SPECIAL REPORT

Reducing the Incidence of Allergic Contact Dermatitis and the Role of Latex Free Surgical Gloves

Acute Contact Dermatitis Caused by Latex in Healthcare Professionals and Patients

The Role of Latex-Free Surgical Gloves and How to Reduce the Incidence of Allergic Contact Dermatitis

Case Study: Safety, Productivity and Sustainability Are at the Heart of Bourges Hospital's Organisation's Programme for the Next Four Years

The Innovation of Surgical Glove Polymers to Deliver Strength, Comfort and Safety

The Cost and Benefit of Latex Alternatives

Value-Based Procurement (VBP) Has Come of Age

Gloving Guidelines for Safety and Latex Allergy Avoidance in the Operating Room

Future Outlook – Trends in Latex Allergies and Glove Use in the Healthcare Setting

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Foreword

Sensitivity to latex remains a health burden in both healthcare workers and patients, most commonly manifested as contact dermatitis in glove users and causing significant morbidity in patients with repeat exposure. While awareness, bans on powdered latex, and guidelines for latex use have improved the impact of latex allergies in the healthcare setting, the risk and prevalence of reactions are persistent, and latex use continues to be common in many regions. Acceptance of non-latex synthetic alternatives in surgical gloves has previously lagged but may likely increase given the improvements in both the safety and function of these materials.

As healthcare facilities transition to synthetic alternatives to latex gloves, such as those made from neoprene or polyisoprene, materials and manufacturing processes are changing to meet requirements for better fit, comfort, dexterity, tactile sensitivity, and durability in surgical gloves. Aside from providing the benefit of avoidance of latex allergies and having improved physical properties, modern synthetic gloves continue to improve with the introduction of those that are rubber accelerator-free to avoid contribution to contact dermatitis. These improved properties over previous iterations of non-latex glove alternatives are making the switch from latex increasingly attractive. These transitions to synthetic alternatives are addressing a persistent need to avoid latex sensitivities and are becoming more common, with legislation even dictating the elimination of latex gloves in some locations. In addition to the safety benefits, institutions and systems are looking to cut long-term costs by transitioning to latex alternatives through the prevention of productivity loss, legal liabilities, and procedural expense.

Altogether, improved safety, function, economics, and sustainability are supporting the rise of modern latex alternatives in surgical gloves. In this Report, we present reviews and commentaries on allergic reactions to latex gloves, advances in synthetic materials, long-term cost and sustainability considerations, clinical guidelines, awareness, and the experiences of hospital organisations with synthetic gloves as alternatives to latex.

Michael James
Editor

Dr. Michael A. James PhD *is a medical writer, biotech entrepreneur/founder in the fields of oncology and virology, and former faculty of Surgery and Pharmacology/Toxicology at the Medical College of Wisconsin. He holds a PhD in microbiology from the University of Iowa and was trained in cancer cell biology and molecular biology at Washington University in St. Louis.*

The images featured in this report are all from Centre Hospitalier Angoulême, which is the largest public health institution in the French department of Charente. Their mission is to take care of everyone who knocks at the door for treatment, regardless of their activities, gender or race. For maximum protection of both their patients and healthcare staff, the hospital has implemented a "zero latex" strategy in its entire Surgery Unit. By doing so they have not only eliminated all incidents related to latex allergies, they have also dramatically improved the workflow in their Surgery Unit, allowing them to fully concentrate on what they do best: taking care of those in need.

Acute Contact Dermatitis Caused by Latex in Healthcare Professionals and Patients

Michael A James, PhD

Introduction to Healthcare Workers' Risk of Latex Allergy

Healthcare professionals are at increased risk of developing latex allergies because of repeated exposure to latex. Latex sensitivities in operating room personnel averaged 15% among both developed and developing countries according to a 2021 meta-analysis[1], with the most prevalent cause of occupational latex allergy in healthcare being frequent latex glove use[2]. The negative impacts of latex allergy in healthcare professionals include the loss of work hours, income, employment, and quality-of-life[3]. Decreased work hours and productivity can significantly impact procedure delays and timely disease management. Being diagnosed with latex allergy can predispose individuals to risk of anaphylactic shock caused by latex exposure[4], which is the most common cause of anaphylaxis in the operating theatre[5]. Overall, the most common manifestation of latex allergy is contact dermatitis, followed by allergic rhinitis, contact urticaria, conjunctivitis, and asthma[6]. In the healthcare setting, work in both the ward and operating theatre, auxiliary staff work, atopy (a genetic predisposition to allergy), and over 10 years of hospital experience are independent risk factors for the development of allergies to latex gloves[6].

Improving Allergy Awareness

Awareness and education among patients and physicians will continue to be necessary to prevent and manage allergies to latex. On the physician's side, understanding how to evaluate risks and identify cases is critical and relies on physical examination and a thorough history. Identification of cases and communication with healthcare teams allows for timely intervention and prevention of reactions through avoidance of latex exposure, often requiring the use of latex alternatives where broad transitions away from latex have not been implemented. Awareness of contributing factors to contact dermatitis, the most common sensitivity caused by latex products, must be achieved in healthcare workers. Contact dermatitis is known to be caused by latex because of its protein content[7]. Awareness of latex alternatives in healthcare professionals is also crucial for the avoidance of latex-related contact dermatitis. However, several additional factors can contribute to contact dermatitis, including skin irritants, weather changes, and harsh antimicrobial soaps[8].

Patients can play a proactive role in avoidance of latex reactions through their own awareness of the risks and contributing factors. This applies to repeat exposure to medical equipment and devices containing latex, which often include surgical gloves. Such knowledge promises to continue to reduce the burden of latex allergies, particularly through the use of non-latex synthetic gloves. Outside the clinical setting, patients' awareness can also be of benefit through the avoidance of contributing factors and allergens, such as foods that may generate cross-reactivity with latex allergens. These include kiwi, avocado, chestnut, pear, celery and banana, and existing allergies to such foods are associated with higher risk of latex allergy[5].

The Case for Switching from Latex to Synthetic Gloves

It has been known for some time that the removal of latex gloves is effective in helping to prevent latex allergies in spina bifida patients, who are repeatedly exposed to latex[9]. Many institutions and regulatory agencies are now implementing or moving toward the removal of latex from the operating room. For example, the Mayo Clinic was able to reduce the use of latex in paediatric operating rooms by 93% through the replacement of latex with latex-free alternatives[10], showing that implementation of such programs is feasible in large medical centres. Programs replacing latex with synthetic alternatives are key components in the effort to make operating suites safe for staff and patients.

While the safety benefit of latex alternatives in glove choice is clear, there has historically been hesitance to adopt these alternatives based on the perception that their properties,

Unlike many of their predecessors, modern synthetic gloves provide the best combination of protection, comfort, and control within the industry

Advancements leading to modern synthetic surgical gloves have provided both safety (hypoallergenicity and asepsis) and function (tactile sensitivity, dexterity, comfort, and durability) in the operating room

such as tactile sensitivity, dexterity, durability, comfort, and ease of donning, were inferior. Since prevention of transfer of infectious agents is a primary function of surgical gloves, durability is a necessity for their usefulness. In surgery, dexterity, tactile sensitivity, and control are also necessary.These needs have increasingly been met by advanced synthetic materials and manufacturing processes, with research demonstrating their equivalence or superiority to latex for protection, sensitivity, dexterity, and control. This comes in a valuable combination with safety from latex allergies for both patients and healthcare staff.

