



Up in Smoke: Let's Clear the Air and Call for Nationwide Smoke Evacuation



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PURPOSE

Significance: Let's clear the air- it's estimated that over 500K healthcare workers are exposed to surgical smoke plume each year in the United States (U.S.), demonstrating a large occupational health hazard and patient safety concern.¹ Smoke plume is a harmful by-product from heat generating devices, like electrocautery or laser, used during surgical procedures. Prevention of surgical smoke is unavoidable, but the ability to minimize the exposure is widely available.

Background: Surgical smoke plume is hazardous with no safe level of exposure; by-products in surgical smoke have been found to be carcinogenic, mutagenic, and teratogenic.² Currently, 20 states have enacted mandatory smoke evacuation and 18 military treatment centers (MTFs) have applied or obtained the Association of periOperative Registered Nurses (AORN's) 'Go Clear Award' for surgical smoke evacuation efforts.³

Clinical Question: By utilizing the evidence on surgical smoke, how can nurses support local, state, and federal smoke evacuation policy? Further, how can military nurses spark change in smoke evacuation at the military treatment facility (MTF) or Defense Health Agency (DHA) level?

U.S. SMOKE EVACUATION MAP

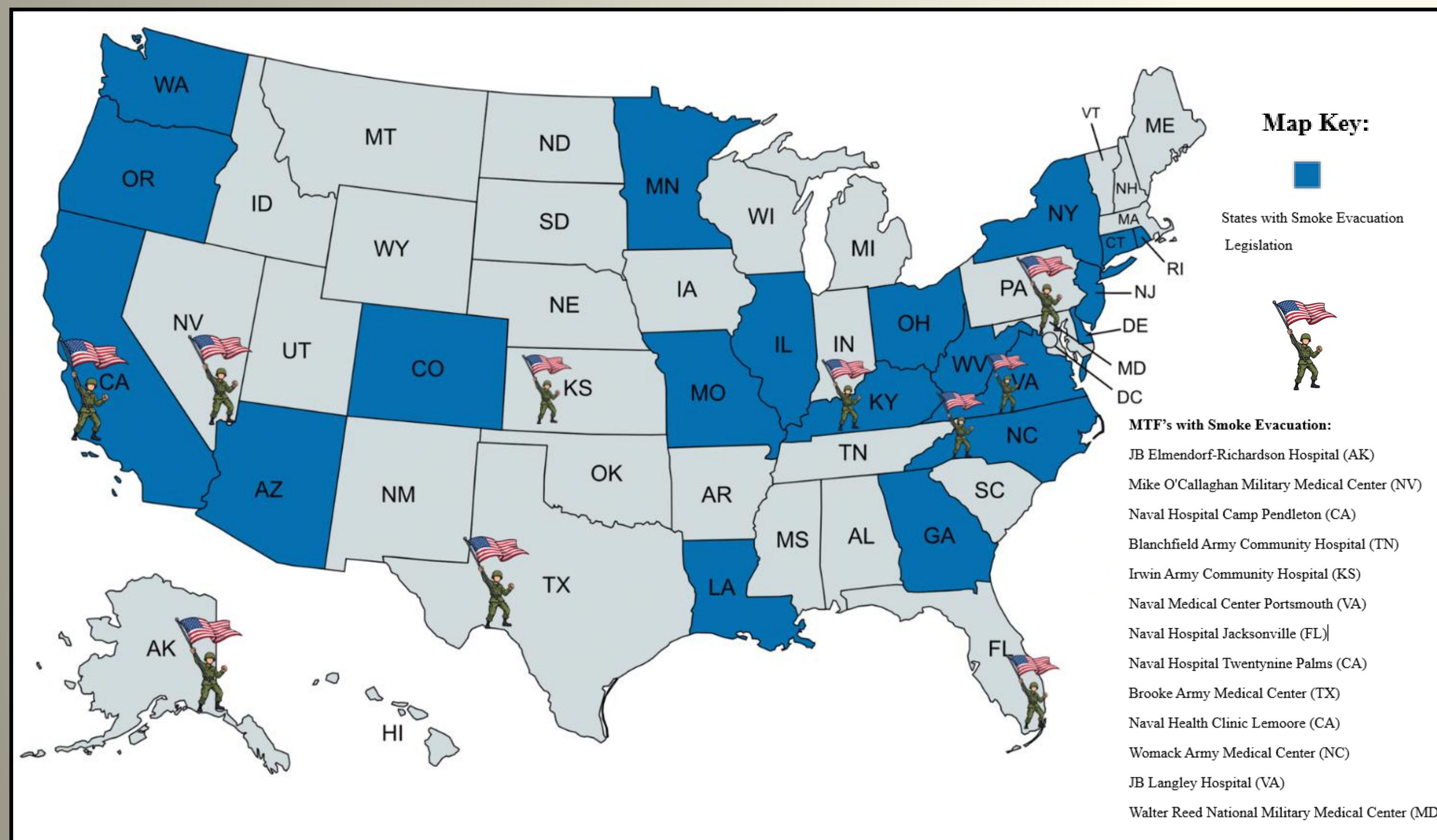


Figure 1. Illustration of states with smoke evacuation and MTF's that obtained AORN's 'Go Clear Award'.³ Illustration generated by Stefanie Erickson & Alexis Carlson via Canva AI on 11 Nov 2025.

EVIDENCE GUIDING CHANGE

•Where there's surgical smoke, there's over 150+ harmful pollutants patients and staff are being exposed to.⁴ The main breakdown of surgical smoke by-products include 95% water vapor, and 5% particulate matter (PM) from chemicals, cellular fragments, pathogens, and inactive particles. However, the 5% is not insignificant to health.

