Royal Australasian College of Surgeons

REUSABLE SURGICAL GOWNS POSITION STATEMENT

Reusable sterile surgical gowns are safe, effective, and have a lower environmental impact than disposable gowns

Introduction

Climate change has been recognised as the 'biggest global health threat of the 21st century' (Lancet Climate Change Commission 2009). Given this imminent threat, the health-care community has a responsibility to advocate for, and participate in, emissions reductions and improved sustainability practices. Health care has a considerable carbon footprint, contributing to 7% of Australia's carbon dioxide emissions (Malik 2018). The operating theatre is responsible for a significant proportion of this carbon footprint (Burguburu 2022). This is due to both the large amount of solid waste associated with surgery (up to 30% of an hospital's waste) (Wyssusek 2019), and also the greenhouse gas emissions generated by surgical practice.

The position of the Royal Australasian College of Surgeons (RACS) is that surgeons and hospitals should employ the principles of effective waste management and sustainability in order to reduce the impact of surgery on the environment (RACS 2018). One suggested approach is to revisit and implement the simple principles of the 'waste hierarchy', which is underpinned by the five Rs – reduce, reuse, recycle, rethink and refuse.

A surgical gown is an example of a product which is available in reusable and disposable alternatives. The literature over the last decade confirms that reusable surgical gowns are equivalent to disposable gowns in terms of sterility and infection prevention (WHO 2018), water resistance (McQuerry 2021), comfort (Conrardy 2010, Angelopoulos 2022) and are cost-effective (Angelopoulos 2022). More importantly from a climate change perspective, reusable gowns have a vastly lower environmental impact as demonstrated in several life cycle analyses (LCA) (Vozzola 2020). Implementing the routine use of reusable surgical gowns is a tangible and effective way that surgeons and hospitals can reduce the impact of surgery on the environment (Vozzola 2022). Switching to reusable surgical linens has been recommended in a joint report by the Royal College of Surgeons of England, Edinburgh and Glasgow (Royal College of Surgeons of England 2022).

Purpose of surgical gowns

Surgical gowns refer to gowns that are used by healthcare workers when scrubbed for an operation. They have two primary purposes: to protect the patient and to protect the healthcare worker. First, surgical gowns act to protect patients from micro-organisms which may exist on the healthcare worker's clothes and skin. The use of a surgical gown helps to create a sterile field, in order to decrease the risk of infection to the patient. Second, surgical gowns act to protect healthcare workers from both micro-organisms and from gross contamination from bodily fluids which may be encountered during an

operation. A surgical gown is part of a suite of personal protective equipment, which also includes masks, gloves, and eye protection.

Barrier protection levels

The Association for the Advancement of Medical Instrumentation standards sets out four levels of barrier protection for surgical gowns, with level 4 being the highest level of liquid and viral protection (AAMI 2012).

The 4 AAMI levels and suggested appropriateness of each

- Level 1 – minimal fluid barrier protection – not suitable for surgical procedures
- Level 2 – low fluid barrier protection – suitable for procedures with low risk of liquid exposure
- Level 3 – medium fluid barrier protection – suitable for most procedures
- Level 4 – high fluid barrier protection – suitable for procedures with high volume liquid exposure (eg. Trauma)

Compliance with standards

In order for disposable gowns to be compliant with ACORN Standards, the manufacturers must obtain approval from the TGA and, therefore, must meet the requirements set out in the AAMI standards. Therefore, if they are TGA approved, they will have met the required standards.

Reusable gowns need to be approved by the TGA and manufactured in accordance with the appropriate sections of the Australian Standard AS3789 Textiles for health care facilities and institutions. This standard has 10 parts, of which parts 2 and 8 are the most relevant and provides specifications and minimum requirements for both the fabric and the gowns. AS 3789 Part 2: Theatre linen and pre-packs (1991) covers the requirements for the size and design of gowns, especially the location of the water-repellent barrier material. There is a minimum requirement to provide an effective barrier and protect staff against occupational exposure to biohazardous material (Standards Australia 1991, ACORN 2020). The more recent AS 3789 Part 8: Recyclable barrier fabrics (1997) covers reusable gowns made using barrier fabrics. This standard requires the fabric to meet certain minimum performance requirements, including water and vapour permeability, but allows colour to be a matter of agreement between the parties.

