Introduction

By the early 1900s the use of Natural Rubber Latex (NRL) gloves was common in the surgical suite in both Europe and the United States. Although the use of latex gloves in surgery became routine after World War I, gloves such as examination gloves, were not consistently used in other areas of patient care until the onset of the AIDS epidemic and the spread of hepatitis.

The increase incidence of Hepatitis B (HBV), Hepatitis C (HCV) and AIDS (HIV) infections in the early to mid-1980s resulted in a tremendous increase of latex examination gloves although alternatives such as vinyl and technology for various synthetics existed. Latex examination gloves were proven to be one of the best methods of preventing transmission of HIV and hepatitis from infected patients to healthcare workers.

By 1987, the US Centers for Disease Control and Prevention (CDC) instituted Universal Precautions (today called “Standard Precautions”) recommending the use of personal protective equipment such as gloves, masks, gowns, and eye shields to prevent transmission of bloodborne pathogens to save lives and prevent injury or illness in the workplace. This practice was quickly mandated in many countries by healthcare authorities and professional healthcare associations around the world and may have accounted for this tremendous increase in glove usage. Between 1987 and 1996, the use of NRL gloves among medical professionals rose by more than 1000% (McCall, 2003; CDC).

In 1986, about 1 billion disposable gloves were sold worldwide*

In 2001, more than 30 billion pieces, including both latex and non-latex gloves, are manufactured every year. More than 20 billion of them, representing over $1 billion in purchases, are shipped to the United States. It is the single largest category of product sold by healthcare distributors. (Repertoire 2001)

In 2008, more than 12 billion units of medical gloves were sold in the EMEA region.

Production of Gloves ('000 Pairs)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Gloves (All types)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>3,186,794</td>
</tr>
<tr>
<td>1990</td>
<td>3,592,020</td>
</tr>
<tr>
<td>1991</td>
<td>4,439,018</td>
</tr>
<tr>
<td>1992</td>
<td>6,490,206</td>
</tr>
<tr>
<td>1993</td>
<td>9,726,772</td>
</tr>
<tr>
<td>1994</td>
<td>6,566,404</td>
</tr>
<tr>
<td>1995</td>
<td>6,991,781</td>
</tr>
<tr>
<td>1996</td>
<td>8,204,626</td>
</tr>
<tr>
<td>1997</td>
<td>9,010,261</td>
</tr>
<tr>
<td>1998</td>
<td>10,475,379</td>
</tr>
<tr>
<td>1999</td>
<td>10,916,612</td>
</tr>
<tr>
<td>2000</td>
<td>11,318,970</td>
</tr>
<tr>
<td>2001</td>
<td>12,082,387</td>
</tr>
<tr>
<td>2002</td>
<td>12,319,576</td>
</tr>
<tr>
<td>2003</td>
<td>15,051,026</td>
</tr>
<tr>
<td>2004</td>
<td>18,219,298</td>
</tr>
<tr>
<td>2005</td>
<td>19,146,849</td>
</tr>
<tr>
<td>2006</td>
<td>20,570,058</td>
</tr>
<tr>
<td>2007</td>
<td>20,570,666</td>
</tr>
<tr>
<td>2008</td>
<td>22,585,554</td>
</tr>
<tr>
<td>2009</td>
<td>23,132,708</td>
</tr>
<tr>
<td>2010</td>
<td>26,257,329</td>
</tr>
<tr>
<td>2011</td>
<td>30,897,840</td>
</tr>
<tr>
<td>2012</td>
<td>31,753,978</td>
</tr>
<tr>
<td>2013*</td>
<td>8,451,432</td>
</tr>
</tbody>
</table>

* Jan-March Source: Department of Statistics, Malaysia

Glove formers on production line
Latex Glove History

William Halsted is the surgeon given credit for the introduction of surgical gloves in 1896. As chief of surgery at Johns Hopkins Hospital, his nurse, Caroline Hampton (later to become his wife), developed severe dermatitis from mercuric chloride, the disinfectant used to clean instruments and hands. As a result, he asked the Goodyear Rubber Company to make rubber gloves. These gloves were developed not to protect the patient but rather to protect the hands of those providing healthcare. Goodyear made two pairs of rubber gloves with gauntlets. They proved so effective in protecting Caroline Hampton’s skin that they became a common item used in the operating room.

By chance Halsted’s glove request coincided with early discoveries about the relationship between infection control and improved patient outcome. In 1847 in Vienna, Semmelweis identified a link between infection and death in maternity patients cared for by physicians who were not washing their hands. Further, in 1843 in the United States, Oliver Wendell Holmes became an advocate for various medical reforms and notably posited the controversial idea that the hands of doctors were capable of carrying puerperal fever from patient to patient.

