Lumicare Submission – The Australian Government Productivity Commission - Opportunities in the Circular Economy

Introduction

Sustainability in healthcare has become a critical focus in Australia as the nation grapples with the environmental and economic challenges posed by climate change and resource depletion. The Australian healthcare system, known for its high standards of care, is now seeking to integrate sustainable practices to reduce its carbon footprint, enhance resource efficiency, and promote health equity. This involves adopting environmentally friendly technologies, minimizing waste, and implementing policies that prioritize both patient care and ecological stewardship. By fostering a culture of sustainability, Australia aims to ensure that its healthcare system not only meets the needs of the present population but also safeguards the health of future generations.

Ultrasound Disinfection

The use of ultrasound (US) has become an indispensable tool in contemporary medical practice, enabling the diagnosis and monitoring of various health conditions with enhanced precision. By employing high-frequency sound waves, US provides detailed imaging of the various organs, aiding in the detection of abnormalities, guiding interventions, and facilitating better patient outcomes. However, the increasing use of US also raises concerns regarding the potential transmission of infections, emphasizing the critical need for thorough disinfection practices to safeguard patient health.

The intimate nature of many US interventions, involving direct contact between the ultrasound probe and the mucosa, poses a unique challenge in terms of infection prevention. The human body harbors a diverse microbial ecosystem, including bacteria, viruses, and fungi, both beneficial and potentially pathogenic. If high level disinfection protocols are not adhered to, the transfer of microorganisms between patients via contaminated probes can occur, potentially leading to nosocomial infections.

A meta-analysis of contamination rates on endovaginal/rectal probes found a prevalence rate of 12.9% for potentially pathogenic bacteria and 1.0% for viruses after probes were subjected to low-level disinfection [1].

Subsequently shared patient equipment that is to be reused must undergo reprocessing - cleaning, disinfection and/or sterilisation. The minimum level of reprocessing for reusable instruments and equipment is determined by the degree of risk for infection involved in the use of the items and manufacturer instructions. The National Safety and Quality Health Service (NSQHS) standards require health service organisations to have adequate identification of, and procedures for, reprocessing reusable medical equipment. These processes must be consistent with relevant national and international standards, in conjunction with manufacturers' guidelines. The choice of products for cleaning and

[1] *Leroy S. Infectious risk of endovaginal and transrectal ultrasonography: systematic review and metaanalysis. J Hosp Infect. 2013; 83(2):99–106. https://doi.org/10.1016/j.jhin.2012.07.014 PMID: 22981638*

disinfection is an important one; effectiveness of the product, suitability for the surface and practicality must all be considered.

The Spaulding Classification System provides a system to determine, based on intended use, the level of reprocessing necessary for shared patient equipment/reusable medical devices.

Category	Definition	Level of reprocessing required
Critical	These items confer a high risk for infection if they are contaminated with any microorganism and must be sterile at the time of use. This includes any objects that enter sterile tissue or the vascular system, because any microbial contamination could transmit disease.	Require cleaning followed by sterilisation.
Semi-critical	These items come into contact with mucous membranes or non-intact skin, and should be single use or sterilised after each use. If this is not possible, high-level disinfection is the minimum level of reprocessing that is acceptable.	Require cleaning followed by high-level disinfection at a minimum. Sterilisation of these items is strongly recommended.
Non-critical	These items come into contact with intact skin but not mucous membranes.	Require cleaning and this can be followed by low or intermediate level disinfection.

For the purposes of high-level disinfection of ultrasound probes that come into contact with mucous membranes or non-intact skin high-level degree of disinfection, there exist currently four processes. These processes are **chemical soaking, chemical aerosol, surface wiping, and UV-C irradiation**. **Chemical soaking** is a process that requires placing the ultrasound transducer such that it is immersed into a chemical reagent. Such processes generally require a soaking time for the transducer to be left immersed in the chemical reagent of between 8 minutes to 45 minutes. Whilst the appropriate level of disinfection may be achievable, the disadvantage of this process is that the chemical reagent is hazardous and any exposure to the chemical reagent may harm the operator and patient and disposal of the chemical waste may harm the environment. Further, as care is required in handling the chemicals, this method is manually operated and time-consuming.

Chemical aerosol is a process whereby the ultrasound transducer is placed within a chamber that is flooded with nebulized hydrogen peroxide. Typically, the transducer is placed within the chamber for between 7 to 12 minutes, depending on the specific conditions. Once again, due to the use of the chemical reagent, the disadvantage of this method is that the residual of chemical reagent left on transducers may harm the operators and patients and expose the environment to potentially hazardous chemicals.

It is possible to achieve the desired level of disinfection through the use of **surface wipes**. Such a process uses different chemical wipe combinations to manually wipe the surface of the transducer. The procedure requires steps of pre-cleaning, disinfection and rinsing. However, a drawback with such a method is that it requires manual application and is prone to human error, is costly, is time intensive and generates a large amount of non-recyclable waste.

