



## **EVACUATION OF SURGICAL PLUME NEEDS TO BE A PRIORITY IN ALL SURGICAL FACILITIES**

Managers in U.S. operating rooms must comply with mandates such as those imposed by OSHA through the Blood Borne Pathogen Rule<sup>1</sup>. The cost of such regulation is reflected in the purchases of fluid management devices, safety scalpels and syringes, face shields, other related consumables and nursing time needed to implement the requirements.

Certainly, managers must prioritize these mandates...but should they do so while disregarding related rules issued by OSHA<sup>2</sup>, guidelines of JCAHO<sup>3</sup>, a NIOSH safety alert<sup>4</sup> and the best practices recommendations of AORN<sup>5</sup>? All of these entities, as well as others<sup>6 7 8 9 10</sup>, advocate for evacuation of surgical plume from the operating room because of the potentially infectious elements<sup>11</sup> and mutagenic/carcinogenic chemicals identified as present in the plume<sup>12</sup>. It needs to be remembered that smoke is composed of vapor (liquid) and particulates released when cells are ruptured by the heated instruments used for incision and coagulation of human tissue. That body fluid (intra- and intercellular water as well as blood) contains the same potential pathogens found in blood<sup>13 14</sup> and other fluids whose management has been carefully regulated by OSHA's Blood Borne Pathogen Rule. What this mandate implies is that healthcare workers need to be protected from pathogens found in blood, ascites and saline irrigation but not protected from fluids from the same body that are also present in surgical smoke which also contains carcinogenic chemicals **not** found in the other bodily fluids.

While the threat of splash-back of bodily fluids onto the mucus membranes of nurses is minimal with current precautions, the threat to the worker from inhaled surgical plume is definite and continuous because

surgical masks offer little if any protection to the worker from inhalation of contaminated smoke<sup>15</sup>.

It is not surprising, therefore, that reports of HPV (human papilloma virus) infection in the respiratory tract of doctors involved in the fulguration of venereal warts have been reported<sup>16 17</sup>. Nor is it surprising to note that the incidence of respiratory illnesses in perioperative nurses is twice that found in the general U.S. population<sup>18</sup>.

Recent research has indicated that smoke plume is primarily composed of nanoparticles with a median diameter of 33.5nm.<sup>19</sup> They cross the aveolar membrane by a process of translocation and proceed to distant sites such as the liver, lymph nodes and the heart.<sup>20</sup> Such nanoparticles are associated with diseases such as Alzheimer's, systemic lupus erythematosus, cardiac arrhythmias, organ cancers and coronary artery disease.<sup>21</sup>

Studies indicate that poor air quality results in increased absenteeism and decreased productivity. Alternatively, efforts to improve air quality can decrease absenteeism by as much as 60%<sup>22</sup> and increased productivity by 17%<sup>23</sup>. In a 2010 report, absenteeism in Canadian nurses which was due to illness, often respiratory (25%), was as high as 9% among public sector nurses. This resulted in an overtime rate of 17.3% at a total annual cost of \$660,300,000<sup>24</sup>.

Perhaps a fractional decrease will be found in the operating room when surgical plume, bone dust, chemical vapors from glues and other air contaminants are removed through effective smoke capture resulting in enormous savings in manpower costs for the surgical facility. Devices capable of achieving such capture in O.R.'s have not yet been available so that no comparable studies regarding absenteeism have yet been reported although such a device with such a capability has been described<sup>25</sup>.

Certainly, the entire principle of laminar air flow dictates that infection rates are decreased by performing surgery in a clean air environment<sup>26</sup>.

Consider the “sick building syndrome”<sup>27</sup>, the deaths caused by primary<sup>28</sup> and secondary<sup>29</sup> cigarette smoke inhalation and studies linking inhalation of asbestos to mesothelioma<sup>30</sup> decades after the exposure and COPD caused by, “...exposure to air pollutants in the ambient air and workplace environment...”<sup>31</sup> for one to appreciate both the benefits and the liabilities of clean air or the lack thereof.

