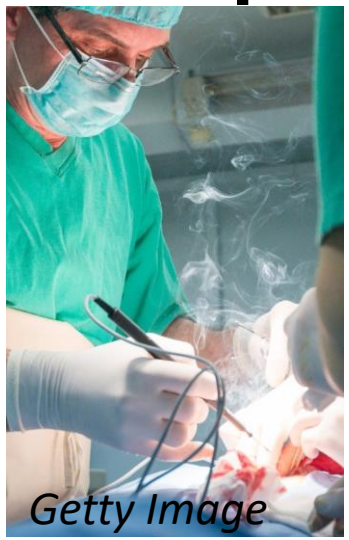
Ensuring Surgical Smoke Safety: Best Practice and Protocols in the Operating Room



Smoke -Free OR Global Advocate

Johnson Ogundare

DNP(c), MPH, RN, RPON, CNOR, PGDE, ACHE, C-CEOR, C-OHIMP, Mini-MBA

Chairperson, TORG Executive Council/CEO SNEMIS-Nigeria

8th December. 2023

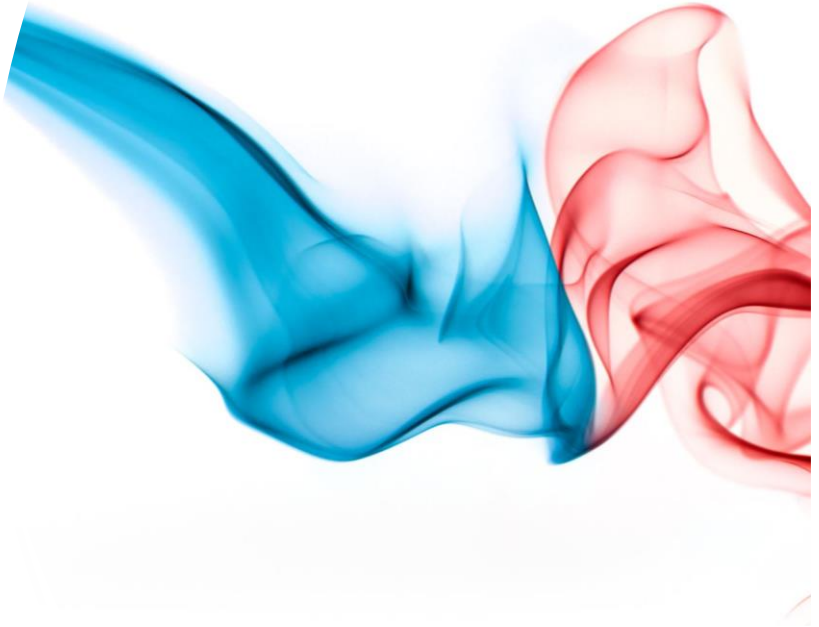
We are all connected!

- TORG
- One Connection
- One Purpose
- One Ecosystem
- **Everyone Deserves a Smoke-Free OR** (AORN, n.d.)

Thank you all for your service to humanity…..

Outline

- Background
- Relevant Evidence of Hazardous Health Effects of Surgical Smoke Exposure
- Surgical Smoke: Hierarchy of Control
- Protocols and Best Practices: AORN Guideline
- FAQs
- Conclusion



Disclaimer

This presentation and information shared here are for educational and knowledge sharing purposes

There is no intention to help market any equipment brand or surgical smoke evacuation systems

No conflict of interest

There is no financial benefit for giving this presentation

Expected outcome and Purpose

Learning Outcome:

The perioperative care providers will gain knowledge of evidence-based surgical smoke safety practices and transfer this knowledge into practice.

- **Purpose**

To discuss global advocacy for surgical smoke safety and the implementation of recommended guidelines.

Objectives

Discuss surgical smoke and related health effects on humans

Emphasize the importance of surgical smoke elimination as a recommended best practice

Relate components of AORN Guidelines to intra-operative best practices for a smoke-free intra-operative care environment.

Background

Over the past decades, the role of surgical smoke as a source of occupational hazards within the intra-operative care environment has been the subject of much interest and debate.

Considering the characteristics of its composition, surgical smoke may pose a significant threat to the health and safety of surgical staff and patients (Zhou et al., 2023).

Patients and surgical staff remain at risk of hidden hazards associated with surgical smoke exposure each time energy-generating devices or lasers are used to seal vessels, destroy tissue or cut bone.

