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# Louise Anne Doyle

Surgical Plume in the Operating Room



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## Learning Objectives

DEFINE SURGICAL SMOKE

IDENTIFY THE HAZARDS OF SURGICAL SMOKE

**REVIEW REGULATORY STANDARDS** 

DISCUSS RECOMMENDED PRACTICES

DESCRIBE PERIOPERATIVE CARE TO MINIMISE THE HAZRADS OF SURGICAL SMOKE



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Are you still smoking?







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## Smoke Free Hospitals



### The smoking ban applies to covered & uncovered areas of bus stops including where people queue or gather.

A \$300 fine may apply under the Smoke-free Environment Act. Learn more at health.nsw.gov.au/smokefree

Tobacco Information Line:

1800 357 412 on Erolish seeker? Call the Translatino and Intercretino Service on 13 14 50 for assistar







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WE ARE SMOKE FREE No smoking on hospital grounds





## What is surgical smoke?





- Surgical smoke is the gaseous by-product produced by any procedure which uses a surgical device to ablate, cut, coagulate, desiccate, fulgurate or vaporise tissue.
- Surgical Smoke is referred to by many names:
  - Cautery smoke
  - Diathermy plume
  - Smoke plume

## How is Surgical Smoke produced?





The National Association of Theatre Nurses (NATN) standards report states that:

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 All thermal instruments used in surgery produce smoke which potentially contains infective agents that may be hazardous to staff

Diathermy is a surgical technique which uses heat from an electric current to

- cut tissue
- seal bleeding vessels



## **Content of Surgical Smoke**



Over 80 chemicals have been identified in surgical smoke (Kokosa & Eugene, 1989)

16 of these chemicals are on the EPA priority pollutant list (Nick Meginnis-Stryker corp).

Surgical Smoke contains: Toxic gases and Vapors Benzene Hydrogen cyanide Formaldehyde Bioaerosols

Dead and Live cellular material (including blood fragments and viruses)



## Hazards of Surgical Smoke...

## Risks Associated with Cigarette Smoke

- Benzene
- Hydrogen cyanide
- Formaldehyde
- Carbon monoxide
- Methane
- Phenol
- Nicotine

## Risks associated with Surgical Smoke

- Benzene
- Hydrogen cyanide
- Formaldehyde
- Carbon monoxide
- Methane
- Phenol

## Hazards of surgical smoke...

Journal List > Ann Med Surg (Lond) > v.1; 2012 > PMC4523153



Ann Med Surg (Lond). 2012; 1: 23–24. Published online 2012 Aug 25. doi: <u>10.1016/S2049-0801(12)70008-0</u> PMCID: PMC4523153 PMID: <u>26257903</u>

Commentary On: "Surgical Smoke – A Health Hazard in the Operating Theatre: A Study to Quantify Exposure and a Survey of the Use of Smoke Extractor Systems in UK Plastic Surgery Units"

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Article notes 
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Over the last 20 years, smoke plumes have been proven to be mutagenic, carcinogenic, and a vehicle of transmission for malignant cells and viruses. 1-3 Smoke plumes can be generated by electrosurgical, laser, and ultrasonic devices. Studies have shown electrosurgical devices led to the formation of smaller particles

Volume 30 | Issue 4

Article 2

12-1-2017

## Surgical plume and its implications: A review of the risk and barriers to a safe work place

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Journal of Occupational Medicine and Toxicology

In vitro toxicological evaluation of surgical smoke from human tissue

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Open Access Research First Online: 02 April 2018





## Hazards of surgical smoke

Surgical Plume has been a cause of concern for over three decades

The risks of smoke exposure generated by electrosurgical units have been investigated since the 1980.

- Dr Mihashi classic research in 1981 concluded that 77% of the particles in surgical smoke are 1.1 micron in size or smaller
- A study in 1988 by Dr Baggish demonstrated that these small particles lead to pulmonary congestion with bronchial hyperplasia and hypertrophy

OSHA estimate of exposure

- 500,000 workers each year
- Surgeons, nurses, anaesthetists, techs, patients

Ig of tissue creates a surgical smoke plume with the mutagenic effect of smoking 6 unfiltered cigarettes.

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## Components of Surgical Smoke

- The Smallest particle visible to the naked eye is 20 microns
- Viruses range from 0.3-0.2 microns
- Lung damaging dust ranges from 0.5-5 microns
- Face masks filter 5microns
  - Small enough to pass through the standard surgical mask (NIOSH 1998, OSHA 1998)



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## Components of Surgical Smoke

HEPATITIS B VIRUS	0.042
HEPATITIS C VIRUS	0.042
PAPILLOMAVIRUS	0.045
HIV	0.180
MYCOBACTERIA TUBERCULOSIS	0.5



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## Hazards of surgical smoke...