Those early gloves were not the thin barrier protection of today. They were thick and reusable, sterilized by boiling, and donned over wet hands. As sterilization techniques were refined, wet glove over wet hand donning was eventually abandoned and the use of powdered lubricants came into fashion. Gloves continued to be reused but were washed in mild soap, rinsed in distilled water, inspected for holes and tears, and then allowed to dry. They were then hand-powdered in a powder box before being wrapped and steam-sterilized. Extra powder packets were also available for the surgical team to apply to their hands just prior to donning.

Finally, in 1966, single-use powdered gloves became available, and these continue to set the standard of care today.
Powdered Lubricant History

The boiled wet glove over wet hand scenario described above was not without its problems. It caused the skin to become macerated. As sterilization techniques were refined, wet glove over wet hand donning could be abandoned. A dry method that could withstand the rigors of the new steam autoclave (sterilization process) was needed in order to don gloves, and powdered lubricants began to be used.

Powder is used in the manufacturing process for the following three reasons:

1. Donning of glove:
   Donning powder is applied to the inside of the finished glove so that the wearer is able to put the glove on smoothly. The powder also acts to absorb sweat from the hands of the wearer.

2. Eliminate glove blocking
   A powder may be used on the surface of the finished glove to keep the gloves from sticking to itself and to the glove package, also referred to as “blocking.”

3. Mold release
   A powder used in slurry that coats the glove former at the beginning of production, so that the latex uniformly covers the former and the finished glove is able to be removed from the former.
Donning Lubricant Agents

A variety of powdered lubricants have been used since 1890:

Club moss

*Lycopodium clavatum*, or club moss, was one of the early glove lubricants in use by approximately 1890. Club moss was sometimes combined with talc to provide the powder necessary to ease the donning of latex gloves. With its use came early reports of complications, including tissue irritation, masses and adhesions.

Talcum powder

Following this revelation, many glove manufacturers switched to a talc-only lubricant. Talcum powder is a combination of magnesium silicate (chemically pure talc) with calcium magnesium carbonate, calcium magnesium silicate, and sometimes other substances. Early in its use, talc was also implicated in producing granuloma, adhesion, and inflammatory responses.

Search began in the early 1940s for a talc substitute. It took a while before a suitable alternative could be found. Various powders were experimented with, but they could not withstand the time and pressure in the autoclave without clumping. Additionally, the removal of glove powders was not a precaution practiced by the surgical team at that time.

Cornstarch

In 1947 experiments by Lee and Lehman led to the discovery of a mixture of cornstarch, a powder treated with epichlorhydrin, and other ingredients. Cornstarch was able to withstand the autoclave and was acceptable to the wearer. Animal experiments established that cornstarch was absorbed with little or no reaction (Woods et al., 1997). As a result, early in the 1950s a corn starch derivative began replacing talc as the surgical glove powder of choice.

Due to the continued reporting of talc complications, several national Pharmacopeia restricted the use of talc as an absorbable dusting powder for medical glove lubrication. Unfortunately cornstarch too was not without its problems, and further experiments by Lee demonstrated that even this compound produced adhesions, inflammation and a foreign body-like reaction.
Mold Release Agents

Talc and cornstarch have also been used in the glove manufacturing process in order to remove the finished product from the dipping mold. Cornstarch was trialed early on but could not be used because it would dissolve and disperse in the dipping solution. Today, a release agent such as calcium carbonate may be used. A powder-free coagulant is also available as a mold release substitute.

Dipping formers into natural rubber latex
Today’s Powders

Regulations

Today, most international standards do not accept the use of talc as a lubricant.

- European standard EN 455-part 3 (Medical gloves for single use - Part 3: requirements and testing for biological evaluation) specifies for instance that “Gloves shall not be dressed with talcum powder (magnesium silicate)"
- American standards ASTM D3577 - 06e1 “Standard Specification for Rubber Surgical Gloves” and ASTM D3578 - 05e1 Standard Specification for Rubber Examination Gloves specify that the outer surface and inner surface of these rubber gloves shall be free of talc.
- In APAC countries, ISO standards are predominantly used as the reference standards. Countries that have their own standards e.g. ANZ, Japan and China are usually based on ISO as well.
  - Australia Medical Device Regulations require for the safety of the device to be established - as do many others and this is where talc would not be deemed acceptable.
  - Where ISO does not exist for a certain method or specification, state of the art standards are acceptable as well. This means the ASTM and EN are covered for APAC.

In Europe, gloving powders used for medical gloves must be in compliance with several specifications defined in standards and must also comply as well with EN ISO 10993 – Biological evaluation of medical devices and EN ISO 14971, Medical devices - Application of risk management to medical devices (ISO 14971:2000). They also have to comply with the European Pharmacopeia, while in the US they have to meet the requirements of a specific monograph for absorbable dusting powder set out in the United States Pharmacopeia (USP). In most of the cases manufacturers use a cornstarch cross-linked with epichlorhydrin or phosphorus oxychloride and with no more than 2% magnesium oxide (to prevent caking or turning to paste).
Washing Powdered Gloves

Since the early 1970s, many national and international standards have required manufacturers to label their sterile powdered surgical glove packages with a specific warning to remove the powder.

