Occupational Hazards of Surgical Smoke Plume in the Operating Theatre

A report analysing the responses of 955 perioperative practitioners on the awareness, education, management and policy surrounding surgical smoke plume in the UK

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The Surgical Plume Alliance

A collaboration between:

ICSP International Council on Surgical Plume, Inc.

AfPP Progressing Safer Surgery
The Association for Perioperative Practice

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Foreword

In September 2021, the Association for Perioperative Practice (AfPP) and the International Council on Surgical Smoke Plume (ICSP), and its associate members, formed a collaboration called the Surgical Smoke Plume Alliance (SPA).

The aim of SPA is to raise awareness of the hazards of surgical smoke plume and the occupational risks to surgical team members and patients when they are exposed to it. Surgical smoke plume is emitted whenever energy generating devices such as lasers, diathermy, ultrasonic tools, are used.

Evidence based research provided by the Health and Safety Executive (HSE 2012), and guidance from the British Standards International Organisation (BS ISO 16571:2014), has established that the inhalation of surgical smoke plume emitted by energy-based devices - which are used to cut, coagulate, or vaporise tissue during surgery - can adversely affect the health and safety of operating theatre staff, patients and visitors if not effectively captured, filtered, and removed.

SPA's mission is to review current policy, guidance and legislation; to help interpret and apply these policies to daily surgical practice; to provide evidence and standards based education; to support healthcare facilities and personnel with materials and resources on surgical smoke plume; to assist in the implementation of plans to manage surgical smoke plume; to help ensure compliance with policy to establish a perioperative environment free of surgical smoke plume in all operating theatres; and to advocate for legal and regulatory mandating of surgical smoke plume evacuation devices to whenever an energy generating device is being used.

This report contains key findings from a survey of 955 healthcare professionals who work within the perioperative setting and procedures rooms.

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Summary of Key Findings

In a survey of 955 perioperative practitioners, the following findings emerged regarding the occupational hazards of surgical smoke plume in the operating theatre:

- 90% of perioperative practitioners are concerned about the risks to their health from surgical smoke plume.
- 52% of perioperative practitioners have not received any education on the hazards of exposure to surgical smoke plume.
- Of those said they had not received any education, 96% would attend training if it was made available.
- Only 16% of perioperative practitioners are aware of a local policy for surgical smoke plume management being in place within their organisation.
- 79% of perioperative practitioners said their workplace has smoke plume evacuation equipment in place. However, only 14% said the equipment was always used during laparoscopy and/or endoscopy procedures. Only 12% said it was always used during other types of surgical procedure.
- Only 23% of perioperative practitioners reported that their workplace had surgical smoke plume evacuation devices available in all operating theatres and procedure rooms.
- 72% of perioperative practitioners have experienced negative health symptoms associated with exposure to surgical smoke plume in the operating theatre environment.
    - 53% experienced headaches
    - 38% experienced coughing
    - 36% experienced eye irritation
    - 13% experienced shortness of breath
- 99% of perioperative practitioners who experienced symptoms said they experienced them more than once.
- Only 12% of perioperative practitioners who experienced symptoms reported them.
- 77% of those who reported their symptoms said no action was taken.

Background

This report summarises the findings of a survey conducted by the Surgical Smoke Plume Alliance (SPA) to investigate theatre practitioners' experiences with surgical smoke plume and how hospitals, and other healthcare facilities, are managing exposure to surgical smoke plume.

The survey ran from 9 November to 31 December 2021. Responses were collected from 955 individuals working in and around the operating theatre. See the 'Survey Sample' section of this report for further information on respondents.

What is surgical smoke plume?

Surgical smoke plume results from the vaporisation of cells through absorptive heating when energy-based devices such as lasers, electrosurgical instruments, and ultrasonic devices are used to cut, coagulate, or vaporise tissue during surgical procedures during surgical procedures.

95% of all surgical procedures produce surgical smoke plume. Therefore, facilities should have a plume evacuation system available in every operating theatre and procedural room. Facilities that have fewer systems put some staff at risk of exposure while protecting others, and this is a practice that is not equitable.

What are the hazards associated with exposure to surgical smoke plume?

Research has identified that surgical smoke plume contains smoke, numerous toxins, mutagenic and carcinogenic particulates, bacteria, and viruses including Human Papillomavirus (HPV), Human Immuno Deficiency Virus (HIV), and the potential for Severe Acute Respiratory Syndrome Coronavirus 2(SARS CoV-2).

Other hazards present include, but are not limited to:

- Aerosolised Haemoglobin (Hgb) and blood borne pathogens
- Carbon
- Tissue fragments and live cells
- Carbon monoxide
- Toluene and Benzene - known carcinogens
- Hydrogen Cyanide – a neurotoxin used in chemical warfare
- Perchloroethylene – the main component in dry cleaning fluid
- Formaldehyde – found in embalming fluid and used to preserve surgical specimens

All UK healthcare professionals working in the perioperative environment are exposed to surgical smoke plume each day. Through this exposure, they also risk exposure to the toxins, carcinogens, blood borne pathogens, prions, viable cells, viruses and bacteria in surgical smoke plume.

PPE & Surgical Smoke plume Evacuation Systems

Masks are not sufficient to protect against all airborne plume particles and gases and should **NOT BE** considered as first line of protection against the occupational hazards of exposure to surgical smoke plume. They may be used in conjunction with an approved Plume Evacuation System, which should always be mandated as the first line of protection.

A plume evacuation system may be a portable device, a central or stationary system, disposable devices for use at the surgical site, or other systems that meet all manufacturing requirements and standards. Plume Evacuation Systems incorporating ULPA (Ultra Low Penetration Air Filter) filters at 0.1micron, with 99.9995% efficiency, are always required to evacuate surgical smoke plume. HEPA filters (High Efficiency Particulate Air Filter) should not be used as plume evacuation filters as they only filter particulates down to 0.3microns and are only 99.97% efficient.

Wearing a disposable, unvalved respirator mask FFP3 - that is splash-resistant and complies with classification EN149:2001+A12009 and EN1468:2005 as a Type IIR surgical mask – is recommended for all surgical procedures where energy-based devices, lasers, and diathermy, etc. are being used. If properly fit tested on personnel and worn at all times in accordance with health and safety procedures, these masks have been tested to provide at least 95% filtering protection from airborne particles. However, they must **only** be considered as secondary protection.

Under the management of risk and hierarchy of control (Health and Safety Executive (HSE), 2012) elimination and removal of hazards is required as a first line of defence to prevent exposure at the source, including adequate ventilation systems and appropriate organisational measures, where reasonably practicable. Only then must Personnel Protective Equipment (PPE) be used as legislated by Control of Substances Hazardous to Health (COSHH 2002). Employees must be trained in the function and limitation of each item of PPE. Protection measures must be applied appropriate to the activity undertaken and consistent with a risk assessment.

Survey Sample

955 responses were collected in the survey. Below is a breakdown of the survey sample based on various relevant categories.

Workplace

The majority of respondents (81%) worked in an NHS hospital at the time of the survey. A further 15% worked in a private hospital, with the remaining 4% reporting to work in a day surgery centre, clinic, or other organisation.

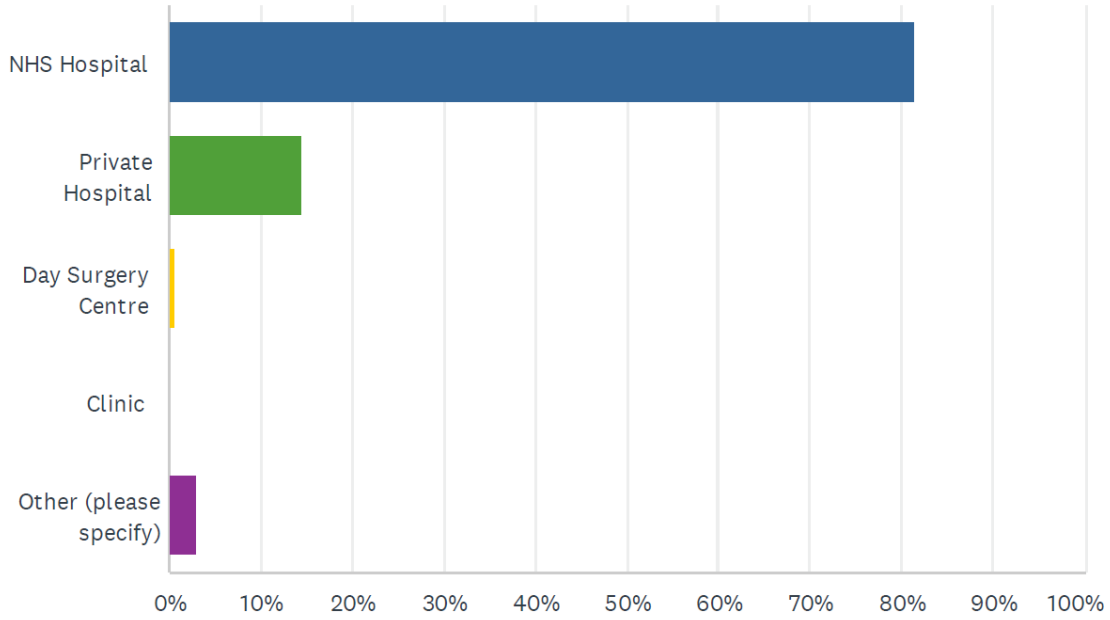

Fig 1. *Breakdown of respondents by type of workplace*

The other organisations category included overseas hospitals and agency staff who work across various types of organisations.

Number of Operating Theatres and Procedure Rooms

The size of the theatre departments respondents worked in ranged from five or less operating theatres and procedure rooms (26%) to 51+ (1%).

The vast majority of respondents (83%) worked in organisations with 20 or fewer operating theatres and procedure rooms.

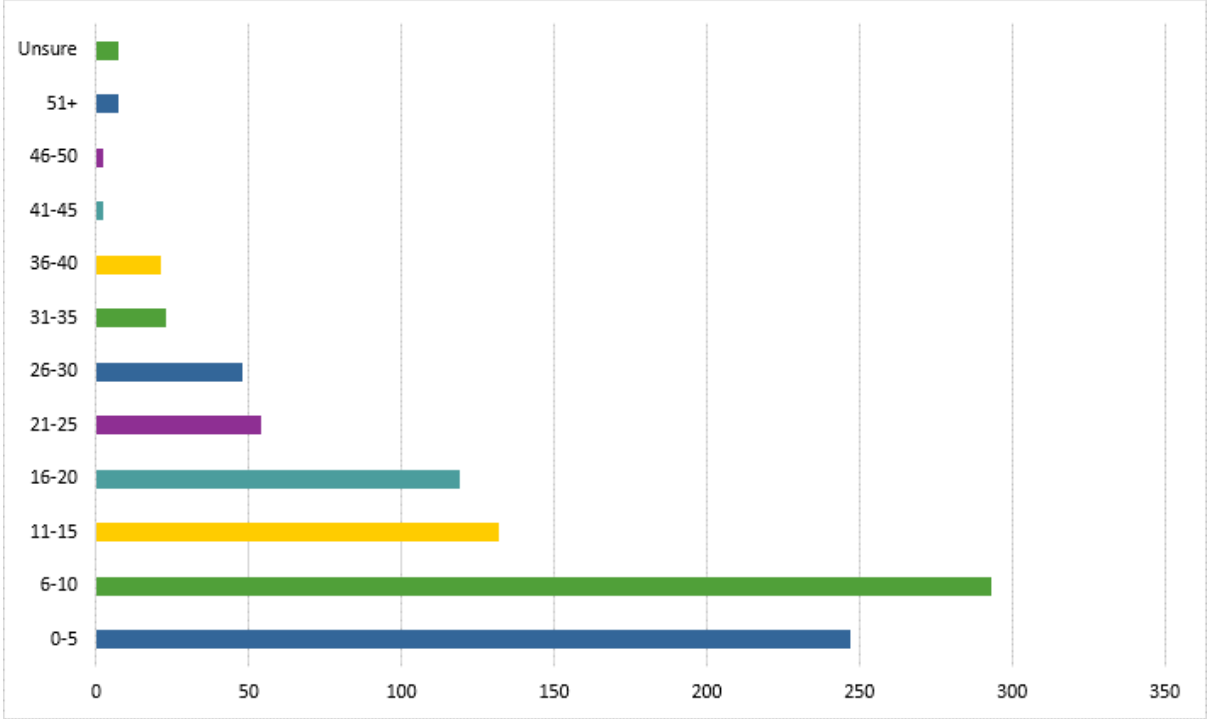

Fig 1. *Breakdown of respondents by type number of operating theatres and procedure rooms in their workplace*

Job Role

The survey respondents worked in a wide variety of roles within perioperative care.

