Surgical Smoke Intervention & Implementation Plan to Effect Practice Change

Objectives

- Describe methods to lead organizational change to design a smoke intervention plan
- Evaluate best practices evidence to support clinical decisions
- Relate quality improvement metrics for successful smoke evacuation program implementation

Identify the Problem

Surgical Smoke PICOT

- **P**= Perioperative practitioners exposed to surgical smoke
- **I**= Education and practice change to reduce surgical smoke exposure
- **C**= Compliance comparison after initiation of practice change
- **O**= Attain compliance level of 100%
- **T**= Practice change in 3 months

Riva, 2012

We need

A Plan

12 Step Plan – Surgical Smoke Cessation

1. Administration commitment
2. Form Multi-disciplinary team
3. Develop smoke free policy
4. Gap analysis
5. Evaluate/acquire equipment
6. Pretest

7. Education
8. Equipment in-service
9. Competency validation
10. Post Test
11. Compliance monitor
12. Program maintenance


S
Smoke Man to the rescue

Gap Analysis – Navigating the Journey

Georgia Council Smoke Mobile

	Meets Recommendation?		
	Yes	No	Comments
Recommendation 1: The health care organization should provide a surgical smoke-free environment.			
Has the health care organization assessed the perioperative team's risk exposure to surgical smoke, including:			
• Job classifications that place team members at risk?			
• Number of surgical procedures where surgical smoke is generated?			
• Percentage of surgical procedures where surgical smoke is not evacuated?			
• Type of energy-generating devices used?			
• Number of smoke evacuators available?			
• Number of ORs needing smoke evacuators?			
• Current usage of smoke evacuation soft goods (ie, smoke evacuator tubing, smoke evacuator filters)?			
Recommendation 2: The perioperative team should evacuate all surgical smoke.			
Does a multidisciplinary team select surgical smoke safety equipment to be used in the perioperative setting?			
Does a multidisciplinary team evaluate smoke evacuators before purchase?			
Recommendation 3: Perioperative team members should receive initial and ongoing education and competency verification on surgical smoke safety.			
Are initial and ongoing education and competency verification activities related to surgical smoke safety practices conducted at predetermined intervals?			
Do education and competency verification activities include:			
• Defining *surgical smoke*?			
• Describing critical factors for managing surgical smoke for all procedures that generate surgical smoke?			
• Identifying sources of surgical smoke?			
• Explaining the effect of particle size on the speed and distance smoke travels?			
• Describing the health effects of smoke exposure to patients and health care workers?			
• Selecting smoke evacuation systems and supplies in accordance with the procedure being performed?			
• Testing smoke evacuation equipment before the procedure?			
• Connecting equipment correctly?			
• Using smoke evacuation equipment correctly during the procedure?			
• Using standard precautions to handle used smoke evacuation supplies?			

AORN, 2019

Smoke Investigation Tool - Gap Analysis

Smoke Investigation Tool

1. Number of operating rooms_____

2. Is smoke currently being evacuated?

_____Always _____Sometimes _____Never

3. Current attitude of health care personnel:

a. Is smoke harmful	Yes	No	Indifferent
i. RN's	_____	_____	_____
ii. Ancillary Personnel	_____	_____	_____
iii. Surgeons	_____	_____	_____
iv. Anesthesia	_____	_____	_____
v. Risk Management	_____	_____	_____
vi. Occupational Health	_____	_____	_____
vii. Administration	_____	_____	_____

b. Should health care workers be protected from the harmful effects of smoke?

i. RN's	_____	_____	_____
ii. Ancillary Personnel	_____	_____	_____
iii. Surgeons	_____	_____	_____
iv. Anesthesia	_____	_____	_____
v. Risk Management	_____	_____	_____
vi. Occupational Health	_____	_____	_____
vii. Administration	_____	_____	_____

c. Should patients be protected from surgical smoke?

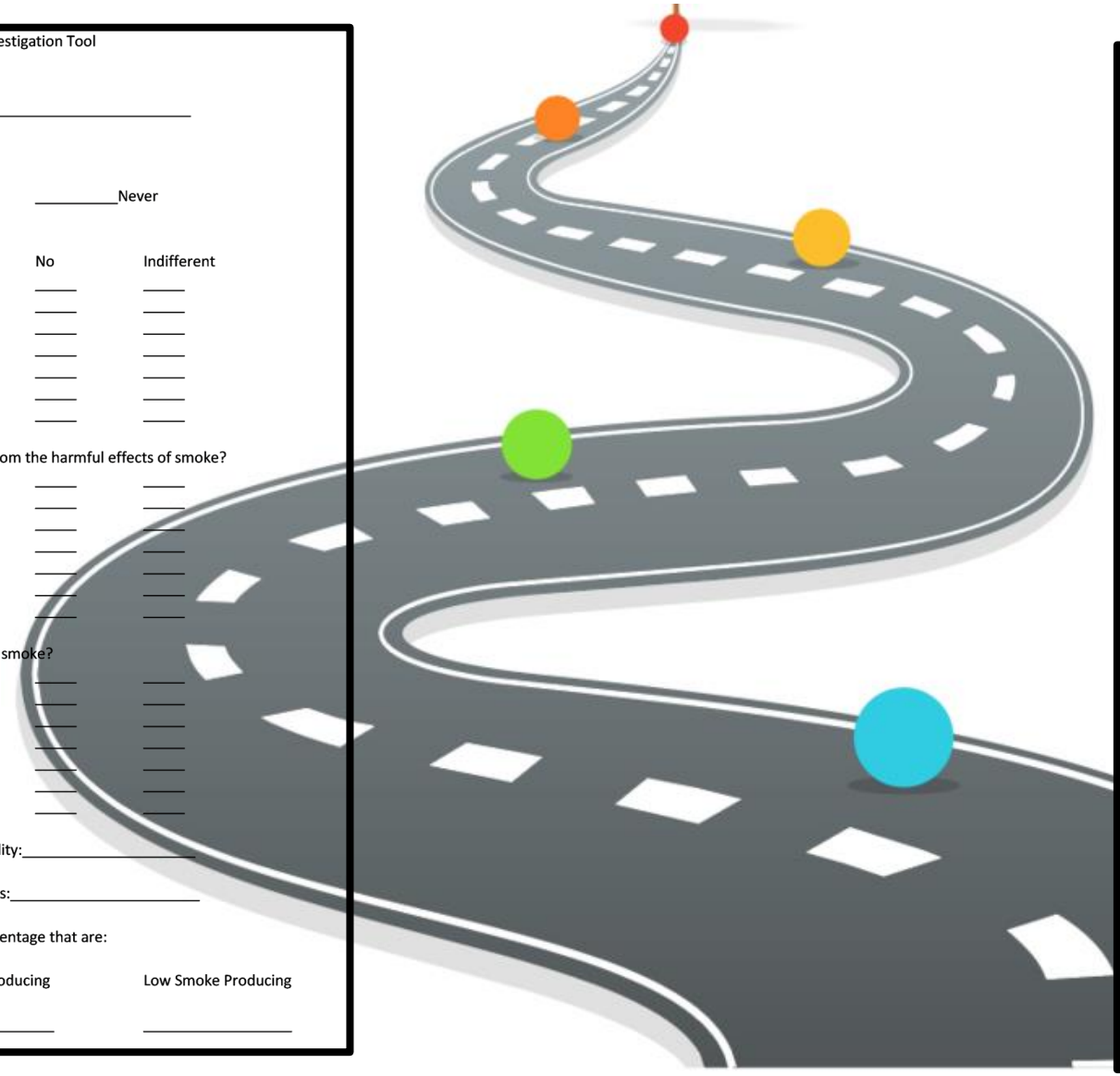
i. RN's	_____	_____	_____
ii. Ancillary Personnel	_____	_____	_____
iii. Surgeons	_____	_____	_____
iv. Anesthesia	_____	_____	_____
v. Risk Management	_____	_____	_____
vi. Occupational Health	_____	_____	_____
vii. Administration	_____	_____	_____

4. Number of smoke evacuators currently in your facility:_____

5. How many of your operating rooms use inline filters:_____

6. Of the number of cases monthly, estimate the percentage that are:

High Smoke Producing	Medium Smoke Producing	Low Smoke Producing
_____	_____	_____



7. How many of your operating rooms use inline filters:_____

8. Of the number of cases monthly, estimate the percentage that are:

High Smoke Producing	Medium Smoke Producing	Low Smoke Producing
_____	_____	_____

9. Are the Risk Managers, Infection Control and Occupational Health practitioners in your facility aware of the hazards of surgical smoke?

Yes_____ No_____ Do Not Know_____

10. Has an educational presentation on surgical smoke been presented at your facility?

Yes_____ No_____ Don't Remember_____

11. What are the obstacles to the implementation of a smoke evacuation program in your facility?

_____
_____
_____

12. Can you identify from your investigation a person(s) who would "champion" a smoke evacuation program in your facility?

Name(s) _____
_____
_____

13. From the results of your investigation, accurately assess where the facility falls on the smoke evacuation continuum:

Never Evacuate Smoke	Intermittent Smoke Evacuation	100% Compliance
↓	↓	↓
14. Action Plan: _____	_____	_____
Use resources:	Implement steps to	Good Job!
Develop a plan	increase compliance	Keep up the good work:
		Monitor Compliance
		Education as needed

Pretest

Surgical Smoke Pre-Test

1. Surgical smoke/plume is created by the use of:
   a. Electrosurgery units
   b. Lasers
   c. Ultrasonic scalpels
   d. All the above

2. A chemical found in surgical smoke that has been identified as a trigger for leukemia is:
   a. Acrolein
   b. Benzene
   c. Toluene
   d. Formaldehyde