Surgical Smoke History & Guideline Timeline

Electrosurgical technology was developed by Harvey Cushing and William T. Bovie in 1926

1976	Surgical smoke first discussed in the literature
1988	Emerging health issue. OSHA issued a Hazard Information Bulletin on laser surgery smoke
1989	NIOSH evaluation of smoke evacuators for laser surgery
1996	NIOSH published a Hazard Control for surgical smoke
2005	Surgical smoke hazard included in AORN Recommended Practices and a Tool Kit
2016	AORN published Surgical Smoke Safety Guideline
2021	AORN Guideline for Surgical Smoke Safety- Updated

Components of Surgical Smoke

- 95% = Water or Steam and;
- 5% = Cellular debris in the form of **particulate matter** (Ulmer, 2008).

Surgical smoke is a serious issue of occupational health concerns

Surgical Smoke: A serious issue of occupational health concerns

- Scientific studies have shown that surgical smoke contains hazardous chemicals, particles that can harm the lungs, blood, and possibly living cells, viruses, and germs.
- The surgical smoke contains hazardous substances such as;

Benzene
Toluene
Ethylbenzene
Acetone
Formaldehyde
polycyclic aromatic hydrocarbons
and carbon monoxide

Surgical Smoke Exposure: Truth from Literature

Exposing the Reality: Surgical Smoke is Dangerous

150 Chemicals (Pierce et al., 2011).

16- Recognized EPA priorities pollutants (Andreasson, 2012)

77% of Surgical smoke particulate matters are <1.1µm

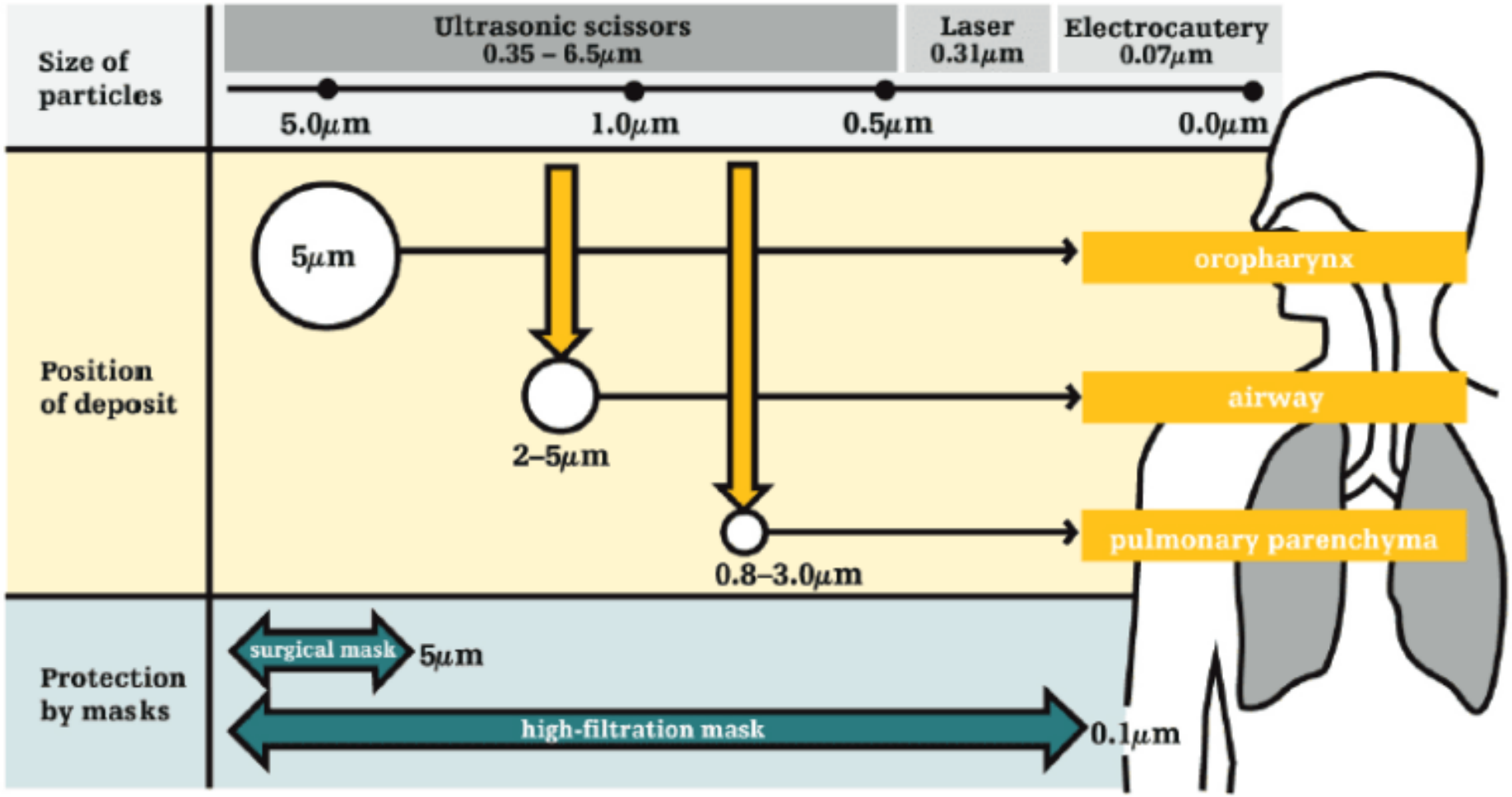
Surgical Facemask is not enough barrier to surgical smoke exposure (Ball, 2016)