Over half of respondents were Registered Nurses (RNs) or Operating Department Practitioners (ODPs) (37% and 28% respectively). The remaining 35% of respondents worked in more than 12 different perioperative roles.

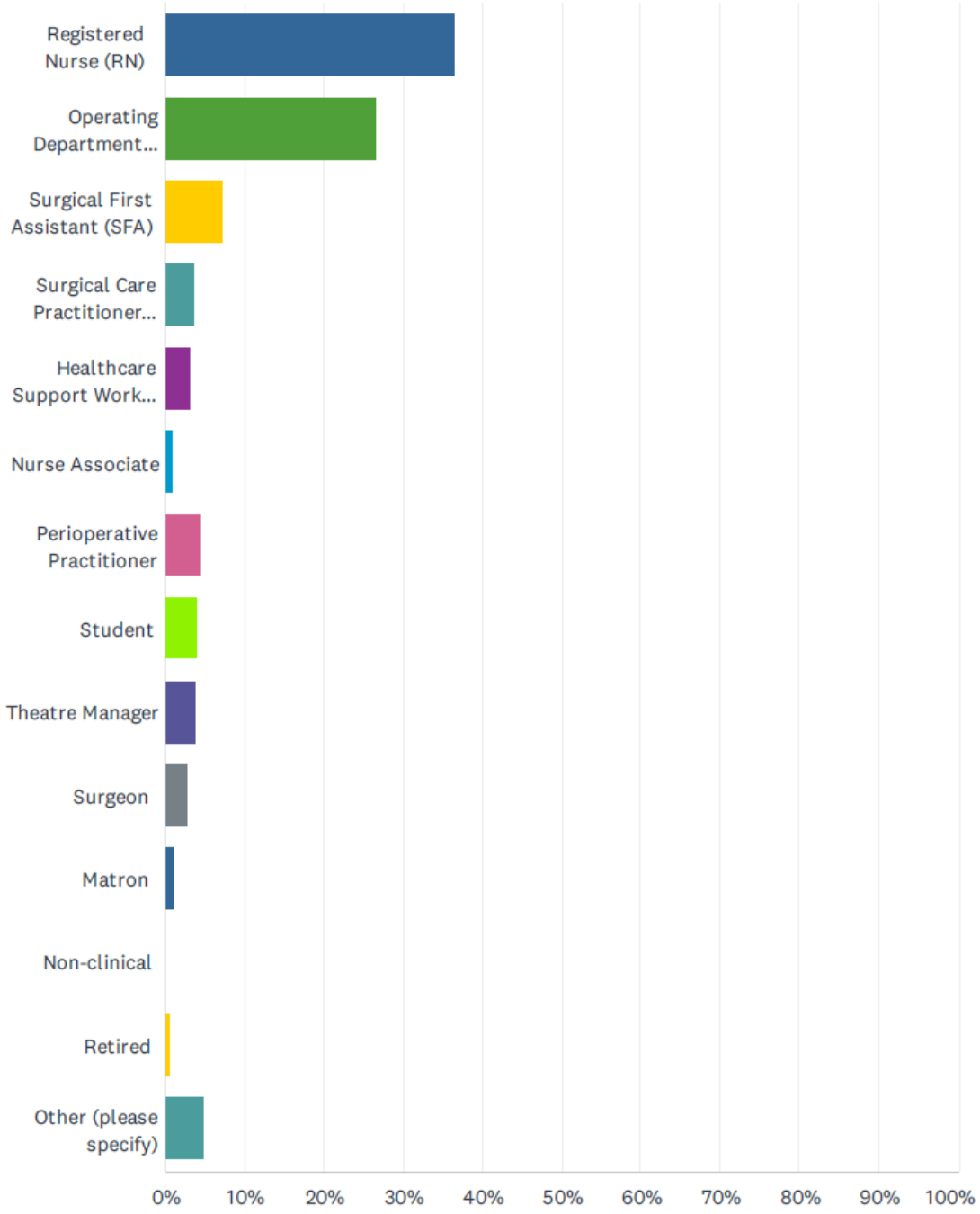

Fig 3. *Breakdown of respondents by job role*

Table 1. *Breakdown of respondents by job role*

Answer	**% Responses**
Registered Nurse (RN)	36.54%
Operating Department Practitioner (ODP)	26.70%
Surgical First Assistant (SFA)	7.33%
Healthcare Support Worker (HCSW)	3.25%
Nurse Associate	0.84%
Perioperative Practitioner	4.40%
Student	3.98%
Theatre Manager	3.87%
Surgeon	2.83%
Matron	1.05%
Non-clinical	0%
Retired	0.73%
Other	4.92%

The other job roles category included Healthcare Assistants, Theatre Team Leaders, Lecturers and Clinical Educators.

Employment Contract

The majority of respondents (69%) were working full-time in a perioperative role. 19% worked part-time, 5% had a bank contract and 4% had an agency contract.

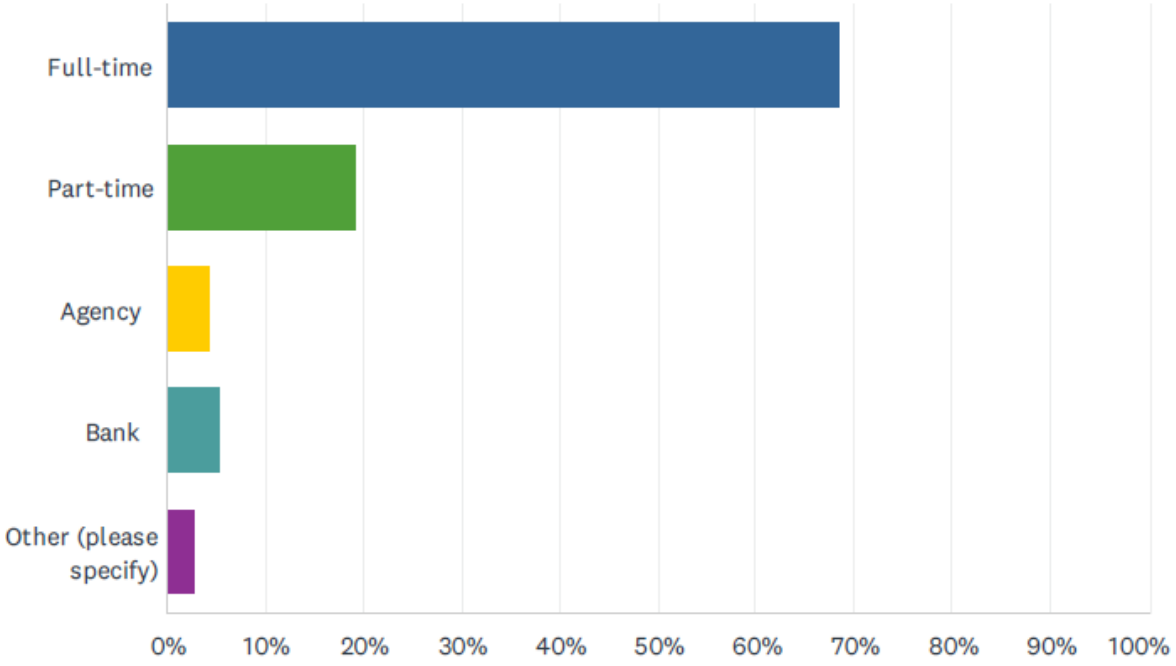

Fig 4. *Breakdown of respondents by employment contract type – two respondents skipped this question*

The other employment contracts category included students working placement hours, retired practitioners and practitioners working a combination of part-time NHS contract plus an agency contract.

Length of Service

Over half of respondents (53%) had worked in the perioperative environment for more than 15 years. 6% were in the early years of their career with less than two years' experience; 14% had worked two to five years; 13% six – 10 years; and 13% 11 – 10 years.

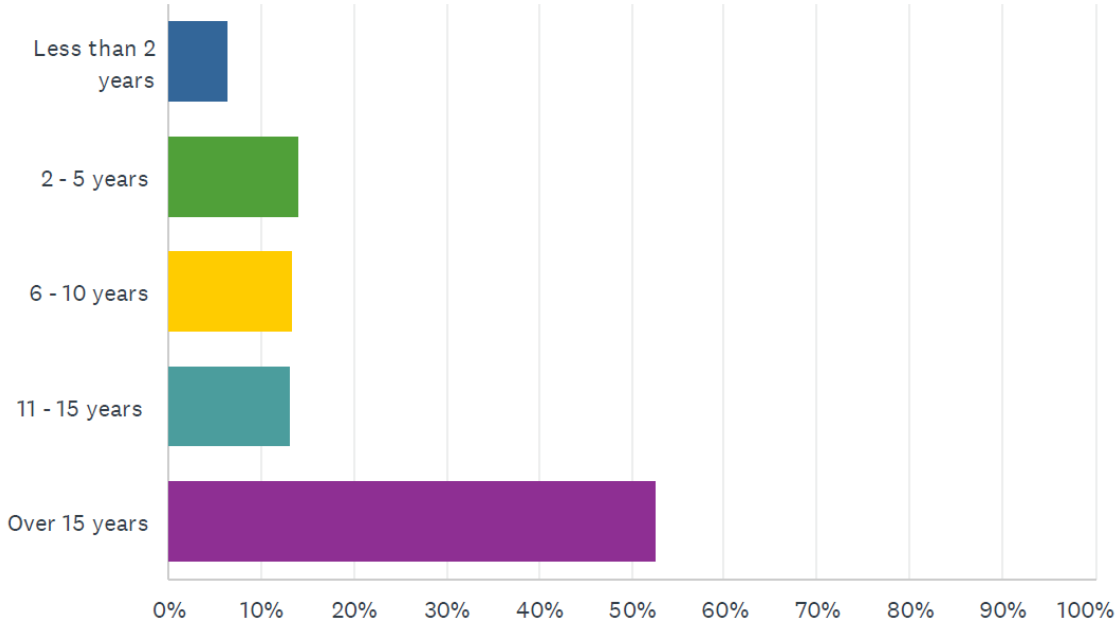

Fig 5. *Breakdown of respondents by length of service*

Figuratively speaking, in Fig 5., 53% of respondents to the survey had worked for over 15 years in the perioperative environment whilst being unknowingly subjected to exposure from surgical smoke plume. What is not evident is the level and duration of exposure to substances hazardous to their health, the cumulative effect of this exposure, or the possibility of developing adverse health effects later in life.

Findings

The findings of the survey can be split into four categories:

- Awareness and Education
- Management and Policy
- Surgical smoke plume Evacuation Equipment
- Symptoms

Awareness and Education

The vast majority of perioperative practitioners surveyed were aware of the hazards associated with surgical smoke plume, with only 7% saying they were unaware of the health and safety risks.

