***Numbered papers below refer to papers listed within the Evidence Tables section

Evidence-based conclusion 1 [Grade C]: The limited published data indicate that dedicated smoke evacuation/extraction devices are effective at reducing the levels of surgical smoke during various surgical procedures.

Notes: Although fourteen papers of relevance were identified, only thirteen of these were graded and few were of high quality as scored under SIGN criteria, and many of the data are experimental, and actual workplace exposure assessment is limited in both volume and quality.

***Related Evidence Table for Pico 1 Studies: Paper References: 4, 10 and 11**

Healthcare specialities providing source data (where stated): General surgical departments, also mock surgical procedures carried out under experimental conditions.

Evidence-based conclusion 2 [Grade D]: The available data originate from a variety of equipment types and surgical specialisations but suggest that correct (close) positioning of smoke evacuation devices to source emissions, if not already tip mounted, is likely to be important to the efficiency of surgical smoke removal.

Notes: More research is required to provide a stronger body of evidence on the efficacy of surgical smoke evacuation devices. Although the trend in available data indicate a reduction in staff exposure to smoke when these systems are implemented – i.e. compared to when absent - most studies are experimental and lab based, rather than well designed around the actual working practice of the exposed HCW population.

The limited amount of work related data available mean that information of high quality – as sought by a systematic review approach - are not currently available to allow the individual evaluation of dedicated smoke evacuation systems in the occupational setting.

Related Evidence Table Paper References: 4, 10 and 11

Healthcare specialities providing source data (where stated): General surgical departments, also mock surgical procedures carried out under experimental conditions.

Evidence-based conclusion 3 [Grade: Not applicable]: The level and quality of available evidence was not sufficient to support further evidence statements here, and the notes below reflect this, and are based on other available information assessed during this review.

Notes: Due to the current absence of supporting evidence it is not possible to form evidence based conclusions on reported respiratory ill health symptoms linked with surgical smoke exposure. Further studies are required and would benefit from careful design in order to reliably assess the relationship between staff exposure to surgical smoke and any subsequent reported ill health effects.

A similar absence of reliable data prevents the formulation of evidence-based conclusions on the development of respiratory disease due to surgical smoke exposure. Further studies are again required to reliably explore the relationship between staff exposure to surgical smoke and any subsequent short or long-term development of respiratory disease.

Related Paper References: 7, 8 and 16
Healthcare specialities providing source data (where stated): Surgical nurses; laser (dermatological) surgeons; other HCW exposed to surgical smoke on a regular basis.

NB. As reflected in the tables above, there was insufficient evidence to make any evidence-based conclusions relating to PICO questions 2 and 3.

3.5 KNOWLEDGE GAPS

There is insufficient high quality published evidence available to provide comprehensive evidence-based conclusions for Pico questions 1 and its sub-question (Q 1.1). For Pico questions 2 & 3 there were insufficient published studies to support any form of evidence-based conclusion, and only supporting information and evident knowledge gaps are presented here.

One of the challenges of this review, in common to many other occupational studies, involved the lack of data about real worker-activities. For the Pico questions asked in this study, much of the available information was derived from experimental research conducted away from front line surgical activity. This is likely to reflect the difficulties with trying to evaluate new systems and equipment, while ensuring that the very best treatment is still delivered to the patient. While purely experimental testing can provide some level of information on the potential for worker exposure to surgical smoke, it cannot be extrapolated from to accurately assess *actual* worker exposure during surgical procedures.

Only one paper assessed in this review combined effective experimental design with the involvement of a real operating room environment (Ref. 4). Another paper assessed an irrigation-based smoke reduction process for a particular type of bladder surgery, but used an experimental assessment rather than testing in the surgical setting (Ref. 9). Overall, most of the smoke reduction papers retrieved here were found to comprise either non-systematic literature reviews of limited (SIGN) impact (Refs. 2, 3, 5, 6, 12 and 14), or else experimental findings not easily extrapolated to the occupational setting (Refs. 9, 10, 11 and 13).

