Surgical Smoke Evacuation in the Time of COVID-19
Surgical Smoke Safety

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AORN Perioperative Practice Practice Specialist
Outcomes

• Review the hazards of surgical smoke and best practices for preventing patient and healthcare worker exposure
• Discuss the evidence-based guidelines for surgical smoke evacuation and control
• Examine specific considerations and recommendations related to surgical smoke during the COVID-19 pandemic
• Review the current surgical smoke evacuation public policy landscape
What is Surgical Smoke?

By-product
- malodorous
- visible

Energy devices
- ESU, laser, ultrasonic devices
- High-powered tools

AKA
- Plume, smoke plume
- Bio-aerosols, LGAC

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Inhaling Surgical Smoke

Did you know?

= 15 min

Tomita et al., 1981
Health Effects

- Respiratory issues
- Anxiety
- Carcinoma
- Skin and eye issues
- Headache, nausea, vomiting
- Lightheadedness
- Throat irritation
- Renal and hepatic issues

Alp et al., 2005
Ball, 2010
The diagram illustrates the position of deposit for different sizes of particles. The size of particles is categorized into three types: Ultrasonic scalpel (0.35 - 6.5μm), Laser (0.31μm), and Electrocautery (0.07μm). The position of deposit is shown as follows:

- 5μm: Nasopharynx
- 2-5μm: Trachea, Bronchus
- 0.8-3.0μm: Alveoli
Patient Hazards

- Reduced visibility
- Procedure delay
- Absorption

- Carboxyhemoglobinemia
- Port-site metastasis
Virus Presence in Surgical Smoke

HPV
HIV
HBV
SARS-CoV-2 Virus

• Small particle size ~0.05-0.2 microns
• Presence in tissue and body fluids
• Easily transmissible
• Aerosolization and potential presence in surgical smoke

Vourtzounis et al., 2020
Zakka et al., 2020

Access Now: AORN COVID-19 Clinical Support
AORN Surgical Smoke Safety Guideline

1. Provide a surgical smoke-free work environment
2. Evacuate all surgical smoke
3. Use smoke evacuators with ULPA filters
4. Dispose of filters and tubing appropriately
AORN Surgical Smoke Safety Guideline

Multidisciplinary team decision

Provide education and competency verification

Develop policies and procedures

Participate in QI activities
Hierarchy of Controls

- **Elimination**: Physically remove the hazard
- **Substitution**: Replace the hazard
- **Engineering Controls**: Isolate people from the hazard
- **Administrative Controls**: Change the way people work
- **PPE**: Protect the worker with Personal Protective Equipment

https://www.cdc.gov/niosh/topics/hierarchy/default.html
Evaluating Smoke Evacuation Equipment

MULTIDISCIPLINARY TEAM
SAFETY, EFFICIENCY, AND COST
FLOW RATE
FUNCTIONALITY
NOISE LEVEL
COMPATIBILITY AND APPLICATION
FILTER TYPE

Guideline for a Surgical Smoke Safety, 2019
ECRI, 2020

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ULPA Filters

Education and Misconceptions

Jason Mucilli
Principal R&D Engineer
Surgical Safety Portfolio R&D Lead
Medtronic, Surgical Innovations
Smoke Evacuation Filters
Filter Anatomy and International Standards

• Typical smoke evacuator filters will consist of four stages: Prefilter, ULPA, Carbon and Expanded Foam

• ISO 16571\textsuperscript{4} dictates that “the filtration system shall include an ULPA filter in accordance with EN1822\textsuperscript{5}… with an overall particulate efficiency of not less than 99.9995% (U15 Filter Class)” tested at the most penetrating particle size
Smoke Evacuation Filters- ULPA Efficiency Ratings and Particle Capture Mechanisms

- What does it mean to be 99.9995% efficient?
  - If inlet air contains $1,000,000 \frac{\text{particles}}{\text{cm}^3}$, the filtrate must contain less than $5 \frac{\text{particles}}{\text{cm}^3}$.
Smoke Evacuation Filters- ULPA Efficiency Ratings and Particle Capture Mechanisms

- Particle Capture Mechanisms Explained:

- **Straining**: particles larger than the average space between fibers

- **Inertial Impaction**: airflow may force larger particles with sufficient inertia to impact the fibers and adhere

- **Interception**: Similar to impaction - except no direct impact - Entrapped by adhesion forces

- **Diffusion**: Very small diameter particles are knocked off path by other molecules - trapped particles

Figure 1: Particle Capture Mechanisms
Smoke Evacuation Filters - ULPA
Most Penetrating Particle Size (MPPS)

- Three ‘micro-scale’ mechanisms have been combined in studies using physics modeling of motion and airflow
- Figure 2 overlays these efficiency curves
- The minimum efficiency point is known as the most penetrating particle size (MPPS)

**Key Takeaway:** The MPPS does not equal the lower size limit!¹,²,³

- MPPS can better be described as ‘the most difficult particle size to capture
- Particle sizes smaller and larger than this point are captured at an even greater efficiency
- U15 rated ULPA filters have an MPPS of 0.1 – 0.2um; particles smaller and larger than this are captured with 99.9995% efficiency or greater