1-Day of OR exposure = 27 cigarettes (Hill, 2012)

Surgical smoke can contain viruses much smaller (e.g., HIV = 0.15µm, HPV = 0.055µm, HepB = 0.042µm)

Relevant Evidence: Surgical Smoke

Typically, smaller particles are more worrisome in terms of their chemical impact, whereas larger particles are of greater concern in terms of their biological effects.



Surgical smoke is a serious issue of occupational health concerns

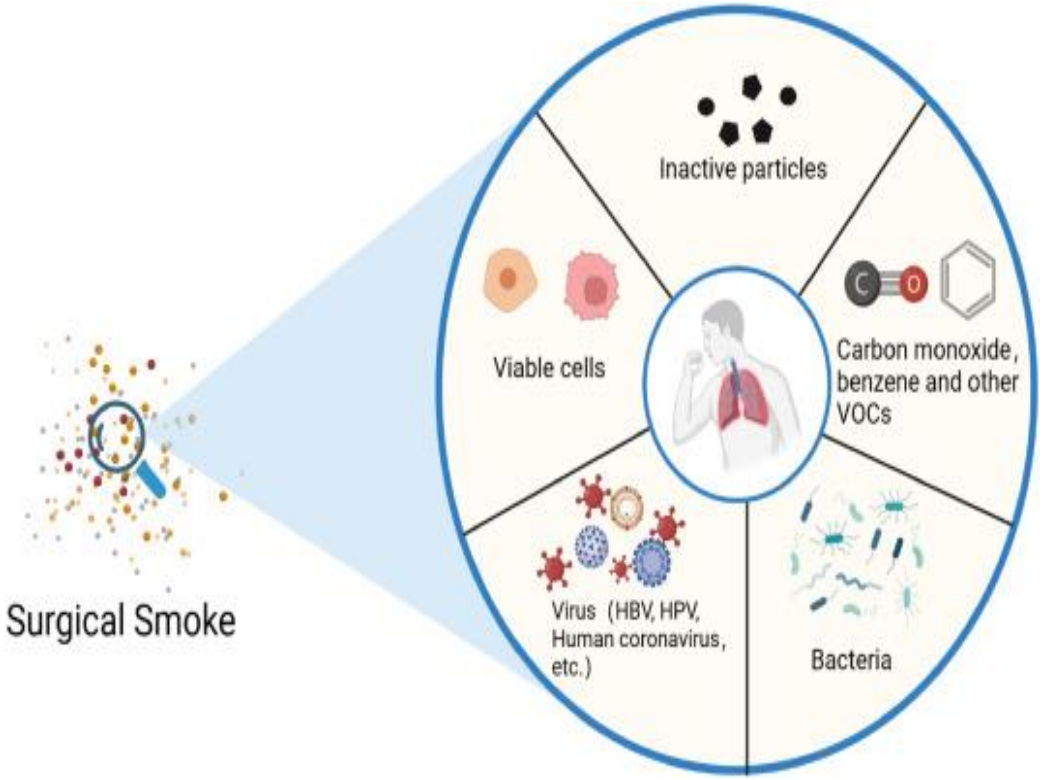
Okoshi et al.(2015)

Relevant Evidence: Potential health effects

The Risks of Surgical Smoke (Alp et al., 2006)	
Respiratory System	Nasopharyngeal lesions, sneezing, throat irritation, acute and chronic inflammatory changes in respiratory tract (emphysema, asthma, chronic bronchitis)
Eye	Eye irritation, lacrimation
Skin	Dermatitis
Gastrointestinal System	Nausea, vomiting, colic
Blood Disorders	Anemia, leukemia
Infection	HIV, hepatitis, HPV
Other	Carcinoma, lightheadedness, hypoxia, dizziness, headache, weakness, anxiety

Relevant Evidence: Surgical Smoke

- 1-Day exposure to surgical smoke is equivalent to 27-30 unfiltered cigarettes (Fereidouni et al., 2021).
- AORN endorses legislative and regulatory approaches mandating surgical smoke evacuation for optimal patient care and safe surgery outcomes (AORN, 2021).