Many OT Nurses complain of the following when exposed to surgical smoke:

- Chronic Cough
- Wheezing
- Increased congestion
- Throat irritation
- Asthmatic flares
- Headache
- Fatigue
- Eye Irritation



## Hazards of surgical smoke

Surgical smoke is also a patient safety issue which results in similar complaints particularly in endoscopic procedures:

- Nausea
- Headache

A study by Dr OTT et al conducted in 1997 proved the theory of the benefits of smoke evacuation for patients post endoscopic procedure.

### Surgical Wound Infection

• Studies now suggest that smoke evacuation reduces wound contamination

- OSHA (The Occupational Safety and Health Administration. A US governmental agency)
  - The general duty clause, Section 5(a)(1) of the Occupational Safety and Health Act of 1970, applies to all employers and requires each employer to provide employees with a place of employment, which is free from recognized hazards capable of causing serious physical harm.
  - "Health Hazard Information Bulletin: Hazard of Laser Surgery Smoke" states "when performing laser therapy on patients infected with viruses such as hepatitis or HIV, the smoke plume should be assumed to be infectious, and appropriate precautions, such as a well maintained vacuum apparatus should be observed"
- JCIA (Joint Commission International Accreditation)

"The organisation manages risks related to hazardous materials and waste" EC.02.02.01

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- NIOSH (The National Institute of Occupational Safety and Health) under the CDC
  - No regulatory or enforcement authority
  - Conducts health hazard evaluations and issues health hazard alerts



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Control of Smoke From Laser/Electric Surgical Procedures

#### HAZARD

During surgical procedures using a laser or electrosurgical unit, the thermal destruction of tiss creates a amount be byrorduct. Research studies have confirmed that this smoke birums can conta toxic gases and vapors such as benzene, hydrogen cyanide, and formaldehyde, bloaenso dead and two colliaid material infolucing blood (regerents), and vinuse. At hydro concentrations the visual problems for the surgeon. The smoke has unpleasant odors and has been shown to he mutagenic potential.



NIOSH research has shown airborne contaminants generated by these surgical devices can t effectively controlled. Two methods of control are recommended. Ventilation and Work Practice

#### VENTILATION

Recommended verifiation techniques include a combination of general room and local exists, verificition (LEV). General room verifiation is not by itself sublicient to cepture contaminar generated at the source. The two major LEV approaches used to reduce surgical smoke leve for health cere personnel are portable smoke evacuators and room suction systems.

Smoke evacuators contain a suction unit (vacuum gump), filter, hose, and an inlet nozzle. Th smoke evacuator should have high efficiency in entorme particle reduction and should be use in accordance with the manufacturer's recommendators to achieve maximum efficiency, capture velocity of about 100 to 150 feet per minute at the iniet nozzle is general recommended. It is also important to choose a filter that is effective in collecting it contaminants. A High Efficiency Particulate Art (HEPA) filter or equivalent is recommended trapping particulates. Various filtering and cleaning processes also exist which remove inactivate airborne gases and vapors. The various filters and absorbers used in smoi evacuators require monitoring and replacement on a regular basis and are considered possible biohazard requiring proper disposil.

Room suction systems can puil at a much lower rate and were designed primarily to captu liquids: rather than particulate or gases. If these systems are used to capture generation smoke, users must install appropriate filters in the line, insure that the line is cleared, and th filters are disposed property. Generally speaking, the use of smoke evacuators are mo effective than noom suction systems to control the generated smoke from non-endoscop laser delective using/ait productives.



NIOSH research has shown airborne contaminants generated by these surgical devices can be effectively controlled"

- Ventilation
- Evacuators
- Effective Disposal
- Maintenance
- Universal Precautions

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## World Nursing Organisations:

AfPP

Standard 2.6 Lasers states:

- Dedicated smoke evacuation machines must be used to remove the smoke...' (AfPP 2007).
- AORN •
  - Recommends the use of smoke evacuation systems whenever smoke is generated •
  - Specifically cites the risk of viral contamination during laser, vaporisation procedures ٠
- ACORN •

Standard S20 states:

- Personnel shall utilise appropriate equipment and procedures to prevent exposure to surgical plume
- Exposure to surgical plume shall be minimise during the surgical procedure
- Surgical smoke capture devices shall be available for use during procedures in which surgical smoke is generated (ACORN-2006).