Advancements in the Functional Properties of Synthetic Gloves

Unlike many of their predecessors, modern synthetic gloves provide the best combination of protection, comfort, and control within the industry. Latex gloves are associated with a high rate of perforation during procedures that involve mechanical stress to the glove[11]. This, together with the risk of latex allergy in patients and healthcare staff, makes it clear that there has been a need for better alternatives. While synthetic alternatives in surgical gloves had been previously only used in cases where a patient or staff member had a known latex allergy. This limited use was due to inferior durability and dexterity as perceived by the medical staff[12]. However, modern polyisoprene and neoprene (polychloroprene) alternatives have minimised that impediment to the switch to non-latex gloves for the prevention of latex allergies and preserved or improved the function of surgical gloves.

In terms of comfort, dexterity, and asepsis, polyisoprene and neoprene surgical gloves have been found to be superior or equivalent to latex in multiple studies[12]. A recent study showed that neoprene surgical gloves had similar tactile sensitivity to latex in pressure threshold (SWMT) and two-point discrimination (2PD) tests[13]. Another showed that, while all gloves affected tactile sensitivity over bare skin, there was variability among gloves in sensitivity as measured by 2PD and Semmes-Weinstein monofilament testing, with Gammex Latex Sensitive® providing significantly better sensitivity than other types tested, particularly in the monofilament test[14]. Double gloving did not affect sensitivity in this study. Another study demonstrated that the puncture rate of neoprene gloves was equivalent to latex[15]. These and several other studies have established sensitivity, dexterity, and amelioration of latex allergy with synthetic non-latex gloves[16],[17].

Optimising Operating Room Safety with Polyisoprene Gloves

Among the reasons to transition to non-latex synthetic gloves, safety in terms of asepsis and latex allergies comes to the forefront. Published research and case studies have increasingly supported the superior safety performance of modern synthetic glove alternatives. Surgical site infection can be a result of perforation or tearing of surgical gloves during certain procedures[11],[18]. Concerns regarding the durability of early non-latex gloves, in particular nitrile gloves, have necessitated modern manufacturing techniques to improve their durability[19],[20]. However, the superior durability of neoprene and polyisoprene has been established for decades. In the late 1990's, it was shown that the perforation resistance of neoprene gloves was equivalent to that of latex gloves[15]. Additionally, it was recently demonstrated that polyisoprene gloves are as protective against infection as latex gloves in perioperative situations[12].

While the safety benefit of synthetic gloves is clear in terms of avoidance of latex allergy, skin irritants in synthetic gloves, such as chemical accelerators, can still contribute to contact dermatitis[21]. However, manufacturing steps, such as leaching and washing, have mitigated these concerns in modern synthetic gloves. Switching to these "accelerator-free" gloves has been shown to alleviate contact dermatitis symptoms in healthcare workers with over two thirds eliminating symptoms altogether[22]. Recently, the chemical additive content of "accelerator-free" polyisoprene gloves (Ansell) was suggested to be below the threshold for causing type IV hypersensitivity[23].

In summary, advancements leading to modern synthetic surgical gloves have provided both safety (hypoallergenicity and asepsis) and function (tactile sensitivity, dexterity, comfort, and durability) in the operating room. The transition to these most recent iterations of non-latex gloves is well justified for the benefit of healthcare workers and patients.

REDUCING THE INCIDENCE OF ALLERGIC CONTACT DERMATITIS AND THE ROLE OF LATEX FREE SURGICAL GLOVES

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Among the reasons to transition to non-latex synthetic gloves, safety in terms of asepsis and latex allergies comes to the forefront. Published research and case studies have increasingly supported the superior safety performance of modern synthetic glove alternatives

The Role of Latex-Free Surgical Gloves and How to Reduce the Incidence of Allergic Contact Dermatitis

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Hygiene routines in hospitals and where patient care is provided have become increasingly strict as the healthcare sector has faced new challenges with HIV and the recent Covid pandemic. Thus, increased use of protective gloves for prolonged time periods increased the risk of contact dermatitis

Introduction

Adverse skin reactions to gloves used in healthcare primarily include quickly appearing reactions like urticaria and the usually later appearing dermatitis. The causes can be completely mechanical but often include non-immunological or immunological reactions in the skin. Often the cause is multifactorial, where endogenous causes, such as previous atopic dermatitis, might be of importance. Glove use in such cases causes occlusion of the skin, and extended use of the same or frequently changed gloves will lead to temporarily increased hydration of the skin causing disruption of the skin barrier. The shear stress of tight-fitting gloves may elicit physical urticaria in predisposed individuals. The clinical symptoms and timing of appearance usually give an indication as to whether this is a urticaria-like reaction or dermatitis (Fig 1). However, for quickly appearing reactions and regarding allergic contact dermatitis, an immunological cause such as latex must be excluded. Latex allergy, an antibody-mediated reaction to proteins in the sap from the rubber tree, Hevea brasiliensis, is diagnosed with a positive prick test and/or radioimmunoassay test (RAST) for latex-specific IgE. In allergic contact dermatitis, a T-cell mediated reaction is caused by residuals of additives used in glove production. A positive patch test for substances used or in glove production and/or the glove material will confirm the diagnosis. In this article, we will only address immunologic reactions in contact urticaria caused by latex in natural rubber gloves and, in particular, T-cell mediated reactions, also called contact allergies. Allergic contact dermatitis is unfortunately associated with many kinds of protective gloves that contain sufficient amounts of additives that cause contact allergy.

Allergic Contact Urticaria Caused by Gloves

Latex allergy, giving rise to contact urticaria, possible symptoms in the airways, and sometimes even progression to a state of anaphylaxis was of particular concern during 1980s and 1990s. Escalated use of disposable gloves during the increase in HIV-infected patients in combination with latex gloves with high amounts of allergenic proteins contributed to a high incidence of latex allergies. Also, use of powdered gloves increased exposure to air-transported allergens in healthcare locations, which increased the risk of systemic symptoms. Intense preventive measures were therefore taken to control the situation by demands on quality control of gloves with respect of allergen content and strict routines in health care.

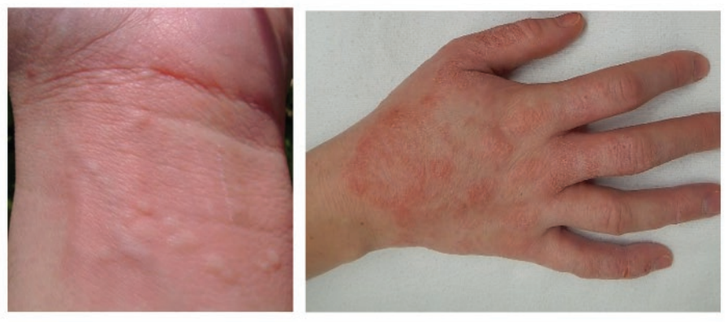

Figure 1. Allergic skin reactions from gloves. A, Contact urticaria. B, Allergic contact dermatitis.

Contact Dermatitis to Gloves

Hygiene routines in hospitals and where patient care is provided have become increasingly strict as the healthcare sector has faced new challenges with HIV and the recent Covid pandemic. Thus, increased use of protective gloves for prolonged time periods increased the risk of contact dermatitis. Hand dermatitis can impair the skin barrier, which is a risk factor for spread of infectious agents, such as staphylococci, and individuals with hand dermatitis may therefore be prohibited to work in areas with strict routines. Furthermore, hygiene routines with frequent hand washing and use of alcoholic disinfectants are often painful for an individual with an impaired skin barrier, making compliance with healthcare routines difficult. Dermatitis is thus a common cause for sick leave and may even cause the individual to leave the profession.