- In 1971 the FDA required manufacturers to label their glove packages with the following warning: “CAUTION: Powder should be removed from the gloves after donning by wiping gloves thoroughly with a sterile wet sponge, sterile wet towel, or other effective method.”
- EN 455-3 today requires the following labeling: “CAUTION: Surface powder shall be removed aseptically prior to undertaking operative procedures in order to minimize the risk of adverse tissue reactions.”
- In APAC most countries follow these guidelines above.

Ineffective

Studies have shown that this procedure of washing surgical gloves is not effective in removing cornstarch powder from gloves, and may in fact cause the cornstarch to clump together. Ellis pointed out in a publication that “conventional washing of the donned glove in saline solution was ineffective. It has been shown that careful washing of the gloves in two successive bowls of saline solution fails to remove all the starch.” He also documents another technique that was shown to reduce the number of starch granules from 2,720 (with no attempt to remove starch) to zero when utilizing a “one-minute cleansing with 10 mL of povidone-iodine, followed by a 30-second rinse under sterile water” (Ellis, 1990).

Poor compliance with printed instructions has been cited in the literature, and washing powder off gloves prior to surgery is not completed consistently. Some of the reasons for poor compliance include awareness of required washing, cost of materials and time necessary to complete the activity. Additionally, powdered gloves are sometimes used in departments that cannot wash them properly as they do not have the sterile materials readily available to do so (e.g., ER, outpatient clinics, bedside, and interventional radiology).
Washing Powdered Gloves

Costs

In a study by Fraser, the cost associated with washing procedures for cornstarch dusted gloves was determined by adding basin costs that contained the solution, solution cost, and unit wiping materials together and dividing by the number of team members.

The direct cost of washing materials averaged $0.46 per glove with a range between $0.26 to $1.25 per glove, depending on the materials used and the level of washing required.

### Estimated cost in Europe

<table>
<thead>
<tr>
<th>Function</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile basin or bowl (disposable)</td>
<td>€ 1.10</td>
</tr>
<tr>
<td>Sterile towel (ea.)</td>
<td>€ 0.75</td>
</tr>
<tr>
<td>10 mL povidone-iodine</td>
<td>€ 0.05</td>
</tr>
<tr>
<td>+ 500 cc sterile water or saline</td>
<td>€ 0.60</td>
</tr>
<tr>
<td>Glove washing set-up total*</td>
<td>€ 2.50</td>
</tr>
</tbody>
</table>

Also consider additional costs:

1.5 minutes of OR time x € 19 per minute = € 28.50 of OR cost

Total additional OR expense due to glove washing = € 31

*costs will vary by country, region, distributor, and contracts

### Estimated cost in Asia

<table>
<thead>
<tr>
<th>Process</th>
<th>Washing Powder Gloves</th>
<th>Qty.</th>
<th>Qty Per Case</th>
<th>Powder</th>
<th>Powder-Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Glove</td>
<td>1 Pair</td>
<td>4 Pairs / Case</td>
<td>RM 1.30</td>
<td>RM 2.50</td>
</tr>
<tr>
<td>2</td>
<td>Sterile Water</td>
<td>500 mL</td>
<td>500 mL / Case</td>
<td>RM 2.50</td>
<td>No Cost</td>
</tr>
<tr>
<td>3</td>
<td>Sterile Basin (120”x120”)</td>
<td>1 Unit</td>
<td>1 unit / Case</td>
<td>RM 8.00</td>
<td>No Cost</td>
</tr>
<tr>
<td>4</td>
<td>Sterile Gauze</td>
<td>1 Sheet</td>
<td>1 Sheet / Case</td>
<td>RM 0.50</td>
<td>No Cost</td>
</tr>
</tbody>
</table>
Health and Safety Concerns

It has been demonstrated that NRL proteins bind to the cornstarch particle. Exposure to starch powder from both surgical and examination gloves can cause a number of undesirable reactions and complications for the patient and the healthcare provider. These vary from well-known allergy symptoms and upper respiratory-tract disorders to post-operative complications including adhesions and infections as well as laboratory misdiagnosis.

Glove powder can act not only as a vehicle for latex antigens but also for opportunistic and pathogenic microorganisms, which increase the occupational risks to both healthcare workers and patients.

Patient Exposure

Clinical reports, case studies, and further experimentation continue to report adverse reactions to gloving powders, when left in the wound, including inflammation, granuloma formation, granulomatous peritonitis, adhesions, allergic responses, contribution to wound infection, and delayed wound healing. All of these contribute to longer hospital patient stays and increased healthcare costs.

