoms of a chronic Type IV glove-associated reaction may extend beyond the glove border⁹ and the symptoms are delayed.

Numerous contact sensitizers including formaldehyde, quaternary ammonias and gluteraldehydes have been associated with inhalation as well as dermal contact Type IV responses. Powder may act as a vehicle for these substances to be transported and inhaled.

Allergic Reactions: Type IV (continued)

Glove Selection for Reducing the Risk of Developing a Type IV Allergy

In order to reduce the risk of developing a Type IV glove-associated reaction, choose latex or synthetic gloves low in residual chemicals (see Vol. 1 *FirstHAND: Critical Glove Barrier Issues*).

They should be low in residual chemicals generally and low in chemical contact sensitizers specifically. This will reduce exposure to the chemicals that can cause genetically prone individuals to develop this type of allergy. There are two claims that manufacturers may use to identify gloves that have low levels of chemical contact sensitizers. The first is a “low dermatitis potential” claim, and the second is specific to the chemical(s) being tested. Manufacturers must obtain permission from the FDA before applying these claims. Both require test data from the 200 Person Modified Draize Test.

Below is the packaging label for Claim 1, “Low Dermatitis Potential”. In order to make this claim, a minimum of 200 individuals not known to be allergic to glove chemicals will have had negative 200 person skin sensitization test (Modified Draize) results.

Claim 1¹³

Low Dermatitis Potential

This product demonstrated reduced potential for sensitizing users to chemical additives.

Warning: Do not use this product if you have a known allergy to natural rubber protein* or chemical additives.**

* This warning is important because natural rubber latex (NRL) gloves which are low in residual chemicals are not necessarily low in NRL protein allergens. The phrase is not used if the gloves are synthetic.

** This is necessary as the gloves were not evaluated on individuals allergic to the chemical additives.

After passing the 200 person Modified Draize Test for Claim 1, the manufacturers may evaluate their gloves on 25 individuals already allergic to one of the specific chemical contact sensitizers normally found in gloves. If the FDA accepts the data, the following statement for Claim 2 may be placed on the label:

Claim 2¹³

Low Thiuram &/or Carbamate &/or Thiazole

This product demonstrated reduced potential for causing reactions in individuals sensitized to [Name of chemical(s)].

Warning: Do not use this product if you have a known natural rubber protein allergy.*

* This warning is important because natural rubber latex (NRL) gloves which are low in residual chemicals are not necessarily low in NRL protein allergens. The phrase is not used if the gloves are synthetic.

Each chemical listed must have been patch tested on 25 individuals allergic to that specific chemical.

To aid in comparing the residual chemical content of one glove to another, it is helpful to obtain the following information from the manufacturer:

- *Confirmation that the Low Dermatitis Potential statement is on the label*
- *High performance liquid chromatography (HPLC) test data*
- *Thin layer chromatography (TLC) test data*

Glove-Associated Reactions

Allergic Reactions: Type IV (continued)

These assays should specifically test for the presence of chemical contact sensitizers most often cited as inducing glove-associated allergic contact dermatitis. Powder-free gloves should be considered to reduce the potential for powder associated aerosolization and inhalation of chemicals which may be bound to the powder.

Important: Determine if the information provided applies to all the gloves the manufacturer will supply your facility. Private label gloves may come from several different manufacturers with different formulations and manufacturing processes, thus possessing different residual chemicals.

Management

If a glove-associated Type IV reaction is suspected, consult with the supervisor, employee health and/or occupational health professional. A dermatologist should be consulted if symptoms persist. Dermatologists may use a commercially prepared diagnostic patch test⁹ series containing the chemical sensitizers most often found in gloves. This may give information that will assist in avoiding the chemical(s) to which you are allergic—in gloves or other products. Management practices may include:

- *Switching to gloves documented to be low in residual chemicals and low in chemical contact sensitizers.*
- *Selecting powder-free gloves only.*
- *Wearing glove liners made of cotton, nylon or other materials.**
- *Considering allergen contact avenues other than the gloves. For example, the accelerator thiuram is also present in fungicides, pesticides and a number of adhesive materials.⁸*



The patch test is used in the diagnosis of Type IV allergy. Chemical contact sensitizers known to be used in the manufacture of both latex and synthetic gloves are often used as test samples as are lotions, soaps, glove fragments and other potential sources of chemical sensitizers.