Contact Allergens in Gloves

About 3000 different chemicals are known contact allergens. Among these are a few metal salts, such as nickel, cobalt, and chromium salts. However, the vast majority are low-molecular weight organic chemicals, for example, preservatives, plastic monomers, fragrances, and rubber accelerators. Contact allergy to residuals of accelerators is the main cause of occupation-related allergies in healthcare workers in southern Sweden according to a study performed by Hamnerius and co-workers[1]. In this investigation, diphenylguanidine (DPG) was the rubber allergen that caused the highest number of positive tests. Less common allergens where thiurams, zinc dithiocarbamates, mercaptobenzothiazole, and thioureas. Additionally, antioxidants, biocides, retarders, pigments, and donning agents are described as glove allergens.

Clinical Investigation and Testing

If a patient presents with dermatitis, often with prolonged symptoms over days, delayed hypersensitivity or type 4 allergy must be considered as opposed to type I allergy. In that case, a patch test (epicutaneous tests) is mandatory. This test is conducted by application of selected allergens on the back of the patient in a controlled dose with exposure for 48 hours. Thereafter, the patches are removed and the back is examined by trained dermatologists on days 3 and 7 to detect possible test reactions where the skin has been exposed to the allergens. Usually, a screening test is performed covering the most frequent allergens in our daily environment followed by targeted patch testing taking into consideration the patient´s particular exposures. Some rubber allergens are found in the screening series, but occupational dermatology clinics usually have a rubber series with about 30 different “rubber allergens”. Some of them are tested as mixes, for example, those of rubber allergens: thiuram mix, carba mix, mercapto mix, or the black rubber mix (Table 1). The latter preparation is not relevant to medical gloves as these antioxidants are not used in these products. The thiuram mix, consisting of one thiuram monosulfide and three thiuram disulfides, gives the highest frequency of positive tests among rubber allergens. This is a contradiction, as thiurams are not used as accelerators in protective gloves. Instead, this outcome is explained by the chemical redox relationship between thiurams and dithiocarbamates, making thiurams a marker for dithiocarbamate allergy through cross-reactivity. Carba mix, on the other hand, contains two dithiocarbamates and diphenylguanidine. Mercaptomix contains mercaptobenzothiazol accelerator, its disulfide, and two additional

Contact allergy to residuals of accelerators is the main cause of occupation-related allergies in healthcare workers in southern Sweden according to a study performed by Hamnerius and co-workers

Table 1. Common rubber allergen mixes for patch testing

Thiuram mix	Tetramethylthiuram monosulfide (TMTM) Tetramethylthiuram disulfide (TMTD) Tetraethylthiuram disulfide (TETD) Dipentamethylenethiuram disulfide (DPTD)
Carba mix	Zinc diethyldithiocarbamate (ZDEC) Zinc dibutyldithiocarbamate ZDBC) 1,3-Diphenylguanidine DPG)
Mercapto mix	2-Mercaptobenzothiazole (MBT) 2,2'-Dibenzothiazyl disulfide (MBTS) N-Cyclohexyl-2-benzothiazolsulfenamide (CBS) 2-(4-Morpholinylmercapto)-benzothiazole (MMBT)
Thiourea mix	N,N'-dimethylthiourea (DMTU) N,N'-Diethylthiourea (DETU) N,N'-Diphenylthiourea (DPTU)

sulfenamides. An additional group of allergenic accelerators is thioureas, which are used in polychloroprene rubber.

An important complement to the test preparations mentioned above is testing with preparations of the actual gloves in use. This can be performed by simply applying a 2cm x 2cm piece of the glove on the skin. A number of clinics also make extracts of the glove in acetone or alcohol to test with. The advantage of testing with the actual material is that the content is not fully known in products such as gloves. If the glove or extract of the material is tested, possible chemical substances formed during production will be patch tested simultaneously.

The epicutaneous test is a provocation test to elicit a reaction in an already sensitized individual. The dose used in patch testing to elicit an allergic reaction is much less than the sensitization dose, and thus, the technique cannot evaluate whether a substance is an allergen per se, as testing in non-sensitized individuals should not evoke an allergic reaction. Only a very low concentration is necessary to give a positive reaction in an allergic subject compared to that in a healthy person.

Exposure and Relevance

Once an individual is found to have a contact allergy, the relevance of the reaction must be evaluated. Does the contact allergy explain the symptoms? As hand dermatitis in health care personnel can have a large impact, once a rubber contact allergy is found, it is of the utmost importance to identify whether the gloves used contain allergens or substances that cross-react. If the gloves contains the allergen, preventive measures can easily be taken. If culprit allergens are identified, alternative gloves without the harmful components can be chosen. To achieve satisfactory assessment of relevance, some important information is needed. For example, accurate information from the manufacturer on residual additives in the gloves or results from chemical analysis of the gloves performed by the investigating clinic is required. Information that includes only added chemicals can be misleading as additives can react with each other during manufacturing resulting in new potent contact allergens[2]. There is not yet any part of the standard in the CEN 455 series that includes a specification on how the chemical analysis of residual chemicals in gloves should be done. However, recommendations are imminent.

To achieve satisfactory assessment of relevance, some important information is needed. For example, accurate information from the manufacturer on residual additives in the gloves or results from chemical analysis of the gloves performed by the investigating clinic is required

The Situation Today and in the Future

The glove market looks quite different in various parts of the world. In Scandinavia, latex gloves are relatively rare and have been so for decades. Therefore, latex allergy is rare among healthcare workers in that region[3]. The quality of natural rubber latex has improved, and determination of allergen content is tested. These preventive measures have proven highly effective. However, the scenario is different for allergic contact dermatitis, in which context the use of protective gloves has increased and thus also the risk of sensitization of the user.

Accelerator free gloves are now often used by personnel in hospitals and can be a valuable alternative for users with a diagnosed contact allergy to rubber accelerators. If the use of accelerator-free gloves becomes the norm rather than the exception, the number of sensitized users will decrease.

Speeding up the crosslinking of polymers with sulfur is the reason for addition of accelerators. There are several alternative approaches to manufacturing hypoallergenic gloves. Accelerators can be chosen with low allergenic potential. Examples include xanthates, which are assumed to degrade during manufacturing, or bulky dithiocarbamates such as zinc diisononyldithiocarbamate with low uptake rate to the skin because of high molecular weight. Also, crosslinking using new technologies is constantly under development[4]. Covalent crosslinking can be achieved by formation of oxygen links in polychloroprene rubber with zinc oxide as vulcanizing agent. Another example is the introduction of carboxylic acid functionality in the nitrile butadiene polymer, which enables both electrostatic crosslinking with zinc ions and covalent crosslinking with epoxylated molecules. Another approach is a photo-initiated process where UV-light enables crosslinking between polyisoprene chains. A completely different technology is the use of thermoplastic elastomers where styrene block copolymers organize themselves into a crosslinked network based on non-covalent attraction between styrene fragments in the polymers.

Use of disposable gloves is mandatory in healthcare. Although allergy is not the only cause of glove-related dermatitis, development of hypoallergenic products is particularly important both for the individual and society. However, introduction of new manufacturing techniques or additives might result in products containing new contact allergens. It is therefore important for patch testing clinics to be alert and follow the development in the glove industry.

REDUCING THE INCIDENCE OF ALLERGIC CONTACT DERMATITIS AND THE ROLE OF LATEX FREE SURGICAL GLOVES

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Case Study: Safety, Productivity and Sustainability Are at the Heart of Bourges Hospital's Organisation's Programme for the Next Four Years

Dr. Laurent Vaz, *Chairman of the Medical Commission at Bourges Hospital, France*

How banning latex from the surgery unit has helped our hospital achieve important milestones.