•Patients undergoing minimally invasive surgery (MIS) without smoke evacuation have an increased risk of harm due to smoke obstructing the surgeon's view of the surgical site, absorption of toxic by-products, and increased levels of carboxyhemoglobin that mask hypoxia.^{2,4-5} Healthcare workers have demonstrated numerous negative side effects associated with surgical smoke that carries risk beyond the OR suite. Common symptoms include headaches, cough, exacerbation of asthma and wheezing, rhinitis, eye irritation, fatigue, cardiorespiratory disease, and cancer over time.^{4,6-7}

EBP PROTOCOL

EBP Protocol: A combination method to contain and evacuate surgical smoke is the most effective which includes built in ventilation systems, room suction, portable smoke evacuation systems, and personal protective equipment (PPE) such as high filtration or N-95 masks for high-risk cases.^{1,8-12}

- Portable smoke evacuation systems are the most effective form of surgical smoke evacuation as they decrease smoke exposure by 99.9% if used appropriately. Built in surgical smoke cautery devices, MIS smoke evacuation capabilities, or stand-alone tubing are some of the options available depending on the procedure type.
- Surgical smoke evacuation systems need to be on at all times when smoke is generated, the inlet nozzle needs to be within 2" of the surgical site, ULPA filtration utilized, and all filters and tubing are to be treated as hazardous waste to safeguard staff.

Professional Organization Viewpoints:

- Under Surgical Smoke Safety, AORN has 6 recommendations in the Perioperative Guidelines.⁹ The recommendations include promoting a smoke-free environment, utilizing surgical smoke evacuation and filtration, respiratory precautions for secondary protection, education/policies/procedures, and quality assurance.
- The National Fire Protection Agency - NFPA 99: Healthcare Facilities Code.⁸
- The National Occupational Institute for Safety and Health (NOISH) - Hazard Controls 11, Control of Smoke from laser/energy Publication 96-128.¹¹
- The American National Standards Institute (ANSI) - ANSI Z136.3-2024—Safe Use of Lasers in Health Care.¹⁰
- The Joint Commission's publication - Quick Safety: Alleviating the dangers of surgical smoke, Issue 5619.¹²
- Occupational Safety and Health Administration. Laser/electrosurgery plume: Overview & eTool hospitals: Surgical suite smoke plume.¹