Therefore, an important output of this review was to identify knowledge gaps for this topic, and despite the evidence base being limited, the following actions would help to improve the quality of evidence:

- Standardisation of study protocols would ensure greater consistency in the design and collection of data related to surgical smoke extraction and reporting of worker ill health. Standardisation would enable meaningful comparison between different studies. For example, the use of larger, multi-centre studies would improve statistical power, and could provide improved evidence that smoke extraction devices can be effectively implemented by different surgical disciplines across different settings.

- More studies should investigate the following aspects:

    - Actual worker exposure during real surgical procedures, with appropriate controls in place and using repeated activities to obtain robust data series. Currently, the majority of publications in this area are based on extrapolated assumptions from experimental testing alone;

- An increased number of cohort studies should include health (symptom) questionnaires and assess the exposed and non exposed populations over time; this is likely to improve the understanding of the risk for short or long term respiratory ill health in workers exposed to surgical smoke.

- Staff attitudes to the introduction of surgical smoke extractors appear to vary considerably within the surgical community, and in part cost is likely to influence the uptake of these devices. A side-by-side assessment of some of the more popular devices in a worker setting should include comprehensive cost analysis alongside any reports of efficacy. This would provide independent, up to date UK-based costs for the available systems, some of which are named within this report but for which this information is currently unavailable.

It is also important to emphasise an important general observation from the current study; that overall the findings reported here could be regarded as reassuring. It is clear that few data are available, and more work may be justified, but an equally fair appraisal could be that the absence of information associated with such a common surgical task (thermal tissue incision), is an indication that this is a reflection of limited ill health associated with surgical smoke exposure. If such exposure directly responsible for common respiratory problems, these would perhaps be more evident clinically. As part of the HSL study, an online question was raised by HSL's Chief Medical Officer amongst members of the Group of Occupational Respiratory Disease Specialists (GORDS). Members of GORDS were asked directly if they had treated healthcare staff suspected of suffering from surgical smoke induced respiratory illness; in their view none had seen cases where they had suspected a firm link. Although this is only anecdotal information, it almost certainly reflects the low reported incidence of such cases within the UK.

3.6 IMPACT OF COST

In view of the paucity of high quality evidence available from this review of surgical smoke control and its potential effects on those exposed, it would be premature to undertake formal assessment of cost impact on those who may choose to implement the use of smoke extraction devices within the surgical setting.

Following the current review it is clear that most equipment cost information is dated in nature, and that any quoted costs do not have direct relevance for the UK market place. In addition, although many cited brands of equipment continue to be sold to this day, it is likely newer models, changing both quality and cost, have since superseded this equipment.

Most importantly, the studies summarised here have failed to independently evaluate the machines side by side in the workplace environment; current publications are essentially technical performance articles on medical devices. This type of information does not serve the practical demands of occupational health research well and does not provide the detailed information required for clinical managers to make informed equipment choices based on working efficacy and up to date cost.

Further research is required in this area to provide pertinent information that would make a cost-impact assessment possible and meaningful for the UK healthcare community.

Although not specifically required for the agreed Pico questions, staff attitude to smoke extraction is important and worthy of mention here. Some relevant, lower quality data are available from reviewed papers and although these do not directly relate to cost, such information does indicate the likelihood that smoke extraction systems might be purchased and used. These limited data suggest that, while most HCWs questioned do agree in principle that

smoke removal is desirable, those who can influence change may not implement it or sanction extractor use within their own workplace (Refs. 1, 7 and 15). The reasons for this vary, though questionnaire surveys cite lack of reliable information on the health effects of smoke exposure, lack of information on extraction systems, lack of management support and general resistance by some surgeons.

4 REFERENCES

4.1 PAPERS CITED WITHIN THE MAIN TEXT BUT NOT SYSTEMATICALLY REVIEWED

Adisesh, A., Robinson, L., Codling, A., Harris-Roberts, J., Lee, C and Porter, K. (2009). Evidence-based review of the current guidance on first aid measures for suspension trauma. HSE Books; report no. RR708. At: http://www.hse.gov.uk/research/rrpdf/rr708.pdf.

