

# Respiratory Protection to Prevent Potential Transmission of Human Papillomavirus During Surgical Procedures That Generate Smoke

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# Outline

- ❑ **Background**
- ❑ **Current Recommendations**
- ❑ **Literature Review**
- ❑ **Potential Recommendation**
- ❑ **Future Considerations**

## Background

- ❑ **Update of Sexually Transmitted Diseases Treatment Guidelines, 2014**
  - Question: Is there a risk to healthcare personnel (HCP) for acquiring human papilloma virus (HPV) from inhalation of smoke during laser or electrosurgical treatments of oral or anogenital warts, or intraepithelial neoplasias (e.g., CIN)?
  
- ❑ **Provider-specific recommendations for respiratory protection during laser/electrosurgical procedures may be addressed in separate guidelines**
  - Dental personnel- CDC's Division of Oral Health

## Background

- **The numbers of inpatient and outpatient treatments of HPV associated lesions with surgical laser or electrosurgical procedures are unknown**
  - Only a small portion are treated with surgical laser/electrosurgical procedures
  - Suspect majority treated in outpatient settings

## HPV-Associated Disease

- **Selected HPV types and some manifestations of infection potentially treated with laser or electrosurgical procedures**
  - HPV types 6 and 11, “low risk”
    - Anogenital warts
    - Recurrent Respiratory Papillomatosis (RRP)
      - Warts growing in the larynx and respiratory tract
  - HPV types 16 and 18, “high risk”
    - Associated with the majority of cervical cancers
    - Associated with oropharyngeal cancers

## Potential HPV Disease Among HCP

- **From inhaled HPV virus particles**
  - Oral Warts- HPV type 6, 11
  - RRP- HPV type 6, 11
  - Oropharyngeal Cancers- HPV type 16, 18

# Current Recommendations: Surgical Smoke and Respiratory Protection

## □ CDC- Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

### ■ VI. Other Potential Infectious Aerosol Hazards in Health-Care Facilities

- In settings where surgical lasers are used, wear appropriate personnel protective equipment (PPE), including N95 or N100 respirators to minimize exposure to laser plumes (Category IC [OSHA;29 CFR 1910.134,139])
- Use central wall suction units with in-line filters to evacuate minimal laser plumes (Category II)
- Use a mechanical smoke evacuation system with a high efficiency filter to manage the generation of large amounts of laser plume, when ablating tissue infected with human papilloma virus (HPV) or performing procedures on a patient with extrapulmonary TB (Category II)

# Current Recommendations

## □ CDC-NIOSH

- Control of Smoke from Laser/Electric Surgical Procedures
  - Ventilation-
    - General Room
    - Local Exhaust Ventilation (LEV) (e.g., Smoke evacuator)
  - Work Practices
    - Product maintenance, proper product use, adherence to standard precautions, etc.



# Current Recommendations

## □ OSHA

- Laser/Electrosurgery Plume Statement
  - “There are currently no specific OSHA standards for laser/electrosurgery plume hazards.”

# Current Recommendations

## □ AORN 2013

- Equipment and Product Safety: Electrosurgery and Laser Safety Sections
  - “Respiratory protection that is at least as protective as a fit-tested surgical N-95 filtering facepiece respirator should be considered for use in conjunction with LEV in disease transmissible cases (eg, human papillomavirus)....”

# Literature Review-HPV

## □ Systematic Literature Review

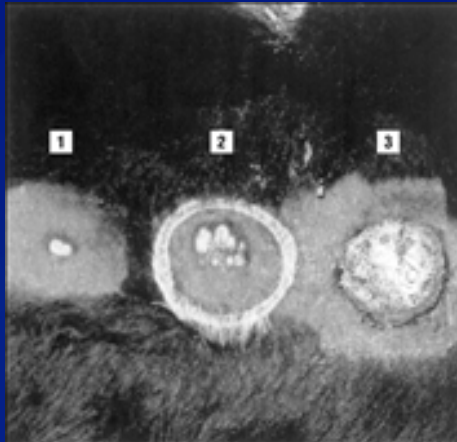
- 25 articles related to occupational exposures to HPV in surgical smoke were identified and reviewed by CDC Division of STD Prevention

## HPV in Surgical Smoke Plumes

- ❑ **No randomized trials**
- ❑ **HPV DNA detected in surgical smoke**
  - 7 studies report detection in CO<sub>2</sub> laser plume; 1 study reports detection in electrocautery plume
  - Viability not demonstrated due to lack of an appropriate bioassay

## Bovine Models

- **Viabile Bovine Papiloma Virus (BPV) demonstrated in smoke plumes**
  - CO<sub>2</sub> laser smoke plume from BPV fibropapillomas collected and injected into calves
    - Plume samples positive for BPV DNA
    - 3/3 calves developed fibropapillomas at sites of inoculation



*Garden JM, et. al. 2002. Arch Dermatol. 138: 1303-1307*  
Modified slide courtesy of Eileen Dunne, CDC