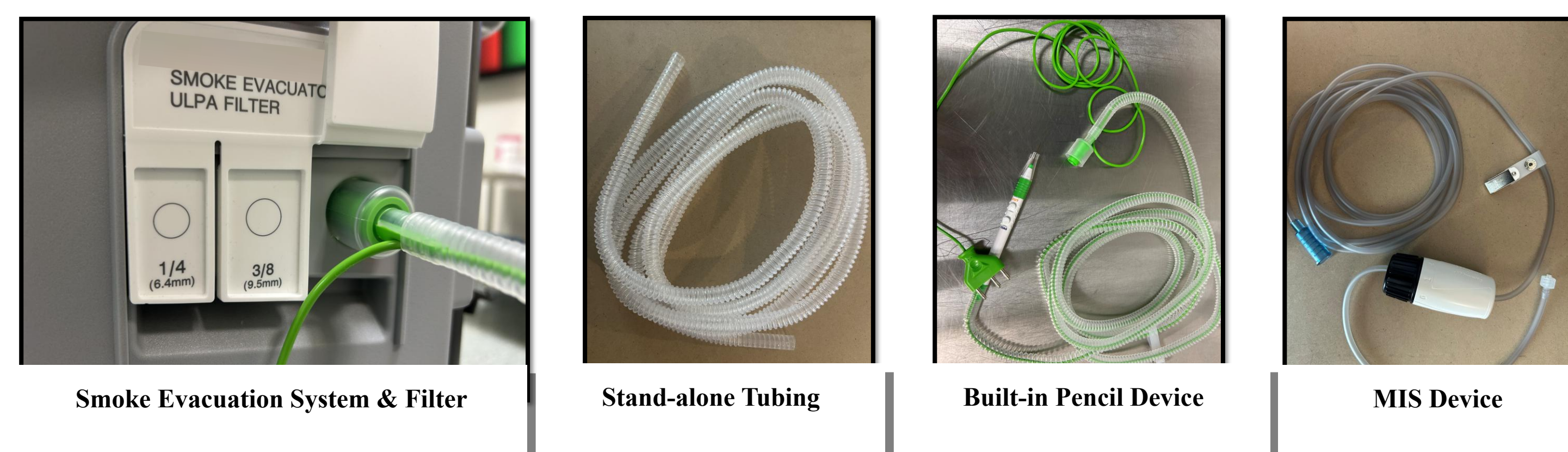


Figure 2. Display of surgical smoke evacuation systems, devices, and components. Photographs taken by author 21 Jul 2025.

IMPLEMENTATION

- Under Captain Carlson's direction, a renewed interest in surgical smoke evacuation to improve patient safety and occupational health occurred for Mike O'Callaghan Military Medical Center- impacting 4.1K surgeries annually.
 - She revamped the existing policy mirroring current literature and professional organizational guidelines- highlighting AORN's 6 recommendations on surgical smoke evacuation.⁹
 - The policy was presented to the Evidence-based Practice and Process Improvement Council and the Surgical Council to gain support from key facility stakeholders.
 - By leveraging support from Patient Safety and Risk Management officials, mass notification of policy changes and educational resources were provided to staff and uploaded across the DHA.
 - Department-wide education occurred to ensure 490 staff were properly trained regarding the risks of surgical smoke exposure, proper use of surgical smoke evacuation products, documentation, and quality assurance measures.
 - A surgical smoke competency verification process was cultivated to capture initial training, sustained educational activities, and annual educational requirements to decrease knowledge deficits and support compliance levels.
- Carlson is advocating for surgical smoke evacuation to become DHA policy across all 700+ MTFs.¹³ She provided testimony to the DHA's Chief of Safety and Occupational Health for enacting surgical smoke evacuation to improve patient safety for 9.5M beneficiaries and occupational health measures for 130K staff.
- The DHA director pitched Carlson's suggestion at the Patient Safety and Occupational Safety RRC Work Package Group (WP3.8). The group accepted her proposal and are working to gain a better understanding of how to approach the issue and enact measures on a larger scale.

DISCUSSION

- Beyond the science and health impacts of surgical smoke, there are also potential legal and ethical concerns.^{2,14} The lack of a nation-wide mandatory policy has led to inconsistent smoke evacuation. Based off one's location, equal safety measures for smoke plume are not provided spurring concerns of ethics, equality, and equity. Enacting surgical smoke evacuation policy in every state and MTF, would help to up-hold patient and staff rights to nonmaleficence, beneficence, autonomy, and justice. In recent years, nurses have spearheaded progress to improve occupational health and patient safety through advocacy for surgical smoke evacuation bills and MTFs obtaining AORN's 'Go Clear Award'.³
- **OR Nursing Implications:** The understanding of harmful effects of smoke plume exposure has been low among healthcare providers.⁴ It has been found that nurses are a primary advocate for legislation of surgical smoke evacuation and can promote education regarding the risks to patients and staff.¹⁵ Nurses have a duty to advocate and be involved with policy creation according to the American Nursing Association's (ANA) code of ethics.¹⁵ Further, nurses belong to the largest, most trusted profession in the U.S. with the potential to have a substantial impact on surgical smoke policy and procedure beyond the OR suite for generations.