Beswick, A., Robinson, E., Evans, G. & Codling, A. (2011). An evaluation of the efficacy of safer sharps devices – a systematic review. HSE report reference OH1706; 2011/648734. Online publication pending at time of writing, at: www.hse.gov.uk.

British Thoracic Society (BTS) and Scottish Intercollegiate Guidelines Network (SIGN) (2009). British Guideline on the Management of Asthma: A national clinical guideline. Available at: http://www.sign.ac.uk/pdf/sign101.pdf.

Harbour, R.T. (2008). SIGN 50: A guideline developer's handbook. Scottish Intercollegiate Guidelines Network, Edinburgh. At: http://www.sign.ac.uk/guidelines/fulltext/50/index.html.

Hemingway, P. and Brereton, N. (2009). What is a systematic review? Published as part of the 'What is' series by Hayward Medical Communications, a division of Hayward Group Ltd. At: http://www.medicine.ox.ac.uk/bandolier/painres/download/whatis/Syst-review.pdf.

Nicholson, P.J. and Llewellyn, D. (2010). Occupational contact dermatitis & urticaria. British Occupational Health Research Foundation (BOHRF). London, 2010. ISBN 978-0-9564979-0-1.

Nicholson, P.J. (2011) How to undertake a systematic review in an occupational setting. Occupational and Environmental Medicine. **64**; 353-358.

Pratt, R.J., Pellowe, C.M., Wilson, J.A., Loveday, H.P. Harper, P.J. Jones, S.R.L.J., McDougall, C. and Wilcox, M.H. (2007) Epic2: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. Journal of Hospital Infection. **65**S; S1–S64.

Tuma S. and Sepkowitz K.A. (2006) Efficacy of safety-engineered device implementation in the prevention of percutaneous injuries: a review of published studies. Clinical Infectious Disease. **42**; 1159-1170.

4.2 PAPERS USED FOR SYSTEMATIC REVIEW

Ball, K. (2001). Update for nurses and anaesthetists. Part 1. The hazards of surgical smoke. AANA Journal. **69;** 125-132. Listed as **Reference 5** in the evidence tables.

Ball, K. (2010). Compliance with surgical smoke evacuation guidelines: implications for practice. AORN Journal. **92**; 142-149. Listed as **Reference 7** in the evidence tables.

Bigony L: (2007). Risks Associated with Exposure to Surgical Smoke Plume: A Review of the Literature. AORN Journal. **8**(6); 1013-1020 (N.B. This paper is also cited within the body text). Listed as **Reference 2** in the evidence tables.

Carbajo-Rodríguez, H., Aguayo-Albasini, J-L., Soria-Aledo, V. and García-Lópeza, C. (2009). Surgical smoke: risks and preventive measures. CIR ESP. **85**(5); 274-279. Listed as **Reference 12** in the evidence tables.

de Boorder, T., Verdaarsdonkm R., and Klaessen, J. (2007). The visualisation of surgical smoke produced by energy delivery devices: significance and effectiveness of evacuation systems. Thermal Treatment of Tissue: Energy Delivery and Assessment IV (edited by Thomas P. Ryan) Proceedings of SPIE: **6440**; 1-7. Listed as **Reference 13** in the evidence tables.

Edwards, B.E. & Reiman, R.E. (2008). Results of a survey on current surgical smoke control practices: AORN Journal. **87**; 739-749. Listed as **Reference 15** in the evidence tables.

Gates, M.A., Feskanich, D., Speizer, F.E., Hankinson, S.E. (2007). Operating room nursing and lung cancer risk in a cohort of female registered. Scand. J. Work Environ. Health. **33**(2): 140-147. Listed as **Reference 16** in the evidence tables.

Gloster, H.M. and Roenigk R.K. (1995). Risk of acquiring human papillomavirus from the plume produced by the carbon dioxide laser in the treatment of warts. J. Am. Acad. Dermatol. **32**; 436-41. Listed as **Reference 8** in the evidence tables.

Liang, J.H., Xu, C.L., Wang, L.H., Hott, P.G., Gao, X.F. & Stin, Y.H. (2008). Irrigation eliminates smoke formation in laser laparoscopic surgery - *Ex vivo* results. Surgical Laparoscopy Endoscopy & Percutaneous Techniques **18**; 391-394. Listed as **Reference 9** in the evidence tables.