* If you choose to use liners, be sure to replace them every time gloves are changed. Glove liners do not replace hand washing.

Type I (Immediate Type Hypersensitivity, Natural Rubber Latex Allergy, Protein Allergy)



The second allergy and potentially the most severe⁹ of the three glove-associated reactions is a Type I Hypersensitivity. This is an IgE antibody mediated allergy^{8,14} to the naturally occurring proteins found in raw natural rubber latex (NRL) from the rubber tree, *Hevea brasiliensis*.¹ Ten to twelve of the approximately 240 protein peptides in raw latex⁸ have been reported to be the major allergens, capable of inducing the production of IgE antibodies.¹⁵ Genetically prone individuals are those whose DNA have the instructions for making IgE to the specific allergen under question. Successive challenges by that specific latex protein allergen amplifies the production of IgE antibodies specific to that allergen. These IgE antibodies attach to increasing numbers of circulating mast and basophil cells.⁵ The now sensitized cell populations are dispersed throughout the body with the highest concentrations found within and around mucosal tissues (e.g. ocular, oral, respiratory, gastro-intestinal and genital tracts). These cells slowly die off naturally, as all cells do, but are replaced with newly created sensitized cells after

allergen exposure. Finally, a sufficient number of these sensitized cells may be present to actually trigger clinical symptoms when in contact with the allergen. This is known as the “symptom threshold limit” and is unique to each individual.

Allergic Reactions: Type I (continued)



Surgeon with facial symptoms experienced by some individuals with Type I, latex allergy.



Hives are dermal symptoms that may be experienced in a Type I allergic reaction by individuals allergic to protein allergens in natural rubber latex.

Once an individual's symptom threshold level is reached, subsequent contact with the specific protein allergen(s) triggers the sensitized cells to release immunological mediators¹⁴ such as histamine.⁹ Exposure can occur through direct skin or mucosal contact, invasive procedures, inhalation or aerosolized allergens⁹ (e.g. carried by powder).

For example, individuals allergic to NRL protein should avoid environments where high protein powdered gloves are worn as NRL protein laden powder may be inhaled and a reaction precipitated. The individual may or may not have asthma specific to latex protein allergens. If they do, the inhalation of the NRL proteins can precipitate an asthma attack.

Those who have the genetic make-up to develop many different allergies (e.g. allergies to ragweed, grasses, pollens, peanuts, and foods) are referred to as atopic individuals. Because atopic individuals have a greater probability for developing any allergy, they are also at a higher risk for having the genetic make-up for developing an allergy to NRL proteins.¹⁴

Others who appear to be at increased risk for latex allergy include those born with spina bifida¹⁴ and those who have had surgery during the first weeks of life followed by multiple surgeries or procedures thereafter.¹

Symptoms

Once their symptom threshold has been reached, individuals who have an allergy to natural rubber latex proteins may have a reaction within minutes to an hour after exposure to the allergen(s),¹⁴ thus the term Immediate Type Hypersensitivity.

There are a number of different symptoms for Type I allergy. These may appear locally at the point of contact or may spread throughout the body. Table 2 is a listing of possible symptoms.