¹,²,³
Expert Opinion During COVID-19

- Minimize exposure to staff members
- Wear appropriate personal protection
- Use caution during aerosol-generating procedures
- Minimize use of surgical energy
- Evacuate all surgical smoke
Laparoscopy and COVID-19

Filtration devices
Trocars
Insufflation
COVID-19 & Laparoscopy
Smoke evacuators
Respiratory PPE
Energy-generating devices

Francis, N., Dort, J., Cho, E. et al., 2020
A comprehensive Surgical Smoke-Free Recognition Program to ensure a safe environment wherever surgical smoke is generated to protect patient and worker safety.
CLEARING THE AIR, TOGETHER

INTERNATIONAL CAMPAIGN TO CLEAR THE AIR OF SURGICAL SMOKE

AORN
GO CLEAR AWARD™
Surgical Smoke-Free Recognition Program

AORN Foundation
Supporting the Nurses Who Make Surgery Safe

Medtronic

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PROGRAM BENEFITS
CREATING A SAFER ENVIRONMENT

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<table>
<thead>
<tr>
<th>Program Objectives</th>
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<tbody>
<tr>
<td>Provide a smoke-free environment for patients and perioperative team members.</td>
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<tr>
<td>Deliver surgical smoke education for the entire perioperative team.</td>
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<tr>
<td>Provide education on smoke evacuation methods for perioperative team members.</td>
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<tr>
<td>Increase smoke evacuation compliance on all surgical smoke generating procedures.</td>
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GETTING STARTED
PREREQUISITES

Obtain Facility Commitment

Secure Leadership Support

Identify Implementation Team

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GAP ANALYSIS
EVALUATE EQUIPMENT NEEDS

Equipment
- # of surgical smoke evacuators
- Usage of soft goods (e.g. tubing and filters)

Evacuation
- Understand current smoke evacuation
- % of procedures evacuating surgical smoke

Results
- Use Gap Analysis results to determine equipment needs
- Start evaluating products using Product Evaluation Form

*AORN does not support or endorse any particular solution.
ONLINE EDUCATION PROGRAM CORNERSTONE

Pretest Knowledge Assessment

Intraprofessional Educational Modules & Quizzes

Post-test Knowledge Assessment

*All perioperative team members must complete education

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COMPLIANCE MONITORING
CONDUCT A CLEAR AUDIT

CHECK
Check for compliance to smoke policy

LEARN
Learn from observed practices

EVALUATE
Evaluate outcomes

ASSESS
Assess indicators

REPORT*
Report outcomes & reward performance

*Must have three months of compliance audit results before submitted for the AORN Go Clear Award

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AWARD CRITERIA
CRITICAL FACTORS

- Education
- Post-Test
- Compliance
- Equipment
AWARD CRITERIA
THREE YEAR DESIGNATION

GO CLEAR AWARD™
Surgical Smoke-Free Recognition Program
BRONZE LEVEL

GO CLEAR AWARD™
Surgical Smoke-Free Recognition Program
SILVER LEVEL

GO CLEAR AWARD™
Surgical Smoke-Free Recognition Program
GOLD LEVEL

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Surgical Smoke Evacuation in the Time of COVID-19
RECOGNITION
RECOGNIZING FACILITIES FOR THEIR COMMITMENT

AWARD PLAQUE | AORN WEBSITE | AORN EXPO | MEDIA KIT

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Surgical Smoke Evacuation in the Time of COVID-19
Legislation and Advocacy

Jennifer Pennock, MS, AORN
Senior Manager, Government Affairs
2021 Predictions
What Can You Do?

• Go Clear Award
• Gather Stories from OR Staff
• AORN Advocacy Engagement
COVID-19 FAQs and Tool Kit

SAFE SURGERY TOGETHER

Updated Clinical Information to Support Nurses & Healthcare Teams During COVID-19 Pandemic

View FAQs  View Tool Kit

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Care of the Perioperative COVID-19 Patient (eBook)

- Roadmap for Resuming Elective Surgery after COVID-19
- Checklists and workflows
- Evidence-based

Preop ▶ OR ▶ Recovery
Management of Smoke Tool Kit

- Guideline Essentials
  - Case studies
  - Key takeaways
  - Policy & Procedure templates
  - Customizable presentations
  - Competency tools
  - How-to videos
- Awareness posters
- Educational resources
Medtronic & AORN

A Partnership

Will Riseley

U.S. Marketing Manager
Electrosurgery, Smoke Evacuation, Energy Hardware
Medtronic, Surgical Innovations
Medtronic & AORN Partnership with a shared purpose

- Medtronic Mission: Alleviate pain, restore health, and extend life
- Co-Developers and sponsors of the Go Clear™ program since development in 2015
  - > 1,000 facilities registered for the program
  - > 16,000 staff members enrolled in the education modules
  - 102 facilities have received the Go Clear Award

Valleylab™ commitment to innovation & safety

- Leaders for over 50 years
- Safety at the heart of everything
- Continued investment in Research & Development
References for Smoke Safety


References for Smoke Safety


References for Smoke Safety


References for ULPA Filters Medtronic

4. ISO 16571:2014, 3.28, 8.3.2
5. EN1822-1
Questions