Makama, G.J. & Ameh, E.A. (2007). Hazards of surgical diathermy. Nigerian Journal of Medicine. **16;** 295-300. Listed as Reference 3 in the evidence tables. Listed as **Reference 3** in the evidence tables.

Pillinger, S.H., Delbridge, L. & Lewis, D.R. (2003). Randomized clinical trial of suction versus standard clearance of the diathermy plume. British Journal of Surgery **90**; 1068-1071. Listed as Refernce. Listed as **Reference 4** in the evidence tables.

Smith, J.P., Moss, C.E.; Bryant, C.J.; Fleeger, A.K. (1989). Evaluation of a Smoke Evacuator used for Laser Surgery. Lasers in Surgery and Medicine. **9**(3); 276-281. Listed as **Reference 11** in the evidence tables.

Smith J.P., Topmiller, J.L. and Shulman, S. (1990). Factors affecting emission collection by surgical smoke evacuators. Lasers in surgery and medicine **10**; 224-233. Listed as **Reference 10** in evidence tables.

Spearman, J., Tsavellas, G. & Nichols, P. (2007). Current attitudes and practices towards diathermy smoke. Ann. R. Coll. Surg. Engl. **89**; 162-5. Listed as **Reference 1** in the evidence tables.

Undisclosed author. (1999). Surgical smoke evacuation systems Health Devices. **28**(9); 333-362. Listed as **Reference 6** in the evidence tables.

Watson, D.S. (2009). Surgical Smoke: What Do We Know? Online publication (www.afpp.org.uk); The Association of Perioperative Practice (AfPP). Listed as **Reference 14** in the evidence tables.

25	15	Topic=((electrocaut* or electro caut*) SAME (particle* or chemical* or respiratory)) AND Topic=(expos*) *Timespan=All Years*	☐	☐
26	37	Topic=((medical laser) SAME (particle* or chemical* or respiratory)) AND Topic=(expos*) *Timespan=All Years*	☐	☐
27	63	#26 OR #25 OR #24 OR #23 *Timespan=All Years*	☐	☐
28	7,257	#27 OR #22 *Timespan=All Years*	☐	☐
29	27	#28 AND #15 AND #3 *Timespan=All Years*	☐	☐
30	92,203	Topic=(asthma or exacerbat* or diagnos*) AND Topic=(expos*) *Timespan=All Years*	☐	☐
31	8,424	Topic=(cough or challenge test*) AND Topic=(expos*) *Timespan=All Years*	☐	☐
32	2,340	Topic=(airway challenge*) AND Topic=(expos*) *Timespan=All Years*	☐	☐
33	47,170	#32 OR #31 OR #13 *Timespan=All Years*	☐	☐
34	19	#33 AND #28 AND #3 *Timespan=All Years*	☐	☐
35	8	#30 AND #28 AND #3 *Timespan=All Years*	☐	☐
36	24	#35 OR #34 *Timespan=All Years*	☐	☐

5.3 APPENDIX 3 - EVIDENCE TABLES

The review evidence for individual papers is tabulated below, with related scoring of papers. The following scoring guide has been used to grade the documents and comprises the evidence statements and grades provided by the Scottish Intercollegiate Guidelines Network (SIGN).

KEY TO EVIDENCE STATEMENTS - LEVELS OF EVIDENCE

1++ High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias

1+ Well-conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias

1- Meta-analyses, systematic reviews, or RCTs with a high risk of bias

2++ High quality systematic reviews of case control or cohort or studies
High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal

2+ Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal

2- Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal

3 Non-analytic studies, e.g. case reports, case series

4 Expert opinion

N.B. Studies where no comparison group has been used will normally constitute no higher than level 3 evidence.

Non-systematic reviews and consensus reports (including consensus guidelines) constitute level 4 evidence, and do not normally require data extraction of this kind. However, for completeness, most papers falling in to this category have still been reviewed within this study by completion of a data extraction form.