We have partnered with suppliers that use optimised compact packaging for surgical gloves, which has enabled us to reduce the space occupied by gloves by a significant 23%

The Medical Commission is a vital entity, established in each public hospital nationwide, that is entrusted with the responsibility of developing and implementing quality care policies. It plays a crucial role in overseeing the organisation and coordination of medical and paramedical services in close collaboration with the Director of Care, who primarily oversees the management of nurses and care assistants. Together, they ensure the provision of optimal healthcare services while maintaining high standards of patient care. To achieve this, all public health hospitals need to produce a four-year-plan that sets out a clear roadmap towards ambitious goals.

The Medical Commission's Organisation's Programme is Preparing Bourges Hospital for the Future

Our organisation's programme outlines our strategy for upholding and improving public healthcare provisions in the region. Within this comprehensive plan, we have sections dedicated to the important themes that drive our ambition to develop into a 'future-ready' hospital. One such a theme is our ecological responsibility. Regrettably, healthcare facilities often rank as the primary contributors to municipal pollution. This impact extends beyond the mere act of commuting to work. With 2,200 employees traveling to the hospital, vehicle emissions are a concern. Our healthcare operations also generate a significant amount of waste, including biohazardous materials that requires specialised disposal methods, incurring substantial costs. It is our duty to reduce waste to optimize our ecological footprint, and to achieve this we have adopted the philosophy to partner with suppliers who are able to guide and support us in our ecological transition. Here, we highlight those efforts as they apply to choice of surgical gloves. We have partnered with suppliers that use optimised compact packaging for surgical gloves, which has enabled us to reduce the space occupied by gloves by a significant 23%. In a hospital setting, where there is never enough space, this is a huge benefit. But above all, this also translates into a significant decrease in packaging waste.

Latex-Free Surgical Gloves: A Crucial Milestone in Enhancing Hospital Staff Safety and Patient Care Quality

Performance, in our context, encompasses delivering the right care to the right individual at the right time, while prioritising the satisfaction of both the caregiver and the patient. We know that latex is allergenic, and until recently, we have been dealing with it through well-observed safety processes. Previous initiatives led by our pharmacy to replace all latex gloves by synthetic alternatives had been met with resistance from the surgeons, who claimed that they were losing tactility and comfort. But the new generation of latex-free gloves are clearly on another level. During the trials, surgeons were amazed at how comfortable they were. They unanimously agreed that the tactility that they were used to had not been compromised, and that implementation was easy. Our surgery unit is now 100% latex free, and this has an immediate positive impact for both our staff and our patients. Over the course of a 30- to 40-year career, healthcare professionals will gradually get sensitised or become allergic to latex. It is estimated that up to 13% of hospital staff has been sensitised to latex. For them, not having to be in contact with latex means that they can perform at their best, without having to worry about this important occupational health risk. Our patients, who are sometimes not aware that they are sensitised to latex, let alone of the impact that a latex allergy can have on their lives, can rest at ease when they are in our care. That is an important attribute in a 'post AIDS' generation, which, with growing numbers, has been sensitised through the use of latex preservatives in their younger years. Vigilant screening for latex allergies during anaesthetic consults had always remained a concern until the implementation of non-latex gloves.

Boosting Productivity: The Impact of Latex-Free Gloves on Hospital Efficiency

By eliminating latex surgical gloves from our surgery unit, we have also eliminated the need to handle multiple types of gloves. We now only need to manage two surgical glove styles. As a result, the logistics of inventory and supply chain management have been significantly simplified. With fewer SKUs to manage, our pharmacy can optimise their stock levels, reduce the likelihood of stockouts or overstocking, improve overall inventory control, and reduce the number of orders placed. This streamlined approach not only saves time and effort in ordering and organising deliveries, but also equals optimised transport flows and minimises the potential for errors in selecting the appropriate glove sizes. Our pharmacy has conducted an analysis and found that, through this optimisation alone, they save at least four full-time working days. Our Theatre Manager is also reporting important productivity benefits. We now have full control over our theatres, and procedures for latex sensitised patients no longer require a specific schedule to be followed. Patient screening is easier and faster, and there is no longer the risk that allergies are detected late in the process, often causing rework, deferral or even cancellation of surgery. For the clinical team, it is also easier to remember the staff's glove sizes and avoid all risk of errors. Life in the O.R. is now simpler for all, and the team can focus more on delivering quality care and attending to patient needs, leading to improved hospital productivity and operational efficiency.

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The Innovation of Surgical Glove Polymers to Deliver Strength, Comfort and Safety

Geraldo Oliveira, *VP, R and D Ansell*

Despite the continuous advancement of technology, manufacturers have reached the limit of process capability to remove latex protein from NRL gloves

Why Has the Natural Rubber Latex (NRL) Polymer Used in Glove Formulations Stopped Improving?

Surgical gloves are a sterile medical device providing a two-way protective barrier to cross-contamination at a surgical site for the patient and wearer. Initially ,they were produced using non-rubber latex (NRL) and different types of powder as lubricants to make the donning of gloves easier, talcum powder and corn starch being the most recent. However, evidence has shown that the powder on the glove can be the allergen carrier, besides contributing to post-operative complications and inflammation. This led to the development of powder-free NRL gloves in the early 1990s as a safer alternative. With the evolution of glove technology, quality surgical gloves have been made thinner to improve the long-wearing comfort level and tactile sensitivity without compromising strength and durability.

In 1984, the first anaphylactic reactions caused by NRL surgical gloves were reported, followed in 1991 by the first report of a fatal anaphylactic reaction to latex. This led to increased research and awareness of the life-threatening risk of Type I latex allergy, hence the push for a safer solution. Medical glove manufactures find ways to reduce protein content during the manufacturing process using various methods, such as extensive leaching during dipping, chlorination, offline washing, etc. Regulatory guidelines and mandatory testing such as that using the Modified Lowry method (ASTM D5712; EN 455-3 Annex A) were introduced to ensure that the level of total protein content in gloves is kept at level that is deemed low risk. However, there are limitations to the testing method in terms of sensitivity level and the capability of identifying and quantifying the allergenic proteins that are clinically relevant to latex allergy. To go beyond the regulatory requirements and common industry practice, manufacturer may use the FITkit® test to overcome the significant limitations of the Modified Lowry method mandated by the regulatory bodies. Though this highly sensitive method enables the measurement of the four dominant protein allergens (i.e. Hev b 1, Hev b 3, Hev b 5 and Hev b 6.02) in NRL that are commonly known to cause latex allergy, it still has limitation in identifying other variants that could potentially be a risk.

Despite the continuous advancement of technology, manufacturers have reached the limit of process capability to remove latex protein from NRL gloves. The highly sensitive FITkit® test still has a limit of detection, which doesn't mean an allergen is 100% removed from the glove. Therefore, the risk for latex sensitization or allergic reaction cannot be entirely avoided.

What Other Glove Polymers Can Be Used to Produce Surgical Gloves?

Aside from NRL, Nitrile Butadiene Rubber (NBR), neoprene, and polyisoprene (PI) are available. Neoprene was the first to be used by manufacturers and is appreciated by many because of options that are less likely to cause Type IV chemical allergies and contain no allergens that cause Type I latex allergies. It is also known to have excellent chemical barrier properties. Over time, continued industry feedback to synthetic polymer raw material producers has led to improved polymer formulations with new molecular structures that are better suited for producing surgical gloves. Synthetic Polyisoprene (PI) is fast-growing in the industry, despite the cost of the material being much higher compared to other polymers. PI has become so popular because it delivers a perfect match to NRL in terms of comfort, fit, and feel since it has the closest polymer structure. As a synthetic rubber polymer, it doesn't contain NRL proteins, making it an attractively safer option. However, whilst free of NRL proteins, PI generally requires high loading of chemical accelerators in the manufacturing process to aid and speed up vulcanization, a process of cross-linking rubber molecules to form the elastic film.