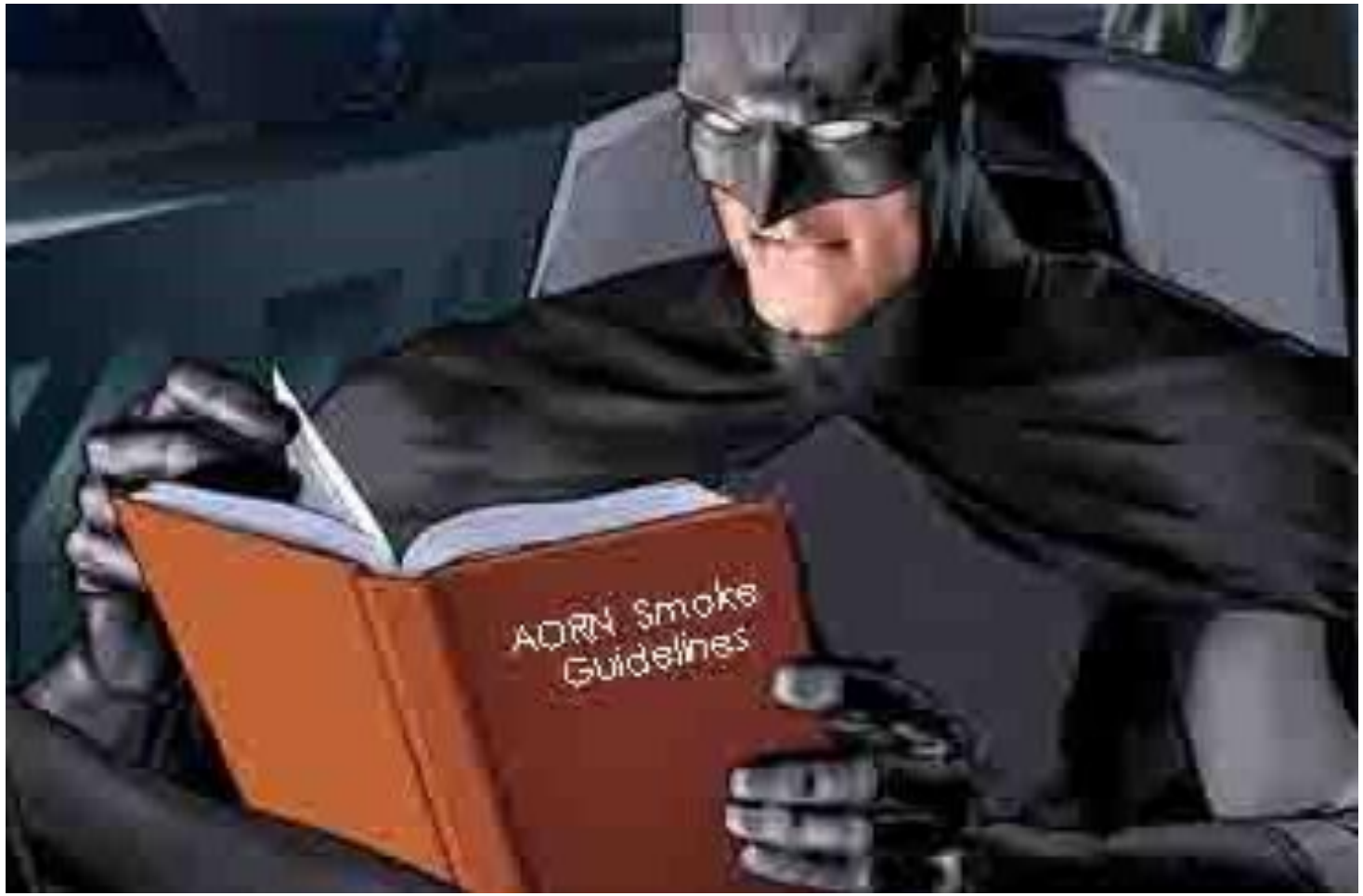
3. Smoke evacuation system components include a vacuum source, a capture device, and a three-stage filtration system.
   a. True
   b. False

4. Elevated levels of methemoglobin and carboxyhemoglobin can affect:
   a. The patient's level of anesthesia
   b. The surgeon's ability to achieve hemostasis
   c. Pulse oximetry accuracy
   d. Falsely elevated blood pressure readings

5. Standard surgical masks filter particle sizes:
   a. About 5 centimeters in size
   b. About 5 micrometers in size
   c. Less than 1.1 micrometers in size
   d. No particles because masks are not filters

Preliminary test to determine baseline knowledge

Education



Training for perioperative staff – hands on

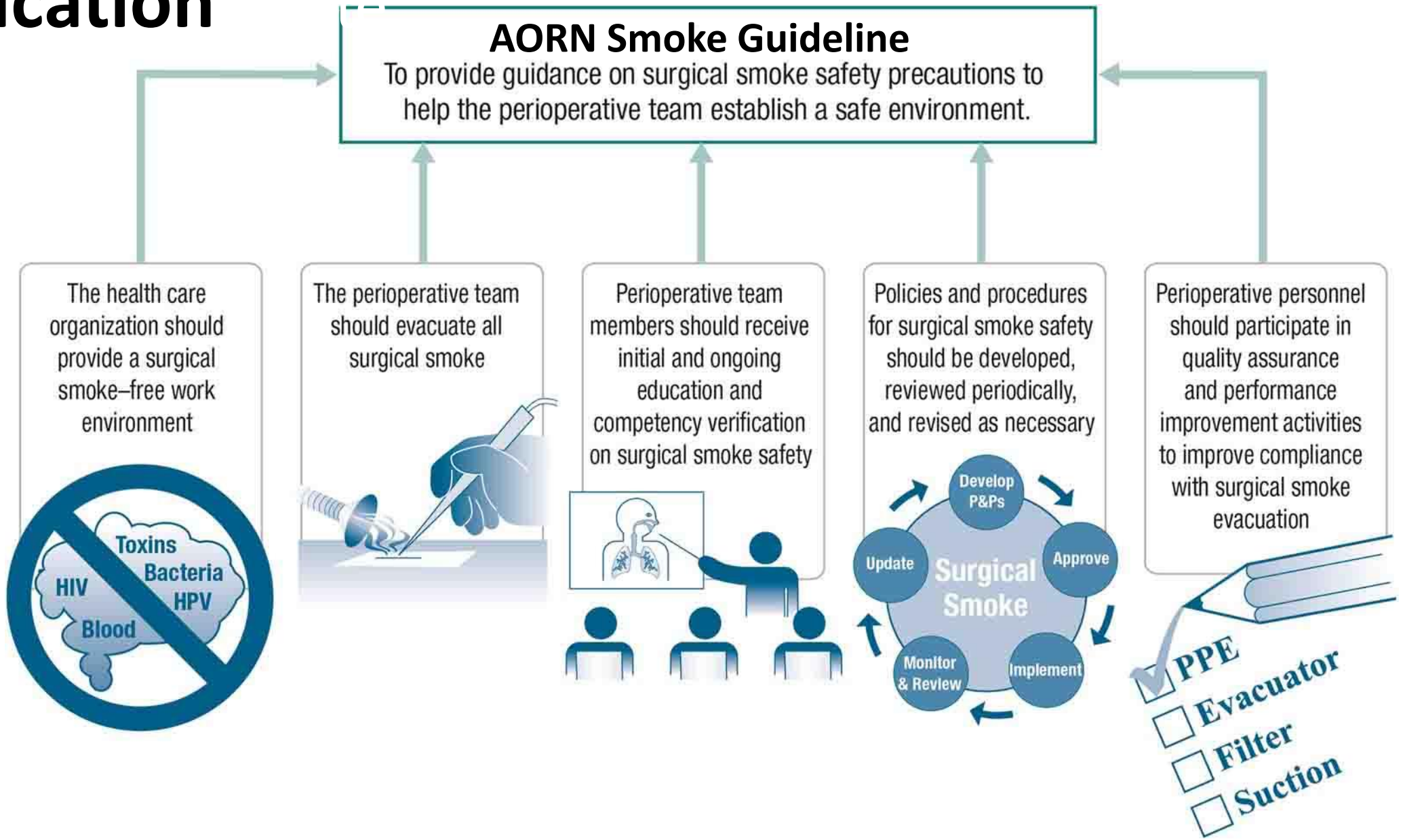
Didactic learning with lectures by experts

Self-study guides

Online learning

Peer-reviewed literature

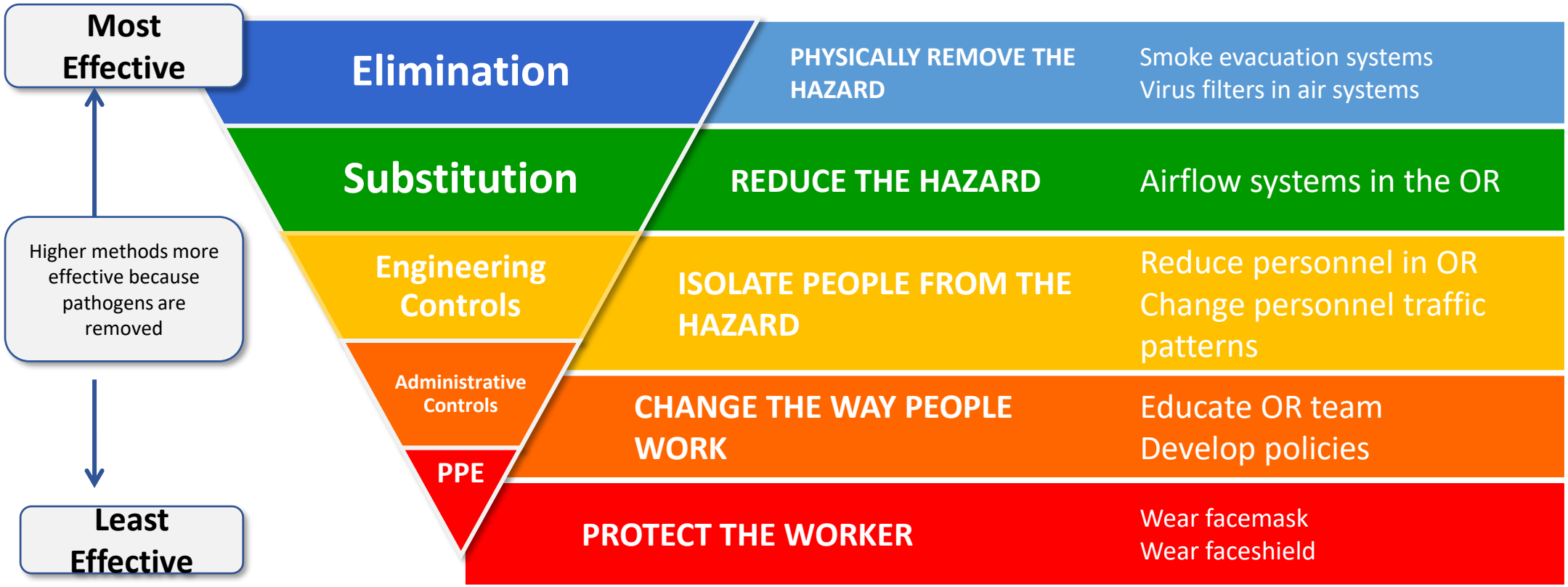
Education



AORN, 2019

Regulatory Standards/Recommendations

NIOSH - Hierarchy of Controls



https://www.cdc.gov/niosh/topics/hierarchy/default.html

Surgical Smoke

FACS.ORG

COVID-19: Considerations for Optimum Surgeon Protection Before, During, and After Operation

3. **Specific Operative Risk Issues**
   - Have **minimum number of personnel** in the operating room, i… as we… throughout. No visitors or observers.
   - Use **smoke evacuator** when electrocautery is used.