Table 2

Dermal	Gastrointestinal	Facial	Respiratory	Systemic
<i>General Itching</i> ^{22, 23}	<i>Abdominal Cramps</i> ^{22, 23}	<i>Flushing</i> ^{22, 23}	<i>Asthma</i> ²²	<i>Anaphylactic shock</i> ²²
<i>Hives</i> ^{22, 23}	<i>Diarrhea</i> ^{22, 23}	<i>Itchy, watery eyes</i> ^{22, 23}	<i>Difficulty in breathing</i> ^{22, 23}	<i>Cardio-respiratory arrest</i> ²³
<i>Swelling</i> ^{22, 23}	<i>Nausea</i> ^{22, 23}	<i>Rhino-conjunctivitis</i> ²²	<i>Laryngeal Edema</i> ²²	<i>Dizziness</i> ²³
	<i>Vomiting</i> ^{22, 23}	<i>Runny nose</i> ^{22, 23}	<i>Sneezing/Coughing</i> ^{22, 23}	<i>Drop in blood pressure</i> ^{22, 23}
		<i>Swelling of eyelids/lips/face</i> ^{22, 23}	<i>Wheezing</i> ^{22, 23}	<i>Rapid heart rate</i> ²³

Glove-Associated Reactions

Allergic Reactions: Type I (continued)

These symptoms may be more of a nuisance, like hay fever, and never go any further; or they may progress and become more severe. It is important to note that response trigger levels are extremely individual depending on a person's genetic make-up and their circumstances of exposure.

If a latex allergy is suspected, an allergist should be consulted. After a thorough medical history is taken, a RAST (Radioallergosorbant tests)^{8, 14} or ELISA (enzyme-linked immunosorbent assay)¹⁶ blood assay may be performed to determine the presence of IgE antibodies specific to NRL proteins.⁹ If the serum is positive for these antibodies, the individual is identified as sensitized to NRL. If they experience no clinical symptoms, they are not yet considered allergic.

Often, a skin prick test (SPT) may be performed by placing samples of latex proteins in solution directly on the skin to test for a reaction.^{8, 14} A small sharp device or tine is used to prick a shallow break in the skin through the allergen droplet. Positive responses are identified by the development of a hive at the site. This is usually referred to as a wheal and flare response. If the serum is positive for NRL specific IgE antibodies or there is a positive SPT result, the individual is said to be sensitized to NRL. If they have experienced no clinical symptoms in routine contact with NRL products, they are not yet termed "latex allergic".

It should be noted that some positive responses could actually be due to cross-reactive allergies to several different substances.^{9, 14} Reports have stated that individuals who are allergic to any of these cross-reactive allergens may be at an increased risk for developing a latex allergy and vice versa.¹⁶ Table 3 is a compilation of some documented cross-reactive allergens.



Table 3

<i>Almond</i> ¹⁷	<i>Celery</i> ^{14, 17, 18, 19}	<i>Grapefruit</i> ¹⁷	<i>Oregano</i> ²⁰	<i>Potato</i> ^{9, 14, 18, 19}	<i>Turnip</i> ¹⁴
<i>Apple</i> ^{14, 17, 18, 19}	<i>Cherry</i> ^{14, 18, 19}	<i>Hazelnut</i> ^{17, 19}	<i>Papaya</i> ^{9, 14, 18, 19}	<i>Ragweed</i> ¹⁹	<i>Walnut</i> ^{17, 19}
<i>Apricot</i> ^{18, 19}	<i>Chestnut</i> ^{14, 17, 18, 19}	<i>Hevea brasiliensis</i> ¹⁶	<i>Passion Fruit</i> ^{14, 17, 18, 19}	<i>Rye</i> ¹⁹	<i>Wheat</i> ^{14, 19}
<i>Avocado</i> ^{9, 14, 17, 18, 19}	<i>Date</i> ²¹	<i>Kiwi</i> ^{9, 14, 17, 18, 19}	<i>Peach</i> ^{14, 17, 18, 19}	<i>Sage</i> ²⁰	
<i>Banana</i> ^{9, 14, 18, 19}	<i>Dill</i> ²⁰	<i>Lettuce</i> ¹⁷	<i>Peanut</i> ^{17, 19}	<i>Spinach</i> ^{14, 17}	
<i>Beet</i> ¹⁷	<i>Ficus Benjamina</i> ¹⁷	<i>Mango</i> ^{14, 19}	<i>Pear</i> ^{14, 17, 19}	<i>Strawberry</i> ^{17, 19}	
<i>Buckwheat</i> ¹⁷	<i>Fig</i> ^{14, 17, 18, 19}	<i>Melon</i> ^{14, 18, 19}	<i>Pineapple</i> ^{14, 18, 19}	<i>Timothy Grass</i> ¹⁴	
<i>Carrot</i> ^{19, 20}	<i>Grape</i> ^{18, 19}	<i>Mugwort</i> ¹⁹	<i>Plum</i> ¹⁹	<i>Tomato</i> ^{9, 14, 17, 18, 19}	

