

Environmental cleaning: emerging environmental cleaning technologies

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This factsheet provides guidance on emerging cleaning technologies for health service organisations and staff responsible for environmental cleaning and infection prevention and control (IPC). Emerging cleaning technologies discussed in this factsheet include ultraviolet (UV) irradiation, high-intensity narrow-spectrum (HINS), disinfectant fogging and steam vapour. The information provided in this factsheet complements the recommendations relating to environmental cleaning and the use of emerging cleaning technologies in the [Australian Guidelines for the Prevention and Control of Infection in Healthcare](#). This factsheet does not address the use of products with copper, silver, triclosan, polycations or other compounds that may have some antimicrobial effect.¹

Introduction

Standard precautions are work practices that constitute the first-line approach to IPC and should be used in all healthcare settings. The use of these precautions and targeted interventions reduces the transmission risk of infectious agents and the prevalence of healthcare-associated infections (HAIs).¹

An emerging cleaning technology refers to new devices or products (automatic or manually controlled) that clean the environment and/or equipment surfaces.^{1,2}

There is growing evidence supporting the efficacy of some emerging cleaning technologies in reducing the burden of pathogens on environmental surfaces. However, many of these technologies are expensive, have potential safety risks and require additional training programs to

be developed before the implementation and use.^{1,2} **Table 1** summarises common emerging cleaning technologies, including the benefits and limitations of their use.

The [Australian Guidelines for the Prevention and Control of Infection in Healthcare](#) (AICGs) and the [National Safety and Quality Health Service \(NSQHS\) Standards](#) provide recommendations for all health service organisations on maintaining a clean and hygienic environment.

Comparison of emerging environmental cleaning technologies

When exploring emerging cleaning technologies, staff should consider current evidence for the effectiveness of the technology. Staff should also consider the effectiveness of the organisation's existing IPC program, the risk of infection within the organisation and any gaps in the organisation's existing environmental cleaning programs. **Table 2** provides sample questions that staff should consider before deciding to introduce an emerging cleaning technology into an organisation's environmental cleaning program.

Emerging cleaning technologies should:

- Be used after manual cleaning with neutral detergent has been completed until evidence changes
- Complement an organisations existing cleaning program
- Not replace manual environmental cleaning methods.¹⁻⁵



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Suitability of emerging cleaning technologies

Table 1: Summary of common emerging cleaning technologies

	Ultraviolet (UV) Irradiation	Fogging or Misting Machines	High-Intensity Narrow Spectrum Lights (HINS)	Steam Vapour
What is it?	Free-standing machine that delivers pulses of UV light onto surfaces to kill microorganisms. ^{2,3,5,6}	Free-standing machine that generates a wet or dry fog of small particles of a disinfectant solution, usually hydrogen peroxide (H ₂ O ₂) into the air. ²⁻⁵	Ceiling-mounted device that emits a continuous visible light into the clinical environment. ^{8,9}	Device that delivers high pressure dry steam (<140°C) to surfaces and vacuums dirt and water from the area that is being cleaned. ¹⁰
How does it work?	The UV light breaks the molecular bonds in DNA and RNA, causing damage to the cellular structure of microorganisms, and cellular death. ^{2,3,5,6}	H ₂ O ₂ kills microorganisms by releasing free radicals that oxidise the DNA, RNA, and lipid membranes of cells, causing cellular death. ^{3,5}	Uses a process called photodynamic inactivation, causing molecules to react with oxygen when exposed to light, leading to cellular death. ⁸	Microorganisms are killed by the high temperature of the steam. ¹⁰
Benefits	<p>Non-touch, automated method of inactivation of pathogens.</p> <p>The device does not damage surfaces and is easy to use.</p> <p>A chemical free process.</p> <p>Delivers a pre-set level of UV light to deactivate pathogens on environmental and equipment surfaces.^{2,3,5,6}</p>	<p>Particles of disinfectant can reach difficult-to-access surfaces of the clinical environment and equipment.</p> <p>Can be used on porous and non-porous surfaces.</p> <p>Uses a non-corrosive chemical.</p> <p>Delivers a pre-set measured dose or level of environmental disinfection.^{3,5}</p>	<p>Safe to use around patients.</p> <p>Wide range of antimicrobial activity.</p> <p>Inactivates pathogens on surfaces, equipment and in the air.</p> <p>Can be used continuously.</p> <p>Will not disrupt daily hospital routines.</p> <p>Easy to install onto ceilings.^{8,9}</p>	<p>Non-toxic, fast method of removing bioburden.</p> <p>No chemicals used, time and cost effective, low water consumption.</p> <p>Can be incorporated into routine cleaning.</p> <p>Equipment is portable and lightweight.^{5,10}</p>
Limitations	<p>Only surfaces in the direct line of the UV light emitted from the device will be treated.</p> <p>Not suitable for porous surfaces.</p>	<p>The device has a long cycle time and can only be used in a vacant room.</p> <p>There may be an extended downtime whilst the solution</p>	<p>Effect on some microorganisms is dose dependent.^{8,9}</p>	<p>Cannot be used on electrical devices.</p> <p>Not suitable for use in patient areas due to risks of burns.</p>

