# Surgical Smoke Management: Adoption of AORN Guideline for Surgical Smoke Safety

Shirley A. Jones DNP, RN, CNOR[1] • LTC Angela S. Howell[2] • HM1 Elizabeth Stack[3]

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Walter Reed National Military Medical Center

## INTRODUCTION/ BACKGROUND

Surgical smoke, also known as cautery smoke or surgical plume, is produced through the thermal disruption of tissue using electrocautery, laser ablation, and harmonic dissection.[1-4] It can also be comprised of aerosolized particles released from bone saws, drills, and ultrasonic devices.[5] Surgical smoke is often both visible and odorous, with estimates indicating that 85% of surgical procedures generate surgical plume.[5] A seminal study found that the average daily usage time of smoke generating devices is 12 minutes and 43 seconds. Research supports that during this time the devices produce passive air pollution equivalent to 27-30 unfiltered cigarettes.[6] Like cigarette smoke, exposure to surgical smoke can result in cardiovascular and respiratory disease along with numerous other adverse health risks.[7-14] Therefore, it is recommended that steps are taken to reduce exposure.

The Occupational Safety and Health Administration (OSHA) estimates that 500,000 healthcare workers are exposed to surgical smoke each year.[5] Compared to the general population, these workers report twice the incidence of respiratory related illnesses.[5] Exposure and inhalation have been linked to both acute and long-term effects. Some of the well documented acute effects of surgical smoke exposure are eye irritation, nose and throat irritation, coughing, nausea/vomiting, headache, sneezing, weakness/fatigue and light headedness.[1, 3, 5, 10] Inhalation has also been linked to infection, congestion, and aggravation of conditions such as asthma and chronic obstructive pulmonary disease (COPD).[15] Long term exposure and inhalation has been linked to lung damage, the transmission of disease, and cancer. Patient exposure during laparoscopic procedures enhances risks related to the presence of carbon monoxide, elevated carboxyhemoglobin, and the occurrence of methemoglobin. There are also risks for patients related to loss of visibility in the surgical field, and port-site metastasis.[1, 5, 7, 16] Guidelines for surgical smoke management have been established to reduce exposure to toxic surgical plume. However, workplace safety groups, healthcare quality organizations, professional organizations, and governing bodies use language which only "recommend" rather than require use of the appropriate precautions.[1, 5] Consequently, surgical smoke evacuation is frequently overlooked despite the evidence of the hazard it presents.

## PURPOSE & AIMS

The purpose of this project is to provide a safer environment of care by reducing perioperative patient and personnel exposure to surgical smoke.

The aims are to:

- Develop an awareness of surgical smoke safety precautions and how to create and maintain a smoke-free work environment as evidenced by a minimum of 90% staff completion of didactic education on surgical smoke hazards; healthcare regulations, standards, and guidelines; and smoke evacuation in the perioperative setting with post-test scores of >80%.
- Have available one smoke evacuator per operating room that generates surgical smoke.
- Include smoke evacuation bovie pencils in surgical packs for procedures that are known to generate surgical smoke.
- Establish a minimum of 90% compliance rate on smoke evacuation audits as evidenced by utilizing an auditing tool and making direct observation of staff behaviors.
- Update the units smoke evacuation policy to include the best evidence-based practice for managing surgical smoke.

## METHODOLOGY

This project utilized the Plan-Do-Check-Act (PDCA) methodology to deliver a comprehensive initiative adapted from the Association of periOperative Registered Nurses (AORN) Go Clear program and consistent with the Institute of Medicine (IOM) strategies to promote adoption of clinical practice guidelines.

