

ISSUE 4

INSIDE THIS ISSUE

| | |
|---|----|
| Infection risks associated with incorrect glove use or use of inferior glove products | 2 |
| Standards that define glove quality | 4 |
| Acceptable Quality Level | 6 |
| The relevance of quality gloves during outbreak situations – Professor Ojan Assadian | 8 |
| Why quality gloves matter in Dentistry - Professor Laurence Walsh | 10 |
| What's hot in gloves | 13 |
| References | 15 |

WHY QUALITY GLOVES MATTER

A self-study monograph for continuing education for healthcare workers with an interest in occupational and patient safety and infection prevention.

LEARNING OBJECTIVES

At the conclusion of this activity, participants should be able to:

1. Define infection risks associated with incorrect glove use or use of inferior glove products in healthcare settings;
2. Explain global and national manufacturing standards that dictate glove quality;
3. Discuss how to make an assessment of glove quality;
4. Appreciate the views of clinical experts in regard to selection of quality gloves and the importance of glove quality in a non-surgical setting, such as dentistry;
5. Understand emerging research related to antimicrobial gloves.



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The opinions expressed in this edition are the authors' only and may not represent the official position of Ansell or Bond University.

In this edition we welcome contributions from two global experts. Professor Ojan Assadian offers insight into how to apply glove quality parameters during glove selection and Professor Laurence Walsh considers the importance of using quality gloves in dentistry.

Professor Assadian has performed consulting work for Quantum Management & Service, a paid service provider of Ansell and/or its affiliates.

Professor Walsh has performed paid consulting work for Ansell and/or its affiliates.

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INFECTION RISKS ASSOCIATED WITH INCORRECT GLOVE USE OR USE OF INFERIOR GLOVE PRODUCTS

Gloves are critical personal protective equipment (PPE) used in multiple industries and professions to prevent direct contact between a potential harmful microorganism, chemical, object, solution or surface and the wearer's hand(s). In healthcare, gloves are used primarily as a barrier to prevent a healthcare worker (HCW) from having direct contact with a contaminated surface, an infectious patient, blood and body fluids and/or harmful solutions or chemicals. As well, patients are protected from contamination by the HCW's hands when the HCW wears gloves. Whilst a variety of medical gloves are used widely in healthcare settings the scope of this edition of InTouch is limited to consideration of single use examination or surgical gloves and their use for the purposes of infection prevention and control.

In every healthcare setting gloves must be comfortable, flexible and durable otherwise users may be disinclined to don gloves or the level of concentration or performance may suffer. In a very recent study Loveday considered how various healthcare disciplines used gloves (Loveday, Lynam, Singleton, & Wilson, 2014). She explored the long recognized practice of non-compliant HCWs who failed to change gloves appropriately between patients and procedures. Loveday found that glove use was appropriate in only 42% of observed occasions. This deviation from recommended glove use practice is concerning especially given the co-existing increased transmission risks associated with ongoing poor hand hygiene compliance. The World Health Organization (WHO) reported global rates ranging from 5% to 89%, with an overall average of 38.7% (World Health Organization, 2009) and likely inadequate and infrequent cleaning of high touch objects in hospitals (Boyce, 2016; Murphy et al., 2011). In combination these factors create the "perfect storm" for organism reservoirs and transmission of potentially pathogenic microbes via either HCWs' hands or contaminated surfaces.

Loveday's work also explored the specific stages during healthcare delivery when HCWs were most glove non-compliant. This included interdisciplinary variations and how underlying beliefs impacted HCWs' choices regarding how they use gloves. Consistent with hand hygiene evidence, Loveday's research showed that nurses (45%) were more glove compliant than medical and allied health staff (24%). It also mirrored the findings of hand hygiene research which has repeatedly shown that HCWs tend to value self-protection more than patient protection.

Loveday concluded the following are commonly occurring themes that emerged from her work.

HCWs:

- Often used gloves when they weren't needed.
- Frequently put gloves on too early or removed them too late in relation to the corresponding stage of hand hygiene.
- Glove misuse was associated with significant increased risk of cross contamination.

Timing of glove use and removal is an important aspect of infection prevention. So too is selection of a glove appropriate for the task. The wide variety of tasks typically required of HCWs range from specific grasping situations, handling of power tools, rapid donning in emergencies, palpation of skin, the need to determine surface temperature and contact with rough and jagged edges of either equipment or bone shards. There are many other tasks requiring different features of gloves. Whilst the clinical situations are diverse the range and performance attributes of commonly available gloves are comparatively limited. Typically, HCWs select gloves according to their fit, elasticity, tactility and ease of donning. Comfort is of special significance to HCWs including surgeons, who typically are required to wear gloves for extended periods. Glove fit and avoiding hand fatigue are critically important in these cases as is the durability of the glove and its ability to withstand operating conditions without tearing, breaking or leaking (Mylon, Lewis, Carre, Martin, & Brown, 2014). Torn or broken gloves are inefficient barriers and potentially predispose the transfer of infectious agents from or to the HCW's hand or the patient or touched surfaces.