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- IFPN
  - 'It is important that employers and employees are aware of the problem of smoke plume and ensure that there are policies in place to reduce the exposure to smoke plume and that such policies also comply with workplace health and safety laws, or other legislative guidance, and with International Electro-technical Commission (IEC), standards pertinent to the particular healthcare setting' (IFPN 2007). The guideline can be accessed at <u>www.ifpn.uk.org</u>
- ORNAC
  - The Canadian surgical smoke recommended practice states: 'Whenever electrosurgery is used, it should be used in conjunction with a smoke evacuator' (ORNAC 2007).

## Protective measures against smoke in the OT:



The control of substances hazardous to health regulations (COSHH) requires employers to carry out an assessment of the risks from hazardous substances and to always try to prevent exposure at the source. If exposure to diathermy emissions cannot be prevented then it should be adequately controlled.

- Ventilation of the OR
  - Maintain negative pressure with a min of 15 air exchanges per hour
  - Maintain filters and change according to manufacturers recommendation (a dirty filter will impede room air exchanges)
- Regular maintenance and filter replacement
- Use of a smoke evacuator (synchronized with HF current or laser activation)
- Remove smoke directly where it develops (Ex.: use of an effective clip-on applicator)

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## The Best Defence against Smoke



#### Anaesthetists Circulating staff

Operating department practitioners Recovery staff Scrub staff Surgeons

## **The Problem**

Every year patients and staff are injured needlessly during electrosurgical (surgical diathermy) procedures. These injuries are often due to user error and poor systems of work and not to the equipment itself. Everyone in the electrosurgery team should understand the risks and take action to avoid injuries.

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## THE ELECTROSURGERY TEAM

### **Everyone in the team should:**

#### **Understand:**

- The different types of electrosurgery equipment available
- The risks of electrosurgery and how to minimise them
- The principles of electrosurgical safety
- The importance of selecting appropriate skin preparation solutions (avoid alcohol based preparations as per MDA SN2000(17))
- Why to be careful when using two electrosurgery systems, laser or ultra sonic systems concurrently
- Why insulated quivers are used to store the active electrode when not in use

#### **Consider:**

- The patient's age, weight and fat distribution
- The position of the return electrode in relation to the patient's position, the operating site, scars, metal implants or foreign bodies
- Active implants such as pacemakers which may need to be checked by a cardiology team pre/post operation
- Consent to shaving
- Allergy to return electrode gel
- Rectify simple problems
   Check the return electrode site after plate removal

Know how to:

accessories prior to use

Prepare the patient properly

Avoid risks to other theatre staff

Remember ... you are professionally responsible for your own actions
Safe working needs TEAM working

Check the electrosurgery machine and its

For information about the MHRA's Electrosurgery educational package visit www.mhra.gov.uk/ConferencesLearningCentre/LearningCentre/Electrosurgery/Index.htz

#### Be aware of:

- Whether the electrosurgery machine is in good order and if it and its accessories have been maintained properly
- The lowest power setting that can be used for safe and effective cutting and coagulation
- The lack of absolute power settings on different devices
- The potential for injury due to capacitive coupling in laparoscopic surgery
- The correct accessories for the machine and their mode of use
- Recommendations for the use of smoke evacuation. Visit www.mhra.gov.uk and go to 'Publications/posters and leaflets' for more information
- How to report adverse incidents and near misses to MHRA and the Trust Medical Device Liaison Officer
- The dangers of activating the electrosurgical device inadvertently or whilst other staff are in direct physical contact with the patient
- Any factor that may affect the use of electrosurgery, eg, presence of a pacemaker

# Everyone in the team should

- Understand the different types of electrosurgical equipment available
- Be aware of the
   risks associated with
   electrosurgery and
   how to minimise it
- <u>Avoid risk to other</u> <u>theatre staff</u>

The Best Defence against Smoke...

## • BEYOUR OWN BEST ADVOCATE IN PROTECTING YOURSELF!!!

• The only way to safely and efficiently remove surgical smoke is to use a smoke evacuation system

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## Smoke Evacuation Systems



The OptMumm' Sinoke Evacuator is the centerplace of a space-saving, fully integrated sinoke evacuation system that will help you breathe easier.









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## Smoke Evacuation Systems (IPSES)





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## Reasons for Resistance

- Lack of Knowledge
- Complacent Culture
- Human Resistance
- Cost
- Noise
- Bulky Equipment



"Use available tools and knowledge to minimise exposure to surgical smoke. Until there are regulations that reduce the occupational hazard of surgical smoke, become an expert in what can be done" (Dawes, 2000).

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