Guideline

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Work Health and Safety - Controlling Exposure to Surgical Plume

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Summary	This Guideline provides assistance in the management of risk associated with exposure to surgical plume.
Author Branch	Workplace Relations
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Applies to	Local Health Districts, Specialty Network Governed Statutory Health Corporations, Affiliated Health Organisations, NSW Health Pathology
Audience	Nurses, dentists, doctors, visiting practitioners, infection control and Operating Theatre staff
Distributed to	Divisions of General Practice, Environmental Health Officers of Local Councils, Government Medical Officers, Health Associations Unions, NSW Ambulance Service, Ministry of Health, Private Hospitals and Day Procedure Centres, Tertiary Education Institutes
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GUIDELINE SUMMARY

WORK HEALTH AND SAFETY – CONTROLLING EXPOSURE TO SURGICAL PLUME

PURPOSE

To provide guidance to NSW Health Organisations in meeting their duty of care under the *Work Health and Safety Act 2011* (WHS Act) and *Work Health and Safety Regulation 2011* (WHS Regulation) in eliminating risk, and if not reasonably practicable, to minimise risk associated with surgical plume.

This guideline applies to all NSW Health Organisations and all other bodies and organisations under the control and direction of the Minister for Health or the Secretary of the NSW Ministry of Health where facilities under their control create surgical plume, such as in: operating theatres; dental clinics; morgues during autopsy; laboratories / research and testing facilities.

KEY PRINCIPLES

Each facility where surgical plume is created should:

- Conduct risk assessments in consultation with workers
- Implement controls identified through the risk assessments
- Review controls at a frequency relative to the level of risk to ensure their ongoing effectiveness.

USE OF THE GUIDELINE

Each NSW Health Organisation where surgical plume is created should have systems in place to identify hazards associated with surgical plume and to eliminate or minimise the risk through implementing the appropriate controls.

REVISION HISTORY

Version	Approved by	Amendment notes
January 2015 GL2015_002	Deputy Secretary, Governance, Workforce and Corporate	New guideline.

ATTACHMENTS

1. Work Health and Safety – Controlling Exposure to Surgical Plumes: Guideline.

Work Health and Safety - Controlling Exposure to Surgical Plume

NSW GOVERNMENT Health

GUIDELINE

Issue date: January-2015

GL2015_002

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1. BACKGROUND

1.1 About this document

The purpose of this document is to provide guidance to NSW Health Organisations in meeting their primary duty of care under the *Work Health and Safety Act 2011* (WHS Act) and *Work Health and Safety Regulation 2011* (WHS Regulation) in the management of risks associated with surgical plume.

The guideline applies to any setting where energy-based surgical devices may generate a plume e.g. operating theatres, dental clinics, morgues, laboratories and other research and testing facilities.

Surgical plume, which is generated during operative or other invasive procedures by heat generating devices, such as electrosurgical units, presents a potential hazard to workers and patients. Hazard identification and risk assessment, in consultation with workers, must be undertaken having regard to the type of energy-based surgical device being used, the type of surgical procedure, whether a plume evacuation system is installed and the design of the facility where the procedures are undertaken, in order to eliminate or minimise the risk of exposure of workers and patients to surgical plume. Workers must also be consulted in identifying risk controls.

1.2 Key definitions

Energy-based surgical devices: heat-generating devices that are used in clinical procedures to disrupt tissue, as described under the definition of “plume”.

Hazard: means a situation or thing that has the potential to harm a person.

NSW Health organisation (NSW HO):

For the purposes of this document the term **NSW HO** is used to mean:

- Local Health Districts
- Speciality Health Networks
- NSW Health Pathology.

Person conducting a business or undertaking (PCBU): under the *Work Health and Safety Act (WHS Act) 2011* the term ‘employer’ is replaced by ‘persons conducting a business or undertaking’ (PCBU). A PCBU conducts a business or undertaking alone or with other PCBUs, and is responsible for the primary duty of care for workplace health and safety, so far as is reasonably practicable.

Plume: noxious airborne contaminants generated as by-products, particularly by procedures that rely on the ablation, cauterization, thermal desiccation, or mechanical manipulation of target tissue by devices such as lasers, electrosurgical generators, broadband light sources, ultrasonic instruments, and surgical instruments such as high speed drills and bone saws.

NOTE: Plume may include visible and invisible aerosol particulates, smoke and gases.

Plume evacuation system: a portable, mobile, or fixed device for capturing and neutralizing plume.