Regarding glove compliance HCWs tend to value self-protection more than patient protection

Mylon highlights the importance of ensuring that gloves are comfortable recognizing that uncomfortable gloves can cause HCWs to lose or have lapses in concentration.

INFECTION RISKS ASSOCIATED WITH INCORRECT GLOVE USE OR USE OF INFERIOR GLOVE PRODUCTS



This can also increase the potential for them to make errors during care delivery which may inadvertently affect the patient's or their own safety. Accidental sharps injury and subsequent exposure to an infectious agent is one such example (Mylon et al. 2014). Moylan's work also recognizes that glove design is most often generic in that size varies in half inch increments with no standard options differentiating between male and female hands and limited combinations of hand breadth and length.

Torn or broken gloves are inefficient barriers and potentially predispose the transfer of infectious agents from or to the HCW's hand or the patient or touched surfaces.

Glove thickness is also an important consideration in selection. Some clinicians require gloves that enable them to maintain good tactile ability such as that required to assess skin temperature or to palpate during vascular access or fine surgical procedures. The ideal glove is of a

thickness that is protective and durable but does not limit the HCW's ability to perform tactile-dependent tasks. Choosing the correct glove is a critical component of using gloves as a barrier to prevent transmission of infection. It can also be a complex process. Clearly there is no "one size fits all" solution to glove selection and wearers may have to choose between tear and puncture resistance vs dexterity and tactile sensitivity. This section details a variety of HCW considerations and glove characteristics that need to be taken into account when selecting either examination or surgical gloves. Understanding glove quality and being able to assess it are equally important. They are determined by a combination of national, international and manufacturer standards including acceptable quality levels (AQLs) that are discussed in the next sections of this newsletter.

Choosing the correct glove is a critical component of using gloves as a barrier to prevent transmission of infection

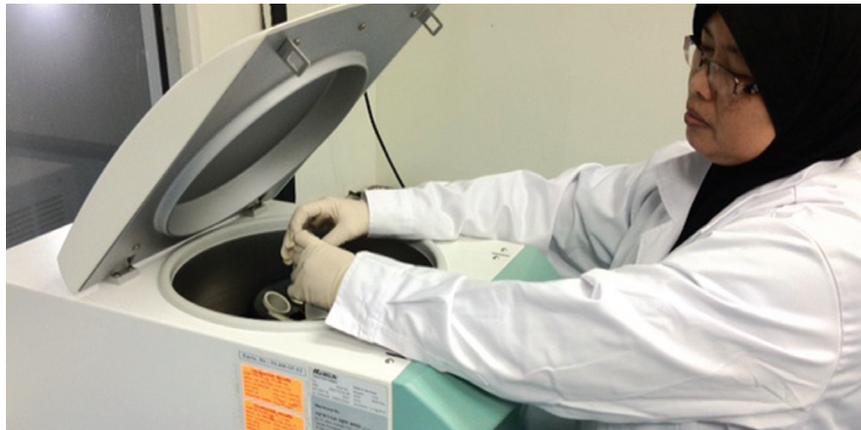
STANDARDS THAT DEFINE GLOVE QUALITY

Most countries have specific Standards relevant to the manufacture and performance of surgical and examination gloves. It is beyond the scope of this edition of InTouch to discuss specific detail on any of those Standards.

Instead this section will outline a composite description of the general requirements for glove specifications and then briefly elaborate on a few of these.

Glove Standard specifications address characteristics or factors such as:

- Performance and efficacy.
- Biocompatibility with blood, saline and any intended chemical contact.
- Powder levels.
- Allergenicity (chemicals and proteins).
- Pinhole and Acceptable Quality Level (AQL).
- Barrier integrity (tensile strength and elongation).
- Length, cuff, size, color, odor, and thickness.
- Human factor, fatigue and donning.
- Packaging and Labelling; if applicable special labelling claims such as chemotherapy.
- Shipping Stability and Shelf Life



Centrifuge equipment for protein extraction testing - Courtesy of Ansell, Malaysia

STANDARDS THAT DEFINE GLOVE QUALITY

Powder-Free

Gloves with trace amounts of residual former-release powder (2 mg or less per glove) and no intentionally added donning powders are commonly referred to as “powder free.”