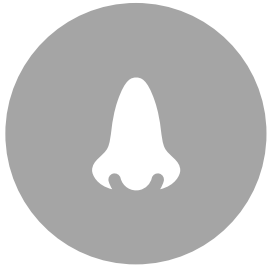


Zhou et al. (2023)

Surgical smoke is a serious issue of occupational health concerns

Surgical Smoke Exposure: Common Health Risks

EYE IRRITATION



NOSE AND THROAT IRRITATION

ACUTE HEADACHE

NAUSEA

A 2019 review by *Liu et al* discussed cases of the same types of HPV lesions excised during surgery as the cause of surgeons and nurses in the room developing laryngeal cancers.

Relevant Evidence: Case Report

Rioux et al.,(2013)

- A 62-year-old gynecologist who recently consulted his local otorynolaryngologist after having a foreign body sensation in his throat for many weeks. A biopsy of the base of the tongue revealed a squamous cell carcinoma the lesion was positive for HPV 16.
- He had been practicing for 30 years, of which he spent 15 doing weekly laser ablations with a CO2 laser. He reported poor ventilation in this clinic space and subsequently moved to a different area where he performed loop electrosurgical excision procedures for the next 15years.

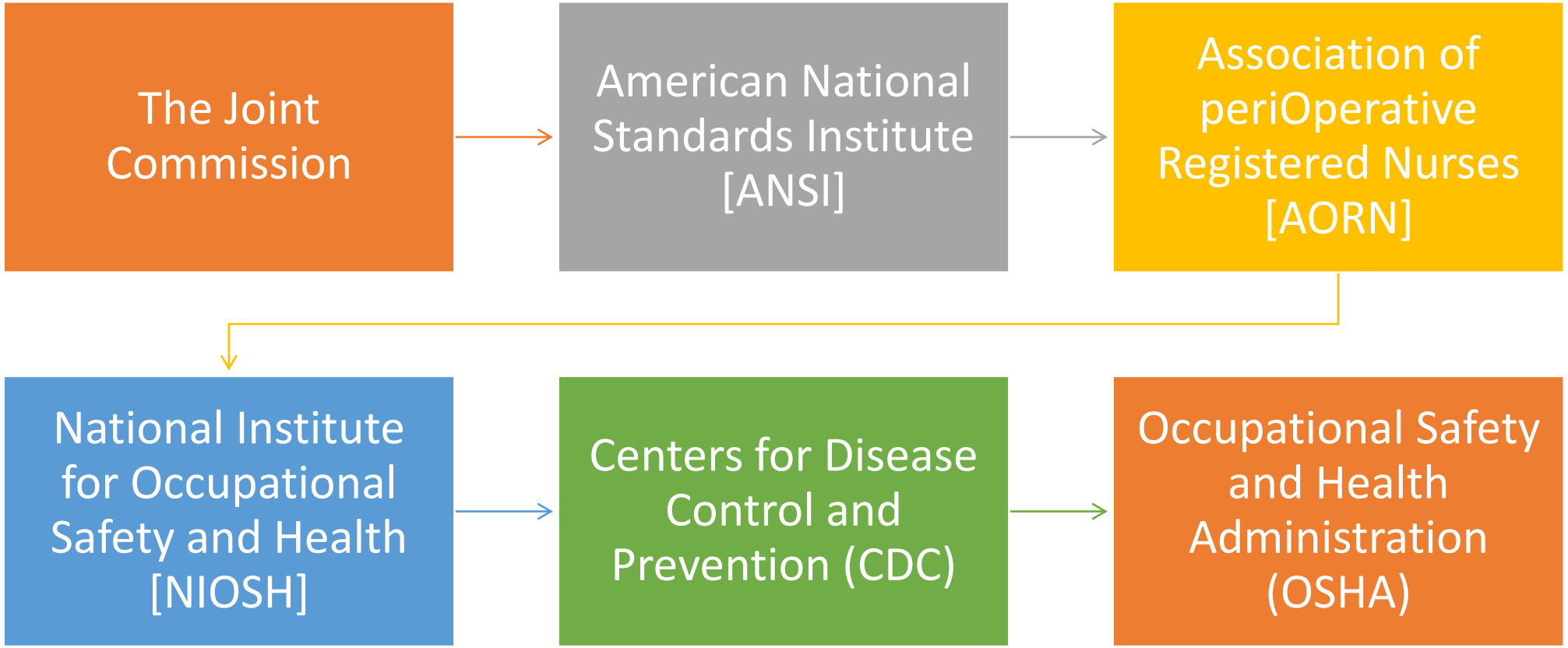
Surgical smoke is a serious issue of occupational health concerns