INDEX Evidence Table Index

Paper Reference	Evidence Grade	Paper Reference	Evidence Grade	Paper Reference	Evidence Grade
PICO Question 1		**PICO Question 2**		**PICO Question 3**	
1*	3	15*	2+	16	2+
2*	4				
3*	4				
4	1+				
5*	4				
6*	4				
7*Ψ	3				
8*	Not graded				
9*	2+				
10	2+				
11	2-				
12*	4				
13	3				
14*	4				

Key for table sections below:

A = Number of Healthcare Workers (HCW)
B = Characteristics of HCW
C = Intervention
D = Comparison
E = Length of follow up
F = Outcome measure
G= Effect size
H = Main results

Key: * = this review would not normally be included as evidence due to the nature of the study design, but some useful additional information was provided which was worthy of documenting below

Ψ = Reference used for Pico question 1 and 2

SIGN	**Evidence Table PICO Question One**: Spearman, J., Tsavellas, G. & Nichols, P. (2007) Current attitudes and practices towards diathermy smoke. Ann R Coll Surg Engl., **89**, 162-5.
Reference: 1	**PROVIDING SUPPORTIVE INFORMATION ONLY**
Evidence Level: 3 (score based more on technical quality of work, rather than strong relevance, which was limited and more suited to background information)	
Study Type: Cross-sectional survey with a non-systematic literature review component	
Source of Funding: Not stated.	
A	All those targeted by the questionnaire were either surgical consultants (n= 103), specialist registrars (n = 52) or senior theatre nurses (abbreviated questionnaire sent to this group, n = 14); based within the Wessex region, UK. There was a 70% response rate (67c, 40s, 11n).
B	All questionnaire responders worked in a surgical environment and were therefore regularly exposed to surgical smoke.
C	Not applicable. However, the questionnaire did ask those questioned whether or not they used diathermy smoke extraction devices.
D	NA. But the aim of the study was to gauge the views of surgeons, specialist registrars and senior nurses on surgical smoke. A standard questionnaire was sent to surgeons and trainees and an abbreviated questionnaire to head theatre nurses in each hospital in the Wessex region.
E	Not applicable.
F	Not applicable, as no interventional strategy was assessed.
G	Not applicable as no specified intervention was studied. Of the questionnaire data received back, the overall findings indicated the following: • 51% of consultants, 78% of specialist registrars and 91% of theatre nurses felt that diathermy smoke was harmful; • 22%, 38% and 18% (resp.) of these same groups felt that current surgical smoke procedures were adequate; • 60%, 58% and 64% (resp) of these same groups felt that current surgical smoke precautions were inadequate; and • 13%, 5% and 18% were unsure

SIGN	**Evidence Table PICO Question One**: Spearman, J., Tsavellas, G. & Nichols, P. (2007) Current attitudes and practices towards diathermy smoke. Ann R Coll Surg Engl., **89**, 162-5.
Reference: 1	**PROVIDING SUPPORTIVE INFORMATION ONLY**
H	Although the attitudes and methods adopted by different surgeons and theatre staff were recorded, there was no direct assessment of any specific strategy to reduce staff exposure to smoke; so this did not directly address PICO question 1. In addition, no comparison group was used – this was simply a study of the attitudes and methods of a defined group of healthcare workers. No adverse health effects were recorded by those responding to the survey. '*A Handful of surgeons commented that they would welcome smoke extractors, but were unaware of any efficient systems available*' The authors believe that, '*Greater awareness of the hazard and available technology to extract fumes from the theatre environment might lead to a greater uptake*.'In summary, the findings were as follows: • Of 111 surgeon & registrar responses, 97% used diathermy always or often. • 45% of surgeons cleared smoke compared to 70% registrars. • Reasons to clear smoke were to improve view, safety and smell. • Of those who cleared smoke, 89% of surgeons and 92% of registrars used standard wall-mounted suction, • 14% of surgeons used specific laparoscopic smoke extractors, whilst 8% (and 11% s) vented smoke by opening laparoscopic ports. • One surgeon blew smoke away to improve view. • One registrar used smoke extractors but only for *Pseudomyxoma* cases. • 7% of surgeons and 20 registrars used additional precautions, including not using diathermy excessively and wearing a mask. • There was some uncertainty amongst surgeons about the dangers and hence the need for precautions. • Many felt evidence of actual harm was needed to prove harm. • Some had raised the issue of exposure to smoke with management but found no support. • Some suggested new technologies were reducing smoke generated. • Some said smoke extractors were available but too expensive and awkward to use on everyday cases. • A few said they would welcome smoke extractors but did not know of any efficient system available. • One surgeon who had worked in the US said it was compulsory to clear smoke there.