Note: Plume evacuation systems are also called plume scavenging systems, plume evacuators, laser plume evacuators, plume scavengers, and local exhaust ventilation (LEV).

Surgical boom: is a device hung from the ceiling that contains and delivers medical gases, electricity, and other utilities to the boom end, which can also carry other devices such as electrosurgical units and monitors (sometimes referred to as pendants, or medical gas supply units).

Ultra-low particulate air (ULPA) filter: a filter that removes particles as small as 0.12 microns with a filtration efficiency of not less than 99.999%.

Risk: is the possibility that harm (death, injury or illness) might occur when exposed to a hazard.

Risk control: means taking action to eliminate health and safety risks so far as is reasonably practicable, and if that is not possible, minimising the risks so far as is reasonably practicable. Eliminating a hazard will also eliminate any risks associated with that hazard.

Ventilation: is the movement or replacement of air, typically between an indoor space and the outside. The exchange is made to control temperature, replenish oxygen, or remove moisture, odours, smoke, heat, dust, airborne bacteria, and carbon dioxide.

Workers: is defined in the WHS Act and PD2013_005 *Work Health and Safety: Better Practice Procedures* as anyone who carries out work for NSW Health and includes: employees, contractors (including visiting practitioners), sub-contractors and employees of contractors and subcontractors, employees of a labour hire company, volunteers, apprentices or trainees and students on clinical work experience or other placements.

1.3 Legislation and Standards

Each NSW HO constitutes a PCBU.

Under the *WHS Act* s19, the NSW HO has a primary duty, so far as is reasonably practicable, to ensure the health and safety of workers and other persons at the workplace, including patients. Deciding what is ‘reasonably practicable’ to protect people from harm requires weighing up all relevant matters, including:

- What the person concerned knows, or ought reasonably to know, about the hazard or the risk, and ways of eliminating or minimising the risk
- The likelihood of a hazard or risk occurring and the degree of harm that would result, and then making a judgement about what is reasonable in the circumstances
- The cost associated with available ways of eliminating the risk and whether the cost is grossly disproportionate to the risk.

Under the WHS Act s47 and s48 the NSW HO is required to consult with workers to consider their views and enable them to contribute to decisions affecting their health and safety. Consultation is to be undertaken during the risk management process and, for surgical plumes, particularly when selecting equipment.

Under WHS Regulation cl34, the NSW HO, in managing risks to health and safety, must identify reasonably foreseeable hazards that could give rise to risks to health and safety.

In managing risks to health and safety as required under *WHS Regulation* cl35, the NSW HO in so doing must:

a) Eliminate risks to health and safety so far as is reasonably practicable, and

b) If it is not reasonably practicable to eliminate risks to health and safety – minimise those risks so far as is reasonably practicable.

WHS Regulation cl36 requires that the hierarchy of controls be used to minimise the risks to health and safety where the risk cannot be eliminated.

WHS Regulation cl37 requires that the control measures to eliminate or minimise risk are maintained in order to remain effective.

WHS Regulation cl38 requires that the control measures are reviewed and if necessary revised in order to maintain so far as reasonably practical a work environment which is without risk to health and safety.

2. OCCUPATIONAL EXPOSURE

2.1 What is Surgical Plume?

During surgical procedures energy-based surgical devices intentionally vaporise tissue creating a potentially hazardous, visible and invisible by-product or plume.

The plume can contain a variety of contaminants, including viable bacteria, viruses, cellular debris, particulates, noxious and toxic aerosols, gases, vapours and fumes[1]. Blood-borne pathogens may also be present in surgical plumes. Often a noxious odour is emitted within the surgical plume due to the 'hot' tool impacting tissue.

The visible plume is often referred to as a 'smoke' plume. Plume may include visible and invisible aerosol particulates, smoke and gases.

2.2 Energy Sources

Emerging research tends to indicate that the hazards of surgical plume are the same, regardless of the energy source used to disrupt tissue[2]. The number of particles present in plume can vary depending on the type of surgery and its duration.

Electro surgery and laser plume is characterised by smaller particles.

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[1] *Canadian Standards Association Standard Z305.13-13 Plume scavenging in surgical, diagnostic, therapeutic, and aesthetic settings*
[2] AORN Journal, Risks associated with exposure to surgical smoke plume: a review of the literature, Lorraine Bigony, December 2007

Ultrasonic scalpels produce a vapour. High speed electric devices such as saws and drills used in orthopaedic, ear nose and throat (ENT), neuro, cardiothoracic, dental and other types of surgery heat up and require irrigation to cool them. This sends aerosols into the operating room. Vapours and aerosols contain larger particles.