Relevant Evidence: Case Scenarios Okoshi et al.,(2015)

- Navarro-Mezaet al. (2013) reported that in Mexico, many surgical residents develop lumps in their throat (58%) and sore throat (22%) as a result of exposure to electrocautery smoke.
- Ball et al. found that perioperative nurses had a twofold higher occurrence of respiratory issues, including bronchitis, asthma, sinus infections, and allergies, compared to the general population.

Surgical smoke is a serious issue of occupational health concerns

Surgical Smoke Safety: QI Change Driving Forces



OSHA-endorsed CDC/NIOSH Hierarchy of controls

Most Effective

ELIMINATION: *Most effective as it mitigates the risk of human exposure by not generating surgical smoke* (Williams, 2022).

SUBSTITUTION: *Evaluate suitable surgical energy devices that produce less surgical emissions* (AORN, 2022).

ENGINERING CONTROLS: *To prevent humans from being exposed to surgical smoke, this method evacuates all surgical smoke from the operating room.*

ADMINISTRATIVE CONTROLS: *Develop policies and offer education to reduce the risk of surgical smoke exposure* (AORN, 2022).

PERSONAL PROTECTIVE EQUIPMENT: *A surgical mask as respiratory protection is not a primary barrier to surgical smoke, but it is essential for residual surgical smoke protection* (AORN, 2022).

Least Effective

Some Smoke Evacuation Systems

- PLEASE LOOK THEM UP

Guideline for Surgical Smoke Safety (AORN)

- The 2021 endorsed guideline offers recommendations on taking safety measures against surgical smoke to help the perioperative team create a safe environment for both surgical patients and team members by consistently implementing control measures.
- The overview presents strategies for creating a smoke-free setting, implementing smoke evacuation and filtration measures, ensuring respiratory protection, offering education, establishing policies and procedures, and maintaining quality standards.

2021 Guideline Outline

2021 Guideline Outline (AORN, 2021)

1. Smoke-Free Environment

- The health care organization should provide a surgical smoke-free work environment (1.1)
- Use the CDC/NIOSH Hierarchy of Controls (1.3)
- Collaborate and make a plan as a team before surgery and reassess the plan as needs change (1.4)
- An interdisciplinary team should select smoke safety equipment (1.6)

2. Smoke evacuation and filtration

- Evacuate and filter all surgical smoke (2.1)
- Include an ULPA and activated carbon filter (2.2.1)
- Do not release unfiltered surgical smoke into the OR during minimally invasive procedures (2.5.2)

3. Respiratory Protection

- Wear PPE (ie, respiratory protection) as secondary protection against residual surgical smoke (3.2)
- Wear respiratory protection when participating in procedures in which smoke-generating devices are used on HPV tissue (3.3)
- May wear respiratory protection during open smoke-generating procedures involving the liver (3.4) *[Conditional]*

4. Education

- Provide initial and ongoing education (4.1)

5. Policies & Procedures

- Develop facility policies and procedures (5.1)

6. Quality

- Participate in quality improvement activities (6.1)

Surgical Smoke Evacuation: Barriers

Surgical smoke is a serious issue of occupational health concerns

4. Education

- Definition of surgical smoke and health effects
- Sources of surgical smoke
- Selection of smoke evacuation systems
- Application of the Hierarchy of Controls
- Use of equipment according to MIFU
- Handling and disposing of used supplies
- Facility policies & procedures

aorn.org/essentials

SAFE SURGERY TOGETHER

AORN

5. Policies and Procedures

5.4. Include procedures for reporting injuries or failures with smoke evacuator devices that potentially affect patient or staff safety. *[Recommendation]*