SIGN	**Evidence Table PICO Question One**: Bigony, L. (2007) Risks associated with exposure to surgical smoke plume: a review of the literature. AORN J., **86:** 1013-1020
Reference: 2	**PROVIDING SUPPORTIVE INFORMATION ONLY**
Evidence Level: 4 (would not normally be included as evidence but some useful additional information was provided which was worthy of documenting below)	
Study Type: Narrative literature review (non systematic)	
Source of Funding: NA	
A	NA
B	NA
C	NA – The toxicity of diathermy fumes was reviewed
D	NA
E	NA
F	Original data were not presented by the authors themselves, but of the papers reviewed the following were reported: • Study 1: AMES mutagenicity test (SalmonellaTA98 strain) • Study 2: Behavioural changes in rats and also histological changes in the airways • Study 3: Culture of melanoma cells to determine their viability following experimental cauterization • Study 4: Survival of bovine papilloma virus (BPV) in diathermy fumes following re-inoculation into calves. • Study 5: Characterisation by ion flow mass spectroscopy of chemical constituents of diathermy fumes
G	NA

SIGN	**Evidence Table PICO Question One**: Bigony, L. (2007) Risks associated with exposure to surgical smoke plume: a review of the literature. AORN J., **86:** 1013-1020
Reference: 2	**PROVIDING SUPPORTIVE INFORMATION ONLY**
H	**Information about studies reviewed:** **Study 1**: Gatti *et al* (1992) reported mutagenicity of surgical breast reduction diathermy fumes, but the mutagenic properties were lost if the fumes extract was stored for longer than two hours after collection. Chemical analysis suggested the fumes contained traces of cyanide, butadiene, acetylene, ammonia, and formaldehyde. **Study 2:** Wenig *et al* (1993) This study examined smoke collected from laser ablation and cauterization of pig skin. Rats exposed to the fumes became sluggish but resumed normal activity when the source of fume was removed. Pathological changes in the lung included vascular changes and congestion of the lung alveoli (gas exchanges surfaces) **Study 3: Fletcher JN *et al* (1999)** Examined Electrosurgical smoke as a potential vehicle for transmission of malignant cells to other body sites during surgery. The study identified live cells in fresh diathermy smoke immediately after cauterization, and showed experimentally that tumour cells captured with electro-surgery fumes would survive in tissue culture up to one week after the procedure. **Study 4:** Garden *et al* (2002) This study examined the transmission of infectious agents in surgical fumes. The study showed the survival of BPV DNA such that of 3 calves inoculated with the DNA isolated from the fumes two developed fibro papillomas identical to the original lesions. **Study 5**: Moot *et al* (2007) Nine air samples of electrosurgical smoke and three control samples were analysed by ion flow MS. They collected the nine identifying consistent presence of acetylene and butadiene. Low concentrations of volatile organic compounds and a level of hydrogen cyanide 30 times less than that found in directly inhaled cigarette smoke.