There are additional diagnostic tests called challenge tests. One is when the individual wears the glove or parts of the glove to see if a reaction ensues. Another is the provocation challenge in which a glove is snapped in front of the patient's face. The patient is then observed for any expression of symptoms.

Allergic Reactions: Type I (continued)

Glove Selection for Reducing the Risk of Developing an NRL Type I Allergy

In order to reduce the risk of developing a Type I glove-associated allergy, you may choose either latex or synthetic gloves. The choice will depend on the glove barrier needed for the task at hand. (See Vol. 1 *FirstHAND: Critical Glove Barrier Issues*.) If latex gloves are chosen, they should be low in natural rubber latex protein allergen(s). Powder-free gloves should be considered to further reduce the potential for powder associated aerosolization.

To compare NRL gloves produced from different manufacturers, ask for the following information:

- *Total Protein: This is determined utilizing the ASTM D5712 Modified Lowry method, and will provide the total amount of protein whether it is from natural rubber latex or any other source. Lower is better.*
- *NRL Antigenic Protein: The ASTM D6499 Test Method for the Immunological Measurement of Antigenic Protein in natural rubber and its products, ELISA Inhibition or the LEAP (Latex ELISA for Antigenic Protein) assays measure only latex proteins that the body can recognize (antigenic). This does not mean the protein is an allergen although there is a close correlation. Lower is better.*
- *NRL Allergenic Protein: There are RAST and alternate methodologies to measure the NRL allergens in a glove using the serum of latex allergic individuals. Lower is better.*

Management

If a glove-associated Type I reaction is suspected, consult with the supervisor, employee health and/or occupational health professional. An allergist experienced in diagnosing Type I latex allergies should be consulted if symptoms persist. Upon diagnosis of latex allergy, management practices may include:

- *Wearing gloves made from materials other than natural rubber latex.*
- *Notifying your colleagues and personal health care providers.*
- *Requesting that colleagues not wear powdered latex gloves.*
- *Wearing medical alert identification.*
- *Carrying a source of epinephrine injection if prescribed.*
- *Being observant of any symptoms that may develop after contact with cross-reactive allergens. (See Table 3.)*

The accompanying guides may assist the healthcare professional in the identification and differentiation of glove-associated reactions.

Summary

Glove-associated reactions are a concern for the healthcare professional. Each reaction has specific causes, symptoms and management criteria. The accompanying attachment may serve as a guide for the differentiation of glove-associated reactions. Prudent glove selection is critical to reduce the risk of developing glove-associated reactions and respiratory complications. By becoming aware of the causes of these reactions, recognizing their signs and symptoms, and acquiring information on glove selection and management practices, healthcare professionals can better safeguard their health and the health of others within their environment.