Nursing Advocacy for Surgical Smoke Evacuation

Local Level	State Level	National Level	International Level
Raise awareness, educate, and connect with grassroots organizations.	Leverage professional organizations, state connections, and support state legislation.	Join national professional organizations, and support national movements.	Join international nursing organizations, movements, and connect on a global scale with industry leaders.
Join facility committees, boards, and groups.	Be aware of state nurse practice acts, board of nursing policy, and resources.	Join national nursing professional organizations, like AORN or ANA.	Join international organizations, like the International Federation of Perioperative Nurses (IFPN).
Join local professional organizations, like AORN local chapters.	Join state nursing associations, smoke-free movements, and learn individual state policy.	Join national legislative forums, like AORN's, to become involved in surgical smoke movement.	Join international evacuation movements, like the Surgical Smoke Coalition.
Join local community grassroots organizations and movements.	Write to local state legislators to advocate for surgical smoke evacuation legislation and bill creation.	Engage with healthcare national organizations and other fields to garner support outside healthcare arena.	Attend global conferences to forge international connections and compare strategies.
Help cultivate department or facility-wide policy and procedures.	Partner with professional organizations to provide testimony to legislators.	Showcase research, EBP, or PI projects via panel webinars, posters, or national conferences.	Showcase research, EBP, or PI projects outside home nation or at global conferences.

Figure 3. Nursing advocacy at different levels for civilian and military perioperative nurses in the U.S. 6-7, 14-15

REFERENCES

- Occupational Safety and Health Administration. eTool hospitals: Surgical suite smoke plume. The U.S. Department of Labor. Retrieved from <https://www.osha.gov/e-tools/hospitals/surgical-suite/smoke-plume>
- Rodger, D. The case for compulsory surgical smoke evacuation systems in the operating theatre. Clinical Ethics. 2021 Nov 25;17(2):14775092110635. <https://doi.org/10.1177/1477509211063589>
- Association of periOperative Registered Nurses (AORN). Center of excellence in surgical safety: Go clear smoke evacuation award recipients. Retrieved on 28 Nov 2025 from <https://www.aorn.org/education/education-for-facilities/surgical-safety-center-of-excellence/go-clear-award>
- Kahramanov, N. Surgical smoke: A matter of hygiene, toxicology, and occupational health. PubMed. 2024 Mar 05;19. <https://doi.org/10.3205/d44000469>
- Benaim EH, & Jaspers I. Surgical smoke and its components, effects, and mitigation: A contemporary review. Toxicological Sciences. 2024 Jan 18;198(2). <https://doi.org/10.1093/toxsci/kfa005>
- Surgical Smoke Coalition. A policy overview report: Surgical smoke an underestimated health hazard [pdf]. https://www.afs-medical.com/sites/default/files/product_downloads/surgical-smoke-coalition-report-1.pdf
- Surgical Smoke Coalition. The European Surgical Smoke Coalition publishes the results of its first survey on surgical smoke among healthcare professionals in five European countries. (2023). <https://surgical-smoke-coalition.com/2022/11/02/the-european-surgical-smoke-coalition-publishes-the-results-of-its-first-survey-on-surgical-smoke-among-healthcare-professionals-in-five-european-countries-and-the-uk/>
- National Fire Protection Association. NFPA 99 - Healthcare Facilities Code® (2024 ed.). 2024. Retrieved from <https://docsinfofiles.nfpa.org/files/AboutTheCodes/99/TLA99-12-2.pdf> - nfpa 99
- Association of periOperative Registered Nurses (AORN). Guideline for surgical smoke safety. 2023 Jan 01.
- American National Standards Institute (ANSI). ANSI Z136.3-2024—Safe use of lasers in health care. 2024. Retrieved 18 March 2025. https://www.lia.org/resources/laser-safety-standards/ansi-z136-3-safe-use-lasers-health-care/#!/id=Atm08OpD_5tJbwsSYBkZdFRo8TfngR9McAicxGdKJkKQLN
- National Institute for Occupational Safety and Health (NIOSH). Control of smoke from laser/electrical procedures. 1996 Sep. DHHS (NIOSH) publication no. 96-128. <https://www.cdc.gov/niosh/docs/hazardcontrol/pdfs/hc11.pdf>
- The Joint Commission. Quick safety: Alleviating the dangers of surgical smoke. 2020 Dec; (56). <https://www.jointcommission.org/media/jc/newsletters/quick-safety-56-surgical-smoke-fmal3.pdf>
- Defense Health Agency. About the agency. Retrieved on 28 Nov 2025 from <https://dha.mil/About-DHA>
- Vortman RK, & Smalley PJ. Our journey to pass a surgical plume evacuation law. American Journal of Nursing. 2024 Feb 01;124(2):32-38. [10.1097/01.NAJ.000106372.54000.69](https://doi.org/10.1097/01.NAJ.000106372.54000.69)
- American Nurses Association. Code of ethics for nurses. 2025. <https://codeofethics.ana.org/home>