ELEVATING GYNECOLOGIC SURGERY

….make use of a closed smoke evacuation/filtration system with Ultra Low Particulate Air Filtration (ULPA) capability

SAGES Recommendations

Most Important

ELIMINATION

Smoke Evacuator
- ULPA filter system to remove virus
- Automatic activation when electrosurgery tool activated

Smoke Capture Device
- Appropriate size/configuration for amount of smoke
- Capture smoke within 2” of smoke production
- Detectable odor means smoke not being evacuated

SUBSTITUTION

Positive Pressure OR’s
- Designed to protect a patient and clean supplies within a room
- Clean filtered air pumped into room
- At least 15 air exchanges per hour
  - 15 exchanges = 99.9% clear in 28 min
  - 20 exchanges = 99.9% clear in 21 min

Negative Pressure OR’s
- Designed to contain airborne contaminants within a room
- Air flows into the OR from outside areas:
  - Keep doors closed
  - Post procedure leave room vacant until air exchanges remove contaminants

ENGINEERING CONTROLS

- Restrict employee traffic in at risk areas of the operating room
- Reduce personnel in the operating room to necessary team members

ADMINSTRATIVE CONTROLS

- Educate all operating room team members on mitigation strategies
- Provide training to minimize risk
- Develop policies and procedures to reduce risk of smoke and aerosolized infection

PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Select PPE based on exposure risk
- **Airborne Precautions**
  - Surgical mask, N95 Respirator, Powered Air Purifying Respirators
- **Standard Precautions**
  - Gloves, gowns, face shields
  - Hand hygiene

https://www.cdc.gov/niosh/topics/hierarchy/default.html

SAGES/FUSE Recommendations

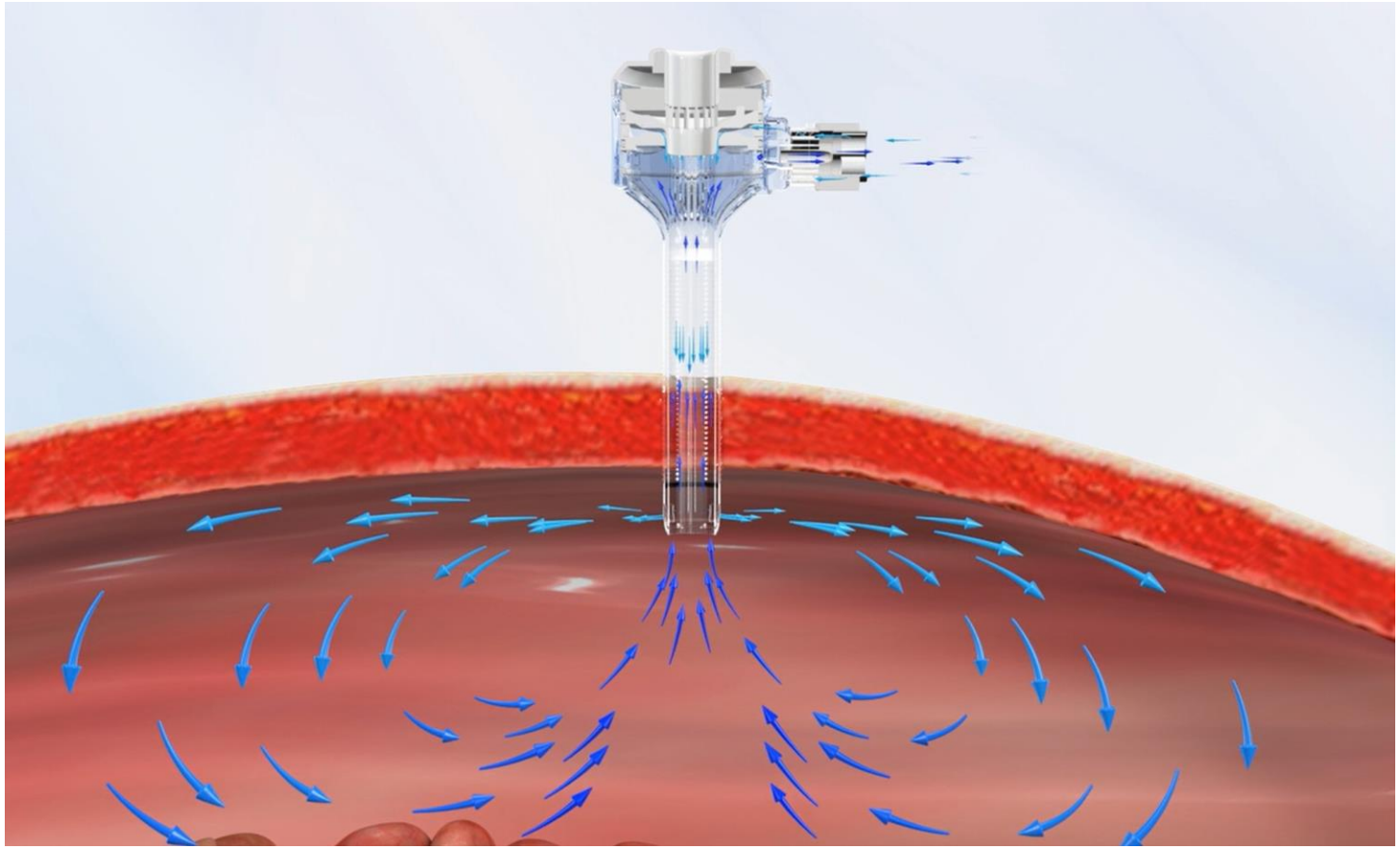
SPECIAL CONSIDERATION FOR INFECTIOUS DISEASE (e.g. COVID 19, Human Papilloma Virus)

- Utilize standard surgical smoke mitigation techniques
- All members in the OR should wear N-95 masks, eye protection, gowns and face shields.
- If converting to open surgery, desufflate prior to opening unless emergent clinical scenario
- Remove specimen after CO_2 gas and smoke filtered out
- Avoid suture closure devices that allow for leakage of insufflation.
- The fascia should be closed after desufflation

STANDARD LAPAROSCOPIC SMOKE MITIGATION

- Make port incisions as small possible to avoid leakage
- An ultra-filtration (smoke evacuation system or filtration) ULPA should be used
- Ports should not be vented to the open air after placement
- Pneumoperitoneum pressure should be kept at the lowest possible pressure which does not compromise operation
- Suction of CO2 or smoke with a standard suction irrigator connected to a non-ultrafiltered reservoir should be minimized.
- During desufflation, all escaping CO2 gas and smoke should be captured with an ultra-filtration system..

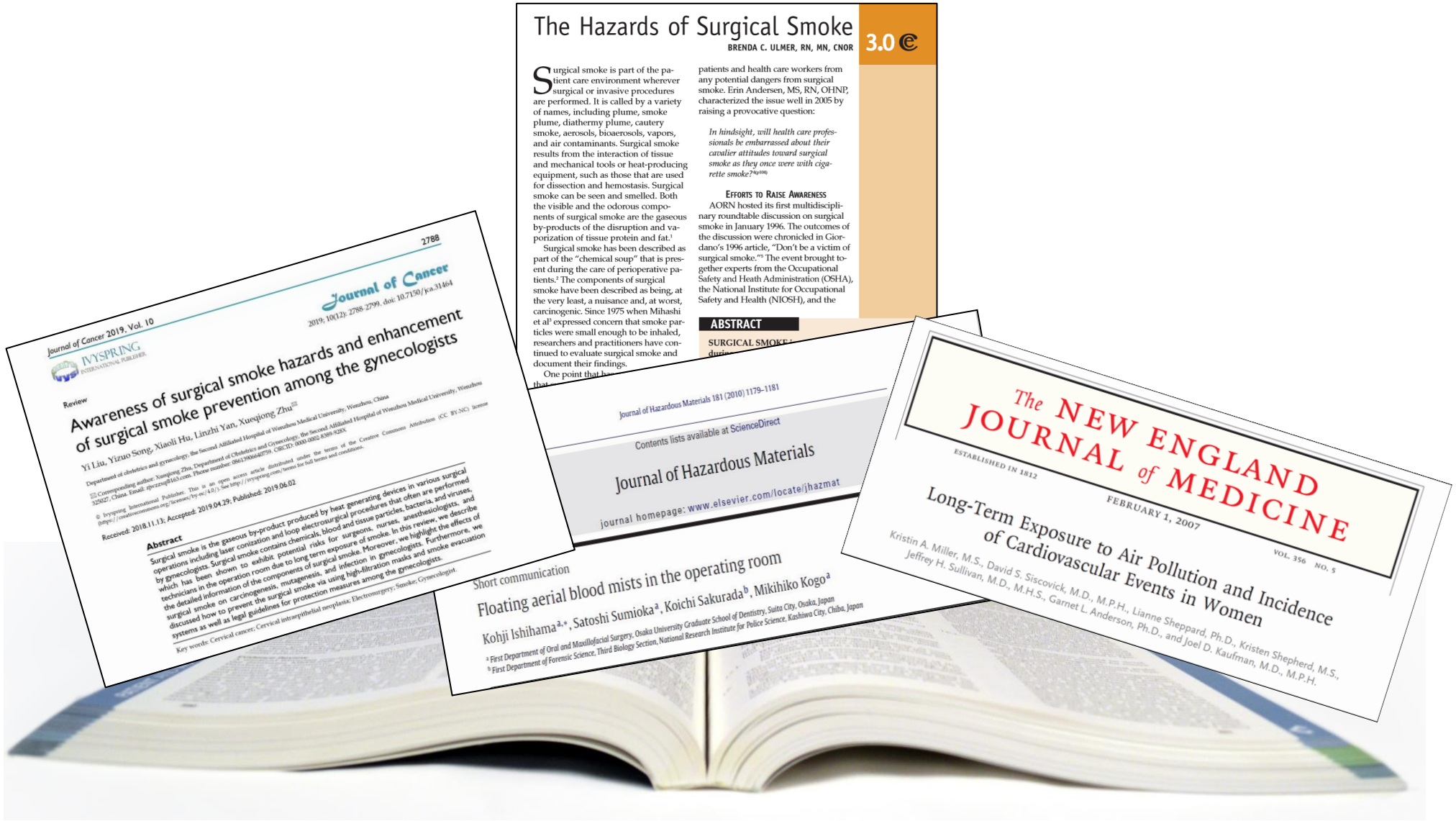
Sealed Air System



Maintains stable pneumo by recirculating filtered C02 through small pressure nozzles in the cannula to create a sealed air pressure barrier that equals peritoneal pressure

Munro & Gomel, 2019

Education



Book of Evidence

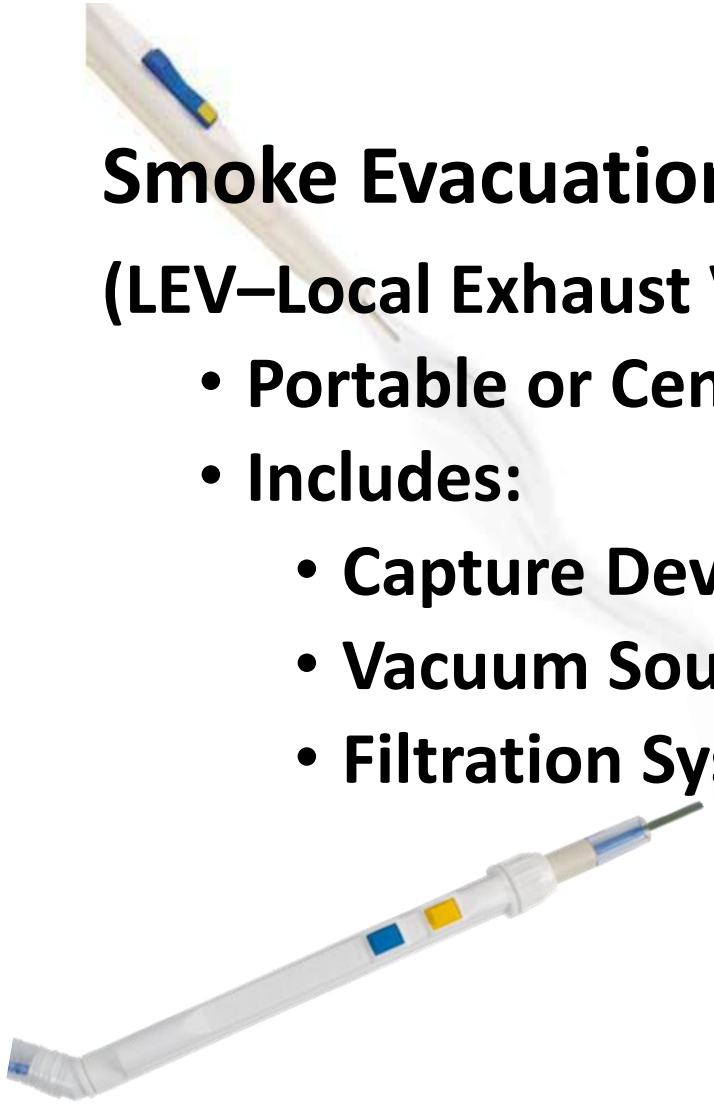
Chavis, et al, 2016

Education/Training

Smoke Evacuation System

(LEV–Local Exhaust Ventilation)

