Operating Room Surgical Smoke: Dangers, Protective Measures, and the Way Forward

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POLICY BRIEF

JOHNS HOPKINS SCHOOL of NURSING

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Surgical smoke has been a **known workplace hazard** since the Occupational Safety and Health Administration (OSHA) issued the first such alert in 1988.

Over **500,000 healthcare workers** are exposed to electrosurgical smoke every year, and this known hazard impacts surgeons, nurses, surgical assistants, anesthesia providers, equipment representatives, consultants, and technicians.[1]

Dangers of Surgical Smoke

Potential health impacts related to surgical smoke exposure: chronic oxidative stress and systemic inflammation, pneumonia, bronchiolitis, asthma, Chronic Obstructive Pulmonary Disease (**COPD**), Coronary Artery Disease (**CAD**), Chronic Heart Failure (**CHF**), a variety of neurologic and psychiatric conditions, and decreased life expectancy.[1,2]

Figure 1
Surgical Smoke Hazards

27-30
cigarettes mutagenic equivalent in a days worth of surgical smoke

Over 40
hazardous chemicals can be found in surgical smoke

100nm-1µm
sized particles are unlikely to be stopped by even the best surgical mask

Note. Surgical smoke hazards are well documented and typical surgical mask do not adequately protect those who are exposed [2]

Operating rooms are known leaders in contributing to positive cash-flow and revenue generation across hospitals and healthcare systems.[3] Surgical smoke evacuation is in the industry's financial and ethical best interest and protects both staff and patients. As the surgical patient is most often sedated or unconscious during a procedure, the onus is on the healthcare team to be **advocates for all**.

Surgical Smoke is a Persistent Risk

While there are costs associated with equipment installation, staff education, maintenance, disposables, and program monitoring, the potential for harm from **surgical smoke exposure remains a hazard for too many** in the operating room.

[1]Alp, E., Bijl, D., Bleichrodt, R. P., Hansson, B., & Voss, A. (2006). Surgical smoke and infection control. *The Journal of Hospital Infection*, *62*(1), 1–5. https://doi.org/10.1016/j.jhin.2005.01.014
[2]Limchantra, I. V., Fong, Y., & Melstrom, K. A. (2019). Surgical smoke exposure in operating room personnel: A review. *Journal of the American Medical Association Surgery*, *154*(10), 960. https://doi.org/10.1001/jamasurg.2019.2515

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Dangers of Surgical Smoke

Hazardous Contents:

Surgical smoke is **95% steam** and **5% particulate matter** (PM).[2]

- The majority of PM from surgical sources falls between 100nm and 1µm; PM this size is known to cause cardiovascular and respiratory problems.[2]
- **Surgical masks are *largely ineffective*** against small PM.[2]
- Even advanced N95 respirators only filter PM larger than 300nm or 0.3µm.[2]

Surgical smoke is produced during active use of electrosurgical or laser devices and contains:

Toxic gases, Vapors, Particulates, **Cellular material, Viruses,** and **Bacteria.**[1]

Table 1 lists some of the hazardous compounds in surgical smoke.

Experimental studies show concentrations of noxious surgical smoke components **exceed recommended exposure limits** for multiple compounds.[2]

1 gram of cauterized tissue can produce mutagenic compounds equivalent to those found in 3-6 cigarettes and a full surgery equates to the second-hand smoke generated from approximately 1.5 packs of cigarettes.[2]

Surgical smoke has also been shown to have **cytotoxic, genotoxic, and mutagenic effects**.[1]

Table 1
Compounds in Surgical Smoke

Chemical Compounds
Acrolein
Acrylonitrile
Benzene
Carbon monoxide
Formaldehyde
Hydrogen cyanide
Hydrocarbons
Phenols
Nitriles
Biological Compounds
Cytotoxins
Cancer Cells
Viruses
Cellular Debris
Other Blood Borne Pathogens

Note. This is a sample of compounds found in surgical smoke plumes from electrosurgery, laser, and ultrasonic scalpel procedures. [1]

Protective Measures

- **Current measures:** 1) smoke dispersal in the ambient environment, 2) suction evacuation, or 3) physical barrier filtration such as in-line suction filters and face masks.[2]
- **Future measures:** Electric filters that produce ozone and necessitate an additional carbon filter.[2]
- Many methods of limiting surgical smoke exposure continue to be perceived as insufficient.[2]