FDA U.S. FOOD & DRUG ADMINISTRATION

Medical Device Reporting (MDR): How to Report Medical Device Problems

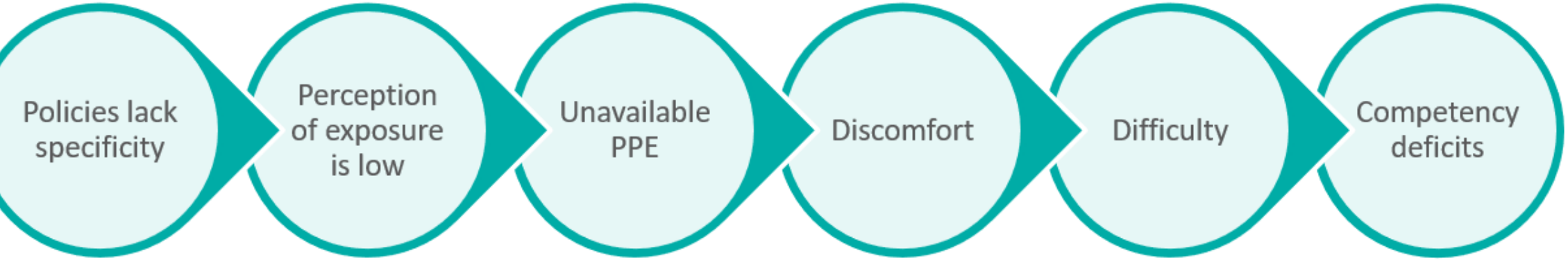
https://www.fda.gov/medical-devices/medical-device-safety/

SAFE SURGERY TOGETHER

AORN

6. Quality

6.4. Identify barriers to wearing recommended PPE (ie, respiratory protection) in the perioperative setting when indicated as secondary protection against residual surgical smoke, and address them through interventions to improve compliance. *[Recommendation]*

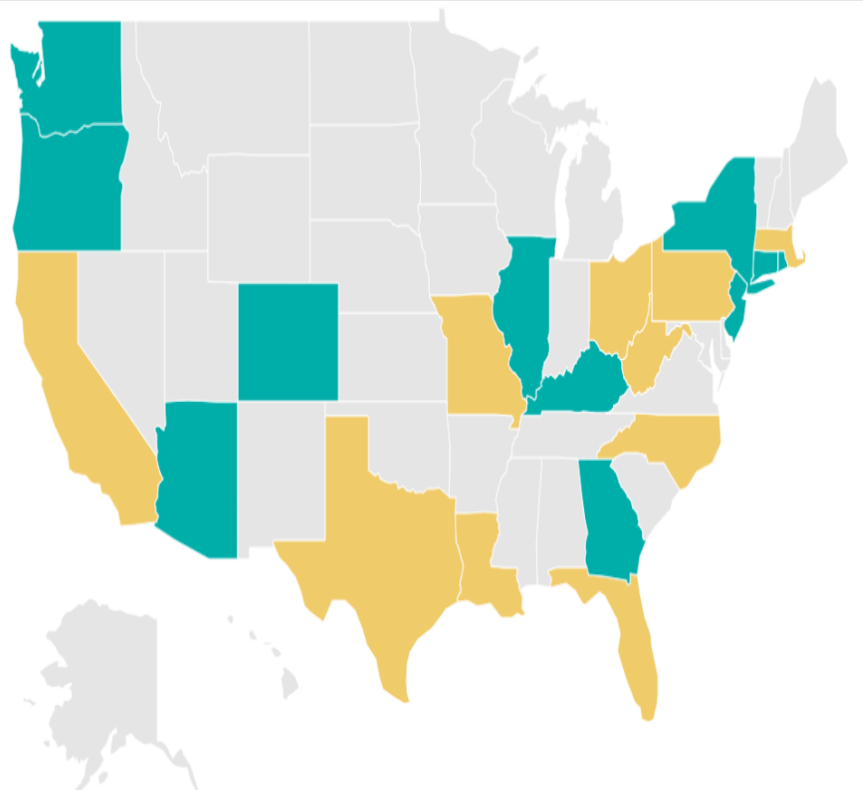


SAFE SURGERY TOGETHER

AORN

KEY TAKE-AWAYS

- Surgical masks do not provide protection against airborne (aerosol) particles in surgical smoke.
- Surgical smoke should be removed by a smoke evacuation system during both open and laparoscopic procedures.
- Surgeons should assess the potential dangers of surgical smoke.
- OR staff education about these dangers is imperative
- Team compliance with the use of evacuation devices to minimize potential health hazards to patients and surgical personnel is essential.