- Portable or Central
- Includes:
  - Capture Device
  - Vacuum Source
  - Filtration System



Education/Training

Wall suction on minor procedures, small amounts of smoke

Inline ULPA filter must be used

All used smoke accessories must be handled using Standard Precautions

Education/Training

Standard surgical mask = 0.6 – 5 µ

High filtration mask = 0.1– 0.5 µ

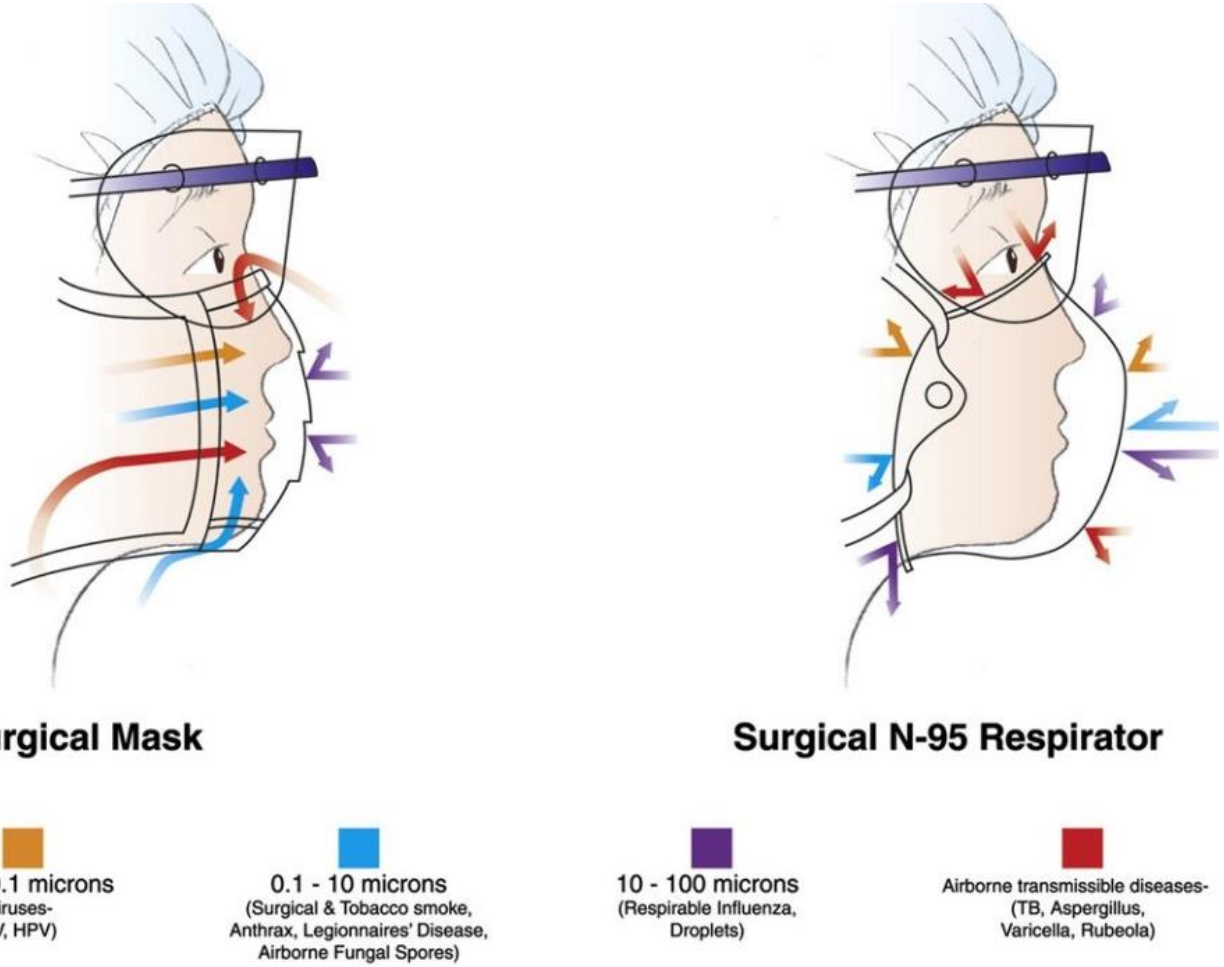
Face masks <u>not</u> be the first line of defense against smoke

Surgical and high filtration masks do not seal the face and may allow dangerous contaminants to enter the health care worker's breathing zone

Benson, et al, 2013

N-95 Surgical Respiratory

Secondary personal protection does not eliminate pathogen



CDC recommends Standard Precautions, Contact Precautions, Airborne Precautions, plus eye protection as Personal Protection Equipment (PPE) for healthcare worker (CDC, 2019)

Education

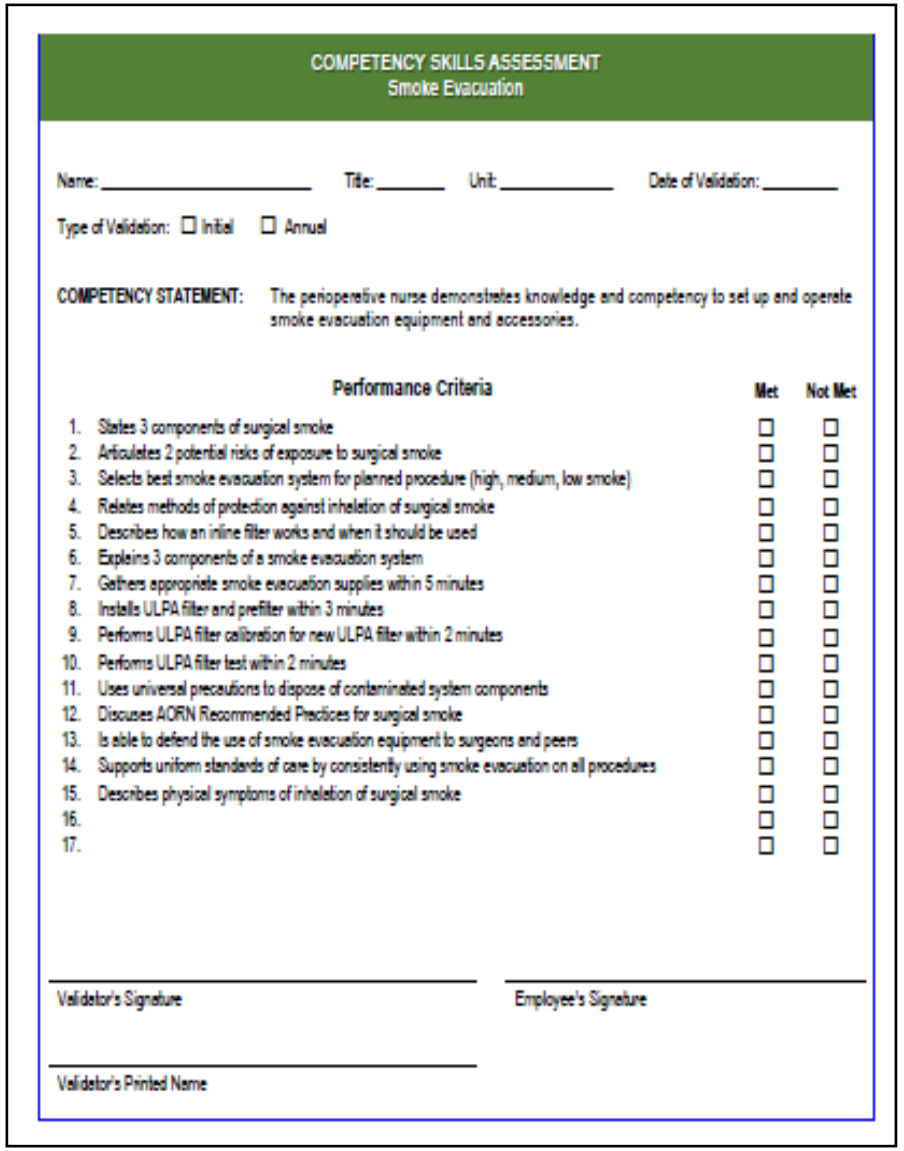
"If exposure to diathermy emissions can't be prevented then it should be adequately controlled."

Hill, O'Neill, Powell & Oliver, 2012

Education

Assess Skill & Validate Competency

Skills--proper use of smoke evacuation collection devices and maintenance of smoke evacuator--should be assessed and validated



COMPETENCY SKILLS ASSESSMENT
Smoke Evacuation

Name: _____ Title: _____ Unit: _____ Date of Validation: _____

Type of Validation: ☐ Initial ☐ Annual

COMPETENCY STATEMENT: The perioperative nurse demonstrates knowledge and competency to set up and operate smoke evacuation equipment and accessories.