The risk of litigation to hospitals by their employees based upon a disregard by the administration of the tenets of the Clean Air Act and the General Duty Clause of the OSHA Act must be considered by the Compliance Officer of the healthcare facility who’s concern it is to limit such liability. These federal regulations require that the employer (hospital) provide a safe working environment for their employees which includes non-contaminated air to breathe. Clearly, a smoke-filled operating room which harbors irritants and potential pathogens does not qualify as a “safe working environment.” Litigation related to the absence of clean air has already been ruled on by the courts in the plaintiff’s favor<sup>32 33</sup>. Minimizing such exposure is critical and possible to achieve if such a solution is currently available and hospitals fail to act on such information.

While one can readily see the need to provide unadulterated air for the O.R. team to breathe during their working hours, how can it be done in a practical way? Past and current attempts have involved trying to have a team member corral smoke, which is hot and wants to rise quickly and disperse widely, toward a 3/8” I.D. or a 7/8” I.D. tube which is connected to a suction source. Unfortunately, these devices can be tiring to hold, interfere with the surgeon’s vision, require team involvement and most significantly, are often less than effective. Smoke is still inhaled and the smell is unpleasant for the team. They, in turn, have largely given up the effort, especially when the suction source is noisy or simply ineffective. Despite these impediments to use, some hospitals, recognizing the beneficial effects of clean air for their staff, have invested in central vacuum or individual units which unfortunately often go unused except if hospital policy mandates their use by the O.R. staff.

Why the indifference of staff to the health hazards of smoke in the O.R. but not when it invades their non-professional activities? Perhaps when they say, "Smoke is not a problem in my O.R.," what they mean is..."There are no effective smoke capture devices so why should I bother?" This is akin to the coal miner that tolerates inhalation of coal dust because there are no alternatives to his making a living. After a number of years of exposure, he goes on to develop Black Lung Disease<sup>34</sup>. Allowing smoke-filled O.R.'s is that much more inane when one recognizes that smoking is not allowed either in or outside of the hospital.

Perhaps what is needed to get the O.R. nurse to use, if not become a champion of smoke evacuation, is a device that works; that is, a product that consistently provides clean air for the operating room. By definition, such a device must be capable of at least 95% smoke capture for prolonged periods of time without interfering with the surgeon's protocols. Further, it should be simple for the nurse or surgical tech to use or apply to the patient, frees the team from involvement during the case and doesn't obstruct the surgeon's vision. To date, the methods available, notably the "wand" and the "ESU pencil" both have drawbacks. The wand requires a team member to chase the plume and commonly obstructs the surgeon's vision although it collects smoke well if kept within 1" of the smoke source<sup>35</sup>. The ESU pencil, while convenient, causes hand fatigue, can interfere with vision and over time, has limited smoke capture ability<sup>36</sup>.

The better solution may be a new device which has been introduced at tradeshow this year<sup>37</sup> and which has none of the problems cited above. Independent testing at a leading air quality laboratory has confirmed that the product captures 99.5% of plume versus 50% by the ESU pencil<sup>38</sup>. The product called, "Squair," is applied to the skin circumferentially around the wound and is connected via tubing to a suction source capable of generating a minimum of 25-35 cubic feet/minute (cfm) of air flow.

It is barely visible beneath the surgical drape. Because of the flexibility of its cell foam core through which the smoke exits the wound, retractors can

be used. If necessary, the device can be incised to lengthen the incision. It is disposed of as contaminated waste. It is made of fire retardant materials and its cost is modest. It's called, "Squair," which denotes its shape and its promise to bring clean air back to the operating room. It is manufactured by Nascent Surgical, LLC of Eden Prairie, Minnesota and its expanded use is to be anticipated now that the device is readily available.