The predominantly used chemical accelerators in PI glove manufacturing include Diphenylguanidine (DPG), Zinc Diethyldithiocarbamate (ZDEC), and Zinc mercaptobenzothiazole (ZMBT) to name a few. If not thoroughly leached or treated, residual chemical accelerators may cause an allergic response. Almost half of healthcare workers' skin-related reactions are due to chemical allergies or sensitivities. One of the biggest recent innovations in the industry has been the introduction of biologically safer chemical accelerators into the manufacturing process. These are less harsh on skin, are completely consumed during manufacturing, or remain within the glove film. PI gloves that have eliminated all chemical accelerators known to cause Type IV allergies or sensitivities are available in market.

NBR has not been widely used and accepted for surgical gloves. The softness and flexibility of NRL has not been achieved with NBR. Previously, the technology hadn't existed to enable the production of a thin enough NBR glove for a tight and stiff feel. Continued research and development indicates that NBR could become a feasible latex free option for manufacturers in the near future, especially with the changing market conditions potentially leading to NBR becoming the most cost effective.

Are Glove Polymers Being Blended?

Manufacturers may provide gloves based on blends of different materials. Glove properties will vary with composition. A special blend formulation of both polyisoprene and neoprene has been used in surgical gloves, enabling them to uniquely form crosslinks resulting in a hybrid glove material that combines the best attributes of these two synthetic polymers. There is also potential for exploring the blending of NBR with PI in a surgical glove.

Is NRL More Economic Compared to Synthetic Rubber Surgical Gloves?

On the surface, NRL gloves are cheaper in cost than synthetic rubber gloves as the raw material in each polymer makes up the largest portion of the base cost. Nevertheless, at a broader view, the cost of synthetic rubber gloves may be close to NRL, especially considering the cost savings that a non-latex environment potentially generates.

This is achieved through eliminating the potential risks of latex allergic adverse events, associated cost of lost time and productivity, and the cost of treatment if a patient or healthcare worker develops a clinical response. Increased sick leave amongst healthcare workers can create extra costs through agency replacement staff, training, and employee turnover. In addition to this, there are other advantages to consider, such as decreased O.R. turnover time for latex-allergy patient surgery and the elimination of time and product wasted when surgery is cancelled/postponed if a patient's allergy is discovered at the last minute requiring a teardown of the O.R. There are also logistical advantages, such as the consolidation of SKUs, simplified ordering, and more space available in the O.R. store room due to the reduced number of products required. These are all hidden cost that are typically overlooked.

What is the Environmental Impact of Each Glove Polymer?

Whenever medical gloves are used in surgery they have to be disposed of as clinical waste as they will have come into contact with human tissue, blood, or bodily fluids. Overarchingly, clinical waste is disposed of using high-temperature methods such as incineration (HTI).

However, there is additional environmental impact of different types of glove polymers (i.e. NRL, NBR, Neoprene, PI) when incinerated. NRL, as a biogenic material, generally generates lower carbon emissions than Neoprene, PI, or NBR. The focus of manufacturers should be on the stages that have the highest impact on life-cycle assessment such as manufacturing.

What Is the Future of Surgical Glove Polymers?

The immediate future sees the need for non-latex polymers that have introduced biologically safer chemical accelerators into the manufacturing process since so many skin-related reactions of healthcare workers are due to chemical allergies or sensitivities. The next big innovation is developing environmentally friendly surgical glove polymers that are safe and sustainable across the full life-cycle. Whether this can be bio-based or no longer derived from fossil-based carbon is being investigated. For all polymers used, the essential requirements of surgical gloves, such as user and patient health, safety, comfort, strength, durability, and tactile sensitivity must first be met. The wearer and patient require comprehensive protection, and the future requires surgical gloves to become more sustainable.

The next big innovation is developing environmentally friendly surgical glove polymers that are safe and sustainable across the full life-cycle

The Cost and Benefit of Latex Alternatives

Michael A James, PhD

When loss of productivity and the cost of care for workers affected by latex allergies are added, it becomes evident that the costs outweigh the extra initial investment in surgical gloves made from synthetic, non-latex alternatives

Introduction

Given that synthetic alternatives in gloves are a necessity for the removal of latex allergens from the operating room and the prevention of related negative health impacts on patients and healthcare providers, economic analysis of the benefits and costs of non-latex choices in surgical gloves has become a topic of interest in both large and small medical facilities. The total long-term cost is affected by health-related costs for patients, hospitals, and healthcare workers, short-term economics, and long term economics. The factors affecting the net cost of synthetic alternatives are discussed herein, including the price of preventable hypersensitivities in patients and healthcare professionals, the cost of conversion to non-latex alternatives, and the newest economical options in safe surgical gloves.

The Economic Burden of Latex Allergies

The use of natural latex in gloves over the past decades has resulted in a significant amount of allergy-related morbidity in healthcare workers. This has had measurable effects on productivity. As an example of the potential effects of allergies on productivity, allergic rhinitis in the occupational setting, including that caused by latex allergy, was found to impair work productivity, and that measure showed significant interaction with measures of quality-of-life[1]. The economic burden of latex allergies is also affected by the cost of admission, lost work time, and the cost of litigation. Although costs are expected to be higher today, the total estimated costs of latex allergy-related partial or total disability in a healthcare worker in the United States were $62,000 or $109,000, respectively, in 1999[2]. Litigation costs alone for latex allergies were estimated at over $21,000 per claim in the United Kingdom in 2021[3]. When loss of productivity and the cost of care for workers affected by latex allergies are added, it becomes evident that the costs outweigh the extra initial investment in surgical gloves made from synthetic, non-latex alternatives. This balance has been shown to have a real effect in the UK healthcare setting, as a 2021 study reported a savings of $10,000/year by transitioning to synthetic gloves[3]. In the United States, the financial benefit of the transition to a latex-free environment was demonstrated to apply to both large and small healthcare facilities[2].

The above analyses apply only to healthcare workers. However, there are also costs associated with latex allergies in patients caused by the use of latex in operating rooms and wards. The most common breach of latex precautions for patients was reported to be indwelling catheters followed by latex gloves in a U.S. study[4]. The prevalence of latex allergies is particularly high in those requiring multiple interventions in hospital settings, e.g. spina bifida patients[5],[6], for whom the cost of care is already high. Other conditions also predispose patients to sensitization to latex, including urogenital abnormalities, anorectal malformations, ventriculoperitoneal shunt, cerebral palsy, thracheoesophageal fistula, quadriplegia, and preterm birth[7]. Costs for hospitals extend to the assessment of risk in patients that may be exposed to latex. Litigation and financial judgement can also occur in cases of hospital-acquired latex allergy, as was the case with a latex reaction associated with interstitial cystitis at Emory Hospital in the United States[8]. Within 5 years, there were over 200 medical claims and 37 lost-time claims due to latex glove reactions in a U.S. hospital association in Michigan[9]. The average cost of defending a malpractice case was reported to be nearly $159,000 between 2016 and 2018 by the American Medical Association[10]. These legal, medical, prevention, and productivity costs may be effectively prevented by the elimination of latex and the use of synthetic latex alternatives.