Protein Level Claims

Manufacturers who can reliably reduce the levels of latex proteins in their gloves to a known level may make a labelling claim. At present, U.S. Food and Drug Administration (FDA) does not allow a protein labelling statement or claim below the current 50µg/dm² sensitivity limit of the ASTM Lowry Test Method (D5712).

Chemical Sensitization Claims

Certain chemicals used in the manufacture of medical gloves, can cause skin sensitization and irritation. If manufacturers sufficiently reduce or eliminate the presence of these chemicals, they may make appropriate labelling claims regarding the reduced potential of chemical sensitization.

Biocompatibility

Biocompatibility is the quality of being compatible with living tissue by not being toxic or injurious and not causing immunological reactions. In a regulatory sense, biocompatibility is testing to determine the potential toxicity resulting from bodily contact with a medical device. Because medical gloves are in direct contact with skin, a primary skin irritation study and a dermal sensitization study are appropriate. Further, should a glove contain a color, flavor and /or scent additives it should be submitted for biocompatibility testing to demonstrate the safety of the additives.

Chemotherapy Claims

Chemotherapy gloves should meet an appropriate ASTM Standard or an equivalent consensus standard for medical gloves. This standard covers a protocol for the assessment of resistance of medical glove materials to permeation by potentially hazardous cancer chemotherapy drugs under conditions of continuous contact. An assessment is made based on the permeation (breakthrough) of chemotherapy drugs through the glove material over a certain period of time. This practice for assessment of resistance of medical gloves to permeation by chemotherapy drugs provides healthcare workers with critical information, so that, they may select gloves that afford them the best protection from exposure to the chemotherapy drug. Physical features, such as increased thickness and length, make them more suitable for the safe handling of chemotherapy agents (usually minimal thickness of 0.10 mm, minimal length of 270mm).

Barrier Integrity - Tensile Strength and Elongation

Specific standard tests that gloves must meet during manufacture and simulated conditions similar to real-time working conditions are included in the Standards to ensure that gloves are capable of withstanding specific force and stresses including stretching. This ensures that gloves are able to withstand certain pressures beyond those that would be required when worn under typical working conditions and durations.

AQL - Freedom from Holes

Manufacturers must subject a specific proportion of gloves they manufacture to testing for watertightness according to a specific testing protocol. Watertightness testing is one way that the quality of gloves in terms of freedom from holes can be assessed. Passing this test is one way of proving that gloves provide an adequate barrier against bi-directional transfer of microbes between patients or contaminated surfaces and glove wearers.

The next section reviews Acceptable Quality Level specifications in further detail according to various International Standards.

ACCEPTABLE QUALITY LEVEL

WHAT IS AN ACCEPTABLE QUALITY LEVEL (AQL)?

AQL is an industry standard. It is a statistical sampling process for evaluating quality. According to the International Standards Organization (ISO) (2859-1: 1999)^a, AQL is “the worst tolerable process average when a continuing series of lots is submitted for acceptance sampling”. Process average is the typical percentage of defective gloves in the lots/batches sampled. A General Inspection Level is allocated to designate the relative amount of gloves inspected.

WHAT STANDARDS APPLY FOR AQL?

Various International Standards, as shown in Table 1 below, determine the AQL that manufacturers must comply to. However, manufacturers can set their own standards as long as they are stricter than the international standards. The lower the AQL, the lower the chance of finding a defect in the batch of gloves and the higher the quality of the product.

TABLE 1

| SURGICAL GLOVES STANDARDS | INSPECTION LEVEL | AQL | EXAMINATION GLOVES STANDARDS | INSPECTION LEVEL | AQL |
|--|------------------|-----|---|------------------|-----|
| AS/NZS 4179:2014^b Applicable to Australia/New Zealand | GI | 1.0 | AS/NZS 4011:2014^c Applicable to Australia/New Zealand | GI | 1.5 |
| ASTM 3577:2009^d Applicable to US & Canada | GI | 1.5 | ASTM D3578:2010^e ASTM D6319:2010^f ASTM D6977:2010^g Applicable to US & Canada | GI | 1.5 |
| EN 455 Part 1:2000^h Applicable to the European Union | GI | 1.5 | EN 455 Part 1:2000^h Applicable to the European Union | GI | 2.5 |
| ISO 10282:2014ⁱ Adopted by the rest of the World | GI | 1.5 | ISO 11193-1:2008^j Adopted by the rest of the World | GI | 2.5 |
| JIS T9107:2005^k Applicable to Japan | GI | 1.5 | JIS T9115:2000^l Applicable to Japan | GI | 1.5 |