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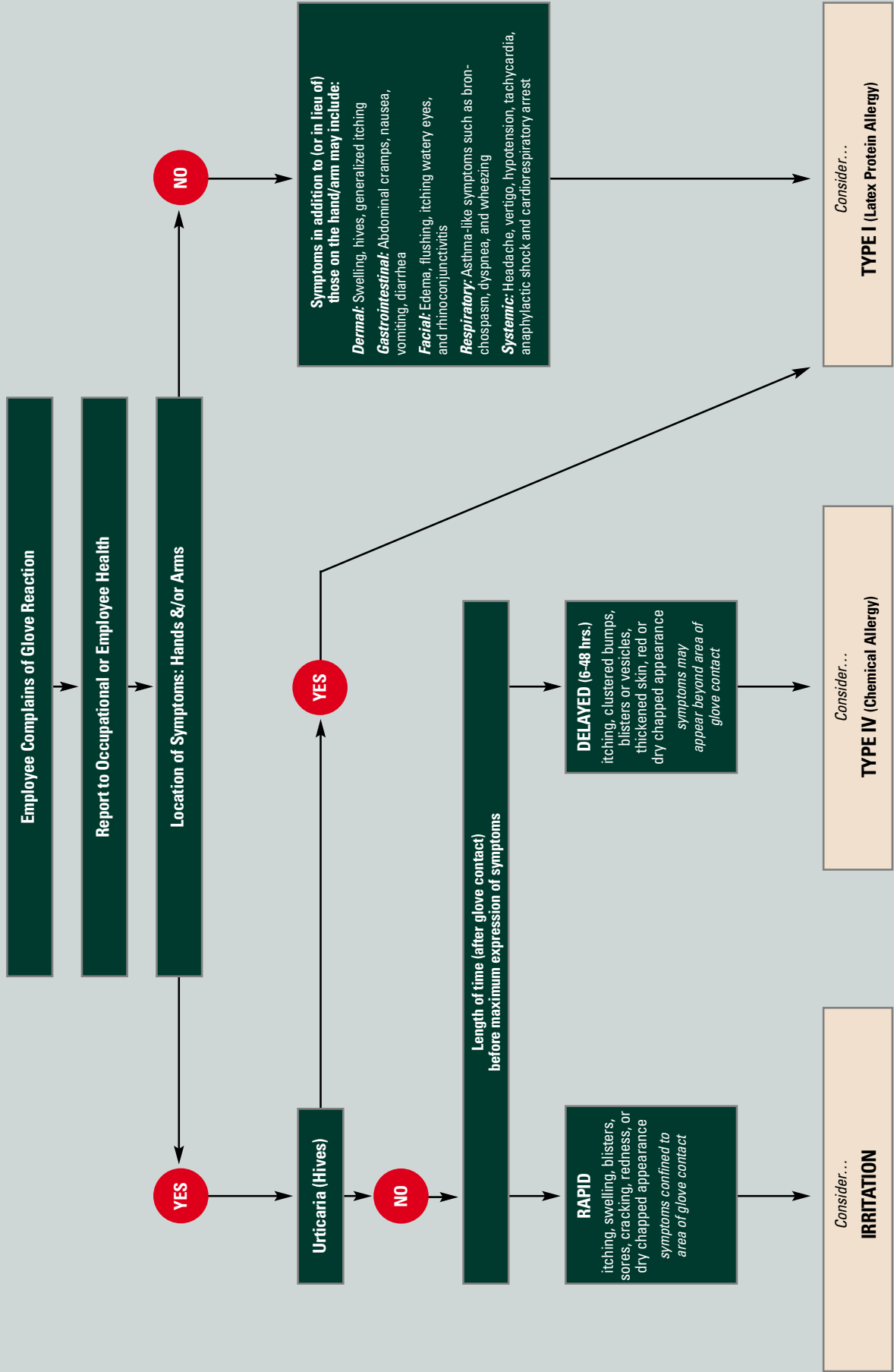
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References