Reusable gowns must also comply with ACORN Standards and will do so if they comply with the many Australian Standards which govern the manufacture, labelling, transport, sterilisation and laundering of reusable gowns.

These standards are:

AS/NZS 4146:2000: Laundry practice

AS 3789 Textiles for healthcare facilities and institutions, Part 2: Theatre linen and pre-packs (1991)

AS 3789 Textiles for healthcare facilities and institutions, Part 8: Recyclable barrier fabrics (1997)

AS/NZS 1957:1998 Textiles: Care Labelling.

AS/NZS 4187:2014 Reprocessing of reusable medical devices in health service organisations

All providers of reusable sterile linen must be accredited against these standards by independent accreditors. Proof of accreditation may be requested by healthcare services. Infection Control personnel from healthcare facilities should be able to inspect the laundries to ensure they are implementing and complying with standards.

Therefore, if an organisation wants to move to reusable sterile gowns, they simply need to ensure that the provider can produce evidence that they have met each of the above standards by accreditation through an independent assessor.

However, it is critical that ongoing monitoring of adverse events related to staff and patient safety (such as surgical site infections) are incorporated into any plan to transition from single-use gowns to reusable gowns. Most hospitals will already have systems in place to monitor for these events (as part of required compliance with National Safety and Quality in Healthcare Standard 3 in Australia and Standards New Zealand 8134:2021 Standard 5 in New Zealand) and these should be closely watched, particularly during the period of transition to ensure staff and patient safety is not compromised and that local systems and processes are robust.

Options for gowns

Surgical gowns can be classified as reusable or disposable.

Reusable gowns are made from woven or knitted cotton-polyester blended fabrics or full polyester fabrics. Barrier fabric reinforces the gowns in critical zones in order to provide liquid resistance, which is usually comprised of expanded polytetrafluoroethylene or polyurethane barrier membranes. These highly engineered, technologically advanced reusable gowns have replaced the woven cotton fabrics, which were less effective at resisting liquid penetration (Vozzola 2020).

Disposable gowns are made from disposable material, usually nonwoven polyester and polypropylene fabrics, and are designed for single use only.

Characteristics of gowns

The most important requirement for an operative gown is that it provides protection to both patient and healthcare worker, as outlined above. The other important considerations in choosing reusable versus disposable gowns include environmental impact, cost, and comfort/clinical usability.

i) Protection for patient and healthcare worker

Protection for healthcare worker:

Historically, it was argued that reusable fabric gowns were not sufficiently water resistant against large volume bodily contamination. However, the traditional reusable woven cotton gowns have been replaced by modern gowns composed of water-resistant, highly engineered fabrics and are now effective at all levels 1-4 fluid protection.

McQuerry et al conducted a study to evaluate the performance of disposable versus reusable medical gowns through assessment of a gown's ability to provide adequate protection across their expected service lifespan (McQuerry 2021). Protection was measured by the gown's water resistance and strength. It was found that industrial laundering did not have a detrimental effect on the water-resistance of reusable gowns, and further, that the strength of reusable gowns was superior to disposable gowns. McQuerry et al also stated that future studies need to be conducted to evaluate bloodborne pathogen penetration for both disposable and reusable gowns, in particular after multiple wash/dry cycles and sterilisation.

Protection for patient:

One purpose of surgical gowns is to reduce the risk of surgical site infection, by reducing the transmission of pathogens. The World Health Organisation (WHO) conducted a meta- analysis to determine whether sterile disposable non-woven drapes and gowns or sterile reusable woven drapes and gowns should be used to prevent surgical site infection (SSI), which was published in the 'Global Guidelines for the Prevention of Surgical Site Infection' in 2018 (WHO 2018). The WHO stated that a key consideration was ensuring that the barrier material prevents penetration of liquid, because there is increased risk of pathogen transmission if barrier material is wet. Further, in order to be effective at preventing pathogen transmission, it is important that reusable woven textiles maintain this protection after many cycles of processing and treatment.