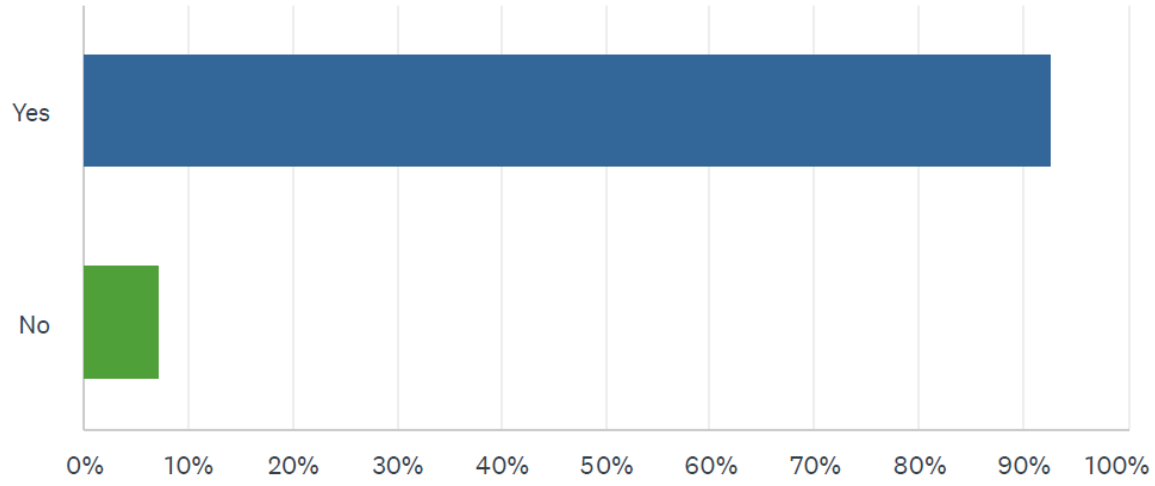

Fig 6. *Responses to the question 'Are you aware of the health & safety risks from surgical smoke plume?' – 19 respondents skipped this question*

Table 2. *Responses to the question 'Are you aware of the health & safety risks from surgical smoke plume?'*

Answer	**% Responses**
Yes	92.84%
No	7.16%

This high level of awareness reflects the success of campaigns over the last four years to raise awareness of the risks associated with exposure to surgical smoke plume.

Organisations focused on practitioner safety, including AfPP, ICSP, British Occupational Hygiene Society (BOHS), Institution of Occupational Safety (IOSH), and Health and Safety Executive (HSE), have campaigned on this issue for many years.

An almost equally large number of respondents (90%) reported that they were concerned about the risks to their health from surgical smoke plume.

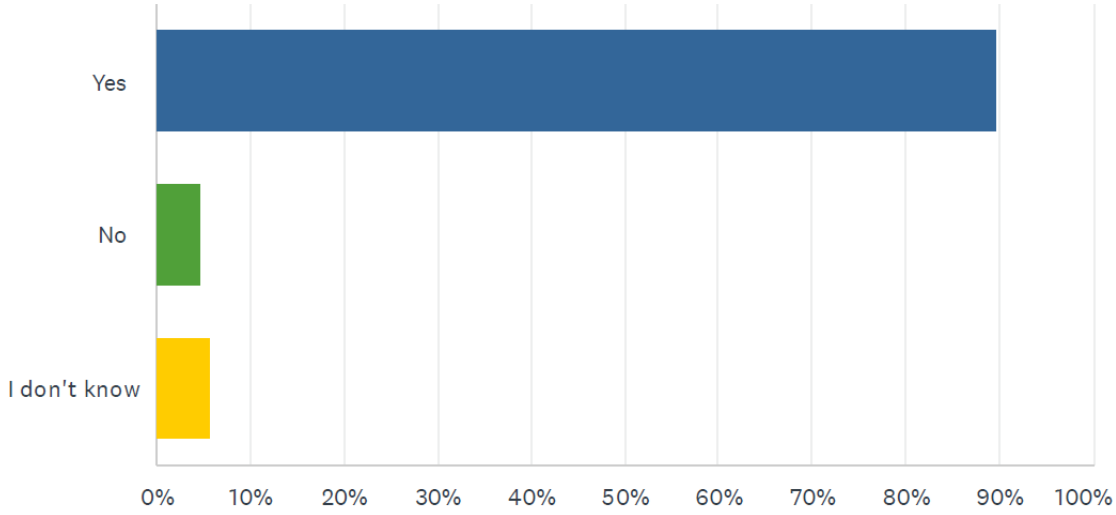

Fig 7. *Responses to the question 'Are you concerned about the risks to your health from surgical smoke plume?' – 19 respondents skipped this question*

Table 3. *Responses to the question 'Are you concerned about the risks to your health from surgical smoke plume?'*

Answer	**% Responses**
Yes	89.74%
No	4.59%
I don't know	5.66%

These responses indicate that surgical smoke plume remains an important issue for healthcare professionals working in the perioperative environments.

The COVID-19 pandemic put additional stress on perioperative practitioners. In another 2021 survey conducted by AfPP, 70% of respondents reported concerns that their wellbeing and mental health was being affected by the circumstances created by COVID-19.

Redeployment, staff shortages, record high surgical backlogs and concerns about their own health were among the factors associated with increased stress levels since 2020.

All NHS Trusts, private hospitals and other facilities carrying out surgical procedures should consider the impact dealing with daily concerns about surgical smoke plume is having on their staff and how they can better support them.

One approach to improve support could be to provide further education and training on how theatre practitioners can protect themselves against breathing in surgical smoke plume.

52% of survey respondents said they had not received any education on the hazards of exposure to surgical smoke plume.

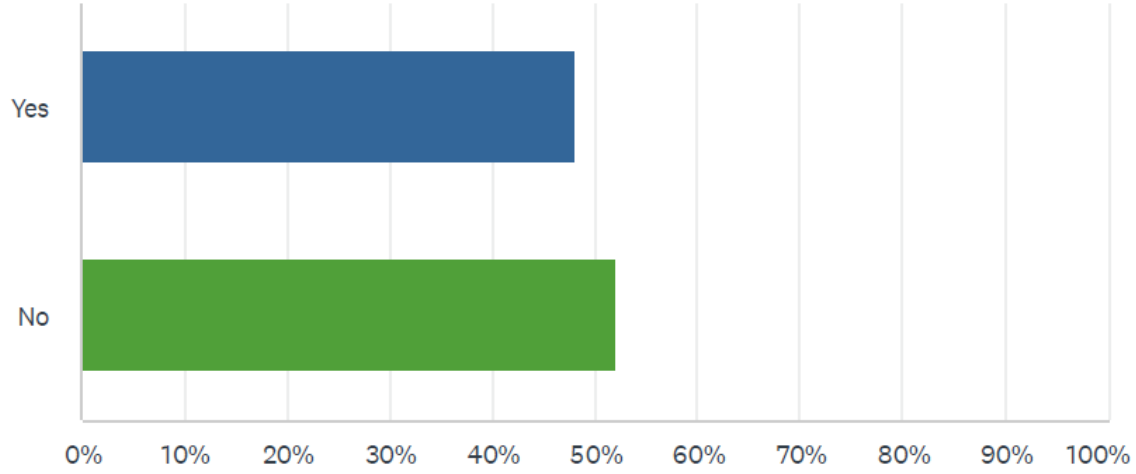

Fig 8. *Responses to the question 'Have you received any education on the hazards of exposure to surgical smoke plume?' – 19 respondents skipped this question*

Table 4. *Responses to the question 'Have you received any education on the hazards of exposure to surgical smoke plume?'*

Answer	**% Responses**
Yes	48.08%
No	51.98%

Fig. 6 shows 93% of perioperative practitioners are aware of the health risks associated with surgical smoke plume, yet only 48% recall receiving any education on these risks.

This gap between awareness and education is concerning. It indicates that, despite the success of campaigns to raise awareness on risks surrounding surgical smoke plume, many practitioners feel they haven't received training on how to manage and mitigate these risks.

Mandatory nationally recognised training should be provided by employing organisations, and for agency staff this should be part of their annual requirements to work.

SPA will strongly advocate for this requirement to be included in local and national policy, along with mandatory regulations and legislation.

Of those who had received education on the hazards of exposure to surgical smoke plume, 62% said this education was delivered through self-study. A further 33% said this education was delivered through independent e-learning.

This further demonstrates the need for a recognised, national training programme. Perioperative practitioners clearly show a trend of undertaking their own learning on surgical smoke plume rather than feeling confident that this training will be delivered in their workplace.

Self-study is generally superficial and may not be applicable to an individual's practice. It cannot provide the same level of information as professional clinical education and training. Education must be provided without commercial bias and be based on established standards and best practices if it is to be effective as the foundation for a sustainable programme to mitigate against the hazards of surgical smoke plume.

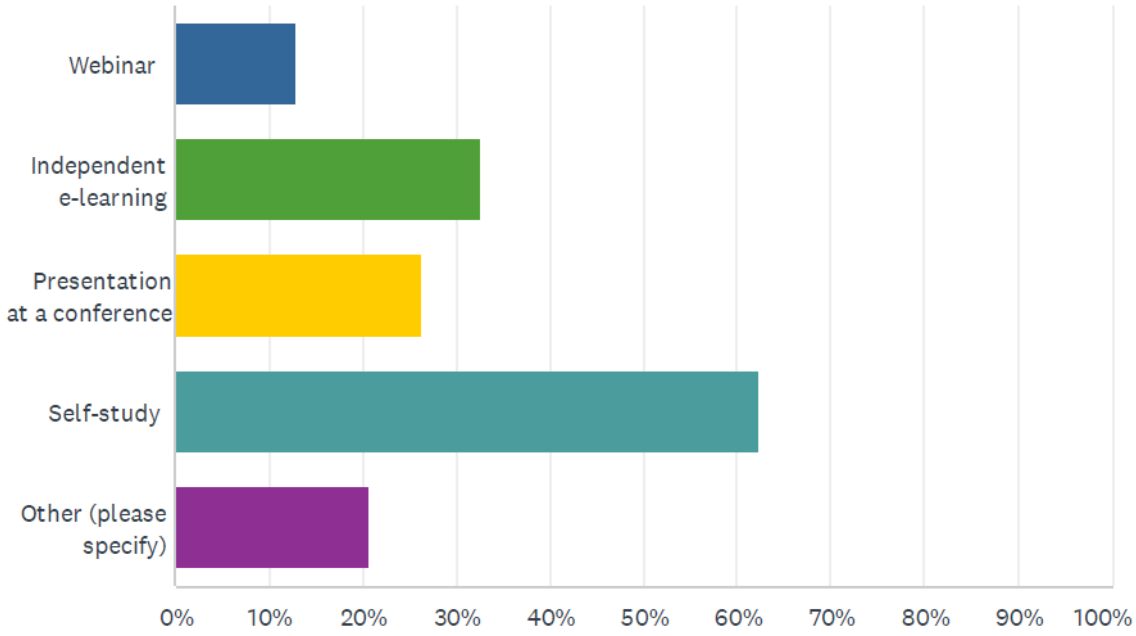

Fig 9. *Responses to the question 'If you answered yes, how was this education delivered? (Please select all that apply)' – 479 respondents skipped this question, 450 of these had answered no to the previous question*

Table 5. *Responses to the question 'If you answered yes, how was this education delivered? (Please select all that apply)'*

Answer	**% Responses**
Webinar	12.82%
Independent e-learning	32.56%
Presentation at conference	26.26%
Self-study	62.18%
Other	20.59%

The other category included presentations delivered by medical device companies, articles in the Journal or Perioperative Practice (JPP) and assignments / lecturers as part of a university course.