When glove powders are introduced during a surgical procedure; they play a role in excess scar tissue formation, inflammatory reactions in the eye and pericardia, as well as the peritoneal and pleural cavities, and other areas (Hunt, 1994). The longer the body is exposed to glove powders, the greater the chance for complications.
Health and Safety Concerns

Patient Exposure (Cont’d.)

In addition to intra-operative complications from gloves, other reports have documented glove powder contamination of epidural catheters, leading to neurological complications, as well as being a potential cause for catheter occlusion (Truscott, 1997). Cardiac complications such as granulomatous endocarditis and thrombi have also been documented (Truscott, 1977). Glove powders have caused contamination of blood filters; granuloma formation from liposuction, facial sinus, and mastoiditis; and inflammation of joints following orthopaedic surgery. Uterine and fallopian tube adhesions, resulting from glove powder, are a significant risk of female infertility; the papers note that powder free gloves should be used even for routine vaginal examination.

In experiments conducted by Newsom and Shaw, it was demonstrated that Methicillin-resistant S. aureus (MRSA) and Vancomycin-resistant Enterococci (VRE) may be able to use glove powder as a vector and/or food source in a hospital environment (Newsom & Shaw, 1997).

Solution: Powder-Free Gloves

The significance of these findings justifies the consideration of switching from powdered to powder-free gloves. The market has responded to this need with many choices and styles of powder-free gloves. Healthcare workers should strive to eliminate any avenue of contamination that could impact positive patient outcomes and prolong a patient’s hospital stay.
Healthcare Worker Exposure

Healthcare workers (HCWs) are exposed to glove powders when they wear gloves, work in areas where powdered gloves are used (such as the operating room, lab, and ER); or when they touch surfaces and items touched by others wearing powdered gloves.

Experts believe the repeated exposure to latex by direct contact, by contact with mucous membrane, or by inhalation plays a role in the following:

1. Irritant Contact Dermatitis

Irritant Contact Dermatitis is a non-immune reaction. It is a local reaction from damage to the skin from such things such as:

- detergents
- frequent hand washing
- inadequate drying
- climate extremes
- pre-existing dermatitis
- aggressive scrubbing techniques
- glove powders

This reaction is simply an irritation of the skin and should not be confused with an allergy. Symptoms can include redness, chapping, chafing, dryness, scaling, cracking, and subjective symptoms such as itching and burning.

2. Immediate Type I Hypersensitivity – Latex Allergy

Latex allergy is a medical term encompassing a range of allergic reactions to the proteins present in natural rubber latex. Latex is the milky sap of the commercial rubber tree, *Hevea brasiliensis*. Latex allergy, type I hypersensitivity can cause an immediate and potentially life-threatening reaction, not unlike the severe reaction some people have to bee stings.

Nutter first reported this immune reaction in 1979. It is not solely the result of exposure to gloves, but also to other natural rubber latex-based products such as condoms, balloons, rubber nipples, and other latex medical equipment. While much less common than delayed (chemical) reactions, the immediate allergic response has received more attention, both from researchers and in the literature, because of its potentially more serious outcome. In the majority of cases reported, the symptoms are a swelling and redness (commonly described as a "wheal and flare" reaction) local to the site of exposure, accompanied by non-specific symptoms such as itching and burning. A type I latex allergic response can elicit a more systemic symptomology such as conjunctivitis, rhinitis, and bronchial obstruction. More seriously and fortunately more rarely, symptoms of anaphylaxis, and in extreme cases, anaphylactic shock, can occur.
Healthcare Worker Exposure

2. Immediate Type I Hypersensitivity – Latex Allergy (Cont’d.)

Depending on the reference source, the incidence of latex allergy is approximately:

- 10% - 17% among healthcare workers
- 13% - 17% among the dental population
- 28% - 67% among the spina bifida population
- 1% - 6% among the general population

A well-documented consequence of the use of starch powder in gloves is its capacity to bind with natural rubber latex (NRL) protein antigens (Hesse, 1997). These allergen/protein coated powder particles can be aerosolized when the gloves are donned or removed, thus contaminating the hospital environment. Inhalation or ingestion of these powders can lead to the sensitization and diverse allergic reactions to NRL (i.e. upper respiratory tract symptoms or eye irritation).

Solution: Powder-Free Gloves

Allmers et al reported a decrease in the number of healthcare workers with suspected NRL allergy including occupational asthma and contact urticaria when powdered gloves are substituted by powder-free gloves. Further, in a study conducted in Sweden, the investigators surveyed HCWs before and after implementation of powder-free glove use. They concluded there was a reduction in upper airway symptoms in the powder-free environment (Edelstam, 2002).
Healthcare Worker Exposure

3. Occupational Asthma

More and more healthcare workers are developing occupational asthma, a lung disease caused by inhaling workplace fumes, gases, or, in the healthcare environment, glove powder. In developed countries, it is the most common work-related lung disease. Although its exact prevalence is unknown, some researchers estimate it may account for 9 percent of asthma cases.