The primary outcome of the analysis was the occurrence of SSI and SSI-attributable mortality. There were four studies included in the meta-analysis which considered reusable versus disposable surgical gowns, including one randomised controlled trial (Bellchambers 1999). Overall, the meta-analysis showed that 'the use of sterile disposable non-woven gowns has neither benefit nor harm compared to sterile reusable woven items'.

ii) Environmental impact

The environmental impact of reusable versus disposable gowns has been analysed using LCAs. LCAs are the recognised method of calculating the environmental impact associated with a product throughout its entire life cycle. For surgical gowns, the environmental impact stems from upstream factors such as manufacturing and transport, and downstream factors such as laundering, sterilisation, and disposal. The environmental impact indicators include energy consumption, global warming potential/greenhouse gas emissions, water consumption, and solid waste generation. These indicators are then compared between reusable and disposable surgical gowns.

Vozzola et al recently completed an environmental assessment of reusable versus disposable gowns in the United States, evaluating the quantitative differences in the environmental impact of the two types of gowns (Vozzola 2020). LCAs were performed on 11 brands of reusable operative gowns and 7 brands of disposable operative gowns. This LCA considered the

following factors: material acquisition, product creation, use and reuse, laundering, sterilisation, end of life disposition, packaging and transport. The study found that reusable surgical gowns had a significantly lower environmental impact than disposable surgical gowns in all four environmental impact indicator categories. When compared with disposable gowns, reusable gowns resulted in:

- 64% less energy use
- 66% less greenhouse gas emissions
- 83% less blue water consumption
- 84% less solid waste generation

This finding is in keeping with multiple LCAs which have been performed over the last ten years, all of which found that reusable gowns are associated with a reduced environmental impact compared with disposable gowns (Overcash 2012, Vozzola 2018, Conrardy 2010).

Another recently published comparative LCA was performed in the United Kingdom, which found that reusable gowns have a lower impact on the environment than disposable alternatives (Elis 2022). Similar to the Vozzola study, reusable gowns were found to have 66% less energy use, 69% less greenhouse gas emissions, 61% less water consumption, and 84% less waste generation. Overall, the study found the climate change impact of a reusable gown is around 30% of the impact of a disposable gown.

iii) Cost

In a health system which is strained with financial pressures, cost is a significant issue when it comes to choosing between reusable and disposable products. Reusable products tend to have a higher initial purchase price compared with disposable products. However, once the number of re-uses, all the costs in the supply chain, and disposal costs are considered, reusable products have been found in preliminary studies to be cheaper than disposable products (Greenhealth 2011), although local costs will vary. A recent Australian study of reusable isolation gowns in an intensive care unit found economic savings of over A$1 each time a reusable gown was worn compared with the disposable alternative (Angelopoulos 2022).

iv) **Comfort**

The comfort of surgical gowns is an important consideration for perioperative staff in choosing between reusable and disposable gowns. In 2010, Conrardy et al conducted a study to assess surgeons' attitudes towards reusable and disposable gowns (Conrardy 2010). Specifically, surgeons were asked to rate comfort, ease of use and protective properties reusable compared with disposable gowns. Overall, surgeons clearly preferred the reusable gowns, based on assessment of comfort, ease of use and protection. Similarly, in a study of reusable isolation gowns in an ICU staff, 82% rated the reusable gowns as 'comfortable' or 'very comfortable' and 74% felt they offered superior protection to a disposable gown (Angelopoulos 2022).

Lastly, a recent survey of surgeons in Australia and New Zealand demonstrated that 26% of surgeons currently use reusable gowns and drapes but if guideline and opportunities were provided to change to reusable gowns and drapes 82% of surgeons would be willing to make the change (Mousley 2023).

Conclusion

Climate change is an escalating threat to human health. Surgeons and hospitals have the opportunity to help combat climate change by reducing greenhouse gas emissions, waste generation, energy consumption and water usage. Choosing reusable surgical gowns rather than disposable surgical gowns is a proven way to reduce the environmental impact of surgical practice. In addition, reusable gowns provide equivalent protection for patient and healthcare worker, as well as cost savings and increased comfort. However, as with any change in healthcare delivery, care must be taken to ensure systems are in place to monitor, report and act on any indication that there may be increased risk to patient or staff safety (such as surgical site infections), particularly during the initial transition from single use to reusable gowns to ensure local systems and processes are robust, for example ensuring there are adequate gowns and laundry services in place to support the transition. Appropriate monitoring of safety and processes is critical for a safe and successful transition to reusable gowns.

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