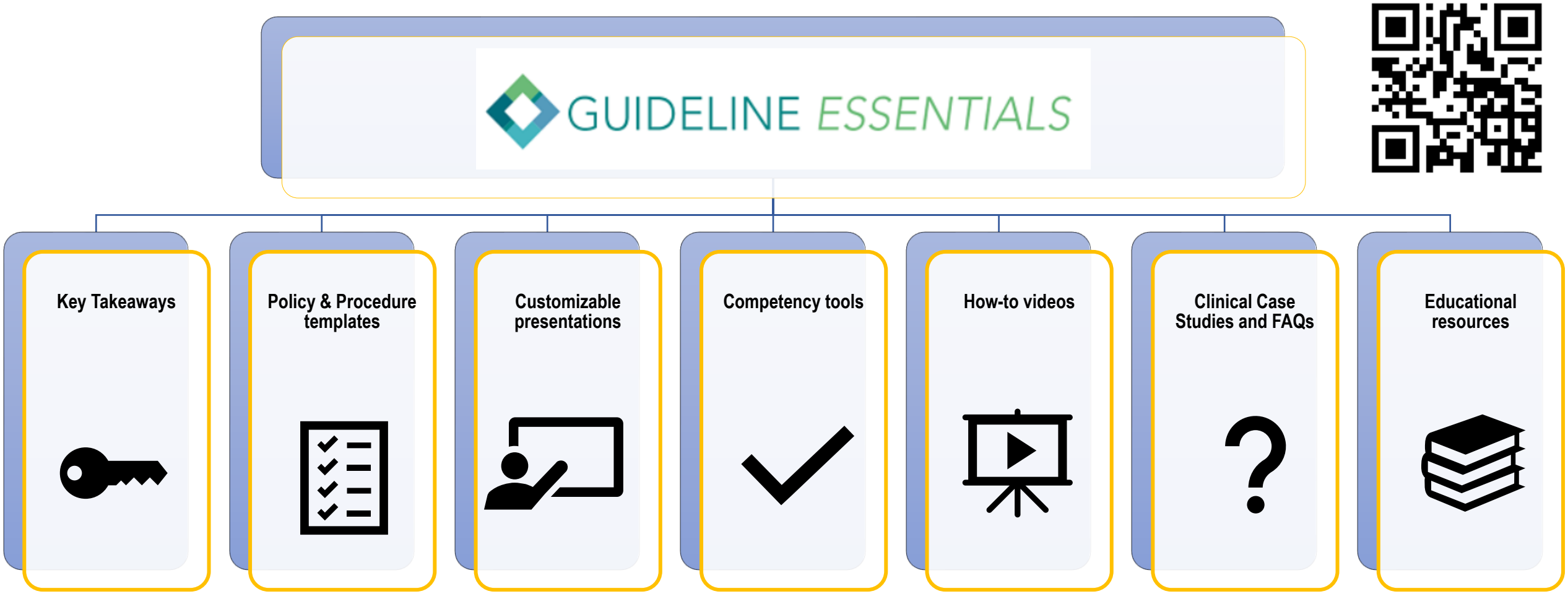
14- states have gone surgical smoke-free: Arizona, Colorado, Illinois, Kentucky, Georgia, Oregon, Rhode Island, New Jersey, New York, Connecticut, Washington, Ohio, and Missouri (AORN, 2023). California joined October 2023 making a total 15 States with SSS Laws

Conclusion

- Every day, surgical patients and staff are exposed to surgical smoke and its airborne constituents generated by electrosurgical units (ESU), lasers, and other energy-generating devices used during surgical procedures (English & Jeter, 2021).
- Managing and regulating the levels of dangers and harmful substances of surgical smoke exposure is the fundamental strategy for protecting patients and surgical staff.
- Compliance with recommend best practices for surgical smoke evacuation, albeit intricate matter.
- Institutionalized policy and procedures for perioperative practice is imperative to providing surgical smoke safety, optimal patient care and safe surgery outcomes

AORN Resources

- eGuidelines Plus is an online facility subscription providing access to the most current AORN *Guidelines for Perioperative Practice* complete with tools, customizable templates and resources to empower your team to apply standardized techniques facility-wide (AORN, 2023).
- Guideline *Essentials:* Download tools, road maps, case studies, and presentations for each of the Guidelines for Perioperative Practice. Share the informational videos with staff to ease implementation. Available for AORN members (AORN, 2023).



https://www.aorn.org/essentials

https://www.aorn.org/guidelines-resources/guidelines-for-perioperative-practice

GO CLEAR AWARD™

Surgical Smoke-Free Recognition Program

A comprehensive Surgical Smoke-Free Recognition Program to ensure a safe environment wherever surgical smoke is generated to protect patient and worker safety.