Of those who had not received education on the hazards of exposure to surgical smoke plume, 96% said they would attend training if it was made available.

This demonstrates that there is high demand for training among perioperative practitioners.

Under the Health and Safety at Work Act (HASAWA 1974), employers are required to ensure the health and safety of their employees. Additionally, under the Control of Substances Hazardous to Health regulations (COSHH 2002), they must also prevent and control exposure to substances hazardous to health.

Breach of the above is reportable to the Health and Safety Executive HSE 2012. The findings of this survey suggest that, to be safe at work, it is necessary for clinicians to understand the science behind why plume is a hazard, the evidence that validates it, and the standards and rules that provide guidance for safe practice.

Therefore, all NHS Trusts, private hospitals and other facilities carrying out surgical procedures should consider providing surgical smoke plume training to their theatre staff to ensure compliance with HASAWA (1974) and COSHH (2002).

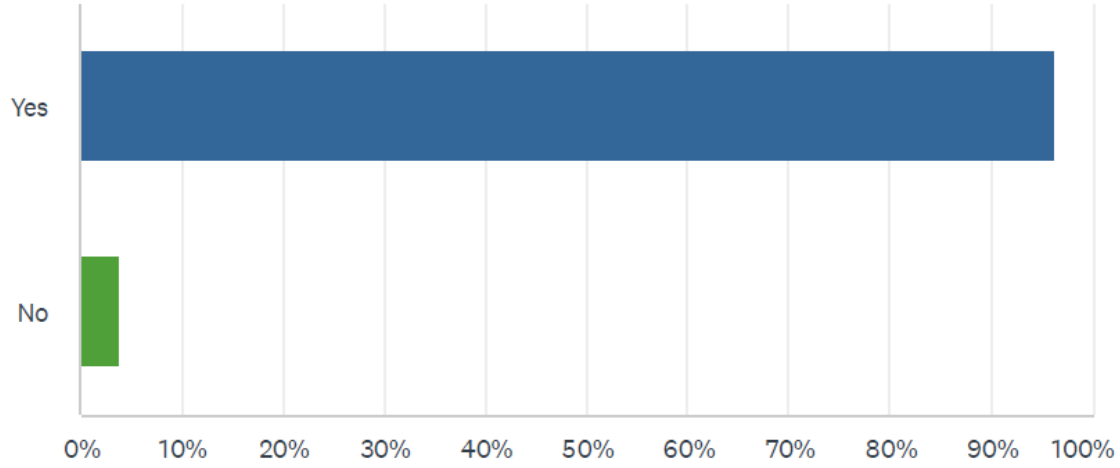

Fig 10. *Responses to the question 'If you answered no, would you attend training if it was made available?' – 335 respondents skipped this question*

Table 6. *Responses to the question 'If you answered no, would you attend training if it was made available?'*

Answer	**% Responses**
Yes	96.13%
No	3.87%

Management and Policy

Only 16% of respondents confirmed that their workplace had a team working on a risk assessment, policy, plan or program for how to manage surgical smoke plume.

This indicates that many organisations do not currently have any official guidance or policy in place for managing the health and safety risks associated with exposure to surgical smoke plume. It may also indicate that guidance is in place, but the theatre team has not been made aware of it, or, that there is no means for ensuring compliance with guidance and policies.

To comply with Control of Substances Hazardous to Health Regulations (COSHH) 2002 and the Health and Safety at Work Act (HASWA)1974, guidance must be provided on how to manage exposure to surgical smoke plume in operating theatres.

All NHS Trusts, private hospitals and other facilities carrying out surgical procedures should ensure they have a policy in place for how to manage surgical smoke plume, and that this policy is appropriately communicated to all theatre staff.

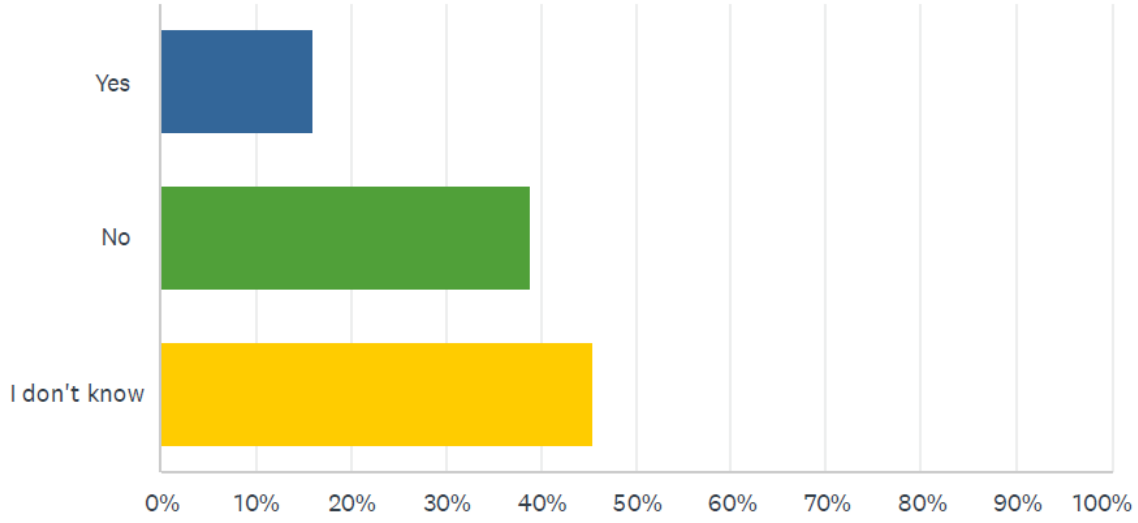

Fig 11. *Responses to the question 'Do you have a team working on a risk assessment, policy, plan, or program on how to manage surgical smoke plume?' – 43 respondents skipped this question*

Table 7. *Responses to the question 'Do you have a team working on a risk assessment, policy, plan, or program on how to manage surgical smoke plume?'*

Answer	**% Responses**
Yes	15.90%
No	38.71%
I don't know	45.31%

When explicitly asked about local policy for surgical smoke plume management within their organisation, once again only 16% respondents could confirm there was a policy.

This further demonstrates the need for better communication surrounding policy on this issue.

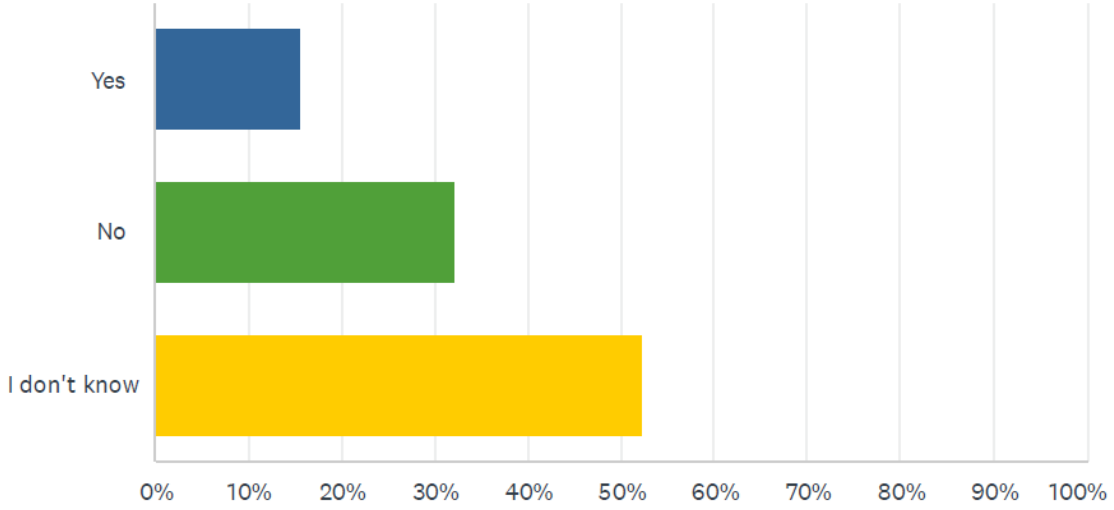

Fig 12. *Responses to the question 'Is there a local policy for surgical smoke plume management within your organisation?' – 43 respondents skipped this question*

Table 8. *Responses to the question 'Is there a local policy for surgical smoke plume management within your organisation?'*

Answer	**% Responses**
Yes	15.57%
No	32.24%
I don't know	52.19%

Surgical Smoke Plume Evacuation Equipment

The large majority of respondents (79%) reported that their workplace had surgical smoke plume equipment in place.

This is a positive sign that UK hospitals and healthcare facilities have invested in the necessary equipment to evacuate surgical smoke plume during surgery, and therefore minimise the associated risks to theatre staff.

However, as later findings will demonstrate, this doesn't necessarily mean that evacuation equipment is present in all operating theatres within an organisation or that the equipment is used during all procedures.

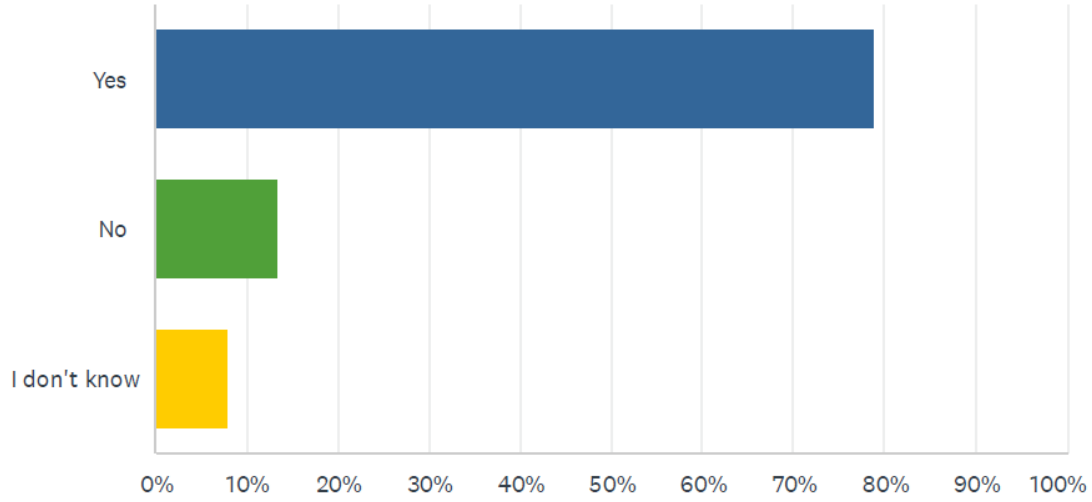

Fig 13. *Responses to the question 'Does your workplace have plume evacuation equipment in place?' – 111 respondents skipped this question*

Table 9. *Responses to the question 'Does your workplace have plume evacuation equipment in place?'*

Answer	**% Responses**
Yes	78.79%
No	13.39%
I don't know	7.82%

64% of perioperative practitioners surveyed acknowledged several barriers preventing the use of plume evacuation equipment in their workplace.

The barriers ranged from a lack of education regarding the risks of surgical smoke plume and lack of policy mandating the use of evacuation equipment to staff not wanting to use the equipment and no evacuation equipment being available.