Occupational asthma can develop even if you have never had asthma before or had childhood asthma that previously cleared. It can worsen any pre-existing asthma. With treatment, occupational asthma is usually reversible. However, the only way to prevent its worst complication —permanent lung damage— is to completely avoid the substance causing the disease. It is possible to develop occupational asthma in almost any workplace, but the risk is highest in certain occupations. The Mayo Clinic in the US, listed the top 15 jobs at risk, and healthcare workers were part of that list. The asthma producing substance found in the hospital setting is the latex particles contained in aerosolized glove powder.

Signs and symptoms may include wheezing, coughing, shortness of breath, chest tightness, difficulty exercising, runny nose, and eye irritation. During the early stages of the disease, symptoms develop shortly after exposure, and up to 12 hours after exposure. Asthma may worsen as the workweek progresses, and subside during weekends and vacations, only to reoccur upon return to work.

In the later stages, symptoms may also develop away from work. Once the lungs have developed a pattern of overreacting to the offending substance, sensitivities to other substances may develop, such as house dust, cigarette smoke, and cold air.

The diagnosis for occupational asthma is made by an allergist on the basis of medical history and physical exam. The physician may perform pulmonary function tests, spirometer, and peak flow tests. The best treatment is to completely avoid the substance that causes symptoms. Asthma medications to help relieve symptoms may be prescribed. It might be necessary for healthcare workers to transfer to another job to prevent exposure to glove powder.

Solution: Powder-Free Gloves

A healthcare facility that removes powdered gloves from the environment is being proactive in ensuring the health and safety of employees and patients. Research has shown that the reduction of residual extractable proteins in latex gloves has a significant impact on reducing the incidence of allergic reactions to latex. Studies in the U.S., Canada, and Europe demonstrate that wearing low protein; powder-free latex gloves greatly reduces the risk of allergic reactions and the likelihood of developing latex sensitivity. In addition, studies have shown that the use of low-protein, powder-free gloves allowed latex-sensitive individuals donning synthetic gloves to work safely alongside their colleagues.
Healthcare Worker Exposure

Occupational Asthma (Cont’d.)

A few newer studies are outlined below:

1. German study “The disappearance of NRL-allergy in Germany and Europe” conducted by Prof. Dr. Henning Allmers, et al., demonstrated that prohibiting the use of powdered natural rubber latex (NRL) gloves led to a decrease of new cases of type-I allergic diseases (asthma and urticaria) in German healthcare personnel.

![Graph: Purchase of non-sterile NRL examination gloves in all German acute care hospitals plus incidence of suspected cases of NRL-induced occupational asthma and contact urticaria per 1,000 insured healthcare workers in private and church-run acute care hospitals from 1996-2005.]

2. Ten year follow-up study of over 2000 healthcare workers in Trieste Hospitals in Italy was published in the May 2013 issue of International Archives of Occupational and Environmental Health. The individuals represented 9,660 person-years of non-powdered latex glove use from 2000 to 2009. The incidence of latex sensitization was 1 case per 1,000 person-years. The researchers concluded that the rate of latex sensitization and latex-related symptoms was very low.

3. In mainland China, powdered, natural rubber latex glove use is still widespread. To learn the prevalence and risk factors for latex glove allergy among clinical nurses there, information was collected from over 8000 female nurses in 35 hospitals in eight provinces. Almost 9% of the nurses surveyed had latex allergy. The study concluded that Chinese nurses are at high risk for latex sensitization, and that “low-protein powder-free natural rubber latex gloves, or latex-free gloves should be widely adopted in China.”

4. A cross-sectional study of female nurses in Thailand also demonstrated the higher risk of latex allergy associated with powdered latex gloves. “Of 899 nurses, 18% reported health effects attributed to the use of latex products,” states the study. It concluded that when compared to data from developed countries, the continued use of powdered latex gloves in developing countries is associated with increased prevalence of latex allergy dermal symptoms.

Occupational Asthma (Cont’d.)

Clearly, regular use of powdered latex gloves with uncontrolled levels of latex proteins puts individuals at much greater risk for developing latex allergy, while modern, low-protein, powder-free latex gloves are a safer choice.

ECRI, a non-profit international health services research agency and a Collaborating Center of the World Health Organization, confirmed that using lower-protein gloves—especially powder-free gloves—can help reduce the suffering and costs that result from NRL sensitivities. It also confirmed that, even though lower-protein NRL gloves sometimes cost more, they may be the most cost-effective choice.