Performance Criteria	Met	Not Met
1. States 3 components of surgical smoke	☐	☐
2. Articulates 2 potential risks of exposure to surgical smoke	☐	☐
3. Selects best smoke evacuation system for planned procedure (high, medium, low smoke)	☐	☐
4. Relates methods of protection against inhalation of surgical smoke	☐	☐
5. Describes how an inline filter works and when it should be used	☐	☐
6. Explains 3 components of a smoke evacuation system	☐	☐
7. Gathers appropriate smoke evacuation supplies within 5 minutes	☐	☐
8. Installs ULPA filter and prefilter within 3 minutes	☐	☐
9. Performs ULPA filter calibration for new ULPA filter within 2 minutes	☐	☐
10. Performs ULPA filter test within 2 minutes	☐	☐
11. Uses universal precautions to dispose of contaminated system components	☐	☐
12. Discusses AORN Recommended Practices for surgical smoke	☐	☐
13. Is able to defend the use of smoke evacuation equipment to surgeons and peers	☐	☐
14. Supports uniform standards of care by consistently using smoke evacuation on all procedures	☐	☐
15. Describes physical symptoms of inhalation of surgical smoke	☐	☐
16.	☐	☐
17.	☐	☐

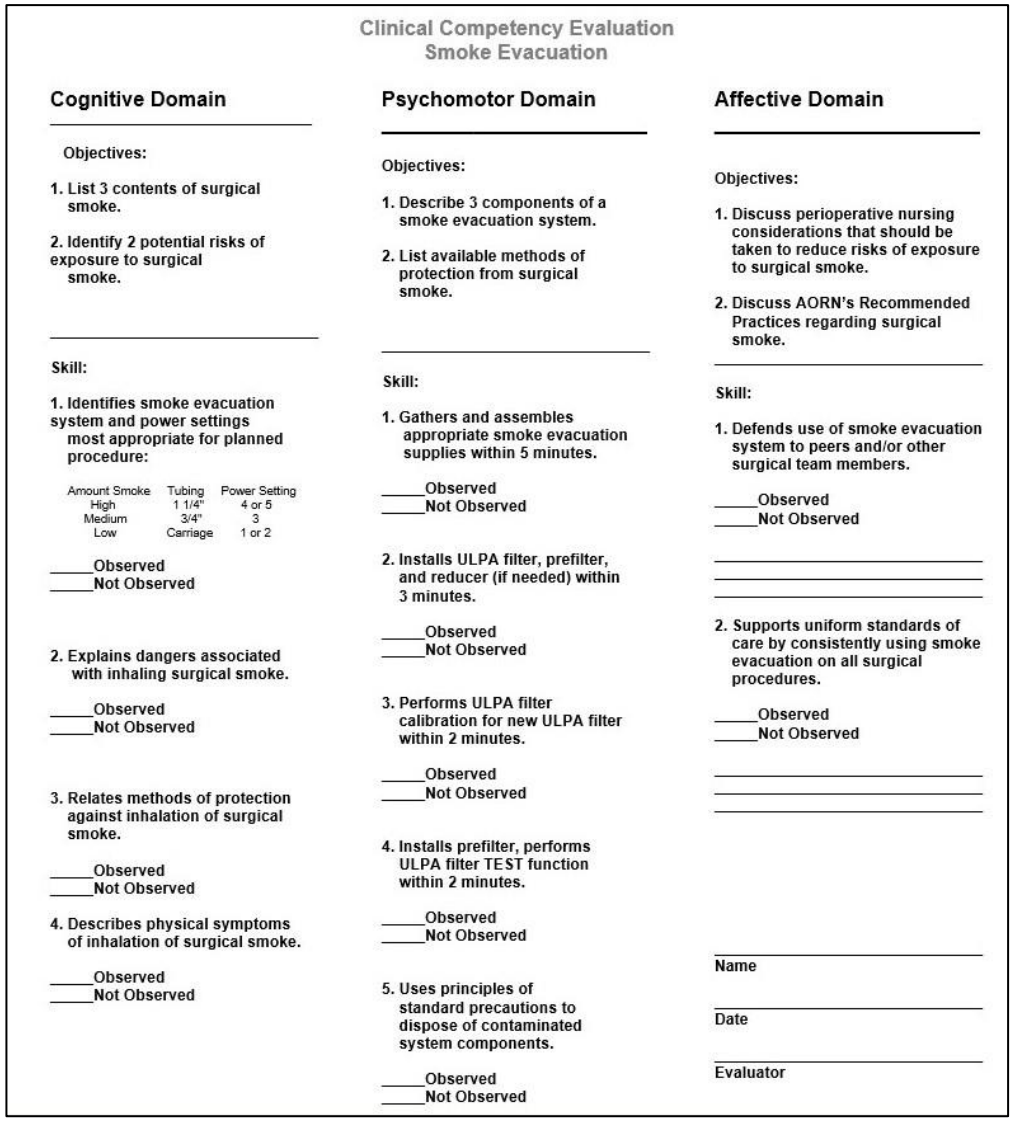
Validator's Signature _____ Employee's Signature _____

Validator's Printed Name _____

Phippen & Ulmer, 2009

Assess Skill & Validate Competency

The smoke evacuation tool measures competency in the cognitive, psychomotor, and affective domains, guided by behavioral objectives



Clinical Competency Evaluation
Smoke Evacuation

Cognitive Domain

Objectives:

1. List 3 contents of surgical smoke.
2. Identify 2 potential risks of exposure to surgical smoke.

Skill:

1. Identifies smoke evacuation system and power settings most appropriate for planned procedure:

Amount Smoke	Tubing	Power Setting
High	1 1/4"	4 or 5
Medium	3/4"	3
Low	Carriage	1 or 2

_____Observed
_____Not Observed

2. Explains dangers associated with inhaling surgical smoke.

_____Observed
_____Not Observed

3. Relates methods of protection against inhalation of surgical smoke.

_____Observed
_____Not Observed

4. Describes physical symptoms of inhalation of surgical smoke.

_____Observed
_____Not Observed

Psychomotor Domain

Objectives:

1. Describe 3 components of a smoke evacuation system.
2. List available methods of protection from surgical smoke.

Skill:

1. Gathers and assembles appropriate smoke evacuation supplies within 5 minutes.

_____Observed
_____Not Observed

2. Installs ULPA filter, prefilter, and reducer (if needed) within 3 minutes.

_____Observed
_____Not Observed

3. Performs ULPA filter calibration for new ULPA filter within 2 minutes.

_____Observed
_____Not Observed

4. Installs prefilter, performs ULPA filter TEST function within 2 minutes.

_____Observed
_____Not Observed

5. Uses principles of standard precautions to dispose of contaminated system components.

_____Observed
_____Not Observed

Affective Domain

Objectives:

1. Discuss perioperative nursing considerations that should be taken to reduce risks of exposure to surgical smoke.
2. Discuss AORN's Recommended Practices regarding surgical smoke.

Skill:

1. Defends use of smoke evacuation system to peers and/or other surgical team members.

_____Observed
_____Not Observed

2. Supports uniform standards of care by consistently using smoke evacuation on all surgical procedures.

_____Observed
_____Not Observed

_____
Name

_____
Date

_____
Evaluator

Re-Education

Repetition– a key learning aid to transition skill from conscious to subconscious. Through repetition, a skill is practiced and becomes routine

APLnextED, 2019

Here’s Vangie

Brenda loses her watch inside Vangie during surgery.

The 50 million dollar question…
How do you get this implemented?

- Data must be measurable
  - Scientific data
  - Financial data
- Administrative Committee
  - Periop Governance
  - Safety Committee
  - Infection Control
  - Risk Management

The first step in developing a smoke evacuation program is a commitment to protecting the healthcare providers from the potentially harmful effects of surgical smoke or plume.

The entire surgical team is responsibility, and accountability with assuring optimal protection is available when providing care in the operating room.

Governance Committee

- **Administrative Committee**
  - **Periop Governance**
    - **Surgery, L&D, Cath Lab & Procedural areas**
  - **Safety Committee**
  - **Infection Control**
  - **Risk Management**

Smoke Man convenes OR Superhero Team

Governance Committee Strategies

- **Met with experts in the area of surgical smoke.**
- **Assessed the statistical impact of surgical plume/smoke on operating room staff.**
- **Evaluate the ability of existing and emerging information, communication, and health care technologies to improve safety and quality and to decrease cost**
- **Evaluate the best available evidence for use in clinical and organizational decision making.**
- **Apply quality improvement methods to impact patient, population, and systems outcomes.**
- **Lead organizational change to professional work life while decreasing cost of care.**
- **Design population-centered care to improve employee health outcomes.**

Decision was to move forward….

Order for Implementation

- **Administrative Support: Financial Impact and Workplace Safety**
- **Choose a Physician and Nurse/Surgical Tech Champion**
- **Educate: Staff and Surgeons**
- **Pre-Test and GAP Analysis**
- **Evidence based resource manuals. Place in physician and staff lounges.**
- **Table Top of all product: Do not force product evaluation during the surgical procedure.**
- **Involve specialty coordinators to work with algorithm for set up that meets the specialty.**

Table Top and Surgery Evaluation

PRODUCT EVALUATION FORM

Date: _____

Name of item: _____

Physician: _____

Procedure used on: _____

	Low 1	2	3	4	High 5
1. Is the item user friendly?					
2. Is the device interfere with surgery					
3. Is the item time efficient?					
4. Is this item compatible with other disposables or equipment?					
5. Does this product perform as it was presented?					
6. Was in-servicing/training adequate?					
7. Is there any rational or reason not to recommend the product?					

Is this an acceptable product? Yes _____ No _____

If no, comments please: _____

_____

Other comments: _____

_____

_____

_____

_____

Person completing form: _____

Sequence for Implementation…

- .1 In-line filters between all wall suctions for small smoke generated cases
- Skills assessment
- “Go Live” date for entire surgical services operating rooms
- Monitor practices to assure protocols and processes are followed
- Post Test
- Policy Implementation
- Compliance monitors every quarter.

Follow Up

Review and Validate

Sample Concurrent Monitor: Evaluation of Smoke Evacuation Compliance

PEER observation monitor to determine compliance with policy to insure safety guidelines are reviewed

Dates _____

INDICATORS:	YES	NO	Not Applicable	Comments
1. Smoke Evacuation Equipment set up for case/procedure				
2. Appropriate smoke evacuation set up for small, medium or large smoke generation				
3. In-line filters set up with wall suction				
4. Laparoscopic Procedures: Smoke evacuation through in-line filters and proper protocol or specialized insufflators				
5. Open cases, smoke evacuation tubing or pencil within 2 inches of smoke generation				

*** If Not Met (as required by standard), please explain why**

Resources:
Recommended Practices & Standards:

- **The Joint Commission**
- The Joint Commission is an independent, not-for-profit organization. The Joint Commission accredits and certifies more than 20,500 health care organizations and programs in the United States and writes standards by which they measure healthcare facilities compliance.
- **Environment of Care EC02.02.01**
  - Healthcare facilities manage their risks related to hazardous materials and waste
  - The hospital minimizes risks associated with selecting, handling, storing, transporting, using, and disposing hazardous gases and vapors
  - Hazardous gases and vapors include, but are not limited to, glutaraldehyde, ethylene oxide, vapors generated while using cauterizing equipment and lasers, and gases such as nitrous oxide

Resources:

The Joint Commission

Accreditation Program: Hospital Chapter: Environment of Care

Standard EC.02.02.01

The [organization] manages risks related to hazardous materials and waste.

Elements of Performance for EC.02.02.01

1.	(D)	The hospital maintains a written, current inventory of hazardous materials and waste that it uses, stores, or generates. The only materials that need to be included on the inventory are those whose handling, use, and storage are addressed by law and regulation. (See also IC.02.01.01, EP 6; MM.01.01.03, EP 4)	A
3.	(D)	The hospital has written procedures, including the use of precautions and personal protective equipment, to follow in response to hazardous material and waste spills or exposures.	A
4.		The hospital implements its procedures in response to hazardous material and waste spills or exposures.	A
5.	(M)	The hospital minimizes risks associated with selecting, handling, storing, transporting, using, and disposing hazardous chem cals.	C
6.		The hospital minimizes risks associated with selecting, handling, storing, transporting, using, and disposing radioactive materials.	A

The hospital minimizes risks associated with selecting, handling, storing, transporting, using, and disposing hazardous gases and vapors.
Note: Hazardous gases and vapors include, but are not limited to, glutaraldehyde, ethylene oxide, vapors generated while using cauterizing equipment and lasers, and gases such as nitrous oxide.

required by law and regulation.