The use of **ultraviolet-C light (UVC),** of wavelengths 255-285nm, has the advantage that it does not use potentially hazardous chemicals nor leave residual chemicals. Also, UVC disinfection has been shown to reduce the time needed to disinfect transvaginal probes[2] and to reduce bacteria and viruses on probes to below detectable levels[3].

Lumicare One

The Lumicare One stands out not only for its innovative healthcare capabilities but also for its commitment to environmental sustainability. Designed with eco-friendly principles in mind, the device incorporates sustainable materials and energy-efficient technologies, minimizing its ecological footprint throughout its lifecycle. By prioritizing recyclability and reducing waste in its manufacturing processes, Lumicare One exemplifies a holistic approach to healthcare that values both patient well-being and the health of the planet. Its integration into healthcare settings not only enhances patient monitoring and care but also aligns with broader efforts to create a more sustainable future, making it a responsible choice for environmentally conscious healthcare providers and organizations.

The Lumicare ONE uses ultraviolet-C (UVC) for high-level disinfection of ultrasound probes, crucial for preventing the transmission of infection between patients. UVC light penetrates and disrupts cell DNA. It's a proven, chemical-free method for disinfection. See attached the Lumicare Product Brochure for further product description.

Leveraging second-generation Aluminium Gallium Nitride (AlGaN) semiconductor material and photolithography technology, Lumicare generates UVC by Light Emitting Diodes (LEDs). Over 100 high-powered UVC LED semiconductors are arranged in a hexagonally shaped chamber providing uniform irradiation and direct light to the probe.

Historically, UVC was generated using fluorescent tubes containing mercury, a toxic metal. Lumicare is committed to supporting Healthcare in ending mercury-based UV disinfection as part of the objective of the Minamata Convention.

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[2] *Kyriacou C, Robinson E, Barcroft J, Parker N, Tuomey M, Stalder C, et al. Time-effectiveness and convenience of transvaginal ultrasound probe disinfection using ultraviolet vs chlorine dioxide multistep wipe system: prospective survey study. Ultrasound Obstet Gynecol. 2022; 60(1):132–8. https://doi.org/ 10.1002/uog.24834 PMID: 34919771*

[3] *Kac G, Podglajen I, Si-Mohamed A, Rodi A, Grataloup C, Meyer G. Evaluation of ultraviolet C for disinfection of endocavitary ultrasound transducers persistently contaminated despite probe covers. Infect Control Hosp Epidemiol. 2010; 31(2):165–70. https://doi.org/10.1086/649794 PMID: 20025531*

UVC LEDs deliver benefits for High Level Disinfection (HLD) by providing higher output at peak germicidal wavelengths. Lumicare CoolTouch™ technology ensures the disinfection chamber remains cooler to protect sensitive ultrasound probes.
The Lumicare ONE device uses LEDs to produce UVC making it the most sustainable High Level Disinfection device for ultrasound probes available, significantly minimising the environmental impact of decontamination:

- Free of harmful chemicals
- Completely free of toxic metals including Mercury found in mercury tubes
- No consumables including plastic bottles
- No refrigeration for chemical consumables
- No high volume waste (testing strips, etc)
- No regularly replaced parts such as florescent tubes.
- Lumicare carefully selects materials that have a long life-cycle
- The Lumicare One 5 year warranty reflects our commitment to product longevity

Key decontamination metrics which provide added value in fighting climate change:

- A Lumicare ONE could in its lifetime replace the use of up to 74,700 chemical disinfection wipes (149 kg of wipes).
- A Lumicare ONE could it its lifetime replace the use of over 500 bottles of chemical hydrogen peroxide (40 Litres).
- A Lumicare ONE could in its lifetime replace the use of approximately 40-80 x Mercury vapour UVC lamps (40-80 kg of wastage).

In addition to our superior environmentally friendly decontamination delivery, the Lumicare is committed to sustainable and responsible manufacturing:

- ~85% of the weight of the Lumicare ONE is recyclable at the end-of-life of the product.
- All packaging cartons are toxic-free and 100% recyclable
- Packaging bags are 100% biodegradable
- Our factory floor is naturally sunlit during daylight hours due to floor to ceiling thermal glass windows (also minimising cooling requirements)
- Our office uses rain water collection for toilet flushing and watering green spaces.
- Our office and factory have tap filters installed for drinking water (no plastic drinking water bottles).
- Our production, purchasing and warehouse operating systems are 100% paperless
- We re-use the cartons from supplier shipments as circulation cartons in our factory, and utilise reusable in-house transportation containers for components movement on the production line.

Lumicare is committed to protecting the environment and responding to climate change. As we grow, Lumicare aims to minimise our environmental impact through sustainability framework and strategy. The Lumicare Board of Directors is ultimately responsible for sustainability at Lumicare, with the CEO and executive leadership team responsible for delivery of the programs, evaluating our performance and sustainability risks, and identifying opportunities for sustainable change.