It promises to improve **compliance** of federal rules and guidelines which require a safe working space for employees. The improved air quality should, as shown in other environments, result in a **lower rate of absenteeism** with a subsequent **reduction in manpower costs**. Finally, the Squair should limit the potential for worker's compensation claims for respiratory illnesses related to exposure to the contaminated air in the O.R. For example, the worker presents to the doctor for a respiratory illness. The doctor asks if there was any exposure to irritants such as smoke, chemicals, etc. The worker say, 'Yes. I work in the operating room.' **That claim could potentially cost three times the amount of the medical charges in premiums over three years because of the impact on the "experience modification factor."**

## REFERENCES

---

<sup>1</sup> OSH Act of 1970 Standard 1910.1030. Bloodborne Pathogens, paragraph(d)(3)(i). Revision date: 14 April 1999. Accessed on [http://www.osha.gov/pls/oshaweb/owadisp.sho\\_document?p\\_table=s](http://www.osha.gov/pls/oshaweb/owadisp.sho_document?p_table=s).

<sup>2</sup> OSH Act of 1970 Standard 1910.134. Respiratory Protection, paragraph (a)(1) and 1910.1030(b), Regulated Waste and Universal Precautions. Ibid.

<sup>3</sup> The Joint Commission Accreditation Program: Hospital E

---

nvironment of Care. Standard EC.02.02.01, 2008.

<sup>4</sup> U.S. Department of Health and Human Services (DHHS). National Institute for Occupational Safety and Health (NIOSH). Publication No. 96-128 (Hazard Control 11), 1998, March 2.

<sup>5</sup> AORN Position Paper on Surgical Smoke and Bio-Aerosols. Anaheim, Ca. April, 2008.

<sup>6</sup> “CSA Standard Helps Clear Toxic Smoke From Operating Rooms” in CSA Plume Scavenging Standard Z 305.13-09, 2009.

<sup>7</sup> “Laser Plumes –Health Care Facilities” in Canadian Center for Occupational Health and Safety, 1997-2011, revised 2009-06-04.

<sup>8</sup> “Safety of Laser Products- Part 8: Guidelines for the Safe Use of Laser Beams on Humans” in Technical Report IEC TR60825-80, 2<sup>nd</sup> ed., 2006-2012.

<sup>9</sup> IFPN Guidelines for Smoke Plume. Available from:  
[www.ifpn.org.uk/webpage.aspx?pagetype=1and pageid=66](http://www.ifpn.org.uk/webpage.aspx?pagetype=1and pageid=66).

<sup>10</sup> “Surgical Smoke: Risks and Prevention Measures” in ISSN 1015-8022 No. Series 2058, 2011.

<sup>11</sup> Barrett, W.L. and Garber, S.M. Surgical Smoke- A Review of the Literature. Business Briefing: Global Surgery, 1-7, 2004.

<sup>12</sup> Ulmer, B. C. The Hazards of Surgical Smoke. AORN J. 2008: 87(4): 721-734.

<sup>13</sup> Ferenczy, A. Bergeron, C. and Richart, R. M. Human Papilloma Virus DNA in CO<sub>2</sub> Laser-Generated Plume of Smoke and its Consequences to the Surgeon. Ob & Gyn. 2004: 75(1): 114-118.

---

<sup>14</sup> Heinsohn, P. Jewett, D. L. Exposure to Blood-Containing Aerosols in the Operating Room: a Preliminary Study. *Ann. Ind. Hyg. Assoc. J* 1993: 54(8): 446-453.

<sup>15</sup> Dykes, C. N. Is it Safe to Allow Smoke in Our Operating Room? *Today's Surg. Nurse*. 1999: 21(2): 15-20, 38-39.

<sup>16</sup> Ferenczy, A. Bergeron, C. and Richart, R. M. Human Papilloma Virus DNA in CO<sub>2</sub> Laser-Generated Plume of Smoke and its Consequences to the Surgeon. *Ob & Gyn*. 2004: 75(1): 114-118.