1. OSHA Technical Information Bulletin: *Potential for Allergy to NRL Gloves and other Natural Rubber Products*; 1999.
2. US Department of Health and Human Services. *Guidance for Medical Gloves*. HHS Publication FDA 97-4257. September 1997.
3. US Department of Health and Human Services Center for Devices and Radiological Health. *Medical Glove Powder Report*, Sept 1997.
4. Truscott, W. Chapter 13; Latex Glove Use: Essentials in Modern Hospital Safety. *Handbook of Modern Hospital Safety*, 1999.
5. Reese DJ, Reichl RB, McCollum J. "Latex Allergy Literature Review: Evidence for Making Military Treatment Facilities Latex Safe." *Military Medicine*. 166:9 (September 2001): 764-770.
6. Page EH, Esswein EJ. *NIOSH Health Hazard Evaluation Report*. HETA 98-0096-2737, CDC: NIOSH publications office, 1998.
7. FDA. *Surgeon's and Patient Examination Gloves; Reclassification and Medical Glove Guidance Manual Availability; Proposed Rule and Notice—21 CFR Parts 801, 878, and 880*. Federal Register: July 30, 1999. 64:146. 41709-41743' www.fda.gov/ohrms/dockets/98fr/073099.txt.
8. Taylor JS, Leow YH. "Cutaneous Reactions to Rubber." *Rubber Chemistry and Technology: Rubber Reviews*. 73:3 (July-August 2000): 427-485.
9. Cohen DE. et. al. "American Academy of Dermatology Position Paper on Latex Allergy." *Journal of the American Academy of Dermatology*. 39 (July 1998): 98-106.
10. Kalish RS. "Glove Dermatitis." ACI International, August 1, 1996.
11. Larson WG, Adams RM, Maibach HI. *Color Text of Contact Dermatitis*. Philadelphia, PA: W.B. Saunders Company; 1992. 40.
12. Rietschel RL, Fowler Jr JF, eds. Chapter 4: Histology of Contact Dermatitis. *Fisher's Contact Dermatitis*, 4th ed. Baltimore MD:Williams & Wilkins; 1995. 38-39.
13. U.S. Department of Health and Human Services Food & Drug Administration, Center for Devices and Radiological Health. *Premarket Notification [510(k)] Submissions for Testing for Skin Sensitization to Chemicals in Natural Rubber Products*. CDRH home web page: <http://www.fda.gov/cdrh/ode/994.pdf>.
14. Warshaw EM. "Latex Allergy." *Journal of the American Academy of Dermatology*. July 1998, 39:1.
15. Yip L; Hickey V;Wagner B; Liss G;Slater J; Breiteneder H; Sussman G; Beezhold D. "Skin prick test reactivity to recombinant latex allergens." *Int Arch Allergy Immunol*; 121:4 (April 2000): 292-9.
16. Ganglberger E, Radauer C, Wagner S, O'Riordain G, Beezhold D H, Brehler R, Niggemann B, Scheiner O, Jensen-Jarolim E, Breiteneder H. "Hev b8, The Hevea brasiliensis Latex Profilin, Is a Cross-Reactive Allergen of Latex, Plant Foods and Pollen." *Int Arch Allergy Immunol*; 2001. 125: 216-227.
17. Levy DA, Leynadier F. "Latex and food allergy." Proceedings from an International Symposium: Latex Allergy 1998, /Paris, France: January 1998.
18. Cheng L, Lee D. "Review of Latex Allergy." *J Am Board Fam Pract*. 12:4 (Jul-Aug 1999): 285-292.
19. Greer Labs. "Allergenic Cross-Reactivity of Latex and Foods." From Internet: <http://home.netcom.com/~nam1/GreerLabs.html>; Allergenic Cross-Reactivity of Latex and Foods: Technical Bulletin #10; January 5, 2000.
20. Kagen SL, Muthiah R. "Latex and food induced anaphylaxis: Oregon, dill, sage and carrot cross-react with natural rubber latex." *Journal of Allergy and Clinical Immunology*. 101:1 Part 2 (1998): S208.
21. Heese A; Peters K; Koch H. "Type I Allergies to Latex and the Aeroallergenic Problem." *Eur J of Surgery*. 163:Suppl 579 (May 1997): 19-22.
22. Falcone KJ, Powers DD. "Latex Allergy: Implications for Oral Health Care Professionals." *Journal of Dental Hygiene*. Summer 1998, 72:3. 25-27.
23. *Latex Allergy and Health Care Workers: Learning to protect yourself*. San Bruno, CA: Krames Communications; 1998, 3.