ACCEPTABLE QUALITY LEVEL

Table 1. International Medical Glove Standards Reference

| |
|---|
| a. ISO 2859-1:1999 Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=1141 Accessed 26-11-15 |
| b. AS/NZS 4179:2014 Single-use sterile rubber surgical gloves http://infostore.saiglobal.com/store/Details.aspx?ProductID=1742680 Accessed 04-12-15 |
| c. AS/NZS 4011.1:2014 Single-use medical examination gloves http://infostore.saiglobal.com/store/Details.aspx?ProductID=1742678 Accessed 04-12-15 |
| d. ASTM 3577:2009 Standard Specification for Rubber Surgical Gloves http://www.astm.org/Standards/D3577.htm Accessed 04-12-15 |
| e. ASTM D3578 : 2010 Standard Specification for Rubber Examination Gloves http://www.astm.org/Standards/D3578.htm Accessed 26-11-15 |
| f. ASTM D6319 - 10 Standard Specification for Nitrile Examination Gloves for Medical Application http://www.astm.org/Standards/D6319.htm Accessed 26-11-15 |
| g. ASTM D6977 - 04 Standard Specification for Polychloroprene Examination Gloves for Medical Application http://www.astm.org/Standards/D6977.htm Accessed 26-11-15 |
| h. EN 455 Part 1: 2000 Medical Gloves for single use http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/medical-devices/index_en.htm Accessed 18-07-2016 |
| i. ISO 10282:2014 Single-use sterile rubber surgical gloves http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=63706 Accessed 04-12-15 |
| j. ISO 11193-1: 2008 Single-use medical examination gloves http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=50766 Accessed 26-11-15 |
| k. JIS T 9107:2005 Single-use Sterile Surgical Rubber Gloves http://infostore.saiglobal.com/store/Details.aspx?ProductID=800132 Accessed 04-12-15 |
| l. JIS T 9115:2000 Single-use Rubber Examination Gloves http://infostore.saiglobal.com/store/details.aspx?ProductID=818168 Accessed 04-12-15 |

HOW IS THE ACCEPTABLE QUALITY LEVEL DETERMINED?

Glove AQL is determined by manufactured lot size, the sampling plan inspection level set by the corresponding international standards, which is the number of gloves randomly selected to be tested and the AQL level also set by the Standards. This calculates the allowable number of nonconformities/imperfections for every glove lot produced. The standards stipulate the minimum AQLs for lot-by-lot inspection against specific criteria such as physical dimensions (width, length and thickness), watertightness, tensile strength and elongation at break (before and after accelerated ageing). The standards also prescribe standardized testing. AQLs commonly required in glove manufacture include air and water tests to indicate any defective glove areas.

At their discretion, manufacturers may routinely choose to produce a glove or range of gloves that exceed the minimum international and national standards. Exceeding these standards gives a higher degree of assurance that the risk of defective gloves in a sampling plan is closer to zero.

Reproduced in part from Ansell Limited. (2015). Acceptable Quality Level (AQL). Victoria, Australia. Available upon request.

THE RELEVANCE OF QUALITY GLOVES DURING OUTBREAK SITUATIONS - PROFESSOR OJAN ASSADIAN



Editor's note: *In his thoughtful commentary below Professor Ojan Assadian draws readers' attention to the importance of considering how local conditions and practices also impact glove quality. An expert on glove quality and a clinician familiar with the outcomes of low quality glove, Professor*

Assadian reminds us how ultimately it is the healthcare worker who chooses their glove and thus the important work we and manufacturers must undertake and refine to ensure standardisation in glove manufacture and quality. We are grateful for Assadian's contribution and his clever use of non-healthcare allegory to demonstrate the importance of manufacturing quality and consistency.

In 1987, Kotilainen from the Infection Control Department at the University of Massachusetts published a remarkable outbreak report linking the quality of examination gloves to a series of herpetic whitlow cases among healthcare workers in a medical intensive care unit (Kotilainen, Brinker, Avato, & Gantz, 1989). Three nurses who routinely gloved to protect themselves from contamination with patients' secretions developed herpes simplex virus type I infection on their right index finger. The investigators noted that only one particular brand of vinyl examination glove had been used in the affected department. When initial viral assay demonstrated 2.5% to 10% penetration of herpes simplex virus type I across unused vinyl gloves, a subsequent evaluation of glove quality of unused gloves was undertaken. Six control brands of vinyl gloves and the involved glove brand failed a water-tightness test in 4% to 28% (average, 11.1%; 132/1200), and the brand of vinyl glove that had been in use in the medical intensive care unit failed this test in 28%. In other words, every 4th glove had a perforation even before it was used.