References

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 Accessed May 27, 2023.

Andreasson, S., Mahteme, H., Sahlberg, B., & Anundi, H. (2012). Polycyclic Aromatic Hydrocarbons in Electrocautery Smoke during Peritonectomy Procedures. *Journal of Environmental and Public Health*, *2012*, 1–6.

Association of periOperative Registered Nurses [AORN. (2023). *Guidelines for perioperative practice*. https://www.aorn.org/guidelines-resources/guidelines-for-perioperative-practice. Accessed August 20, 2023.

Association of periOperative Registered Nurses [AORN]. (2021). *Guideline for surgical smoke safety*. *Guidelines for Perioperative Practice*. Denver, CO.

Ball, K. (2016). Management of Surgical Smoke in the Perioperative Setting. *AORN Annual Conference Presentation.*

References

Ball, K. (2010). Surgical smoke evacuation guidelines: compliance among perioperative nurses. *AORN Journal*, *92*(2), e1-23. https://doi.org/10.1016/j.aorn.2009.10.026 Accessed May 27, 2023

Jones, E. (2021). Surgical Smoke Safety: Guideline Update. AORN Essentials

Hill, D. S. (2012). Surgical Smoke - a health hazard in the operating theatre. A study to quantify exposure and a survey of the use of smoke extractor systems in UK plastic surgery units. *Journal of Plastic Reconstructive & Aesthetic Surgery*, 1–6.

Liu, Y., Song, Y., Hu, X., Yan, L., & Zhu, X. (2019). Awareness of surgical smoke hazards and enhancement of surgical smoke prevention among the gynecologists. *Journal of Cancer*, *10*(12), 2788–2799. https://doi.org/10.7150/jca.31464. Accessed June 5, 2023.

Mitchell, J. P. (2021). Particle size measurements from orally inhaled and nasal drug products. *Journal of Aerosol Medicine and Pulmonary Drug Delivery*, *34*(6), 325–345. https://doi.org/10.1089/jamp.2021.29047.jpm. Accessed December 3, 2023.

Navarro-Meza, M. C., González-Baltazar, R., Aldrete-Rodríguez, M. G., Carmona-Navarro, D. E., & López-Cardona, M. G. (2013). Síntomas respiratorios causados por el uso del electrocauterio en médicos

References

Occupational Safety and Health Administration [OSHA]. (n.d.). United States Department of Labor. Laser/Electrosurgery Plume - Standards | https://www.osha.gov/laser-electrosurgery-plume/standards. Accessed June 4, 2023.

Okoshi, K., Kobayashi, K., Kinoshita, K., Tomizawa, Y., Hasegawa, S., & Sakai, Y. (2015). Health risks associated with exposure to surgical smoke for surgeons and operation room personnel. *Surgery Today*, *45*(8), 957–965. https://doi.org/10.1007/s00595-014-1085-z. Accessed June 3, 2023.

Pierce, J., Lacey, S., Lippert, J., Lopez, R., & Franke, J. (2011). Laser-generated air contaminants from medical laser applications: a stage o-of-the-science review of exposure characterization, health effects, and control. *J Occup Environ Hyg*, *8*(7), 447–466.

Rioux, M., Garland, A., Webster, D., & Reardon, E. (2013). HPV positive tonsillar cancer in two laser surgeons: case reports. *Le Journal d'oto-Rhino-Laryngologie et de Chirurgie Cervico-Faciale [Journal of Otolaryngology - Head & Neck Surgery]*, *42*(1), 54. https://doi.org/10.1186/1916-0216-42-54

Ulmer, B. C. (2008). The hazards of surgical smoke. *AORN Journal*, *87*(4), 721–734; quiz 735–738. https://doi.org/10.1016/j.aorn.2007.10.012 Accessed May 14, 2023.

Zhou, Y.-Z., Wang, C.-Q., Zhou, M.-H., Li, Z.-Y., Chen, D., Lian, A.-L., & Ma, Y. (2023). Surgical smoke: A hidden killer in the operating room. *Asian Journal of Surgery*, *46*(9), 3447–3454.