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[3]Surgical Directions. (2021). *How Hospitals Can Increase OR Profitability.* https://www.surgicaldirections.com/wp-content/uploads/2021/07/11538_SD_IncreaseProfitability_v3.pdf
[4]Association of Perioperative Registered Nurses. (2021). *AORN News.* https://www.aorn.org/about-aorn/aorn-newsroom/health-policy-news/smoke-evacuation-news

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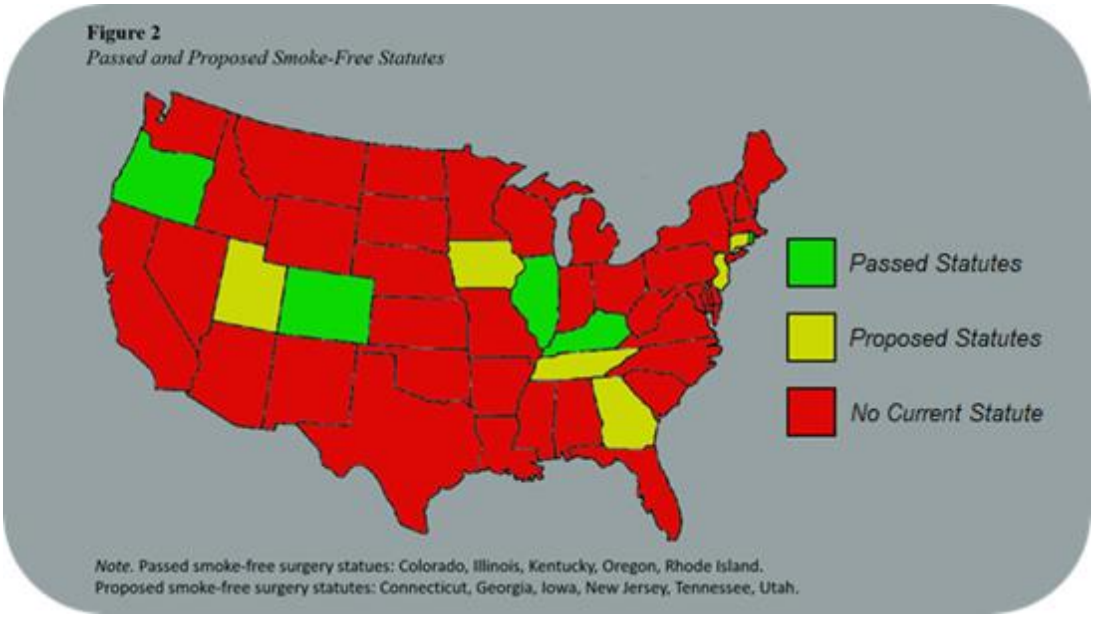
The Way Forward

Five states have adopted smoke-free surgery statutes and six states have proposed or pending legislation (Figure 2).[4]

Newly established statutes and requirements typically take effect 12-18 months after enactment to allow organizations time to acquire relevant equipment, modify local policy, and re-train staff.

Recognizing the significant effort that has occurred over the last three years, there is an urgent need to accelerate the shift to a national smoke-free surgery standard.

Figure 2
Passed and Proposed Smoke-Free Statutes



Note. Passed smoke-free surgery statues: Colorado, Illinois, Kentucky, Oregon, Rhode Island.
Proposed smoke-free surgery statutes: Connecticut, Georgia, Iowa, New Jersey, Tennessee, Utah.

Take Action and Get Involved

The **Association of periOperative Registered Nurses** (AORN), representing more than 42,000 operating room nurses, advocates for Smoke-Free Surgery at the state and federal level as well as through their Go Clear Award Program.[4]

AORN is actively collecting signatures in support of OSHA action to develop a rule mandating surgical smoke evacuation. Such a rule would create a unified national standard establishing a smoke-free surgical environment. The petition will be delivered in November 2021 during Perioperative Nurses Week.[4]

- **Support the OSHA campaign and SIGN THE PETITION HERE**
- **Support this effort locally via the AORN Chapter Directory**

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