This outbreak report was remarkable for many reasons. First, it demonstrated that the use of just "any glove" would not automatically protect the wearer. Second, up to today the quality of gloves often is defined by the maximum proportion of tolerable micro-perforations, and more specifically, at best, the lack of perforation. Indeed, Kotilainen et al. assessed the

gloves' quality by looking for presence or absence of perforation. Other factors contributing to quality were not considered at that time. The authors concluded that extreme variability in glove quality (defined by proportion of perforation) was observed and predicted that "... as the demand for gloves increases, emphasis should be placed on the production of plentiful, better quality ... gloves".

The use of just "any glove" would not automatically protect the wearer.

Almost 30 years have passed, yet, still it remains challenging to define "quality gloves". The international standard ISO 9000 (International Organization for Standardization, 2015 #118) defines quality as the "degree to which a set of inherent characteristics fulfils requirement". Although this definition is a precise and useful description of the term "quality", it may assist with management of manufacturing processes. However, it does not easily help healthcare workers identify a "quality glove". The reason for this discrepancy may be that, other than healthcare workers, ISO 9000 puts emphasis on "inherent characteristics". In both cases, however, a pre-defined expectation (in the language of quality management: "requirement") must be met. If the expectations are not met, the quality is poor, and if met, the quality is good.

The key to identifying quality of gloves is to separate the identification of the characteristics of a glove and the determination of the requirements for each characteristic. The expression "the quality of a cup of coffee" may explain this concept. In this expression, one still does not know if the quality of a cup of coffee is 'good'. The word "quality" must be substituted by the words "flavour", "odour", "temperature" and "colour", which are the characteristics of a cup of coffee. Only now, the requirements for each characteristic can be determined. Still, the barista and the customer may have different views on the quality of the "cup of coffee". The same applies to gloves. Therefore, the quality of a glove ultimately depends on the expectations of the wearer, and not the manufacturer.

Regretfully, manufacturers of gloves know exactly which characteristics their product must meet, and that

THE RELEVANCE OF QUALITY GLOVES DURING OUTBREAK SITUATIONS - PROFESSOR OJAN ASSADIAN

one single product will never fulfill all requirements, while healthcare workers rarely contemplate the features a glove must comply with for a specific clinical task. In order to identify the most suitable glove, healthcare workers must identify the one or more distinguishing features of a glove in the context of their anticipated clinical work. A distinguished feature is a criterion, which makes something different from others of the same type. An undistinguished feature may be the number of fingers of a glove. Since all gloves are made with 5 fingers, the number of fingers does not define the quality of a glove. However, gloves differ in the material they are made of, which again influences physical properties.

In order to identify the most suitable glove, healthcare workers must identify the one or more distinguishing features of a glove in the context of their anticipated clinical work.

For instance, gloves made of natural rubber (latex) provide excellent comfort and fit due to their high elasticity, and retain their shape and fit during rigorous manipulation. Depending on the physical properties of different nitrile mixtures, gloves made of nitrile may have the same high elasticity as latex gloves, and allow preventing fatigue of hands during long manipulations. However, some nitrile gloves have a low elasticity, making them only suitable for short duration work, yet, due to their higher stiffness such gloves may have lower frequencies of glove perforation after patient manipulation (Hubner et al., 2013; Pitten, Herdemann, & Kramer, 2000). Vinyl (Polyvinyl chloride) gloves have a very limited elasticity, limiting fit and comfort, and may become large in wrist diameters, making such gloves baggy around the cuff after extended use. Vinyl gloves, however, are strong against acids and bases, various salts and alcohols, and may therefore be a good selection for those who need protection against various chemical compounds.

In general, medical or examination gloves are worn for two main reasons:

- to reduce directly the risk of contamination of healthcare workers' hands with blood or body fluids, or toxic compounds such as oncologic chemotherapeutics, and
- indirectly to reduce the risk of microbial transmission to the surrounding, to the wearer himself, and from one patient to another.

While for the first intention different features such as a low number of perforations before use, ability to pull gloves from a glove box, ease and speed to don, maintenance of dexterity, fit at fingers and wrist, and, if required, protection against distinct chemicals may be distinct features healthcare workers should consider, prevention of microbial contamination of the environment from a contaminated glove to adjacent surfaces can be achieved by knowledge, practice and clinical practice. Recently, however, it was demonstrated that novel developed antibacterial examination gloves coated with polyhexamethylenebiguanid hydrochloride (PHMB) on their external surface significantly reduced bacterial contamination of surfaces after typical patient care activities (Kahar Bador, Rai, Yusof, Kwong, & Assadian, 2015). The use of such antibacterial gloves may support further reduction of cross-contamination in healthcare settings and could be another distinct feature of gloves in situations where heavy microbial bioburden is anticipated.