Calculation of Long-Term Savings with Synthetic Gloves

The initial investment in a transition to latex-free hospital environments must be balanced with the long-term costs associated with latex allergies. Studies have shown that the cost effectiveness of the continued use of latex gloves is decreased by long-term costs, including disability, diagnosis, and treatment[2],[3]. While reduced disability-related claims for latex allergies have the potential to reduce long-term costs with a transition to synthetic alternatives[7], the burden of risk assessment and testing (prick tests, patch tests, IgE tests, and glove-use tests) for patients and staff should also be considered in the calculation of the long-term costs. Both personnel and supply resources can be conserved with a transition to non-latex alternatives in addition to the creation of a better work environment and increased quality-of-life for patients and staff. Both procurement and human resource departments can play a role in calculating and weighing the long-term costs of such factors as lost productivity, lost resources, litigation, medical costs, prevention, diagnosis, and risk assessment against the initial investment in the transition to synthetic alternatives to latex and/or complete conversion to a latex-free environment.

Economic Options in Synthetic Gloves

Modern synthetic alternatives, including neoprene and polyisoprene, offer both safety regarding latex-allergies and asepsis and long-term value when weighed against the costs of using latex. Durability, fit, comfort, ease of donning, tactile sensitivity, and dexterity are leading reasons for the preference of synthetic gloves with latex-like physical properties, such as neoprene and polyisoprene, over nitrile[11],[12]. Given that chemical accelerators used in the glove manufacturing process can also act as skin irritants and contribute to contact dermatitis caused by gloves, the use of “accelerator-free” synthetic gloves has been shown to improve symptoms[13] and may enhance the morbidity-related long-term cost savings of synthetic gloves. In particular, there is evidence that “accelerator-free” polyisoprene gloves can prevent potential reactions to such components[14]. Considering the prevalence and cost of glove-related contact dermatitis, these options may prove to be the most economically beneficial choices in the long term. An offering of function, safety, and long-term cost savings plays into the choice of synthetic gloves that give the best economic benefit.

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An offering of function, safety, and long-term cost savings plays into the choice of synthetic gloves that give the best economic benefit

REDUCING THE INCIDENCE OF ALLERGIC CONTACT DERMATITIS AND THE ROLE OF LATEX FREE SURGICAL GLOVES

Value-Based Procurement (VBP) Has Come of Age

Brian Mangan MSc FCIPS MD, *Brian Mangan Associates*
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Why value-based procurement is maturing from an 'interesting theory' to an operational necessity across global health systems. Plus some tips for turning intent into meaning action.

What is VBP and Where is it Happening?

VBP is a purposeful shift in emphasis from a reduction in product costs to working with industry to consider technologies that can influence a reduction in total costs within the patient pathway. VBP takes into consideration a broader set of factors than the traditional price & volume drivers. Having been established theoretically for almost 10 years, value-based procurement (VBP) has become an increasingly prominent force in the global health care landscape in recent years as a result of several macro factors. The perspectives in this article are drawn from our own global experiences in support of VBP programs. The insights we offer have been gleaned from conversations with a leading multinational medical device and technology manufacturers and health system procurers alike.

From the provider perspective, we suggest that value-based approaches are being considered and implemented across multiple jurisdictions from North America and Europe to the Middle East, Australia and New Zealand as they pursue ways to deliver environmentally sustainable and cost-effective healthcare against a backdrop of increasing demand. It would be fair to expect value-based programs of some form to be the norm going forward, and we expect there to be increasing external and internal pressure on health systems and suppliers to comply. An appreciation of the environmental factors that have created the need for VBP would be helpful when it comes to determining why and how to deploy it to optimal effect in a health system.

What Factors are Motivating the Move to a VBP Approach?

Long term and consistent downward pressure on price has created an undesirable race to the bottom which risks leaving procurers & health systems with nowhere else to turn. It is increasingly apparent that the 'well has run dry' with further year-on-year price reductions untenable. The traditional adversarial approach taken by both procurer and supplier has been, in part, underpinned by a cynicism that suppliers attempts to discuss and propose value has merely been a vehicle for them to 'explain away' the premium price points of their biggest brands. At the same time suppliers have been suspicious of the mixed messages of the health system interest in value that doesn't make a happy bed fellow with the 'blunt instrument' of a price driven mini-competition. It's is clear that genuine long term partnership working will only be realised at scale when there is a meaningful shift in the levels of trust from all parties.

Supply chain resilience came sharply into focus as a result of the C-19 pandemic. The global versus local topic has been keenly debated by all stakeholders. Mapping and understanding the complete supply chain in order to identify and mitigate fragility is proving an additional reason to re-examine the price/volume driven focus.

Sustainability is clearly a high priority especially for institutional procurers who have a clearly-stated net zero target to contribute to. Calculating the environmental cost as part of supplier selection is often a non-negotiable and is clearly an opposing force to the conventional price dominated decision making approach. Similarly Social Value is an emerging component of the VBP story. Consideration and calculation of the non-financial human impact of procurement activities on all stakeholders is shaping the future landscape. It is both exciting and rewarding from a procurement perspective to have the scope to play such an active and influential role in these areas given their strategic importance not only to health systems but to the wider economy and communities they serve.

Clinical outcomes and patient centricity remain a central pillar, and again, there is a clear role for procurers to play in ensuring the delivery of the right quality in addition to the conventional right product at the right price in the right place.

VBP is a purposeful shift in emphasis from a reduction in product costs to working with industry to consider technologies that can influence a reduction in total costs within the patient pathway

Clinical outcomes and patient centricity remain a central pillar, and again, there is a clear role for procurers to play in ensuring the delivery of the right quality in addition to the conventional right product at the right price in the right place

The procurement contribution to the patient pathway and the understanding of quality has evolved significantly. This aspect of the procurers influence is heightened further still as a result of the C-19 recovery plans. Patient backlogs are, for some, larger than ever and represent a clear risk to delivering safe and efficacious care. A value-based approach affords the procurer a clearer line of sight over how they help deliver the desired strategic outcomes for their organisation.

Workforce scarcity and disruption: A fatigued and demoralised workforce that was already operating at near capacity is now stretched further still by C-19 and the resultant backlog. The cost of living crisis is driving experience and talent out of some health services as people are forced to seek better-paid roles elsewhere. The human cost of delivering care is already showing up as a topic within the wider value discussion. How can partnerships be established that deliver tangible and measurable impacts to positively influence learning and development, workforce wellbeing, satisfaction, and even support your organisations recruitment, retention or absenteeism rates?

Winter pressures heap additional strain on health systems – more of the same wont suffice. Could a value-based approach help to smooth the spikes of seasonality and break the cycle that sees the winter burden create serious risk within the health system?

VBP is a stepping stone to value-based health care (VBHC). With VBHC as the long term direction of travel, embedding value-based procurement as business-as-usual is a way to kick start a systematic approach to specifying and measuring outcomes in health.

The Best Way to Take Action is to START

Just like any shift in the professional arena it will take a combination of skills, knowledge, and behaviour to bring the intent to life. VBP is no different. However, recognising this is half of the battle won. Here is a simple checklist of considerations to make it happen.

Stakeholders: Think about who the key stakeholders are within your organisation, do you have an existing relationship with them or will you need to engage with them from fresh? Once identified, are your stakeholders ready for the desired change toward a value approach? How can you consistently assess readiness and what are the best means to communicate it to them to build a shared understanding?

Targets: Are your targets coherent or contradictory to a value-based approach? Are they short term and product/cost driven in nature? What is required to redefine your targets so that they reflect a whole care pathway?

Authority: Is there alignment on the necessity for a value-based approach in your organisation from the top down? Confirming this and consistent communications to and from the top leadership within your organisation around value will help clear the path to optimising its implementation.