SIGN	**Evidence Table PICO Question One**: Makama, G.J. & Ameh, E.A. (2007). Hazards of surgical diathermy. Nigerian Journal of Medicine **16:** 295-300.
Reference: 3	**PROVIDING SUPPORTIVE INFORMATION ONLY**
Evidence Level: 4 (would not normally be included as evidence but some useful additional information was provided which was worthy of documenting below)	
Study Type: Narrative literature review (non systematic)	
Source of Funding: Not stated.	
A	NA
B	NA
C	NA. This is a narrative review and the authors reported no direct interventional data.
D	NA
E	NA
F	NA
G	NA
H	This paper did not strictly require data extraction due to the type of study presented (SIGN Level 4 narrative review). So it is limited in terms of its usefulness and does NOT answer the PICO question 1 with any original data generated by the authors' work. **However, some useful information is presented in the paper re: types of smoke extraction systems available:** The paper names diathermy smoke extraction systems that have been evaluated elsewhere included: • Lina Grey Shark • EMT Healthcare • Clearflow The author cites these brands from another (RCT) paper, which has been retrieved and reviewed as part of the current HSL study (see Pillinger et al., 2003 – also evaluated under the PICO 1 category).

SIGN	**Evidence Table PICO Question One**: Pillinger, S.H., Delbridge, L. & Lewis, D.R. (2003). Randomized clinical trial of suction versus standard clearance of the diathermy plume. British Journal of Surgery **90:** 1068-1071.
Reference: 4	
Evidence Level: 1+	
Study Type: Randomised control study	
Source of Funding: Not stated, but appears to be healthcare industry supported	
A	The study was based around treatment of thirty patients during a 2 month period from November 2002 (28 women and 2 men)
B	The healthcare workers were all actively working in a surgical department and were involved in the procedures described for the thirty patients. All thirty patients (age range 23-77yrs) underwent thyroid or parathyroid surgery with standard anterior cervical collar incision and division of strap muscles. There was no significant difference in type and time of surgery between the two groups. Staff exposure levels to diathermy smoke was the primary consideration of the study, but the patients operated on had all given their written consent, and were subject to a standard 8cm cervical collar incisions procedure, during which diathermy was used.
C	The study aimed to determine whether the use of a Lina Grey SharkTM suction device could reduce staff exposure to diathermy plume, as compared with the same surgical procedures where no suction / extraction was used.
D	Only one type of suction device was tested – the Lina Grey Shark^{TM} suction device. The control group had no suction device in use.
E	Not applicable. Data were collected purely within the period that the procedures were undertaken and sampled. All surgery was performed over a two-month period from Nov 2002.
F	Staff exposure to airborne particulates from diathermy plume; with or without the presence of smoke extraction

SIGN	**Evidence Table PICO Question One**: Pillinger, S.H., Delbridge, L. & Lewis, D.R. (2003). Randomized clinical trial of suction versus standard clearance of the diathermy plume. British Journal of Surgery **90:** 1068-1071.
Reference: 4	

G

Value: For control group	**Value: For test group**
= 0.137 mg of airborne particles / m^3 of air	0.012 mg of airborne particles / m^3 of air
Measure:	**Measure:**
Staff exposure to airborne particulates from diathermy plume	Staff exposure to airborne particulates from diathermy plume
P value	**P value**
P<0.001	*P<0.001*
CI	**CI**
95% CI, 0.063 mg/m^3 to 0.211 mg/m^3	95% CI, 0.005 mg/m^3 to 0.019 mg/m^3
Primary outcome?	**Primary outcome?**
Staff were, on average, exposed to ten times more diathermy plume in this control group than in the interventional group	Staffs were, on average, exposed to ten times less diathermy plume in this interventional group than in the control group

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Evidence for exposure and harmful effects of diathermy plumes (surgical smoke)

Evidence based literature review

The methods used to dissect tissue and stem blood flow during surgery have changed as technology has developed. Lasers and electro-surgery have become commonplace, so that medical staff in the operating theatre are (potentially) increasingly exposed to the thermal decomposition products of tissues. Variations in ventilation systems and the presence or absence of local exhaust ventilation are likely to influence the extent to which this occurs. A systematic review was carried out to identify existing evidence about surgical smoke (known as diathermy plume) and the potential harm to health care workers exposed in operating theatres. Limited published data were identified, but indicated that dedicated smoke evacuation/extraction devices are effective at reducing the levels of surgical smoke during various surgical procedures, and that correct (close) positioning of smoke evacuation devices to source emissions is likely to be important to the efficiency of surgical smoke removal. The data were insufficient to allow conclusions to be drawn on reported respiratory ill health symptoms linked with surgical smoke exposure.

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