## HCP Exposures to HPV During Laser Procedures

- ❑ **No HPV DNA on the oral mucosal of HCP adhering to recommended PPE**
  - CO<sub>2</sub> laser treatment of 10 patients (5-genital warts; 5-RRP);
    - Unclear if smoke evacuation used
    - Gloves, goggles, laser surgical masks were used
  - Post-procedure HPV DNA detected
    - Genital warts: Gloves- 5/5 HCP; Oral mucosa- 0/18 HCP
    - RRP: Gloves- 4/10 HCP; Oral mucosa- 0/? HCP
    - All detected HPV types matched types from patient lesions

# HCP Exposures to HPV During Laser and Electrosurgical Procedures

- HPV DNA isolated from nostrils of HCP who may not have worn surgical masks
  - Outpatient treatment of genital warts with
    - Electrocoagulation (Inconsistent mask use)
    - CO<sub>2</sub> laser (smoke evacuator, masks, goggles used)
  - Post-procedure HPV DNA detection
    - Electrocoagulation
      - Nasolabial folds (4/19 HCP)
      - Nostrils (3/19 HCP)
    - CO<sub>2</sub> laser
      - Nasolabial folds (1/11)
  - Air samples obtained (open petri dishes)
    - CO<sub>2</sub> laser: 2/5 (2 m from patients) with HPV DNA
      - Unclear if detected HPV DNA matched to patient samples

## HPV in Air During and After HPV Laser Treatment

- HPV DNA detected on surgeons and in OR air may not be patient derived
  - Assessment of presence of HPV DNA on surgeon and in OR air after Argon plasma laser (APC) (no vapor production) and CO<sub>2</sub> laser treatment (smoke evacuator/PPE used) of genital warts

### HPV Detection: the OR Air Samples and Laser Surgeon

	1 m dist.	2 m dist.	Overnight	Surgeon glasses	Nasolabial folds
APC	0/18	2/18	0/5	0/10	2/10
CO2 laser	0/10	0/10	0/5	n.d.	n.d.

Patient derived HPV: 6, 11;

Air sample HPV: 12, 107; Surgeon nasolabial fold HPV: 38



## Case Reports

- **2 reports of RRP among HCP present during laser treatment of HPV-associated lesions**
  - 44 yo YAG laser surgeon who performed procedures on colorectal cancers and anogenital warts
    - Diagnosed with laryngeal papillomas
    - Routinely used mask, gloves, eye protection
    - **No laser smoke evacuation system used**, but suction from endoscope was present
  - 28 yo GYN nurse who assisted with CO<sub>2</sub> laser and electrosurgical removal of anogenital warts
    - Diagnosed with laryngeal papillomas
    - **Procedures performed in improperly ventilated utility room**

*Hallmo P and Naess O. 1991. Eur Arch Otorhinolaryngol. 248: 425-427*

*Calero L and Brusis T. 2003. Laryngo-Rhino-Otol. 82: 790-793*

## Survey Studies

### □ Unclear if increased incidence of warts among laser surgeons

- Of 3 survey studies examining the incidence of warts in laser surgeons, 1 compared the incidence of warts in CO<sub>2</sub> laser surgeons (5.4%) to a community control group (4.9%)
  - Increase in nasopharyngeal warts among laser surgeons (13%) compared to Mayo Clinic patients treated for nasopharyngeal warts (0.6%)
- Control group limitations
  - Community control group
    - Single community compared to national professional society members
  - Wart anatomical site control group limitations
    - Mayo Clinic wart treatment population unlikely represents the average anatomical distribution of disease

## Literature Review- Summary

- ❑ **Likely viable HPV in laser/electrosurgical smoke plumes**
  - BPV model
- ❑ **Risk for HPV transmission to HCP during smoke generating procedures seems low but needs further study**
  - Limited studies detected post-treatment HPV DNA on HCP nasolabial folds and oropharynx
    - Unclear if current ventilation and PPE standards were followed
  - During/after laser/electrosurgical procedures, risk of significant air contamination with HPV seems low, but needs further assessment
  - Unclear if RRP in case reports resulted from occupational exposure

## Considerations

- ❑ **Certain healthcare settings (e.g., outpatient) may pose challenges in implementing appropriate ventilation during procedures**
- ❑ **Individual surgical cases may carry a higher risk of smoke plume escape**

## Potential Recommendation

- ❑ Treatment of HPV-associated conditions including anogenital warts, oral warts, anogenital intraepithelial neoplasias (e.g. CIN) and recurrent respiratory papillomatosis with laser or electrosurgical procedures should be performed in an appropriately ventilated room using Standard Precautions (<http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf>) and local exhaust ventilation (e.g., smoke evacuator) (<http://www.cdc.gov/niosh/docs/hazardcontrol/hc11.html>). While evidence of inhalational transmission of HPV is limited, HCP performing such procedures should consider wearing an N-95 respirator to further reduce the risk of inhalation of potentially infectious aerosols during the procedure.

## Future Considerations

- ❑ **Viability of viruses and bacteria demonstrated in laser and/or electrocautery plume**
  - Bovine Papilloma Virus (BPV)
  - Human Immunodeficiency Virus (HIV)
    - Live virus with non-sustained viral replication
  - *Coagulase Negative Staphylococcus, Corynebacterium species, Neisseria species, Escherichia coli*
- ❑ **Reviewing literature to consider respiratory protection for procedures where other infectious diseases might be aerosolized in surgical smoke.**

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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