Relationships: Is there a preparedness to work in partnership with suppliers? If you can establish and maintain a principle of openness and trust, then you will be surprised how much progress can be made.

Terminology: It's essential to establish a clear understanding of what value means within your organisation. In doing so, you can maintain clear and focused communications with both suppliers and internal stakeholders. Avoidance of ambiguity will also give your value-based approach a consistency in how both direct and indirect value will be attributable to the supplier activities or not.

Value-Based Procurement: Make It Choice Not Chance

In closing, it's certainly true that redefining relationships and challenging long established practices and behaviours requires time and energy. To create momentum, start small, build pilots, and test & learn in a meaningful and collaborative way with your chosen partners. To paraphrase Charles Darwin "It is not the strongest of the species that survives, nor the most intelligent, but the one most adaptable to change." Make that positive change to your value-based procurement practice a purposeful choice and not simply left to chance.

Consideration and calculation of the non-financial human impact of procurement activities on all stakeholders is shaping the future landscape

Gloving Guidelines for Safety and Latex Allergy Avoidance in the Operating Room

Michael A James, PHD

Several organisations worldwide issue recommendations and guidelines for practices related to surgical gloves. These guidelines are written in an effort to ensure safety for patients and healthcare professionals. In general, guidelines are particularly focused on patients with known latex allergies, glove changing, and double gloving. Safety guidelines for glove use address three general hazards in the operating room: latex allergies, sharps injuries, and surgical site infections.

Guidelines for Avoiding Latex Sensitization and Reactions

In the past, the prevalence of latex allergies was exacerbated by the use of powdered gloves. Recommendations for healthcare facilities using powdered latex are now obsolete since most western regulatory agencies have banned powdered latex. The Health and Safety Executive (HSE) in the United Kingdom dictates that non-latex alternatives should be used when protection is appropriate, and if latex is used, it should be low protein and powder-free[1]. While latex remains a recommended glove choice because of fit and durability, latex alternatives, including nitrile and newer synthetic materials (polyisoprene and neoprene) are cited in guidelines, such as those published by NHS Scotland[2]. However, in situations where exposure to chemicals, chemotherapy, and sharp surfaces are expected, high tensile strength is needed and neoprene is recommended in particular. Most organisations have limited their recommendations to those intended to avoid latex reactions in identified cases of latex allergy. The Australian Society of Clinical Immunology and Allergy (ASCIA) recommends synthetic non-latex alternatives in cases with a latex allergy for all procedures in the operating suite and during recovery and that they should be operated on early in the daily schedule to avoid exposure to latex particles from recent prior use of latex in the room[3]. Despite the focus on known cases of latex allergy, guidelines have included other populations at high risk of developing a latex allergy, including those with allergies to foods that may cross-react with latex, those with eczema, and those with repeated exposure to frequent surgery or catheterisation when young[4]. For the perioperative management of high-risk patients, guidelines suggested in the literature have recommended the use of non-latex gloves, careful identification of risk, and labelling of latex products[5]. While most guidelines do not currently mandate a switch to synthetic latex alternatives, these guidelines may not have caught up to recent data on modern synthetic gloves demonstrating optimal fit, comfort, protection, durability, dexterity, and tactile sensitivity. The exclusive use of these alternatives, including neoprene and polyisoprene, particularly those with a low content of rubber accelerators, may be recommended in the future based on the risk and impact of type I latex and type IV chemical latex allergies in healthcare professionals. In fact, a ban on latex gloves in healthcare settings in Illinois in the United States has already been passed and came into effect in January 2024[6]. Such a transition may also eliminate some of the special procedures that are required to be in place to avoid reactions in patients with a diagnosed latex allergy.

For the perioperative management of high-risk patients, guidelines suggested in the literature have recommended the use of non-latex gloves, careful identification of risk, and labelling of latex products

Guidelines for Sharps Safety

Sharps safety recommendations are primarily intended to prevent the transmission of bloodborne pathogens, primarily from the patient to the healthcare worker. HSE and other agencies recommend double-gloving or glove liners for surgery and where sharps are being handled[7]. The American College of Surgeons has recommended the universal adoption of double-gloving to avoid sharps injuries and exposure to bloodborne pathogens[8]. A significant decrease in the incidence of inner glove perforation can be accomplished[9],[10],[11],[12] and exposure to blood and bloodborne pathogens are reduced through double-gloving[11],[13]. Further, the thickness of single gloves was found not to affect puncture resistance[14]. Evidence also suggests that perforations in the outer glove are more detectable by the user when double-gloving is practised[12]. This factor is important since over 80% of perforations went undetected by surgeons in some studies[10].

Durability and puncture resistance are important for sharps safety. However, in surgery, so are dexterity and tactile sensitivity

Durability and puncture resistance are important for sharps safety. However, in surgery, so are dexterity and tactile sensitivity. Survey results revealed that while the majority of surgeons in Poland thought that double-gloving provides superior protection from perforation and bloodborne pathogens, there was poor adherence to double-gloving guidelines. In this study, those always using double gloves during surgery represented less than 1%, and 13% reported that they had never double-gloved[15]. Low adherence to double-gloving guidelines may be a result of negative perception of tactile sensitivity. In contrast to that perception, Moog et al. reported that sensitivity assessed using two-point discrimination (2PD) and Semmes-Weinstein monofilament testing (SWMT) did not significantly differ between single-gloved and double-gloved users, although some synthetic gloves, such as Gammex Latex Sensitive®, had better sensitivity in SWMT and a higher acceptance level based on quality[16]. Other studies have also shown similar 2PD results between single- and double-gloving, while some differences in SWMT results have been reported[17]. Despite this controversy, increased protection with double-gloves has been evident for some time[14],[18]. Acceptance and perception of tactile performance using double gloves may improve with increased experience and education.

Guidelines for the Prevention of Surgical Site Infection

The estimated cost of surgical site infections (SSI) to the National Health Service of the United Kingdom was over £10,000/patient in 2009[19]. A recent study in the United Kingdom estimated the cost of the average extension of hospital stay for SSI by nearly 10 days added £3776 of cost per patient[20]. This study also highlighted that for some patients, antibiotics added significantly to that cost, potentially because of resistant strains. A 2015 review by the British Orthopaedic Association estimated that each prosthetic joint infection cost £100,000[21]. Among hospital-acquired infections, SSI are the most common, causing substantial heath impact, mortality, and financial burden[22]. Such infections can require intensive care treatment and longer hospital stays. It can take as little as 3 hours for skin flora to regrow to pre-washing levels during surgery. Therefore, hand disinfection may not be sufficient for the prevention of SSIs[23], which necessitates physical barriers to sepsis, such as proper use of appropriate surgical gloves. Many of the factors mentioned above have led to the call for a reduction in SSIs through hygiene guidelines, including those related to surgical gloves. A critical factor for ensuring a proper barrier with gloves is their durability and resistance to rupture or tearing. Surgical gloves can hydrate over time during surgery with specific evidence for such in latex gloves. It has been found that 30 minutes of hydration of latex gloves during surgery was associated with a 24% reduction in the force required for rupture[24]. According to the World Society of Emergency Surgery (WSES) Guidelines, surgical teams should change gloves periodically because of the loss of mechanical resistance over time[23]. While double gloving has been shown to reduce infection rates in cerebrospinal fluid shunts by over 50%[25], most guidelines do not cite SSI prevention as a reason for double-gloving. Although the Japan Society for Surgical Infection did not find sufficient evidence to recommend double-gloving to prevent SSIs, their guidelines highlight the finding that double-gloving can reduce the risk of exposure to potentially infectious agents because of the lower rate of perforation in the inner glove[26].