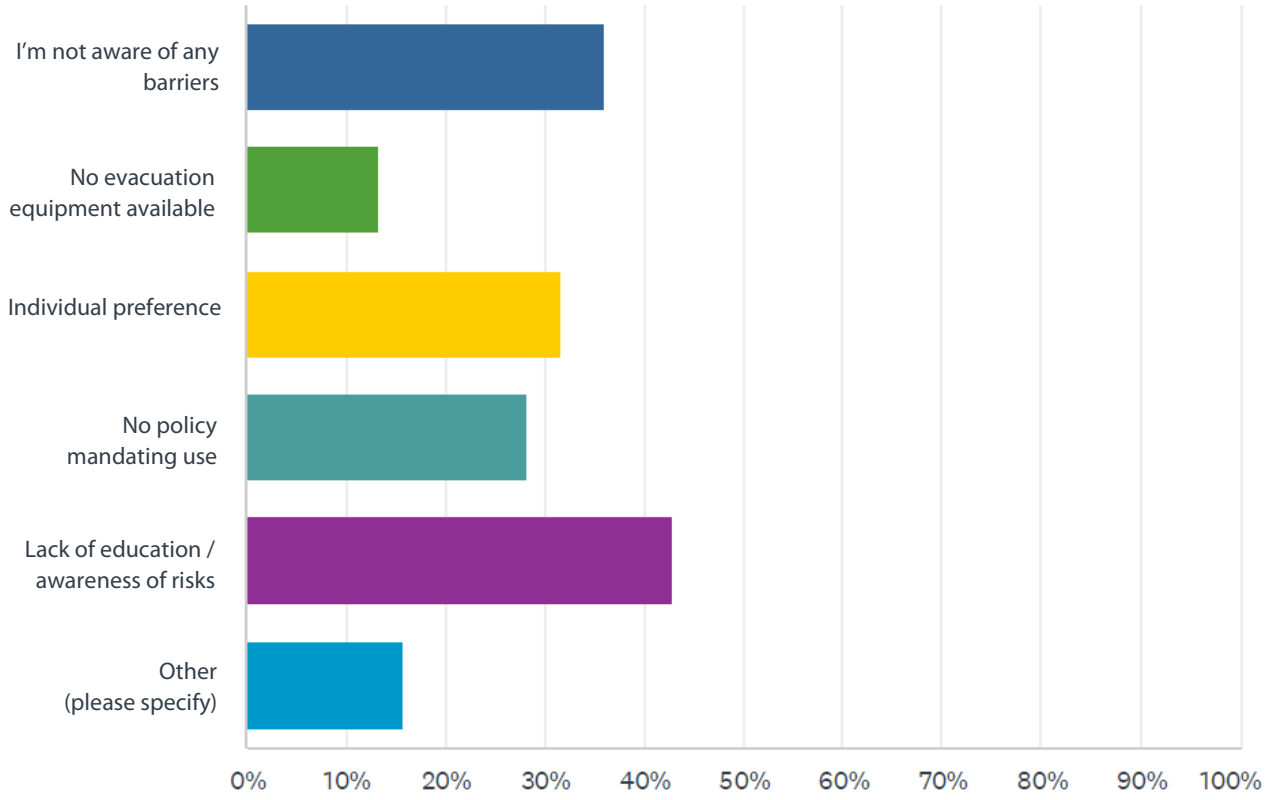

Fig 14. *Responses to the question 'Are you aware of any barriers preventing the use of plume evacuation equipment in your workplace? (Please select all that apply)' – 43 respondents skipped this question*

Table 9. *Responses to the question 'Are you aware of any barriers preventing the use of plume evacuation equipment in your workplace? (Please select all that apply)'*

Answer	**% Responses**
I'm not aware of any barriers	35.96%
There is no plume evacuation equipment available	13.27%
Individual preference – staff don't want to use the equipment	31.47%
There is no policy requiring the equipment be used	28.18%
There is a lack of education / awareness regarding the risks	42.76%
Other	15.79%

The other barriers category included the cost of the evacuation equipment, not having enough equipment for use in all operating theatres and surgeons finding the equipment too bulky / obstructive of vision of the surgical site / noisy to use.

These findings again support the need for consistent policy and education surrounding the management of surgical smoke plume.

Number and type of surgical smoke plume evacuation units

Responses to the question 'If evacuation equipment is in place, how many units are there?' supported the above suggestions that evacuation equipment cannot be used in all surgical procedures because there are fewer units than operating theatres in many organisations.

By directly comparing the reported number of operating theatres and procedure rooms to the reported number of evacuation units for each respondent, we can see that the number evacuations in place is insufficient in many cases.

6.5% of respondents said their organisation had 31 or more operating theatres and procedure rooms. However, only one respondent said their organisation had between 31 – 35 surgical smoke plume evacuation units. Zero respondents said their organisation had more than 36 units. This indicates that practitioners and patients are being put at risk by carrying out procedures in rooms which do not have suitable surgical smoke plume evacuation equipment available.

Another interesting finding is that a significantly higher number of respondents were unsure about the number of surgical smoke plume evacuation devices available in their organisation than were unsure about the number of theatres / procedure rooms – 29% versus 0.7%. This supports earlier findings that general lack of awareness about the availability of surgical smoke plume evacuation equipment may be a barrier to the use of the equipment.

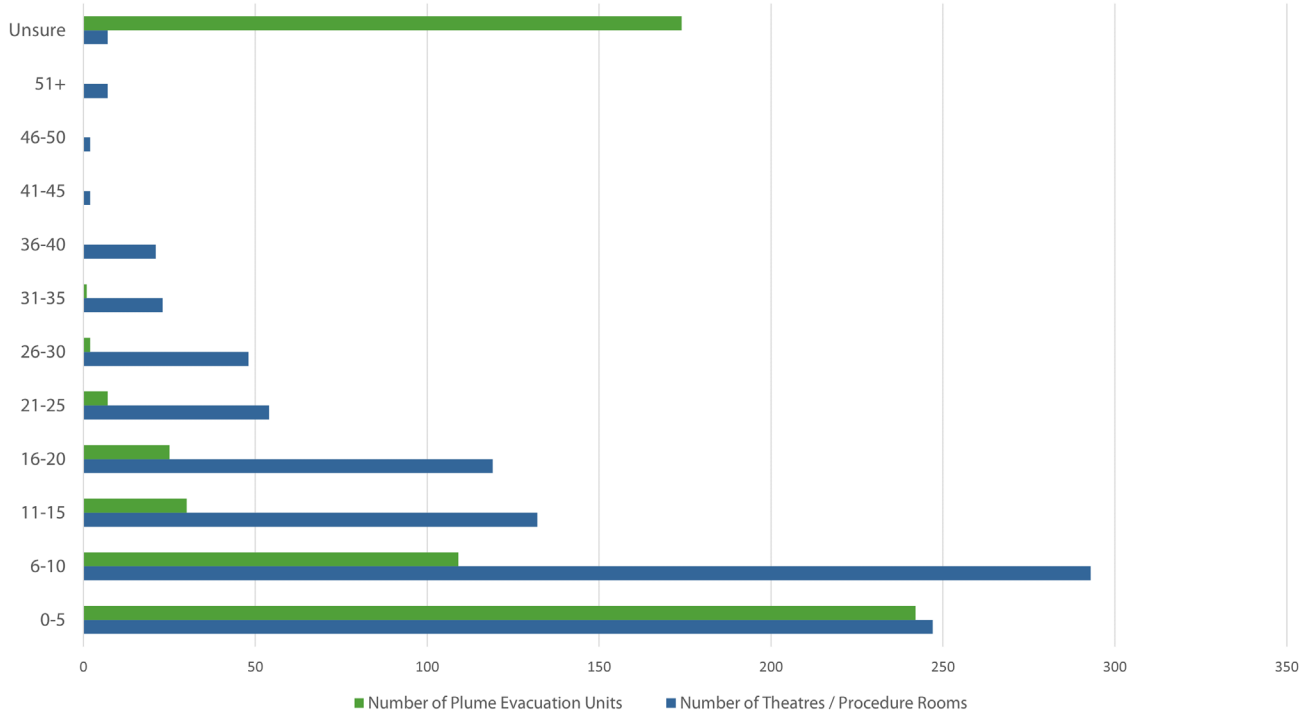

Fig 15a. Comparison of *responses to the question 'If evacuation equipment is in place, how many units are there?' – 365 respondents skipped this question – and responses to the question 'How many operating theatres and procedure rooms are there in your workplace?' – 0 respondents skipped this question*

Table 10a. *Responses to the questions "How many operating theatres and procedure rooms are there in your workplace?' and 'If evacuation equipment is in place, how many units are there?'*

Answer	**% Responses for number of operating theatres / procedure rooms**	**% Responses for number of surgical smoke plume evacuation units**
0-5	25.86%	41.02%
6-10	30.68%	18.47%
11-15	13.82%	5.08%
16-20	12.46%	4.24%
21-25	5.65%	1.19%
26-30	5.03%	0.34%
31-35	2.41%	0.17%
36-40	2.20%	0.00%
41-45	0.21%	0.00%
46-50	0.21%	0.00%
51+	0.73%	0.00%
Unsure	0.73%	29.49%

Using the data above, we were able to map whether the number of surgical smoke plume evacuation devices matched the number of operating theatres and procedure rooms for each respondent. Based on their answers, only 23% reported that there were enough surgical smoke plume evacuation units for all operating theatres and procedure rooms in their workplace.

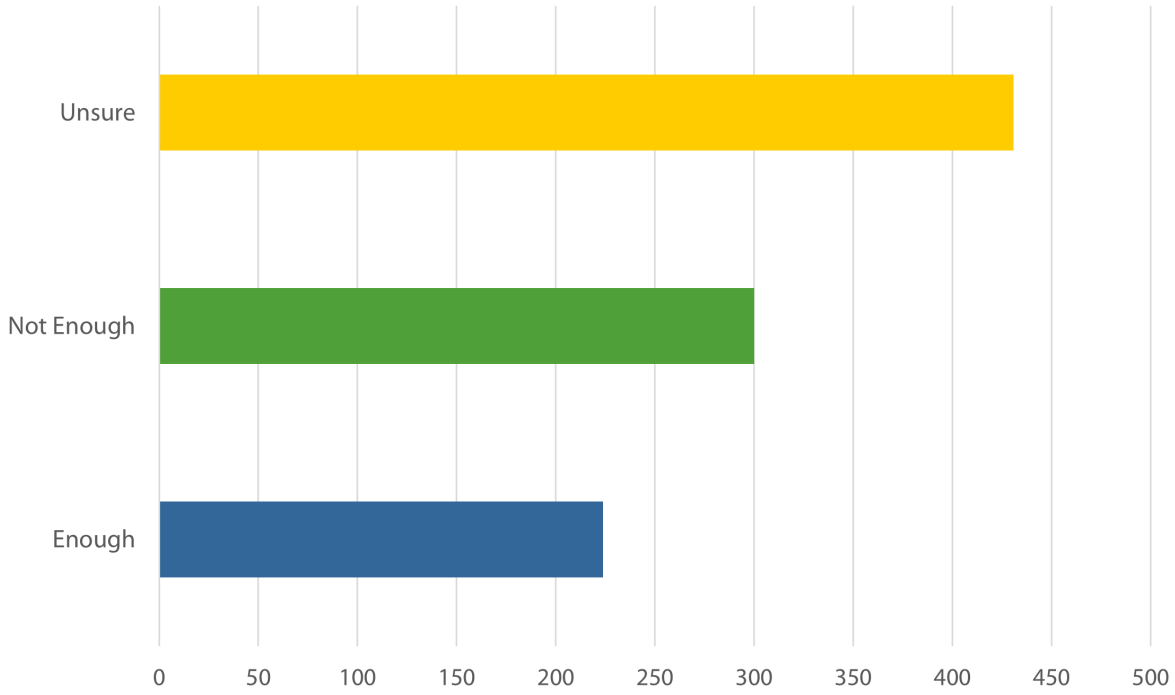

Fig 15b. *An analysis of whether there are enough surgical smoke plume evacuation devices for all operating theatres and procedure rooms based on the answers shown in Table 10a.*

Table 10b. *An analysis of whether there are enough surgical smoke plume evacuation devices for all operating theatres and procedure rooms based on the answers shown in Table 10a.*

Answer	**% Responses**
Unsure	45%
Not Enough	31%
Enough	23%

When asked about the type of units used, the majority of respondents (68%) reported that their workplace uses portable smoke plume evacuation units.