<table>
<thead>
<tr>
<th>Regulatory agencies, institutions and associations endorsing the use of powder-free, low-protein latex gloves</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDC</td>
</tr>
<tr>
<td>FDA</td>
</tr>
<tr>
<td>WHO</td>
</tr>
<tr>
<td>National Institute for Occupational Safety and Health (NIOSH)</td>
</tr>
<tr>
<td>Association of periOperative Registered Nurses (AORN)</td>
</tr>
<tr>
<td>American Nurses Association</td>
</tr>
<tr>
<td>Association for Professionals in Infection Control and Epidemiology (APIC)</td>
</tr>
<tr>
<td>American College of Surgeons</td>
</tr>
<tr>
<td>Association of Surgical Technologists.</td>
</tr>
<tr>
<td>American Academy of Allergy, Asthma &amp; Immunology</td>
</tr>
<tr>
<td>American College of Allergy, Asthma &amp; Immunology</td>
</tr>
<tr>
<td>Australian College of Operating Room Nurses (ACORN) Standards</td>
</tr>
<tr>
<td>Australian Dental Association (ADA) Guidelines for Infection Control</td>
</tr>
<tr>
<td>BGW (in German Berufsgenossenschaft für Gesundheitsdienst und Wohlfahrtszwecken)</td>
</tr>
<tr>
<td>German Social Accident Insurance Institution for the Health and Welfare services</td>
</tr>
<tr>
<td>Royal college of Physicians – UK</td>
</tr>
<tr>
<td>Royal Australasian College of Surgeons (RACS)</td>
</tr>
<tr>
<td>Robert Koch Institut (RKI)</td>
</tr>
<tr>
<td>Gesetzliche Unfallversicherung (GUV)</td>
</tr>
<tr>
<td>Bundesverband Medizinprodukte (BVMED)</td>
</tr>
<tr>
<td>Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF)</td>
</tr>
</tbody>
</table>

Direct Costs

Additional direct costs which may be associated to healthcare provider exposure to glove powders include:

- Employee health issues (sick time)
- Loss of salary for extra sick days taken
- Cost of replacing trained staff
- Workman’s compensation for occupational asthma
- Doctor visit cost i.e., cost of diagnostic tests, medication, or treatments
- Cost of testing employees for latex allergy
- Cost of infection incidents
- Loss of physician – professional search – decreased productivity with MD absent

These all contribute to lost healthcare employee productivity and disability, for which the risk can be significantly decreased with the use of powder-free gloves.
Powder-Free Gloves

Because the manufacturing process is more complex for powder-free latex gloves, the additional cost is reflected in their sale price. In the long run, however, the health advantages of the powder-free latex glove are inarguable; whether the glove is being used healthcare, in a tattoo parlor or at an airport security checkpoint.

Powder-free latex surgical gloves of the latest generation receive a synthetic coating (hydrogel, silicone or another polymer) that produces the same qualities as those of powdered gloves (stretch, ease of donning, flexibility). This also helps in donning of the glove and prevents glove blocking.

As Ansell has a variety of products and dipping lines, the dipping processes can differ from product to product. However, the above diagram would be appropriate for all powder-free gloves with polymer coating on the inner surface.
Ansell Cares

For years, Ansell has been raising industry’s awareness of the fact that the level of proteins in natural rubber latex (NRL) contributes to the sensitivities and allergies experienced by healthcare staff who wear, or even work in the vicinity of, NRL gloves.

As the world leader and specialist in medical gloves, Ansell has also been very attentive to all possible risks related to the use of NRL gloves. For years it has educated consumers about such risks, while at the same time providing alternative gloving solutions that work. Its efforts have included early commitments to fundamental research, the creation of its Ansell Cares initiative, and ever increasing investments in innovative R&D and dedicated engineering. Ansell’s position is to enable the healthcare community to make a responsible choice when choosing gloves to provide the best protection for healthcare workers and patients.

Ansell Cares was created in Dec 1991 in response to the FDA’s Medical Alert on Latex Allergy to provide valuable support to the healthcare industry through a carefully structured program of education, research and awareness.

Ansell Cares was developed with three goals in mind:

To research the cause, prevention and treatment of latex allergies.

To educate patients and healthcare workers to recognize, prevent and treat these reactions.

To create awareness of the issues of latex sensitization.

Today Ansell Cares:

Remains a global multifaceted education program guided and supported by leading scientists, physicians, educators and researchers from around the world.

Creates education and awareness campaigns among healthcare professionals, industry experts and consumers, to help identify and prevent healthcare-associated infections, and preventable errors and injuries in the perioperative setting.

Seeks to provide a safer working and living environment while promoting good health and well-being.
Glove powder includes dusting or donning powders, mold-release compounds, and manufacturing debris. Dry lubricants such as cornstarch, silicone etc., are used to make donning gloves easier and to prevent gloves from sticking together during the manufacturing process, of which cornstarch, which meets the specification for absorbable dusting powder in the United States Pharmacopoeia (USP), is the most common lubricant for medical gloves.

Only absorbable dusting powders that have an approved Premarket Approval Application (PMA) or New Drug Application (NDA) may be used for lubricating surgeon’s gloves. There are no comprehensive studies of the amount of absorbable dusting powder used on powdered gloves. It is estimated that amounts of total particulates may range from 120 to 400 mg for a medium size powdered glove. (FDA Medical Glove Powder Report)

Glove powder is composed of particles, thus, issues related to biologic responses to foreign bodies apply to both natural rubber latex (NRL) and synthetic gloves that are powdered.