2.3 Settings where Surgical Plume is Generated

Surgical plume can be found in public health facilities, such as:

- Operating theatres
- Dental clinics
- Morgues during autopsy
- Laboratories - research and testing facilities.

3. RISK MANAGEMENT

A risk management approach to health and safety as required under the *WHS Regulation* must be undertaken in order to protect workers and patients from exposure to plume, which includes the following*:*

3.1 Hazard Identification

Surgical plume is potentially hazardous to workers and patients that are exposed to it. Research indicates the plume may contain toxic chemicals and biological components in surgical smoke and aerosol particulates.

To identify hazards associated with plume, consideration needs to be given to the:

- Physical work environment where the surgical plume is created
- Nature of the ventilation system including whether it is positive or negative pressure
- Instruments and equipment being used
- Nature of the procedure, work tasks and how they are performed
- Work design and management
- Any particular risks associated with the patient.

3.2 Risk Assessment

A risk assessment involves considering what could happen due to exposure to surgical plume. A risk assessment can help determine:

- How severe a risk is
- Whether any existing control measures are effective
- What action should be taken to control the risk
- How urgently the action needs to be taken.

The risk assessment should be carried out in consultation with workers who may be affected by the hazard and should include:

- Work health and safety practitioners
- Infection control practitioners
- Technical experts who can assist in identifying the appropriate control measures, and
- Clinicians.

The following should be taken into consideration when conducting a risk assessment at a facility[3]:

- Number and type of procedures that are to be performed
- The equipment being used
- Size and layout of the procedure room or treatment area
- Available ventilation in the procedure room / treatment area including whether it is positive or negative pressure
- Expected volume of plume, and
- Manufacturer's specifications, related to the effectiveness of the equipment.

3.3 Control Measure Identification

WHS Regulation cl35 requires that the highest levels of practicable control measures appropriate to the level of risk are used. Where a facility determines it is unable to eliminate plume, so far as reasonably practicable, then the risks must be minimised, so far as reasonably practicable, using the Hierarchy of Controls as defined in cl 36 of the WHS Regulation.

These measures would include:

1. Adequate plume evacuation at the source i.e. use plume evacuation systems
2. Effective room exhaust ventilation (air filtration systems). Please note that all devices and systems intended for plume filtration need to be 0.1 micron at 99.999% efficiency.[4]
3. Safe work procedures, including standard precautions against exposure to blood-borne pathogens when entering or working in an area where infectious material from a plume could be present in the air or on surfaces
4. Maintenance of the plume evacuation system e.g. replacing filters in accordance with the manufacturer's instructions
5. Waste disposal in accordance with NSW Health Policy

[3] *Canadian Standards Association CSA Standard Z305.13-13 Plume scavenging in surgical, diagnostic, therapeutic, and aesthetic settings December 2013, 4.5.2.*
[4] *IEC Standard TR60825-8 Safety of laser products –Part 8: Guidelines for the safe use of laser beams on humans*

6. Providing information to workers in the danger of surgical plume and methods for controlling the risk
7. Training, including refresher training, in the use and maintenance of plume evacuation equipment and personal protective equipment (PPE)
8. Auditing for compliance by persons who have the knowledge, experience and training needed to competently identify whether the controls are effective and are being complied with, whether the controls may have created other hazards and be able to provide suggested solutions to resolve any issues.

Where it is not reasonably practicable to eliminate smoke plumes, some options to consider, based on risk, are as follows:

3.3.1 Isolate the Hazard / Reduce Risk through Engineering Controls

Isolating a hazard or reducing risk through engineering controls is identified at Level 2 of the hierarchy of controls.

In order to address the requirements of the risk assessment, the consultation team should evaluate the controls identified through the risk assessment. Refer to Appendices A and B for examples of isolation / engineering controls, their management and operational requirements. Some points to consider are:

- Effectiveness
- Filter and canister design
- Filter monitoring
- Fluid removal capabilities
- Foot pedal activation versus automatic activation
- Noise levels
- Single use versus reusable
- Size, and
- Cost of equipment, installation and operating expenses.

3.3.2 Administrative and Personal Protective Equipment (PPE) Controls

Where it is determined that risk still remains after implementing controls as outlined in 3.3.1 above, risk should be further minimised, so far as reasonably practicable by Administrative and PPE controls, which should only be used[5]:

- When there are no other practical control measures available (as a last resort)
- As an interim measure until a more effective way of controlling the risk can be used, **or**
- To supplement higher level control measures.