Figuratively the table 10a clearly demonstrates only (23%) reported that there were enough surgical smoke plume evacuation units for all operating theatres and procedure rooms in their workplace, with (45%) unsure and (31%) not enough Table 10b.This clearly identifies the need to provide smoke plume evacuation units in all areas of practice where energy based devices (i.e. lasers, etc.) are being used to improve health and safety of all surgical teams and their patients. Financial cost should not be a driver when putting patients and staff at risk (HSAWA) 1974 and (COSHH) 2002.

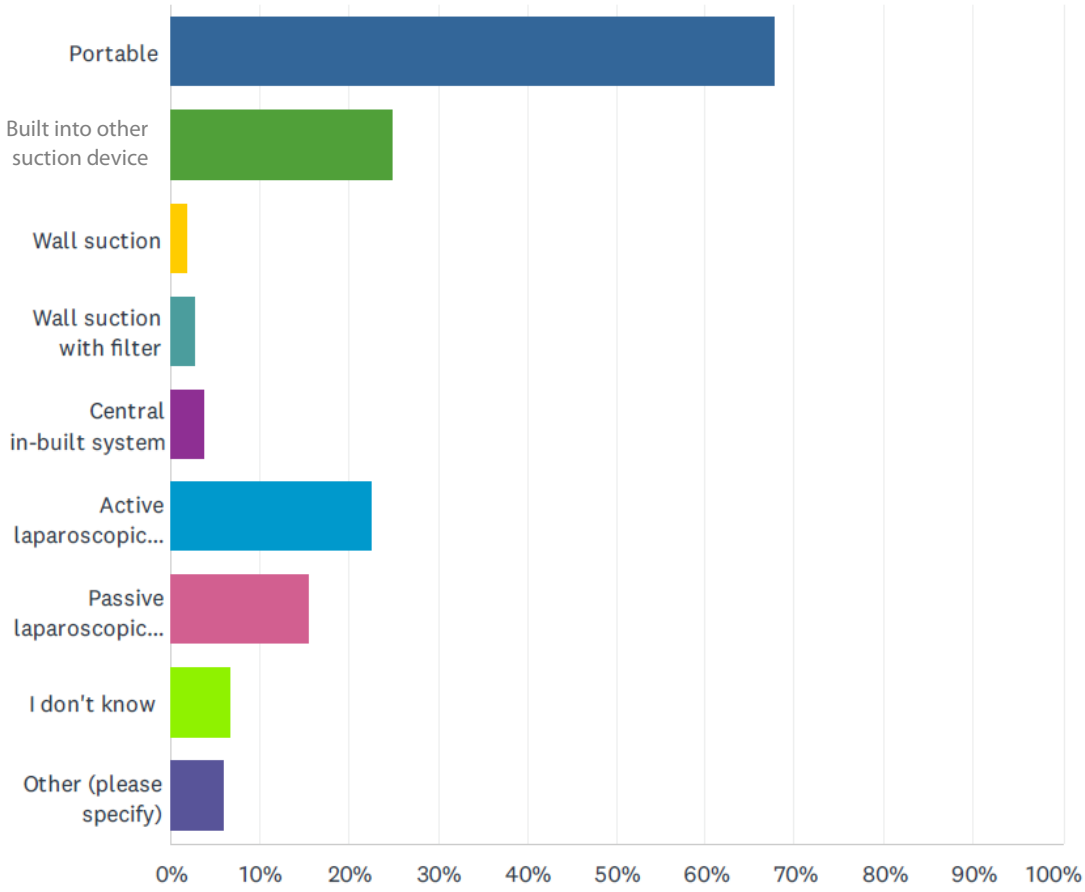

Fig 16. *Responses to the question 'If you have evacuation equipment in your workplace, what type? (Please select all that apply)' – 267 respondents skipped this question*

Table 11. *Responses to the question 'If you have evacuation equipment in your workplace, what type? (Please select all that apply)'*

Answer	**% Responses**
Portable	67.73%
Built into other suction device	24.85%
Wall suction	1.89%
Wall suction with filter	2.76%
Central in-built system	3.78%
Active laparoscopic device	22.53%
Passive laparoscopic device	15.55%
I don't know	6.83%
Other	5.96%

The other type of unit category included laminar flow and diathermy linked smoke evacuation.

Selecting plume evacuation equipment depends on the assessment of a number of variables. For example, the types of procedures being carried out, local support available during program development and training, the number of rooms and their type / size, etc.

All NHS Trusts, private hospitals and other facilities carrying out surgical procedures should assess both the practices and technologies available to ensure the equipment they purchase through procurement meets all regulations and standards and has capture systems that meet their specific clinical needs.

Plume evacuation during laparoscopy and/or endoscopy procedures

Worryingly, only 14% of respondents said they always evacuate plume during laparoscopy and/or endoscopy procedures.

Failure to evacuate surgical smoke plume during laparoscopy and endoscopy procedures where energy-based devices are used leads to a build-up of a gaseous environment. This can interfere with the surgeon's ability to visualise the surgical treatment site, which is a hazard to both the surgeon and the patient.

Furthermore, gases can diffuse across the peritoneum and be absorbed into the patient's circulatory system. This can result in reducing cellular oxygenation. Absorption of toxic components by the patient - especially benzeine and toluene - have been found in significant amounts in urine after laparoscopic procedures (Dobrogowski et al 2014).

Inappropriate desufflation of gases into the operating theatre environment also poses inhalation risks and increased risk of exposure to transmission of blood borne pathogens, and toxic gases, by the theatre team. The venting of intra-abdominal smoke plume into the room air should be prohibited by all policies and practices.

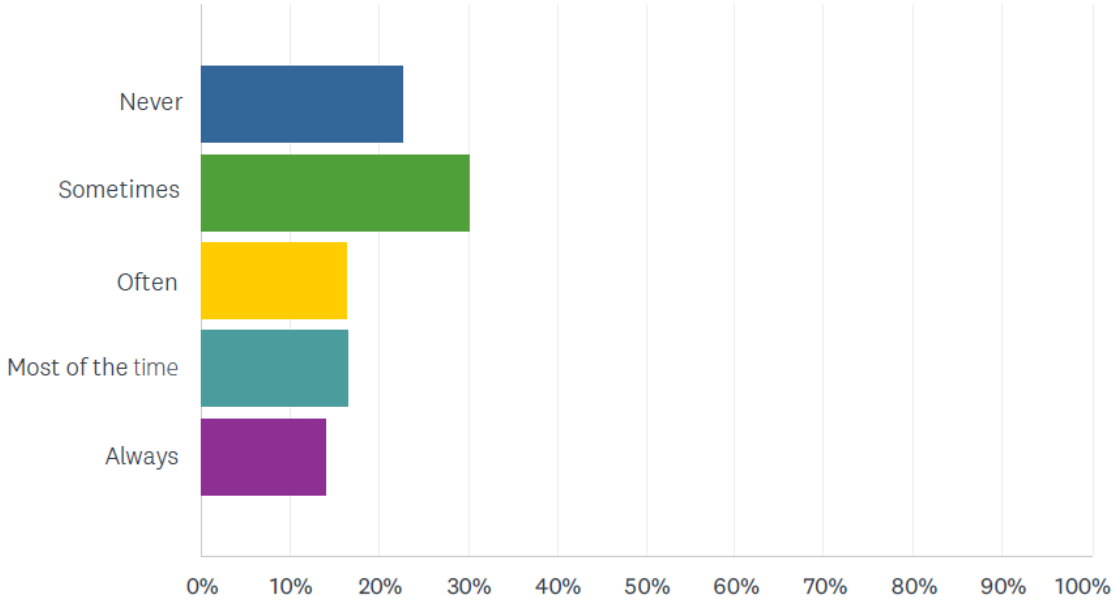

Fig 17. *Responses to the question 'How often do you evacuate plume during laparoscopy and/or endoscopy procedures?' – 111 respondents skipped this question*

Table 12. *Responses to the question 'How often do you evacuate plume during laparoscopy and/or endoscopy procedures?'*

Answer	**% Responses**
Never	22.75%
Sometimes	30.33%
Often	16.35%
Most of the time	16.59%
Always	13.98%

When asked for more information about the type of smoke plume evacuation system used for laparoscopy, 31% of respondents answered, 'I don't know / we don't use one'.

This further highlights the lack of awareness and education surrounding the importance of evacuating surgical smoke plume during these procedures and the risks of not doing so.

Passive filtering systems and manual venting through the trocar were the most commonly reported type of system used (25% and 24% respectively).

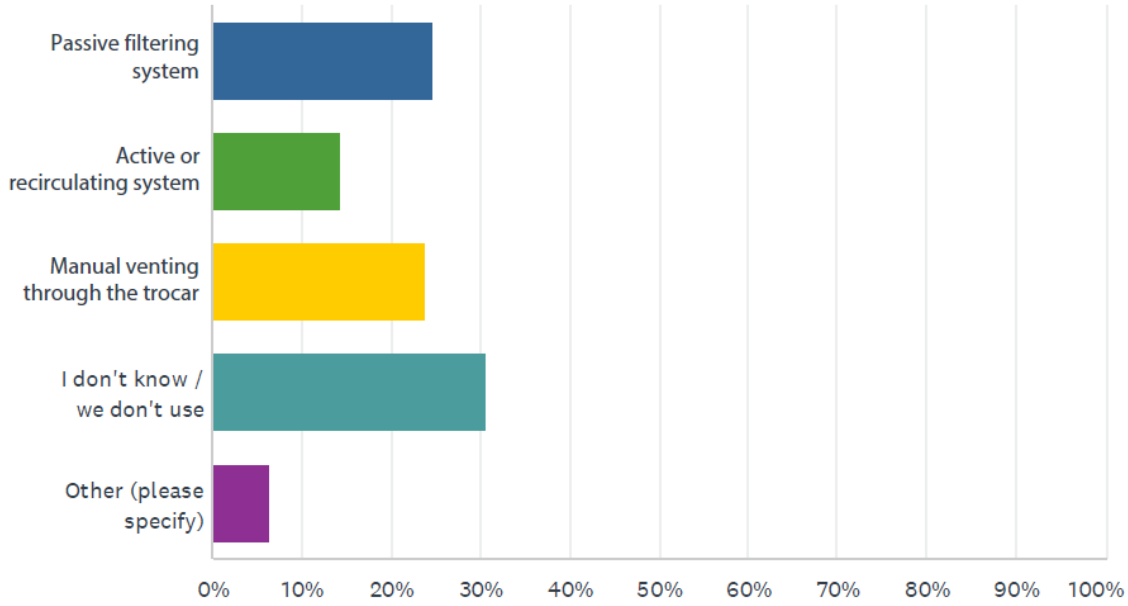

Fig 18. *Responses to the question 'What type of system do you use for laparoscopy?' – 111 respondents skipped this question*

Table 13. *Responses to the question 'What type of system do you use for laparoscopy?'*

Answer	**% Responses**
Passive filtering system	22.75%
Active or recirculating system	30.33%
Manual venting through the trocar	16.35%
I don't know / we don't use any	16.59%
Other	13.98%

The other systems category included responses from practitioners who do not work on laparoscopy procedures and practitioners who use a combination of active and passive systems.

Plume evacuation during other surgical procedures

As well as asking about usage of evacuation equipment during laparoscopy and/or endoscopy, we also asked about their usage during other surgical procedures.

We separated laparoscopic procedures from other surgical procedures due to the specific risks outlined in the previous section. However, wherever and whenever plume is generated, it must be evacuated.