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	Ultraviolet (UV) Irradiation	Fogging or Misting Machines	High-Intensity Narrow Spectrum Lights (HINS)	Steam Vapour
	<p>The device may need to be moved around a room several times to different locations to ensure all surfaces and equipment in a room are treated with the UV light.</p> <p>The device has a long cycle time and can only be used in a vacant room.^{4,6}</p>	<p>dissipates before the clean room can be used.</p> <p>May need more than one device to treat a large area.^{2,3,5}</p> <p>Only solutions that are recommended by the manufacturer should be used for disinfection fogging.⁷</p>		<p>May disperse water and dirt to surrounding environment.</p> <p>Surfaces are damp after cleaning and require drying.^{1,5,10}</p>
Is user training required?	Yes	Yes	Minimal training required.	Yes
Work Health and Safety considerations	<p>UV light can cause headaches and visual disturbances (short term effect).</p> <p>To prevent UV exposure to others, the room being treated must be secured to prevent people entering while the device is in operation.^{2,3,5,6}</p>	<p>Staff need to use personal protective equipment (PPE) when handling chemicals.</p> <p>H₂O₂ exposure can cause toxicity (headaches, sore throat).⁷</p> <p>Rooms being treated must be securely sealed while the device is in operation to prevent fogging vapor escaping into the surrounding areas.</p> <p>Times will vary for different devices.</p> <p>H₂O₂ concentration levels should be monitored to ensure they remain within safe health limits.^{2,3,5}</p>	Nil issues identified.	Risk of scalds and burns. ⁵

Table 2. Would an emerging cleaning technology be suitable for my organisation?

Questions to assist with assessing the suitability of an emerging technology
<p>Why does the health service organisation need this emerging cleaning technology?</p> <p><i>Additional questions</i></p> <ul style="list-style-type: none"> • Does the organisation have sufficient environmental cleaning processes in place to address the risks associated with an outbreak caused by a multi-resistant organism (MRO) or another highly transmissible disease, such as COVID-19? • Can the risk of infection be mitigated with improvements to current cleaning programs or other interventions? • How would an emerging cleaning technology reduce the risk of HAIs, MROs, or outbreaks in the healthcare organisation? Is there good evidence to support its use?
<p>How would the health service organisation use this emerging cleaning technology?</p> <p><i>Additional questions</i></p> <ul style="list-style-type: none"> • Who will be using the emerging cleaning technology? • Will staff require training to use the emerging cleaning technology and if so, how will this happen? • Under what circumstances will the emerging cleaning technology be used? For example, integrated into the regular cleaning schedule, or only to be used for outbreak management? • Can the emerging technology be used in all departments or on all equipment? • Will there be a 'down-time' during or after the use of the emerging cleaning technology? How will this affect service delivery in the healthcare facility?
<p>Does the emerging cleaning technology meet the current recommendations for environmental cleaning?</p> <p><i>Additional questions</i></p> <ul style="list-style-type: none"> • Have the recommendations in the Australian Guidelines for the Prevention and Control of Infection in Healthcare been considered prior to selecting an emerging cleaning technology? • Is this technology approved by the Australian Register of Therapeutic Goods (ARTG)?
<p>Can the health service organisation meet the manufacturer's instructions for the use?</p> <p><i>Additional questions</i></p> <ul style="list-style-type: none"> • Can the healthcare organisation safely store and maintain the emerging cleaning technology and its related equipment or chemicals?

What are the establishment and ongoing costs of use of this emerging cleaning technology?

Additional questions

- Is the use of this emerging cleaning technology a cost-effective solution?
- What other costs are associated with the use of this device? For example, costs related to consumables, additional equipment to use the device safely, PPE, ongoing staff training, warranties, and ongoing maintenance of equipment.

Is the use of the emerging technology environmentally sustainable?

Additional questions

- What is the energy and water consumption required to implement and use this technology?
- Do the technology use chemicals that have a negative impact on the environment?
- Does the technology require a large quantity of resources (for example, PPE) to use safely?

References

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