

Guidelines for safely managing surgical plume

This guideline is for all perioperative teams and medical practitioners. It describes how to minimise the risk of exposure to electrosurgical plume (smoke) produced by surgical heat generating instruments.

Electrosurgical plume is known to contain potentially hazardous compounds, and repeated exposure to plume and bio-aerosols pose respiratory, ocular, dermatological and other health-related risks.

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Definitions

Term	Definition
Surgical plume	Is visible and invisible noxious airborne contaminants produced by the thermal destruction of tissue by use of lasers or electrosurgical devices that rely on the ablation, cauterization and thermal desiccation, and by any powered devices/tools that disrupt tissue or bone integrity, such as power tools.
Energy based surgical devices	Heat-generating devices which are used in clinical procedures to disrupt tissue.

Devices that produce surgical plume

Plume producing devices routinely used during surgical procedures are:

- Electrosurgical (diathermy) – bipolar and monopolar
- Lasers
- Radiofrequency, eg arthroscopic RF system
- Ultrasonic, eg Harmonic scalpel

- Power tools – high speed drills, bone saws

Effects of surgical plume

Surgical plume contains many components that are recognized health hazards. These include:

- Odour-causing and odourless toxic gases
- Vapours
- Dead and live cellular debris (including blood fragments)
- Viruses
- Chemical compounds

Airborne particles can pose respiratory, ocular, dermatological, mutagenic, carcinogenic, and other health-related risks to surgical team and patients.

Operating theatre negative/positive pressure systems force the plume/odour from the theatre into corridors, offices, PACU and other areas – can reach as far as approximately 50 metres.

How to manage surgical plume

For any procedures where surgical plume is produced, evacuation systems must be used in addition to general room ventilation.

To determine the equipment most suitable for your procedure refer to:

- Plume evacuation systems
- Personal protective equipment (PPE)

Masks must always be worn, refer to the [PPE table below](#) for appropriate types.

Evacuation system	Application	Method
<p>Portable plume evacuation units</p> <p>Brand Examples:</p> <ul style="list-style-type: none"> • Big Green IC Medical Evacuator Console • Medtronic Smoke Evacuator • Jackson Allison Buffalo • Neptune waste management system 	<p>For all plume generating surgical procedures that can be captured by an evacuation unit.</p> <p>Maintenance of pneumoperitoneum needs to be considered when selecting the evacuation unit – need to be able to titrate the vacuum whilst not compromising plume evacuation or impacting on visibility in the peritoneum for the surgeon (see also</p>	<p>Typically activated by a footswitch/pencil-switch or remote/automatic-activation feature working with the laser's or electrosurgical unit's activation device.</p> <p>Vacuum pump, filter, hose and inlet nozzle are activated simultaneously to ESU.</p> <p>Captured plume is then passed through a series of</p>

Evacuation system	Application	Method
	<p>disposable endoscopic and laparoscopic systems).</p> <p>Note: Standard suction tubing with a hand held suction device is to be used to evacuate fluid only.</p>	<p>filters that remove the harmful elements. The filtered air is released through the system's exhaust port back into the room.</p> <p>Note: if there is detectable odour when a smoke evacuation system is in use, it is a signal that:</p> <ul style="list-style-type: none"> • Smoke is not being captured at the site where it is being generated. • There is inefficient air movement through the suction or smoke evacuation wand. • The filter has exceeded its usefulness and should be replaced.
<p>Plume evacuation devices</p> <p>Examples:</p> <ul style="list-style-type: none"> • Plume diathermy pencil 	<p>Used with portable plume evacuation systems.</p> <p>A variety of capture devices can be used, for example, an electro-surgery pencil that combines with a plume evacuation unit that is synchronised to the pencil.</p> <p>Pencils with the power cable contained within pliable plume evacuation tubing are optimum. Also, a swivel end where the tubing connects to the pencil to allow a free range of movement.</p> <p>Note: Neptune is not compatible with all diathermy pencils</p>	<p>Close proximity of the plume evacuation device (within 5cm of the plume source) maximises particulate matter and odour capture and enhances visibility at the surgical site.</p> <p>Visualisation of the surgical site must not be compromised.</p> <p>Plume must be vented through a closed system.</p>