12.		The hospital labels hazardous materials and waste. Labels identify the contents and hazard warnings. Footnote: The Occupational Safety and Health Administration's (OSHA) Bloodborne Pathogens and Hazard Communications Standards and the National Fire Protection Association (NFPA) provide details on labeling requirements.	A

KEY: A indicates scoring category A; C indicates scoring category C; ⚠ indicates situational decision rules apply; ⚠ indicates direct impact requirements apply; (M) indicates Measure of Success is needed; (D) indicates that documentation is required

Resources:
Recommended Practices & Standards:

Association of periOperative Registered Nurses (AORN)

- **2017 AORN Guideline for Surgical Smoke Safety:** AORN is a professional association based in Denver, Colorado that represents the interests of more than 160,000 perioperative nurses. The following are contained in Recommended Practices:
- **Recommendation I** "The health care organization should provide a surgical smoke free environment."
- **Recommendation II** The perioperative team should evacuate all surgical smoke. "The collective evidence, standards, and guidelines from NIOSH, the Healthcare Infection Control Practices Advisory Committee, and professional organizations indicates that evacuating surgical smoke protects patients and health care workers from the hazards of surgical smoke."
- **Recommendation III** "Perioperative team members should receive initial and ongoing education and competency verification on surgical smoke safety."
- **Recommendation IV** "Policies and procedures for surgical smoke safety should be developed, reviewed periodically, revised as necessary, and readily available in the practice setting in which they are used."
- **Recommendation V** "Perioperative personnel should participate in a variety of quality assurance and performance activities that are consistent with the health care organization's plan to improve understanding and compliance with the principles and processes of surgical smoke safety."

2017 Guidelines for Perioperative Practice, First Published: December 2016.

Resources:

OSHA, NIOSH & ANSI 136.3

- **OSHA** estimates that 500,000 workers are exposed to surgical smoke each year (Gao, Koehler, Yermakov & Grinshpun, 2016).
- **The National Institute of Occupational Safety and Health** (NIOSH) research confirms that smoke plume could contain toxic gases and vapors such as benzene, hydrogen cyanide, and formaldehyde, bioaerosols, dead and live cellular material and viruses (Edwards & Reiman, 2012).
- **ANSI 136.3** Laser-generated airborne contaminants (LGAC) produced during surgical procedures are a result of the vaporization or disruption of tissue at the cellular level.
  - An analysis of the plume has shown the presence of toxic gaseous compounds, bio-aerosols, cellular material, viruses, and contains aerosolized blood, blood by-products, and pathogens (ANSI, 2018).

Resources:

Research

Nicholas Mowbray utilized a high-level method to support the results of the surgical team's exposure to surgical smoke. Over 19,000 published articles were reviewed and identified and twenty research studies supported the findings regarding the constituents of surgical smoke, with rating guidelines supported by the Center for Evidence-Based Medicine (Mowbray, Ansell, Warren, Wall & Torkington, 2013).

Health problems from biologicals
Health problems from biologicals

The World Health Organization (WHO) states that there are over 200 genotypes of HPV, 13 are known to cause cancer and that 80% of the population has some form of HPV

“Do you use smoke evacuation on every case?” If we are practicing true, universal precautions, then we should evacuate surgical smoke plume for every case.

Is a smoke evacuator on every patient, every time?

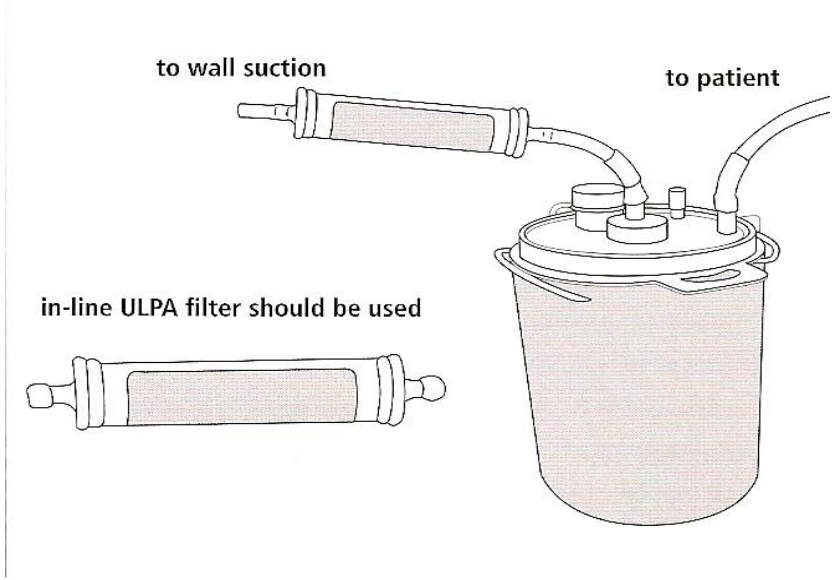
Evaluate Evidence Based Practices

- Substantial evidence over 5 years
- Separate Resources for Staff and Surgeons
- The change in practice, standards, and regulations are valuable in changing practice and standards of care to protect the operating room staff.
- Current research supports that surgical smoke is a health hazard, and the ultimate goal is compliance to practice.
- Address the key indicators to promote compliance and education.
- Data supports the issue of surgical smoke and air quality in the operating room.
- Significant attention to the dangers of surgical smoke is being brought forward by The Joint Commission, ANSI, AORN, NIOSH, and others.

Algorithms & Practices: Surgery Service Lines

What you can’t see can’t hurt you!!

In-line filter should be used when wall suction is chosen….best practice is in all rooms

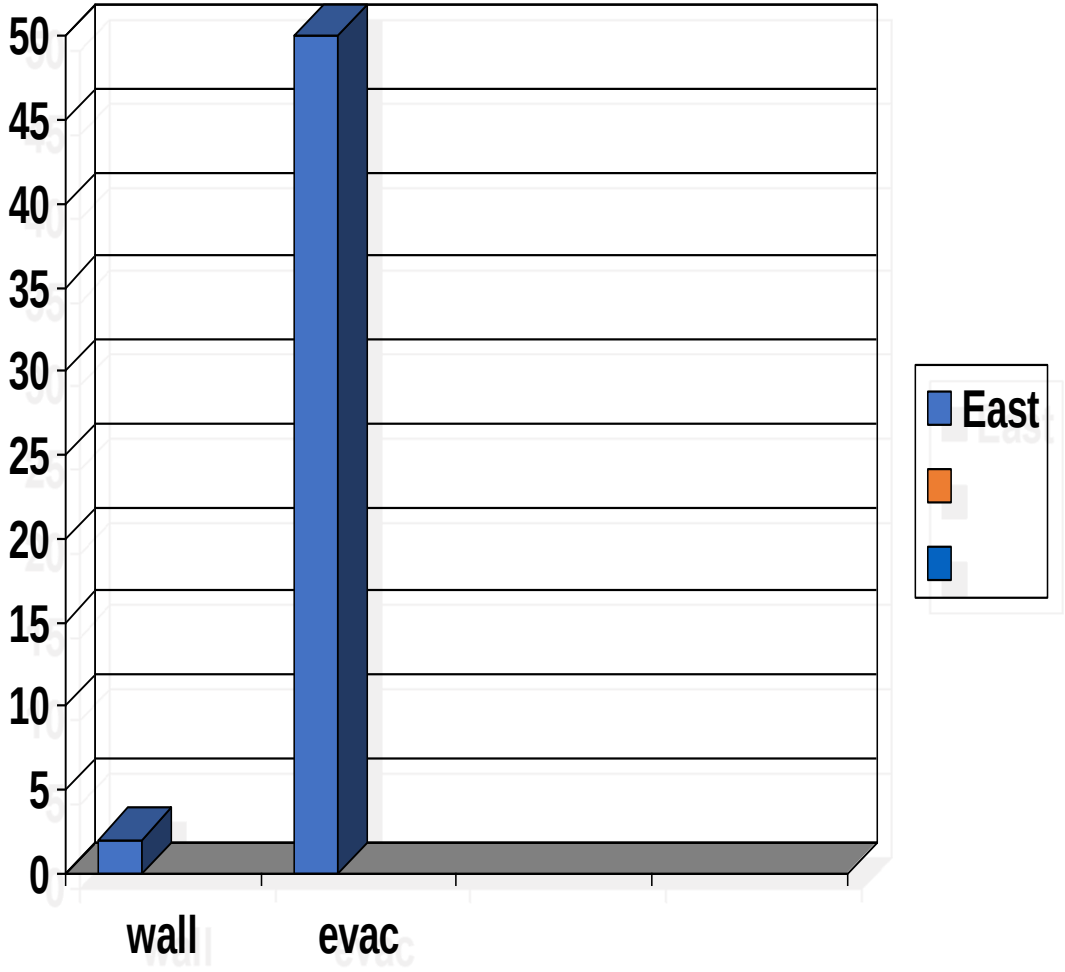


By-pass the filter in the canister…will compromise cfm

…and assignment of filter change weekly

Wall/Canister Suction

- Corrodes pipes
  Contaminates building
- Flow may not be high enough to capture surgical smoke…



Wall suction 2 cfm
Evacuator 30-70 cfm

Endosurgical Smoke

- Loss of visibility
- Delay of procedure
- Special health hazards
  - Recirculating filters
  - Deflation of body cavity

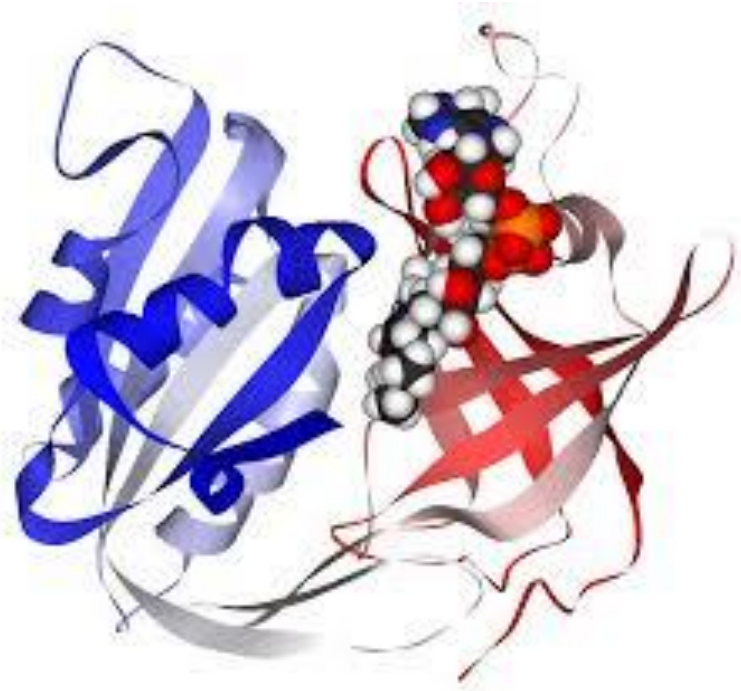
Threats to Patients…

Smoke produced in closed cavities leads to:

Increased Methemoglobin Levels

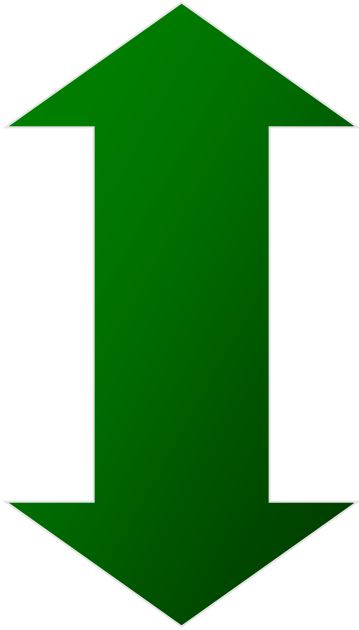
Carboxyhemoglobin

Hypoxia



Methemoglobin

=



O_2 Perfusion of Tissues

CO_2

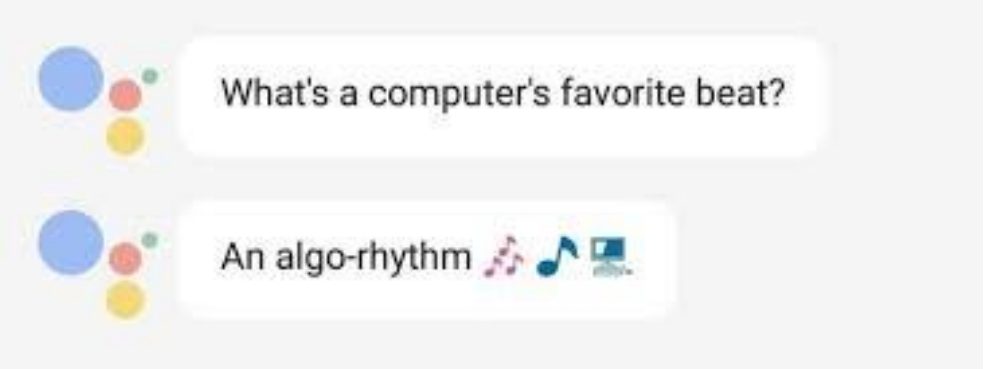
Production in Laparoscopy

345 ppm after 5 minutes

475 ppm by end of procedure

35 ppm = EPA level for 1 hour exposure

Algorithm of Practices



- Service line coordinators
- Include surgeons in determining product and hook-up
- Consideration with surgical culture
- Preference cards updated to hook-up
- Categorize hook up options
- KISS technique

Algorithm of Practices

Open Procedures that Generate a Nominal to Light Amount of Surgical Plume

- Temporal Artery
- Surgery of the Hand
- Vocal Cord Polyp Removal Biopsy
- Surgery of the Ear
- Nasal Procedures
- Craniotomies
- Thoracoscopy
- ENT-Other
- Endoscopy-Other

Algorithm of Practices…

Open Procedures that Generate a Moderate to Heavy Amount of Surgical Plume

- Plastic Surgery
- Breast Surgery
- Total Joints
- Spine Surgery (Fusion, Scoliosis)
- C-Sections
- Electrophysiology (Implants)
- Neurosurgery
- General Cases: (Hysterectomy, Hernia Repair)
- Dermatologic Surgery (MOHS, ED&C)
- Thoracic procedures
- CVOR

Algorithm of Practices

Laparoscopic Procedures that Generate Surgical Plume

- Lap Chole
- Lap Colon
- Lap Hysterectomy
- Lap Band
- Robotic Surgery
- Laparoscopic-Other

Implementation Practices

Make it a Transparent Practice

Physician and Staff Issues:

Is it quiet and don't interrupt my surgery!

Operating Room Staff Considerations

- Wall suction or Smoke Evacuators?
- Procedural Hook-up
  - Position smoke tube close to the tissue impact site
  - Shortest and largest lumen without compromise to the field
  - Suction Fluid from alternate tubing
  - Quiet: Controlled activation
  - Hands off if possible
  - Availability in every operating room
- Assess physician needs
- Routine assessment of filter changes
- Assess different set-up per services
  - Small smoke generated cases/in-line
  - Laparoscopy
  - Smoke Evacuators
- Policy enforcement

Policy Implementation

HOSPITAL SYSTEM **SURGICAL SERVICES**

Surgical Plume Evacuation

Original Date	Review Dates	Revision Dates

POLICY

It is the policy of _____ Hospital System that smoke plume generated during surgical cases will be captured and filtered through the use of smoke evacuators or in-line filters positioned on suction lines.

DEFINITIONS

Surgical Plume: The thermal destruction of tissue which creates a smoke byproduct by lasers, electrosurgical units, radio frequency devices, ultrasonic devices and power tools. Research studies have confirmed that smoke plume can contain toxic gases and vapors such as benzene, hydrogen cyanide, formaldehyde, bioaerosols, dead and live cellular material (including blood fragments), and viruses. At high concentrations, the smoke causes ocular and upper respiratory tract irritation in healthcare workers (HCWs), and creates visual problems for the surgeon. The smoke has unpleasant odors and has been shown to have mutagenic potential. Surgical smoke plume is created by electrosurgical systems, lasers, ultrasonic scalpels, and other heat destructive devices.

PROCEDURE/GUIDELINE

A. The reduction of surgical plume inhalation should be implemented by the use of smoke evacuation systems or 0.1 micron in-line filters on suction lines.

B. On surgical procedures which generate small amounts of plume:
   1. 0.1-micron in-line filter will be positioned between the wall suction and the suction canister.
   2. In-line filters will be changed weekly in every area that generates plume.
   3. A suction tubing no longer than 12 feet in length will be used with a suction tip or attached to the ESU (see Appendix A).
   4. Low suction rates have been associated with wall suction devices (which limit efficiency in plume evacuation) but are suitable for minimal plume evacuation.
   5. Contaminated filters and plume evacuation supplies will be disposed of by personnel using personal protective equipment.

C. On surgical procedures that generate greater amounts of smoke, a smoke evacuation system with an evacuation hose will be used (see Appendix B).
   1. Corrugated smoke evacuation tubing with a smooth inner lumen will be connected directly to the smoke evacuator and used when evacuating large amounts of plume.
   2. The standard suction tubing will be used to evacuate fluid and the corrugated tubing will be used to evacuate surgical plume.
   3. The plume capture device will be positioned in close proximity to the generation of the surgical plume.

D. Laparoscopic Surgery should be performed in a manner that minimizes personnel's exposure to blood, fluids, droplets, noxious fumes, gases, or plume.
   1. Plume should be evacuated throughout the procedure and a 0.1 in-line filter should be attached between the wall and the room suction canister.
   2. The release of gas, electrosurgical smoke, ultrasonic plume, and laser plume during Endoscopic surgery exposes the surgical team to plume.
   3. A closed system should be used when releasing insufflated gases. The release of the pnuemoperitoneum should be performed using a 0.1 in-line filter on the suction line or using a closed smoke evacuation system that employs an irrigation/suction probe.

E. Air exchanges in the O.R. should adhere to guidelines established by the Centers for Disease Control and Prevention and the American Institute Architects (AIA).
   1. All air should be filtered with appropriate filters as recommended by the AIA. A number

Appendix A

Examples of procedures which require an in-line filter on the suction line which is positioned between the wall outlet and the suction canister:

1. Temporal Artery Biopsy
2. Hand procedures
3. Vocal Cord polyps
4. Tonsillectomies
5. Laparoscopies
6. Ear procedures
7. Dermatological procedures
8. Nasal procedures
9. Thorascopy
10. Back procedures
11. Craniotomies
12. Breast Biopsies

Appendix B

Examples of procedures which require a smoke evacuator with an evacuation hose:

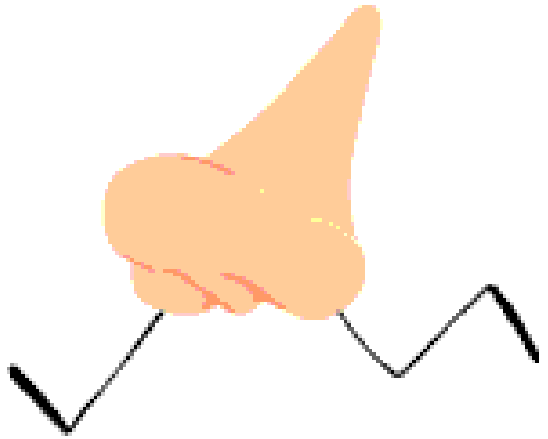
1. Abdominal surgical procedures
2. Breast Reduction Procedures
3. Large extremity procedures
4. Vaporization of condyloma
5. Thoracic procedures
6. Excisional neck procedures
7. Spinal fusions

Implementing and Managing Change

Kotters 8 Steps for Implementing Change

- **Step 1: Create Urgency**
- **Step 2: Form a powerful coalition of stake holders**
- **Step 3: Create a Vision for Change**
- **Step 4: Communicate the vision**
- **Step 5: Remove Obstacles**
- **Step 6: Create short term wins**
- **Step 7: Build on the Change**
- **Step 8: Anchor the Changes**

Picking the best protection isn't just a matter of common sense. It's a matter of common *senses*.



Listen to your nose and you'll know!

In hindsight, will health care professionals be embarrassed about their cavalier attitudes toward surgical smoke as they once were with cigarette smoke?

Eric Anderson, MS, RN, OHNP

Vangie's acceptance speech runs long.


COMPLIANCE OFFICER
It's not who we are underneath, but what we do that defines us.

Performance Improvement Tools

- Design, Measure, Assess, Improve, and Control (DMAIC)
- Plan, Do, Check, Act (PDCA) Tool
- Fishbone diagram
- Root cause analysis (RCA)
- Cause and effect map
- Failure mode and effects analysis (FMEA)
- Strategic, Measurable, Achievable, Relevant, Timely (SMART)
- Pareto analysis chart (PAC)