[5] *How to Manage Work Health & Safety Risks Code of Practice*, December 2011

3.3.2.1 Administrative Controls

Documentation

Safe work procedures, checklists and training material should be developed to protect workers and patients based on the risks and controls identified in each facility, taking into consideration that the identified controls may have an impact on other safety requirements within the facility. In preparing the aforementioned material, consideration should be given, but not be limited to the following[6]:

1. Adequate plume removal during medical or surgical procedures performed in or near respiratory passages
2. Jet ventilation application during laser treatment in the upper respiratory tract
3. Appropriate removal of plume from surgical sites during enclosed procedures such as laparoscopy and endoscopy
4. The use of the plume evacuator nozzle, including set-up and positioning
5. Adequate room ventilation.

3.3.2.2 Awareness, Training and Competency

The NSW HO should ensure that all workers whose health and safety is likely to be affected by surgical plume:

1. Understand and comply with the requirements of safe work procedures and other pertinent material
2. Know how to use plume evacuation equipment, as specified in the relevant safe work procedures and manufacturer instructions, where use is a requirement of their work, e.g. set-up and positioning of the intake device
3. Know how to use, maintain and store PPE which is allocated to the tasks that they are carrying out and comply with relevant safe work procedures and manufacturer instructions
4. Demonstrate competency in the use of plume evacuation devices and equipment where use is a requirement of their work.

The facility should provide documentary evidence of training and competency evaluation, in the set-up, use, storage and maintenance of the equipment, used by the site.

Workers who are responsible for maintaining plume evacuation equipment should be trained in the proper maintenance and disposal of the equipment and its accessories.[7] Please refer to Appendix C for guidance.

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[6] Canadian Standards Association CSA Standard Z305.13-13 *Plume scavenging in surgical, diagnostic, therapeutic, and aesthetic settings* December 2013, 4.3.1.
[7] Canadian Standards Association CSA Standard Z305.13-13 *Plume scavenging in surgical, diagnostic, therapeutic, and aesthetic settings* December 2013, 4.5.2.

3.3.2.3 PPE

The following PPE should be utilised in conjunction with controls identified in accordance with 3.3.1 above:

- Respirators capable of 0.1 micron filtration. (Please note that disposable respirators should be changed at a frequency determined by a risk assessment that is based on the type of operating procedure. Respirators, for example, would be changed more frequently where the operating procedure generates a lot of wet aerosol such as orthopaedic surgery)
- Face shields and eye protection
- Gowns and other standard surgical wear such as head, foot covers and gloves.

3.4 Review of Control Measures

Control measures should be reviewed, at an agreed frequency, in consultation with workers who may be affected by surgical plume. The review should include the following questions:

Control Measure Review	✓
Are the control measures working effectively? (Worker health checks could assist in detecting ill-health effects at an early stage in plume exposed workers and will assist in identifying the effectiveness of the existing controls).[8]	
Have the control measures introduced new problems?	
Has the evacuation system made the job safer?	
Are the safe work procedures appropriate and effective?	
Have all workers, who may be affected by surgical plume, been identified and provided with instruction and training?	
Is the instruction, training and training material that has been provided to staff appropriate and effective?	
Are workers providing feedback on the effectiveness of the control measures?	
Is there new legislation or standards that may impact on the risk control measures?	
Is the chosen evacuation system effective in removing surgical plume?	
Is the equipment being set-up, used, tested and maintained as per manufacturer instructions?	

[8] *Evidence for exposure and harmful effects of diathermy plumes (surgical smoke) 2012*

Control Measure Review	✓
Have any incidents, injuries, ill health or concerns been reported?	
Is supervision adequate to ensure that workers understand and comply with work practices and equipment use?	
Has any new information become available since the last review that will impact on equipment or work practices?	

APPENDIX A: PLUME EVACUATION SYSTEMS

General

Plume evacuation systems remove the plume before it reaches a person's breathing zone, reducing the potential hazards of exposure to the surgical plume. Such a system should collect plume at the site of the plume production using suction-based capture devices.

When plume is discharged into the air a dedicated plume evacuation unit should be used that meets surgical requirements (see Appendix D, Checklist: *Qualities of a good plume evacuation system*) and is suitable for the amount of plume produced.

Most evacuation systems are portable tabletop models or freestanding floor models, some systems are included within surgical booms.