Only 12% of respondents said they always evacuate surgical smoke plume during other types of procedure.

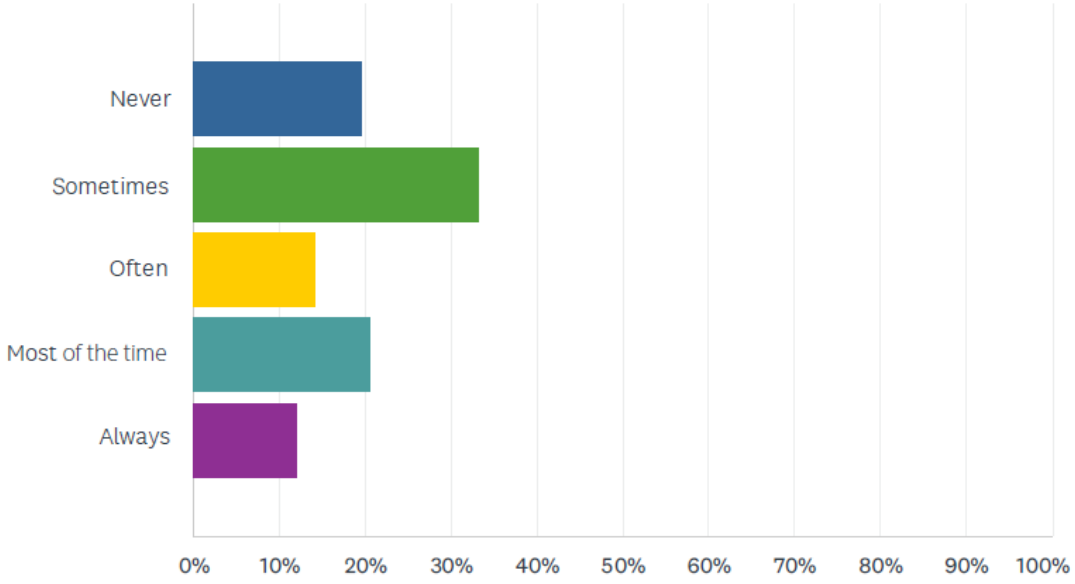

Fig 19. *Responses to the question 'How often do you use a plume evacuation system during other types of surgical procedure?' – 111 respondents skipped this question*

Table 14. *Responses to the question 'How often do you use a plume evacuation system during other types of surgical procedure?'*

Answer	**% Responses**
Never	19.67%
Sometimes	33.18%
Often	14.22%
Most of the time	20.73%
Always	12.20%

Symptoms associated with exposure to surgical smoke plume

A staggering 72% of respondents said they had experienced symptoms associated with exposure to surgical smoke plume while working in the operating theatre environment.

The most common symptoms reported were headache (53%), coughing (38%) and eye irritation (36%).

However, more severe symptoms like allergic reactions and shortness of breath were also reported (by 5% and 13% of respondents respectively).

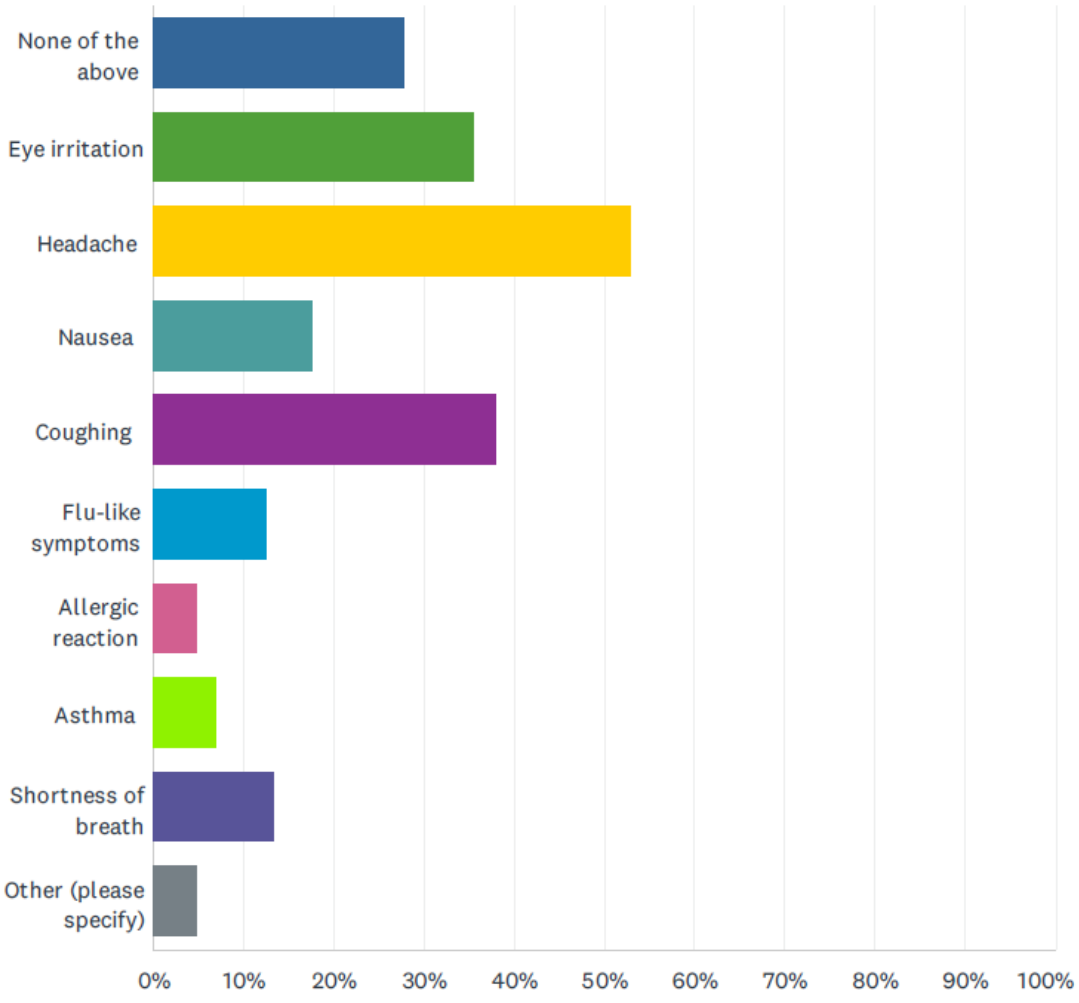

Fig 20. *Responses to the question 'Have you ever experienced any of the following symptoms while working in the operating theatre environment? (Please select all that apply.)' – 122 respondents skipped this question*

Table 15. *Responses to the question 'Have you ever experienced any of the following symptoms while working in the operating theatre environment? (Please select all that apply.)'*

Answer	**% Responses**
No symptoms	27.97%
Eye irritation	35.53%
Headache	53.18%
Nausea	17.65%
Coughing	38.18%
Flu-like symptoms	12.48%
Allergic reaction	4.92%
Asthma	6.96%
Shortness of breath	13.45%
Other	4.92%
Non-clinical	0%
Retired	0.73%
Other	4.92%

The other symptoms category included sore throat, dry mouth, itchy nose and dizziness.

We asked about this list of symptoms specifically as they are symptoms most reported by those exposed to surgical smoke plume. Evidence show better results are gathered from research when respondents are presented with a list of symptoms rather than an open-ended question.

Whilst we acknowledge that these symptoms can be caused by factors other than exposure to surgical smoke plume, clearly there is a trend that practitioners experience negative health symptoms while working in the perioperative environment.

As research has shown these symptoms can be linked to plume exposure, all NHS Trusts, private hospitals, clinics, and other facilities carrying out surgical procedures should consider how improving their management of surgical smoke plume could reduce these symptoms in theatre staff.

A review of plume management procedures should be conducted as part of the organisation's wider health and safety policies.

Reducing the negative symptoms practitioners experience in the perioperative environment can improve their overall wellbeing and satisfaction with their workplace. Additionally, it may help reduce staff absences which is essential for organisations who are already experiencing shortage of theatre staff.

Of the respondents who had experienced symptoms, 99% experienced them more than once.

This demonstrates that, for most practitioners, experiencing negative health symptoms is a recurring issue within the operating theatre environment. Therefore, further action must be taken to reduce these experiences where possible.

The fact that 81% of respondents reported experiencing symptoms occasionally – often indicates this is an area worth investment from healthcare organisations.

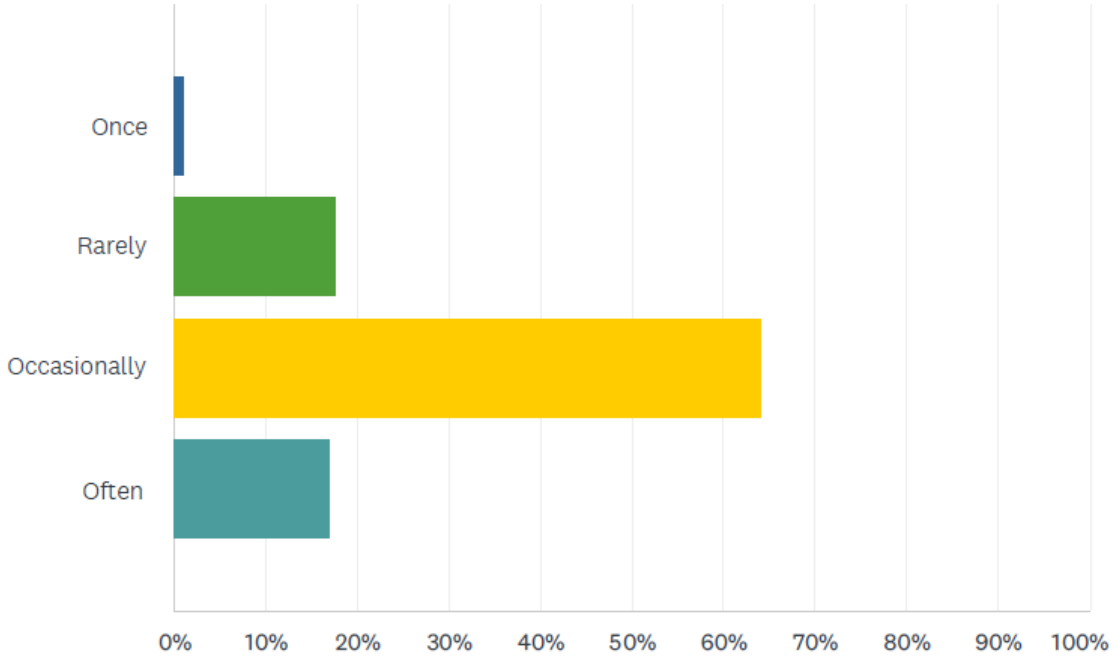

Fig 21. *Responses to the question 'How often did you experience the symptom(s) while working in the operating theatre environment?' – 345 respondents skipped this question*

Table 16. *Responses to the question 'How often did you experience the symptom(s) while working in the operating theatre environment?'*

Answer	**% Responses**
Once	1.15%
Rarely	17.70%
Occasionally	64.10%
Often	17.05%

97% of respondents said they were able to continue working whilst experiencing the symptom(s).