ahrq.gov, 2019

PDCA Compliance Monitor

Walter A. Shewhart
Father of Total Quality Management

Team/Department/Unit: _____ **Date:** _____

Key Strategic Area: Surgical Services **Reports to:** _____

Opportunity: Monitor compliance to surgical smoke evacuation policy

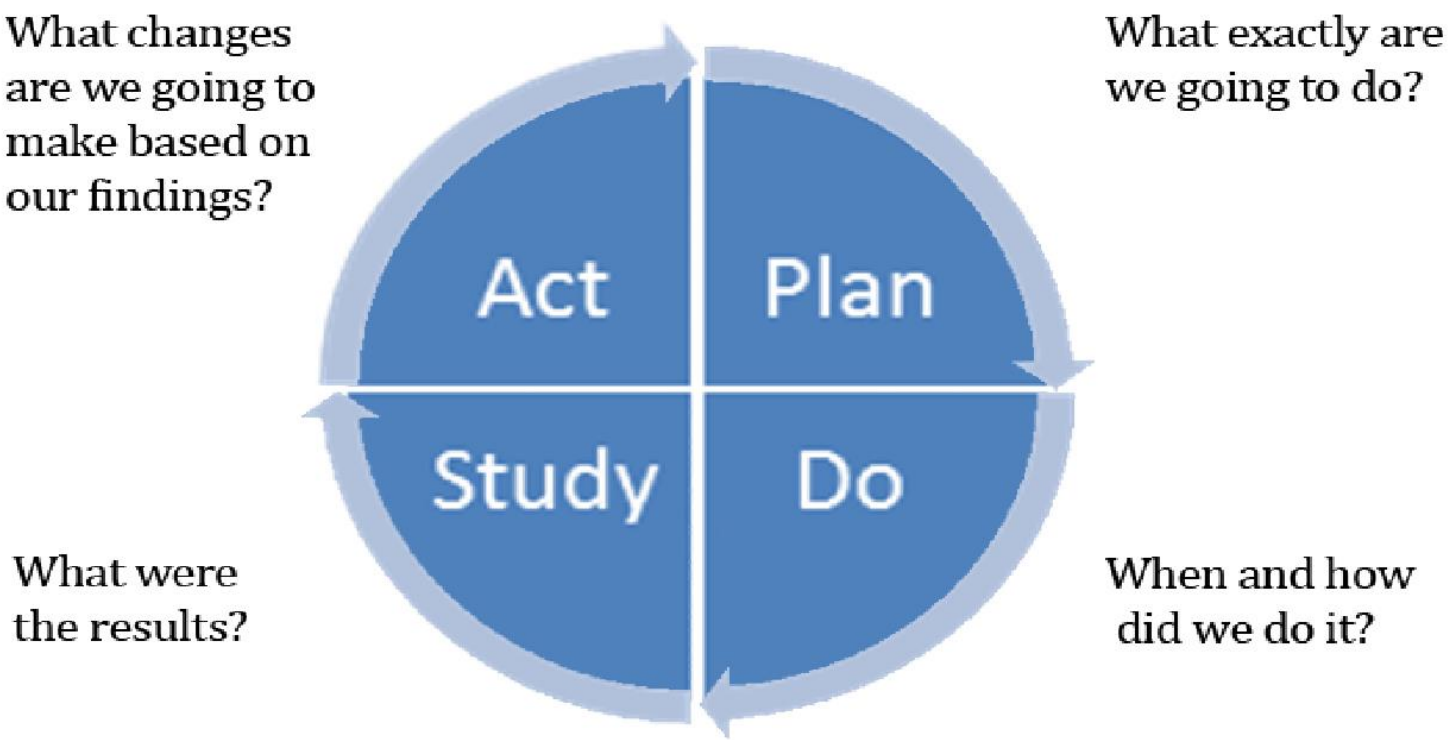
Priority: Health Outcome/Patient Safety/Quality of Care [ ] High Risk/High Volume/High Cost/Problem Prone [ ]
Customer Perception [ ] Strategic Plan [ ]

P D C A

P = Plan the Improvement	**C = Check Indicators & Study Results**	**% Compliance**
	Indicators Identified	
Peer observation to assess compliance to policy that insures safe removal of surgical plume in the operating room.	1. In line filters are changed weekly in every area that generates plume.	**100%**
	2. Contaminated filters and plume evacuation supplies will be disposed by of personnel using personal protective equipment.	**100%**
Team members:	3. When large amounts of smoke are generated, a corrugated evacuation tubing will be connected directly to the smoke evacuator and used when evacuating plume.	**100%**
All OR Staff Circulators.	4. The smoke/plume evacuation device will be positioned in close proximity to the generation of surgical plume.	**100%**
	5. A standard suction will be used to evacuate fluid when the corrugated tubing is used to evacuate surgical smoke.	**100%**
	100% Compliance to policy.	
D = Do the Improvement		
September 1 through September 15th, data randomly collected on 30 patients having surgical procedures.		
Data will be collected by peer observation.	**A = Act to Hold the Gain and Continue Improvement**	
Data will be posted for staff review.	1. Congratulate staff on compliance to policy.	
	2. Monitor again to assess continued compliance to policy.	

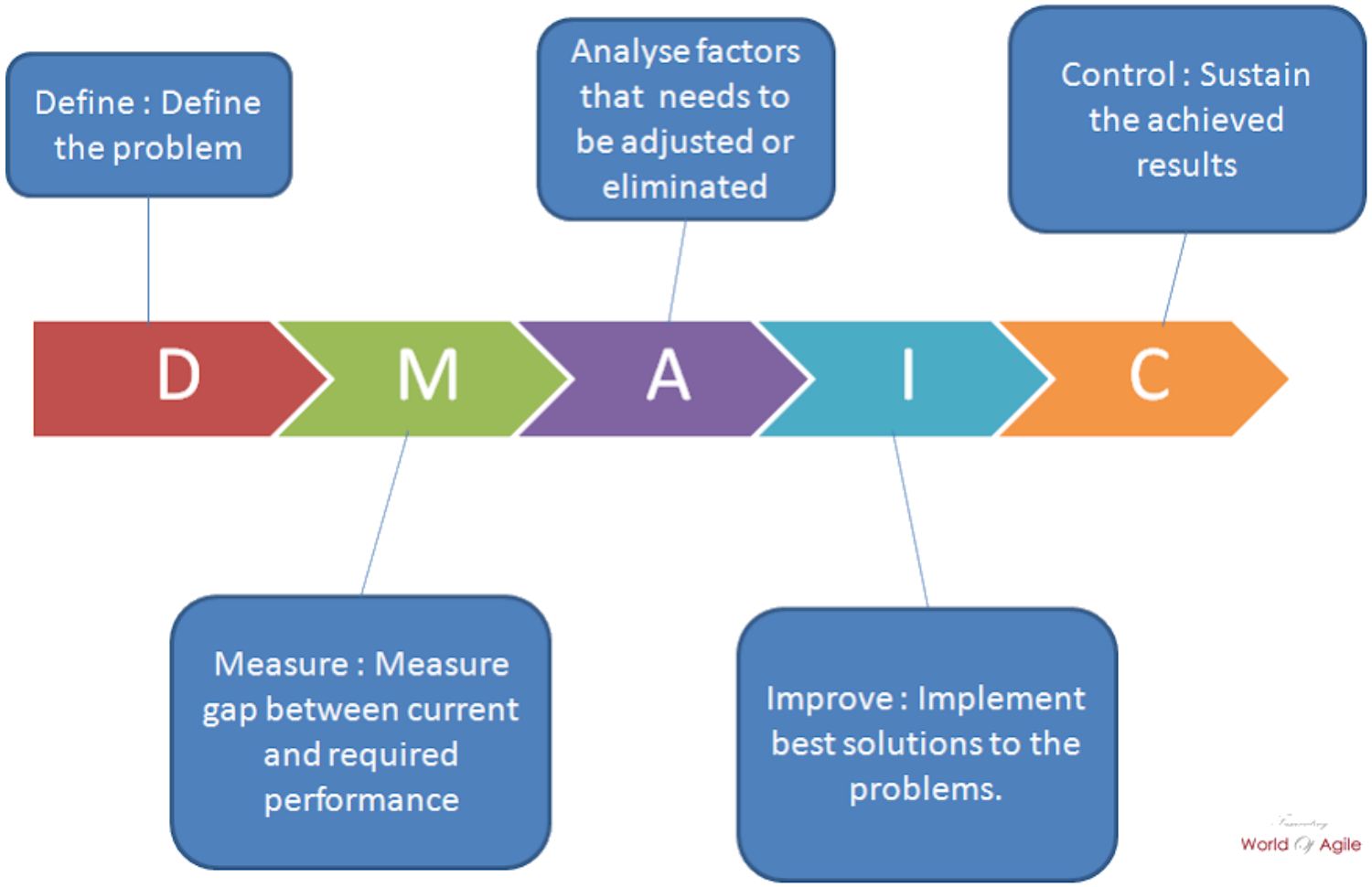
Best, 2006
Dennis, 2019

PDSA – Plan-Do-Study-Act



Best 2006
CMS, 2019

Six Sigma - DMAIC



Nayar, 2019

Six Sigma - DMAIC

DMAIC DATA COLLECTION SMOKE EVACUATION

COMPLIANCE MONITOR		DATE		PREPARED BY	

ID #	PERFORMANCE MEASURE	OPERATIONAL DEFINITION	DATA SOURCE & LOCATION	SAMPLE SIZE	WHO WILL COLLECT DATA?	WHEN WILL DATA BE COLLECTED?	HOW WILL DATA BE COLLECTED?	HOW WILL DATA BE USED?	ADDITIONAL DATA: ANY BARRIERS TO COMPLIANCE
1	Case monitoring to measure compliance with surgical smoke evacuation policy	Effective smoke evacuation used: inline filters; smoke evacuators; appropriate collection methods	Date, case, surgeon, length of case, inpatient or outpatient	25 random cases per month	Peer data collection by RN's; AST's	First 2 weeks of each month	Peer observation	To assess percent of policy compliance	List any circumstances that prevented use of smoke evacuation equipment
2									
3									
4									
5									
6									
7									
8									
9									

Data Collection Plan Template | Sheet1

DMAIC Tool Template

D M A I C

Phase/Activity	Target Date	Comp Date
Define	xx-xx-xx	xx-xx-xx
•		☐
•		☐
•		☐
•		☐
•		☐
•		☐
•		☐
Measure	xx-xx-xx	xx-xx-xx
•		☐
•		☐
•		☐
•		☐
•		☐

Phase/Activity	Target Date	Comp Date
Analyze	xx-xx-xx	xx-xx-xx
•		☐
•		☐
•		☐
Improve	xx-xx-xx	xx-xx-xx
•		☐
•		☐
•		☐
•		☐
•		☐
Control	xx-xx-xx	xx-xx-xx
•		☐
•		☐
•		☐

Smoke Man Tips

Tips & Tricks to Promote Smoke Evacuation

Place posters about the dangers of surgical smoke in locations around the OR:

- Scrub sinks
- Lounges
- Inside restroom doors (Potty Training)

Assemble a **Smoke Book of Evidence** with peer-review articles about the dangers of surgical smoke to place in the lounges

Develop a **Smoke Book of Options** with pictures of smoke evacuation equipment and accessories so that all perioperative team members are aware of the different options available for smoke evacuation

Make a **Smoke Feedback Box** where perioperative team members can give suggestions on smoke evacuation efforts

For Surgeons: Create a **Smoke Tool Box** containing a number of types of smoke pencils. This will allow surgeons to feel how the different smoke pencils fit hands, and, participate in selecting the smoke pencil that would work best

After smoke evacuation program begins post a chart stating number of days of being smoke free along with current percentages (like street signs in towns alerting drivers of monthly seat belt usage)

Conduct a contest within the facility for suggestions on the best way to make smoke evacuation seamless to implement, which includes overcoming facility-specific barriers to implementation

Set the goal of updating surgeon preference cards with the type of smoke evacuator and accessories to be used for each procedure

Partner with smoke product suppliers to stay abreast of new products and accessories that facilitate ease of evacuating smoke. Establish two-way communication to inform vendors of needs—what works and what does not work

Use RF activated systems so that the smoke evacuator activates when the ESU pencil is used

Use coated active electrode tips with tissue response generators, which decreases the production of surgical smoke (Kasich, 2015). This does not negate smoke evacuation

Catch people doing something right—develop a facility reward for consistent use of smoke evacuation equipment

For general staff meetings, consider including the topic of smoke evacuation where staff can voice experiences related to implementing smoke evacuation


WHAT PEOPLE THINK
SUPERHEROES LOOK LIKE
WHAT SUPERHEROES
ACTUALLY LOOK LIKE

Questions?