For minimally invasive surgical procedures which use insufflators to distend the abdominal cavity, (e.g. laparoscopic procedures) both active and passive disposable (single use), and reusable devices are available, allowing for removal of plume, without loss of the pneumoperitoneum.

The Canadian Standards Association's Standard Z305.13-13 *Plume Scavenging in surgical, diagnostic, therapeutic, and aesthetic settings* describes in its Annex A the types of plume evacuation systems available, their components, system flow rates and system characteristics and diagrams. Extracts are as follows:

Types of Plume Evacuation Systems

1. **Portable and mobile systems**

   Many evacuating systems are either portable tabletop models, which can be carried or placed on a shelf or cart, or mobile, free-standing floor models, which often have wheels or are incorporated into a cart. Typically, these systems are activated by a footswitch or remote/automatic-activation feature working with the laser's or electrosurgical unit's activation device. The system's evacuation source captures smoke through tubing positioned in accordance with the manufacturer's operating instructions (usually within 5 cm of the plume source). Some evacuating systems are designed to be used with electrosurgical devices and have small-lumen capture devices that attach to the electrosurgical handpiece. Others have wands, nozzles, or hoses that need to be held or adapters for laparoscopic procedures. The captured smoke is then passed through a series of filters, which remove the harmful elements, and the filtered air is released through the system's exhaust port back into the room.

2. **Disposable endoscopic or laparoscopic systems**

   There are two types of disposable endoscopic or laparoscopic evacuation systems, the active and passive devices. Both types are packaged as sterile, single-use devices, and are typically used exclusively for minimally invasive surgical procedures that use insufflation (e.g. laparoscopic procedures). These evacuation systems provide surgical staff with improved visibility into the peritoneal cavity without compromising the ambient room air or the pneumoperitoneum and minimise the patient's exposure to plume. The active devices can use two cannulas (an inlet and outlet) to form a closed-loop filter that maintains distension while moving the gas

through the loop. Alternatively the plume can be actively evacuated through one cannula using a vacuum source. The filtered gas may be returned to the pneumoperitoneum. Passive evacuation systems use the pneumoperitoneum's pressure to exhaust gas through a cannula and filter into the room.

3. **Local stationary systems**

   Local stationary evacuation systems have a suction source located within a surgical boom or in the interstitial space above the operating room; connections and controls are located on the boom. These evacuation systems capture plume with a capture device and hose and vent the scavenged and filtered gas inside or outside of the room. The system's filter is typically located at the boom for easy replacement. Some filters are manufactured for single-patient use.

4. **Central stationary systems**

   Central stationary evacuation systems have a dedicated central suction source and piping to several points of use where users can adjust airflow using a control panel. These evacuation systems capture plume with a capture device and hose and convey the scavenged gas to a central filter and suction source, and thence to the building's exterior. Central stationary evacuation systems have most of their components permanently installed in mechanical spaces.

   NOTE: Central stationary systems are not recommended where the following applies:

   - Have a central suction source that service a number of rooms
   - The filtration component is located at a distance from the room, and
   - Allows contaminants to be transferred through facility ducts.

   Stationary systems are acceptable if the air is filtered in each room, and transferred out of the facility as clean air.

5. **Medical vacuum system**

   A dedicated evacuation system should be used.

   In the event that a medical vacuum is used to scavenge plume, a ULPA filter must be used between the fluid trap (e.g. suction canister) and the vacuum regulator. Fluids must not be allowed to enter the medical vacuum pipeline.

   The filter shall be changed and disposed of in accordance with the manufacturer's instructions and facility policy. The suction canister is used to collect any liquids and tissue fragments and protect the filter. If liquids are suctioned into the filter, it can be damaged and clogged.

   The suction line must be a non-collapsing, disposable tube of a length sufficient to connect the vacuum system to the surgical site.

   The suction wand should allow easy access to the surgical site.

   The medical vacuum system shall be subject to routine inspection and preventive maintenance to ensure proper vacuum pressure and flow.

Plume evacuation devices / intake devices

A plume evacuation device is the intake device that suctions or captures the plume at the operating site and is part of the plume evacuation unit/system.

A variety of capture devices can be used with portable plume evacuation systems, for example, an electro-surgery pencil that combines with a plume evacuation unit that is synchronised to the pencil.

Plume capture devices should enable the plume to be evacuated by suctioning not further than 2cm away from the point of plume. However, during this process visualisation of the surgical site must not be compromised. The plume must be vented through a closed system[9].