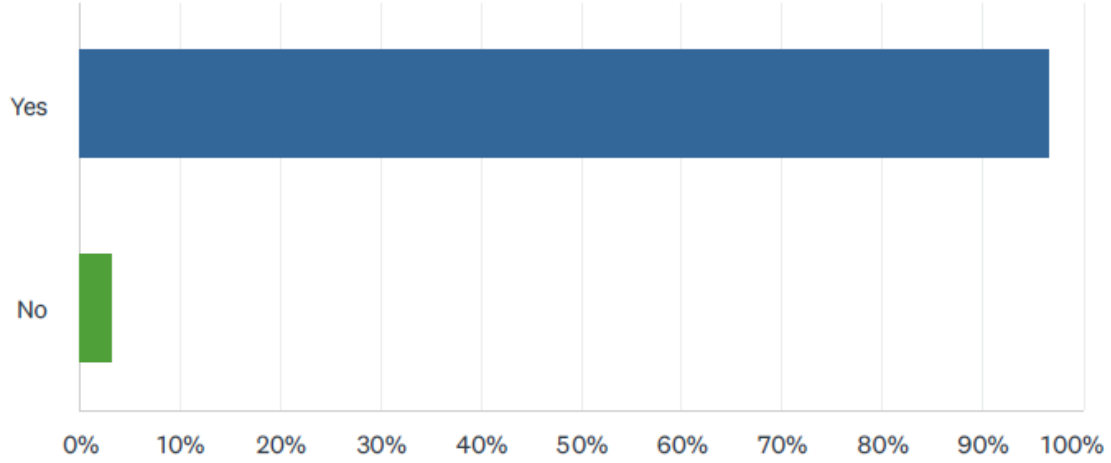

Fig 22. *Responses to the question 'Were you able to continue to work whilst experiencing the symptom(s)?' – 343 respondents skipped this question*

Table 17. *Responses to the question "Were you able to continue to work whilst experiencing the symptom(s)?'*

Answer	**% Responses**
Yes	96.73%
No	3.27%

As well as being likely to continue working with symptoms, 88% of respondents reported that they did not report their symptoms to anyone.

This trend for practitioners working through their negative health and not reporting them may explain why the health and safety risks of surgical smoke plume are often overlooked.

All NHS Trusts, private hospitals, clinics and other facilities carrying out surgical procedures must ensure that they create a culture where theatre staff feel they can report any symptoms, that their reports will be taken seriously, and that they will lead to mandatory policy that will help eliminate the risk of future symptoms.

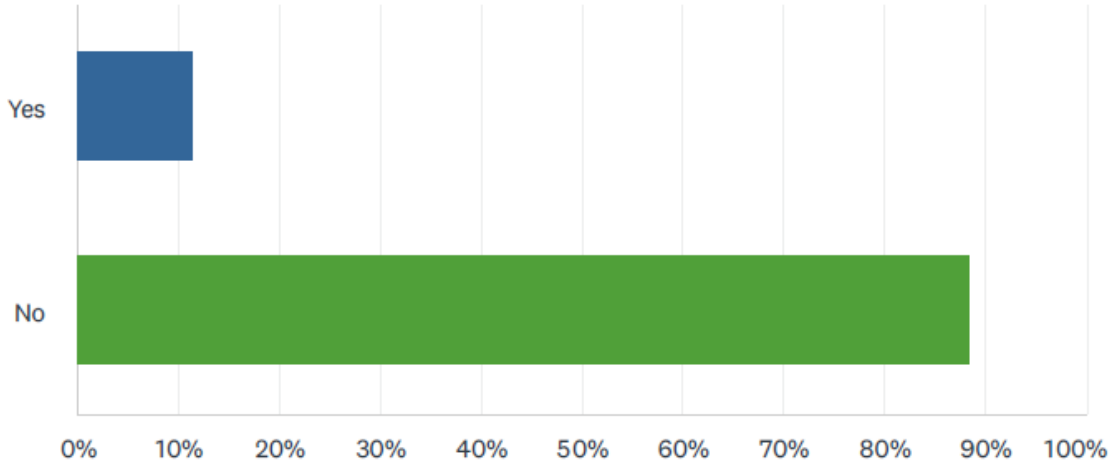

Fig 23. *Responses to the question 'Did you report the symptom(s) to anyone?' – 347 respondents skipped this question*

Table 18. *Responses to the question 'Did you report the symptom(s) to anyone?'*

Answer	**% Responses**
Yes	11.51%
No	88.49%

We then asked those who had reported their symptoms to answer two further questions:

a) Who did you report the symptom(s) to?
b) Was any action taken?

40% said they reported their symptoms to their line manager. Interestingly, 9% chose to report their symptoms to their GP rather than someone at their workplace.

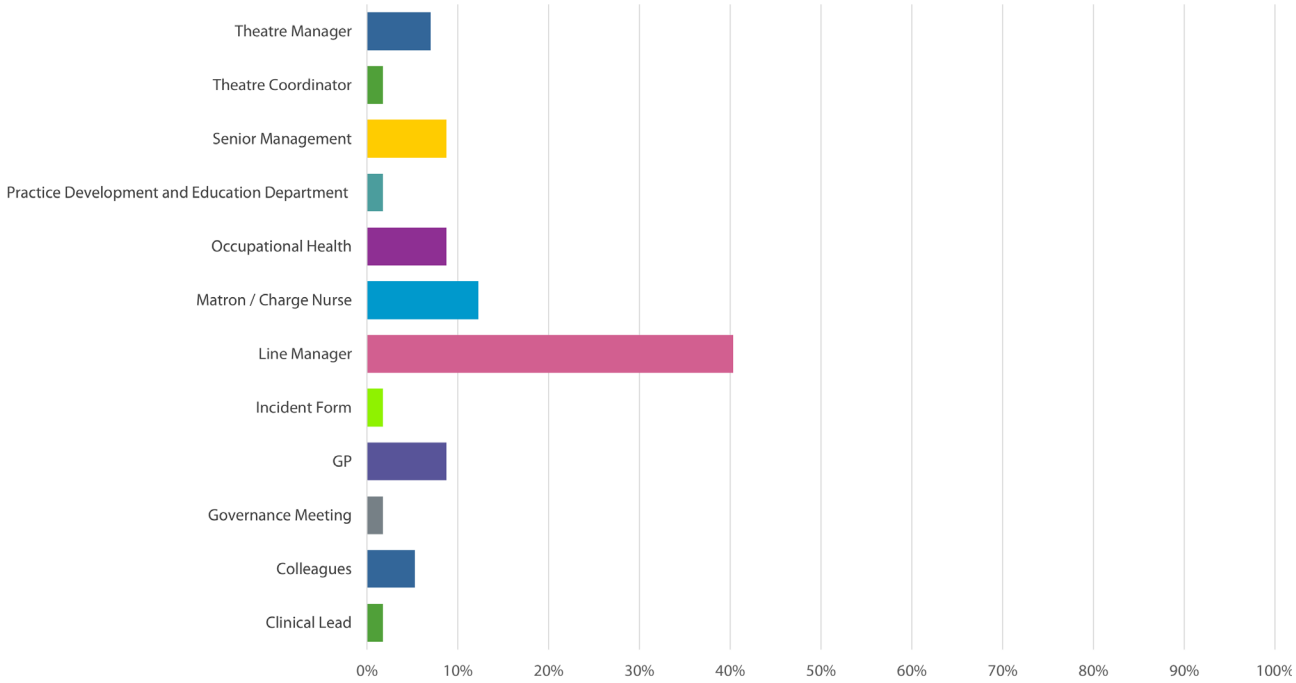

Fig 24. *Responses to the question 'Who did you report the symptom(s) to?' – 57 respondents answered*

Table 19. *Responses to the question 'Who did you report the symptom(s) to?'*

Answer	**% Responses**
Theatre Manager	7.02%
Theatre Coordinator	1.75%
Senior Management	8.77%
Practice Development & Education Department	1.75%
Occupational Health	8.77%
Matron / Charge Nurse	12.28%
Line Manager	40.35%
Incident Form	1.75%
GP	8.77%
Governance Meeting	1.75%
Colleagues	5.26%
Clinical Lead	1.75%

Unfortunately, of those who reported their symptoms, only 23% said any further action was taken.

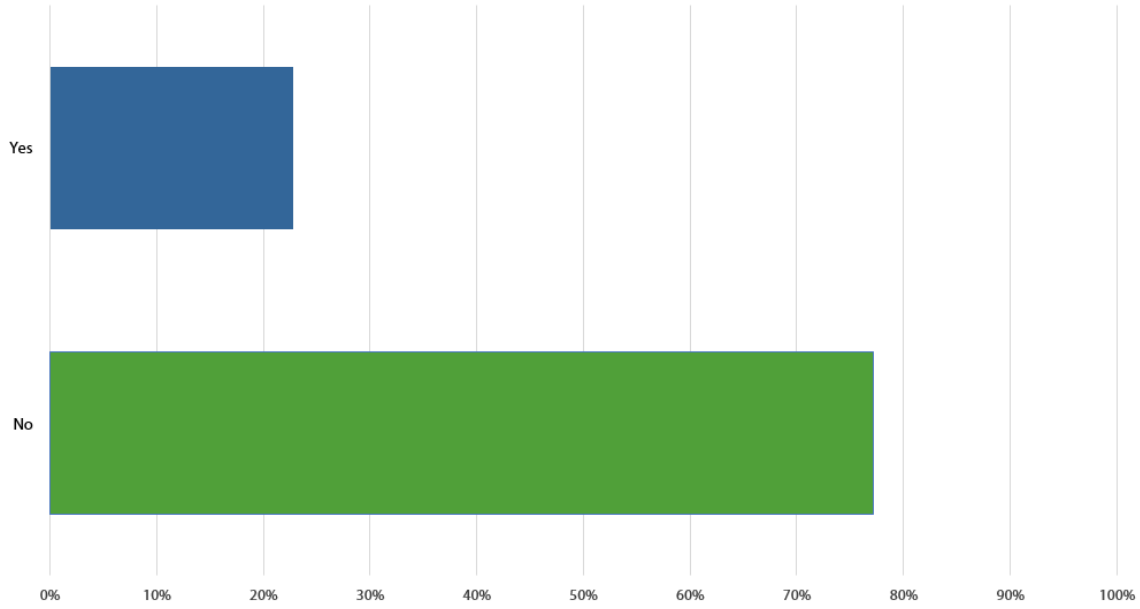

Fig 25. *Responses to the question 'Was any action taken?' – 57 respondents answered*

Table 20. *Responses to the question 'Was any action taken?'*

Answer	**% Responses**
Yes	22.81%
No	77.19%

47% of the actions taken were to treat the physical symptoms being exhibited. For example, giving a staff member the rest of the day off, referrals for allergy testing and prescribing an inhaler or nebuliser.

Only 17% of the actions taken related to reviewing the equipment and/or policies in place in the operating theatre. For example, one organisation set a Standard Operating Procedure (SOP) that visiting surgeons and theatre teams must use the plume evacuation system during surgical procedures.

Consistent, accurate reporting mechanisms, and administrative support, is required to enable staff to submit reports. This initiation would be in the format of a mandatory local policy and comprehensive education programme for all surgical team members.

Conclusions

The summary findings from this survey identify the risks patients, and all healthcare professionals, are exposed to in the perioperative setting and procedure rooms whenever electrosurgery is performed. The surgical smoke plume produced in these procedures contains particulate matter, various chemicals and harmful microorganisms (Hill, 2012).

Inadequate preventative measures, a lack of effective management strategies (including risk assessments) and a general absence of specific perioperative education and training cause barriers to the implementation of surgical smoke plume evacuation devices.

Moving forward, SPA`s key focus is on:

- Establishing strategic guidance, standards, and recommendations for healthcare professionals working in the perioperative environment.
- Disseminating information and empowering healthcare professionals to identify best practice from evidence-based research.

This will provide the strategies needed to risk assess and establish local policies for the implementation of surgical smoke plume evacuation devices as the first line of protection in all operating theatres in the UK, for every procedure that generates surgical smoke plume.

SPA will facilitate a consultation on the issues around surgical smoke plume. It will work to identify systemic barriers to the reduction of surgical smoke plume at a national level. We will then use these findings to inform the development of national guidance on surgical smoke plume prevention and the mandating of surgical smoke plume evacuation devices.

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