In conclusion, no other person than the healthcare worker will be able to identify those distinct characteristics of gloves, which are relevant for the actual clinical task. Since different characteristics of gloves may influence the level of self-protection and protection of others, it is important that clinical users get familiar with different features of gloves provided by various manufacturers, and to give feedback to those, who are purchasing gloves.

No other person than the healthcare worker will be able to identify those distinct characteristics of gloves, which are relevant for the actual clinical task.

WHY QUALITY GLOVES MATTER IN DENTISTRY

PROFESSOR LAURENCE WALSH



***Editor's note:** Professor Walsh offers InTouch readers a valuable gift with his insights into the importance of using quality gloves in dentistry. Walsh considers a single report of pre-use glove contamination arguing that it is a timely reminder of the importance of glove*

placement. Additionally, he covers the unavoidable use of sharps in almost all dental procedures as well as the protection needed from harsh chemicals. The patient's needs are also discussed around glove taste and texture. His contribution makes compelling reading for all clinicians not just dentists.

For dental clinicians, disposable gloves provide an essential first layer of protection to separate their skin from contact with patient fluids (including saliva and blood) and from the over 700 species of bacteria normally present in the mouth. This has direct benefits including the elimination of nailbed infections caused by bacteria, viruses and fungi (i.e. whitlow), which were a major occupational risk for dentists prior to the routine wearing of gloves for all procedures. Gloves protect the skin of the dentist and also reduce exposure to the many hazardous substances used in everyday clinical dental practice, including strong acids, strong alkalis, organic monomers of various types, and solvents such as acetone and ethanol which are found in the bonding agents used in adhesive dental procedures. Using gloves of a high quality contributes to the long term health of the hands by limiting contact with other chemicals used in dentistry which can cause irritation or allergy, such as methacrylate resins and aldehydes. This brief article discusses some additional key aspects of gloves which are important in dentistry. Readers are advised that irritant and hypersensitivity reactions to glove accelerants and powders affect dental clinicians similarly to other clinicians. As these issues were discussed in detail in the last issue of InTouch they will not be addressed any further in this issue.

Examination gloves enter the mouth and so should be dispensed from boxes with minimal environmental contamination. Glove boxes should be at least one metre away from the patient's mouth during procedures

to prevent fluid splashes and splatter. Glove dispensers should be mounted so as to improve access but also reduce the potential for contamination.

Examination gloves which become soiled due to contamination from procedures can themselves become important sources of contamination. This problem has been demonstrated in a range of health care settings (Hughes, Cornwall, Theis, & Brooks, 2013; Stock et al., 2012). Keeping glove boxes accessible is important since many dental procedures require planned changes of gloves during the procedure for the chairside assistant or the dentist. This is in addition to unplanned interruptions such as the need to replace gloves which show visible tears or other defects during use.



Hepatic Whitlow - Courtesy of Dr John Molinari

Historically the rate of defective new examination gloves has been between 1-2% and among surgical gloves it was 1.8% (Lange, Walsh, & Savage, 1993; Otis & Cottone, 1989). Defects in new gloves potentially expose the skin of the healthcare worker to patient fluids, environmental contaminants and microorganisms from the patient. Defects can develop as the glove material is stretched during use, for example in the thumb and forefinger regions from grasping items with force, and in fingertip regions from exposure to sharp items. A higher quality glove will be more durable and will develop fewer defects over the time it is worn.

WHY QUALITY GLOVES MATTER IN DENTISTRY

PROFESSOR LAURENCE WALSH

Defects in new gloves potentially expose the skin of the healthcare worker to patient fluids, environmental contaminants and microorganisms from the patient.

Many dental procedures involve the use of sharp instruments and sharp items, so the glove material must resist tears and punctures. Glove materials vary in their physical properties such as their tear strength. Nitrile gloves are less likely to develop small tears and leaks during use compared to latex gloves, despite not being thicker. Some dental patients and staff may prefer nitrile over latex for reasons not related to strength, such as more pleasant smell, flavour or taste. To achieve suitable resistance to tearing, the glove material must be strong and also have sufficient thickness to handle the stresses of donning gloves and the shear forces developed when items are grasped with force – as is often done in oral surgery and when hand instruments are used to scale teeth. Low quality gloves are thinner and more prone to tear when stretched (Lange et al., 1993). This is a particular problem when gloving, as the glove material becomes stretched as it slides over the skin of the hands. Having long fingernails stretches the glove material at the fingertips, which adds further stress.