Summary

Published guidelines for glove use to prevent latex reactions, while currently limited to known cases of sensitivity or suspected cases, call for the use of synthetic alternatives to latex. There is now precedent for mandates to transition to these alternatives in all cases. For the prevention of sharps injury and SSI, double-gloving and frequent glove-changing are predominant. Overall, double use of modern synthetic surgical gloves may provide the best protection with increased durability over time and the elimination of latex allergens, while preserving tactile sensitivity.

REDUCING THE INCIDENCE OF ALLERGIC CONTACT DERMATITIS AND THE ROLE OF LATEX FREE SURGICAL GLOVES

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Future Outlook – Trends in Latex Allergies and Glove Use in the Healthcare Setting

Michael A James, PHD

Changes have improved the incidence of latex allergies in developed countries but have not been applied evenly across the globe, with prevalence in healthcare workers remaining unacceptably high

The Persistent Relevance of Latex Allergies in the Healthcare Setting

Healthcare in the 1980s became plagued by allergies and asthma caused by natural rubber latex[1]. Since latex is derived from a natural product, it is composed of a plethora of proteins. Many of these proteins are potentially allergenic[2] and can cause local and more serious systemic reactions. IgE-mediated reactions to latex are also known to trigger cross-reactivity with several foods, including banana, kiwi, avocado, and chestnut[3]. Antigens can become aerosolised, contributing to sensitisation of both healthcare professionals and patients[3]. This challenge spurred a departure from gloves that were powdered because the powder acted as a carrier of latex allergens and exacerbated sensitivity issues. More recently, increasingly protective and functional latex alternatives are being used to manufacture gloves. These changes have improved the incidence of latex allergies in developed countries but have not been applied evenly across the globe[1], with prevalence in healthcare workers remaining unacceptably high. While it is estimated by the US Occupational Safety and Health Administration that 8–12% of healthcare workers are sensitive to latex[4], there is higher prevalence reported for operating room personnel in developed and developing countries worldwide, estimated at almost 15%[12]. Patients are also susceptible to sensitisation to latex in the hospital, particularly those exposed to multiple procedures[3]. Given this persistent need to protect healthcare professionals and patients from latex allergy-related morbidity, the elimination of latex, particularly from the operating room, is becoming a focus of regulatory agencies and hospitals. This approach has been shown to effectively prevent latex sensitisation in certain study populations, e.g. spina bifida patients who are exposed to repeated procedures[6].

A variety of clinical manifestations of latex allergy remain impactful and relevant in current times. In a recent European review of latex allergies, skin, respiratory, and systemic manifestations were cited, including pruritus, contact urticaria, Ig-E mediated sensitivity, rhinitis, wheezing, hypotension, bronchospasm, cardiorespiratory collapse, and shock[3]. Eczematous dermatitis, a type IV hypersensitivity, is also a manifestation of latex allergy[7]. Contact dermatitis, the most common manifestation and most common cause of anaphylaxis in the operating room [2], can also be promoted by rubber accelerators used in the manufacturing of latex and synthetic gloves[7]. A latex allergy diagnosis is associated with increased lifetime risk of anaphylactic shock caused by latex exposure[8]. Advances in non-latex synthetic gloves are now available and increasingly being adopted as their protective and functional properties have been improved. These include neoprene and polyisoprene gloves and those with reduced accelerator content.

Regulation Regarding Latex Gloves and Alternatives

Until recently, there had been little precedent for legislation and regulation of latex use in the healthcare setting. Previously, regulation was limited to powdered gloves, with the Food and Drug Administration banning powdered latex surgical and examination gloves and absorbable powder for the lubrication of surgical gloves in late 2016[9]. Other countries, including Germany, the U.K., and Japan, have banned powdered latex surgical gloves. More recently, precedent has been set for the banning of latex gloves altogether. In 2022, the governor of Illinois signed a ban on latex gloves in both the healthcare and food-service industries[10]. While this legislation provides options for entities that cannot source non-latex alternatives, it specifies that alternatives must be used in cases of known latex allergy, emergency medical services, and where the patient is unable to give a medical history related to latex allergy. The trend toward elimination of latex may bring additional regulatory and legislative mandates for the use of alternatives to latex for surgical gloves and other devices containing latex.

Latex Allergy Education and Awareness

The management of latex allergies in the healthcare setting requires proper education and awareness of clinicians, staff, and patients. The evaluation of risk of latex sensitisation through repeat exposure to latex should be thorough and appropriately understood by staff. Likewise, identification of existing latex hypersensitivities in patients requires an understanding and awareness of the necessity for a thorough history and examination. Such existing allergies must be communicated well among healthcare teams. Staff must be educated on the contributing factors of contact dermatitis, including seasonal weather changes [11], antimicrobial soaps[11], latex sensitivities, allergen carriers, and accelerators in both latex and synthetic gloves. Further, currently available alternatives to latex should be known to healthcare professionals, including neoprene and polyisoprene gloves and those with reduced accelerator content. As awareness of the latex allergy risks associated with multiple exposures to gloves and medical devices has increased, the prevalence of latex allergies acquired in the healthcare setting have decreased. Now, as glove technology improves with superior synthetic compounds and manufacturing processes, awareness of these technologies must follow.

For patients, it is also important to be aware of factors that may exacerbate reactions as outlined above and potential cross-reaction with foods. In patients with allergies to these foods, latex hypersensitivity is more likely[2]. Awareness and education regarding these factors and the exploitation of current knowledge and advancements in latex allergy avoidance through latex alternatives in healthcare professionals promise to alleviate the persistent burden of latex allergies.

Pandemic-Minded Considerations in Glove Use and Latex Allergies

The recent Covid-19 pandemic and the possibility of similar future pandemics resulting from current population levels and dynamics have implications on the impact of healthcare-acquired latex sensitisation. The average number of invasive procedures and duration of glove use increased during the pandemic[12]. With these changes, the rate of allergy complaints among nurses also increased. Patients with latex allergies experienced decreased quality-of-life during the pandemic attributed to poorer energy level, physical and social function, pain, and health changes[13]. These effects were diminished through treatment of latex allergies with continuous sublingual immunotherapy. Our knowledge of these potential effects of epidemic or pandemic disease on glove use and latex allergies in both healthcare professionals and patients can help prepare and implement preventive strategies in the future.

Technologies

Although synthetic alternatives to latex have existed for some time, advancements in the technology continue to improve the properties and perceptions of synthetic gloves. Neoprene and polyisoprene have shown advantages over nitrile in terms of durability, fit, comfort, dexterity and tactile sensitivity, and have been received with higher evaluation of quality[14], potentially facilitating their acceptance. Further improvement of gloves made from these materials include the advent of synthetic gloves that are “accelerator-free”, which reduce or eliminate an additional potential source of adverse reactions and sensitisation. The transition to these gloves has been shown to improve or eliminate hand eczema in healthcare workers that had been diagnosed with contact dermatitis resulting from glove use[15]. Continued advancements in synthetic surgical gloves are likely to facilitate the acceptance of and transition to these latex-alternatives as hospitals and regulators increasingly mandate such changes to better protect healthcare workers and patients.

Continued advancements in synthetic surgical gloves are likely to facilitate the acceptance of and transition to these latex-alternatives as hospitals and regulators increasingly mandate such changes to better protect healthcare workers and patients

Given this persistent need to protect healthcare professionals and patients from latex allergy-related morbidity, the elimination of latex, particularly from the operating room, is becoming a focus of regulatory agencies and hospitals

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Notes

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