Glove-Associated Reactions: Identification Algorithm*

* This is a guideline only. Your staff allergist and dermatologist should review hospital protocols regarding glove-associated reactions.



Glove-Associated Reactions: Differentiation Guideline

Irritation



Symptoms:

Burning, itching, redness, inflammation, swelling, excessive dryness, cracks or horizontal fissures, sores, blisters, papules (small, hard bumps), thickened skin with crusting and peeling

Extent:

Stops at glove boundary

Causes:

Chemicals, powder, endotoxin, friction, occlusion (lack of air to the skin), long-term water or sweat contact

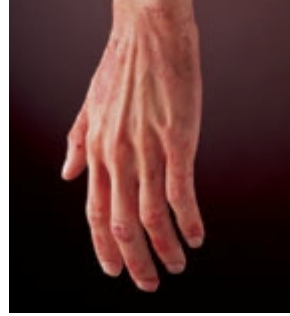
Susceptibility:

Anyone can experience

Action:

- Consult with your supervisor, employee health and/or occupational health professional
- Consult a dermatologist if symptoms persist
- Wear a larger glove to increase air circulation until hands heal
- Change gloves more frequently to allow air to get to the hands if gloves are worn for long periods
- Wear powder-free gloves
- Consider anti-inflammatory creams; however, avoid petroleum-based creams when wearing latex gloves
- Choose gloves low in residual chemicals
- Consider using glove liners made of cotton, nylon or other materials

Type IV, Chemical Allergy



Symptoms:

Redness, swelling, small blisters, clustered vesicles, itching, pain, dry, thickened skin, crusting, scabbing, sores, peeling, scaling, open lesions, papules

Extent:

May extend beyond glove boundary

Causes:

Chemical additives—accelerators (thiurams, thiazoles, carbamates, thioureas), antioxidants, antiozonates, plasticizers, donning agents, biocides, etc.

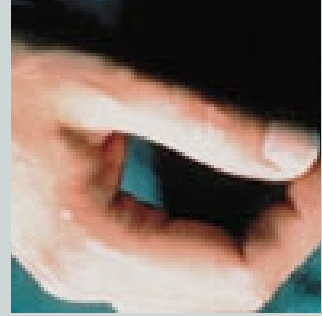
Susceptibility:

Must have the genetic predisposition to develop an allergy to those specific chemicals

Action:

- Consult with your supervisor, employee health and/or occupational health professional
- Consult a dermatologist if symptoms persist
- Wear powder-free gloves
- Switch to gloves documented to be low in contact sensitizers and low in residual chemicals
- Consider allergen contact avenues other than the gloves
- Consider glove liners made of cotton, nylon or other materials

Type I, Latex Protein Allergy



Symptoms:

Hives, swelling, watery eyes, runny nose, difficulty breathing, asthma, abdominal cramps, dizziness, low blood pressure, rapid heart rate, anaphylactic shock

Extent:

May extend beyond glove boundary; may become systemic

Causes:

Protein allergens from the raw natural rubber latex of the rubber tree *Hevea brasiliensis*

Susceptibility:

Must have genetic predisposition to develop an allergy to latex protein allergens

Action:

- Consult with your supervisor, employee health and/or occupational health professional
- Consult an allergist
- Wear only synthetic gloves
- Notify your colleagues and personal health care providers
- Request that individuals wearing gloves in the area use only powder-free latex or synthetic gloves
- Wear medical alert identification
- Carry a source of epinephrine injection if prescribed
- Be observant of any symptoms that may develop after contact with cross-reactive allergens



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