A higher quality glove will be more durable and will develop fewer defects over the time it is worn.

Glove materials vary in their resistance to chemical agents. Compared to natural rubber latex nitrile has higher tear strength and greater resistance to detergents, acids, and common organic solvents (such as ethanol). Compatibility with the emollients found in alcohol-based hand gels and skin moisturizing products is a further important consideration. Certain oils found in oil-based hand creams can cause degradation of latex gloves. The surface chemistry of glove materials is also relevant to their ability to become contaminated with bacteria, with more

hydrophobic materials such as nitrile carrying fewer bacteria than gloves made from hydrophilic materials (Moore, Dunnill, & Wilson, 2013). The hydrophobic water-repellent surface is well suited to situations where water spray is used during dental procedures, since the glove surface does not typically stay covered with water for very long.

Low quality gloves are thinner and are more prone to tear when stretched.

The glove must cover the hand and wrist/forearm region. Many dentists work in short sleeved gowns for non-surgical dentistry, so as a protective barrier over the skin gloves must have sufficient “hem length” to cover and protect the skin of the wrist from splashes of material during procedures such as examinations, tooth cleaning and placing fillings. These splashes will occur predictably during most dental procedures as water irrigation and suction are applied in the patient’s mouth. Low quality gloves have short hemlines and expose more of the wrist. For surgical dental procedures, wearing long sleeve gowns is commonplace, and so surgical gloves need to cover the cuffs of the gown sufficiently well to form an effective seal.

Quality gloves will have low levels of polymerizing agents and other free chemicals which are released onto the skin of the wearer and into the mouth of the patient – and because of the latter, they will taste better for the patient and expose the patient’s oral mucosa and peri-oral skin to only lower levels of agents. Gloves should be compatible with the oral mucosa and not cause irritation. A final characteristic of a high quality glove is that the texture of the glove is designed to optimize the grip, dexterity and fingertip sensations of the user.

WHY QUALITY GLOVES MATTER IN DENTISTRY PROFESSOR LAURENCE WALSH

A range of specialised features are built into high quality gloves to ensure that the wearer has optimal grip under damp or wet conditions, and is still able to sense fine changes at the regions of their fingertips – something that requires a material that adapts well but is both thin and strong. Such characteristics are critical in dentistry since most procedures involve fine manual skills and careful hand-eye coordination to ensure controlled movement of instruments, with defined start and stop positions for the fingers, and the use of multiple finger rests to achieve stability. Viewing work in a mirror and working under magnification adds additional levels of complexity. A range of dental procedures are done mostly by tactile sensation, for example exploring the root canal of a tooth during root canal treatment, so the dentist must be able to feel slight variations in the internal shape of the roots when using an exploring file which is often less than 200 microns in diameter.

A final characteristic of a high quality glove is that the texture of the glove is designed to optimize the grip, dexterity and fingertip sensations of the user.

In the mid 1990's some dental practitioners struggled with transition to glove wearing as the norm and inconsistencies in the use of gloves in patient care, surgery cleaning and instrument reprocessing were reported (Lange, Savage, & Walsh, 1996). Today, dental and oral health students are trained in the simulation laboratory and teaching clinics to wear gloves as a matter of routine. Modern patients expect to see their treating dental staff put on fresh gloves as part of the routine of modern dentistry.

The physical characteristics of disposable gloves have a major influence on the safety and performance of the wearer, thus there is no room for compromise. There are both simple and sophisticated ways to assess glove quality (Katz, Gobetti, & Shipman, 1989; Lange et al., 1993; Sohn et al., 2000) and increasing

attention to how glove materials influence the likelihood of perforations during different types of surgical procedures (Mischke et al., 2014). The selection of gloves for clinical practice is emphasized in some official Guidelines which can serve as a key platform for infection control in all types of local dental practice settings. Compliance with such guidelines is also a formal requirement in many dental schools, dental hospitals and government-funded dental clinics. In recent years there has been a trend to adopt nitrile as a material of choice for non-sterile disposable gloves, to address issues around contact with latex and to gain the benefits of greater puncture resistance and chemical resistance despite muscular movement of the hands (Mansouri, 2010 #111; Phalen, 2011 #112; Phalen, 2012 #113). The author's experience has been favourable following a short period of adaption.