<sup>17</sup> Gardner, J. M., O'Banion, K., Backus, A.D., Olson, C. Viral Disease Transmitted by Laser-Generated Plume (Aerosol). *Arch. Dermatol*. 2002: 138(10): 1303-1307.

<sup>18</sup> Ball, K. Surgical Smoke Evacuation Guidelines; Compliance Among Perioperative Nurses. *AORN J* 2010:92(2): 1-23.

<sup>19</sup> Olson, B. and Schultz, J. A New Device for Open Surgery Smoke Capture. Unpublished.

<sup>20</sup> Gatti, A.M., Montanari, S., Monari, E., Gamberelli, A. Capitani, F., Pansini, B. Detection of micro- and nano-sized biocompatible particles in the blood. *J. Mater. Sci. Mater. Med*. 2004. 15:469-472.

<sup>21</sup> Donaldson, R., Stone, V., Tran, C., Kreyling, W., Borin, PJA. *Nanotoxicology*. 2004. *Occup. Environ. Med*. 61:727-728.

<sup>22</sup> Gilliland, F.D., Behane, K., Rappaport, F. B., et. al. The Effects of Ambient Air Pollution on School Absenteeism Due to Respiratory Illnesses. *Epidemiology* 2001: 12(1): 43-54.

<sup>23</sup> "Indoor Air Quality and Student Performance " in EPA Series 402-K-03- 006, revised August, 2003.

---

<sup>24</sup> “Trends in Own Illness or Disability-Related Absenteeism and Overtime Among Publicly-Employed Registered Nurses” in Quick Facts prepared for the Canadian Federation of Nurses Unions. Informetrica Limited, June, 2011.

<sup>25</sup> Schultz, L. and Droque, J. Unique Devices for Effectively Removing Surgical Plume. *Surg. Serv. Manage.* 2000; 6(4): 8-12.

<sup>26</sup> Barclay, L. Ultraclean Air in the Operating Room May Decrease Infection Rates. *Spine* 2004; 29(3): 2330-2334.

<sup>27</sup> EPA Indoor Air Facts No. 4 (revised). Sick Building Syndrome. Accessed at <http://www.epa.gov/ag/pubs/sbs.html/> on 21 Nov. 2011.

<sup>28</sup> Shanks, T. G. and Burns, D. M. Disease Consequences of Cigar Smoking Smoking and Tobacco Control Monograph No. 9.

<sup>29</sup> Glantz, S. A. and Parmley, W. W. Even a Little Second-Hand Smoke is Dangerous (Editorial). *JAMA* 2001;286(4): 462-463.

<sup>30</sup> Dunnigan, J. Linking Chrysotile Asbestos With Mesothelioma. *Amer. Indust. Med.* 1988; 14(1): 205-209.

<sup>31</sup> “Chronic Obstructive Pulmonary Disease Prevalence and Mortality” in National Center for Health Statistics (NCHS) 2001-2005.

<sup>32</sup> “Flight Attendant Can Sue Over Smoke. Duncan versus Northwest Airlines,” *Newsday.com* 12/11/2000.

<sup>33</sup> Gretchen, P. Maglisch, Commissioner, Department of Labor and Industry, State of Minnesota versus Miller-Dwan Medical Center, Duluth, April, 1999.

---

<sup>34</sup> James, S. Black Lung Disease Seen Rising in U. S. Miners. Business and Financial News, May 20, 2011.

<sup>35</sup> Reference 9, pg. 2/2.

<sup>36</sup> Personal communication.

<sup>37</sup> Squair, Presented by Nascent Surgical, LLC at AORN, ASBS and NASS, 2011.

<sup>38</sup> Olson, B. Memo from Particle Calibration Laboratory Manager, Department of Mechanical Engineering, University of Minnesota dated December 1, 2011.