[9] *Australian College of Operating Room Nurses, Standards for Peri operative Nursing 2014, Surgical Plume*

APPENDIX B: PLUME EVACUATION SYSTEMS - OPERATIONAL REQUIREMENTS

General Requirements

The plume evacuation system should have the following operational requirements:

1. An intake that can be effectively positioned at or near the operative site and point of plume generation.
2. A replaceable filtration system with a defined life that includes:
    - Pre-filtration media
    - An ultra- low penetration air (ULPA) filter which provides filtration of 0.1 micron particles at 99.999% efficiency
    - An activated carbon bed for trapping gasses
    - Variable suction volume capacity to accommodate various levels of plume production
    - A monitoring system that alerts the need for a filter replacement
    - An exhaust system.

General Room Ventilation

General room ventilation is not sufficient on its own to capture contaminants generated at the source.

A combination of general room ventilation and local exhaust ventilation (LEV) (a plume evacuation system) is required to remove/reduce plume.

While air in the operating room is exchanged regularly over a period of an hour, it will not remove noxious surgical plume before its affects people in the room.

It is important to ensure that the filters for the general ventilation system are maintained and changed as recommended by the manufacturer of the system. Dirty air filters will impede room air exchanges.

Wall Suction Unsuitable

The use of wall suction units for plume evacuation in the perioperative environment should be phased-out, even where small amounts of plume are anticipated. Plume evacuation systems should be used.

Suction is reduced in wall suction units when an inline filter is used to capture surgical plume. Also, clinical factors may extend the operation and increase the amount of plume generated beyond what was anticipated, reducing the efficacy of wall suction.

If using wall suction as an intermediary measure while phasing in plume evacuation systems:

1. Install a purpose built 0.1 micron in line filter and position it properly between the wall and floor canister (Note that filters reduce suction)
2. Ensure that the suction lines are cleared and cleaned or replaced

3. Change the filters regularly as directed by the manufacturer as they are time limited and an overused filter affords no protection
4. Dispose of the filters properly as a biological hazard using standard precautions.

APPENDIX C: MAINTENANCE OF EQUIPMENT AND DISPOSAL OF BIOHAZARDS

Maintenance of equipment and disposal of biohazards

- All plume evacuation equipment, including replaceable filters, absorbers, capture devices and hoses, should be maintained, monitored, and replaced on a regular basis in accordance with the manufacturer's recommendations.
- All consumable associated equipment (e.g. masks, filters and tubing) and collection materials should be considered biohazards and must be handled and disposed of, using Standard Precautions (see AS / NZS 4187) for blood-borne pathogens and in accordance with the Ministry of Health's policy on clinical waste management.
- A facility should establish and maintain a preventive maintenance schedule to ensure the continuing effectiveness of the plume evacuation system. This would include a periodic performance check and check of maintenance records.

APPENDIX D: QUALITIES OF GOOD PLUME EVACUATION SYSTEMS[10] CHECKLIST

Requirement	✓
Meets all the relevant standards and regulations for medical equipment.	
Is easy to use and maintain	
Has a capture device that can be effectively positioned near the site of plume generation.	
Has a filtration system that includes an activated carbon bed for trapping gasses and an ULPA filter: 0.1 microns at 99.999% efficiency	
Has an exhaust system	
Does not exceed the level of noise agreed upon at the time of consultation when used. Uses a system that is activated only when the clinician activates the energy based device. (Noise caused by the movement of air into and through a plume evacuation system can be an issue with clinicians. However, the substantial flows of air needed to capture plume will inevitably produce some noise.)	
Indicates when a filter needs changing.	
Offers a variety of capture device options suitable for a variety of applications.	
Is supported by the supplying company	
Has a well written instruction manual, maintenance instructions, and educational resources. The manual must meet the requirements of the WHS Regulations .	
Meets electrical safety standards.	
Has sufficient capacity to handle the anticipated level of plume for all procedures within its expected application.[11]	
Has instructions for the installation, use, servicing, and maintenance of the equipment.	
Flammability characteristics of the capture device are adequate.	
Is cost effective.	
Is designed so that changing filters and maintenance are easy to carry out and do not create ergonomic or infection control risks.	

[10] *Clearing the Air in Surgery, Penny Smalley RN, CMLSO,* Presentation June 2010
[11] Canadian Standards Association CSA Standard Z305.13-13 *Plume scavenging in surgical, diagnostic, therapeutic, and aesthetic settings* January 2009, Annexure A Informative.