The major adverse impact of glove powder appears to be its contributing role in undesirable reactions and complications for both the patient and healthcare provider. All of these contribute to increased healthcare costs:

- Powder can cause the development of adhesions and granulomas
- Powder increases the risk factor for post-operative wound infections
- Powdered gloves can increase latex allergens sensitization and provoke hypersensitivity type I reactions
- Powder contaminates the hospital environment and increases occupational asthma and exposure to latex allergens through inhalation
- Powder can increase the risk of cross contamination of microorganisms
- Powder can interfere with laboratory testing causing false results
- Powder has an abrasive action on the skin
- Powder increases time and costs

Experts recommend that those involved in health and safety policy decisions should switch their organizations’ from powdered to powder-free, low protein latex gloves as an effective method of reducing both patient complications associated with powdered gloves and the incidence of asthma and latex allergy in healthcare providers.
Test

You have completed the Hazards Associated with Glove Powder module of the Preventing Glove-Related Complications course.

Please login and complete the online test for Module 1 now.

LOGIN
Glossary

AIDS (eydz)
AIDS stands for acquired immune deficiency syndrome. It is related to HIV, but they are not one in the same. A person has AIDS only in the final stages of HIV, after the immune system becomes unable to defend itself against foreign invaders like bacteria, other viruses, and fungi, and allows for the development of certain cancers.

Adhesion (ad HEE zhuhn)
Adhesions are fibrous bands that form between tissues and organs, often as a result of injury during surgery.

Anaphylactic shock (an uh fuh LAK tic)
Anaphylaxis is a serious allergic reaction that is rapid in onset and may cause death. It typically causes a number of symptoms including an itchy rash, throat swelling, and low blood pressure.

Anaphylaxis (an uh fuh LAK sis)
Anaphylaxis is a severe, whole-body allergic reaction to a chemical that has become an allergen. After being exposed to a substance such as bee sting venom, the person's immune system becomes sensitized to it. When the person is exposed to that allergen again, an allergic reaction may occur. Anaphylaxis happens quickly after the exposure, is severe, and involves the whole body. Tissues in different parts of the body release histamine and other substances. This causes the airways to tighten and leads to other symptoms.

Antigen (AN ti juhn)
An antigen is any substance that causes your immune system to produce antibodies against it. An antigen may be a foreign substance from the environment such as chemicals, bacteria, viruses, or pollen.

Asthma (AZ muh)
Asthma is a chronic (long-term) lung disease that inflames and narrows the airways. Asthma causes recurring periods of wheezing (a whistling sound when you breathe), chest tightness, shortness of breath, and coughing. The coughing often occurs at night or early in the morning.

Blocking
Using a pattern or form to shape gloves during the manufacturing process.

Bronchial obstruction (BRONG kee uh)
Airway obstruction is a blockage of respiration in the airway. It can be broadly classified into being either in the upper airway or lower airway.

Coagulant (koh AG yuh luht)
A substance that causes coagulation. To cause transformation of (a liquid or solid, for example) into or as if into a soft, semisolid, or solid mass.

Conjunctivitis (kuhn juhngk tuh VAHY tis)
 Conjunctivitis, also known as pinkeye, is an inflammation of the conjunctiva, the thin clear tissue that lies over the white part of the eye and lines the inside of the eyelid.

Cornstarch
A starch or a starchy flour made from corn

Donning
To put gloves on hands.

Granuloma (gran yuh LOH muh)
A granuloma is a small area of inflammation in tissue. Granulomas are most often the result of an infection.

Hepatitis B (hep uh TAHY tis)
Hepatitis B is a liver disease that results from infection with the Hepatitis B virus. It can range in severity from a mild illness lasting a few weeks to a serious, lifelong illness. Hepatitis B is usually spread when blood or another body fluid from a person infected with the Hepatitis B virus enters the body of someone who is not infected.

Hepatitis C (hep uh TAHY tis)
Hepatitis C is an infectious disease affecting primarily the liver, caused by the hepatitis C virus (HCV). The infection is often asymptomatic, but chronic infection can lead to scarring of the liver and ultimately to cirrhosis, which is generally apparent after many years. In some cases, those with cirrhosis will go on to develop liver failure, liver cancer or life-threatening esophageal and gastric varices.

Human Immunodeficiency Virus (HIV)
(im yuh noh di FISH uhuhn)
HIV compromises the body's ability to handle disease and causes AIDS; this is a slow process, and positive people may not have symptoms for over a decade

Inflammation (in fluh MEY shuhn)
Inflammation is part of the complex biological response of vascular tissues to harmful stimuli, such as pathogens, damaged cells, or irritants. The classical signs of acute inflammation are pain, heat, redness, swelling, and loss of function.
Glossary

Lycopodium clavatum
(lahy kuh POH dee uhm)
Lycopodium clavatum is a plant that is normally classified in the genus Lycopodium, which is under the club moss family Lycopodiaceae.