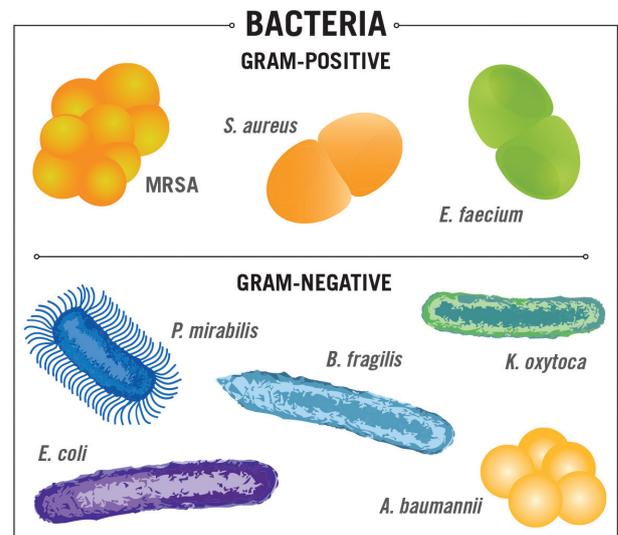
WHAT'S HOT IN GLOVES

“What’s Hot in Gloves” is a newly introduced section of InTouch intended to provide a very brief summary of either emerging general glove-related research, any event(s) that include discussion of gloves, and recent glove-related social media or professional trends. In this issue we concentrate emerging research relating to antimicrobial gloves (on Assadian et al., 2014; Leitgeb et al., 2015; Napp et al., 2015; Reitzel et al., 2009).

Napp recently published their concerns regarding contaminated skin flora from surgeons’ hands contaminating the incision site in the event of glove penetration (Napp et al., 2015). They undertook a controlled experiment comparing the ability of a conventional glove and an antimicrobial containing glove to disinfect fluid passing through the perforation. The glove containing the undisclosed antiseptic agent demonstrated better ability to reduce surrogate organism log counts. As such the researchers concluded anti-microbial gloves may be helpful in reducing patient exposure to operator hand flora in the event of glove penetration, perforation or tear. Napp noted that there is a variety of antimicrobial gloves currently available or being tested and each differs in either its composition or function.

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Different to Napp’s study, Leitgeb et al. recruited non-healthcare worker participants for an experimental, cross-over study requiring them to undertake an antiseptic scrub, don a conventional sterile surgical glove and a sterile chlorhexidine gluconate (CHG) coated surgical glove and perform typical hand movements and forces during a two-hour period before the addition, sampling and cultivating of a standard challenge solution (Leitgeb et al., 2015).



Although no significant difference was noted between the glove types, researchers did demonstrate that after 2 hours of wear antibacterial gloves were still effective. This ability to remain effective is important for long-duration surgery such as orthopaedics, neurology and cardiothoracics. The high bacterial load recovered from surgeons’ hands after long procedures has previously been a concern to researchers (Eklund, Ojarvi, Laitinen, Valtonen, & Werkkala, 2002). Most recently Assadian and colleagues were able to show the superiority of antimicrobial gloves to reduce residual hand flora recovered from surgeons’ hands after almost 2 hours of operating in real-life conditions (Assadian et al., 2014). These results show great promise for the future of antimicrobial gloves and it would not be unreasonable to perhaps predict that wearing of these gloves by surgeons will increasingly become the normal rather than the exceptional, standard of practice. This would be especially warranted in those surgical specialities performing long-duration procedures.

WHAT'S HOT IN GLOVES

CHG has a long history as an infection prevention mechanism. It is commonly found in hand hygiene products, coating of indwelling devices, impregnation of wound dressings and more recently as the active part of some antimicrobial gloves (Milstone, Passaretti, & Perl, 2008). CHG is well tolerated with very few serious reactions none of which have been attributed to the use of CHG in gloves.

Reitzel's paper describes a small, lab-based study in which antimicrobial coated gloves were tested against challenge organisms typical of those found in a contemporary hospital setting (Reitzel et al., 2009). The authors report being motivated to investigate the ability of gloves to kill pathogens on contact due to the ongoing failure of HCWs to adequately perform hand hygiene and their non-compliance with glove recommendations.

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The initial results show early promise in antimicrobial gloves as an additional weapon against healthcare associated infections however for the specific glove studied the authors note the need for testing in real clinical settings rather than lab-based, experimental settings. They also advocate for consideration of the cost-benefit of this new approach. Regardless, they are optimistic that antimicrobial gloves warrant further consideration given their potential to be "an additional means to halt the horizontal transmission of invasive microbial pathogens in health care settings"(Reitzel, 2014 #234).

In subsequent issues of InTouch we look forward to reviewing more emerging science relating to gloves and aspects of glove use, wearing, durability and more as well as further discussion of antimicrobial-impregnated gloves.



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