**Quality Improvement Smokeless Operating Room 2024-2025**
**Walter Reed National Military Medical Center**

| EVENTS | OCT | NOV | DEC | JAN | FEB | MAR | APR |
|---|---|---|---|---|---|---|---|
| **PLAN: Outline the Intervention** | | | | | | | |
| Secure Leadership Support | | | | | | | |
| Perform the Gap Analysis | | | | | | | |
| Conducted a Table Top Demonstration of Available Suction Bovie (Stryker, Ethicon, ConMed) | | | | | | | |
| Review AORN Smoke Free Operating Room Guidance | | | | | | | |
| Conduct Initial Literature Research on Surgical Smoke | | | | | | | |
| Create Staff Smoke Evacuation Education Presentation | | | | | | | |
| Assemble the Implementation Team (Surgeon, Nurse, Tech Champions) | | | | | | | |
| Create Staff Information Posters | | | | | | | |
| Access the Online Program to Register Staff | | | | | | | |
| Collaborate with Purchasing Department to Replace Traditional Bovie with Suction Bovie | | | | | | | |
| Review New Product Purchase Process with Resource Managenent Department | | | | | | | |
| Reevaluate the Gap Analysis | | | | | | | |
| Apply for IRB Approval | | | | | | | |
| Review AORN Smoke Evacuation Policy Recommendations | | | | | | | |
| **DO: Implement the Plan** | | | | | | | |
| Project Kickoff | | | | | | | |
| Self-paced Online Education Activities | | | | | | | |
| Hold In-Service Education on Equipment & Supplies | | | | | | | |
| Develop Policy and Procedures | | | | | | | |
| Formal Presentation to Hospital Quality Department and Board of Directors | | | | | | | |
| Audit and Monitor Usage and Compliance | | | | | | | |
| **CHECK: Analyze the Results** | | | | | | | |
| Data Entry in the Compliance Audit Tool | | | | | | | |
| Data Analysis | | | | | | | |
| Monitor staff completion of AORN Center of Excellence Modules | | | | | | | |
| **ACT: Document Conclusions and Outcomes** | | | | | | | |
| Finalize and Enforce Surgical Smoke Evacuation Policy | | | | | | | |
| Repeat PDSA Cycle | | | | | | | |

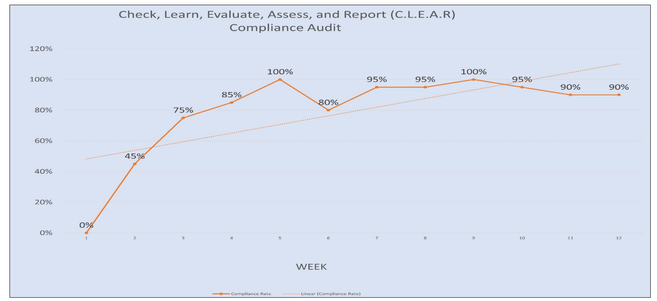
## RESULTS

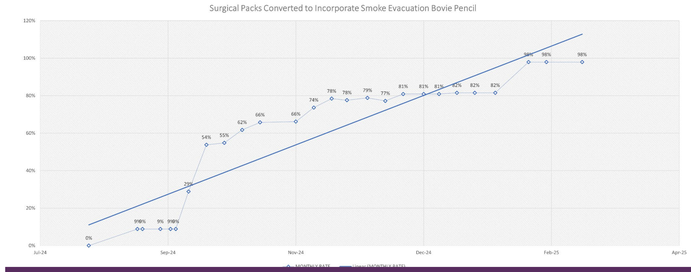
- ✕ 50% of staff completed the didactic education and achieved post-test scores of >80%.
- The main operating room suite has thirty waste management systems with integrated smoke evacuation, four intelligent flow systems, and four mini vac surgical smoke plume evacuators to equip 20 operating rooms.
- 98% of surgical packs for procedures that are known to generate surgical smoke have been converted to incorporate smoke evacuation bovie pencils.
- Direct observation of staff behaviors revealed smoke evacuation compliance of >90% in the main operating rooms.
- The main operating room's standard operating procedure for smoke evacuation has been updated to include the best evidence-based practice for managing surgical smoke.

*The identification of specific products or scientific instrumentation is considered an integral part of the scientific endeavor and does not constitute endorsement or implied endorsement on the part of the author(s), DoD, or any component agency.*

| *AORN Center of Excellence in Surgical Safety Education* | **Registered Nurses (n=52)** | **Surgical Technicians (n=53)** | **Total (n=105)** |
|---|---|---|---|
| *Completed* | 59.6% (n=31) | 41.5% (n=22) | 50.5% (n=53) |
| *In-Progress* | 3.8% (n=2) | 9.4% (n=5) | 66.7% (n=7) |
| *Not Started* | 36.5% (n=19) | 49% (n=26) | 42.9% (n=45) |
| *Post-test score > 80%* | 100% (n=31) | 95% (n=21) | 98% (n=52) |

* Surgeons and anesthesia providers were given the option to sign compliance waivers in-lieu of completing online education modules and post-test.




## CONCLUSION

The AORN Guideline for Surgical Smoke Safety has been implemented. The Main Operating Room (MOR) and Mother Infant Care Center (MICC) now provide a safer environment of care by reducing exposure to surgical smoke for patients and staff. In the initial PDCA cycle, 50% of staff completed the didactic education, although the aim was to have 90% staff completion as a requirement to apply for the Go Clear Award. The next PDCA cycle will address staff resistance to online learning and will include smoke evacuation for minimally invasive procedures that do not use an intelligent flow system. The initiative is being circulated to additional departments and clinics. It is expected that the MOR and MICC will be eligible to apply for the next award cycle in 2026. The Go Clear Award designation signifies the unit's commitment to maintaining a surgical smoke-free environment.

## REFERENCES

## ACKNOWLEDGEMENTS

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