MRSA
MRSA stands for methicillin-resistant *Staphylococcus aureus*; the term is used to describe a number of strains of the bacteria, that are resistant to a number of antibiotics, including methicillin.

Mastoiditis (mas to DAHY tis)
Mastoiditis is the result of an infection that extends to the air cells of the skull behind the ear.

Mold release
A chemical used to prevent other materials from bonding to surfaces of molds or dies.

Natural rubber latex (LEY teks)
Latex rubber is a mixture of organic compounds produced by some plants in special cells called caticifers. Most natural rubber comes from a single species of rubber tree, *Hevea brasiliensis*.

Non-immune (ih MYOON)
Not having immunity; susceptible; likely to be affected with, if exposed.

Occupational asthma (AZ muh)
Occupational asthma is a lung disorder in which substances found in the workplace cause the airways of the lungs to swell and narrow, leading to attacks of wheezing, shortness of breath, chest tightness, and coughing.

Peritonitis (per i AHY tis)
Peritonitis is an inflammation of the peritoneum, the thin tissue that lines the inner wall of the abdomen and covers most of the abdominal organs.

Pericardia (per i KAHR dee uh)
The membranous sac filled with serous fluid that encloses the heart and the roots of the aorta and other large blood vessels.

Proteins (PROH teenz)
Proteins are large biological molecules, or macromolecules, consisting of one or more chains of amino acid residues.

Povidone-iodine
(POH vi dohn - AHY uh dahyn)
Povidone-iodine (PVP-I), brand name Betadine, is a stable chemical complex of polyvinylpyrrolidone (povidone, PVP) and elemental iodine (I). It was first sold in 1955 and has since become the universally preferred iodine antiseptic.

Rhinitis (RAHY nahy tis)
Rhinitis is irritation and inflammation of the mucous membrane inside the nose.

Saline (SEY leen)
In medicine, saline (also saline solution) is a general phrase referring to a sterile solution of sodium chloride (NaCl, more commonly known as salt) in water.

Spirometer (spahy ROM i ter)
A spirometer is an apparatus for measuring the volume of air inspired and expired by the lungs. A spirometer measures ventilation, the movement of air into and out of the lungs.

Talcum powder (TAL kuhm)
A white, grey, brown, or pale green mineral, found in metamorphic rocks. It is used in the manufacture of talcum powder and electrical insulators. Composition: hydrated magnesium silicate.

William Halsted
William Stewart Halsted was an American surgeon who emphasized strict aseptic technique during surgical procedures. He was an early advocate and practitioner of sanitary surgical practice, and he insisted on meticulous cleanliness in the operating room and pioneered antiseptic procedures including the sterilization of all medical equipment, and in 1889 he contracted with a rubber manufacturer to make the first surgical gloves.
Bibliography


Cuming R. Reducing the Hazard of Exposure to Cornstarch Glove Powder. AORN. 2002 Aug; 76(2): 288-95


Dyck R. Historical Development of Latex Allergy. AORN. 2000 July


Ellis H. The Hazards of Surgical Glove Dusting Powders. Surgery, Gyn and Obstetrics. 1990 Dec; 171:521-527


Fay MF, Dooher DT. Surgical Gloves: Measuring Cost and Barrier Effectiveness. AORN. 1992 June; 55:1500-19


http://www.cdc.gov/niosh/dnpri/ch4.t4.htm
http://www.citizen.org/publications/print_release.cfm?ID=6629
http://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/ucm113316.htm
http://www.latexallergyresources.org/articles/article-occupational-latex-allergy-causing-your-patients-asthma
http://www.repertoiremag.com/Article.asp?id=855
http://www.who.int/injection_safety/toolbox/docs/AM_HCW_Safety.pdf
http://www.who.int/injection_safety/toolbox/docs/AM_HCw_Safety.pdf
http://www.latexallergyresources.org/articles/article-occupational-latex-allergy-causing-your-patients-asthma
http://www.repertoireremag.com/Article.asp?id=855
http://www.who.int/injection_safety/toolbox/docs/AM_HCW_Safety.pdf
http://www.latexallergyresources.org/articles/article-occupational-latex-allergy-causing-your-patients-asthma
http://www.repertoiremag.com/Article.asp?id=855


<< Back Continued >>
Bibliography


Питтель Д., Бойс Дж. Здравоохранение и Пациент: Путешествие Семмелвейса. Lancet Inf Dis. 2001; Apr 9-20


Turjanmaa K, Mäkinen-Kiljunen S. 2002 Latex allergy: prevalence, risk factors, and cross-reactivity. Methods 27: 10-14


Bibliography