Evacuation system	Application	Method
Disposable endoscopic or laparoscopic systems (active and passive)	All abdominal laparoscopic surgery. Typically used exclusively for surgical procedures that use insufflation, which can improve visibility for the surgical team.	Active devices use a closed loop system that maintains distention while filtering the plume. Passive systems use the pneumoperitoneum pressure to exhaust gas through a filter.
Medical Vacuum System Examples: • Wall suction	Wall suction devices have a low suction power which can limit the efficiency of plume evacuation hence may only be used for procedures generating minimal amounts of plume A dedicated system should be used For use as an intermediary measure only while phasing in plume evacuation systems.	For wall suction, a 0.1micron in-line filter (e.g UPLA) must be used between the fluid trap (e.g suction canister) and the vacuum regulator. Routine inspection and maintenance of the system is required to ensure proper vacuum pressure and flow.

Control measures

Control measure	Guidance
Safe work practices	Adequate plume evacuation must be used at the source. There must be effective room exhaust ventilation (air filtration systems). All plume filtration devices require an ultra-low penetration air (ULPA) filter (filtration of 0.1 micron particles at 99.999% efficiency). Standard precautions must be used to protect against exposure to blood borne pathogens when entering or working in an area where infectious material from plume could be present in the air or on surfaces.

Control measure	Guidance
	<p>It is important to properly maintain, clean and monitor smoke evacuation systems to ensure optimal and efficient capturing of generated contaminants.</p> <p>Manufacturers instruction for the safe use and maintenance of equipment must always be followed for safe cleaning, storage, filter changes and disposal of equipment and waste.</p> <p>Evacuation equipment (eg filter, hose, and an inlet nozzle) must always be disposed of as infectious waste.</p>
Awareness, training and competency	<p>All workers potentially exposed to surgical plume must:</p> <ul style="list-style-type: none"> • receive education and training on the risks and control measures during orientation and refreshed as indicated by risk or role. • demonstrate competencies in the use of equipment and supplies.

Personal protective equipment

Equipment type	Specifications	Application
<p>N95 mask fit tested (where supplies permit during Covid 19).</p> <p>A high filtration surgical mask worn properly, is ONLY a substitute where N95 masks are not available.</p>	<p>Note – Globally, there is no method to remove the plume when a TURP is being performed because of the nature of this procedure – in this instance PPE is the best line of defence.</p>	<p>All perioperative team during procedures generating surgical plume, including</p> <ul style="list-style-type: none"> • disease transmissible cases (HPV) • aerosol transmissible diseases (TB, Varicella, Rubeola) • aerosol generating procedures (e.g bronchoscopy) <p>Masks should also be worn when power tools are in use</p>
Protective eye wear	<ul style="list-style-type: none"> • well-fitting visor 	Scrub team and

Equipment type	Specifications	Application
	<ul style="list-style-type: none"> Hogies eye-wear 	when handling used plume evacuation filters or tubing
Skin protection (e.g. gloves)	Surgical or examination gloves	Scrub team and when handling used plume evacuation filters or tubing

Monitoring and review of control measures

Control measures are reviewed in consultation with workers who may be affected by surgical plume.

This is important as there are no specific environmental / health monitoring available for surgical smoke exposure.

References

- [AORN Guidelines for perioperative practice Surgical Smoke Safety \(2019\)](#)
- [AORN, Guidelines for perioperative practice – Electrosurgical Safety 2020](#)
- [AORN Smoke Tool Kit <https://www.aorn.org/guidelines/clinical-resources/tool-kits/management-of-surgical-smoke-tool-kit>](https://www.aorn.org/guidelines/clinical-resources/tool-kits/management-of-surgical-smoke-tool-kit)
- [International Council on Surgical Plume <http://www.plumecouncil.com/>](http://www.plumecouncil.com/)
- [Centre for Disease Control \(CDC\): National Institute for Occupational Safety and Health \(NIOSH\)](#)
- [New South Wales Ministry of Health Guidelines “Work Health and Safety- Controlling Exposure to Surgical Plume,” 2015 \[https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2015_002.pdf\]\(https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2015_002.pdf\)](https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2015_002.pdf)
- [Health and Safety at Work Act 2015](#)

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